

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NETFLIX, INC. AND ROKU, INC.,

Petitioners,

v.

CONVERGENT MEDIA SOLUTIONS LLC,

Patent Owner.

Cases: To be assigned
U.S. Patent Nos. 8,850,507 and 8,893,212

**DECLARATION OF ANDREW WOLFE IN SUPPORT OF
PETITIONS FOR *INTER PARTES* REVIEW**

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I. INTRODUCTION

1. My name is Dr. Andrew Wolfe.

2. I have been engaged by the Petitioners Netflix, Inc. and Roku, Inc. to investigate and opine on certain issues relating to U.S. Patent No. 8,850,507

5 (“the ’507 Patent”) in connection with the Petitions for Inter Partes Review.

3. I have also been engaged by Roku, Inc. to opine on certain issues relating to U.S. Patent No. 8,893,212 (“the ’212 Patent”).

4. For the convenience of the Board, I have submitted a single declaration addressing both the ’507 Patent and the ’212 Patent (“the Challenged
10 Patents”).

5. I have further been retained by Netflix, Inc. to opine upon U.S. Patent Nos. 8,527,640; 8,640,183; 8,689,273; and 8,914,840. I have not addressed these patents in this declaration.

6. I understand that Patent Owner, Convergent Media LLC, has asserted
15 the ’507 patent against Netflix in *Convergent Media Solutions, LLC v. Netflix, Inc.*, No. 3:15-cv-02160-N (N.D. Tex) and the ’212 and ’507 patents against Roku in *Convergent Media Solutions, LLC v. Roku, Inc.*, No. 3:15-cv-02163-N (N.D. Tex), which I understand has been consolidated as *Convergent Media Solutions, LLC v. AT&T, Inc.*, 3:15-cv-2156-M (N.D. Tex.).

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7. In this declaration, I will first discuss the technology background related to the '507 and '212 patents and then provide my analyses and opinions on claims 1-18 of the '507 patent and claims 1-23 of the '212 patent. This overview provides some of the bases for my opinions with respect to the '507 and '212 patents. Because of their similarities and the same prior art cited in petitions for the '507 and '212 patents, this declaration is with respect to each of the '507 and '212 patents.

8. This declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include a review of documents and information that may be produced, as well as testimony from depositions that may not yet be taken.

9. In forming my opinions, I have relied on information and evidence identified in this declaration, including the '507 and '212 patents, their prosecution histories, and prior art references listed in the Grounds of Petitioner's challenges, other references listed as Exhibits to the IPR petitions and listed as appendices to this declaration.

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II. QUALIFICATIONS AND EXPERIENCE

A. EDUCATION AND WORK EXPERIENCE

10. Attached as Exhibit A to this declaration is a copy of my curriculum vitae, which provides a substantially complete list of my education, experience and
5 publications that are relevant to the subject matter of this report.

11. I have more than 30 years of experience as a computer system designer, personal computer graphics designer, educator, and as an executive in the electronics industry.

12. In 1985, I earned a B.S.E.E. degree in Electrical Engineering and
10 Computer Science from The Johns Hopkins University. In 1987, I received an M.S. degree in Electrical and Computer Engineering from Carnegie Mellon University. In 1992, I received a Ph.D. in Computer Engineering from Carnegie Mellon University. My doctoral dissertation proposed a new approach for the
architecture of a computer processor.

15 13. In 1983, I began designing touch sensors, microprocessor-based computer systems, and I/O (input/output) cards for personal computers as a senior design engineer for Touch Technology, Inc. During the course of my design projects with Touch Technology, I designed I/O cards for PC-compatible computer systems, including the IBM PC-AT, to interface with interactive touch-based
20 computer terminals that I designed for use in public information systems. I

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continued designing and developing related technology as a consultant to the Carroll Touch division of AMP, Inc. and I designed one of the first custom touchscreen integrated circuits in 1986.

14. From 1986 through 1987, I designed and built a high-performance
5 computer system as a student at Carnegie Mellon University. From 1986 through early 1988, I also developed the curriculum, and supervised the teaching laboratory, for processor design courses.

15. In the latter part of 1989, I worked as a senior design engineer for ESL-TRW Advanced Technology Division. While at ESL-TRW, I designed and
10 built a bus interface and memory controller for a workstation-based computer system, and also worked on the design of a multiprocessor system.

16. At the end of 1989, I (along with some partners) reacquired the rights to the technology I had developed at Touch Technology and at AMP, and founded The Graphics Technology Company. Over the next seven years, as an officer and
15 a consultant for The Graphics Technology Company, I managed the company's engineering development activities and personally developed dozens of touchscreen sensors, controllers, and interactive touch-based computer systems.

17. I have consulted, formally and informally, for a number of fabless semiconductor companies. In particular, I have served on the technical advisory

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boards for two processor design companies: BOPS, Inc., where I chaired the board, and Siroyan Ltd., where I served in a similar role for three networking chip companies—Intellon, Inc., Comsilica, Inc, and Entridia, Inc.—and one 3D game accelerator company, Ageia, Inc.

5 18. I have also served as a technology advisor to Motorola and to several venture capital funds in the U.S. and Europe. Currently, I am a director of Turtle Beach Corporation, providing guidance in its development of premium audio peripheral devices for a variety of commercial electronic products.

10 19. From 1991 through 1997, I served on the Faculty of Princeton University as an Assistant Professor of Electrical Engineering. At Princeton, I taught undergraduate and graduate-level courses in Computer Architecture, Advanced Computer Architecture, Display Technology, and Microprocessor Systems, and conducted sponsored research in the area of computer systems and related topics. I was also a principal investigator for DOD research in video
15 technology and a principal investigator for the New Jersey Center for Multimedia Research. From 1999 through 2002, I taught the Computer Architecture course to both undergraduate and graduate students at Stanford University multiple times as a Consulting Professor. At Princeton, I received several teaching awards, both from students and from the School of Engineering. I have also taught advanced

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microprocessor architecture to industry professionals in IEEE and ACM sponsored seminars. More recently, I have been a lecturer at Santa Clara University teaching graduate courses on Computer Organization and Architecture and undergraduate courses on electronics and embedded computing.

5 20. From 1997 through 2002, I held a variety of executive positions at a publicly-held fabless semiconductor company originally called S3, Inc. and later called Sonicblue Inc. For example, I held the positions of Chief Technology Officer, Vice President of Systems Integration Products, Senior Vice President of Business Development, and Director of Technology. At the time I joined S3, the
10 company supplied graphics accelerators for more than 50% of the PCs sold in the United States. I participated in the design and marketing of over 30 audio/video products including networked audio and video clients and servers.

 21. I have published more than 50 peer-reviewed papers in computer architecture and computer systems and IC design.

15 22. I also have chaired IEEE and ACM conferences in microarchitecture and integrated circuit design and served as an associate editor for IEEE and ACM journals.

 23. I am a named inventor on at least 51 U.S. patents and 28 foreign patents, including patents on video streaming.

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24. In 2002, I was the invited keynote speaker at the ACM/IEEE International Symposium on Microarchitecture and at the International Conference on Multimedia. From 1990 through 2005, I have also been an invited speaker on various aspects of technology and the PC industry at numerous industry events including the Intel Developer's Forum, Microsoft Windows Hardware Engineering Conference, Microprocessor Forum, Embedded Systems Conference, Comdex, and Consumer Electronics Show, as well as at the Harvard Business School and the University of Illinois Law School. I have been interviewed on subjects related to computer graphics and video technology and the electronics industry by publications such as the Wall Street Journal, New York Times, Los Angeles Times, Time, Newsweek, Forbes, and Fortune as well as CNN, NPR, and the BBC. I have also spoken at dozens of universities including MIT, Stanford, University of Texas, Carnegie Mellon, UCLA, University of Michigan, Rice, and Duke.

25. Based on my technical education, and my years of professional experience as both an engineer and as an educator, I consider myself to be an expert in the field of computer architecture and computer system design, audio and video streaming, consumer electronics, and computer programming, including related standards, processes, and protocols. Moreover, I am very familiar with the operation and functional capabilities and limitations of digital audio and video

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devices and media distribution services existing during the late 1990s and early 2000s.

26. My professional experience with computers and consumer electronics, as well as my educational background, is summarized in more detail in my C.V.,
5 which is attached to this declaration. I am qualified to give an opinion regarding the state of the art and the validity of the '212 and '507 patents due to my experience and education in the field.

B. COMPENSATION

27. I am being compensated for the services I am providing in this
10 declaration. The compensation is not contingent upon my performance, the outcome of this *inter partes* review or any other proceedings, or any issues involved in or related to this *inter partes* review or any other proceedings.

C. DOCUMENTS AND OTHER MATERIALS RELIED UPON

28. The documents on which I rely for the opinions expressed in this
15 declaration are documents and materials identified in this declaration, including the '212 and '507 patents, their prosecution histories, the prior art references, the petitions against the above patents, the exhibits submitted in the Petition, and information discussed and any other references specifically identified in this declaration.

20 29.

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III. STATEMENT OF LEGAL PRINCIPLES

A. Obviousness

30. It is my understanding that obviousness under pre-AIA 35 U.S.C.

§ 103 effective before March 16, 2013 is a basis for invalidity. I understand that

5 where a prior art reference does not disclose all of the limitations of a given patent
claim, that patent claim is invalid if the differences between the claimed subject
matter and the prior art reference are such that the claimed subject matter as a
whole would have been obvious at the time the invention was made to a person
having ordinary skill in the relevant art. Obviousness can be based on a single
10 prior art reference or a combination of references that either expressly or inherently
disclose all limitations of the claimed invention. In an obviousness analysis,
inferences and creative steps that a person of ordinary skill in the art would employ
can be taken into account.

B. Claim Construction

15 31. It is my understanding that, when construing claim terms of an
unexpired patent, a claim subject to *inter partes* review receives the broadest
reasonable interpretation (BRI) in light of the specification of the patent in which it
appears.

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IV. LEVEL OF ORDINARY SKILL IN THE ART

32. I understand that the claims and specification of a patent must be read and construed through the eyes of a person of ordinary skill in the art at the time of the priority date of the claims. To determine the appropriate level of a person
5 having ordinary skill in the art, the following factors may be considered: (a) the types of problems encountered by those working in the field and prior art solutions thereto; (b) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (c) the educational level of active workers in the field; and (d) the educational level of the inventor.

10 33. In light of the disclosed technology in the '507 and '212 patents, it is my opinion that a person having ordinary skill in the art should have a Bachelor of Science or equivalent degree in electrical engineering, computer engineering, or computer science with at least 2 years of experience in a technical field related to multimedia technology and computer systems. This description is approximate
15 and additional educational experience could make up for less work experience and vice versa.

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V. IDENTIFICATION OF THE PRIOR ART AND SUMMARY OF OPINIONS

34. It is my opinion that Elabbady and Zintel render obvious claims 1 and 3-18 and Elabbady, Zintel, and Janik render obvious claims 2 of the '507 patent.

5 This is discussed on a claim by claim basis below.

35. It is also my opinion that Elabbady, Palm, and Zintel render obvious claims 1-18, 20, and 22-23, Elabbady, Palm, Zintel, and Janik render obvious claim 21, and Elabbady, Palm, Zintel, and Vallone render obvious claim 19 of the '212 patent.

10 **VI. BACKGROUND OF THE ART**

36. The Challenged Patents are directed generally to interactive television and similar interactive media such as from television or Internet sources, and more particularly to the provision and use of user interfaces that permit interaction using multiple coordinated device sets. *See e.g.*, '507 Patent at 1:10-16.¹ The

15 Challenged Patents discuss and rely upon existing technology in the fields of media distribution, networked communications, discovery protocols, user interfaces, and metadata representations. There had been a great deal of progress in these underlying technologies in the decade preceding the filing of the

¹ Because the Challenged Patents share the same specification, I have only cited to one. The other patent has the same disclosures.

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provisional application cited in the Challenged Patents. This includes the public launch of the World Wide Web in the early 90s, the academic and commercial development of streaming media, advanced in Ethernet and wireless communications technology, the spread of client-server computing systems, and the growth of digital audio and video technology.

37. Streaming audio and video dates back to the earliest days of the World Wide Web. Prior to the introduction of web browsers, researchers at CERN, the European particle physics laboratory, pointed a camera at their coffee pot and streamed the images over the internet to the xcoffee application that allowed users of the X-Windows graphical user interface (GUI) to view the coffee pot in real time. <https://www.cl.cam.ac.uk/coffee/qsf/coffee.html>. In 1993, this was converted to allow use with a standard web browser.

<http://www.bbc.com/news/technology-20439301>. Both X-Windows and the web browser allowed access over a local or wide-area network.



38. By 1994, more traditional video server applications were developed and publicly disclosed. For example, in 1994 and 1995, I published articles

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describing the Princeton Video Library of Politics.² This was a client-server video streaming system that had been developed at Princeton University under a grant from the U.S. DOD. The system was intended to provide a browsable set of video segments that could be viewed, paused, rewound, and otherwise manipulated by

5 students in order to study a historical subject. In our initial video library, the videos were all presidential campaign advertisements that had appeared on television. The server would provide captioned thumbnail images of various video streams. A user could select from among these streams and add annotations or access commentary. An instructor could prepare playlists to correspond to lesson

10 plans. By the very nature of X-Windows, the various display windows could be assigned to one or more client machines.

² Liu, B., Wolf, W., Kulkarni, S., Wolfe, A., et. al, “The Princeton Video Library of Politics”, Digital Libraries ‘94 – The First Annual Conference on the Theory and Practice of Digital Libraries, pp. 215-216, June 1994.

Wolf, W., Liu, B., Wolfe, A., Martonosi, M., and Liang, Y., “A Digital Video Library for Classroom Use”, International Symposium on Digital Libraries, Tsukuba Science City, Japan, August, 1995.

Wolf, W., Liu, B., Wolfe, A., Yeung, M., Yeo, B., and Markham, D., “Video as Scholarly Material in the Digital Library,” Chapter 1 in Advances in Digital Libraries '95, Springer-Verlag, 1995.

Kozuch, M., Wolf, W., and Wolfe, A., “Client-server Architectures for Nonlinear Video Services”, SPIE Conference on Integration Issues in Large Commercial Storage Systems, SPIE, Philadelphia, PA, Oct., 1995

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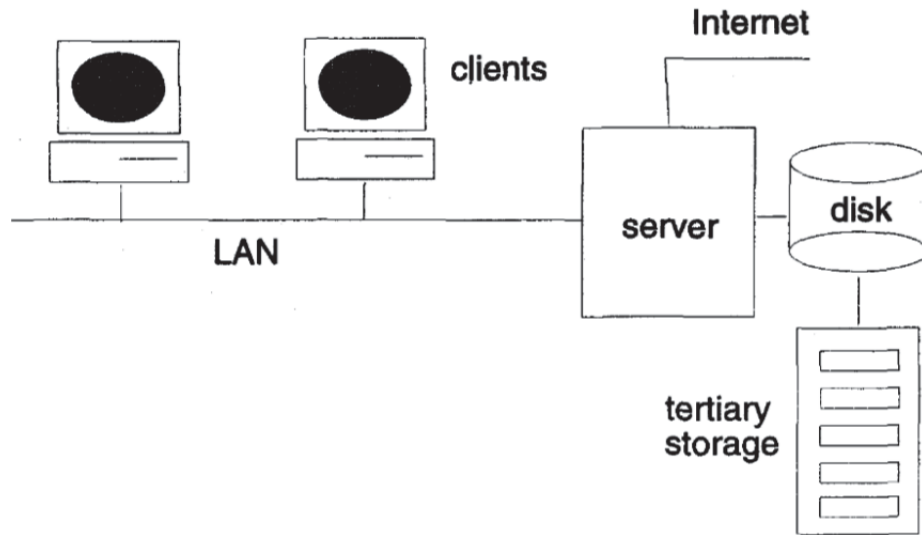
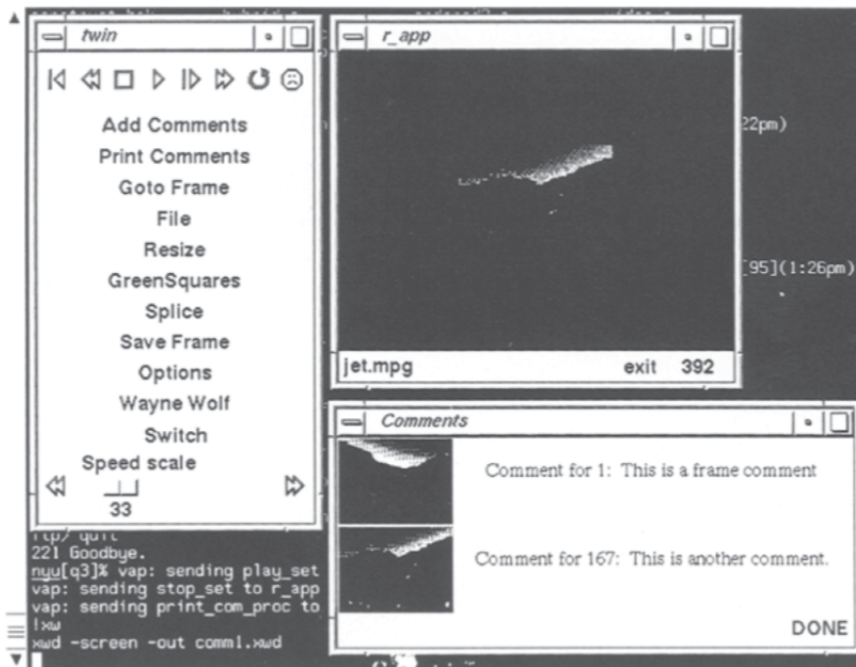


Figure 5.1 Client-server architecture of a classroom-sized video library.
Client-server video architecture - “Video as Scholarly Material in the Digital Library”



5

Figure 5.2 A display from the Princeton annotatable video browser.
User Interface - “Video as Scholarly Material in the Digital Library”

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39. In 1995, internet video distribution capabilities were discussed in the New York Times. Appendix F. By 1998, Real Networks had video streaming capabilities that were being used by major news operations. Appendix G. In April, 1999, Apple added video streaming capability to its Quicktime software with the release of Quicktime 4 and the Quicktime Streaming Server. Appendix D. The Quicktime 4 software used "Nonproprietary industry standard RTP³ and RTSP⁴ protocols for streaming over the Internet." It offered "intuitive user controls" for functions like play, pause, and content selection as well as audio controls. *Id.* It could display media, including streaming video, within a web page. *Id.* It supported HTTP streaming protocols. *Id.* It allowed integration of video with other forms of media. *Id.*

40. By 2000, commercial video streaming services had become well-known. For example, by 2000, Real Networks, known for streaming audio, added streaming video subscriptions to its platform. Appendix O. In particular, the gold pass subscription service included unlimited access to video from ABC News and Sports Illustrated. Appendix O. Quicktime 4 also supported QuickTime TV with

³ Real-time Transport Protocol – see https://en.wikipedia.org/wiki/Real-time_Transport_Protocol

⁴ Real-time Streaming Protocol – see https://en.wikipedia.org/wiki/Real_Time_Streaming_Protocol

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over 40 premium channels in 2000. Appendix D. By 2001, Microsoft had increased the quality of its previously introduced Windows Media video streaming technology to provide broadcast-quality video over the internet. Appendix L. This technology could be used, for example, to select and watch movie trailers. *Id.* It also supported digital rights management (DRM) and enabled commercial on-line movie services such as Intertainer and Cinema-Now. *Id.*

41. Other core technologies were well-known prior to the Challenged Patents as well. For example, 801.11 wireless technology was ratified as a standard in 1994 followed by the more popular Wi-Fi standard 802.11b in 1999. Appendix E. The 5GHz 802.11a standard was also ratified in 1999. *Id.* 802.11a was intended to support multimedia streaming with higher bandwidth than 802.11b. *Id.* The 802.11e standard, specifically intended for real-time video, also began formal development as a standard in 2000. *Id.*

42. Commercial wireless access points using the IEEE 802.11 family standards were widely used and available in any electronic store. As an example, Linksys made a wireless access point in 2001 for use in home networks. *See* EX1022 and 1023. A POSITA would appreciate that devices communicating with other devices over conventional wireless networks would be configured for communication using a wireless communications protocol like IEEE 802.11.

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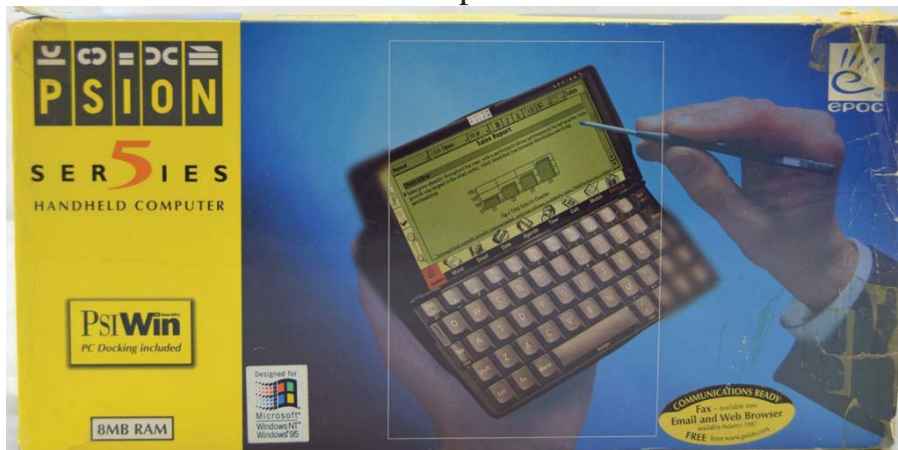
43. Protocols for communicating capabilities between computer systems were also well known at the time. TCP/IP and UDP were used for establishing and maintaining communication channels over a network. '507 patent at 22:24-47. DOCSIS was used to provide internet services over cable TV wiring. *Id.* HTML and HTTP were used to provide data, including streaming content, metadata, and user-interface specifications, over the internet via web browsers. *Id.* at 5:10-17; 22:24-47. XML was used to describe capabilities or systems and characteristics of data sets. *Id.* at 23:47-57; 10:4-32. MPEG 2 and other MPEG variants were used for encoding and transport of audio, video, and metadata. *Id.* at 23:38-39; 20:20-40.

44. Windows-based user interfaces, both touchscreen-based and mouse based, were well-known and in common usage. Apple provided the Macintosh computer family that used a WIMP (Window, Icon, Menu, Pointer) GUI. Microsoft Windows and X-Windows/Linux offered similar features. In addition to common mouse or trackpad-based input, touchscreen input was available on laptops such as the IBM Thinkpad 360PE in 1995, the Psion 5 in 1995, and the FrontPath Progear in 2000, all of which could connect to the internet.

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IBM Thinkpad 360PE



Psion 5

5

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Frontpath Progear

45. Universal Plug and Play (UPnP) is one of the networking and
5 discovery protocols that was known at the time that the provisional application for
the Challenged Patents was submitted. UPnP is “an architecture for pervasive
peer-to-peer network connectivity of intelligent appliances, wireless devices, and
PCs of all form factors.” Universal Plug and Play Device Architecture v. 1.0,
EX1020. It is designed to support zero-configuration, "invisible" networking, and
10 automatic discovery for a breadth of device categories from a wide range of
vendors. This means a device can dynamically join a network, obtain an IP
address, convey its capabilities, and learn about the presence and capabilities of

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other devices. *Id.* UPnP leverages Internet components, including IP, TCP, UDP, HTTP, and XML. Devices communicate using protocols that are declarative, expressed in XML, and communicated via HTTP. *Id.* UPnP allows each device to establish an IP address, whether or not a DHCP server is allocating the addresses.

5 *Id.*

46. Step 1 in UPnP networking is discovery. When a device is added to the network, the UPnP discovery protocol allows that device to advertise its services to control points on the network. Similarly, when a control point is added to the network, the UPnP discovery protocol allows that control point to search for
10 devices of interest on the network. The fundamental exchange in both cases is a discovery message containing a few, essential specifics about the device or one of its services, e.g., its type, identifier, and a pointer to more detailed information. The UPnP discovery protocol is based on the Simple Service Discovery Protocol (SSDP). *Id.*

15 47. Step 2 in UPnP networking is description. A control point initially knows very little about a device. For the control point to learn more about a device and its capabilities, or to interact with the device, the control point must retrieve the device's description from the URL provided by the device in the discovery message. Devices may contain other, logical devices, as well as functional units, or

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services. The UPnP description for a device is expressed in XML and includes vendor-specific, manufacturer information like the model name and number, serial number, manufacturer name, URLs to vendor-specific Web sites, etc. The description also includes a list of any embedded devices or services, as well as URLs for control, eventing, and presentation. For each service, the description includes a list of the commands, or actions, the service responds to, and parameters, or arguments, for each action; the description for a service also includes a list of variables; these variables model the state of the service at run time, and are described in terms of their data type, range, and event characteristics.

10 *Id.*

48. Step 3 in UPnP networking is control. After a control point has retrieved a description of the device, the control point can send actions to a device's service. To do this, a control point sends a suitable control message to the control URL for the service (provided in the device description). Control messages are also expressed in XML using the Simple Object Access Protocol (SOAP). *Id.*

49. Step 4 in UPnP networking is eventing. A UPnP description for a service includes a list of actions the service responds to and a list of variables that model the state of the service at run time. The service publishes updates when these variables change, and a control point may subscribe to receive this

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information. The service publishes updates by sending event messages. Event messages contain the names of one or more state variables and the current value of those variables. These messages are also expressed in XML and formatted using the General Event Notification Architecture (GENA). A special initial event message is sent when a control point first subscribes; this event message contains the names and values for all evented variables and allows the subscriber to initialize its model of the state of the service. *Id.*

50. Step 5 in UPnP networking is presentation. If a device has a URL for presentation, then the control point can retrieve a page from this URL, load the page into a browser, and depending on the capabilities of the page, allow a user to control the device and/or view device status. The degree to which each of these can be accomplished depends on the specific capabilities of the presentation page and device. *Id.*

51. The Universal Plug and Play Device Architecture specification describes each of these steps in detail including the protocols and capabilities.

52. By 2001, home entertainment devices used these technologies to stream audio and video. The Rio Receiver could stream audio content from a PC or a dedicated music server over phone lines or Ethernet using UPnP. Appendix T. The Turtle Beach Audiotron could stream audio content from a PC or from internet

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radio services and could be controlled via a web page from a computer or PDA.

Appendix T. The Replay TV 4000 could stream video from another Replay TV

4000 unit over Ethernet. Appendix P. One unit would discover other units on the network and query them as to which recorded shows were available to watch using

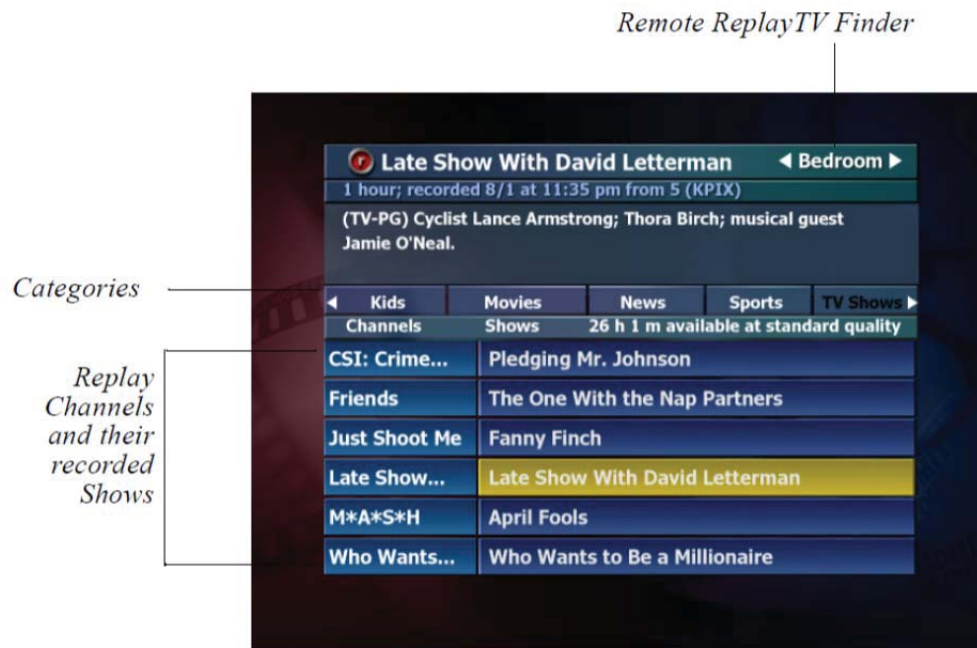
5 HTTP. An XML-coded response would be provided which was used to create a

GUI listing of recordings that could be selected for playback. Appendix P at 45.

Local/remote Replay Guide selection

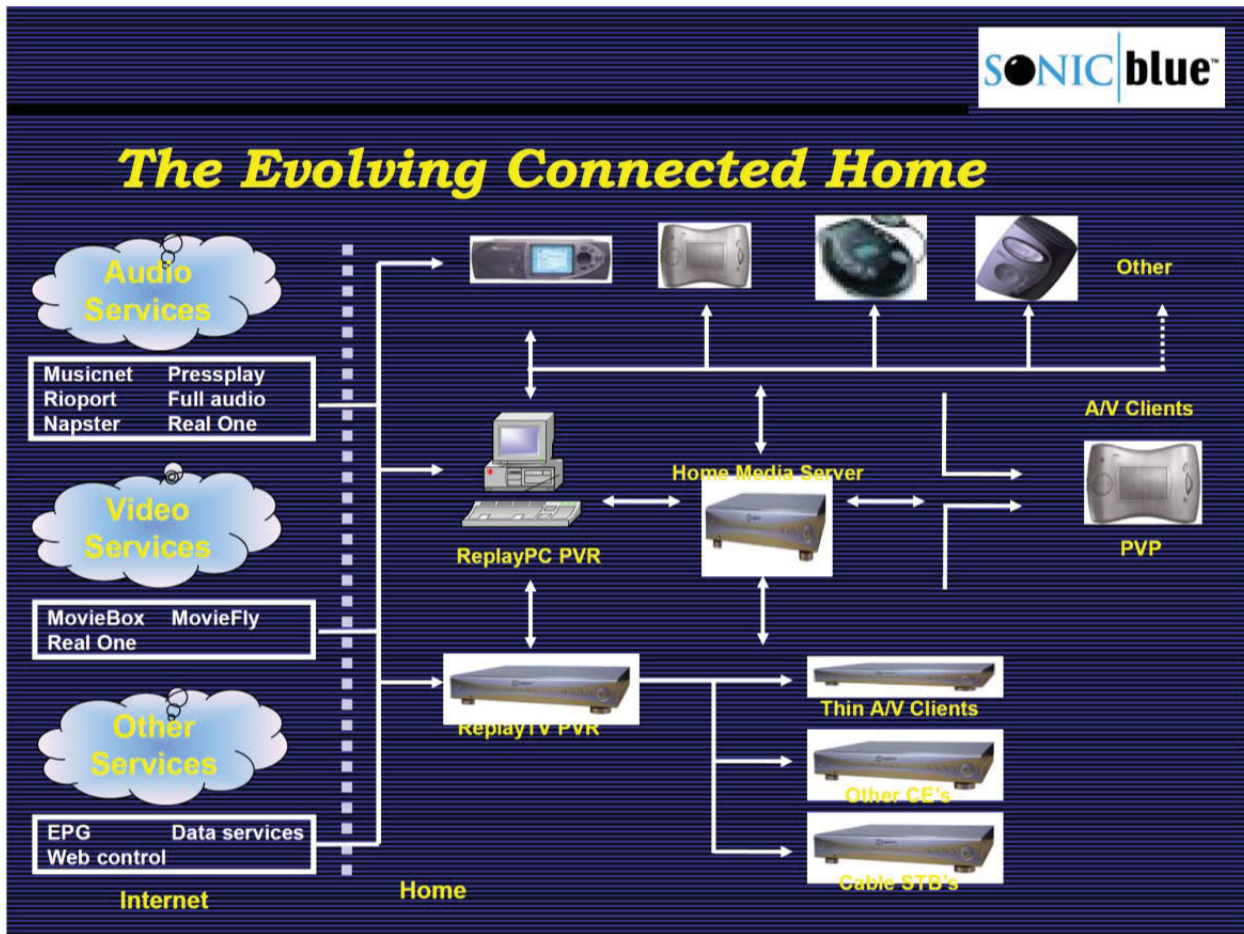
If more than one ReplayTV exists on the network, you will see left and right arrows next to the ReplayTV name in the upper right hand corner of the Replay Guide. This is called the **Remote ReplayTV Finder**. From here, you can access other networked ReplayTVs in your home.

Note: If there is only one ReplayTV on the network, the left and right arrows will not be displayed next to the ReplayTV name.



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53. By 2001, the integration of internet video services, networking protocols, and consumer devices was understood. This is evidenced, for example, in the slide below from a keynote address I presented at an IEEE conference in 2001.



5

VII. THE PRIOR ART

A. ELABBADY

54. Elabbady is a patent assigned to Microsoft Corp. It describes a
10 network of UPnP compatible devices that distribute and consume media content.

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Elabbady, 1:15-18, 5:54-5. UPnP provides peer-to-peer network capability that supports control and media playback across a wide array of devices such as desktop and notebook computers, tablets, PDAs, digital audio receivers and players, digital video receivers, digital TV sets, set-top-boxes, etc. *Id.*, 3:33-45;

5 5:54-58.

55. Elabbady describes several media content sharing modules - a Media Cataloging Service and a Media Library Service. Elabbady, 1:62-67; 2:19-25; 2:62-65; 6:16-23; 7:34-35. Together, the Media Cataloging Service 203 and the Media Library Service 207 allow UPnP compatible devices to browse, access, and
10 share media content that exists on the network. *Id.*, 6:16-23.

56. The Media Cataloging Service 203 (annotated in yellow on Fig. 2B, below) provides centralized media cataloging capabilities for devices on the network. Elabbady, 6:53-56. The Media Cataloging Service 203 aggregates metadata from Media Library Services 207 into a content catalog that is accessible
15 and shareable throughout the network. *Id.*, 6:7-23. To build its catalog, the Media Cataloging Service 203 “may actively/dynamically query the various devices to gather information about shared media content and/or passively receive such information about shared media content from the various devices.” *Id.*, 6:8-15. The media catalog is organized in a markup language, such as HTML, and the

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content contains metadata such as media location and identifier (*e.g.*, URL), format information, and descriptive information. *See id.*, 6:30-42.

57. The Media Library Service 207 (annotated in aqua on Fig. 2B, below) provides metadata for its media library that Media Cataloging Service 203 uses to create the media catalog. *See id.*, 7:16-24. The metadata describes shareable media content. *Id.*, 7:18-24.

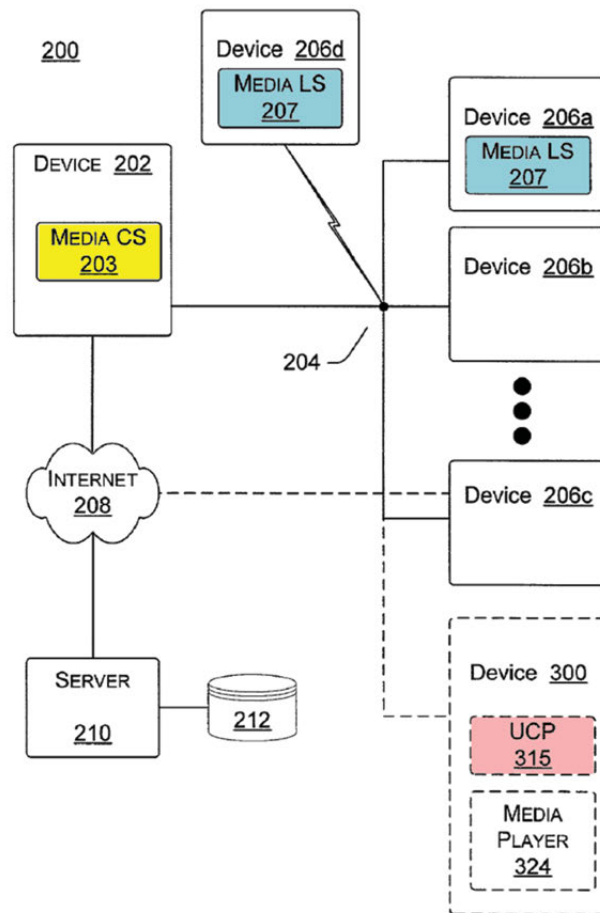


Fig. 2A

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58. Any device can have a Media Catalog Service 203 (*id.*, 9:37-38) and any device that lacks a Media Catalog Service 203 can access the media catalog of another device's Media Catalog Service 203 (*id.*, 8:57-62). Any number of Media Cataloging Services 203 can exist in the network. *Id.*, 9:38-39 (stating that, in certain embodiments, only one of the Media Catalog Services 203 will be active in generating the media catalog); 6:53-56 (stating that there can be a single central Media Cataloging Service 203); *id.*, 9:43-44 (stating if a device having the senior Media Catalog Service 203 leaves the network, the next senior media Catalog Service 203 will maintain the media catalog.)

59. An aggregated media catalog is accessible via a UPnP compliant device's User Control Point 315 (annotated in red on Fig. 2B, above and below) which queries and receives a media catalog describing available content on the network from the Media Cataloging Service 203 (yellow, below). *Id.*, 10:15-23; 11:11-17; 12:22-25. Upon selection of a content item via a user interface, the media content's URL is sent to the device's HTTP client 318, which performs an HTTP GET to the Content Server 320 to obtain and decode the downloaded media content on the Media Decoder/Player 324. *Id.*, 10:39-63; 11:11-17; 12:26-34. Content retrievable via HTTP GET can be resident on the Device 206 (as shown below), a different device (*e.g.*, Devices with Media Library Services 207 (*id.*,

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7:16-24)), or on the Internet (*id.*, 5:33-45). *See id.*, 10:23-33; 11:17-20. Any device on the network can be connected to the Internet, either directly (*id.*, 5:39-45) or through a firewall (*id.*, 7:39), and can have a media player. *Id.*, 8:57-62.

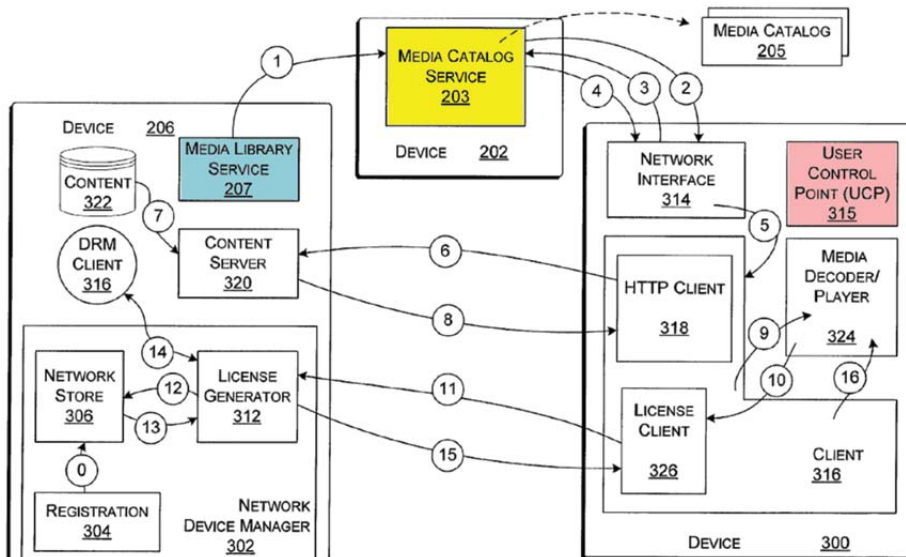


Fig. 3

5 60. A UPnP User Control Point is used to provide user interfaces for selecting a device, presenting a media catalog, receiving a user request for media content, and configuring a media player to receive the media content over the network. *Id.*, 2:9-14; 12:18-21; Elabbady Provisional, 16. “[A]ny UPnP control device (control point) on the home network [can] access” a Media Library Service

10 207. *Id.*, 7:34-35; 8:57-62; 10:12-16; Elabbady Provisional, 1 (“This means that any UPnP control point on the home network can access the UPnP Media Library Service.”).

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61. Elabbady incorporates by reference the Elabbady Provisional in its entirety. Elabbady at 1:7-11. The Elabbady Provisional includes a number of detailed Microsoft specifications and technical documents:

Elabbady Provisional Section	Pages of Elabbady Provisional
Invention Summary	1-4
DigitalAudioReceiver (“DAR”) Device Template	5-12
DAR Architecture	13-17
Digital Media Description Language	18-24
Media Library Service Template	25-36
Music Manager Specification	37-57
Media Library Service System Architecture	58-66

5 62. The Elabbady Provisional describes different multimedia devices, including “digital audio and video players/recorders” and “digital AV device[s].” Elabbady Prov. at 1-2. The Elabbady Provisional repeatedly states that the media catalog includes both audio and video content. *Id.* at 1, 7, 9, 18-24, 27, 57. Although several of the documents in the Elabbady Provisional refer specifically to
10 a digital audio receiver (DAR), a POSITA would recognize that Elabbady’s teachings concerning the DAR would also be applicable to a digital video player as

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well. For example, the UPnP protocols are the same regardless of the device type, so the communications related to discovery, description, and control would be substantially the same for a video player as for an audio player. The Elabbady Provisional even discloses services for the DAR that are capable of controlling video playback. *Id.* at 7, 9 (describing AVTransport service). A POSITA would also know that video files, like audio files, can be stored on a server and downloaded or streamed over HTTP. *See, e.g.*, EX1006 at ¶ 78; EX1004 at 9:22-27. Therefore, a POSITA would understand that a PLAY command and a URL could be sent to a video player to cause it to stream the video associated with the URL. EX1005 at 16-17.

63. The Elabbady Provisional states that digital AV devices can be controlled via control points to provide playback and other functions such as volume control. *Id.* at 15-16; 45. The Elabbady Provisional also describes how user control points can be used to access and play AV content. *Id.* at 1. These control points can be on any AV device to control any other AV device. *Id.* at 14-15; 45.

64. The Elabbady Provisional also states that particular devices can be selected to route content to. *Id.* at 15-16. For example, a list of AV capable devices can be displayed and a device can be selected. *Id.* at 16. Content can then

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be played on the chosen device. *Id.* Content is addressable via URL, and the URL is passed to the chosen device which downloads or streams the content for playback. *Id.*

B. ZINTEL

5 65. Zintel is a patent that was originally assigned to Microsoft Corp. Zintel generally describes the use of UPnP to dynamically connect and control devices and services across a network. Zintel, 1:16-21; 4:57-61. “UPnP makes it possible to initiate and control the transfer of bulk data (e.g., files) or A/V data streams from any device on the network, to any device on the network, under the
10 control of any device on the network.” *Id.*, 5:26-29; 6:48-52.

 66. UPnP categorizes its software components into logical modules. *Id.*, 6:56-59. The two main components to effectuate control are the “User Control Point” and the “Controlled Device.” *Id.*, 6:56-59; 6:60-7:32. The “User Control Point” provides a user interface and allows a user to search for, select, control, and
15 interact with Controlled Devices on the network. *Id.*, 6:60-68; 13:36-39; 30:41-42. User Control Points can aggregate control of multiple Controlled Devices or can be used to interact with a single Controlled Device. *Id.*, 7:4-7. A User Control Point can reside on any physical device, such as a PC, digital TV, set-top box, handheld computer, smart mobile phones, etc. and can be used to control any device in the
20 UPnP network. *Id.*, 7:8-13 (“Nothing prevents a single device from implementing

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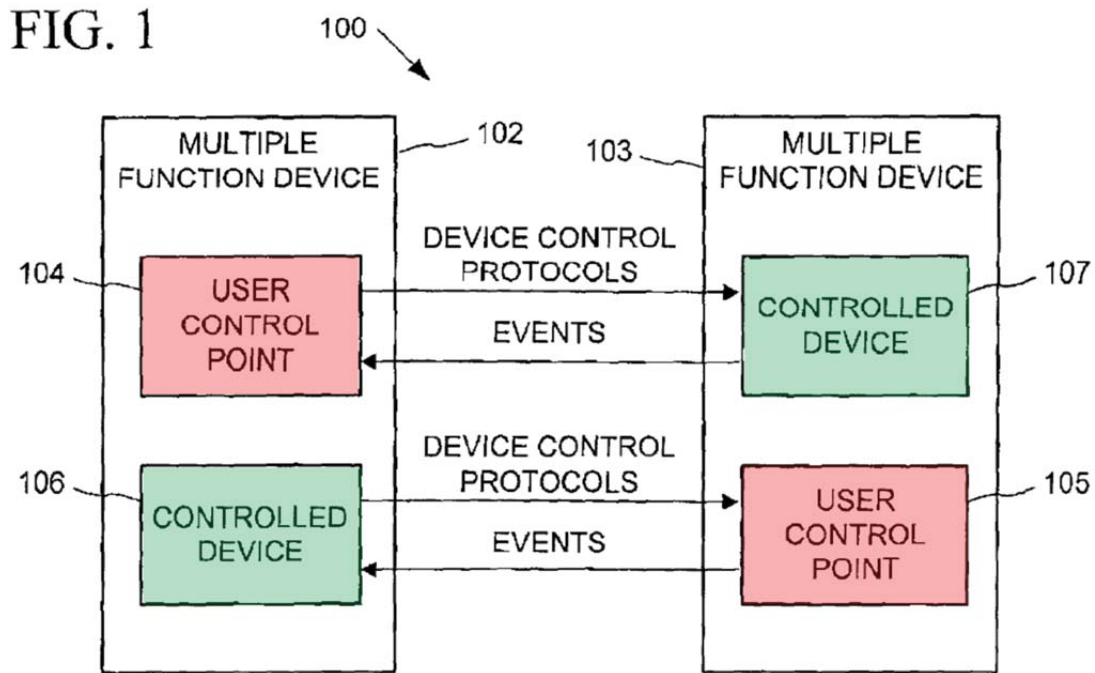
the functionality of a User Control Point and one or more Controlled Devices at the same time.”). Zintel describes an operating system module called a “Rehydrator” which abstracts the details of UPnP communications from applications and provides an API that applications can use to communicate with other UPnP devices. *Id.* at 21:13-18; *see also id.* at 23:28 – 25:41 (describing APIs). For example, the Rehydrator can interpret description information in order to generate proper commands. *Id.* at 21:34-53. I do not rely on the Rehydrator in my analysis because they are not a standard part of UPnP.

67. The “Controlled Device” communicates with the User Control Point to provide command, control, and data transfer. *Id.*, 7:14-23. Controlled Devices respond to discovery requests, provide description documents, can expose their own UI, accepts incoming commands, and sends “Events” (described later). *Id.*, 7:16-18; *id.*, 13:49-14:19. Controlled Devices provide “Services,” the fundamental UPnP controllable entity that provides a common base set of functionality. *Id.* 9:1-12; *see also id.* (stating that manufacturers can add their own specific functionalities). Service functionality can be invoked via command. *See, e.g., id.*, 9:30-44. Example Controlled Device can include: VCRs, DVDs, home appliances, audio/video playback devices, handheld computers, smart mobile phones, and PCs. *Id.*, 7:25-29; *see also id.*, Figs. 3 & 31; 15:53-67. A single physical device can

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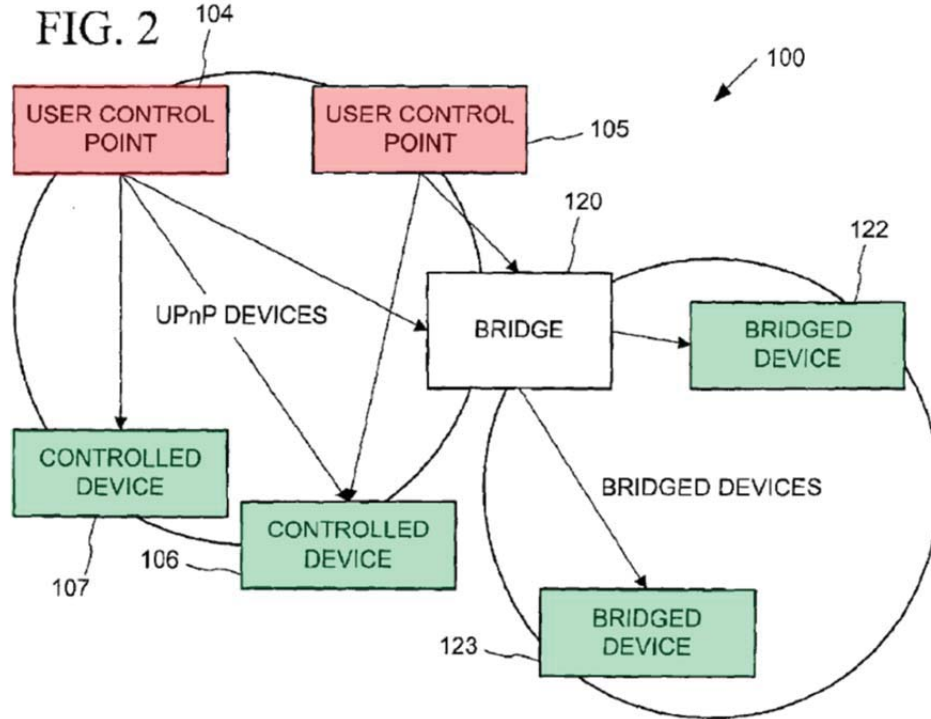
have the functionality of a User Control Point and a Controlled Device at the same time. *Id.*, 7:29-32.

68. The classification of User Control Points and Controlled Devices as modules is functional; it is not a physical constraint. *Id.*, 13:22-23. Any User Control Point can control any Controlled Device on the network. *See id.*, 5:26-32; 5:59-60:10; 6:43-52; 7:11-13; 7:29-32; 48:31-44. A User Control Point can have its own user interface (*id.*, 13:36-40), initiate discovery, receive description documents, allow control of a selected device, can view a UI exposed by a controlled device, execute applications, invoke commands, and receive Events. *Id.*, 13:49-14:19. The Controlled Device responds to discovery requests, provides description documents, can provide UIs for remote User Control Points, accepts incoming commands, and sends Events. *Id.* As shown in Fig. 1, below, User Control Points 104/105 (red, below) and Controlled Devices 106/107 (green, below) are part of multiple function devices 102 and 103, respectively, but can be packaged in any combination. *Id.*, 13:18-20.



69. Fig. 2 illustrates the User Control Points 104/107 (red, below) controlling Controlled Devices 106/107 (green, below). As shown below, User Control Point 104 is shown controlling both Controlled Device 106 and 107 and
5 Bridged Devices 122/123 (also green, below) through a Bridge 120. *Id.*, 13:17-43. Any User Control Point can control and transfer data to/from any Controlled Device on the UPnP network. *Id.*, 5:26-32; 6:43-52.

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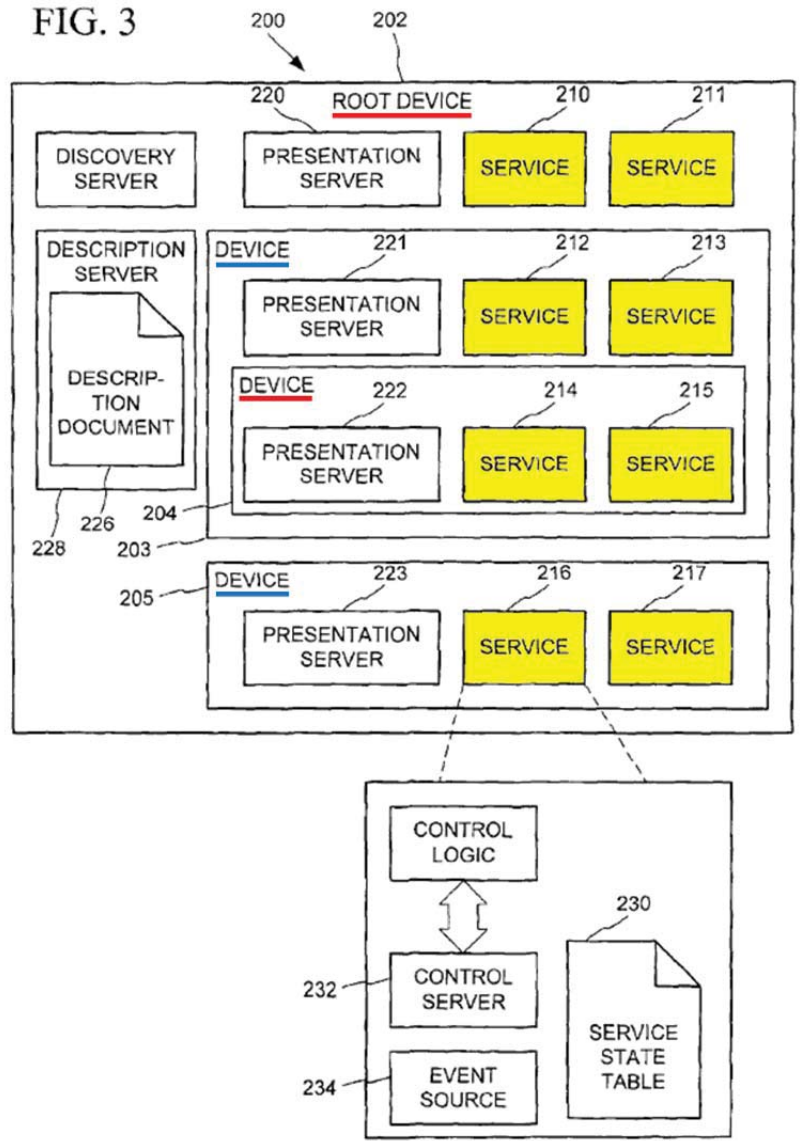
70. “Devices” can be described as logical entities (in addition to physical entities) in the UPnP “Device Model,” according to the particular “Services” they provide. *Id.*, 8:12-20; 7:61-64. User Control Points can invoke commands on
5 Services (*id.*, 9:30-63; *see also* 21:3-18; 21:43-42), such as “getTime() and setTime()for a Controlled Device having a ‘Clock’ Service. . .” *Id.*, 21:65-66; *see also id.*, 25:3-18 (describing setting time on a VCR). The current state of any given Service is recorded in a Service State Table, which shows the state of
10 services such as current channel of a TV or time of a clock. *Id.*, 14:36-55. Events are communicated to User Control Points for notifications of state changes. *Id.*, 13:4-10; 13:30-31. Devices can be searched by type (*id.*, 8:24-31), name (*id.*,

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8:55-56), Service (*id.*, 9:1-12), and can be selected via icon by a User Control Point. *See also id.*, 13:49-14:19 (showing discovery, display, and selection of icons); 16:22-30; 20:1-13; *see also* 30:41-42 (stating that the User Control Point searches for devices); 57:24-35.

5 71. According to the UPnP device model, devices are logical containers, rather than actual physical devices. *Id.*, 15:52-67. For example, one device (*e.g.*, Device 202, underlined in red below) can contain other devices, such as Device 203/205 (underlined in blue below). *Id.*, 15:53-55. Further, as shown below, Device 203 contains Device 204 (underlined in green below). *Id.*, 15:61-62. Each
10 device is a logical container of one or more Services 210-217 (highlighted in yellow). *Id.*, 15:52-55. A “Service 210-217 is a cohesive set of functions that enables flexible packaging into a variety of Devices.” *Id.*, 16:4-8. “The UPnP Device Model was designed to be general and flexible. . .” *Id.*, 16:1-2.

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72. A User Control Point can to perform device discovery to search for devices by UDN, device type, and service type. *Id.*, 19:24-45. User Control Points provide “functionality that displays the icons of discovered Devices and enables the transfer of control to a browser or application to interact with the Controlled Device.” *Id.*, 11:6-10. For example, in Windows, visual navigation of icons “could be implemented as a folder of icons.” *Id.*, 11:6-10. From the discovered

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devices, “UPnP enables the association of user interface (display icon and root Web page) with every Device. . .” *Id.*, 8:18-20. The result of device discovery is one or more Description URLs. *Id.*, 19:54-56.

73. A general example process is illustrated in Zintel where, a User Control Point initiates the discovery of devices, receives description documents, and “[d]isplays a folder of icons per discovered Device and allow[s] transfer of control to a selected device.” *Id.*, 13:49-63; *see also id.*, 27:34-54; 59:51-58; 61:50-67. Thereafter, the User Control Point “[v]iews [the] user interface exposed by a Controlled Device [to] [e]xecute applications . . . [and] [i]nvoke Commands on [the] Controlled Device. . .” *Id.*, 13:63-14:11.

C. JANIK

74. Janik describes numerous client devices such as televisions, webpads (also known as PDAs or tablets with wireless LAN transceivers), audio playback devices, Internet clocks, digital picture frames, and automotive storage devices. Janik at 4:40; 12:37-40; 22:41-47. These are connected in a network with a PC and a storage gateway. *Id.* at 8:38-40; 8:23-26; 10:46-11:3; Fig. 1. The devices have wireless interfaces to communicate. *Id.* at 13:3-8; 21:67-22:4; 22:22-27; 27:34-37. Client devices can access and present audio or video content that is stored locally on a hard drive or on a server on the Internet. *Id.* at 9:1-10; 10:46-11:3.

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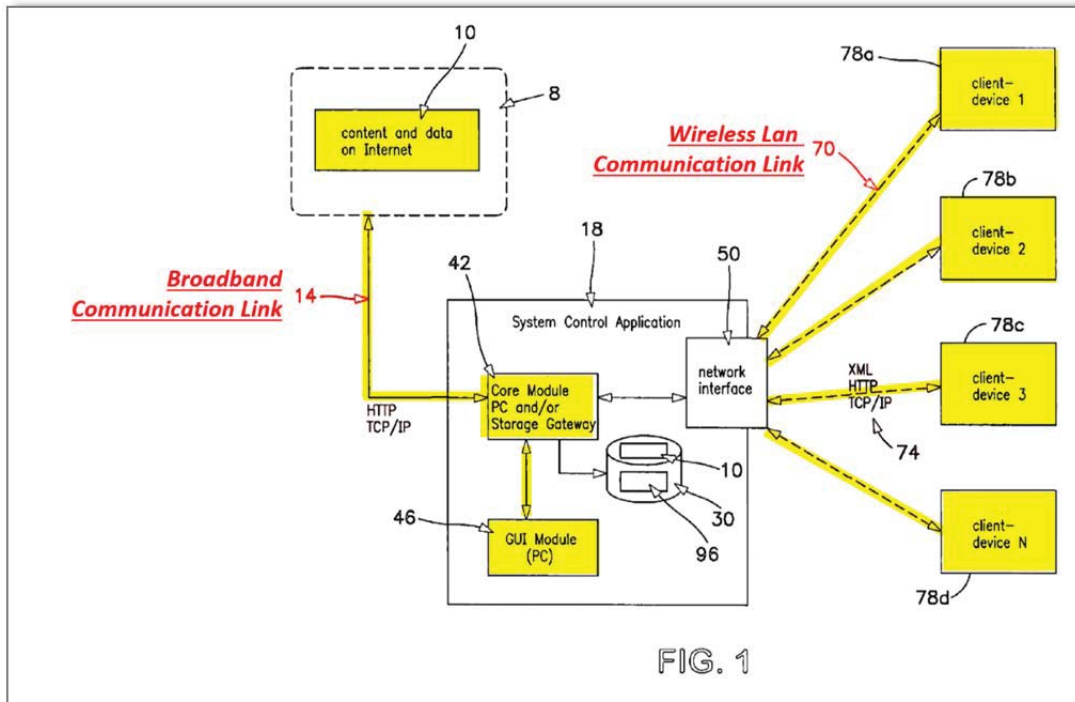
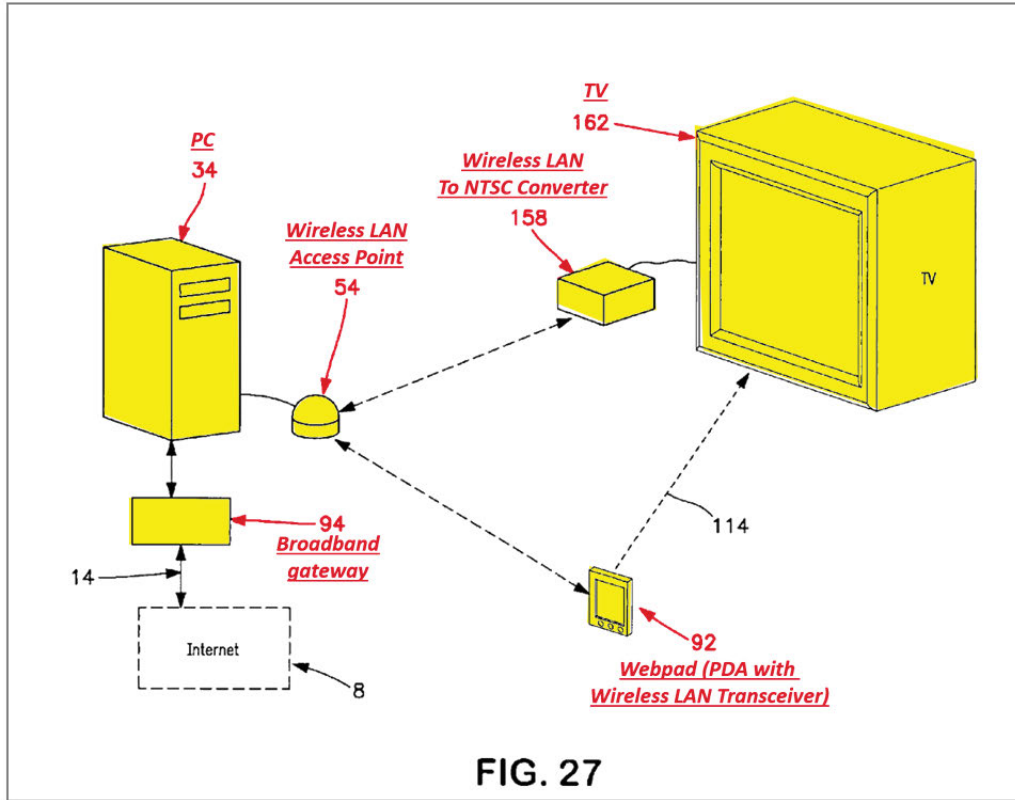


FIG. 1

75. Janik also describes a PC and a TV connected to a LAN-to-NTSC converter, and a webpad. *Id.* at 22:22-39. Here, a user can wirelessly send video content from a PC 34 or a webpad (*e.g.*, a PDA with a wireless LAN transceiver) to a TV. *Id.* at 25:52-58; 24:40-51; 25:1-8; 22:41-47. Janik also teaches that the digital video files can be wirelessly streamed to the webpad. *Id.* at 21:64-22:4.

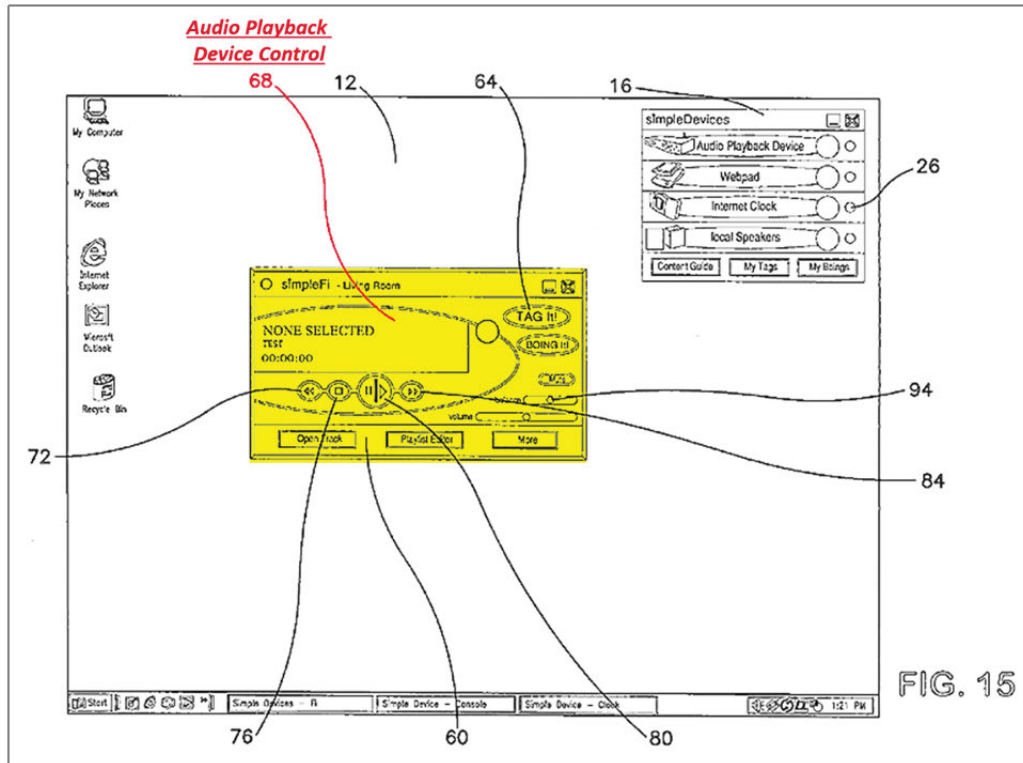
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76. “Client devices are controlled by using a device controller GUI on PC 34” (Janik at 18:21-22) and “[d]evice controllers are launched from console 16 by right clicking on client device control bar 26 on console 16 associated with the specific device that is to be controlled.” *Id.* at 18:22-25. For instance, as shown in 5 Janik’s Fig. 15, an audio playback device controller 60 is launched from the console 16 of the PC. Janik states that “[t]he function of a device controller is to remotely control networked client devices 78, and to also allow for the setting of certain preferences and features for client devices 78.” *Id.* at 18:27-30 (emphasis 10 added). Janik further explains that “audio playback device controller 60 is used to

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directly control audio playback device 86, such as to instruct audio playback device 86 to play, stop or pause on a particular track.” *Id.* at 18:30-34.



D. VALLONE

5 77. Vallone is a patent from Tivo, Inc., which provides a navigation
system for saved content on a DVR (Vallone at 12:53-58; *see also id.* at 14:47-
15:24) that includes bookmarks and favorites. *See, e.g., id.* at Figs. 28-33. With
respect to favorites, Vallone teaches a ratings system, where a person can indicate
content that they like by providing 1, 2, or 3 thumbs up. *Id.* at 16:34-42. Content
10 that receives more thumbs up is correlated with someone’s favorited content.
Thumb indicators are presented next to favorited content. *See, e.g., id.* at 16:56-63;

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17:38-46; *see also id.* at 18:18-27 (showing how the user can rate with thumbs-up).

In addition, Vallone further provides a “favorites” categorization as a selectable

menu option. *Id.* at Fig. 30; *see also id.* at 23:19-33. With respect to bookmarks,

Vallone teaches a “bookmark function that allows the user to bookmark a program

5 where he left off,” or points of interest. *Id.* at 15:34-36. The system can also place

bookmarks automatically – this is done when a user exits the viewing session and

an indicator can be played on the screen with the content showing that a bookmark

had been saved. *Id.* at 15:44-47. As explained by Vallone, bookmarks are helpful

to allow a user to watch portions of a long movie, and return to the bookmarked

10 location to continue the movie. *Id.* at 15:40-50.

78. Example bookmark (annotated Fig. left) and thumbs up tags are shown below. *See id.* at 15:44-47; *see also* Fig. 19; *see also* Fig. 30 (showing “Favorites” category for content). Vallone at 15:44-47 states that the bookmark is

1708 but a POSITA would understand that this is a typo of 1808 because the

15 discussion is with respect to Fig. 18, element 1808 shows a standard bookmark

picture, and 1708 is a “whispering arrow” as described in 14:32-35. 1808 is used

in no other context than the bookmarking feature.

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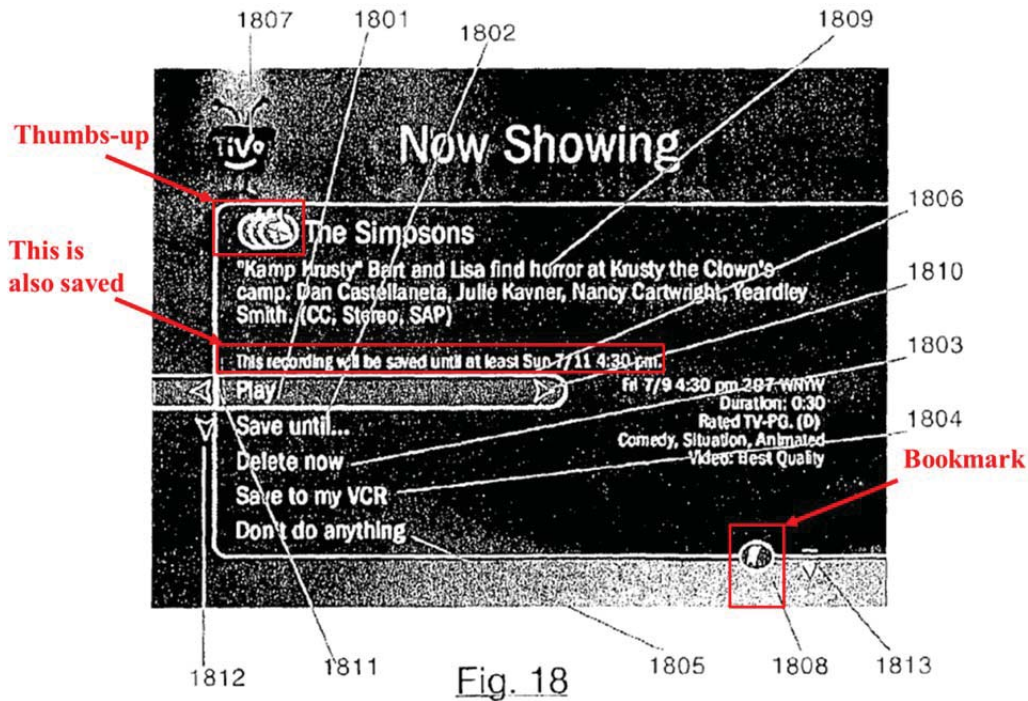


Fig. 18

E. PALM

79. Palm describes networked multimedia players which stream audio/video content from servers on a local network or the Internet. Palm at 5 Abstract, ¶¶ 7, 9, 21, 43, 53, 64-65, 78; Fig. 1. A player device can be a handheld PC running Windows CE or PalmOS. *Id.* at ¶ 71. The player devices allow users to browse for available audio/video content and select items for playback. *Id.* at ¶¶ 40-43, 55-62, 73-74, 77-80, 90. The players receive URLs for content items that enable the player to stream the content items from the media servers. *Id.* at ¶¶ 48, 10 80-83, 88. Palm teaches that the players are UPnP-compliant and are able to automatically discover media servers. *Id.* at ¶¶ 76-77.

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VIII. THE '507 PATENT

80. It is my opinion that Elabbady and Zintel render obvious claims 1 and 3-18 of the '507 patent and the combination of Elabbady, Zintel, and Janik renders obvious claim 2 of the '507 patent. This is discussed on a claim by claim basis
5 below.

A. CLAIMS 1 AND 3-18 OF THE '507 PATENT ARE OBVIOUS OVER ELABBADY AND ZINTEL

81. As an initial matter, I note that claim 1 of the '507 patent closely tracks the general structure of UPnP as described in Zintel. Zintel provides a table,
10 which is reproduced below, that describes the general operation of UPnP. Zintel at 13:44-14:19. Provided below is the claim language and following the claim language is a description on how it matches onto the structure described in Zintel.

82. **[Claim 1[PRE]]:** A method for use in a second computerized device set which is configured for wireless communication using a wireless
15 communications protocol that enables wireless communication with a first computerized device set, wherein the first computerized device set includes a continuous media player, the method comprising: **[Claim 1[A]]:** receiving discovery information that is obtained in accordance with a device management discovery protocol that is implemented at a communication layer above an internet
20 protocol layer, wherein the discovery information allows a determination to be

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made at the second computerized device set that the first computerized device set is capable of receiving an indication of a particular control function related to a parameter of a presentation of a continuous media content on the first computerized device set, wherein the continuous media content includes video data; **[Claim 1[B]]**: making available to a user a first user interface that allows the user to select to direct communications to the first computerized device set; **[Claim 1[C]]**: making available to the user a second user interface that allows the user to select the particular control function related to a parameter of a presentation of the continuous media content; and, **[Claim 1[D]]**: causing to be wirelessly transmitted, in accordance with a wireless local area network protocol, the indication of the particular control function selected by the user via the second user interface to the first computerized device set for subsequent use by the continuous media player to control the presentation of the continuous media content on the first computerized device set.

83. As shown above, Claim 1[PRE] generally describes one device controlling another device. As shown below in yellow, the User Control Point controls a Controlled Device. Claim 1[A] generally describes Discovery and Description. Similarly, as shown in blue, a User Control Point performs discovery and receives description documents from a Controlled Device. Claim[B] generally

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describes providing a user interface to allow a user to select devices. Similarly, as shown below in green, the User Control Point displays a icons for discovered devices and allows a user to control a selected device. Claim 1[C] generally describes a user interface to allow a user to select control functions. Similarly, as

5 described below in red, a User Control Point views user interfaces that have been exposed by the Controlled Device. Finally, Claim 1[D] generally describes performing a function. Shown below, in orange, the same is described. All in all, claim 1 of the '507 patent describes nothing more than a generic application of UPnP, and this is disclosed by Elabbady and Zintel.

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Claim 1[PRE]	User Control Point		Controlled Device	
	Function	Module	Function	Module
Claim 1[A]	Initiate discovery of Controlled Devices.	Discovery Client	Respond to discovery requests.	Discovery Server
	Retrieve Description Documents.	Description Client	Provide Description Documents.	Description Server
Claim 1[B]	Display a folder of icons per discovered Device and allow transfer of control to a selected device.	Visual Navigation		
Claim 1[C]	View user interface exposed by a Controlled Device.	Web Browser	Provide user interface for remote User Control Points.	Presentation (Web) Server
Claim 1[D]	Execute applications.	Application Execution Environment		
	Invoke Commands on a Controlled Device by sending Service Control Protocols in response to local API calls.	Rehydrator	Accept incoming Commands in SCPs and execute them.	Control Server plus native control logic
	Inform a Controlled Device of a desire to receive Events.	Event Subscription Client	Accept requests for Events and remember them.	Event Subscription Server
	Receive an Event.	Event Sink	Send an Event.	Event Source

B. A POSITA WOULD HAVE BEEN MOTIVATED TO COMBINE ELABBADY AND ZINTEL

84. The systems described in Elabbady and Zintel were designed to work together – they are both Microsoft patents that use UPnP. Elabbady describes a media cataloging service that aggregates content to make it available across a network (Elabbady at 6:16-24; 7:16-24; 12:11-17) to UPnP compatible desktops,

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notebook computers, tablets, PDAs, digital audio receivers and players, digital video receivers, digital TV sets, set-top-boxes, etc. *Id.* at 3:33-45; 5:54-58; 6:16-

23. The devices can use the media catalog information to obtain Internet content from “an Internet-based service, such as, a media controller service, a media

5 provider service, a radio program service, a television service, or the like.” *Id.* at 5:26-39; Elabbady Provisional at 7 (stating that Internet services can be used); 40-43 (same); 46 (same).

85. Zintel describes UPnP’s framework and how it performs device discovery and invokes commands across devices using User Control Points and
10 Controlled Devices. Zintel at Abstract; 1:16-21; 2:62-3:10. “IP internetworking has been chosen as [the] UPnP baseline.” *Id.* at 5:40-50; *see also id.* at 52:11-12 (describing streaming media). “UPnP makes it possible to initiate and control the transfer of bulk data (e.g. files) or A/V data streams from any device on the network, to any device on the network, under the control of any device on the
15 network.” *Id.* at 6:26-29.

86. A POSITA would have been motivated to combine the use of UPnP—a known technique taught in Zintel—to improve a similar device discovery method in Elabbady in the same way. Elabbady discloses using the Universal Plug-and-Play (UPnP) protocol in a preferred embodiment to “provide[] a peer-to-peer

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network capability that can support various devices through wired and/or wireless connections,” and to “enable seamless proximity networking in addition to control and data transfer among networked devices in a home, office, or other like environment(s).” Elabbady at 5:54-63. A POSITA reading Elabbady would be motivated to learn about the details of the UPnP discovery protocol. Zintel discloses in detail the UPnP discovery process that allows a device to “make[] itself known through a set of processes-discovery, description, control, eventing, and presentation” so that “an entity can learn more about the device and its capabilities.” Zintel at Abstract. Thus, a POSITA would have combined Zintel’s UPnP discovery method with Elabbady’s UPnP discovery method to obtain predictable results.

87. Further, both Elabbady and Zintel disclose using the UPnP discovery protocol to enable the same networked devices to share and stream media content. Elabbady discloses that networked devices use the UPnP discovery protocol. Elabbady Provisional at 47-51. For instance, Elabbady teaches that “[i]n a UPnP environment, media [cataloging service] can employ the capabilities provided by the UPnP protocol to dynamically discovery and gather (e.g., aggregate) shared media content information.” Elabbady at 6:16-19; *see also* Elabbady Provisional at 7 (stating that its devices “[r]ead[] streamed encoded digital music content from

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a media store on the network or lively streamed (from internet radio)” having the AVTransport functionality that “enables control over the transport of audio and video stream.”). Similarly, Zintel teaches that “UPnP makes it possible to initiate and control the transfer of bulk data (e.g. files) or A/V data streams from any device on the network, to any device on the network, under the control of any device on the network.” Zintel at 5:26-29. And, just like in Elabbady, Zintel’s networked devices include PCs, handheld computers, and audio/video playback devices. *Id.* at 6:60-7:32. Thus, a POSITA would understand that the UPnP method disclosed in Zintel would be easily and predictably applied in Elabbady.

10 88. A POSITA would also be motivated to combine Elabbady and Zintel because both references recognize the same benefits of using UPnP. For instance, Elabbady recognizes that “UPnP advantageously boasts device-driver independence and zero-configuration networking.” Elabbady at 5:63-65. Similarly, Elabbady discloses that “UPnP embraces [] zero configuration” and that
15 “device developers are not required to develop specific device drivers to operate under UPnP.” Zintel at 4:65-67, 48:24-27.

89. Additionally, for reasons provided above, a POSITA would have been motivated to combine Elabbady with Zintel to apply a known technique, such as

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Zintel's UPnP discovery protocol, to a known device ready for improvement, such as Elabbady's devices, to yield predictable results.

Claim 1[PRE]: A method for use in a second computerized device set which is configured for wireless communication using a wireless communications protocol that enables wireless communication with a first computerized device set, wherein the first computerized device set includes a continuous media player, the method comprising:

5
10
15
90. Zintel teaches that, in UPnP, a User Control Point allows a user to search for, select, control, and interact with any Controlled Device on the network. *Id.* at 6:60-68; 7:4-23; 13:36-39; 13:49-14:19; 30:41-42. User Control Points can be on PCs, digital TVs, set-top boxes, handheld computers, and smart mobile phones (*id.* at 7:8-11) and Controlled Devices can be on VCRs, DVDs, home appliances, audio/video playback devices, handheld computers, smart mobile phones, and PCs. *Id.* at 7:25-29; *see also id.* at Figs. 3 & 31; 15:53-67.

20
91. Both Elabbady and Zintel describe a wide range of UPnP compatible devices that comprise the first and second computerized device set, including desktop and notebook computers, tablets, PDAs, digital audio receivers and players, digital video receivers, digital TV sets, set-top-boxes, etc. *See* Elabbady at 3:33-45; 5:54-58; *see also* Zintel at 44:23-24 (describing "personal computers, laptops, palmtops or handheld-PCs, set-tops, servers, mainframes, and other variety computers"); *see also id.* at 7:7-32.

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92. Elabbady recognizes that any device can have a media player.

Elabbady at 5:24-31; 5:66-6:6; *see also* Zintel 7:14-32 (describing video playback devices); 14:36-52; 15:56-63; 17:27-38. Elabbady discloses the “AVTransport . . . service type [that] enables control over the transport of audio and video streams.”

5 Elabbady Provisional at 7; *see also id.* at 1,9, 19-24, 57, 62 (describing video playback). Elabbady also discloses a PC that has Windows Media Player, a ubiquitous multimedia player for Windows computers. Elabbady Provisional at 45. These media players are applicable to both audio and video. Elabbady at 6:66-7:10; Elabbady Provisional at 1.

10 93. The UPnP-compatible multimedia playback devices described in Elabbady and Zintel (Zintel at 4:58-67; 5:26-32; 6:48-52; 7:4-32; Elabbady at 3:23-46; 5:54-57; Elabbady Provisional at 41; 49-51) are connected to wireless networks (*e.g.*, Zintel at 46:26-38; Elabbady at 5:46-53; Elabbady Provisional at 41; 49-51)). More specifically, Elabbady provides Network 204, which can be a
15 wireless Internet Protocol IP based network (*e.g.*, Elabbady at Fig. 2; 5:46-53; Elabbady Provisional at 41) that allows media capable devices to share control and data amongst each-other. Elabbady at 5:24-45. Zintel also discloses a wireless network configuration for UPnP-compatible devices. *See, e.g.*, 1008 at 46:26-38.

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94. Commercial wireless access points using the IEEE 802.11 family standards were widely used and available in any electronic store. As an example, Linksys made a wireless access point in 2001 for use in home networks. *See* EX1022 and 1023. A POSITA would appreciate that devices communicating with other devices over a conventional wireless network would be configured for communication using a wireless communications protocol like 802.11.

95. As stated by Elabbady – “[d]evices 202, [206a-d] and [] devices 202’, 206e-h, and 300[] are representative of a variety of different devices that can be used to provide features/capabilities associated with sharing media content in accordance with the methods and systems provided herein.” Elabbady at 5:66-6:6. In other words, any one of (or multiple) of these devices can be digital A/V players.

96. For the reasons stated above, it is my opinion that Elabbady and Zintel disclose this limitation.

Claim 1[A]: receiving discovery information that is obtained in accordance with a device management discovery protocol that is implemented at a communication layer above an internet protocol layer, wherein the discovery information allows a determination to be made at the second computerized device set that the first computerized device set is capable of receiving an indication of a particular control function related to a parameter of a presentation of a continuous media content on the first computerized device set, wherein the continuous media content includes video data;

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97. Although this limitation refers to “discovery information,” it actually relates more to the UPnP “description” process than to the UPnP “discovery” process. The limitation recites that the “discovery information” provides information about the capabilities of the first computerized device set. It is during
5 the UPnP “description” process that devices exchange description information about their capabilities. This process is described in more detail below.

98. Both Elabbady and Zintel teach using UPnP to perform device discovery for their devices. Elabbady at 6:16-23; 7:25-35; 10:11-23; Zintel at Abstract. UPnP was a well-known prior-art protocol to perform device discovery –
10 the ’507 patent itself recommends that its devices use UPnP device discovery. *See* ’507 patent at 37:28-47; *see also id.* at 54:7-12 (“it may be desirable that embodiments . . . conform to standards such as UPnP”). Elabbady and Zintel use the standard that the ’507 patent recommends.

99. Zintel describes how UPnP compatible devices in a network perform
15 device discovery using a device management discovery protocol to learn each other’s capabilities. Zintel at 10:4-26, 12:22-13:2; 19:23-20:48; 47:19-48:8; 57:24-35 (describing discovery including SSDP protocol). A UPnP device “makes itself known through a set of processes-discovery, description, control, eventing, and presentation.” Zintel at Abstract. And, “[f]ollowing discovery of a UPnP device,

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an entity can *learn more about the device and its capabilities* by retrieving the device’s description.” *Id.* (emphasis added); *id.* at 8:57-67; 6:60-7:32; 20:50-53.

The device’s description includes discovery information such as the device’s model name, the manufacturer’s name, its type, a list of any embedded devices or services, and URLs for control, eventing, and presentation. *Id.* at Abstract; 59:19-62:60.

100. Zintel also describes the structure that performs device discovery between two devices. Zintel discloses two types of modules: User Control Points (“UCP(s)”) and Controlled Devices. Zintel at 6:60-7:32. UCPs “initiate discovery and communication with Controlled Devices.” *Id.* at 6:60-64. The UCP retrieves a description document from the Controlled Device, which includes service definitions, such as the Service Control Protocol Declaration (SCPD). *Id.* at 8:1-11; 16:43-50; 13:49-14:20. The SCPDs “enable UCPs ... to invoke Commands on the Service without any prior or persistent knowledge of the capabilities (or schema) of the Service.” *Id.* at 9:45-52; *see also id.* at 9:21-37; 15:20-21.

Accordingly, Zintel teaches receiving discovery information that allows a device to determine that another device is capable of receiving an indication of a particular control function.

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101. Zintel teaches that its UPnP discovery protocol allows its devices to discover each other's capabilities, including whether a device is capable of receiving indications of control functions. Zintel states that "UPnP's scope includes remote control of devices and bulk data transfer, and can be easily
5 extended to specify [(Audio/Video)] A/V streaming." Zintel at 5:48-50. "UPnP makes it possible to *initiate* and *control* the transfer of bulk data (e.g. files) or A/V data streams from any device on the network, to any device on the network, under the control of any device on the network." *Id.* at 5:26-29 (emphasis added); *see also id.* at 6:48-53. As an example, "device functions code" for an audio/video
10 device such as a VCR "can include code to implement *start, stop, pause, record* and other functions that the VCR can perform." *Id.* at 48:52-65 (emphasis added); 49:21-27; 51:10-35. In addition, Zintel discloses that the Service State Table (SST), which a UCP receives from a Controlled Devices' SCPD (*id.* at 9:45-52; 9:21-37; 15:20-21), of a VCR could represent "tuner channel selection, input and
15 output switch selections, audio and video decoding format and current timer program." *Id.* at 17:32-35.

102. Zintel further teaches that a UCP may control a Controlled Device's software functions and services, using information learned from the SCPD. *Id.* at 48:52-62; 49:21-27; 51:10-35; *see also id.* at 9:45-52; 9:21-37; 15:20-21. The

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SCPD describes the commands supported by the service so that the control point can understand the specific capabilities of the service and how to invoke commands on the service. *Id.* at 9:30-56; 15:27-38; 21:27-32; 28:3-29:10 (describing, e.g., <actionList>); Fig. 17; 57:52-66; 62:9-49; 66:41-48; 67:34-71:11.

5 103. Zintel also teaches that the UPnP device management discovery protocol is implemented at a communication layer above an internet protocol layer. For example, as shown in Figs. 27 and 30, UPnP “simple discovery” is above the Internet Protocol (IP) layer, which is shown as the “TCP/IP stack.” Zintel at 5:34-45; 48:52-49:7; 51:10-35. A POSITA would understand that HTTP is an upper
10 level communication layer that sits above the IP layer.

 104. Based on these detailed teachings of Zintel, a POSITA would understand how device discovery and description would be performed between devices, including digital A/V players. In order to display the list of all players on the network (*see* Elabbady Provisional at 15-16), a device (*e.g.*, a PDA) would first
15 discover the digital AV players and their capabilities using the UPnP protocols discussed in Zintel. *Id.* at 2, 45-46 (control point discovers players on the network); *see also* Zintel at 8:24-31, 16:22-30; 19:23-20:12 (UPnP enables searching for devices by type). The device would then retrieve description documents describing each digital A/V player and the services it supports as

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discussed above. The description documents would include an SCPD for each service as described by Zintel. *See also* Elabbady Provisional at 5-12 (description template for player device). This description information would allow the PDA to determine that a digital A/V player is capable of receiving control commands (i.e.,

5 an “indication of a particular control function related to a parameter of a presentation of a continuous media content”). For example, the digital A/V player might support the AVTransport service and the SCPD for that service would describe the commands that can be invoked. Elabbady Provisional at 7, 9 (describing AVTransport service and simple VariableControl service for volume

10 control, etc.). Indeed, in order for the PDA to send control commands to a player device as disclosed in Elabbady (Elabbady Provisional at 7, 50), the PDA would refer to the SCPD information provided by the player to determine how to generate a proper command. *See* Zintel at 9:45-56, 15:27-38; 57:52-66; *see also id.* at 28:3-53 and Fig. 17 (example SCPD including ChannelUp and ChannelDown actions).

15 Thus, the description information obtained from the digital A/V player, including the SCPD information describing the supported control commands, would allow the PDA to determine that the digital A/V player (i.e., the first computerized device set) is capable of receiving control commands.

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105. Elabbady discloses that the digital media included in the catalog for playback on a digital A/V player includes video data. Elabbady Provisional at 1-2 (“video clips”), 7 (discussing AVTransport service for controlling “audio and video streams”), 19-24 (metadata for video content), 27 (media items include “movie clip[s]”), 61 (media library includes “video clip[s]”); *see also* Elabbady at 5 1:21-26 (playback of “digital video files”); 3:23-46 (invention can be used with “digital video player devices,” “digital video receiver devices,” “set-top boxes,” etc.); 6:66-7:10 (media content includes “video data”). In addition, Zintel discloses the use of UPnP to support “A/V streaming” to devices on the network. 10 Zintel at 5:26-29; 5:48-50; 6:43-52; *see also id.* at 7:25-29 (“audio/video/imaging playback device” as controlled device).

106. The Elabbady Provisional contains the AVTransport service is a “service type [that] enables control over the transport of audio and video streams.” Elabbady Provisional at 7; *see also id.* at 9 (stating same); *see also* Elabbady at 15 3:33-46 (stating that the disclosure is applicable to audio and video); *id.* at 7:3-10 (describing media content as including audio and video).

107. For the reasons above, it is my opinion that the combination of Elabbady and Zintel describes this limitation.

20 **Claim 1[B]: making available to a user a first user interface that allows the user to select to direct communications to the first computerized device set;**

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108. Elabbady provides numerous interfaces that allow a user to select to direct communications to a device. For example, Elabbady teaches a control point that provides a list of all digital A/V players on the network. Elabbady Provisional
5 at 16. One of the listed digital A/V players can be selected to invoke playback. *Id.* The control point for listing and selecting devices can be on a remote PDA. *Id.*

109. Elabbady also teaches numerous other user interfaces that allow a device to direct communications to another. Elabbady states that its PDA has UI controls to “access, present and navigate music” and “for basic playback control of
10 digital media players.” *Id.* at 50. Elabbady also discloses a Variable Control service that enables a control point to change its volume and an AV Transport service that allows it to play video. Elabbady Provisional at 7; *see also id.* at 9. These services are rendered in a user interface. *See* Elabbady Provisional at 7 (stating that the AV Transport service is rendered as a UI). Elabbady teaches that a
15 PDA is able to control a digital A/V player. Elabbady Provisional at 16.

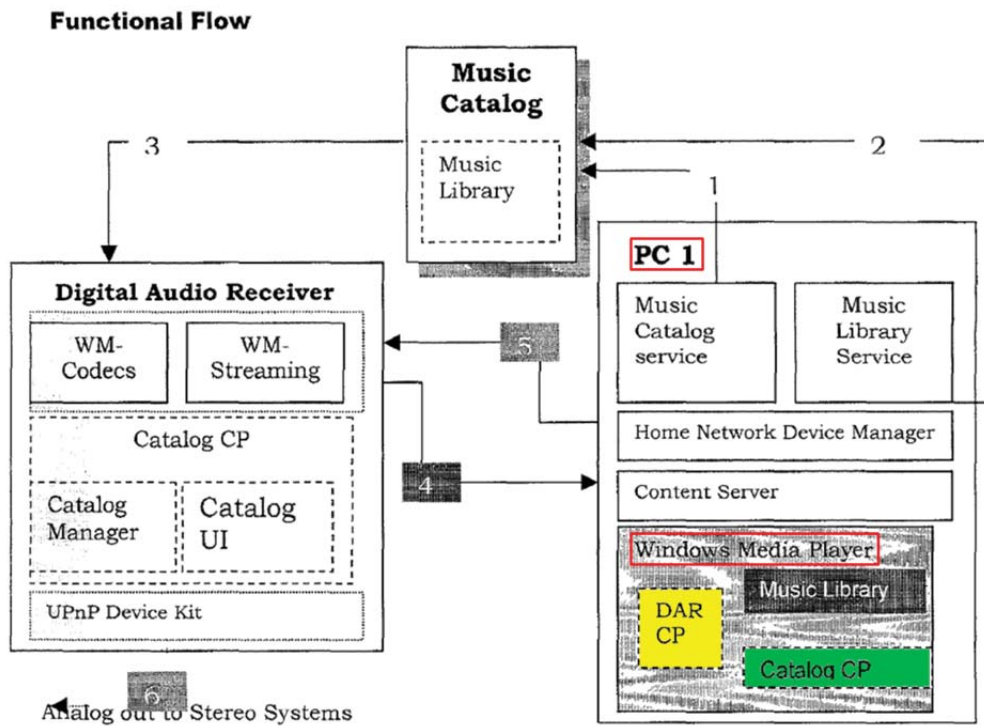
110. Further, Elabbady discloses a user interface for browsing the media catalog to allow a user to select media content for playback. Elabbady., 9:9-12, 11:13-16; 12:18-21. The Media Catalog Service 203 and Media Library Service 207 are both accessible via a UCP, which can retrieve and display media content
20 for user selection. *See, e.g.,* Elabbady at 8:57-9:22; 10:12-22; 12:18-21; *see also*

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id. at 10:23-38; 11:11-20; 12:18-33; Elabbady Provisional at 9-10, 16, 27, 42. The media catalog browser can likewise be located on any device such as a PDA or PC. Elabbady Provisional at 16; 45.

111. A POSITA would understand that selection of a digital A/V player as
5 disclosed in Elabbady would be a selection to direct communications to that device set. Indeed, a POSITA would understand that the A/V device and catalog control points can be on any device. Elabbady Provisional at 16; 45. Both of these control points can also be on a PC with Windows Media Player. Elabbady Provisional at 45. They can also be on a PDA. *Id.* at 16. As shown below, a PC with Windows
10 Media Player (annotated in red) has a device control point (annotated in yellow) and a catalog control point (annotated in green). At the time of (and well-before) the filing of the '507 patent, Windows was a sophisticated GUI-based operating system and a POSITA would have understood the control points would be rendered as GUIs.

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112. Further, like Windows' GUI, the selection and control of devices is accomplished via user interfaces in UPnP. In the "software architecture of a client device per UPnP standards" (Zintel at 4:29-32), the applications are "software code module[s] that provide[] a *user interface features for locating desired devices* (e.g., embedded computing device 900) and services on the computer network, and *also user interface features to interact* with the located device or service." *Id.* at 51:17-22 (emphasis added). In addition, UCPs can display folders of icons to allow a user to navigate and select devices. *Id.* at 11:6-10; *see also id.* at 8:18-20.

10 A UCP can "[v]iew[] [the] user interface exposed by a Controlled Device [to] [e]xecute applications . . . [and] [i]nvoke Commands on [the] Controlled Device. .

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.” *Id.* at 13:63-14:11. The display of UIs to control is a common implementation of UPnP.

113. Accordingly, it is my opinion that the combination of Elabbady and Zintel teach this limitation. For example, a particular digital A/V player can be selected via user interface to direct content to. Elabbady Provisional at 16.

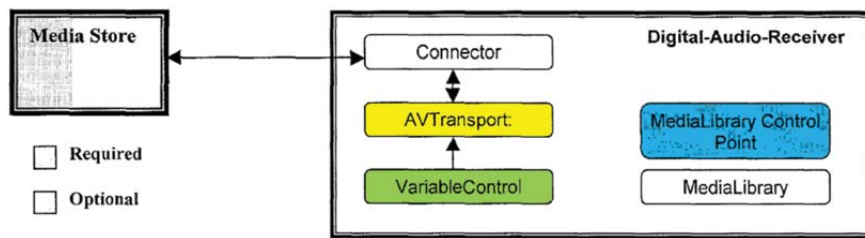
Claim 1[C]: making available to the user a second user interface that allows the user to select the particular control function related to a parameter of a presentation of the continuous media content; and,

114. Elabbady teaches that the PDA has user interface controls to “access, present and navigate music” and “for basic playback control of digital media players.” Elabbady Provisional at 50. The PDA is “capable of basic audio playback control: Play/Pause/Scan/Skip forward/Skip backward.” *Id.* at 50. Elabbady teaches “several services - like play, pause, and stop” and the control point to select the content can be on an external device. *Id.* at 15-16; 45. These control points can also be on a PC. *Id.* at 45.

115. Elabbady describes several services that can be controlled. For example, the AVTransport service (annotated in yellow, below) is a “service type [that] enables control over the transport of audio and video streams.” Elabbady Provisional, 7. The “VariableControl” service (annotated in green, below) provides “variable-setting control such as a volume control.” *Id.* The “Media Library service (annotated in blue, below) exposes a list of metadata describing

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media content stored locally on the host device and on user-selected list of Internet sites.” *Id.* Elabbady also discloses that a device also “exposes several services—like play, pause, and stop—via which the control point can manipulate a device.” *Id.* at 15; *see also id.* at 16. A POSITA would understand that these services would be a part of any digital A/V player. Moreover, a POSITA would understand that a user would interact with any of these services relating to media presentation on the digital A/V player.



116. The control of Services, such as multimedia playback, is a fundamental functionality of UPnP. As stated in Zintel, “[a]ll (UPnP) Controlled Devices ... expose one or more Services,” and a user control point can obtain information about the types of “Services” that are offered by a controlled device. Zintel at 20:62-21:12. A “Service” is a UPnP controllable entity, and all services can be controlled by a UCP. *Id.* at 9:1-2; 11:25-37. For example, a VCR can provide services for “start, stop, pause, record” (*id.* at 48:62-65) and transport, tuner, timer, and clock. *Id.* at 15:56-62. Indeed, “UPnP makes it possible to initiate and control the transfer of bulk data (e.g., files) or A/V data streams from

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any device on the network, to any device on the network, under the control of any device on the network.” *Id.* at 5:26-32; *see also id.* at 6:48-52.

117. Accordingly, it is my opinion that the combination of Elabbady and Zintel teach these limitations.

5 **Claim 1[D]: causing to be wirelessly transmitted, in accordance with a**
wireless local area network protocol, the indication of the particular control
function selected by the user via the second user interface to the first
computerized device set for subsequent use by the continuous media player to
10 **control the presentation of the continuous media content on the first**
computerized device set.

118. Elabbady teaches that the control function selected would be transmitted across the network to the Controlled Device. These control functions (*e.g.*, play, pause, scan, skip, stop, volume control, and browsing of library contents Elabbady Provisional at 15-16, 50) were explained in more detail above and also discussed is how both Zintel and Elabbady describe using a wireless network. Zintel at 46:26-38; Elabbady at 5:46-53; *see also* Elabbady Provisional at 15 42 (stating that the PDA has a wireless network connection). Accordingly, these commands would be sent wirelessly from one device to another.

119. Elabbady teaches that one device wirelessly transmits various 20 indications of control functions to another device. In fact, Zintel describes using the same Simple Object Access Protocol and XML protocols in UPnP that the ’507 patent describes in its embodiments. ’507 patent at 10:3-32; 103:52-62; 153:2-12;

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158:3-17. Zintel describes this operation – “after a control point has retrieved a description of the device, . . . the control point retrieves a detailed UPnP description for each service . . . [that is] expressed in XML and includes the commands, or actions, the service responds to, and parameters, or arguments, for each action.” Zintel at 57:54-59. “To control a device, a control point . . . send[s] a suitable control message to the . . . service. . . Control messages are [] expressed in XML using the Simple Object Access Protocol (SOAP).” *Id.* at 57:62-66; *see also* 66:62-68:20. When a device uses UPnP to receive discovery information from a second device, it receives the device’s XML device description that contains the codes associated with the second device’s functions.

120. These codes are an indication of the particular control functions. As mentioned above, a device can send functions (*e.g.*, play, pause, scan, skip, stop, volume control, and browsing of library contents (Elabbady Provisional at 15-16, 50)) to another. And, as discussed in Claim 1[PRE], the digital A/V player includes a continuous media player and Elabbady’s methods are applicable to video. *Id.* at 7 (describing the “AVTransport” module that “enables control over the transport of audio and video streams”). Elabbady’s PDA or PC controls the presentation of the continuous media content on a digital A/V player by wirelessly sending codes (or indications of the particular control function) that are associated

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with the digital A/V player's device functions. Moreover, both Zintel and Elabbady describe using a wireless local area network protocol, which a POSITA would understand to encompass known standards such as IEEE 802.11. EX1003 at 46:26-38; EX1004 at 5:46-53; *see also* EX1005 at 42 (stating that the PDA has a wireless network connection). Thus, a POSITA would understand that these codes or commands would be sent wirelessly from one device, such as a PDA or a PC, to another device, such as a digital A/V player.

Claim 3: “The method of claim 1, wherein the particular control function related to the presentation of the continuous media content on the first computerized device set allows the user to play, pause, rewind, or fast forward.”

121. The particular control function related to the presentation of the continuous media content on the digital A/V player allows the user to play, pause, rewind, or fast forward. For instance, Elabbady teaches that the PDA is “capable of basic audio playback control: Play/Pause/Scan/Skip forward/Skip backward.” Elabbady Provisional at 50; *see also id.* at 7 (stating that the AVTransport module provides a user interface for control); *id.* at 15 (stating that the UPnP Device “exposes several service - like play, pause, and stop which a control point can manipulate the device.”); 45 (showing control points on a Windows PC).

Claim 4 “The method of claim 1, wherein the continuous media content is received by the first computerized device set via a closed network.”

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122. Dependent claims 7 and 8 of the '507 patent state that a "closed network" can be "a cable television network" or "a satellite television network."

123. Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2; 7; 17; *see also* Elabbady at 5:36-39 (describing television service for content). Zintel discloses that UPnP devices, including "audio and video recorders and players" and "entertainment devices (set-top boxes, game consoles, etc.)" can include network adaptors for communicating over and receiving content from "satellite" or "television cable" networks. Zintel at 45:60-46:16; 46:26-38; Fig. 26; *see also id.* at 51:43-47 (PC has "XDSL interface" or cable modem" to connect to the Internet); Fig. 31. Thus, a POSITA would understand that the digital A/V player (first computerized device set) would receive continuous media content from the Internet via a closed network, for example, a cable or satellite network.

15 **Claim 5: "The method of claim 4, wherein the closed network uses at least one proprietary network protocol."**

124. The '507 patent specification does not use the term "proprietary network protocol." However, the '507 patent specification states that a cable TV channel is "closed and/or proprietary." '507 patent, 23:4-11. As mentioned in Claim 4, *supra*, Zintel discloses player devices connected to the Internet via a cable television network. A POSITA at the time of the alleged invention would have

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known that conventional cable TV broadcasts included proprietary cable channels, and that the cable channels used proprietary network protocols in order to prevent unauthorized access.

125. Further, Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. Elabbady at 5:36-39. A POSITA would understand that these services would use proprietary protocols in order to prevent unauthorized access.

Claim 6: “The method of claim 4, wherein a user selection of the continuous media content at the second computerized device set is used in triggering a push transfer to the first computerized device set to request presentation of the continuous media content on the first computerized device set without need for a further user selection of the continuous media content at the first computerized device set.”

126. Elabbady teaches that “the user can access and select music from the catalog and control the playback of music on the intended DAR using a third party UPnP control point on the network” where the third party control point includes a PDA. Elabbady Provisional at 42. Specifically, Elabbady discloses that a user uses a third party UPnP control point such as a PDA to “view[] the catalog content on the catalog’s [user interface] UI and select the music to play using the catalog’s manager.” *Id.* at 46; 42. Elabbady states that “[o]nce the user makes their selection from the catalog, the DAR returns a URL (or UNC) of the selected music

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to the content server,” where the content server “initiates the transmission of the file contents to the DAR.” *Id.* at 46.

127. Further, after transfer of the content to the first computerized device set (*e.g.*, a digital A/V player), there would not be further need for user selection of the continuous media content at the first computerized device set. As discussed in claim 1[C], *supra*, the DAR contains the AVTransport service that enables the DAR to control audio and video streams remotely, and that a remote device (such as a PDA), provides the playback controls such as “play, pause, and stop” that can be used by a User Control Point on to manipulate playback on another device. Elabbady Provisional at 15; *see also id.* at 47 (describing a UI for play, pause, scan, skip, and to query and navigate the music catalog); 50 (same). As illustrated by Zintel the control of playback was a common functionality of UPnP – a VCR provides functionality to implement “start, stop, pause, record and other functions that the VCR can perform.” Zintel at 48:62-65. In the “software architecture of a client device per UPnP standards” (*id.* at 4:29-32), user interfaces are used to interact with devices and services. *See id.* at 51:17-22.

Claim 7: “The method of claim 4, wherein the closed network is a cable television network.”

128. Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2, 7, 17. Zintel discloses that

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UPnP devices, including “audio and video recorders and players” and “entertainment devices (set-top boxes, game consoles, etc.)” can include network adaptors for communicating over “television cable” networks. Zintel at 45:60-46:16, 46:26-38; Fig. 26; *see also id.* at 51:43-47 (PC has “cable modem” to connect to the Internet); Fig. 31.

Claim 8: “The method of claim 4, wherein the closed network is a satellite television network.”

129. As discussed for claim 4, Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2, 7, 17. Zintel discloses that UPnP devices, including “audio and video recorders and players” and “entertainment devices (set-top boxes, game consoles, etc.)” can include network adaptors for communicating over “satellite” networks. Zintel at 45:60-46:16, 46:26-38; Fig. 26.

Claim 9: “The method of claim 4, wherein the closed network, at least in part, includes a fiber optic transmission path.”

130. As discussed in claim 4, Zintel discloses a “television cable” and “cable modem.” Zintel at 46:26-38; 51:36-47. A POSITA reading Zintel at the time of the alleged invention would have recognized that Zintel discloses a closed network, such as a cable television network, that would include fiber optic transmission path for enabling high data rate transmission to the various users. A

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POSITA would know that cable television networks often include fiber optic links. *See, e.g.*, EX1024 [Kwok] (Microsoft patent filed 1995, issued 1998) at 1:37-45 (describing “hybrid fiber/coax (HFC) architecture” resulting from aggressive deployment of fiber-optic cable in CATV networks in recent years);

5 EX1025 at 1:24-43 [Donohue] (describing rise of hybrid fiber/coax in cable networks); EX1026 [Krimmel] (Alcatel patent filed 1997, issued 2000) at 1:15-31 (describing hybrid fiber/coax cable TV network); *see also* Janik at 1:51-54 (“A large majority of households in the U.S. and Europe are viable for at least one or more type of broadband connection, such as cable, DSL, optical networks, fixed

10 wireless, or two-way satellite transmission”). Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. Elabbady at 5:36-39. The Internet connection can be employed through a modem connecting to the Internet. *Id.* at 5:12-15. A POSITA would understand that a typical Internet connection, using a cable modem, would have a fiber optic

15 connection in its transmission path (*i.e.*, through the ISP’s network). ‘507 patent at 21:44-47 (describing HFC Hybrid Fiber/Coax networks); 23:9:11 (describing the known use of HFC networks to provide Internet service from providers); 67:38.

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131. A POSITA understands that Internet traffic regularly goes through fiber optic paths. *See, e.g.*, <http://www.nytimes.com/1999/09/30/business/cut-in-fiber-cable-disrupts-internet-traffic-nationwide.html>; Appendix W.

5 **Claim 10: “The method of claim 4, wherein the second computerized device set communicates at least in part via a wireless local network with the first computerized device set.”**

132. As discussed in claim 1[D], Elabbady discloses a PDA that has a wireless network connection. Elabbady Provisional at 51; *see also* Elabbady at 10 3:33-46. Accordingly, Elabbady teaches that a user uses the PDA with a wireless network connection to access and select content from a catalog, and also to control playback of content on a device. *Id.* at 42; *see also id.* at 49. In the exemplary configuration discussed above, the second computerized device set is a PDA with a wireless connection (*see* EX1005 at 51) and thus communicates at least in part via 15 a wireless local network with the first computerized device set, i.e., the digital A/V player. Further, Elabbady provides a Network 204, (which can be a wireless Internet Protocol IP based network (*e.g.*, Elabbady at 5:46-53)) that allows a wide array of devices (*id.* at 3:33-45; 5:54-58) to share control and data. *Id.* at 5:24-45. Zintel discloses the same. *See, e.g.*, Zintel at 46:26-38.

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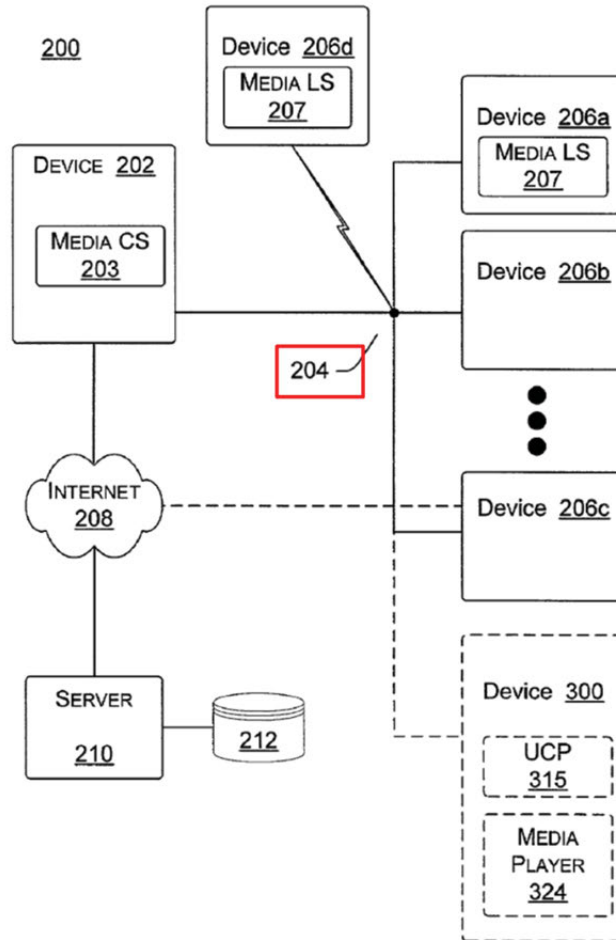


Fig. 2A

5 **Claim 11: “The method of claim 4, wherein the second computerized device set communicates via a wireless local network using an internet protocol with the first computerized device set and the second computerized device set is connected to the closed network.”**

133. As just discussed for claim 10, the combination of Elabbady and Zintel disclose that the second device set (e.g., wireless PDA) communicates over a wireless local network with the first device set (e.g., digital A/V player). UPnP commands are sent using HTTP which is an internet protocol. *See* Zintel at 24:35-

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25:41, 57:62-67 (commands sent via HTTP / SOAP); 48:19-23 (“the Internet HTTP protocol”); 48:46-49 (UPnP is based on “key Internet standards such as ... HTTP”). Accordingly, the wireless communications between the second device set and first device set would use an Internet protocol.

5 134. Furthermore, as discussed for claim 4 above, Zintel discloses UPnP devices connected to the Internet via closed networks (e.g., cable TV networks, satellite).

Claim 12: “The method of claim 1, wherein the first computerized device set comprises a television.”

10 135. Elabbady teaches the digital A/V player can be connected to a television. Elabbady Provisional at 7; 44; 48; Elabbady at 3:33-43. In such an embodiment, the digital A/V player and television would comprise a computerized device set. *See* ’507 patent at Fig. 2 (showing TV and set-top box as a device set).

15 136. Zintel likewise discloses UPnP devices that would be connected to a television to form a computerized device set. Zintel at 7:25-32 (VCR, DVD Player, “audio/video/imaging playback device”); 45:60-46:15 (audio-video equipment, DVD players, set-top boxes, game consoles).

Claim 13: “The method of claim 1, wherein the first computerized device set comprises a television and a set top box.”

20 137. Elabbady teaches that one of the possible form factors is an “UPnP-enabled set-top box that uses the TV.” Elabbady Provisional at 48; *see also*

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Elabbady at 3:33-46 (describing set-top boxes and TVs). Zintel likewise discloses a TV and set-top box. Zintel at 7:8-14

Claim 14: “The method of claim 1, wherein the second computerized device set comprises a wireless phone or tablet.”

5

138. Both Zintel and Elabbady describe a wide range of devices, including tablets and PDAs. *See* Elabbady, 3:33-45; 5:54-58; *see also* Zintel, 44:23-24; 7:7-32. Further, Zintel discloses that its user control points enable communication with a UPnP controlled device and include devices such as “handheld computer and smart mobile phone.” Zintel at 6:60-7:14.

10

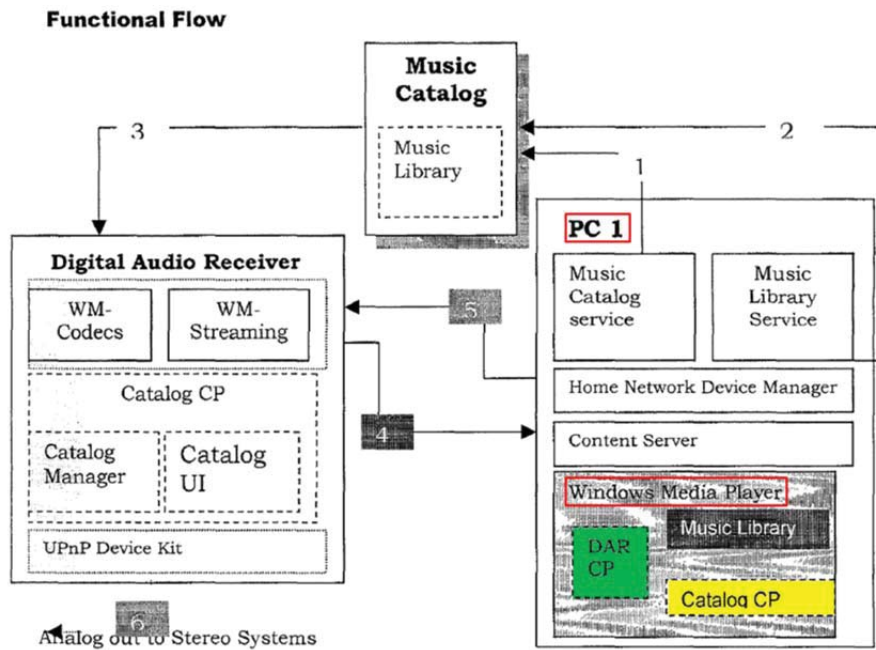
Claim 15: “The method of claim 1, wherein the second computerized device set comprises a PC.”

139. Both Zintel and Elabbady describe a wide range of devices that their disclosures are applicable to, including desktop and notebook computers. *See* Elabbady at 3:33-45; 5:54-58; *see also* Zintel at 44:23-24; 7:7-32. Indeed, As described by Elabbady, a Windows PC could be used. Elabbady Provisional at 60. In particular, Elabbady describes a Windows Media Player running on a Windows PC (both annotated in red below) that has control points for both browsing the catalog (annotated in yellow below) and for controlling the DAR (annotated in green below). *See id.* at 45-46.

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Claim 16: “The method of claim 1, wherein the second computerized device set communicates at least in part via a public Internet with the first computerized device set.”

5

140. Claim 16 does not specify any particular type or content of the communication between the second computerized device to the first device set via the Internet, it only specifies that there is communication. Elabbady discloses that the home network devices are connected to the Internet. Elabbady at 5:32-45. In my opinion, a POSITA would understand that devices connected to the Internet can communicate with each other over the Internet even if they are also connected via a local area network. For example, one family member could use the same PDA that contains the catalog browsing application and digital A/V player control point to send an e-mail using an Internet-based mail application to another family

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member. The recipient could receive that email on a PC that is also used as a player device. This would constitute communication at least in part via the public Internet between the two device sets.

Claim 17: “The method of claim 1, wherein the continuous media content is offered over a proprietary network by a proprietary system operator, the method further comprising the first computerized device set receiving the continuous media content over the proprietary network.”

141. Elabbady discloses denying access to players that are not registered.

10 Elabbady at 10:42-63; Elabbady Provisional at 4 (confirm player registration); 52 (registration of players by Home Network Device Manager) 61 (license requests are only executed for registered players), 65 (confirm player registration). As discussed in Claims 4 and 7, Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. *Id.* at 15 5:36-39. A POSITA would understand that these services would use proprietary protocols in order to prevent unauthorized access. Further, as mentioned in claim 4, a POSITA reading Zintel at the time of the alleged invention would understand that Zintel discloses a cable television network. A POSITA at the time of the alleged invention would have known that conventional cable TV broadcasts 20 included proprietary cable channels, and that the cable channels used proprietary network protocols in order to prevent unauthorized access.

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Claim 18: “The method of claim 1, further comprising: making available to the user a third user interface that allows the user to actuate a hyperlink associated with a starting resource presented at one of the first and second computerized device sets with an attribute specifying that the ending resource of the hyperlink is to be presented at the other of the first and second computerized device set.”

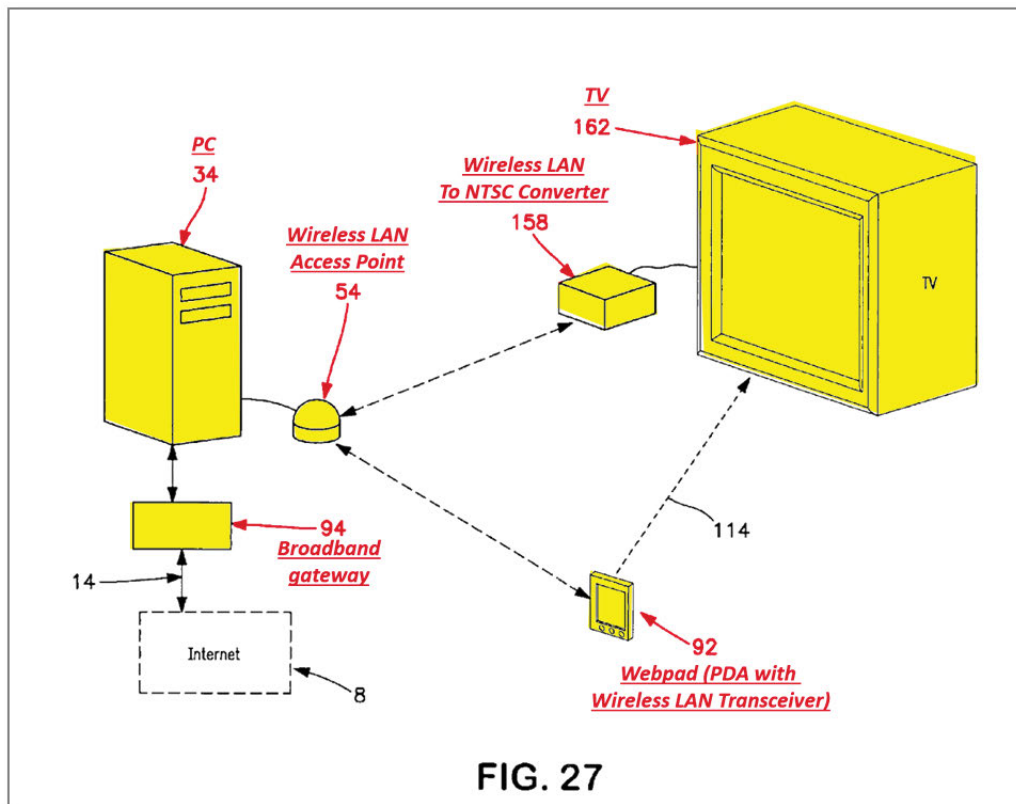
As stated in the '507 patent, the “‘starting resource’ [is] the source from which link traversal is begun, and an ‘ending resource,’ the destination.” '507 patent at 7:20-23. As discussed in Elabbady, one device can select another device to send a URL of content item to. Elabbady Provisional at 16. This can be implemented in HTML or JavaScript and can accordingly be actuated via hyperlink, which would contain information regarding the destination device. *Id.* Accordingly, a user is able to actuate a hyperlink (because it is browser accessible) on a source device (starting resource from which the URL is sent) with an attribute identifying the destination device (ending resource that receives the URL).

C. CLAIM 2 OF THE '507 PATENT IS OBVIOUS OVER ELABBADY, ZINTEL, AND JANIK

142. Janik discloses a “system for delivering video to a TV 162, including the provision for second screen interactive services with a webpad 92.” Janik at 22:20-22. In this system, a wireless “LAN-to-NTSC converter 158” receives video data streamed over the wireless network and allows it to be displayed on the TV. *Id.* at 22:20-39; 23:42-24:26. The webpad is a PDA or a tablet with a built-in wireless transceiver. *Id.* at 22:41-23:21. Similar to Elabbady, Janik discloses that

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the webpad can be used to select content for playback on the TV. *Id.* at 25:1-8;
25:40-51. Figure 27 illustrates this embodiment with annotations and highlighting
added:



5 143. Janik also discloses presenting “ancillary” content on the webpad that
relates to the content being viewed on the TV. For example, “if the currently
playing primary content on the TV 162 is a popular TV show, ancillary content
that is information pertaining to one of the actors is automatically loaded onto and
displayed by the webpad.” Janik at 26:39-42. Or if an advertisement is playing,
10 the webpad can display a website associated with the advertisement. *Id.*

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144. A POSITA would have found it obvious to combine Janik's enhancement content feature with the Internet content playback features of Elabbady and Zintel. A POSITA would appreciate that once a content item has been selected for playback on a digital A/V player, the display of the PDA is available to be used in other ways. A POSITA would have been motivated to provide ancillary information on the PDA, such as actor information or other content as disclosed in Janik. *See* Janik at 26:38-42. Elabbady describes playback of a wide array of content, and providing ancillary content when playing movies would provide a predictable improvement. Accordingly, a POSITA would have been motivated to combine these known techniques to provide a predictable improvement.

145. Furthermore, a POSITA would have combined the prior art elements in Elabbady, Zintel, and Janik according to known methods with predictable results. Each of Zintel and Elabbady use UPnP. UPnP devices maintain Service State Tables that describe the logical states of a device (*e.g.*, a channel that a VCR is tuned to). Elabbady at 14:36-52; 17:33-38; 15:56-63. Janik provides ancillary content based on the state of the TV (*i.e.*, what show is being watched). Maintaining state data relating to the particular content being viewed, and linking

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the content to ancillary content (as taught in Janik), would lead to predictable results.

146. A POSITA would further have been motivated to combine Janik with Elabbady and Zintel because they are in an analogous field. Similar to Elabbady, 5 Janik describes a home network-based multimedia system with playback devices capable of playing content stored on the local network or downloaded from the Internet. Accordingly, a POSITA would have recognized that features described in Janik could be implemented in the systems described by Elabbady.

147. Furthermore, the '507 patent admits that the usage of enhancement 10 content on a secondary device while a primary device played the video content was widely known and employed by major network broadcasters – “[s]ome broadcasters such as ABC and PBS have exploited [enhanced TV] to offer Web content synchronized to a TV program. . .” ’507 patent at 2:35-41; *see also id.* at 45:50-51 (stating that PBS and ABC offered enhanced content). A POSITA would 15 have been motivated to include these features, offered by major broadcasters, into a content consumption network of multiple devices.

20 **Claim 2: “The method of claim 1, further comprising receiving state data relating to the presentation of the continuous media content on the first computerized device set, and; presenting at the second computerized device set, based on the state data, enhancement content that is related to the presentation of the continuous media content on the first computerized device set.”**

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148. The '507 patent explains that “state data [] specifies the current state of a live interactive session in progress” ('507 patent at 33:6-8) and “enhancement content” to include information related to another content. *Id.* at 126:22-26;

5 109:50-56; 1:50-62. For example, enhancement content can include information that relates to specific aspects of a program, such as actors. *Id.* at 125:9-15.

149. Janik discloses presenting enhancement content based on state data related to the presentation of content played on another device, *e.g.*, the TV / LAN-to-NTSC converter 158. For example, “if the currently playing primary content on
10 the TV 162 is a popular TV show, ancillary content that is information pertaining to one of the actors is automatically loaded onto and displayed by the webpad.” Janik at 26:39-42. Janik explicitly discloses that state information is used to retrieve the relevant enhancement content. *Id.* at 26:43-47 (state information sent to content link database server 130 to retrieve ancillary content).

15 150. As discussed in Claim 1, an exemplary configuration based on Elabbady and Zintel includes a PDA controls playback on a UPnP-compliant digital A/V player. As described in Zintel, each UPnP device maintains a Service State Table (SST), which describes the state of the device’s services. Zintel at
20 9:21-28; 14:36-52; 17:33-38; 15:56-63; 28:32-40. A control point can query the values of the state variables in the SST of the controlled device. *Id.* at 28:24-28;

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28:54-61; 29:1-9 (queryStateVariable method). Accordingly, the PDA in the exemplary configuration would be able to obtain state data from the digital A/V player about the playback state.

151. It would have been obvious to incorporate Janik's teachings regarding
5 enhancement content to the exemplary configuration based on Elabbady and Zintel. Indeed, it would be even easier to implement the enhancement content feature in the exemplary configuration. Janik discloses that the system control application 18 requests the enhancement content and then routes it to the webpad for display. Janik at 26:43-47. This is required in Janik's system because the state
10 data is only available at the system control application 18. *Id.* at 26:4-14. But as just discussed, in the exemplary configuration, UPnP enables the PDA to obtain playback state data from the digital A/V player. Thus, unlike Janik's webpad, the UPnP PDA would have the relevant state data and could simply obtain the enhancement content from the Internet itself and display it.

15 **IX. THE '212 PATENT**

152. It is my opinion that Elabbady, Palm, and Zintel render obvious claims 1-18, 20, and 22-23, Elabbady, Palm, Zintel, and Janik render obvious claim 21, and Elabbady, Palm, Zintel, and Vallone render obvious claim 19 of the '212 patent. This is discussed in further detail below.

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**A. CLAIMS 1-18, 20, AND 22-23 OF THE '212 PATENT ARE
OBVIOUS OVER ELABBADY, PALM AND ZINTEL**

153. In my opinion, a POSITA would be motivated to combine Elabbady,
Palm, and Zintel because the references provide similar and complementary
5 teachings to achieve the same goals. Elabbady describes a system that that enables
users to select content items from a catalog for playback on different network
devices including digital A/V players. Palm describes networked multimedia
players which stream multimedia content from content servers on a local network
or on the Internet. Palm at ¶¶ 5, 7; Fig. 1. Similar to Elabbady, the player devices
10 in Palm query a remote computer for catalog data which allows a user to browse
for content. Palm at ¶¶ 43, 78-88. Both Elabbady and Palm teach the use of
markup languages such as XML to provide metadata about content items to the
players. Elabbady at 6:37-52; Elabbady Provisional at 2, 18-24, 27; Palm at ¶¶ 48,
80, 82. Both Elabbady and Palm teach that the metadata includes URLs which the
15 player devices use to download or stream the content from the convent server.
Elabbady at 10:17-32, 12:18-27; Elabbady Provisional at 2, 15-16, 17, 19-20, 23;
Palm at ¶¶48, 80-83, 88. Both Elabbady and Palm describe limiting access to
authorized playback devices and/or using DRM technologies. Elabbady at 7:50-
8:56, 10:39-63; Elabbady Provisional at 61, 64-65; Palm at ¶¶ 91-95.

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154. Furthermore, Elabbady and Palm describe systems based on UPnP
and a POSITA would thus naturally look to a reference like Zintel that provides a
detailed discussion of UPnP. Zintel even points out that UPnP can be used in the
kinds of systems described in Elabbady and Palm, i.e., “to initiate and control the
5 transfer of bulk data (e.g., files) or A/V data streams from any device on the
network, to any device on the network, under the control of any device on the
network.” Zintel at 5:26-29. Furthermore, Broadcom (assignee of Palm) and
Microsoft (assignee of Zintel and Elabbady) were part of the Audio/Video
Working Committee for UPnP. EX1015 at 7. A POSITA would have looked to
10 work by companies who developed UPnP-related publications.

155. In my opinion, a POSITA would recognize the advantages of
combining Elabbady, Palm, and Zintel. Elabbady describes the use of a handheld
PDA as a control point for browsing the multimedia catalog and initiating playback
on a selected device. Elabbady Provisional at 2, 15-17. Palm discloses that a
15 handheld computer can itself be a player device that downloads or streams
multimedia content from a content server. Palm at ¶ 71. Palm also discloses that it
is advantageous for a player to be able to retrieve multimedia catalog data directly
from a content server on the Internet. *Id.* at ¶¶ 43-44.

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156. Elabbady and Palm teach that a handheld computer could be used to select a content item from a catalog provided by a content server on the Internet and then choose to play it on a digital A/V player on the network. Elabbady at 15-17 (control point selects any player on the network). This would be advantageous in that it eliminates the need for a computer on the local network to keep track of Internet content which may change rapidly. Furthermore, as Palm mentions, allowing content providers to control the catalog enables them “to insert additional content such as advertising and branding messages into the actual content or to the menus” and to provide “portals” which present multimedia items available from “a ring of content servers.” Palm at 43. Finally, Zintel provides detailed teachings about UPnP that would allow a POSITA to implement such a system and enable A/V content to be transferred or streamed “from any device on the network, to any device on the network, under the control of any device on the network.”

Claim 1[PRE]: “A method for use in a second computerized device set which is configured for wireless communication using a wireless communications protocol that enables communication with a first computerized device set, wherein the first and second computerized device sets include respective first and second continuous media players, the method comprising”

157. Zintel teaches that, in UPnP, a User Control Point allows a user to search for, select, control, and interact with any Controlled Device on the network. *Id.* at 6:60-68; 7:4-23; 13:36-39; 13:49-14:19; 30:41-42. User Control Points can be on PCs, digital TVs, set-top boxes, handheld computers, and smart mobile

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phones (*id.* at 7:8-11) and Controlled Devices can be on VCRs, DVDs, home appliances, audio/video playback devices, handheld computers, smart mobile phones, and PCs. *Id.* at 7:25-29; *see also id.* at Figs. 3 & 31; 15:53-67.

158. Both Elabbady and Zintel describe a wide range of UPnP compatible
5 devices that comprise the first and second computerized device set, including desktop and notebook computers, tablets, PDAs, digital audio receivers and players, digital video receivers, digital TV sets, set-top-boxes, etc. *See* Elabbady at 3:33-45; 5:54-58; *see also* Zintel at 44:23-24 (describing “personal computers, laptops, palmtops or handheld-PCs, set-tops, servers, mainframes, and other
10 variety computers”); *see also id.* at 7:7-32. Palm similarly discloses a system with multiple computerized device sets having multimedia players. Palm at ¶¶ 37-38; Fig. 1 (showing multiple multimedia devices 105).

159. Elabbady recognizes that any device can have a media player.
Elabbady at 5:24-31; 5:66-6:6; *see also* Zintel 7:14-32 (describing video playback
15 devices); 14:36-52; 15:56-63; 17:27-38. Elabbady discloses the “AVTransport . . . service type [that] enables control over the transport of audio and video streams.” Elabbady Provisional at 7; *see also id.* at 1,9, 19-24, 57, 62 (describing video playback). Elabbady also discloses a PC that has Windows Media Player, a ubiquitous multimedia player for Windows computers. Elabbady Provisional at

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45. These media players are applicable to both audio and video. Elabbady at 6:66-7:10; Elabbady Provisional at 1.

160. Commercial wireless access points using the IEEE 802.11 family standards were widely used and available in any electronic store. As an example, 5 Linksys made a wireless access point in 2001 for use in home networks. *See* EX1022 and 1023. A POSITA would appreciate that devices communicating with other devices over a conventional wireless network would be configured for communication using a wireless communications protocol like 802.11.

161. The UPnP-compatible multimedia playback devices described in 10 Elabbady, Palm, and Zintel (Zintel at 4:58-67; 5:26-32; 6:48-52; 7:4-32; Elabbady at 3:23-46; 5:54-57; Elabbady Provisional at 41; 49-51; Palm at ¶¶ 8, 38) are connected to wireless networks (*e.g.*, Zintel at 46:26-38; Elabbady at 5:46-53; Elabbady Provisional at 41; 49-51)). More specifically, Elabbady provides Network 204, which can be a wireless Internet Protocol IP based network (*e.g.*, 15 Elabbady at Fig. 2; 5:46-53; Elabbady Provisional at 41) that allows media capable devices to share control and data amongst each-other. Elabbady at 5:24-45. Zintel also discloses a wireless network configuration for UPnP-compatible devices. *See, e.g.*, 1008 at 46:26-38.

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162. In my opinion, a POSITA would understand that a digital A/V player could be the claimed first device and a PDA could be the claimed second device.

163. As stated by Elabbady – “[d]evices 202, [206a-d] and [] devices 202’, 206e-h, and 300[] are representative of a variety of different devices that can
5 be used to provide features/capabilities associated with sharing media content in accordance with the methods and systems provided herein.” Elabbady at 5:66-6:6. In other words, any one of (or multiple) of these devices can be digital A/V
players.

164. For the reasons stated above, it is my opinion that Elabbady, Palm,
10 and Zintel disclose this limitation.

**Claim 1[A]: “receiving discovery information that is obtained in accordance with a device management discovery protocol that is implemented at a communication layer above an internet protocol layer wherein the discovery information allows a determination to be made at the second computerized
15 device set that the first computerized device set is capable of supporting selected functions”**

165. Although this limitation refers to “discovery information,” it actually relates more to the UPnP “description” process than to the UPnP “discovery” process. The limitation recites that the “discovery information” provides
20 information about the capabilities of the first computerized device set. It is during the UPnP “description” process that devices exchange description information about their capabilities. This process is described in more detail below.

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166. Both Elabbady and Zintel teach using UPnP to perform device discovery for their devices. Elabbady at 6:16-23; 7:25-35; 10:11-23; Zintel at Abstract. Palm likewise discloses using UPnP. Palm at ¶¶76-77. UPnP was a well-known prior-art protocol to perform device discovery – the ’507 patent itself recommends that its devices use UPnP device discovery. *See* ’507 patent at 37:28-47; *see also id.* at 54:7-12 (“it may be desirable that embodiments . . . conform to standards such as UPnP”). Elabbady and Zintel use the standard that the ’507 patent recommends.

167. Zintel describes how UPnP compatible devices in a network perform device discovery using a device management discovery protocol to learn each other’s capabilities. Zintel at 10:4-26, 12:22-13:2; 19:23-20:48; 47:19-48:8; 57:24-35 (describing discovery including SSDP protocol). A UPnP device “makes itself known through a set of processes-discovery, description, control, eventing, and presentation.” Zintel at Abstract. And, “[f]ollowing discovery of a UPnP device, an entity can *learn more about the device and its capabilities* by retrieving the device’s description.” *Id.* (emphasis added); *id.* at 8:57-67; 6:60-7:32; 20:50-53. The device’s description includes discovery information such as the device’s model name, the manufacturer’s name, its type, a list of any embedded devices or

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services, and URLs for control, eventing, and presentation. *Id.* at Abstract; 59:19-62:60.

168. Zintel also describes the structure that performs device discovery between two devices. Zintel discloses two types of modules: User Control Points (“UCP(s)”) and Controlled Devices. Zintel at 6:60-7:32. UCPs “initiate discovery and communication with Controlled Devices.” *Id.* at 6:60-64. The UCP retrieves a description document from the Controlled Device, which includes service definitions, such as the Service Control Protocol Declaration (SCPD). *Id.* at 8:1-11; 16:43-50; 13:49-14:20. The SCPDs “enable UCPs ... to invoke Commands on the Service without any prior or persistent knowledge of the capabilities (or schema) of the Service.” *Id.* at 9:45-52; *see also id.* at 9:21-37; 15:20-21. Accordingly, Zintel teaches receiving discovery information that allows a device to determine that another device is capable of receiving an indication of a particular control function.

169. Zintel teaches that its UPnP discovery protocol allows its devices to discover each other’s capabilities, including whether a device is capable of receiving indications of control functions. Zintel states that “UPnP’s scope includes remote control of devices and bulk data transfer, and can be easily extended to specify [(Audio/Video)] A/V streaming.” Zintel at 5:48-50. “UPnP

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makes it possible to *initiate* and *control* the transfer of bulk data (e.g. files) or A/V data streams from any device on the network, to any device on the network, under the control of any device on the network.” *Id.* at 5:26-29 (emphasis added); *see also id.* at 6:48-53. As an example, “device functions code” for an audio/video device such as a VCR “can include code to implement *start, stop, pause, record* and other functions that the VCR can perform.” *Id.* at 48:52-65 (emphasis added); 49:21-27; 51:10-35. In addition, Zintel discloses that the Service State Table (SST), which a UCP receives from a Controlled Devices’ SCPD (*id.* at 9:45-52; 9:21-37; 15:20-21), of a VCR could represent “tuner channel selection, input and output switch selections, audio and video decoding format and current timer program.” *Id.* at 17:32-35.

170. Zintel further teaches that a UCP may control a Controlled Device’s software functions and services, using information learned from the SCPD. *Id.* at 48:52-62; 49:21-27; 51:10-35; *see also id.* at 9:45-52; 9:21-37; 15:20-21. The SCPD describes the commands supported by the service so that the control point can understand the specific capabilities of the service and how to invoke commands on the service. *Id.* at 9:30-56; 15:27-38; 21:27-32; 28:3-29:10 (describing, e.g., <actionList>); Fig. 17; 57:52-66; 62:9-49; 66:41-48; 67:34-71:11.

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171. Zintel also teaches that the UPnP device management discovery protocol is implemented at a communication layer above an internet protocol layer. For example, as shown in Figs. 27 and 30, UPnP “simple discovery” is above the Internet Protocol (IP) layer, which is shown as the “TCP/IP stack.” Zintel at 5:34-5 45; 48:52-49:7; 51:10-35. A POSITA would understand that HTTP is an upper level communication layer that sits above the IP layer.

172. Based on these detailed teachings of Zintel, a POSITA would understand how device discovery and description would be performed between devices, including digital A/V players. In order to display the list of all players on 10 the network (*see* Elabbady Provisional at 15-16), a device (*e.g.*, a PDA) would first discover the digital AV players and their capabilities using the UPnP protocols discussed in Zintel. *Id.* at 2, 45-46 (control point discovers players on the network); *see also* Zintel at 8:24-31, 16:22-30; 19:23-20:12 (UPnP enables searching for devices by type). The device would then retrieve description 15 documents describing each digital A/V player and the services it supports as discussed above. The description documents would include an SCPD for each service as described by Zintel. *See also* Elabbady Provisional at 5-12 (description template for player device). This description information would allow the PDA to determine that a digital A/V player is capable of receiving control commands (*i.e.*,

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an “indication of a particular control function related to a parameter of a presentation of a continuous media content”). For example, the digital A/V player might support the AVTransport service and the SCPD for that service would describe the commands that can be invoked. Elabbady Provisional at 7, 9

5 (describing AVTransport service and simple VariableControl service for volume control, etc.). Indeed, in order for the PDA to send control commands to a player device as disclosed in Elabbady (Elabbady Provisional at 7, 50), the PDA would refer to the SCPD information provided by the player to determine how to generate a proper command. *See* Zintel at 9:45-56, 15:27-38; 57:52-66; *see also id.* at 28:3-

10 53 and Fig. 17 (example SCPD including ChannelUp and ChannelDown actions). Thus, the description information obtained from the digital A/V player, including the SCPD information describing the supported control commands, would allow the PDA to determine that the digital A/V player (i.e., the first computerized device set) is capable of receiving control commands.

15 173. Elabbady discloses that the digital media included in the catalog for playback on a digital A/V player includes video data. Elabbady Provisional at 1-2 (“video clips”), 7 (discussing AVTransport service for controlling “audio and video streams”), 19-24 (metadata for video content), 27 (media items include “movie clip[s]”), 61 (media library includes “video clip[s]”); *see also* Elabbady at

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1:21-26 (playback of “digital video files”); 3:23-46 (invention can be used with “digital video player devices,” “digital video receiver devices,” “set-top boxes,” etc.); 6:66-7:10 (media content includes “video data”). In addition, Zintel discloses the use of UPnP to support “A/V streaming” to devices on the network.

5 Zintel at 5:26-29; 5:48-50; 6:43-52; *see also id.* at 7:25-29 (“audio/video/imaging playback device” as controlled device).

174. The Elabbady Provisional also contains the AVTransport service (annotated in yellow below) which is a “service type [that] enables control over the transport of audio and video streams.” Elabbady Provisional at 7; *see also id.* at 9
10 (stating same); *see also* Elabbady at 3:33-46 (stating that the disclosure is applicable to audio and video); *id.* at 7:3-10 (describing media content as including audio and video).

175. For the reasons above, it is my opinion that the combination of Elabbady, Palm, and Zintel describes this limitation.

15 **Claim 1[B]: “making available to a user a first user interface that allows the user to enable communications with the first computerized device set”**

176. Elabbady provides numerous interfaces that allow a user to enable communications with a device. For example, Elabbady teaches a control point that
20 provides a list of all digital A/V players on the network. Elabbady Provisional at

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16. One of the listed digital A/V players can be selected to invoke playback. *Id.*

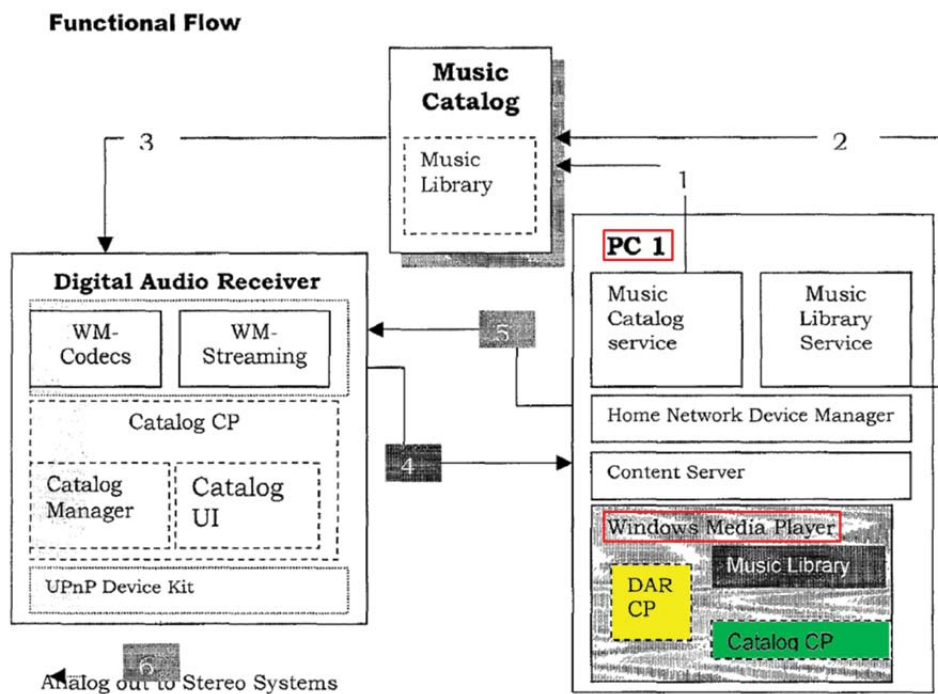
The control point for listing and selecting devices can be on a remote PDA. *Id.*

177. Elabbady also teaches numerous other user interfaces that allow a device to direct communications to another. Elabbady states that its PDA has UI controls to “access, present and navigate music” and “for basic playback control of digital media players.” *Id.* at 50. Elabbady also discloses a Variable Control service that enables a control point to change its volume and an AV Transport service that allows it to play video. Elabbady Provisional at 7; *see also id.* at 9. These services are rendered in a user interface. *See* Elabbady Provisional at 7 (stating that the AV Transport service is rendered as a UI). Elabbady teaches that a PDA is able to control a digital A/V player. Elabbady Provisional at 16.

178. Further, Elabbady discloses a user interface for browsing the media catalog to allow a user to select media content for playback. Elabbady., 9:9-12, 11:13-16; 12:18-21. The Media Catalog Service 203 and Media Library Service 207 are both accessible via a UCP, which can retrieve and display media content for user selection. *See, e.g.*, Elabbady at 8:57-9:22; 10:12-22; 12:18-21; *see also id.* at 10:23-38; 11:11-20; 12:18-33; Elabbady Provisional at 9-10, 16, 27, 42. The media catalog browser can likewise be located on any device such as a PDA or PC. Elabbady Provisional at 16; 45.

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179. A POSITA would understand that the A/V device and catalog control points can be on any device. Elabbady Provisional at 16; 45. Both of these control points can also be on a PC with Windows Media Player. Elabbady Provisional at 45. They can also be on a PDA. *Id.* at 16. As shown below, a PC with Windows Media Player (annotated in red) has a device control point (annotated in yellow) and a catalog control point (annotated in green). At the time of (and well-before) the filing of the '507 patent, Windows was a sophisticated GUI-based operating system and a POSITA would have understood the control points would be rendered as GUIs.



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180. Further, like Windows' GUI, the selection and control of devices is accomplished via user interfaces in UPnP. In the "software architecture of a client

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device per UPnP standards” (Zintel at 4:29-32), the applications are “software code module[s] that provide[] a *user interface features for locating desired devices* (e.g., embedded computing device 900) and services on the computer network, and *also user interface features to interact* with the located device or service.” *Id.* at 5 51:17-22 (emphasis added). In addition, UCPs can display folders of icons to allow a user to navigate and select devices. *Id.* at 11:6-10; *see also id.* at 8:18-20. A UCP can “[v]iew[] [the] user interface exposed by a Controlled Device [to] [e]xecute applications . . . [and] [i]nvoke Commands on [the] Controlled Device. . . .” *Id.* at 13:63-14:11. The display of UIs to control is a common implementation 10 of UPnP. A POSITA would understand that the selection of digital A/V players would enable communications with the selected player.

181. For the reasons above, it is my opinion that the combination of Elabbady, Palm, and Zintel describes this limitation. For example, a particular digital A/V player can be selected via a user interface. Elabbady Provisional at 16.

15 **Claim 1[C]: “making available to the user a second user interface that allows the user to browse internet content including a listing of continuous media content, the continuous media content being available to be accessed and presented on demand, wherein the listing is accessible via the internet using an internet protocol, the listing allowing the user to identify a particular**
20 **content item of the continuous media content”**

182. Palm discloses that a player can provide a user interface for browsing a listing of Internet content items available for playback on-demand. Palm at ¶¶ 9,

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43-44, 65. Palm discloses that the player makes HTTP requests to the content server which provides responses that are used to display the catalog. *Id.* at ¶¶ 41 (HTTP server on media server 115 dynamically generates markup and XML scripts for playlists), 43 (“[M]edia server's 115 role is similar to one of a web server: to allow the multimedia device 105 to navigate through a set of screens which describe the media titles, or the play lists, and to access the content in a direct access fashion for playback purpose.”), 65 (“most of the menu generation is the responsibility of the media server 115”) 78 (player retrieves catalog “home page” from media server) 86 (home page and “categories”). HTTP is an internet protocol. Zintel at 48:19-23 (“the Internet HTTP protocol”); 48:46-49 (UPnP is based on “key Internet standards such as ... HTTP”). In one embodiment, the markup provided by the content server is in Wireless Markup Language (WML) (Palm at ¶ 65), but Palm also notes that HTML could be used (*id.* at ¶¶ 47, 71-72, 74). Palm also discloses that the client device used to browse the catalog of Internet content can be a handheld computer like Elabbady’s PDA. *Id.* at ¶¶ 65, 71.

183. Elabbady similarly discloses providing a catalog UI on a PDA that allows users to select content items for playback on-demand. Elabbady Provisional at 1-2, 15-16. Similar to Palm, Elabbady describes a client/server

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approach for generating the catalog UI. Elabbady Provisional at 27-33 (describing
GetView requests, etc.), *see also id.* at 15-16. Although Elabbady discloses
retrieving catalog data from the media library service on the local network,
Elabbady’s catalog includes Internet content. Elabbady Provisional at 1-2
5 (Microsoft has a “Leadership Role” in the “digital/internet media mania.”); 7
(player plays “internet radio” and “media content stored ... on user-selected list of
Internet sites”); 27 (same); 40, 42 (Internet radio), 46 (streaming Internet radio); 61
(media content on Internet sites); *see also* Elabbady at 5:32-45 (devices connected
to Internet content servers); 6:64-65 (PCs can play digital media content
10 downloaded over the Internet); Fig. 2A; *see also id.* at 4:61-5:15 (communication
with remote computer 182 over the Internet).

184. In my opinion, a POSITA would have taken the teachings of Palm to
provide a device that would obtain the catalog data from an Internet content server.
The content items in the catalog would be available for playback on-demand as
15 taught in both Palm and Elabbady.

185. For the above reasons, in my opinion the combination of Elabbady,
Palm, and Zintel discloses this limitation.

20 **Claim 1[D]: “responsive to the user identifying the particular content item of
the continuous media content, causing to be wirelessly transmitted, in
accordance with a wireless local area network protocol, an identification of
the particular content item from the second computerized device set for**

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subsequent use by the first computerized device set to facilitate accessing and presenting the particular content item on the first computerized device set”

186. Elabbady and Palm both disclose that selecting a content item from the catalog can trigger downloading and playback. Elabbady Provisional at 3-4, 5 54-55 (figures and description of steps 4-18); Elabbady at 12:18-33; Elabbady Provisional at ¶¶ 80-81, 88. Elabbady also discloses that when a digital A/V player on the network is selected as the player, the PDA sends the URL for the selected content item to the player along with a PLAY command:

2. DAR Control Point

1. The control point presents a list of all DARs on the network if there is more than one DAR on the network.
2. The control point invokes the “Play” action on the DAR UPnP device selected in the previous step. The URL of the song selected by the user is sent. The URL was obtained as a result of GetView action.

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Elabbady Provisional at 16; *see also id.* at 15-17.

187. In my opinion, a POSITA would recognize that even if player selection is supported as disclosed in Elabbady, the PDA could be configured to send the URL to the player in response to selection of a content item. Indeed, the PDA would allow for selection of the next content item (e.g., song) to be played and it would be obvious for the PDA to presume the user intends to use the same

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playback device selected just minutes earlier barring some action by the user to change the selected player. In particular, the player selection step could simply be skipped and selection of the content item would trigger sending the URL to the previously selected digital A/V player. Elabbady Provisional at 16-17.

5 188. In my opinion, a POSITA would appreciate that the ‘Play’ command and URL would be sent wirelessly in accordance with a wireless local area network protocol. *See* Elabbady Provisional at 16-17. A PDA would communicate with the digital A/V player over a conventional home wireless network. Palm at ¶¶ 8, 71; Elabbady Provisional at 42 (control point can reside on
10 PDA with wireless network connection); Elabbady at 5:46-53. A POSITA would know that devices on a conventional home wireless network would communicate using wireless LAN protocols such as IEEE 802.11.

 189. Commercial wireless access points using the IEEE 802.11 family standards were widely used and available in any electronic store. As an example,
15 Linksys made a wireless access point in 2001 for use in home networks. *See* EX1022 and 1023. A POSITA would appreciate that devices communicating with other devices over a conventional wireless network would be configured for communication using a wireless communications protocol like 802.11.

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190. In my opinion, for the above reasons, the combination of Elabbady, Palm, and Zintel discloses this limitation.

5 **Claim 1[E]: “wherein the supported selected functions include at least receiving of the identification of the particular content item, the accessing of the particular content item and the presenting of the particular content item”**

10 191. The devices described in Elabbady and Zintel use UPnP. Zintel at Abstract; Elabbady at 6:16-23; 7:25-35; 10:11-23. As described above, content identifiers are transferred in the form of URLs from one device to another and media content is accessed via those URLs via HTTP GET and played on the media player of any one particular device (*e.g.*, a DAR or any other device disclosed by Elabbady). A POSITA would understand that UPnP compatible devices discover each other’s capabilities, including whether they can receive identification of, access, and present content.

15 192. Further, Elabbady describes the services that its devices offer such as “AVTransport . . . [that] enables control over the transport of audio and video streams. . .” and “the Connector service type, which describes A/V connection setup procedures . . . [that] enables modeling of streaming capabilities of A/V devices, and binding of those capabilities between devices.” Elabbady Provisional
20 at 7. The connector service has a number of properties, including content-format and “is used to negotiate a data transfer protocol and format between the [] DAR

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and the rendering device . . . [which] could range from simple bulk data transfer over HTTP, or SMB to streaming over RTP.” *Id.* As described in more detail in Claim 1[D], these services work to receive URLs, perform HTTP GETs with those URLs, and render the downloaded media.

5 193. These capabilities would be discoverable and, as described in more detail in Claim 1[A] and according to Zintel, “a UPnP device, an entity can ***learn more about the device and its capabilities*** by retrieving the device’s description.” Zintel at Abstract (emphasis added); *id.* at 8:57-67; 6:60-7:32; 20:50-53. The device’s description includes discovery information such as a list of any embedded
10 devices or services, and URLs for control, eventing, and presentation. *Id.* at Abstract; 59:19-62:60. Further, the UCP retrieves a description document from the Controlled Device, which includes service definitions, such as the Service Control Protocol Declaration (SCPD). *Id.* at 8:1-11; 16:43-50; *see also id.* at 13:49-14:20. The SCPDs “enable UCPs . . . to invoke Commands on the Service without any
15 prior or persistent knowledge of the capabilities (or schema) of the Service.” *Id.* at 9:45-52; *see also id.* at 9:21-37; 15:20-21. As described above, Elabbady’s DAR device (for example) is capable of receiving URLs, downloading based on those URLs, and playing media.

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194. In addition, Zintel also discloses that the discoverable capabilities include whether a device is capable of presenting of the particular content item. For example, as mentioned above, Zintel teaches that “SST of an audio or video playback device could implement a transfer buffer or queue of material *to be played.*” Zintel at 14:36-55 (emphasis added). Zintel also discloses that for audio/video devices such as VCRs, “device functions code can include code to implement *start, stop, pause, record* and other functions that the VCR can perform.” *Id.* at 48:52-65 (emphasis added). Zintel teaches that “device function” implements UPnP and is a software code of a first networked device that is used by a second networked device to implements the first networked device’s functionality. *Id.* at 48:52-62; 49:21-27; 51:10-35. A POSITA reading Zintel at the time of the alleged invention would understand that Zintel’s disclosure related to the device functions of audio/video devices such as VCRs disclose that a first computerized device is capable of presenting of the particular content item.

195. Zintel also discloses that the supported selected functions include receiving of the identification of and accessing the particular content item. For instance, Zintel states that the Service State Table (SST) of an audio or video playback device “could implement a transfer buffer or queue of material to be played.” Zintel at 14:36-55. At the time of the alleged invention, a POSITA

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would understand that Zintel’s disclosure of a transfer buffer or queue of audio/video material to be played discloses that the audio/video playback device in Zintel—the first computerized device set—is capable of receiving an identification of a particular content and is capable of accessing said item.

5 196. In my opinion, for the above reasons, the combination of Elabbady, Palm, and Zintel discloses this limitation.

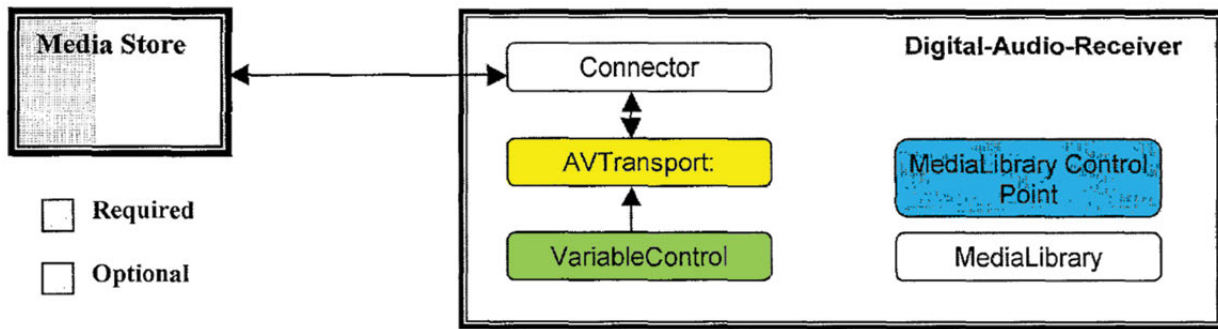
10 **Claim 2: “The method of claim 1, further comprising making available to the user a third user interface that allows the user to remotely control presentation of the particular content item on the first computerized device set”**

15 197. Elabbady teaches that the PDA has UI controls to “access, present and navigate music” and “for basic playback control of digital media players.” Elabbady Provisional at 50. The PDA is “capable of basic audio playback control: Play/Pause/Scan/Skip forward/Skip backward.” *Id.* at 50. Elabbady teaches that the “DAR Control Point” used to “control the DAR device” and control “several services – like play, pause, and stop” and the control point to select the content to be rendered can be on the PDA. *Id.* at 15-16 (describing the Media Library Control Point and DAR Control Point); *see also id.* at 45 (describing the control points on the PC).

20 198. Elabbady describes several services that the PDA can control. For example, the AVTransport service (annotated in yellow, below) is a “service type

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[that] enables control over the transport of audio and video streams.” Elabbady Provisional at 7. The “VariableControl” service (annotated in green, below) provides “variable-setting control such as a volume control.” *Id.* The “Media Library service (annotated in blue, below) exposes a list of metadata describing media content stored locally on the host device and on user-selected list of Internet sites.” *Id.* Elabbady also discloses that the DAR UPnP Device also “exposes several services—like play, pause, and stop—via which the control point can manipulate a device.” *Id.* at 15; *see also id.* at 16.



10 199. The control of Services, such as video playback, is a fundamental
functionality of UPnP. As stated in Zintel, “[a]ll (UPnP) Controlled Devices ...
expose one or more Services,” and a user control point can obtain information
about the types of “Services” that are offered by a controlled device. Zintel at
20:62-21:12. A “Service” is a UPnP controllable entity, and all services can be
15 controlled by a UCP. *Id.* at 9:1-2; 11:25-37. For example, a VCR can provide
services for “start, stop, pause, record” (*id.* at 48:62-65) and transport, tuner, timer,

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and clock. *Id.* at 15:56-62. Indeed, “UPnP makes it possible to initiate and control the transfer of bulk data (e.g., files) or A/V data streams from any device on the network, to any device on the network, under the control of any device on the network.” *Id.* at 5:26-32; *see also id.* at 6:48-52.

5 **CLAIM 3: “The method of claim 2, wherein the third user interface allows the user to play, pause, rewind, and fast forward the presentation of the particular content item on the first computerized device set”**

200. As described in claim 2, Elabbady teaches that the PDA has UI
10 controls “for basic playback control of digital media players” including play, pause, and skip forward/backward. Elabbady at 50; *see also id.* at 7 (stating that the AVTransport module provides a user interface for control); *id.* at 15 (stating that the UPnP Device “exposes several service – like play, pause, and stop which a control point can manipulate the device.”); *see also id.* at 45 (illustrating controls
15 on the PC).

CLAIM 4: “The method of claim 2, wherein the first, second and third user interfaces are integrated into a unified user interface on the second computerized device set that enables multi-screen, multimedia browsing”

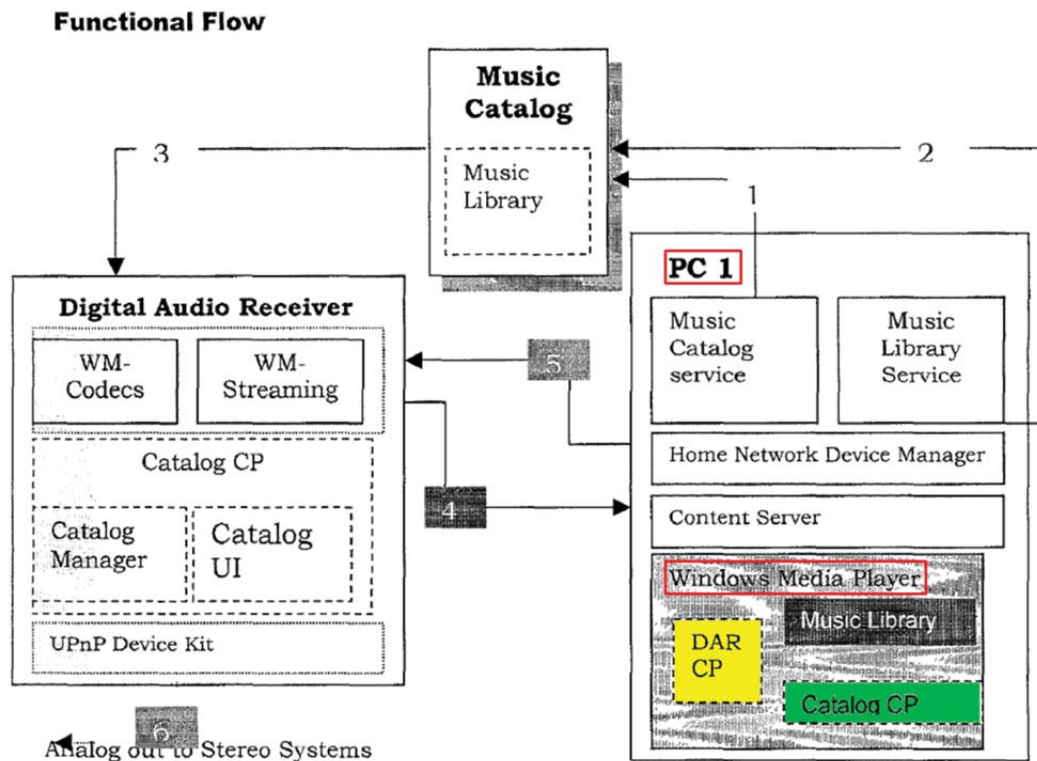
20 201. As discussed in claims 1[B], [C], and 2, Elabbady describes multiple user interface functionalities, such as allowing a user to: to select a device (*e.g.*, Elabbady Provisional at 16; *see also id.* at 2), invoke a play (*id.* at 2), “access, present and navigate music” and “for basic playback control of digital media

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players” (*id.* at 50), access a “[v]ariable-setting control such as volume control” (*id.* at 9), access a “AV transport service . . . [that] enables control over the transport of audio and video streams” (*id.* at 7), and access a Media Library Service that allows a user to browse media and internet content (*id.* at 7; *see also* Elabbady at 12:18-21; 9:9-12; 11:13-16; Fig. 4). A POSITA would understand that interaction with these elements is provided via user interface. With respect to the identified exemplary first user interface (*e.g.*, device selection), second (*e.g.*, media catalog browsing), and third (*e.g.*, some device playback such as play, pause, stop, skip, etc.), a POSITA would understand that they would be integrated into a unified user interface.

202. As described by Elabbady, a Windows PC could be used. Elabbady Provisional at 60; *see also id.* at 45-46. At the time of (and well-before) the filing of the ’212 patent, Windows was a sophisticated GUI-based operating system. Elabbady describes a Windows Media Player running on a Windows PC (both annotated in red below) that has control points for both browsing the catalog (annotated in green below) and for controlling the DAR (annotated in yellow below). *See id.* at 45-46. A POSITA would understand that these control points would be rendered on the Windows GUI.

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Claim 5: “The method of claim 1, wherein the particular content item is accessed by the first computerized device set via a closed network”

5 203. Dependent claims 7 and 9 of the '212 patent state that a “closed network” can be “a cable television network” or “a satellite television network.”

204. Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2; 7; 17; *see also* Elabbady at 5:36-39 (describing television service for content). Zintel discloses that UPnP
10 devices, including “audio and video recorders and players” and “entertainment devices (set-top boxes, game consoles, etc.)” can include network adaptors for communicating over and receiving content from “satellite” or “television cable”

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networks. Zintel at 45:60-46:16; 46:26-38; Fig. 26; *see also id.* at 51:43-47 (PC has “XDSL interface” or cable modem” to connect to the Internet); Fig. 31. Palm likewise discloses that media players may use “broadband Internet access media include[ing] xDSL, cable modems, satellite, wireless, etc.” Palm at ¶ 8.

5 **CLAIM 6: “The method of claim 5, wherein the closed network uses at least one proprietary network protocol”**

205. The ’212 patent specification does not use the term “proprietary network protocol.” However, the specification states that a cable TV channel is
10 “closed and/or proprietary.” Elabbady at 23:4-11. As mentioned above, Zintel and Palm disclose player devices connected to the Internet via a cable television network. A POSITA at the time of the alleged invention would have known that conventional cable TV broadcasts included proprietary cable channels, and that the cable channels used proprietary network protocols in order to prevent unauthorized
15 access.

206. Further, Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. *Id.* at 5:36-39. A POSITA would understand that these services would use proprietary protocols in order to prevent unauthorized access.

20 **Claim 7: “The method of claim 5, wherein the closed network is a cable television network”**

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207. As discussed for Claim 5, Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2, 7, 17.

Zintel discloses that UPnP devices, including “audio and video recorders and players” and “entertainment devices (set-top boxes, game consoles, etc.)” can

5 include network adaptors for communicating over “television cable” networks.

Zintel at 45:60-46:16, 46:26-38; Fig. 26; *see also id.* at 51:43-47 (PC has “cable modem” to connect to the Internet); Fig. 31. Palm likewise discloses that media

players may use “broadband Internet access media include[ing] xDSL, *cable modems*, satellite, wireless, etc.” Palm at ¶ 8.

10 **Claim 8: “The method of claim 7, wherein the closed network, at least in part, includes a fiber optic transmission path”**

208. As discussed in claim 5, *supra*, Zintel discloses a “television cable” and “cable modem.” Zintel at 46:26-38; 51:36-47. A POSITA reading Zintel at

15 the time of the alleged invention would have recognized that Zintel discloses a closed network, such as a cable television network, that would include a fiber optic

transmission path for enabling high data rate transmission to the various users. A

POSITA would know that cable television networks often include fiber optic

links. *See, e.g.*, EX1024 [Kwok] (Microsoft patent filed 1995, issued 1998) at

20 1:37-45 (describing “hybrid fiber/coax (HFC) architecture” resulting from

aggressive deployment of fiber-optic cable in CATV networks in recent years);

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EX1025 at 1:24-43 [Donohue] (describing rise of hybrid fiber/coax in cable networks); EX1026 [Krimmel] (Alcatel patent filed 1997, issued 2000) at 1:15-31 (describing hybrid fiber/coax cable TV network); *see also* EX1007 at 1:51-54 (“A large majority of households in the U.S. and Europe are viable for at least one or more type of broadband connection, such as cable, DSL, optical networks, fixed wireless, or two-way satellite transmission”). Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. Elabbady at 5:36-39. The Internet connection can be employed through a modem connecting to the Internet. *Id.* at 5:12-15. A POSITA would understand that a typical Internet connection, using a cable modem, would have a fiber optic connection in its transmission path (*i.e.*, through the ISP’s network). *See also* ‘212 patent at 21:44-47 (describing HFC Hybrid Fiber/Coax networks); 23:9:11 (describing the known use of HFC networks to provide Internet service from providers); 67:38.

209. A POSITA understands that Internet traffic regularly goes through fiber optic paths. *See, e.g.*, <http://www.nytimes.com/1999/09/30/business/cut-in-fiber-cable-disrupts-internet-traffic-nationwide.html>; Appendix W.

Claim 9: “The method of claim 5, wherein the closed network is a satellite television network”

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210. As discussed for claim 5, Elabbady discloses UPnP-compliant digital A/V players that have access to the Internet. Elabbady Provisional at 1-2, 7, 17. Zintel discloses that UPnP devices, including “audio and video recorders and players” and “entertainment devices (set-top boxes, game consoles, etc.)” can include network adaptors for communicating over “satellite” networks. Zintel at 45:60-46:16, 46:26-38; Fig. 26. Palm likewise discloses that media players may use “broadband Internet access media include[ing] xDSL, cable modems, *satellite*, wireless, etc.” Palm at ¶ 8.

10 **Claim 10: “The method of claim 5, wherein the first computerized device set comprises a television”**

211. Elabbady teaches the digital A/V player can be connected to a television. Elabbady Provisional at 7; 44; 48; Elabbady at 3:33-43. In such an embodiment, the digital A/V player and television would comprise a computerized device set. *See* ’212 patent at Fig. 2 (showing TV and set-top box) as a device set.

212. Zintel likewise discloses UPnP devices that would be connected to a television to form a computerized device set. Zintel at 7:25-32 (VCR, DVD Player, “audio/video/imaging playback device”); 45:60-46:15 (audio-video equipment, DVD players, set-top boxes, game consoles). Palm also discloses that the player device could be a set-top box and could be connected to a television. Palm at ¶ 64-65.

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Claim 11: “The method of claim 5, wherein the first computerized device set comprises a television and a set top box”

213. Elabbady teaches that one of the possible form factors for a DAR is an
5 “UPnP-enabled set-top box that uses the TV to display the control and navigation
UI.” Elabbady Provisional at 48; *see also* Elabbady at 3:33-46 (describing set-top
boxes and TVs). Zintel likewise discloses a TV and set-top box. Zintel at 7:8-14.

Claim 12: “The method of claim 5, wherein the second computerized device set is a wireless phone or tablet”

10 214. A POSITA would recognize that the second computerized device set
could be implemented as a wireless phone or tablet. Both Zintel and Elabbady
describe a wide range of devices, including tablets and PDAs. *See* Elabbady, 3:33-
45; 5:54-58; *see also* Zintel, 44:23-24; 7:7-32. Further, Zintel discloses that its
15 user control points enable communication with a UPnP controlled device and
include devices such as “handheld computer and smart mobile phone.” Zintel at
6:60-7:14.

Claim 13: “The method of claim 5, wherein the second computerized device set is a PC”

20 215. Elabbady discloses a PC with control points for the catalog and for the
digital A/V player. Elabbady Provisional at 45; *see also* Elabbady at 3:23-46
 (“personal computers,” “laptop devices,” “network PCs”); 5:54-58; Fig. 3 (device
300 with control point 315). Zintel discloses that UPnP control points can be on

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PCs. Zintel at 7:8-13; *see also id.* at 44:23-24. Palm also discloses that the client device for browsing the catalog of Internet content items can be a PC. Palm at ¶ 72. In my opinion, a POSITA would recognize that the second computerized device set could be implemented as a PC.

5 **Claim 14: “The method of claim 5, wherein the second computerized device set communicates at least in part via the public Internet with the first computerized device set”**

216. Claim 14 does not specify any particular type or content of the
10 communication between the second computerized device and the first device set via the Internet, it only specifies that there is communication. Elabbady discloses that the home network devices are connected to the Internet. Elabbady at 5:32-45. In my opinion, a POSITA would understand that devices connected to the Internet can communicate with each other over the Internet even if they are also connected
15 via a local area network. For example, one family member could use the same PDA that contains the catalog browsing application and digital A/V player control point to send an e-mail using an Internet-based mail application to another family member. The recipient could receive that email on a PC that is also used as a
20 Internet between the two device sets.

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Claim 15: “The method of claim 5, wherein the second computerized device set communicates at least in part via a wireless local network with the first computerized device set”

5 217. As discussed in claim 1[D], Elabbady discloses a PDA that has a
wireless network connection. Elabbady Provisional at 51; *see also* Elabbady at
3:33-46. Accordingly, Elabbady teaches that a user uses the PDA with a wireless
network connection to access and select content from a catalog, and also to control
10 playback of content on a DAR. *Id.* at 42; *see also id.* at 49. Further, Elabbady
provides a Network 204, (which can be a wireless Internet Protocol IP based
network (*e.g.*, Elabbady at 5:46-53)) that allows a wide array of devices (*id.* at
3:33-45; 5:54-58) to share control and data. *Id.* at 5:24-45. Zintel discloses the
same. *See, e.g.*, Zintel at 46:26-38. So does Palm. Palm at ¶¶ 8, 38; Zintel at
5:55-58; 46:26-38; 51:63-65.

15 **Claim 16: “The method of claim 5, wherein the second computerized device set communicates via a wireless local network using an internet protocol with the first computerized device set and the second computerized device set is connected to the closed network”**

20 218. As just discussed for claim 15, the combination of Elabbady, Palm,
and Zintel disclose that the second device set (*e.g.*, wireless PDA) communicates
over a wireless local network with the first device set (*e.g.*, digital A/V player).
UPnP commands are sent using HTTP which is an internet protocol. *See* Zintel at
24:35-25:41, 57:62-67 (commands sent via HTTP / SOAP); 48:19-23 (“the Internet

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HTTP protocol”); 48:46-49 (UPnP is based on “key Internet standards such as ... HTTP”). Accordingly, the wireless communications between the second device set and first device set would use an Internet protocol.

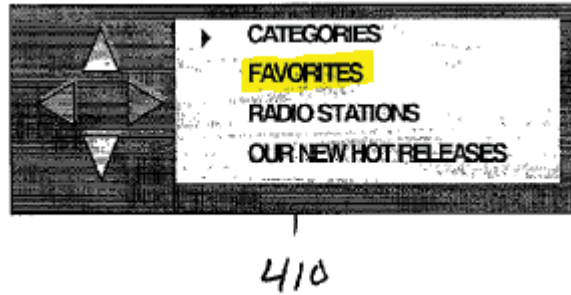
219. Furthermore, as discussed for claim 5 above, both Zintel and Palm
5 disclose UPnP devices connected to the Internet via closed networks (e.g., cable TV networks, satellite).

10 **Claim 17: “The method of claim 1, wherein the user at the second computerized device set is enabled to obtain an additional listing comprised of one or more user-selected programs and is enabled to further select an additional particular content item from the additional listing to facilitate presentation on the first computerized device set”**

220. As described in Claim 1[C], Palm discloses accessing a listing of Internet content items. Palm discloses that there are multiple listings of content
15 items provided via the catalog. *See* Palm at ¶ 11 (invention provides “the user many different ways of indicating their preferences such as, but not limited to selection from a hierarchical list, searches, both interactive and submitted, content provider suggestions, etc.”); *see also id.* at ¶¶ 41-42 (indexing engine on media server can generate different views of the content).

20 221. Palm’s Figure 4 discloses a “Favorites” category which a POSITA would recognize would include user-selected programs:

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222. '212 claim 18 confirms that “favorites” are an example of user-selected programs.

223. In addition, both Palm and Elabbady disclose selection of playlists
5 and it would be obvious that the playlists could include user-selected program items. Palm at ¶¶ 43, 57, 79-80, 88, Elabbady Provisional at 36 (showing playlist called “MYPLAYLIST”). Even the results of a search, *e.g.*, a search by artist (*see* Palm at ¶¶ 12, 58, 62; Elabbady Provisional at 29-33), would be a listing of user-selected program items.

10 **Claim 18: “The method of claim 17, wherein each of the one or more user-selected programs comprises a member of the group consisting of a list of bookmarked selections, a list of favorite programs, and a list of saved programs”**

15 224. As just discussed for Claim 17, Palm discloses an additional listing that consists of “Favorites.” Moreover, as also discussed for claim 17, both Palm and Elabbady disclose playlists it would be obvious to a POSITA for the playlist to include a list of user-selected content items which would be saved programs.

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Claim 20: “The method of claim 1, wherein a user selection associated with the second user interface triggers a push transfer to the first computerized device set for presentation of the particular content item without need for a further selection at the first computerized device set”

5

225. Elabbady teaches that “the user can access and select music from the catalog and control the playback of music on the intended DAR using a third party UPnP control point on the network” where the third party control point includes a PDA. Elabbady Provisional at 42. Specifically, Elabbady discloses that a user uses a third party UPnP control point such as a PDA to “view[] the catalog content on the catalog’s [user interface] UI and select the music to play using the catalog’s manager.” *Id.* at 46, 42. Elabbady states that “[o]nce the user makes their selection from the catalog, the DAR returns a URL (or UNC) of the selected music to the content server,” where the content server “initiates the transmission of the file contents to the DAR.” *Id.* at 46.

10

15

226. Further, after transfer of the content to the first computerized device set (a digital A/V player), there would not be further need for user selection of the continuous media content at the first computerized device set. As discussed in claim 1[C], the DAR contains the AVTransport service that enables the DAR to control audio and video streams remotely, and that a remote device (such as a PDA), provides the playback controls such as “play, pause, and stop” that can be used by a User Control Point on to manipulate playback on another device.

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Elabbady Provisional at 15; *see also id.* at 47 (describing a UI for play, pause, scan, skip, and to query and navigate the music catalog); 50 (same). As illustrated by Zintel the control of playback was a common functionality of UPnP – a VCR provides functionality to implement “start, stop, pause, record and other functions that the VCR can perform.” Zintel at 48:62-65. In the “software architecture of a client device per UPnP standards” (*id.* at 4:29-32), user interfaces are used to interact with devices and services. *See id.* at 51:17-22.

Claim 22: “The method of claim 1, wherein the particular content item is offered over a proprietary network by a proprietary system operator, the method further comprising the first computerized device set receiving the particular content item over the proprietary network”

227. Elabbady discloses receiving video services from “a television service” from Internet-based service providers, among others. *Id.* at 5:36-39. A POSITA would understand that these services would use proprietary systems in order to prevent unauthorized access. Further, as mentioned in claim 5, a POSITA reading Zintel at the time of the alleged invention would understand that Zintel discloses a cable television network. A POSITA at the time of the alleged invention would have known that conventional cable TV broadcasts included proprietary cable channels, and that the cable channels used proprietary network protocols in order to prevent unauthorized access.

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Claim 23: “The method of claim 1, further comprising making available to the user a third user interface that allows the user to actuate a hyperlink associated with a starting resource presented at one of the first and second computerized device sets with an attribute specifying that the ending resource of the hyperlink is to be presented at the other computerized device set”

228. As stated in the '212 patent, the “‘starting resource’ [is] the source from which link traversal is begun, and an ‘ending resource,’ the destination.”

Zintel at 7:21-24. As discussed in Elabbady, one device can select another device

to send a URL of content item to. Elabbady Provisional at 16. This can be

implemented in HTML or JavaScript and can accordingly be actuated via

hyperlink, which would contain information regarding the destination device. *Id.*

Accordingly, a user is able to actuate a hyperlink (because it is browser accessible)

on a source device (starting resource from which the URL is sent) with an attribute

identifying the destination device (ending resource that receives the URL).

**B. CLAIM 19 OF THE '212 PATENT IS OBVIOUS OVER
ELABBADY, PALM, ZINTEL, AND VALLONE**

229. Vallone is a Tivo patent that describes a navigation system for saved content on a DVR (Vallone at 12:53-58; *see also id.* at 14:47-15:24) that also

includes bookmarks and favorites. *See, e.g.,* Vallone at Figs. 28-33. Vallone’s

“bookmark function ... allows the user to bookmark a program where he left off.”

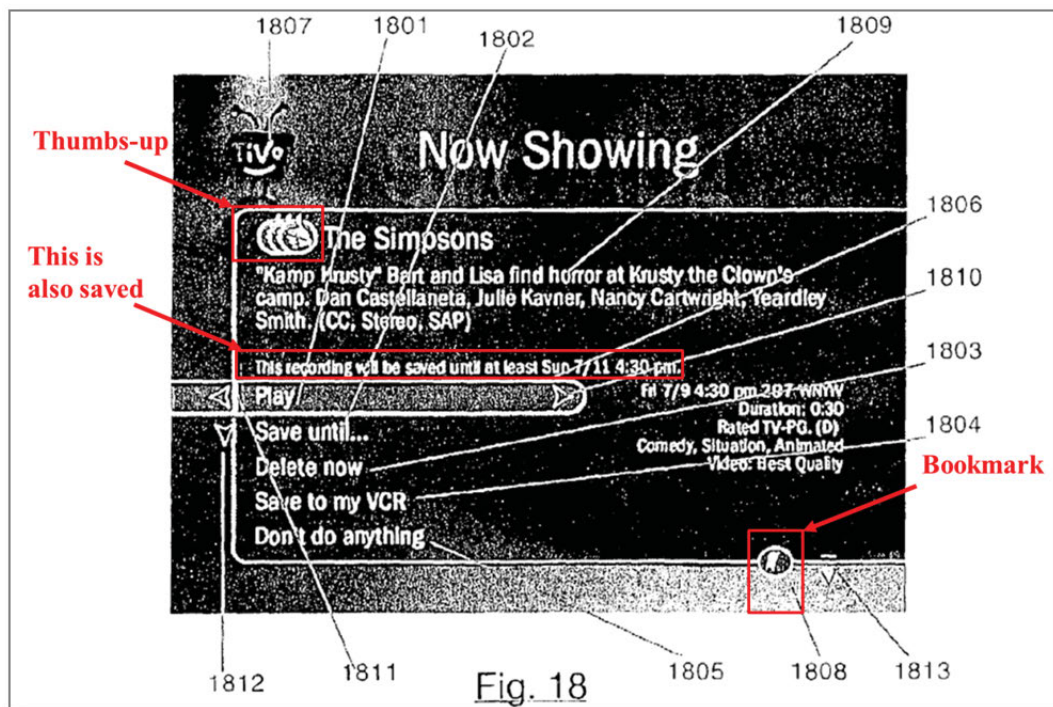
Id. at 15:34-36. Bookmarks can be created automatically, e.g., bookmarks are

created when a user exits a viewing session. *Id.* at 15:44-58. Bookmark indicators

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are placed next to the listing of bookmarked content. *Id.* Bookmarks allow users to return to bookmarked locations to continue their viewing session. *Id.* at 15:40-50.

230. Example bookmark and thumbs up tags are shown below. *See id.* at 15:44-47 (stating that 1708 is a bookmark, but a POSITA would understand that this is a typo of 1808 because the discussion is with respect to Fig. 18, element 1808 shows a standard bookmark picture, and 1708 is a “whispering arrow” as described in 14:32-35); *see also* Fig. 19; *see also* Fig. 30 (showing “Favorites” category for content).



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231. A POSITA would have been motivated to combine Vallone’s teaching of bookmarks with Palm’s catalog of Internet content items. Palm, Elabbady, and Vallone are in the same field – they all describe navigating, organizing, and selecting content for playback via user interface. Vallone describes favorites and bookmarks for saved content and Palm describes favorites and playlists. Elabbady describes aggregating cataloging information, including user playlists. Because Palm, Elabbady, and Vallone are in analogous fields (selection and navigation of content), a POSITA would have been motivated to combine them.

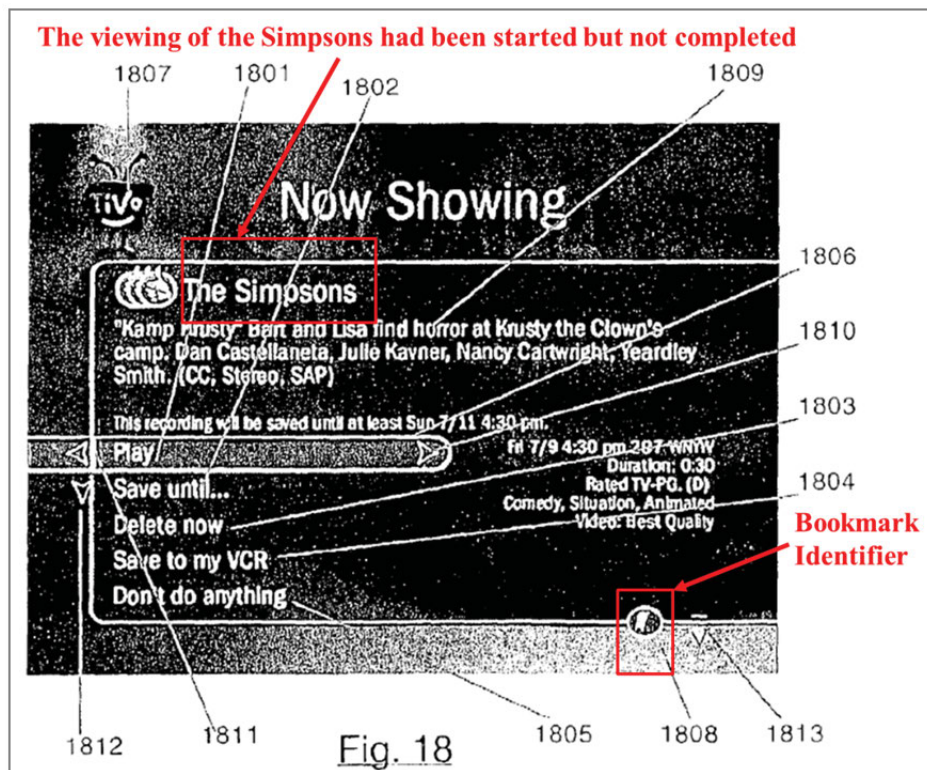
232. Further, a POSITA would have been motivated to improve upon the teachings of Elabbady and Palm with the teachings of Vallone. Palm and Elabbady describe saved content and favorites. Vallone further provides bookmarks. A POSITA would have been motivated to use bookmarks to allow a user to return to a particular viewing or listening session. “Bookmarking” of content is commonly practiced, for example, when a person places a bookmark in a book or when they save their place in a particular movie or song. A POSITA would have had exposure to bookmarking generally, and would have been motivated to combine such a feature with the teachings of Elabbady and Palm to bookmark media items. Accordingly, a POSITA would have been motivated to

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add bookmarking features to media content items such as the movies disclosed in Elabbady to allow a user to return to content.

5 **Claim 19: “The method of claim 1, wherein the list includes an identification of one or more programs for which presentation had been begun on the second computerized device set”**

233. Vallone teaches automatically bookmarking content whenever a user leaves a content viewing session, i.e., after presentation had begun. VALLONE at 15:44-47. The bookmarked content is provided with an identifier. *Id.* at 15:44-47;
10 *see also* Fig. 18.



234. It would have been obvious to combine Vallone’s teachings of bookmarks with Palm’s catalog of Internet content items to allow users to see that

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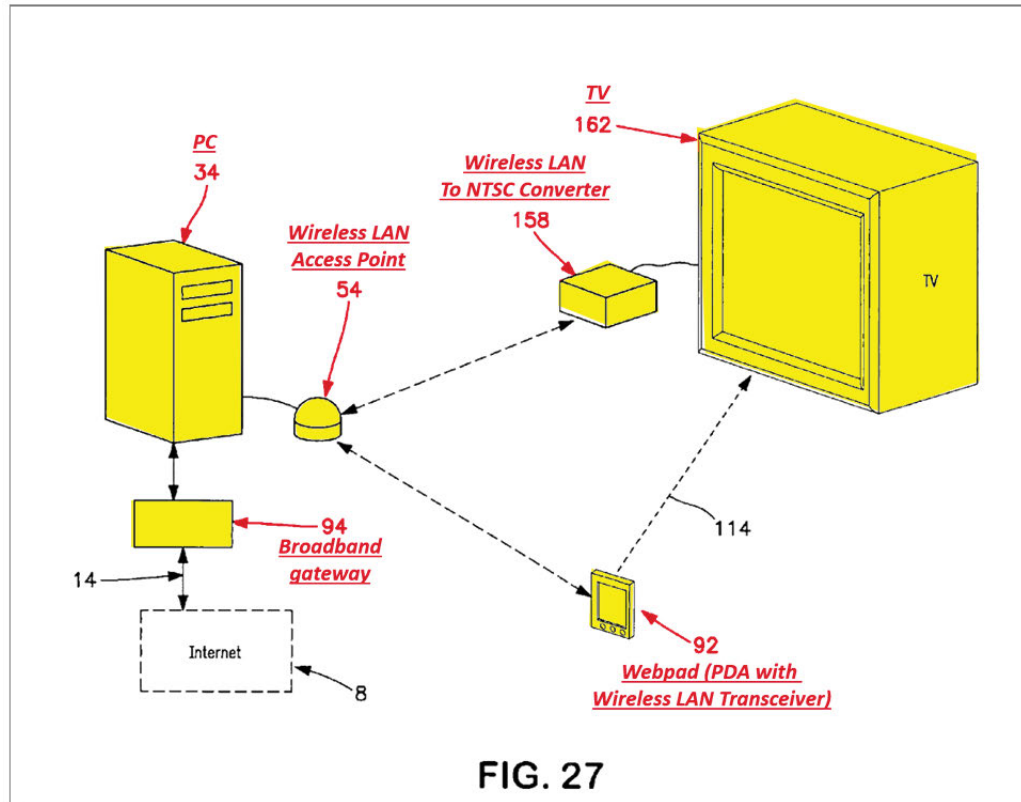
the user had previously started playing a particular content item. Palm, Elabbady, and Vallone all describe browsing and selecting content for playback via a user interface. Moreover, Vallone states “[o]ne skilled in the art will readily appreciate that the invention’s bookmarks can be applied to any video or audio application where the physical position in the material is readily ascertainable, e.g., DVDs, VCRs, MP3s, etc.” Palm discloses MP3s and other multimedia content where the playback position would be readily ascertainable. EX1006 at ¶¶ 53, 65, 82. Palm also discloses that listings of content items received from the content server can include metadata associated with the content items. *Id.* at ¶¶ 82, 84. It would be easy for the metadata to indicate a bookmark and playback position so that an indicator could be shown in the catalog UI as disclosed in Vallone.

**C. CLAIM 21 OF THE ’212 PATENT IS OBVIOUS OVER
ELABBADY, PALM, ZINTEL, AND JANIK**

235. Janik discloses a “system for delivering video to a TV 162, including the provision for second screen interactive services with a webpad 92.” Janik at 22:20-22. In this system, a wireless “LAN-to-NTSC converter 158” receives video data streamed over the wireless network and allows it to be displayed on the TV. *Id.* at 22:20-39; 23:42-24:26. The webpad is a PDA or tablet with a built-in wireless transceiver. *Id.* at 22:41-23:21. Similar to Elabbady, Janik discloses that

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the webpad can be used to select content for playback on the TV. *Id.* at 25:1-8;
25:40-51. Figure 27 illustrates this embodiment with annotations added:



236. Janik also discloses presenting “ancillary” content on the webpad that
5 relates to the content being viewed on the TV. For example, “if the currently
playing primary content on the TV 162 is a popular TV show, ancillary content
that is information pertaining to one of the actors is automatically loaded onto and
displayed by the webpad.” Janik at 26:39-42. Or if an advertisement is playing,
the webpad can display a website associated with the advertisement. *Id.*

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237. A POSITA would have found it obvious to combine Janik's enhancement content feature with the Internet content playback features of Elabbady, Palm, and Zintel. A POSITA would appreciate that once a content item has been selected for playback on a digital A/V player, the display of the PDA is available to be used in other ways. A POSITA would have been motivated to provide ancillary information on the PDA, such as actor information or other content as disclosed in Janik. *See* JANIK at 26:38-42. Elabbady and Palm describe playback of a wide array of content, and providing ancillary content when playing movies would provide a predictable improvement. Accordingly, a POSITA would have been motivated to combine these known techniques to provide a predictable improvement.

238. Furthermore, a POSITA would have combined the prior art elements in Elabbady, Zintel, and Janik according to known methods with predictable results. Each of Palm, Zintel, and Elabbady use UPnP. UPnP devices maintain Service State Tables that describe the logical states of a device (*e.g.*, a channel that a VCR is tuned to). Zintel at 14:36-52; 17:33-38; 15:56-63. Janik provides ancillary content based on the state of the TV (*i.e.*, what show is being watched). Maintaining state data relating to the particular content being viewed, and linking

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the content to ancillary content (as taught in Janik), would lead to predictable results.

239. A POSITA would further have been motivated to combine Janik with Elabbady, Zintel, and Palm because they are in an analogous field. Similar to Elabbady and Palm, Janik describes a home network-based multimedia system with playback devices capable of playing content stored on the local network or downloaded from the Internet. Accordingly, a POSITA would have recognized that features described in Janik could be implemented in the systems described by Elabbady and Palm.

240. Furthermore, the '212 patent admits that the usage of enhancement content on a secondary device while a primary device played the video content was widely known and employed by major network broadcasters – “[s]ome broadcasters such as ABC and PBS have exploited [enhanced TV] to offer Web content synchronized to a TV program. . .” ’212 patent at 2:35-41; *see also id.* at 45:50-51 (stating that PBS and ABC offered enhanced content). A POSITA would have been motivated to include these features, offered by major broadcasters, into a content consumption network of multiple devices.

Claim 21: “The method of claim 1, further comprising receiving state data relating to presentation of the particular content item on the first computerized device set; and presenting at the second computerized device set, based on the state data, enhancement content that is related to the

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presentation of the particular content item on the first computerized device set

241. The '212 patent explains that “state data [] specifies the current state of a live interactive session in progress” (Elabbady Provisional at 33:6-8) and
5 “enhancement content” to include information related to another content. *Id.* at 126:22-26; 109:50-56; 1:50-62. For example, enhancement content can include information that relates to specific aspects of a program, such as actors. *Id.* at 125:9-15.

242. Janik discloses presenting enhancement content based on state data
10 related to the presentation of content played on another device, *e.g.*, the TV / LAN-to-NTSC converter 158. For example, “if the currently playing primary content on the TV 162 is a popular TV show, ancillary content that is information pertaining to one of the actors is automatically loaded onto and displayed by the webpad.” EX1012 at 26:39-42. Janik explicitly discloses that state information is used to
15 retrieve the relevant enhancement content. *Id.* at 26:43-47 (state information sent to content link database server 130 to retrieve ancillary content).

243. As discussed in Claim 1, an exemplary configuration based on Elabbady, Palm, and Zintel includes a PDA which selects a content item and initiates playback on a UPnP-compliant digital A/V player. As described in Zintel,
20 each UPnP device maintains a Service State Table (SST), which describes the state

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of the device's services. Zintel at 9:21-28; 14:36-52; 17:33-38; 15:56-63; 28:32-

40. A control point can query the values of the state variables in the SST of the controlled device. *Id.* at 28:24-28; 28:54-61; 29:1-9 (queryStateVariable method).

Accordingly, the PDA in the exemplary configuration would be able to obtain state

5 data from the digital A/V player about the playback state.

244. It would have been obvious to incorporate Janik's teachings regarding enhancement content to the exemplary configuration based on Elabbady, Palm, and Zintel. Indeed, it would be even easier to implement the enhancement content

feature in the exemplary configuration. Janik discloses that the system control

10 application 18 requests the enhancement content and then routes it to the webpad for display. Janik at 26:43-47. This is required in Janik's system because the state

data is only available at the system control application 18. *Id.* at 26:4-14. But as just discussed, in the exemplary configuration, UPnP enables the PDA to obtain

playback state data from the digital A/V player. Thus, unlike Janik's webpad, the

15 UPnP PDA would have the relevant state data and could simply obtain the enhancement content from the Internet itself and display it.

245. For the above reasons, it is my opinion that the claims of the '507 and '212 patents are unpatentable.

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I hereby declare that all the statements made in this Declaration are of my own knowledge and true; that all statements made on information and belief are believed to be true; and further that these statements were made with the
5 knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I declare under the penalty of perjury that all statements made in this
10 Declaration are true and correct.

Executed on September 8, 2016 in Los Gatos, CA.



Digitally signed by Andrew Wolfe
DN: cn=Andrew Wolfe, o, ou,
email=awolfe@awolfe.org, c=US
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Consultant on processor technology, computer systems, consumer electronics, software, design tools, and intellectual property issues. Testifying and consulting expert for IP and other technology-related litigation matters.

Sample clients include:

AMD	Nvidia	Samsung
IBM	Motorola	HTC
SMIC	AMKOR	Huawei
Dell	Honeywell	Western Digital
Nintendo	Kingston	Sonos
Moneygram	Arraycomm	Insilica
Synaptics	Activision	Sawstop
Mysticom	P.A.R.C.	Qeester Ventures

Lecturer, [September 2013-present]

Santa Clara University

Teaching graduate courses on Computer Organization and Architecture and undergraduate courses on electronics and embedded computing.

Chief Technical Officer, [1999-2002]; Sr. VP of Business Development, [2001-2002]; VP, Systems Integration, S3 Fellow, [1998 – 1999]; Director of Technology, S3 Fellow, [1997 - 1998]

SONIC|blue, Inc., Santa Clara, CA (formerly S3 Inc.)

Strategic Business Development:

Developed and implemented strategy to reposition S3 from PC graphics into the leading networked consumer electronics company.

- Acquired Diamond Multimedia and coordinated integration of communications, Rio digital music, and workstation graphics divisions into S3.
- Identified and negotiated acquisitions to grow digital media businesses including Empeg, ReplayTV, and Sensory Science.
- Identified and negotiated strategic investments including Comsilica, Intellon, KBGear Interactive, Entridia, DataPlay and others.
- Developed strategy for integrated graphics/core-logic products and established a joint venture with Via Technologies to design and market these products.
- Negotiated divestiture of graphics chip business to Via and the workstation graphics division to ATI.

Product Planning and Development:

- Drove roadmap development within SONICblue product divisions.
- Managed Business Development for all product lines.
- Led New Product Development and Corporate Vision processes.
- Acting co-General Manager of Rio digital music business in 2nd half of 2001. Responsible for all areas of product development, business development, and cost management.
- Managed development of the Savage/MX and Savage/IX mobile 3D graphics accelerators and Savage/NB system logic products.

Public Relations, Public Policy and Investor Relations:

- Present company products and strategy at industry events such as CES, Comdex, and Microprocessor Forum.
- Discuss new products and initiatives with the press.
- Promote issues of interest to SONICblue to industry groups and in Washington.
- Brief analysts, and investors on company progress. Participate in quarterly conference calls.

IP Management and Licensing:

- Negotiated and managed partnership agreements including a critical cross-licensing agreement with Intel.
- Renegotiated technology-licensing agreements with IBM for workstation graphics products.
- Evaluated outside technology opportunities, managed video research and development, and managed corporate IP strategy with legal staff including patent filings, cross licensing, and litigation.

Consulting Professor, [1999-2002]

Stanford University, Stanford, CA

Teaching computer architecture and microprocessor design.

Assistant Professor [1991 - 1997]

Princeton University, Princeton, NJ

Teaching and research in the Electrical Engineering department. Research in embedded computing systems, multimedia, video signal processors, compiler optimization, and high performance computer architecture. Principal investigator or project manager for ~\$6M in funded research.

Visiting Assistant Professor, [1992]

Carnegie Mellon University, Pittsburgh, PA

Research and preparation of teaching materials on advanced microprocessor designs including new superscalar and superpipelined processor architectures.

Founder and Vice President and Consultant, [1989 - 1995]

The Graphics Technology Company, Inc., Austin, TX

Founded company to develop touch-sensitive components and systems for the first generation of PDA devices and interactive public systems. Obtained financing from Gunze Corp., Osaka, Japan. Company is now part of 3M.

Senior Electrical Engineer, [1989]

ESL - TRW, Advanced Technology Division, Sunnyvale, CA

Designed the architecture for an Intel i860-based multiple-processor digital signal processing system for advanced military applications. Designed several FPGA interface chips for VME-bus systems.

Design Consultant, [1986 -1987]

Carroll Touch Division, AMP Inc., Round Rock, TX

Developed several new technologies for touch-screen systems. Designed the first ASIC produced for AMP, a mixed-signal interface chip for controlling touch-screen sensors. Developed the system electronics, system firmware, and customer utility software for numerous products including those based on the new ASIC.

Senior Design Engineer, [1983 -1985]

Touch Technology Inc., Annapolis, MD

Advisory Boards:

Director, Turtle Beach Corporation (NASDAQ:HEAR) (formerly Parametric Sound Corporation), KBGear Interactive, Inc., Comsilica, Inc., Rioport.com, various S3 subsidiaries.

Technical Advisory Boards, Ageia, Inc., Intellon, Inc., Comsilica, Inc., Entridia, Inc., Siroyan, Ltd., BOPS, Inc, Quester Venture Funds

Carnegie Mellon University Silicon Valley Advisory Board; Johns Hopkins University Tech Transfer Advisory Board

Awards:

Micro Test-of-Time Award (in recognition of one of the ten most influential papers of the first 25 years of the symposium), 2014

Business 2.0 “20 Young Executives You Need to Know”, 2002

Walter C. Johnson Prize for Teaching Excellence, 1997.

Princeton University Engineering Council Excellence in Teaching Award, Spring 1996

AT&T/Lucent Foundation Research Award, 1996.

Walter C. Johnson Prize for Teaching Excellence, 1995

IEEE Certificate of Appreciation, 1995, 2001.

AT&T Foundation Research Award, 1993.

Semiconductor Research Corporation Fellow, 1986 - 1991.

Burroughs Corporation Fellowship in Engineering, 1985 - 1986.

Professional Activities:

Program Chair: Micro-24, 1991, Hot Chips 13, 2001.

General Chair: Micro-26, 1993, Micro-33, 2000.

Associate Editor: IEEE Computer Architecture Letters; ACM Transactions in Embedded Computing Systems

Speaker at CES, WinHec, Comdex, Intel Dev. Forum, Digital Media Summit, Microprocessor Forum, etc.

Keynote speaker at Micro-34, ICME 2002

IEEE B. Ramakrishna Rau Award committee – 2012-2015

IEEE Computer Society Awards Committee – 2015

CES Awards Judge - 2016

Over 50 refereed publications.

Patents:

- U.S. Pat. 5,041,701 – *Edge Linearization Device for a Contact Input System*, Aug. 20, 1991.
- U.S. Pat. 5,438,168 – *Touch Panel*, Aug. 1, 1995.
- U.S. Pat. 5,736,688 – *Curvilinear Linearization Device for Touch Systems*, Apr. 7, 1998.
- U.S. Pat. 6,037,930 – *Multimodal touch sensitive peripheral device*, March 14, 2000.
- U.S. Pat. 6,408,421 – *High-speed asynchronous decoder circuit for variable-length coded data*, June 18, 2002.
- U.S. Pat. 6,865,668 – *Variable-length, high-speed, asynchronous decoder circuit*, March 8, 2005
- U.S. Pat. 7,079,133 – *Superscalar 3D Graphics Engine*, July 18, 2006
- EP 1 661 131 B1 – *PORTABLE ENTERTAINMENT APPARATUS*, Jan. 21, 2009
- U.S. Pat. 7,555,006 – *Method and system for adaptive transcoding and transrating in a video network*, June 30, 2009
- U.S. Pat. 7,996,595 – *Interrupt Arbitration for Multiprocessors*, Aug. 9, 2011
- EP 2 241 979 B1 – *Interrupt Arbitration for Multiprocessors*, Oct. 10, 2011
- U.S. Pat. 8,131,970 – *Compiler Based Cache Allocation*, March 6, 2012
- U.S. Pat. 8,180,963 – *Hierarchical read-combining local memories*, May 15, 2012
- U.S. Pat. 8,193,941 – *Snoring Treatment*, June 5, 2012
- U.S. Pat. 8,203,541 – *OLED display and sensor*, June 19, 2012
- U.S. Pat. 8,243,045 – *Touch-sensitive display device and method*, August 14, 2012
- U.S. Pat. 8,244,982 – *Allocating processor cores with cache memory associativity*, August 14, 2012
- U.S. Pat. 8,260,996 – *Interrupt Optimization for Multiprocessors*, Sept. 4, 2012
- 101185761 (KR) – *Noise Cancellation for Phone Conversation*, Sept. 19, 2012
- 101200740 (KR) – *OLED display and sensor*, November 7, 2012
- 101200741 (KR) – *Touch-sensitive display device and method*, November 7, 2012
- U.S. Pat. 8,321,614 – *Dynamic scheduling interrupt controller for multiprocessors*, Nov. 27, 2012
- U.S. Pat. 8,352,679 – *Selectively securing data and/or erasing secure data caches responsive to security compromising conditions*, Jan. 8, 2013
- U.S. Pat. 8,355,541 – *Texture Sensing*, Jan. 15, 2013
- U.S. Pat. 8,370,307 – *Cloud Data Backup Storage Manager*, Feb. 5, 2013
- U.S. Pat. 8,398,451 – *Tactile Input Interaction*, March. 19, 2013
- JP 5241032 B2 – *Routing Across Multicore Network Using Real World or Modeled Data*, April 13, 2013
- ZL201010124820.3 – *Interrupt Optimization for Multiprocessors*, April 17, 2013
- U.S. Pat. 8,428,438 – *Apparatus for Viewing Television with Pause Capability*, April 23, 2013
- JP 5266197 B2 – *Data Centers Task Mapping*, May 10, 2013
- U.S. Pat. 8,508,498 – *Direction and Force Sensing Input Device*, August 13, 2013
- U.S. Pat. 8,547,457 – *Camera Flash Mitigation*, October 1, 2013
- U.S. Pat. 8,549,339 – *Processor core communication in multi-core processor*, October 1, 2013
- 101319048 (KR) – *Camera Flash Mitigation*, October 10, 2013
- U.S. Pat. 8,628,478 – *Microphone for remote health sensing*, January 14, 2014
- 101362017 (KR) – *Thread Shift: Allocating Threads to Cores*, Feb. 5, 2014
- 101361928 (KR) – *Cache Prefill on Thread Migration*, Feb. 5, 2014
- 101361945 (KR) – *Mapping Of Computer Threads onto Heterogeneous Resources*, Feb. 5, 2014
- JP 5484580 B2 – *Task Scheduling Based on Financial Impact*, Feb. 28, 2014
- JP 5487306 B2 – *Cache Prefill on Thread Migration*, Feb. 28, 2014
- JP 5487307 B2 – *Mapping Of Computer Threads onto Heterogeneous Resources*, Feb. 5, 2014
- 101372623 (KR) – *Power Management for Processor*, March. 4, 2014
- 101373925 (KR) – *Allocating Processor Cores with Cache Memory Associativity*, March 6, 2014
- U.S. Pat. 8,676,668 – *Method for the determination of a time, location, and quantity of goods to be made available based on mapped population activity*, March 18, 2014
- U.S. Pat. 8,687,533 – *Energy Reservation in Power Limited Networks*, April 1, 2014
- 101388735 (KR) – *Routing Across Multicore Networks Using Real World or Modeled Data*, April 17, 2014
- U.S. Pat. 8,725,697 – *Cloud Data Backup Storage*, May 13, 2014
- U.S. Pat. 8,726,043 – *Securing Backing Storage Data Passed Through a Network*, May 13, 2014
- ZL201010124826.0 – *Dynamic scheduling interrupt controller for multiprocessors*, May 14, 2014
- JP 5547820 B2 – *Processor core communication in multi-core processor*, May 23, 2014
- U.S. Pat. 8,738,949 – *Power Management for Processor*, May 27, 2014

- U.S. Pat. 8,751,854 – *Processor Core Clock Rate Selection*, June 10, 2014
 JP 5559891 B2 – *Thermal Management in Multi-Core Processor*, June 13, 2014
 101414033 (KR) – *Dynamic Computation Allocation*, June 25, 2014
 JP 5571184 B2 – *Dynamic Computation Allocation*, July 4, 2014
 101426341 (KR) – *Processor core communication in multi-core processor*, May 23, 2014
 U.S. Pat. 8,799,671 – *Techniques for Detecting Encrypted Data*, Aug 5, 2014
 101433485 (KR) – *Task Scheduling Based on Financial Impact*, Aug. 18, 2014
 U.S. Pat. 8,824,666 – *Noise Cancellation for Phone Conversation*, Sept. 2, 2014
 U.S. Pat. 8,836,516 – *Snoring Treatment*, Sept. 16, 2014
 U.S. Pat. 8,838,370 – *Traffic flow model to provide traffic flow information*, Sept. 16, 2014
 U.S. Pat. 8,838,797 – *Dynamic Computation Allocation*, Sept. 16, 2014
 U.S. Pat. 8,854,379 – *Routing Across Multicore Networks Using Real World or Modeled Data*, Oct. 7, 2014
 JP 5615361 B2 – *Thread Shift: Allocating Threads to Cores*, Oct. 15, 2014
 U.S. Pat. 8,866,621 – *Sudden infant death prevention clothing*, Oct. 21, 2014
 U.S. Pat. 8,881,157 – *Allocating threads to cores based on threads falling behind threads*, Nov. 4, 2014
 U.S. Pat. 8,882,677 – *Microphone for remote health sensing*, Nov. 11, 2014
 U.S. Pat. 8,924,743 – *Securing Data Cache through Encryption*, December 30, 2014
 U.S. Pat. 8,994,857 – *Camera Flash Mitigation*, March 31, 2015
 JP 5699140 B2 – *Camera Flash Mitigation*, April 8, 2015
 U.S. Pat. 9,143,814 – *Method and system for adaptive transcoding and transrating in a video network*, Sept 22, 2015
 U.S. Pat. 9,178,694 – *Securing Backing Storage Data Passed Through a Network*, November 3, 2015
 U.S. Pat. 9,189,282 – *Thread-to-core mapping based on thread deadline, thread demand, and hardware characteristics data collected by a performance counter*, November 17, 2015
 U.S. Pat. 9,189,448 – *Routing image data across on-chip networks*, November 17, 2015
 U.S. Pat. 9,208,093 – *Allocation of memory space to individual processor cores*, December 8, 2015
 U.S. Pat. 9,239,994 – *Data Centers Task Mapping*, January 19, 2016
 EP2228779 B1 – *Traffic flow model to provide traffic flow information*, Jan. 27, 2016
 U.S. Pat. 9,262,628 – *Operating System Sandbox*, February 16, 2016
 U.S. Pat. 9,330,137 – *Cloud Data Backup Storage Manager*, May. 3, 2016

Testimony by deposition or at trial – 2011-present

Case	Venue	Case Number
ACER, INC., ACER AMERICA CORPORATION and GATEWAY, INC v TECHNOLOGY PROPERTIES LIMITED, PATRIOT SCIENTIFIC CORPORATION, and ALLIACENSE LIMITED	Northern District of California	5:08-cv-00877 IF
Apple Inc. v. Motorola, Inc. and Motorola Mobility, Inc., C.A. 337-TA-750 (U.S. Int’l Trade Commission), C.A. No. 10-661 (W.D. Wisc.), 10-662 (W.D. Wisc.), and Motorola Mobility, Inc. v. Apple Inc., 10-23580 (S.D. Fla.)	ITC	337-TA-750
Auburn University v. IBM	M.D. Alabama	3:09-cv-694-MEF
In the Matter of Certain Universal Serial Bus (“USB”) Portable Storage Devices, Including USB Flash Drives (Trek v Kingston, Imation)	ITC	337-TA-788
In the Matter of CERTAIN PORTABLE ELECTRONIC DEVICES AND RELATED SOFTWARE (Apple V HTC)	ITC	337-TA-797
TVI v SONY CORPORATION et. al	Northern District of California	5:10-cv-00475-JF/HRL
In the Matter of CERTAIN ELECTRONIC DEVICES WITH GRAPHICS DATA PROCESSING SYSTEMS, COMPONENTS THEREOF AND ASSOCIATED SOFTWARE (S3 v Apple)	ITC	337-TA-813
Walker Digital, LLC v. Ayre Acoustics, Inc. et al	ITC	337 -TA-824
ENOVA TECHNOLOGY CORPORATION v INITIO CORPORATION, INITIO CORPORATION (California), WESTERN DIGITAL CORPORATION, BUFFALO INC., and BUFFALO TECHNOLOGY (USA), INC.	District of Delaware	C.A. 10-040LPS
In the Matter of Certain Consumer Electronics and Display Devices and Products Containing Same (GPH v HTC)	ITC	337-TA-836
In the Matter of Computers and Computer Peripheral Devices and Components Thereof and Products Containing the Same (TPL v Kingston et. al)	ITC	337-TA-841
In the Matter of Certain Electronic Imaging Devices (Flashpoint)	ITC	337-TA-850
Pacing Technologies LLC v. Garmin International and Garmin USA, Inc.	Southern Dist. of California	CV 12-1067 BEN
ProconGPS, Inc. v. Star Sensor, LLC et al.	Northern District of California	3:12-cv-01903-SI
Spireon, Inc. v. CallPass Tech, LLC et al	Northern District of California	3:12-cv-01903-SI
PQ Labs, Inc v Yang Qi, Zaagtech Inc, Jinpeng Li, Haipeng Li.	Northern District of California	12--00450-CW
In the Matter of Certain Consumer Electronics with Display and Processing Capabilities (GPH v Vizio)	ITC	337-TA-884
Florida Atlantic University Research Corporation, et al. v. TPV Technology Limited, et al	S.D. Fla.	09-12-CV-80701 09-12-CV-80694 09-12-CV-80697
Inter Partes Review of: U.S. Patent No.: 8,294,677 and U.S. Patent No.: 8,330,738 (TPK v Wintek)	PTO	IPR2013-00433 IPR2013-00436
Inter Partes Review of: U.S. Patent No.: 8,176,267 (SMI v Phison)	PTO	IPR2013-00473

APPENDIX A

Immersion Technologies v HTC CORPORATION et al.	District of Delaware	1:12-cv-00259-UNA
Smartflash v. Samsung et al.	E. D. Texas	6:13-CV-448
Black Hills Media LLC v Sonos LLC	C.D. California	2:14-cv-00486
Kangaroo Media, Inc. et al. v. YinzCam, Inc.	District of Western Pennsylvania	2:12-cv-00382-JFC
Inter Partes Review of: U.S. Patent No. 8,176,267 (CATR v Kingston)	PTO	IPR2015-00149
Inter Partes Review of: U.S. Patent No. 6,890,188 (Imation v Kingston)	PTO	IPR2015-00066
INTELLECTUAL VENTURES II LLC v JP MORGAN CHASE & CO., et al.,	Southern District of NY	13 Civ. 3777
Samsung Electronics Co., Ltd. and Samsung Electronics America Inc. vs. NVIDIA Corporation, Old Micro, Inc. f/k/a Velocity Micro, Inc., and Velocity Holdings, LLC	E. D. Virginia	3:14-cv-00757-REP
Certain Touchscreen Controllers and Products Containing Same (Synaptics v Shenzhen Huiding Technology Co., Ltd)	ITC	337-TA-957
Inter Partes Review of: U.S. Patent No. 7,742,053 (LG v ATI) (also 6,897,871 and 7,327,369)	PTO	IPR2015-00325 IPR2015-00326 IPR2015-00330
Ericsson Inc., et al. v TCL Communication Technology Holdings, LTD, et al.	E. D. Texas	2:15-cv-11
Certain Table Saws Incorporating Active Injury Mitigation Technology and Components Thereof (Sawstop v Bosch)	ITC	337-TA-965
INTER PARTES REVIEW OF U.S. PATENT NO. RE43,931 (TCL v Ericsson)	PTO	IPR2015-01739, IPR2015-01740, IPR2015-01741, IPR2015-01742, IPR2015-01743, IPR2016-00463, IPR2016-00464, IPR2016-00465, IPR2016-00563

Apple Introduces QuickTime Streaming Server Software - The First Open Server for Internet Streaming

Open Source and Mac OS X Server Versions Available; Leading Vendors Bring QuickTime-Compatible Servers To Market

NAB, LAS VEGAS—April 19, 1999—Apple Computer, Inc. today introduced QuickTime Streaming Server software, the underlying server technology that powers QuickTime 4's ability to stream live and stored video and audio over the Internet. The technology can be downloaded by developers as Open Source software—the Darwin Streaming Server—from (www.apple.com/publicsource) and is also available as a free update to Mac OS X Server, Apple's new modern server operating system. Apple also announced that leading media server companies such as IBM and SGI are integrating QuickTime Streaming software into their product lines.

“Finally, streaming live video and audio over the Internet no longer requires proprietary software and expensive servers,” said Steve Jobs, Apple's interim CEO. “By including streaming as part of Mac OS X Server and introducing Darwin Streaming Server, Apple is significantly lowering the cost of streaming digital video and audio and the result should be a deluge of high quality streamed content.”

QuickTime Streaming Server software is available as an update for Mac OS X Server, the Company's new server operating system, which combines the proven strength of UNIX with the simplicity of Macintosh. With the addition of QuickTime Streaming software, Mac OS X Server becomes a complete modern server operating system for the Internet. Mac OS X Server software can be purchased for U.S. \$499 and is also available bundled with a powerful Macintosh Server G3 for U.S. \$4,999.

Key features of QuickTime Streaming Server running on Mac OS X Server include:

- Ability to serve over 1,000 simultaneous audio and video streams at modem rate connections;
- Simple licensing model, with no 'per stream' charges;
- Support for industry-standard RTP and RTSP streaming protocols;
- Management tools allowing full administration of the server and comprehensive reporting on performance and throughput;
- Easy set up, with simple installer available for download from (www.apple.com/macosx/server).

Darwin Streaming Server makes QuickTime Streaming Server technology available to Open Source developers. Utilizing Darwin Streaming Server source code, developers can build server products for any platform, with the ability to stream QuickTime content over networks—using the standard Internet Engineering Task Force (IETF) protocols RTP and RTSP. QuickTime Streaming is already being embraced by leading media server companies and is a key

component in IBM's new V
 INTERNET ARCHIVE
 Wayback Machine
 MediaBase media streaming system
 44 captures
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 http://apple.com/pr/library/1999/apr/19qtstreaming.html
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tools, combined with SGI MediaBase server's scalable Internet streaming and asset management capabilities, will expand the market for customers wanting to add media to their web sites," said Jason Danielson, director of product management for Digital Media Products, SGI. "Streaming QuickTime with SGI MediaBase offers the most complete media streaming solution available."

Today, Apple also announced public beta versions of QuickTime 4 and QuickTime 4 Pro (see separate release).

Apple Computer, Inc. ignited the personal computer revolution in the 1970s with the Apple II, and reinvented the personal computer in the 1980s with the Macintosh. Apple is now recommitted to its original mission—to bring the best personal computing products and support to students, educators, designers, scientists, engineers, businesspersons and consumers in over 140 countries around the world.

Press Contacts:

Russell Brady
 Apple Computer, Inc.
 (408) 974-6877
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Eileen Stanley
 Edelman Worldwide
 (650) 968-4033, ext. 2764
eileen_stanley@edelman.com

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Apple Releases QuickTime 4 Public Beta With Internet Streaming

Apple First To Embrace Non-Proprietary Streaming Server Software

NAB, LAS VEGAS—April 19, 1999—Apple Computer, Inc. today released the public beta of QuickTime 4, its industry-leading multimedia software, for both the Macintosh and Windows platforms. QuickTime 4 features “streaming” of live and stored video and audio over the Internet, and is the first Internet streaming solution to use non-proprietary industry-standard RTP and RTSP protocols for streaming over the Internet. In addition, Apple announced that it has begun licensing its open Internet Streaming Server software under an Open Source model (see separate release). The public beta software also includes an all new QuickTime Player that offers easy access to QuickTime content, and significant enhancements to the QuickTime PictureViewer application and QuickTime Web Browser Plug-in.

“We are embracing the non-proprietary open server model for Internet streaming, and even giving away great server software under our Open Source licensing model,” said Steve Jobs, Apple’s interim CEO. “From this day forward, content providers, ISPs and network managers will have a choice—they will not be forced to pay a server tax to Real Networks for their proprietary server software.”

QuickTime 4’s new Internet streaming capabilities allow users to play live and stored video and audio using a variety of compressors and decompressors, enabling them to experience high-quality playback even over 28.8Kbps modems. Key features in QuickTime 4 include:

- QuickTime Player, providing intuitive user controls, a stunning new look and feel, and one-click access to Internet content. QuickTime Player also features audio controls for balance, volume, bass, and treble;
- QuickTime PictureViewer, delivering still image support for a wide range of formats including BMP, GIF, JPEG, PICT, PNG, SGI, TIFF, Adobe Photoshop, and FlashPix;
- QuickTime Web Browser Plug-in, enabling Microsoft Internet Explorer, Netscape Navigator and America Online web browsers to display QuickTime-based media directly inside web pages;
- Compression technologies, allowing content providers to optimize the playback of their content for dial-up Internet access, CD-ROM and DVD-ROM. These include MPEG-1 layer 3 (MP3), Sorenson Video, QDesign Music, Qualcomm PureVoice, H.261, GSM and DVI;
- Network protocol support for Internet Engineering Task Force (IETF) streaming standards, RTP, RTSP, SDP, FTP and HTTP;
- Support for video and animation formats, such as AVI, DV, Macromedia Flash, OpenDML, GIF and FLC;
- QuickTime for Java allowing Java applets to interface with QuickTime’s entire API;
- New small, intelligent installer to speed the download process, especially for QuickTime 4 users with low bandwidth Internet connections. By

INTERNET ARCHIVE enabling users to do...
 Wayback Machine nd offering automatic updates, customers get the fastest possible
 32 captures
 4 Oct 99 - 1 Feb '16
 http://apple.com/pr/library/1999/apr/19qt4beta.html
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QuickTime 4 Pro includes all the features of QuickTime 4 while unlocking the software's advanced authoring and playback capabilities, including:

- Multi-format editing, allowing users to integrate video and audio from anywhere, in any QuickTime supported format, including streaming;
- Advanced export capabilities, enabling users to manipulate still images and convert them to standard publishing formats, such as Adobe Photoshop, TIFF, BMP, PICT, PNG and JPEG;
- Ability to create slide shows that integrate pictures and sound; New Lens Flare and Zoom filters to further enhance movies and images;
- Easy preparation of QuickTime movies for streaming distribution.

Availability, Pricing and System Requirements

Macintosh and Windows users can immediately download a free version of QuickTime 4 public beta software from Apple's QuickTime web site (www.apple.com/quicktime). The advanced playback and editing capabilities of QuickTime 4 Pro are available to users for U.S. \$29.99. QuickTime 3 Pro customers are automatically upgraded to QuickTime 4 Pro free of charge upon downloading the QuickTime 4 public beta software.

System requirements for Mac OS-based systems are: 68020, 68030, 68040 or PowerPC processor; at least 8MB of RAM recommended for 68020, 68030 or 68040 processor-based systems and at least 16MB of RAM recommended for PowerPC processor-based systems; and MAC OS 7.1 or later. PowerPC processor required for streaming.

System requirements for Windows-based systems are: Intel or compatible processor or any MPC2-compliant PC with minimum 66-MHz 486 processor; at least 16MB of RAM; Windows 95, Windows 98, or Windows NT 4.0 system software; Sound Blaster or compatible sound card and speakers; and DirectX version 3.0 or later recommended. Pentium processor required for streaming.

Apple Computer, Inc. ignited the personal computer revolution in the 1970s with the Apple II, and reinvented the personal computer in the 1980s with the Macintosh. Apple is now recommitted to its original mission—to bring the best personal computing products and support to students, educators, designers, scientists, engineers, businesspersons and consumers in over 140 countries around the world.

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 Apple Computer, Inc.
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NOTE TO EDITORS: For additional information visit Apple's PR web site (www.apple.com/pr/), call Apple's Media Helpline at (408) 974-2042, or Dushka Zapata at our PR agency, Edelman Worldwide, at (650) 968-4033, extension 2726.

Wayback Machine <http://apple.com/pr/library/1999/apr/19qt4beta.html> Go SEP OCT 4 1999

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Apple's QuickTime 4 Downloads Top 32 Million and Ten New QTV Channels Premiere

Darwin 1.0 Available Open Source

INTERNET WORLD, LOS ANGELES—April 5, 2000—Reinforcing QuickTime's widespread consumer and industry adoption, Apple® today announced that downloads of its QuickTime™ 4 software have topped 32 million and the QuickTime TV (QTV) network now features over 40 premium channels of music, video and news from leading content providers.

With Apple's QuickTime 4 player, available as a free download from www.apple.com/quicktime, Macintosh® and Windows users worldwide get free access to QTV, the Internet's best entertainment network for web-based audio and video. Apple today added 10 new QTV channels, expanding the diversity of QTV's programming with international content, major— and independent-label music, industry news, fitness, comedy and short films. The new QTV channels include: Beggar's Banquet Records, Caroline's Comedy Club, Cipher New Media, Global Music Network from the UK, HyperTunez from France, IFILM, Oddcast, Pitch TV, Sony Music and ZDTV.

Apple today also announced the release of Darwin 1.0, the advanced operating system core at the heart of Mac® OS X, Apple's next generation operating system. The release of Darwin 1.0 Open Source means tens of thousands of registered Darwin developers can modify, customize and extend key Apple software, including the modern mach kernel and BSD layers found in Mac OS X. Darwin 1.0 is available for immediate download at www.apple.com/darwin. Darwin Streaming Server, the open source version of Apple's QuickTime Streaming Server software, which is used to stream high-quality audio and video over the Internet, will be available in May.

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The IEEE 802.11 Standardization Its History, Specifications, Implementations, and Future

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Abstract

The IEEE 802.11 Standard for Wireless LANs has had a profound impact on the provision of network access and resources to dispersed, and many times varied, network elements. It has not, however, been a static system implemented since its initial ratification. The standard has been under constant amendment and updating, striving to provide new services and capabilities for expanding wireless needs, and address shortcomings in the original standard. From its humble beginnings focusing on interoperability with the broader 802.x standards to provide bridging across various media, to its ongoing search for new RF techniques and spectra for increased support to new applications, IEEE has endeavored to stay ahead of users' requirements for Wireless LAN communications.

1. History of IEEE 802.11

In 1985, the Federal Communications Commission (FCC) deregulated the spectrum from 2.4-2.5 GHz for use by the Industrial,

Scientific, and Medical (ISM) communities. This meant that the spectrum would be available for individual, non-licensed applications [1]. This news was exciting to up-and-coming developers of wireless communications technologies, because they could now develop without spending money on licensing fees. Unfortunately, this led to many developments that were far from the ubiquitous, sprawling networks we see now. At the time, and throughout the development of the 802.11 standard, if wireless network technologies were available, they were usually proprietary, expensive, slow, or simply lacked widespread availability/adaptation – and most suffered from several of these challenges [2].

In the early 1990s, however, the IEEE realized that a wireless communications infrastructure standard was necessary to meet a clearly-desirable market niche. The IEEE established an executive committee, as part of the IEEE 802 standard for Local and Metropolitan Area Networks to focus on developing a wireless LAN standard [2]. The 802.11 committee focused on providing a reliable, fast, inexpensive, robust wireless

solution that could grow into a standard with widespread acceptance, using the deregulated ISM band from 2.4-2.5 GHz.

The original standard, ultimately adopted in 1997, is vastly different from the standard that exists today. The maximum data rate was 2 Mbps. It included forward error correction, and two forms of interference mitigating spread spectrum methods – direct sequence and frequency hopping. It also included a specification for infrared wireless communications, still operating at up to 2 Mbps.

A large part of 802.11's success is its inherent compatibility with current 802 networks, specifically the 802.3 wired Ethernet networks [2]. The independence of physical access (PHY) and media access (MAC) from overlaying communication layers is critical to this compatibility. This compatibility was part of the 802.11 committee's charter [1], but its implementation played a large role in ongoing internetwork growth. The compatibility was built on two pillars – physical layer compatibility and media access layer compatibility. The separation of these layers is critical to, not only the early implementation of the standard, but the ongoing extensibility of the standard.

The physical layer portions of the original standard, and as well as today's standard, focus on allowing the base stations to get wireless broadcasts to one another; transceiving. The broadcast frequencies were in the 2.4 GHz to 2.483 GHz range or in the infrared spectrum (IR) (850-950 nm) [2]. Transmitters used time-division duplex (TDD) radio broadcasts, allowing both uplink and downlink to share the same RF channel, using differential binary phase shift keying (DBPSK) or differential quadrature phase shift keying (DQPSK) signal modulation (Appendix A). Transmitters used either

Direct Sequence Spread Spectrum (DSSS) or Frequency Hopping Spread Spectrum (FHSS) for interference mitigation. Data rates were specified for both 1 Mbps and 2 Mbps operation.

The media access layer (MAC) processes the PHY layer signals into the ubiquitous network layer. Fundamentally, 802.11 uses collision sense media access with collision avoidance (CSMA/CA) for its media access protocol (Appendix B) [2]. The MAC layer also provides several services to assist in the wireless broadcast such as synchronization, power management, frame fragmentation, and frame encryption (WEP - Wired Equivalent Privacy) and authentication, with varying methods of employing these services for both infrastructure-based in distributed (known as ad-hoc) networks. For example, in an infrastructure network, synchronization is performed between all transceivers by using beacons transmitted by the access point. In an ad-hoc network, however, the synchronization responsibility falls to all members of the independent network, creating a sub-network of synchronizers.

Note that there is no 5 GHz spectrum specification in the original 802.11-1997 standard. This frequency allocation was not explored (or at least, published) until shortly after the original standard was adopted. The original standard focused on exploiting the recently-unlicensed 2.4 GHz ISM band, and the practical, and already-in-use infrared spectrum. In fact, the original standard largely overlooks, or at least actively ignores, many compatibility standards that would end up being crucial to widespread acceptance of the standard. For example, the entire standard makes only cursory mention of MAC address space, pointing out that its 48-bit address space is compatible within the broader scope of the IEEE 802 address space,

but is not required to be unique from a global 802 address overlay. This compatible address space, which is still a part of the 802.11 standard today, allows 802.11 networks to interact with the 802.1 LAN specification that provides for bridging between separate physical networks, and is perhaps the cornerstone of the success for the standard. This address compatibility with 802.x networks (and flexibility) played a role in the widespread adoption and interoperability of 802.11 wireless networks [2], even in the face of other, higher-speed competing network standards such as HiperLAN, a competing European standard for wireless network communications, which provided its own convergence to internet protocol (IP) networks, vice relying on 802.1 for internetwork bridging [1].

Despite not having addressed direct compatibility of the 802.11 with 802 networks, the committee left the door open, and in fact immediately fostered the follow on Task Groups to address specific supplemental topics for use within the 802.11 standard framework. The 802.11b task group, TGb, addressed higher speed transmissions within the WLAN environment. The 802.11b Task Group produced the 802.11b amendment, adopted by IEEE in 1999, just two years after the original standard was adopted. It allows for 5.5 Mbps and 11 Mbps data rates, using Direct Sequence Spread Spectrum (DSSS) transmissions [2]. It also prompted the creation of the Wireless Ethernet Compatibility Alliance (WECA); a non-profit association for standardization and promotion of Wi-Fi technologies. From wi-fi.org [5]:

“The Wi-Fi Alliance is a global non-profit industry association of hundreds of leading companies devoted to seamless connectivity. With technology

development, market building, and regulatory programs, the Wi-Fi Alliance has enabled widespread adoption of Wi-Fi worldwide.”

Even today, 802.11b is probably the most widely-recognized, and widely-used 802.11 standard, although 802.11g is quickly surpassing it, with 802.11n up-and-coming in popularity and availability. WECA renamed itself to the Wi-Fi Alliance in October, 2002 [4].

About the same time the 802.11b Task Group was designing the 802.11b amendment, the 802.11a Task Group, TGA, was doing the same for another wireless standard [3]. At the time, many countries had recently opened up some 5 GHz spectrum for unlicensed (but still regulated) use. This spectrum was less “RF dense” than the 2.4 GHz spectrum [2], which includes other interferors such as garage door openers, cordless telephones, microwave ovens, and baby monitors. With less interference high bandwidth available, another, higher capacity standard could be constructed.

The ultimate 802.11a standard included a 54 Mbps data rate using the more-complex orthogonal frequency division multiplexing (OFDM) waveforms (Appendix C), and operated in the 5 GHz range, set aside for the Unlicensed National Information Infrastructure (U-NII) usage [1]. While the standard was completed and adopted in 1999, the more-complex equipment did not begin shipping until 2001.

It is significant to note that while data rates were increased by both 802.11a and 802.11b, that both only increased data bandwidth within RF applications. The IR specification, while still valid, was left behind with 1-2 Mbps maximum throughput, while the RF environment has continued to

increase in data throughput throughout the development of the 802.11 standard.

Not long after 802.11a was adopted, IEEE immediately recognized that the OFDM waveform could benefit the 802.11b standard. Increased data rates would even support bandwidth-hungry multimedia applications as the demand for these applications grew. In July 2000, the 802.11 Task Force G was assigned the task of overlaying the OFDM waveform on the 2.4 GHz spectrum, producing a new standard that was fully backward-compatible with the 802.11b standard. This was no easy feat, but after 3 years the new standard was ratified. The key was in requiring all 802.11g equipment to support complimentary code key (CCK) modulation as a fall-back mechanism to ensure 802.11b compatibility. This fall-back has significant impacts on the total data rate of the network, but allows mixed 802.11b-802.11g network equipment to coexist on the same topology. As 802.11b equipment is phased out and replaced with 802.11g equipment, users can seamlessly upgrade their network without upgrading the entire infrastructure. In June 2003, the amendment was ratified.

As 802.11 enjoyed widespread adoption by home and business users alike, more scrutiny was placed on security. The initial standard included a MAC-level security protocol called WEP, Wired Equivalent Privacy [6]. WEP was intended to provide confidentiality and authentication for connecting users. By using a very small subset (up to four) of pre-shared keys, a user could identify itself as a valid user to an access point, and encrypt every packet of the session [7]. The intent of WEP was not to be a bulletproof security protocol for wireless networks, but to provide reasonable session privacy, like that which could be expected from a direct-connection (wired) connection.

Unfortunately, WEP was rife with vulnerabilities (Appendix D), and continued bad press caused 802.11 users to demand better security [7]. Another task group, Task Group I, was set up to address MAC-level security in an effort to address security problems with WEP [6].

The Task Group model, however, took too long to address the concerns of equipment manufacturers. The Wi-Fi Alliance began implementing additional security enhancements to provide customers with additional security features. Many members of the Wi-Fi Alliance were part of Task Group I, and these enhancements would be seen as part of the final 802.11i amendment. These original security implementations, labeled Wireless Protected Access included many enhancements to address the weaknesses of WEP, including the use of extended initialization vectors (IV) (56-bits), rotating initialization vectors, more robust integrity checks, and protection against replay/redirection attacks [6].

In June 2004, the 802.11i amendment was ratified. The security enhancements in it became known as WPA2, Wireless Protected Access v2. It was largely a mirror of the WPA enhancements from the Wi-Fi Alliance, with some small, but significant, improvements. First, it incorporated the use of the Advanced Encryption Standard for encrypting and protecting data [8]. The AES was selected/adopted by the National Institute of Standards and Technology (NIST) in November 2001, and was not available when WEP was being designed nearly 10 years earlier. Next, enhanced integrity checks leveraging the AES CCMP (counter mode with cipher block chaining with message authentication code protocol, a recursive acronym) provides additional authentication. 802.11i also supports several implementations of using external

authentication mechanisms, including 802.1X authentications and/or RADIUS [8].

Meanwhile, the IEEE was going through another exercise to increase wireless data rates. Recognizing the seemingly unquenchable bandwidth thirst of users, the IEEE set out to exceed 54 Mbps as an upper data rate limit by creating Task Group n (TGn) in September 2003 [3]. By using multiple-input multiple-output (MIMO) transmitting methods, 802.11n would allow multiple data streams, separated spatially, to increase the overall data rate [9]. This access method, as with 802.11g, is backward-compatible with previous 2.4 GHz implementations of 802.11, as well as 802.11a in the 5 GHz and 3.7 GHz spectra (802.11a was extended to 3.7 GHz by the 802.11y amendment in Nov 2008) [9].

While 2.4 GHz implementations include the largest number of users worldwide, unfortunately the 2.4 GHz spectrum is heavy on interference. While MIMO can provide additional and higher data rates, and protection against some interferences (Appendix E), there is a limit as to how much data can be transferred in the congested spectrum. The 802.11n amendment, ratified in September 2009, can support data rates up to 600 Mbps, but in its current implementation, with the congestion in the 2.4 GHz spectrum, the maximum supported transmission rate is 104 Mbps. This is still a significant increase over the 802.11g amendment, but leaves significant room for growth, should 802.11n be deployed in other RF environments. Indeed, as the amendment does not specify the exact spectrum, the largest performance gains will be realized in the 5 GHz and 3.7 GHz ranges, where significantly less interference is found.

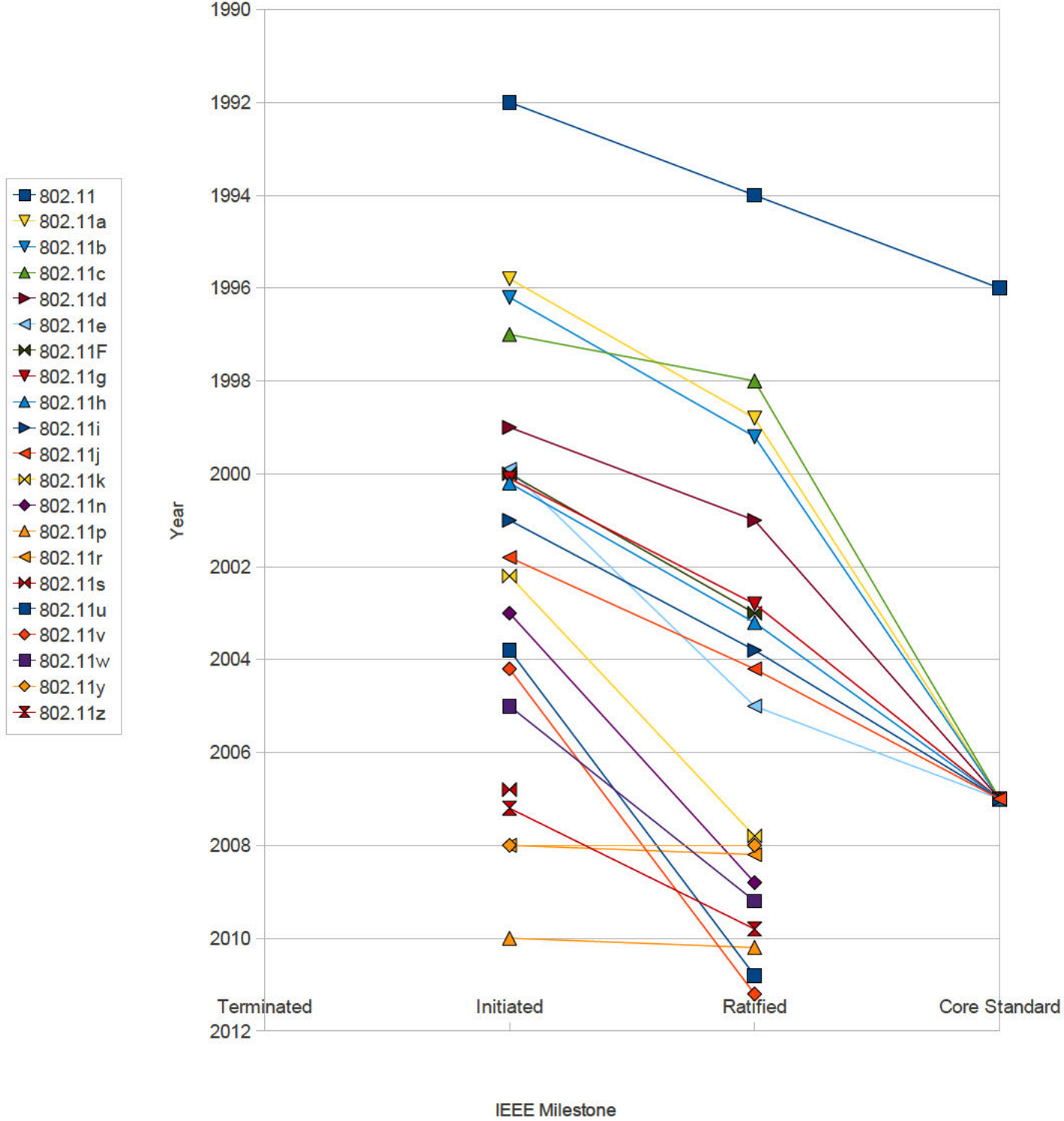
Also, in 2003, the IEEE began consolidating the standard amendments from the Task Groups, and rolling them into a consolidated baseline standard. The standard

up to this point had been known as IEEE 802.11-1999. After many amendments, 802.11a, 802.11b, 802.11d, 802.11e, 802.11g, 802.11h, 802.11i, 802.11j, were all rolled into one consolidated standard – IEEE 802.11-2007. While technically these amendments no longer exist, as they are now part of the baseline standard, most still refer to them by their parent amendment designations to easily identify the specific capability or function of the 802.11 wireless LAN standard [9]. The following illustration is a timeline of when specific amendments were initiated (i.e., the Task Group was formed), and when the amendment was ratified, terminated, or rolled into the core standard.

2. The 802.11 Standard

The 802.11 standard, while a single standard, has many manifestations that allow wireless network access. It covers everything from how synchronization should be performed, to how infrared (IR) wireless networks should be configured, to spread spectrum chip rates for different applications. This paper cannot touch on all portions of the standard. Indeed, the 1200+ page standard (not including its many several-hundred page amendments/enhancements) will require this paper leave many topics unexplored, and many, many more topics completely undiscovered.

Evolution Timeline of 802.11 Standards



2.1 Modes

802.11 networks can operate in two basic modes: infrastructure and ad-hoc[2].

Infrastructure: In infrastructure networks there are two entities: a station (STA) and an access point (AP). This mode is called the Infrastructure Basic Service Set, or just BSS. Access points provide wireless access to network resources for stations, as well as other services such as synchronization and channel selection. Many times, APs are gateways, and provide other services such as network address translation, dynamic host control protocol (DHCP), and other network services. While these services are outside the bounds of 802.11, they are critical to end-to-end usability of the network [2].

Ad-hoc: In ad-hoc networks, there is no access point, just stations. This mode is called the Independent Basic Service Set, or IBSS. Each station communicates and negotiates directly with other stations, with the roles of the Access Point being performed autonomously by the individual stations. This allows a network to be quickly erected and torn down, without the need for in-place infrastructure, thus reducing cost and adding flexibility. While this is not the typical deployment of an 802.11 network, it has its place in the list of 802.11 implementations [2].

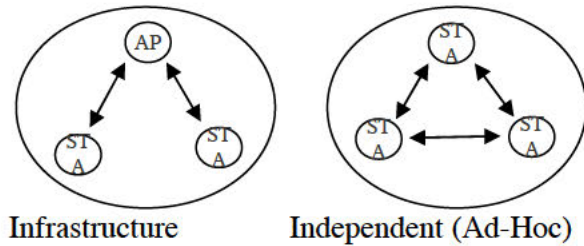


Figure 1: Infrastructure vs. Ad-Hoc (Independent) Modes

2.2 Physical Layer

The biggest changes in the 2.4 GHz wireless network arena has been in the physical layer implementation of the standard. There are many reasons for this. First, the basic access data rate is largely determined by the physical modulation scheme. For data rates to increase, new (more complex) waveforms have been necessary to increase the data rates for the network [9]. Second, since the 2.4 GHz spectrum is unlicensed, there are plenty of interference-producing devices that operate in this range. To avoid, or at least minimize, this interference, spread spectrum methods have been implemented to mitigate these challenges [10]. As data rates and waveforms have changed, new spread spectrum methods have been employed [2].

While the methods used to access the same spectrum may change over time, the unlicensed ISM band has not. IEEE subdivided the entire allocated spectrum into subchannels for use by Wireless LAN transceivers, which are applicable in different regions. Table 1 shows the complete spectrum allocation in the 2.4 GHz range, along with the international regulatory body recognition of the channel allocation [12]. Since the IEEE has continued to provide backward-compatible amendments to the original standard, all the 2.4 GHz methods used by 802.11 for RF transmission are still valid [2]. That is, since no amendment nullifies a previous access method, all the

previous methods are still legitimate waveforms and spread spectrum techniques. For a discussion of RF waveforms, see Appendices.

Channel Number	Frequency (GHz)	Regulatory Body (Region)			
		FCC	IC (Canada)	ETSI (Europe)	Japan
1	2.412	X	X	X	X
2	2.417	X	X	X	X
3	2.422	X	X	X	X
4	2.427	X	X	X	X
5	2.432	X	X	X	X
6	2.437	X	X	X	X
7	2.442	X	X	X	X
8	2.447	X	X	X	X
9	2.452	X	X	X	X
10	2.457	X	X	X	X
11	2.462	X	X	X	X
12	2.467			X	X
13	2.472			X	X
14	2.484				X

Table 1: 24. GHz Channel Allocations by Region [reproduction, 12]

802.11 – Allows for frequency hopping spread spectrum (FHSS) and direct sequence spread spectrum (DSSS) to provide interference mitigation and binary phase shift keying (BPSK) or quadrature phase shift keying (QPSK) to provide 1 or 2 Mbps data rates, respectively. Since all future amendments would be backward-compatible, all future methods support these access rates [9].

802.11b – Uses Direct Sequence Spread Spectrum (DSSS) with overlapping channels to provide interference mitigation, and moves away from FHSS for higher data rates. 802.11b also uses Differential QPSK (DQPSK) or Differential BPSK (DBPSK) to provide 11 Mbps or 5.5 Mbps data rates, respectively [2].

802.11g – Uses Orthogonal Frequency Division Multiplexing (OFDM) to mitigate interference and provide 54 Mbps data rates. Different data rates are supported through different modulation schemes, including 64 and 16 QAM (Quadrature Amplitude Modulation). Table 2 shows how various modulation schemes are coupled with transmission types to accomplish specific data rates for 802.11g. The spread spectrum channels overlay with the 802.11b channel layout (see Table 2, below) [14].

Data Rate (Mbps)	Transmission Type	Modulation Scheme
54	OFDM	64 QAM
48	OFDM	64 QAM
36	OFDM	16 QAM
24	OFDM	16 QAM
18	OFDM	QPSK1
12	OFDM	QPSK
11	DSSS	CCK2
9	OFDM	BPSK3
6	OFDM	BPSK
5.5	DSSS	CCK
2	DSSS	QPSK
1	DSSS	BPSK

Table 2: 802.11g Transmission Characteristics [reproduction, 14]

802.11n – Uses OFDM to mitigate interference, while using multiple-input, multiple-output (MIMO) transmissions to increase the total data rates. For a primer on MIMO, see Appendix E. MIMO has significant long-term consequences for 802.11. The use of multiple data streams to increase total throughput can dramatically increase the total capacity of the 802.11 environment. Currently, the 802.11b/g channels are 20 MHz, with 1 MHz guards. Table 3 shows the new data rates when MIMO is used with various guard intervals (time intervals between transmission of consecutive symbols) and 20 MHz channel widths [15].

802.11n, however, supports both 20 and 40 MHz channels to provide a maximum data throughput of 300 Mbps. Table 4 shows a significant (doubling) increase in data rates, when 40 MHz channel widths are used. Unfortunately, the 2.4 GHz spectrum is not really arranged in a way to easily take advantage of the higher data rates. In the current channel allocation, there are only 3 discrete channels (non-overlapping) in the American 802.11 standard at 2.4 GHz (channels 1, 6, and 11). In current, energy dense spectra, these new data rates cannot be easily implemented effectively, despite being theoretically possible to implement. [15]

Spatial Streams	Modulation Scheme	Data Rate (Mbps) (GI=800ns)	Data Rate (Mbps) (GI=400ns)
1	BPSK	6.5	7.2
1	QPSK	13	14.4
1	QPSK	19.5	21.7
1	16-QAM	26	28.9
1	16-QAM	39	43.3
1	64-QAM	52	57.8
1	64-QAM	58.5	65
1	64-QAM	65	72.2
2	BPSK	13	14.4
2	QPSK	26	28
2	QPSK	39	42.8
2	16-QAM	52	57.8
2	16-QAM	78	86.7
2	64-QAM	104	115.6
2	64-QAM	117	130
2	64-QAM	130	144.4

Table 3: 802.11n Transmissions with 20 MHz Channel Width [reproduction, 15]

This channel allocation is unfortunate, but all is not lost for 802.11n. First, the standard includes mechanisms to allow Access Points and Stations to identify when 40 MHz channel usage is practical, allowing maximum throughput when feasible, but being able to step down to 20 MHz channel allocation when necessary. In many ways,

this is just flow control for frequency division multiplexing. This method protects legacy 802.11b/g networks, as well as other 2.4 GHz transmitters, like Bluetooth [16].

Another method is for the 802.11n station to announce on both 20 MHz channel allocations that all legacy (non-high throughput) network equipment should leave the channel open for some period of time, and then broadcast at the full data rate on both 20 MHz channels (providing 40 MHz channel allocation) for the specified period of time [16].

Additionally, 802.11n is an overlay for 802.11a. Since 802.11a operates in the 5 GHz range, and the spectrum allocation is different, there happen to be 23 discrete 20 MHz channels on which an 802.11n broadcast can capitalize and maximize total throughput. Furthermore, these channels typically have less interference to start with, so channel collisions are less likely to occur [16].

2.3 Media Access

Unlike physical access, media access has not changed all that much for 802.11 since its start. While most 802.x networks use carrier sense multiple access with collision detection (CSMA/CD), 802.11 uses carrier sense multiple access with collision avoidance (CSMA/CA) [2] (Appendix B). This makes some sense as collision detection is easy when there are only two broadcasters on the media. When every station shares the same spectrum for a given access point, however, this is more complex. First, there are more broadcasters, so there are more opportunities to have collisions. Additionally, is the so-called “hidden node problem.” [2] In this instance, two stations are broadcasting to the same access point, but due to physical topology, the two cannot receive one another's broadcast – so there is no mechanism to determine (autonomously) that

they are having a media collision. See Figure 2 for a graphical representation of the hidden node problem.

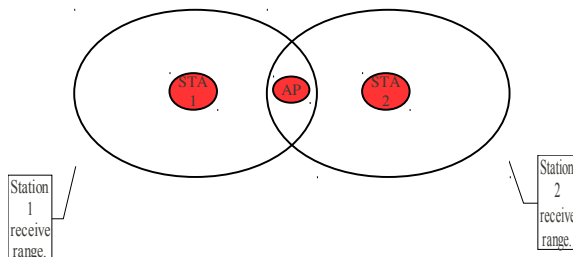


Figure 2: Hidden Node Problem [2]

2.4 IEEE 802.11 Amendments

802.11a – A 5 GHz operating frequency allowing communication up to 54 Mbps using an OFDM waveform [2]. This standard, with its high bandwidth, operating in the reasonably unused 5 GHz frequency band was expected to be the workhorse for business and office applications. While it did find some success in this arena, its high operating frequency was readily absorbed by physical impediments such as walls, floors, and ceilings, significantly decreasing its effective range. Also, the increase in the inexpensive 802.11b hardware made it difficult to justify the the purchase and support of the more expensive 802.11a equipment. Many applications opted for the 802.11b (see below) standard , with lower bandwidth, cheaper hardware costs, and typically further operating ranges.

802.11b – A 2.4 GHz operating frequency (unlicensed ISM), communicating up to 11 Mbps using a Complimentary Code Keying (CCK) broadcast. This standard was expected to be adopted by private individuals and small operating environments due to its inexpensive production costs and relatively convenient configuration options.

Unfortunately, the unlicensed ISM band at 2.4 GHz is a “crowded” spectrum, and there are plenty of interference producing products on the market, to include microwaves, portable phones (now, almost completely digital, and nearly defunct), and Bluetooth headsets.

802.11c – Network bridging procedures for compatibility with other 802 networks (specifically 802.1d).

802.11d – Compatibility and conformance extensions for transmitter operation outside of the typical political subdivisions of the 802.11 standard. This effectively is a standard that allows a transmitter to roam between regions that observe/enforce different effective spectra for 802.11 transmitters [17].

802.11e – Quality of Service (QoS) functions for multi-application support. With these extensions, 802.11 is able to support many delay-sensitive applications which might otherwise suffer adverse effects of not having QoS, such as real-time video or voice over IP (VoIP) [3].

802.11f – Inter-Access Point protocol used for managing the handoff of a user between access points in an 802.11 network. This specification was withdrawn in Feb 2006 [3].

802.11g – A 2.4 GHz operating frequency (unlicensed ISM) , communication up to 54 Mbps using a OFMD broadcast, and fully backward-compatible with 802.11b. This specification allows a significant increase in network throughput for the 2.4 GHz range, and when coupled with its backward-compatible feature and inexpensive hardware has lead to a global adoption as the de-facto preferred wireless network standard for

“typical” computer applications [14].

802.11h – Extensions to the 5GHz broadcast of 802.11a that address mitigating issues from interference on the 5 GHz spectrum from other applications such as radar and satellite broadcasts, including power control and dynamic frequency selection [18].

802.11i – Security enhancements (WPA2) to address the shortcomings of previous security protocols (WEP). This standard includes support for robust encryption by including the AES, and more robust authentication [6].

802.11j – Broadcast standard to allow 802.11 to be formalized in Japan, where broadcast requirements only allow 802.11 to operate in the 4.5-5 GHz spectrum [19].

802.11k – Radio resource measurement for 802.11 networks, allowing mobile stations to dynamically identify which access points (APs) within range will provide the best network performance, based on more than simply received signal strength, but on a complete report from each AP of its current network utilization, availability and received signal strength [20].

802.11n – The incorporation of multiple input multiple output (MIMO) and increased bandwidth channels to the current broadcast sets (802.11g and 802.11a), increasing the total data throughput [9]. Contrary to current marketing, 802.11n is not a replacement to the 802.11g standard, but is a complementary performance increase that allows the use of multiple (usually two for current commercial availability) 802.11g broadcasts to share the same spectrum, thus increasing (doubling in the case of two data streams) the effective 802.11g data throughput [15]. The same technique can be applied to 802.11a in the 5

GHz spectrum. The current 802.11n standard is designed to support up to 600 Mbps throughput [15].

802.11p – Extensions for vehicular (fast-moving) 802.11 access and handoffs, called Wireless Access for the Vehicular Environment (WAVE). This standard operates in the 5.9 GHz range and is designed to work with a specific overlay infrastructure designed specifically to support such vehicular access needs, such as fast transitions and associations [21].

802.11r – Extensions for fast transition of a user between access points, where the mobile subscriber is in charge of determining the handoff between base stations. While the 802.11 standard addresses handoffs, the increased overhead of authentication and encryption, coupled with increased data rates and latency requirements of real-time multimedia applications (specifically VoIP and to a lesser degree video-teleconferencing), the need for a faster managed handoff is critical to Quality of Service for these applications. 802.11r provides the mobile subscriber (STA) the ability to identify how and when a handoff will occur to maintain performance quality [22].

802.11u – Extensions that allow more seamless movement of a mobile subscriber between 802.11 networks and other external networks, e.g. cellular networks. This is a complex problem, with many facets, from RF compatibility to vertical handoff management to authentication considerations. 802.11u, however, provides a common set of abstraction layers for which compatible external networks can/should be configured to allow interoperability [23].

802.11v – Provides extensions for mobile subscribers to share network topology information, including RF information, so clients can optimize wireless network performance [24].

802.11w – Provides services to protect network management frames [25].

802.11y – Includes standards for operating wireless networks in the 3.6 GHz range, for use in the United States [26].

802.11z – Extensions that allow for direct link setup (DLS) enhancements, creating direct peer-to-peer tunnels,, making the link setup independent of the access point and providing power saving features [27].

3. Security in wireless networks

One of the biggest challenges in wireless networks is security. Indeed, in any network, one of the biggest challenges is security. Security is the bane of both the network administrator, whose job it is to implement security and is held responsible for its failings, as well as the network owner, who is ultimately responsible for the safety and security of the network's data and resources. It is a hard problem, with ever-evolving challenges and nuances. 802.11 has had many iterations of security throughout its lifetime [6]. This section is intended as a security primer to help orient the reader to a security philosophy, and to help demonstrate security as it applies to network infrastructures, specifically 802.11.

3.1 What is Security?

“Security is a process.”

While the 802.11 wireless standard contains many hooks to provide security,

these hooks cannot be viewed as comprehensive. A wireless broadcast can be completely secure against attack, but if the user hooks up through a wired connection to the network, then everyone on the perfectly-secure wireless connection is at risk if the wired connection is improperly implemented. The 802.11 standard has a series of smart, built-in mechanisms to control security at the RF level (that is, over the wireless network), it neither provides nor prescribes any method to secure the totality of the data network. 802.11i, discussed later in this section, is simply a piece of the comprehensive puzzle necessary to maintain the network security perimeter.

“Security is evolving.”

In many ways, this is completely obvious, but it is easy to think about security as an on/off switch, and after finding a “secure” solution to the network risks, then the job is done. Flying in the 1960s was a secure method of transportation. In the 1970s, a slew of hijackings changed the security posture to address clear deficiencies in the airport/aircraft security model. This model met new challenges in the 1980s with the bombing of Pan-Am flight 103 over Scotland, so it was again redesigned. In 2001, a new attack/threat emerged, and again the security model was re-addressed. This is an important concept in security, in that it is important to recognize that security models need to be flexible enough to address changing/dynamic conditions, and need to be fungible to accept new methods to address/defeat evolving threats. That is to say that airport security needs to be able to stay functional during a power outage, and it needs to be able to accept modest changes in procedure and technology to address the latest threats as they emerge.

The 802.11 standard, since its initial

ratification, has faced security challenges, and the committee and indeed the community at large, has constantly striven to address the changing security landscape to keep wireless networks secure. It has addressed changes in the security industry, and left itself a flexible method to continue to adapt as changes become necessary.

“Security is more than just the lock on the door. “

Security can fail in one of two ways – it can fail to keep the bad guys out and it can fail to let the good guys in. It is important to remember the latter, as it is easy to forget that a car that won't let you get in is just as useless as a car that let's anyone get in and drive away.

Furthermore, security can have two failure modes; active and passive. A passive security failure is when the bad guy gets through, despite the fact that the system is supposed to stop the bad guy from getting through. When a car thief breaks the window of the car and the car alarm does NOT go off, this is a passive failure. An active failure is akin to a false positive. When the car alarm goes off because a loud motorcycle rides by, the system is actively responding to a stimulus that is not an actual threat. Sometimes active failures can be far more catastrophic (or at least, lead to catastrophe) than passive failures, because active failures frequently lead to complacency.

802.11 is a standard to provide network ACCESS. It can be implemented in such a locked down implementation that users cannot get access when needed, and is not flexible enough to allow new stations access upon request. This may meet the need for access control, but it probably does so at the cost of network flexibility, i.e. it keeps the bad guys out, but fails to let the good guys in. These tradeoffs (restriction vs.

reliable access) will be contrasted in the next section.

“Security should be viewed holistically.”

It is relatively easy to focus on one part of security and make the individual segment secure. Unfortunately, security is a weakest-link proposition. Just because a house has a steel door with a high-security lock, does not mean the house is secure. If the house has unlocked/open windows, then a burglar will simply come in through a window, because it is a weaker entry point than the door. Likewise, a house with a solid door, good lock, robust windows, security alarm, and a dog, in most cases does not need the addition of external flood lights if it sits directly beside a house with open windows. A burglar will go for the house with the open windows and forego the hassle of dealing with the security system and alarm (and additional flood lights), and just go for the neighbor's house – unless the secure house is known to contain the Hope Diamond. This is why home security companies provide yard signs to subscribers – it advertises the existence of the home security system. Security needs to be considered in its totality – from assets to equities, from costs to payoffs, and from risks to gains – it is all tradeoffs, and it is all important to the security of the system.

802.11 provides methods to secure the RF broadcast, and even some of the underlying communication (frames and station authentication). These are an excellent start to a comprehensive security strategy, but they cannot be viewed as adequate to secure the network perimeter. Additional mechanisms must be put in place to address other weaknesses in the network.

“Layer security for best effect.”

Eventually, a security mechanism will

fail; either passively or actively. Putting layers of security mechanisms in place allow one security mechanism to fail, while allowing another to perform its job correctly. Airport security does not simply rely on the security checkpoint. A failure, active or passive, at the security checkpoint will allow a malicious participant free reign over the airport utilities. No, the addition of access card readers for access to the runways, Air Marshals on flights, cameras in the terminals, and vigilant passengers (and airline employees) are all secondary measures against the first line of physical defense at the security checkpoint. The application of layers of security provides a series of safety nets to prevent catastrophic failure of the security system. It is not that catastrophic failures can no longer occur if security is layered, but that their frequency dramatically decreases as the unintended consequences of one security failure are addressed by the inclusion of a secondary measure.

Wireless network security can be viewed the same way. This is closely related to understanding the holistic approach to security, but subtly different. While an AES-encrypted RF link provides security against eavesdropping, a weak or compromised key can undo this security. The use of an underlying secure protocol, such as transport-layer security (TLS, formerly SSL), provides an additional layer of security within the RF link, should the RF link be compromised. This additional protection could be the difference between an eavesdropper reading all network traffic, including bank transaction information (including usernames and password), a catastrophic result, to the eavesdropper reading all Internet browsing history, a likely less-catastrophic result. Layered security is good security practice.

3.2 How is security measured?

In this instance, measured does not typically mean in any kind of numerical or quantitative way. Keeping the above philosophies in mind, there are key goals that security should attempt to address, anytime there is a security discussion, and the ability of security to address these goals is the measure of its effectiveness. It is easy to lose sight of one of these goals when focusing one or both of the others – recall the holistic approach to security in layers.

Confidentiality – Confidentiality deals with ensuring private data remains private, keeping out unauthorized requests to view the data. Working with a doctor or a lawyer, one expects confidentiality of the discussion and any paperwork that is generated.

The use of encryption is another example confidentiality, specifically data confidentiality. 802.11 provides confidentiality through the use of encryption, outlined in the 802.11i amendment, specifically supporting the AES and RC-4 stream cipher.

Integrity – Integrity deals with ensuring, and perhaps validating, data remains unchanged (or at least, marked as changed) in transit or at rest. When someone provides a phone number or credit card number over the phone, frequently the person on the other end reads the numbers back to ensure the data is recorded correctly. This is a very crude form of an integrity check. Notice that it can be used in conjunction with confidentiality, but it is not a requirement. The phone call is not encrypted when a credit card number is provided over the phone, but an integrity check is performed.

Integrity checks are common in many data transactions. By computing an integrity check on every packet, and appending that

integrity check within a [defined] part of each packet, the receiver can determine if the packet was disturbed/tampered in transit. This is certainly not unique to 802.11, and in conjunction with forward error correction schemes not found in 802.11 is actually very common in many RF standards dealing with packet-based transmissions. Regardless, integrity checks are part of the 802.11i amendment.

Availability – Availability deals with ensuring resources are available when requested by an authorized user. A claim check ensures that only one person can pick up laundry from the dry cleaner, but if the dry cleaner is closed, then the claim check is worthless, at least for the moment, until the dry cleaner opens again.

Availability is, in many ways, a tricky beast to tackle for data networks. It is often at-odds with confidentiality and integrity. Enhanced authentication and encryption impact who can access the network resources and indeed the network performance; encryption can have significant processing requirements and impact device performance. Yet, without network availability, the entire utility of the network is lost.

3.3 802.11i

With the above concepts regarding security in mind, let's look at the 802.11i standard, and how it provides mechanisms to perform the above functions.

Confidentiality:

802.11i provides three mechanisms which can provide data confidentiality.

Wired Equivalent Privacy (WEP) – In its perpetual effort to remain-backward compatible, 802.11i allows for the continued use of WEP as a confidentiality provider.

Interestingly, confidentiality was called “privacy” in the original standard, and the 802.11i amendment makes a global change to this term, amending it to “confidentiality.” [8] WEP remains a part of the standard today, but is widely recognized as insecure, and many individual industries have prohibited the use of WEP as a security service for specific functions [6] (for example, ATMs may not use WEP in any transaction regarding user data [29]).

Temporal Key Integrity Protocol (TKIP) – This is effectively an enhanced version of WEP to address some of the more-indicting vulnerabilities of WEP [6]. It still uses RC-4 stream ciphering, but addresses a number of issues including weak initialization vectors for per-packet encryption. Since it relies on RC-4, however, it is still vulnerable to many of the attacks to which WEP is vulnerable. It was included in 802.11i to address WEP's weaknesses, while allowing the current network equipment to be able to implement improved security over WEP – equipment that could not handle the processor-intensive functions of AES [6].

Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP) – This is a custom implementation of the Advanced Encryption Standard (AES)-CCM implementation with 128-bit keys, providing data confidentiality (per packet encryption), along with authentication and integrity on a per-packet basis.

No confidentiality – Open system – 802.11 does allow for unprotected/no-confidentiality transmissions, so long as both the sender and receiver are configured to allow unprotected transmissions [8].

Authentication:

In the original 802.11 standard, WEP provided station (STA) authentication

through the use of shared keys with WEP. If a WEP STA could demonstrate it had knowledge of a suitable key during network association, then the STA was considered an authentic network user [7].

In the 802.11i amendment, this shared-key authentication is still considered valid for WEP implementations, but otherwise 802.11 relies on 802.1X using the Extensible Authentication Protocol (EAP) to provide authentication functions for the network [6]. Keep in mind these are network resource authentication issues, and not packet authentication issues (like the CBC-MAC – cipher-block chain-media authentication code), which provides authentication and integrity checks on individual packets for the 802.x network.

Availability:

802.11 addresses availability through uniformity and predictability, providing a single, global standard for 802.11 products to be interoperable, and ensuring that standard is easily implemented in a way that is not so complex that RF transmissions become unreliable or fickle. By allowing for solid standards, vendor wi-fi certified products can reliably interact to provide consistent, reliable availability to end users [5].

4. 802.11 Applications

Once the wireless LAN framework had been designed and standardized, individual markets had to determine how to use the new technology to benefit specific needs. As more and more wireless LAN products came to market, large manufacturers such as LinkSys, Belkin, and Netgear provided increasingly affordable products to make the introduction of wireless networks into nearly

every use case a reality.

The core application of the 802.11 standard is the ability to wirelessly connect and share data across physically disconnected users. 802.11 wireless networks provide a ubiquitous data sharing media, which promotes user mobility, ease of connection, and a network infrastructure that is compatible across operating systems and applications. It also provides for easy setup and teardown of the network infrastructure, allowing networks to be quickly erected to support requirements, and quickly removed when they are no longer needed, without having to abandon an expensive, in-place infrastructure. All applications exploit these core applications, but specific applications need additional support from the 802.11 standard to meet specific niche-requirements of the application.

4.1 Corporate/Office Applications

Corporate offices are arguably the primary focus of initial wireless LAN implementations. Offices have dozens of hardware requirements, from desktops and servers, to printers and scanners, to fax and copiers, to even remote inventory management handhelds and PDAs. Integrating these devices into a seamless internetworking infrastructure is a challenge. Many of these devices lend themselves to hardwire connections (like desktops), while others are almost crippled by a hardwire connection (like PDAs), with others still in the middle (like laptops). Wireless networks help bridge the gap between these device differences within the workplace, bringing together one single operating network, which is a clear goal for the 802.11 standard.

A corporate office likely has physical control over its office space in a way that allows for relatively easy wiring (and pre-

wiring) for Cat-5 cabling, supporting Ethernet for office applications. Built-to-suit office space, modular construction, and inexpensive materials allow companies to lay out a floorplan, with ample wired data hookups, and to have data ports available to provide for present and future data capacity requirements. Servers, routers, desktops, and printers can all be easily hooked up to the network via hardwire, as the company pre-wires the office space for a semi-static layout (offices do not rearrange their layouts very often), with room for future growth.

This pre-wiring lends itself to static and semi-static arrangements, but does not immediately support forward-leaning portability and mobility requirements. Sales and marketing need a portable office, contained on a laptop. Vice presidents need access to PDAs while on the road. Logistics needs handheld scanners to inventory management. Wireless handsets for the office's new VoIP service is a logical extension of a wireless capability. These applications do not fit neatly into a hardwired infrastructure, although some could, admittedly, be smartly and reasonably overlaid with a smart wiring plan (for example, dedicated Cat-5 hookups for every laptop). A wireless LAN is needed to support real-time updating and continued productivity on these devices.

The 802.11a standard was intended to solve this problem, having large bandwidth (54 Mbps, per the specification), but its limited range, higher costs, delayed time-to-market relative to 802.11b equipment and limited vendor competition made the 802.11a capability a little too ahead of its time. As companies started to adopt wireless networks as a standard part of operating, the cheaper, readily-available 802.11b network equipment was reasonably-priced, ready to install, and its data throughput met the meager needs of

the market at the time (11 Mbps by specification). And so it was that 802.11b ultimately dominated the business market for wireless, intra-office and intra-plant wireless data communications.

Since the standardization of the 802.11g amendment, with its backward-compatible specification, offices have continued to feed their need for data throughput with follow-on equipment in the 2.4 GHz ISM band, getting 54 Mbps data throughput (by specification). This will surely be the case with the follow-on 802.11n standard, which is currently in draft, but will continue to be backward-compatible with 802.11b/g, and will continue to operate in the unlicensed 2.4 GHz ISM band.

Offices face unique security challenges, also, when it comes to 802.11 networks. Specifically, the need to maintain the integrity of data access on the network. How does a corporation provide the flexibility for users on mobile devices (to include laptops) the ability to access the corporate network, and corporate resources, without allowing a rogue wireless device onto the network. This rogue device could simply borrow the Internet connection (low risk) to steal corporate secrets (med/high risk) to attempt to corrupt, collapse the corporate network (high risk). These challenges, while non-trivial, are surmountable. The layered approach to security (discussed more in the previous security section) can certainly help mitigate these risks, and minimize the chances of a total security failure. Access controls on file systems, Intrusion Detection Systems (IDS), MAC address filtering on users connecting to the network, and user-level authentication can combat a rogue device accessing the network, but what can the 802.11 standard provide?

The 802.11i amendment provides

security features such as encryption and authentication for wireless users through the use of WPA2. These security specifications can be used to secure the network against a rogue device connecting to the network by using either MAC (media access control) address filtering or enhanced MAC (media authentication code) packet-based authentication. Additionally, the use of AES encryption can also be used to protect against a rogue listening device passively collecting and exploiting the frames in transit. The 802.11 security methods have been overhauled a couple times in an effort to update/protect against new attacks against wireless networks, with the flexibility for more updates should they become necessary. While WPA2 does not address all the possible security issues in a wireless network, it addresses the lowest level attack of a rogue station attempting to subvert the network integrity.

4.2 Home Applications

Home applications were an obvious extension of the original 802.11 standard, but perhaps a bit premature in some ways, and probably not a primary focus of the standard. At the time of the 802.11 development, more and more consumers were getting personal computers, but certainly multiple computers per home was not the norm – much like automobiles in 1950s America (cars were becoming standard in a home; multiple cars were a luxury), so there was little need for a “network” with only one terminal. Additionally, Internet access in the mid-1990s was still in its infancy for the home user. Dial-up access was available, with any broadband access only being available to intrepid technophiles who contacted the phone company and leased a larger data connection (T-1) for home use. Indeed, there

was little need for networking, let alone wireless networking in most homes.

With the introduction of broadband services in the late 1990s, the explosion of the utility of email and the Internet (remember the dancing baby?), the increasing affordability of desktop computers, and the increase of corporate America's use of laptop computers to perform work from home after hours, a need to interconnect computers in the home, and share broadband internet connections became critical. Wireless networking had its niche opened in home applications.

While the home application is similar in many ways to an office application, there are many differences. While a corporation may have the resources to pre-wire large portions of its office space to allow for simple addition and removal of network devices, a home user probably doesn't have the foresight, know-how, money, time, or desire to pre-wire their home for network connectivity. While some new homes, particularly in the early- to mid-2000s came pre-wired with Cat-5 wiring for Ethernet, the vast majority of homes don't come with this infrastructure. Retro-fitting a comprehensive wiring plan over an older home or rented apartment, particularly one with plaster walls, becomes a remarkably tedious endeavor – one that will challenge the patience of the most handy of handy-men.

This inability to retro-fit a home with wiring makes the wireless network most appealing as the ease of setup, and the ability of a “typical” wireless router (for the cost of ~\$50), will easily provide adequate RF coverage of the “typical” American home (~2,000 sf). For a reasonable price, a home user can provide network coverage to anywhere in their home, versus having to select a handful of locations and painstakingly pulling cable to support a wired

network. The advantage clearly goes to the wireless infrastructure.

Note that the advantage of mobility is not the primary consideration for most home users. While a laptop may very well be a network device for a home user, it is the desire to set up the network quickly and easily that makes the wireless network appealing to the home user. So, what are the security concerns?

The home user probably is not concerned about security the same way that a corporation is. Admittedly, this is probably out of ignorance in most cases, but also, the value-proposition is not structured quite the same way. The threats are the same – someone stealing/borrowing the internet connection, stealing data, or trying to maliciously destroy the network, but the risks are actually different. A user can only have his/her data stolen when his/her computer is on, as opposed to a corporation that has its server on 24-hours, or at least on 10-hours a day during business hours. Once again, 802.11 authentication and encryption can help protect data in transit, and can keep a rogue device from gaining access to the network or the network data, but encryption is enabled on surprisingly few home networks. A home probably does not have an “IT support” person or team close by to help with network connectivity issues, so a collapsed/failed network has a bigger impact on usability than a corporation.

Certainly, these are broad assumptions about the user class (the IT support people probably live SOMEWHERE, so clearly their homes have an IT support network), but the fundamental idea that the “average” home user is interested in reliability and ease of use over security and flexibility is key to understanding the core security challenge to the average home user – availability.

The biggest security feature the 802.11 standard has to offer the home user is availability – the ability to simply and reliably connect to the network each and every time the user desires. A home user can easily misconfigure their network or laptop to lose network connectivity, and may not know how to solve the problem in the event of a misconfiguration. It may be, at least in the short run, in their best interest (and certainly easier) to prevent the loss of data access by simply not configuring anything that might limit their ability to access the network [30].

Configuring a wireless internet access point with heavy encryptions and strong authentication mechanisms can mitigate most risks of data loss and unauthorized access, but again, a layered approach to security with a holistic outlook helps address ALL security risks. Data loss and unauthorized access can be mitigated by other mechanisms. For example, data loss can be prevented by additional controls such as static encryption or simply shutting down the desktop whenever it is not in use, and unauthorized access can be significantly decreased by good desktop firewall software (and perhaps even an IDS). So including data protection methodologies in conjunction with an open access point, helps a home user meet all their security requirements, even if they do not realize it. Many home users have antivirus and firewall software “because it's a good idea,” and many do not have any protection mechanisms in place on their wireless access point. While they may not have arrived at this solution by taking a holistic approach to security, they may have arrived at a suitably-comprehensive security solution simply by following the industry's common wisdom.

4.3 Hotspot Applications

Hotspot applications were probably always a

vision of the original 802.11 authors, but not in their most current implementation. Hotspots are available in so many places, but not available “everywhere” in the ubiquitous way that the authors probably envisioned. I imagine the original authors originally envisioned large portions of downtown areas covered by a ubiquitous single network, getting coverage from dozens of wireless access points. While this may exist in some small urban microcosms, as part of some urban renewal project or a technology outreach program, this is not how wireless hotspots have mostly developed. Many corporate and college campuses have achieved this arrangement, but their application still mirrors the corporate application above, with a known user class and understood devices, more than an open infrastructure for the convenience of a largely unknown population.

Most hotspots today, those which provide wireless network access openly to an undefined population are limited to single establishments providing wi-fi service to patrons for the duration of their stay at the establishment. Coffee houses, McDonald's, airports and airport lounges, hotels, and libraries seem to top the list for hotspot providers. A patron comes into the establishment, establishes themselves as a legitimate customer, and is then provided access to the network resources upon demand.

Unlike home and corporate applications, providing wired infrastructure is not only inconvenient, in many ways it is self-defeating. By definition, the user population is mobile, and the establishment is catering, and in fact promoting this mobility – a coffee shop does not WANT a user to stay for 6-8 hours after ordering a single latte. PDAs, iPhones, Androids, and iPads are an expected network devices for these users, and

a wired connection simply will not provide the desired network connectivity. The mobility of the user, and subsequently the wireless network access, is crucial to the business case of the hotspot in most cases.

So while internetworking is a significant driver for corporate applications, and ease of installation is important for home applications, hotspot applications focus on the transient nature of the expected user class. In this environment security becomes a very peculiar being. In most hotspots, because the proprietor does not have an interest on the network (in most cases), i.e. they are not users of the hotspot, data loss is not a critical factor. Additionally, having the internet connection stolen is not immediately a factor, as the internet connection is provided for the very purpose of allowing transient mobile users to access it. So what are the security concerns?

The primary security issues with a hotspot internet connection are accessing the hotspot without being a legitimate patron of the providing establishment (authentication – low risk) or legal issues with the connection of the mobile user (hacking other websites/users, or performing illegal functions, like sharing large volumes of illicitly-obtained music) (med/high risk). The latter is usually protected against from a legal perspective, by requiring users to acknowledge the legal uses of the hotspot – a function that resides well outside the 802.11 purview.

The former, however, can be a significant service issue for a hotspot proprietor. For example, a coffee shop in an apartment building needs to address how to keep apartment-dwellers from connecting to their network and using all their bandwidth, effectively denying intended service from coffee-drinking patrons who intend on using the hotspot service. Unfortunately, the

802.11 standard does not have anything to immediately address this requirement, and such proprietors need simply find third-party services to help address these issues.

5. The Future of 802.11

So what lies ahead for the 802.11 standard? In many ways, the 802.11 standard is already preparing for the future. Amendments have been included to allow for more formalized decentralization of the network infrastructure [35]. Other amendments are working toward promoting vehicular access [33], and still others are identifying newer, faster access speeds [37, 38]. They are complex problems with complex solutions, but the future of 802.11 seems to be in good hands. Here are a few of the amendments that will support 802.11's growth into the future of wireless networking.

5.1 Ratified Amendments

802.11p – Support for Wireless Access in Vehicular Environments (WAVE)

802.11 is primarily focused on allowing independent stations to identify and associate with one another, and while 802.11 is built for “mobility,” it does not embrace a truly “mobile” user, i.e. a user that is presently in transit. 802.11 can be shoehorned into mobile user and mobile sensor environments, but often dynamic association is difficult, and power and antenna requirements may not be appropriate for many sensor requirements. For the most part, 802.11 does not address how to perform association and data sharing in mobile environments, particularly in high-speed environments.

802.11p provides a physical and media access method in the currently-unused (by 802.11, anyway) 0.8 GHz range, known

as the Dedicated Short Range Communications (DSRC) band. While the amendment has hit its stride, yet, being only recently ratified (July 2010), it will support Wireless Access in Vehicular Environments (WAVE), and supports high-speed STA association and data transmission/sharing [33].

This information-sharing will allow vehicles to share information with other vehicles to support a variety of inter-vehicular applications [33], such as collision detection and avoidance, or emergency vehicle detection and alert. One application might be a driver being made aware that a firetruck was on an intercept course with the driver's course within the next mile, instead of hearing it at the next intersection. Another application could be two cars adjusting their distance because one driver was drifting into the lane of the other car. Other stand-alone applications (single vehicle) could also support toll collection at speed, speed monitoring, traffic direction and monitoring, and curfew compliance.

802.11u – Internetwork Support to External Networks

Communications providers have long tried to leverage the overlying digital cellular network with the interstitial wireless LANs. Some cell phone manufacturers have built cell phones that allow a caller to roam from the cellular network to a wi-fi network, and seamlessly transfer to the wireless LAN (IP) network. At least, that was the concept. Time and again these transitions have demonstrated to be dubious, at best. Problems with inter-network authentication, vertical data handoffs, and data services compatibility made what seems like a trivial problem (“bits are bits”) into significant integration and handoff challenges.

The 802.11u amendment has

attempted to formalize the process by which providers and equipment manufacturers build networks and network equipment to be interoperable between wireless LANs and overlying RF networks, such as GSM, CDMA, or WiMAX (and IEEE 802.16) [36]. By formalizing the process of network advertisement and discovery, user equipment (STAs), can identify the local network infrastructures. 802.11u allows a STA to tunnel through the network to the appropriate subscriber network to authenticate with the subscriber network, independent of the 802.11 disposition [23]. This prevents the passing of potentially sensitive credentials to the 802.11 network, and alleviates the 802.11 network from having to be compatible with each and every subscriber network with which a STA might want to authenticate/access [36]. 802.11u finally specifies a QoS Map service which allows the subscriber network to identify how a vertical handoff (layer-3, end-to-end services) should be performed to promote seamless inter-network handoffs [23].

While not in widespread use, yet, having 802.11u ratified is a significant step in the process of promoting inter-network communications, which has historically been very difficult. The compatibility of these networks will help address power and battery issues in mobile devices, using low power in the vicinity of wireless LANs (APs) while still receiving significant data throughput, and having access to 4G and beyond cellular data networks with broad geographic coverage.

5.2 Future/Draft Amendments

802.11s – Support for Wireless LAN Mesh Networking

While today the primary implementations of 802.11 are through access point

(infrastructure) implementations, the standard does allow for independent stations to communicate with one another in ad-hoc mode. In this mode, both stations effectively negotiate the connection between themselves, creating their own small, direct, private network. Nodes of the network can share information directly, and if one has an internet connection, with proper routing configuration, the internet connection can be shared with other members of the ad-hoc network. Unfortunately, ad-hoc networks suffer from the “hidden node” problem, so it is not guaranteed that a single station can send to every other station that is a part of the ad-hoc network.

The 802.11s amendment, which is still in draft, will allow stations to create full-mesh networks throughout the ad-hoc network. This full-mesh arrangement will allow member nodes, not only to communicate with “over the horizon” nodes, those nodes that are “hidden nodes,” but also to transit networks through mesh routing, to reach internet gateways to provide access to the internet, and to simply reach network resources that are not readily available on the ad-hoc network [35].

The 802.11s, as drafted, relies on the Hybrid Wireless Mesh Protocol (HWMP), which is based on the Ad-hoc, On-Demand Vector (AODV) routing protocol. In completely ad-hoc networks, using AODV individual nodes learn about the network topology via a series of route requests and route replies through a tree structure. AODV supports unicast and multicast addresses, and nodes update their routing tables periodically to remove stale routes. An individual node broadcasts a route request every time a destination is required that is not currently in the routing table. Adjacent nodes forward the route request, noting the request has been made by the originator. When a response is

returned, nodes along the return path identify the destination node/address/gateway. Sequence numbers are used to identify the “freshness” of a route, and to prevent routing loops. This method allows the system to be scalable, flexible, and self-healing. This method also allows each node to know little about the entire network topology, until there is a need to communicate with foreign nodes, minimizing unnecessary routing updates [34].

In networks with some infrastructure, like an internet gateway, the HWMP can use tree-like routing to create distance vector routes to the gateway to facilitate consistent, efficient routes to destinations outside the mesh network. This hybrid approach (AODV for inter-network and tree routing for extra-network) allows the mesh network to learn about its own topology changes, without having to exhaustively search the internet for routes to public (extra-network) address space [35].

The introduction of 802.11s will have several impacts on potential future applications. Logistics tracking hardware (for example, hand scanners) can share information with a central database, without the need to have a locally-installed infrastructure. Emergency responders can quickly deploy smart networks to support disaster-recovery operations. Soldiers on the battlefield can generate their own, self-healing ad-hoc networks to share information. Effectively, any application where an infrastructure is immobile, impractical, or otherwise unavailable, can be addressed strictly through deployment of multiple 802.11s -compliant pieces of hardware.

802.11ac/ad – Spectrum Allocation and Techniques to Support Very High Throughput

802.11 currently allows for operation up to

450 Mbps with the 802.11n amendment, when pushed to its maximum potential. This increased bandwidth will be a boon for multimedia applications. The 802.11ac and 802.11ad Task Groups are shooting for more, though – much more. Looking for at least 6 Gbps, the Task Groups are trying to identify how HD video can be transmitted to STAs.

Task Group ac (TGac) is attempting to address this high-bandwidth requirement, called Very High Throughput (VHT), by using the existing 2.4 GHz and 5 GHz bands (technically, they're chartered with “below 6 GHz” operation) [3]. Early signs show that the amendment will support (or attempt to support) multi-user MIMO (MU-MIMO) to accomplish the increased throughput in effectively the same spectrum allocation, and coupled with 256-Quadrature Amplitude Modulation (256-QAM), and up to eight independent data streams, reach data rates over 6.9 Gbps [38]. Cell phone manufacturers have already embraced some portions of what may be included in a new standard by including draft-amendment hardware in new phones. The chips are backward-compatible and cell phone manufacturers do not want to end up behind the technology curve [37].

Task Group ad (TGad) is attempting to provide these higher speeds by using a 60 GHz spectrum. The additional bandwidth available in this spectrum makes the 6 Gbps target much easier, in many ways, and precludes the need for channelbonding – something that's necessary for the TGac to accomplish its throughput goals. Channels for TGad may exceed 2 GHz each, compared to the 80 or 160 MHz for TGac. The cost is that the 60 GHz spectrum has remarkably limited transmitting ranges, and may only operate inside of a single room. To help address this range weakness, 802.11ad may ultimately include beamforming standards to

increase effective ranges [38]. Only time will tell, but ultimately, users will have significantly more throughput available to them.

802.11af – Reappropriation of TV White Space to Support Wireless LANs.

As TV broadcasts have become more efficient with the requirement to be digital, the increased headroom from channels 2 to 51 leave a significant amount of RF spectrum available to perform more functions. Task Group af (TGaf) has been tasked with defining how 802.11 can benefit from this “available” spectrum, providing increased data rates than current 802.11n transmissions. This spectrum also has the benefit of increased coverage (range) since these VHF/UHF bands propagate further than the current 2.4 GHz and 5 GHz bands [39].

802.11ah – Sub-1 GHz Support to Wireless LANs.

Today the 802.11 standard supports operation in 2.4 GHz, 5GHz, 5.8 GHz, and recently-added, 3.7 GHz spectra. The 802.11ah draft amendment is intended to add sub-1 GHz operation to this list. Different regulatory bodies throughout the World have different available frequencies that are being reallocated and made available for future use. Task Group ah (TGah) has been tasked with identifying how a standard can be constructed to allow wireless LANs to capitalize on the various open environments below 1 GHz in light of the ever-changing, and over-congested sub-1 GHz regulation. TGah's primary focus will be on providing a standard that supports Smart Utility Networks including sensor networks, smart grid (power grid) or remote utility measurement and management networks [40]. It appears that 802.11ah is a long way off, but the idea that a sunny day could cause

a house to close its blinds may be a little bit closer after 802.11ah arrives.

6. Conclusions

The 802.11 standard has come a long way from its initial inception in the early 1990s. It started as a method to allow disconnected users to attach to 802.x networks wirelessly, capitalizing on the unlicensed 2.4 GHz and 5 GHz bands. As its popularity increased, however, the need for more bandwidth became apparent. 802.11 still has not been able to satiate users' desire for increased throughput, but the 802.11n standard should at least quell the immediate needs of network applications, providing 100 Mbps service to wireless users.

The bandwidth fix is only temporary, however, as new, bigger, faster, hungrier applications will need even more bandwidth. IEEE is continuing to expand the search for bandwidth from the traditional 2.4 GHz and 5 GHz bands to the 60 GHz band, and looking for over 6 GBps.

While growing as fast as practical, IEEE has kept an eye on security and user privacy; identifying flexible methods to support layered security approaches. Even the Wireless Access in Vehicular Environments amendment (802.11r) allows for privacy concerns to be considered. Truly, though, the 802.11i amendment has been the workhorse for security and confidentiality within the 802.11 standard, and still provides today's security within the wireless networks. When coupled with 802.1X, a layered security approach within the network, 802.11 is afforded increased security robustness.

If there is one thing that has been demonstrated, however, is that the standard is flexible. After demonstrating higher throughput was possible from the humble 1-2

Mbps data rates, there was an immediate move to find better waveforms and hardware. When WEP was demonstrated to be insufficient to protect user privacy concerns, the Wi-Fi Alliance patched the problem until TGi was able to complete an amendment to formally address the security concerns. From operating at data rates of 1-2 Mbps in just a couple frequency bands (IR, 2.4 GHz, and 5 GHz), to operating in sub-1 GHz, 3 GHz, and 5.8 GHz, and beyond, 802.11 in nearly every country, across diverse regulatory domains, the IEEE 802.11 standard has shown it can meet, not only the needs of today's challenges, but it is flexible enough to address challenges in the future.

Appendix A – PSK – Phase-Shift Keying Techniques

Phase-shift keying (PSK) is a data transmission method that allows a carrier signal to indicate digital data by virtue of its transmitted phase. In the case of binary phase-shift keying (BPSK), a digital 0 may be represented by a carrier signal transmitted with no phase change (0 degree, or 0 radians), while a digital 1 may be represented by a complete phase shift (180 degree shift, or π radians – see Figure 3). A receiver simply needs to receive the synchronized carrier signal to determine the phase shift, and then determine the corresponding data value (0 or 1). In the case of BPSK, two data values (1 baud) can be sent per signal (per symbol), since the transmitted signal has two possible phase-shifted states (0 and π radians).

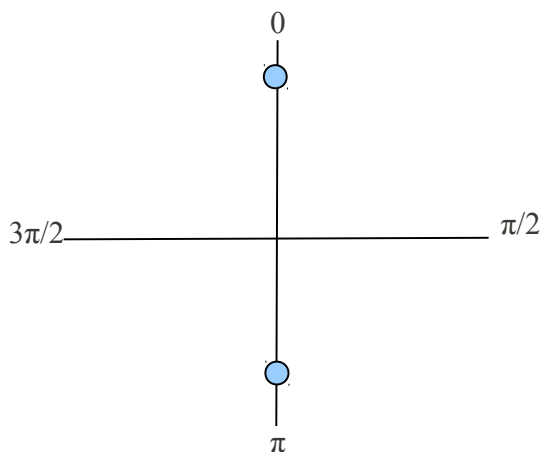


Figure 3: BPSK Phase Diagram

Quadrature phase-shift keying (QPSK) uses the same principle as BPSK, but incorporates the use of two data values per symbol by transmitting a four possible phase-shifts. By transmitting in one of the four quadrants (0, $\pi/2$, π , $3\pi/4$ radians – see

Figure 4), two pieces of information can be transmitted per symbol, e.g. digital values 00, 01, 11, 10. This coupling of data allows for faster data transmissions speeds, but also complicates the transmissions. Significant inter-symbol interference (ISI) and fading, for example, have a much larger impact on a simple QPSK transmission over a simple BPSK transmission.

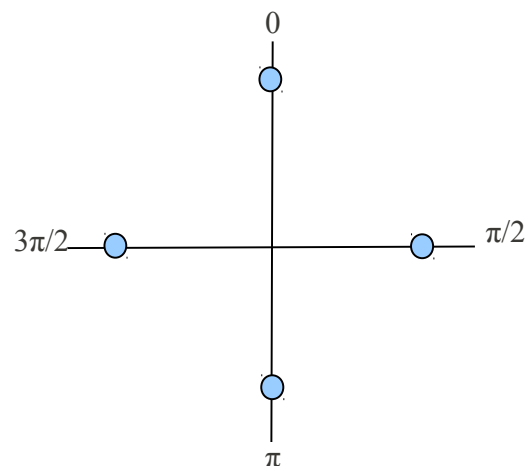


Figure 4: QPSK Phase Diagram

Differential phase-shift keying (DBPSK and DQPSK) is effectively the same method of broadcast, but instead of needing a phase reference for the transmitter and receiver, the phase reference becomes the carrier broadcast. The receiver is able to decode the data values (again, one bit for BPSK and two for QPSK), based on the differential phase-shifting of the received signal. This is more expensive to implement, but solves some issues with fading in RF implementations.

Appendix B – CSMA/CA – Carrier Sense Multiple Access with Collision Avoidance

of re-transmissions necessary over the media.

Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) is a media access method used to allow multiple transmitters to share a single media. In the case of 802.11, the media is the RF spectrum. CSMA/CA allows individual stations to determine if the RF channel is free by having the station listen on the channel to see if it is free.

CSMA/CA process:

1. Determine if the channel is free for a random period of time. (Listen for RF energy in the channel.)
2. Emit a signal to indicate to other stations that the channel is about to be used. (jam signal)
3. Transmit a frame.
4. Listen for another random period of time.

Likewise, other stations are performing the same operation at the same time. In the event the channel is not free during the random wait period, (i.e. another transmitter sends a jam signal and frame during the random listening period) the station simply waits for the other transmitter to transmit its frame by listening to the channel. Once the transmission is complete, the station listens for another random period of time, and tries to transmit when the random window is complete – unless of course another station sends a jam signal.

This media access method allows all transmitters, no matter how many (although there is a practical limit based on the frame size, RF spectrum, and other factors,) to access the same media to perform data transmissions, while minimizing the number

Appendix C – OFDM – Orthogonal Frequency-Division Multiplexing

Orthogonal Frequency Division Multiplexing (OFDM) is very similar in many ways to frequency division multiplexing (FDM). In FDM, a single band of spectrum is broken down into several sub-bands. A broadcaster, through whatever mechanism, selects a sub-band, and modulates its data into that sub-band to broadcast.

In OFDM, the same principle applies. A spectrum is broken down into sub-bands, but in the case of OFDM, each sub-band is constructed in such a way that each sub-band is orthogonal to every other sub-band, such that the co-channel interference across sub-bands is effectively zero. Finally, in OFDM, instead of selecting a single sub-band to broadcast on, the transmitter uses multiple [orthogonal] sub-channels to transmit.

To maximize the effectiveness of this method, each sub-band has a complimentary data set transmitted on it, frequently a low data rate transmission. This further helps the signal-to-noise ratio of each channel.

The idea of having multiple data channels to transmit on is not novel or unique, actually. The idea has been around for decades, but there has been no effective way to break data streams up into independent data channels for modulation onto the sub-channel. It has only been in the last decade or so that FFT transmitters have become reasonably-priced to allow OFDM transmitters (and receivers) to be practical.

OFDM can be combined with MIMO (Appendix E) to provide significant spectral efficiencies and data throughput gains.

Appendix D – WEP – Wired Equivalent Privacy

As part of the original 802.11 standard, the Wired Equivalent Privacy protocol (WEP) was supposed to provide privacy to wireless users commensurate with the privacy one could expect from a direct wired 802.x network connection. Wireless connections require broadcasting information to both the receiver AP, but also any other receivers within range, which complicates this level of privacy, since a wired connection is a point-to-point connection (terminal to terminal), unless a bus system is in place, which was rare, even in the late 1990s, while.

WEP uses pre-shared, 40-bit keys between the AP and station first to authenticate the station as a valid user of the AP resources. A station that presents a valid key is considered to be a valid user of the AP resources. Next, the pre-shared key is used in conjunction with the RC-4 stream cipher to encrypt individual bytes of user data before they are transmitted to the AP. Finally, integrity is maintained using a cyclic redundancy check (CRC).

WEP was quickly identified as not being adequate for wireless privacy applications after the 802.11 standard was originally released. 40-bit keys were used to allow international export of the technique, and woefully weak – at the time the U.S. Government had export restrictions on data protection mechanisms. The use of a stream cipher for protection was a methodical mismatch with the wireless broadcasting of 802.11, as any device in range of the transmissions can eavesdrop, providing the eavesdropper with unfettered (and undetectable) access to effectively unlimited datasets about the encrypted transmissions. As one of the strengths of the stream cipher is

to have unique codes (key plus an initialization vector (IV)) for every packet, providing unlimited, undetectable access to a third party increases the chance the third party may encounter an IV collision where the same code was used to protect user data. With only four pre-shared keys available, WEP was further weakened by having several stations broadcasting using the same keys, exacerbating the problem of eavesdropping on IV collisions.

The weaknesses of WEP were quickly addressed by the Wi-Fi Alliance with the Wireless Protected Access (WPA) method, which was not part of the standard but simply an industry response to user needs. WPA was finally superseded by WPA2 in the 802.11i amendment, which standardized WPA and incorporated stronger access/privacy methods like AES.

Appendix E – MIMO – Multiple Inputs – Multiple Outputs

In many ways, Multiple-Inputs – Multiple Output (MIMO) transmissions are obvious. A MIMO transmitter uses multiple antennas to transmit a data transmission, with a unique data transmission broadcast on each antenna. Each transmission is typically an identical wave form, and all the antennas broadcast on the same channel.

As each unique transmission propagates to the receiver, each experiences [different] multipath fading bases on its spatial relation to the environment. This fading alters the received signals relative to how they were synchronously broadcast, and alters each signal differently. Effectively, the receiver receives several signals on the same channel, but all all at different times. The receiver is configured with multiple antennas, too, so each signal is received on each configured antenna at slightly different times. With no real knowledge of the spatial relation of the transmitter (relative to the receiver), but with explicit knowledge of the antenna configuration of both the transmitter and receiver, the receiver can perform complex computations (basically solving a $N \times N$ matrix, where N is the number of antennas for the configuration) to reconstitute each unique signal from each antenna at the transmitter, thus reconstructing the original data streams.

In the past, multiple antennas on the same channel simply meant interference in the system. Today, however, with complex receivers, these data streams can maintain their integrity, not only in spite of multipath interference, but BECAUSE of the multipath fading. The multipath component is actually used to increase the individual signal-to-noise ratio for each signal, so long as significant

multipath channels exist for a given configuration (frequency, topology, and antenna configuration).

MIMO can be combined with OFDM (Appendix D) to provide significant spectral efficiencies and data throughput gains.

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BUSINESS TECHNOLOGY

BUSINESS TECHNOLOGY; Peering Out a 'Real Time' Window

By PETER H. LEWIS
Published: February 8, 1995

The view from Steve Deering's office is spectacular.

"I'm sitting here right now watching the space shuttle hovering near the Russian space station, listening to live audio from the Russian ship," said Mr. Deering, a computer scientist at the Xerox Corporation's Palo Alto Research Center.

The window through which he watched the space ballet on Monday was the screen of a desktop computer, attached to the global web of computer networks known as the Internet. And the means by which he watched and heard the space rendezvous was an emerging technology called the M-bone, which is turning the Internet into a virtual broadcasting medium.

Whether it is the astronauts on the shuttle or Mick Jagger on a Rolling Stones tour, more and more people are experimenting with the M-bone these days. But unlike conventional broadcasting, the M-bone can allow viewers and listeners to be broadcasters themselves. Practitioners call this "multicasting." (The M-bone is the Internet's multicast backbone, which functions as a network based on the Internet's framework.)

Mr. Deering, a principal developer of the underlying technology, said the M-bone could become a sort of global video telephone system that allows groups of people -- not just individuals -- to share voice and data and images in "real time" over the Internet.

Because the M-bone has been in use only since 1992, and because using the M-bone requires special hardware and software, so far only 1,500 of the estimated 70,000 networks that make up the Internet have been set up as M-bone hubs. As a result, it remains to be seen whether the M-bone will evolve into an Internet-based network connecting every business and home, or whether it is merely a limited prototype for the "information highway" that is supposed to be built eventually by telephone and cable TV companies to carry interactive audio, video and text services.

But already, some corporate researchers have begun using the M-bone as a fairly inexpensive alternative to special teleconferencing systems and even business travel. Because it employs the Internet's existing physical structure, which often leads right to office desktop computers, many businesses are already equipped to explore uses for multicasting.

Scientists, meanwhile, use it to monitor live video and data signals from robot submarines on the ocean floor. Engineers scattered around the world use the M-bone to collaborate on complex projects, employing interactive "white boards" that allow them to share notes and drawings on-line. Medical students in Britain and Sweden can watch as a surgeon in San Francisco performs an unusual operation, voicing questions to the doctor as the procedure takes place.

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What's This? | Don't Show

Speeches by President Clinton and Newt Gingrich, the new Speaker of the House, have been carried live on the M-bone, along with performances by an assortment of musicians.

Although the quote probably won't endure as long as Samuel Morse's first telegraph message -- "What hath God wrought?" -- history was made all the same last November when Mick Jagger of the Rolling Stones opened the first major cyberspace multicast concert by saying: "I wanna say a special welcome to everyone that's, uh, climbed into the Internet tonight and, uh, has got into the M-bone. And I hope it doesn't all collapse."

The M-bone did not collapse, but the astute Mr. Jagger had alluded to the biggest drawback of multicasting, which is the limited bandwidth -- or data capacity -- of the existing Internet.

Audio and video signals consume enormous amounts of bandwidth -- far more than simple text does. And some researchers fear that widespread use of the M-bone could easily clog the Internet and interfere with more common services, including electronic mail.

Because multicasting is still experimental and not well known outside the scientific and academic communities, voluntary guidelines have been sufficient so far. M-bone users typically ask permission from other M-bone users before scheduling a multicast session, allowing those who want to tune in to do so, and those who do not to keep their data spigots closed.

There is also an informal agreement to be sparing when using the feedback capabilities. Because of bandwidth concerns, for example, Mr. Deering and other shuttle watchers have not been permitted to talk with the American and Russian astronauts. And some other multicasts are restricted only to low-quality video or audio-only communications, as a courtesy to others downstream.

The steady increase in computing power and the continuing trend toward high-bandwidth networks could ease the current barriers to widespread M-bone use. Internet bandwidth capacity is already being expanded rapidly to meet the growing demands by businesses for such services as the World Wide Web. And an increasingly popular type of high-speed telephone service known as I.S.D.N., or integrated services digital network, is offering high-capacity Internet links to commercial and residential computers.

Even without the M-bone, multicast applications are now possible on internal corporate computer networks, the kind that link personal computers within a building. But the M-bone, because it is built atop the Internet, can reach far beyond local networks to millions of computers scattered in more than 150 countries. There are M-bone links today in Russia, as well as at the McMurdo Sound research station in Antarctica.

Multicasting has obvious appeal for distance learning in Internet-connected schools; for linking remote offices to hold training sessions or distribute new-product information, and for playing new generations of interactive computer games. Music companies are eyeing the M-bone as a way to distribute new recordings, including music videos.

But potential is one thing; reality is another. Multicasting is still limited primarily to scientific and research organizations that have high-capacity phone lines and powerful computer work stations using Unix -- a complex type of software found mainly in scientific and engineering communities. And while multicasting capabilities are being built into newer networking equipment, it still requires no small amount of software and technical expertise to configure even a new network to use it.

Businesses may be wary of holding sensitive seminars or business meetings on the M-bone because it is no more secure than the notoriously insecure Internet. And what would seem the obvious security solution -- using data-encryption software to transmit multicasts in secret code -- is thwarted by United States Government policies barring the export of data-encryption technology.

And any dreams of beaming video commercials and face-to-face sales pitches over the Internet are tempered by the reality of the existing audience.

"Most people get on the M-bone from work, and most of the workers who are on the M-bone are not consumers," noted Dave Hayes, a network specialist at the Jet Propulsion Laboratories in Pasadena, Calif.

Its current lack of commercial appeal has not stopped scores of researchers from experimenting with the M-bone.

Many of the most creative applications of the M-bone originate at the Internet Multicasting Service, a not-for-profit company in Washington. Via its Internet-based "radio station," RTFM, the company multicasts world news, and last month it began beaming live audio feeds from the House and Senate floors. Internet Multicasting hopes soon to add M-bone reports from Washington restaurants, in which chefs would show and tell what is for dinner.

Unfortunately, one of the most popular Internet radio programs, Internet Multicasting's "Geek of the Week," is not yet on the M-bone. The program, in which technical experts wax rhapsodic about protocols and bandwidth and other geeky subjects, is still available only as audio files that computer users fetch one by one.

Photo: Multicasting is allowing personal computers to be used to watch and participate in events as they happen. Steve Deering developed the technology to transform the Internet into a virtual broadcasting medium. (Jim Wilson/The New York Times) Diagram: "E Pluribus M-Bone" The M-bone - or multicast backbone - on the Internet enables groups of specially equipped computers to share text, audio and video. A multicast differs from a unicast, in which one computer communicates with one other, and from a broadcast, in which one computer communicates with many. In multicasting, many computers can communicate among themselves simultaneously. (pg. D7)

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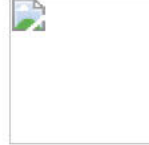
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Internet braces for Clinton's video testimony

September 17, 1998
Web posted at: 3:07 PM ET

by Sandra Gittlen

From...



(IDG) -- Forget the Starr report. The real challenge for the Internet could happen with the release of streaming video of President Clinton's grand jury testimony.

The House of Representatives could vote to make public up to four hours of his testimony. House staffers are meeting with media executives to determine how to disseminate the tape and its accompanying documents on the Internet, according to Sharon Hammersla, computer systems coordinator for the U.S. House of Representatives.

Online news organizations are rushing to figure out their plans for serving up the videostream. The 'Net has not yet seen this kind of anticipated demand for an audio and videostream, according to Katherine Dillon, vice president of ABCNews.com in New York. In contrast to last week's report, which consisted of roughly 450K bytes of text, the videotape could translate into many megabytes of data.

In addition to the sheer size of the file, one issue is how to maintain a user's link for up to four hours. The Internet was not designed for such stateful connections.

Dillon said ABCnews.com is in talks with video player creator RealNetworks to increase the companies' current hosting agreement. "We plan to broadcast the tape live as soon as it is made available," she said. However, she said that editing will have to be done to bleep out inappropriate language.

She said she is also trying to increase her server capacity. "We have a T-3, but now we have to figure out how to load-balance the expected traffic," she said. "We're working out a plan with RealNetworks right now."

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In London, the BBC's online venture is also gearing up. BBC Online has capacity for 20,000 concurrent videostreams, said marketing editor Keith Roberts. The BBC has some experience with this sort of massive demand. Last August, the still nascent BBC Web effort was hard hit by mourners seeking footage of Princess Diana. Although the site did not crash, it did slow down, Roberts said.

The BBC hosts its own RealPlayer video and audio servers separate from the main site's Web servers. "That way, if there is enormous pressure for video and audio, the Web servers for the site will not be affected," he said.

Mindy McAdams, a Web strategist for the American Press Institute in Reston, Va., said media outlets should do more than simply serve up the feed. They should break the videotape into segments and label them clearly so users can go directly to the parts they are interested in.

McAdams said one saving grace for media outlets is that not all of the estimated 20 million 'Net users that clamored for the Starr report have the video and audio gear installed on their computers to access the report.

Sandra Gittlen is an online reporter at Network World Fusion.

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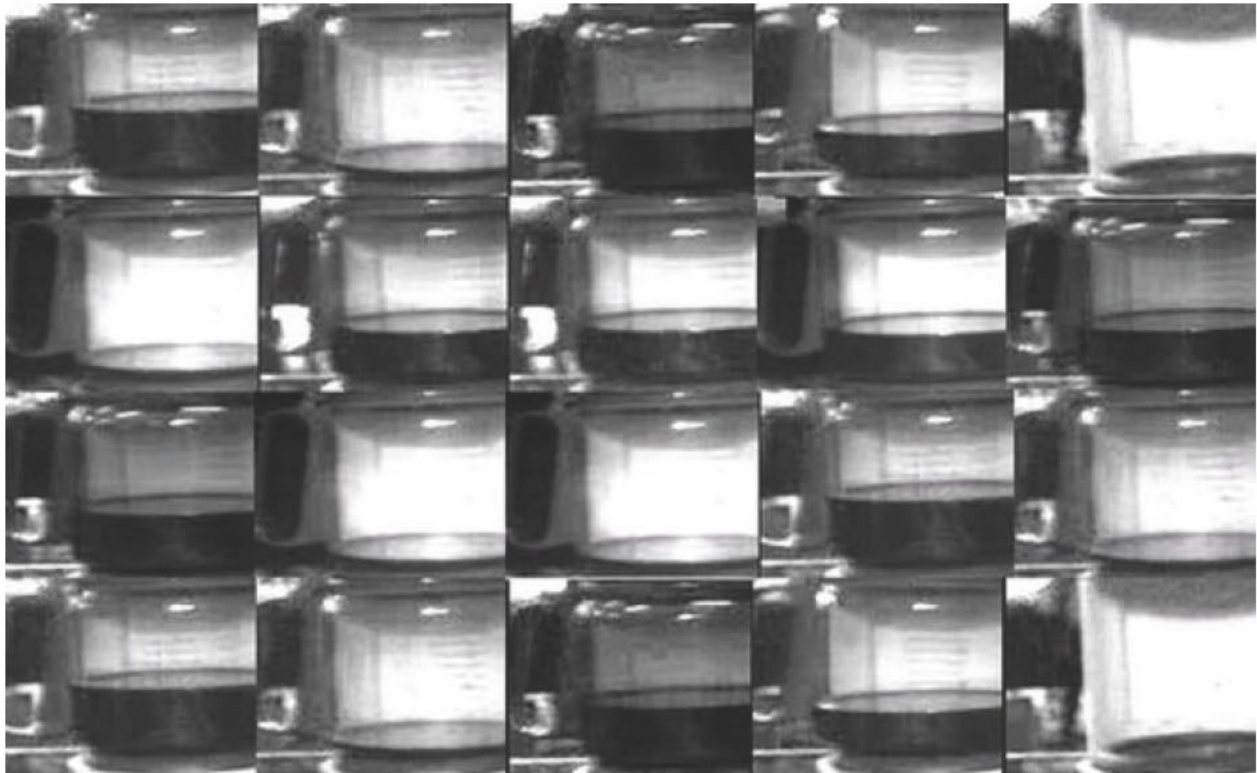
NEWS

Technology

How the world's first webcam made a coffee pot famous

By Rebecca Kesby
BBC World Service

🕒 22 November 2012 | [Technology](#)



Computer technology now moves so fast it's hard to remember life before the internet. But just 19 years ago at the beginning of the nineties, the fledgling world wide web had no search engines, no social networking sites, and no webcam.

The scientists credited with inventing the first webcam - thereby launching the revolution that would bring us video chats and live webcasts - stumbled upon the idea in pursuit of something far more old-fashioned: hot coffee.

As computer geeks at the University of Cambridge beavered away on research projects at the cutting edge of technology, one piece of equipment was indispensable to the entire team - the coffee percolator.



"One of the things that's very, very important in computer science research is a regular and dependable flow of caffeine," explains Dr Quentin Stafford-Fraser.

But the problem for scientists was that the coffee pot was stationed in the main computer lab, known as the Trojan room, and many of the researchers worked in different labs and on different floors.

"They would often turn up to get some coffee from the pot, only to find it had all been drunk," Dr Stafford-Fraser remembers.

Streaming coffee

To solve the problem, he and another research scientist, Dr Paul Jardetzky, rigged up a camera to monitor the Trojan room coffee pot.

The camera would grab images three times a minute, and they wrote software that would allow researchers in the department to run the images from the camera on their internal computer network.

This removed the need for any physical effort to check the coffee pot, and avoided the emotional distress of turning up to find it empty.

However, it wasn't until 22 November 1993 that the coffee pot cam made it onto the world wide web.

Once again it was a computer scientist, momentarily distracted from his research project, who made the breakthrough.

Dr Martyn Johnson was not one of those connected to the internal computer network at the Cambridge lab, and therefore had been unable to run the coffee pot cam software.

He had been studying the capabilities of the web and upon investigating the server code, thought it looked relatively easy to make it run.

"I just built a little script around the captured images," he says.

"The first version was probably only 12 lines of code, probably less, and it simply copied the most recent image to the requester whenever it was asked for."

And so it was that the grainy images of a rather grubby coffee pot in a university lab were written into computer science folklore, as the first ever webcam.

East of Java

"It didn't vary very much," explains Dr Stafford-Fraser. "It was either an empty coffee pot, or a full one, or in more exciting moments, maybe a half-full coffee pot and then you'd have to try and guess if it was going up or down."

Word got out, and before long millions of tech enthusiasts from around the world were accessing images of the Trojan room coffee pot.

Dr Stafford-Fraser remembers receiving emails from Japan asking if a light could be left on overnight so that the pot could be seen in different time zones.

The Cambridge Tourist Information office had to direct visitors from the US to the computer lab to see it for themselves.



The coffee pot cam even got a mention on the BBC's longest running radio soap opera - the Archers.

"I think we were all a little bewildered by it all to be honest," confesses Dr Johnson.

"I sometimes think nothing else I'm ever involved in again in my life will get this much coverage and it was just one afternoon's crazy idea," adds Dr Stafford-Fraser.

Die Kaffeekanne

Ten years and millions of hits later, the scientists wanted to move on.

"The software was becoming completely unmaintainable," remembers Dr Johnson.

"Research software is not always of the highest quality and we simply wanted to throw away the machines that were supporting this."

Despite a wave of nostalgic protest from webcam fans around the world, the coffee pot and the webcam were eventually switched off.

The last image captured was the scientists' fingers pressing the "off" button.

The screenshot shows the eBay website interface. At the top right, there are links for 'home', 'my eBay', 'site map', and 'sign in'. Below these are navigation buttons for 'Browse', 'Sell', 'Services', 'Search', 'Help', and 'Community'. A 'Item view' button is also visible. The main heading is 'Historic Trojan Room coffee pot' with item number '1260882480'. Below the heading, it says 'Computers & Gaming Vintage Hardware General'. A message states 'Bidding is closed for this item.' The current bid is 'GBP 3,350.00 (approx. \$4,721.00)' with a 'Final bid' of 'GBP 10.00 (approx. \$14.00)'. The quantity is '1' and the time left is 'Auction has ended'. The auction started on 'Aug-01-01 05:39:29 PDT' and ends on 'Aug-11-01 05:39:29 PDT'. The seller is 'sim-harris (0)'. The location is 'Cambridge, United Kingdom'. There are icons for 'eBay' and 'eBay Feedback'.

"In 10 years it had gone from being a wacky new idea, to a novelty that a reasonable number of people knew about, to a widely viewed icon of the early web, to an historic artefact, and then to something that people were mourning over when it was no longer there," concludes Dr Stafford-Fraser.

"Only on the internet can that sort of thing happen in just a few years."

The Trojan room coffee pot was sold at auction - predictably over the internet - for £3,350.

It was bought by Der Spiegel news magazine in Germany, which soon pressed the pot back into active service.

*Rebecca Kesby's report on the creators of the world's first webcam airs on the **BBC World Service's Witness programme** on 23 November. You can download a **podcast** of the programme or browse the **archive**.*

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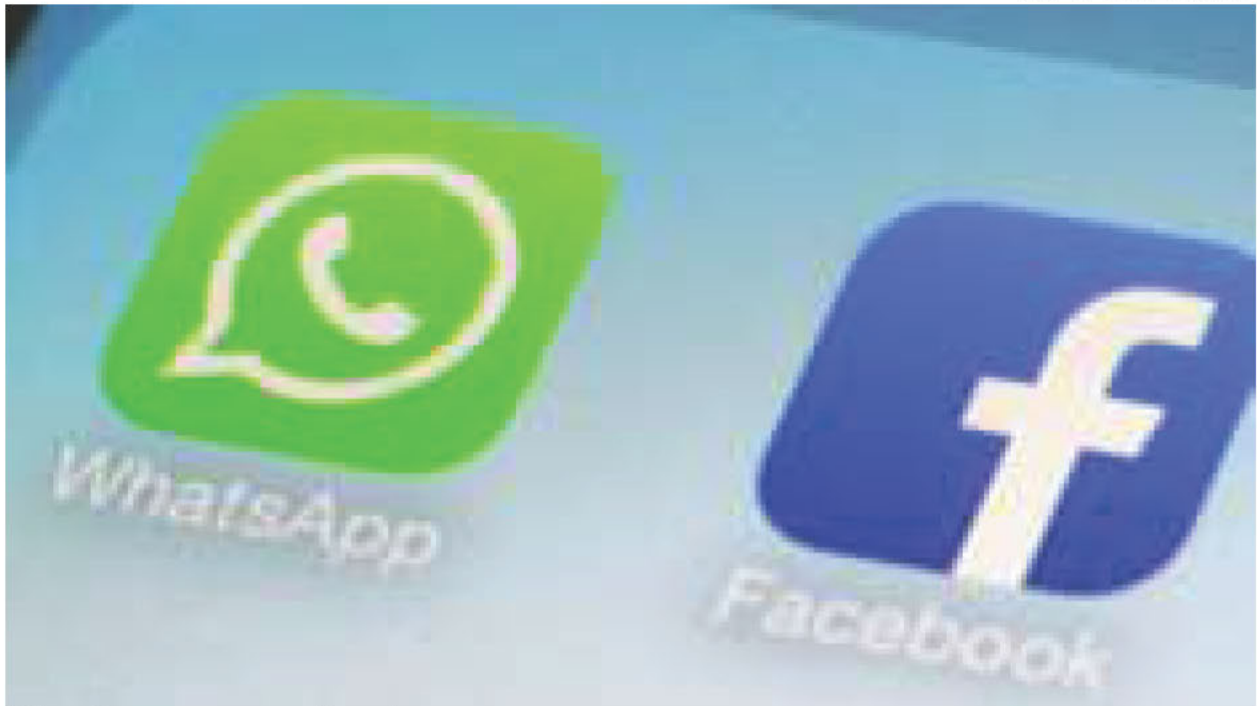
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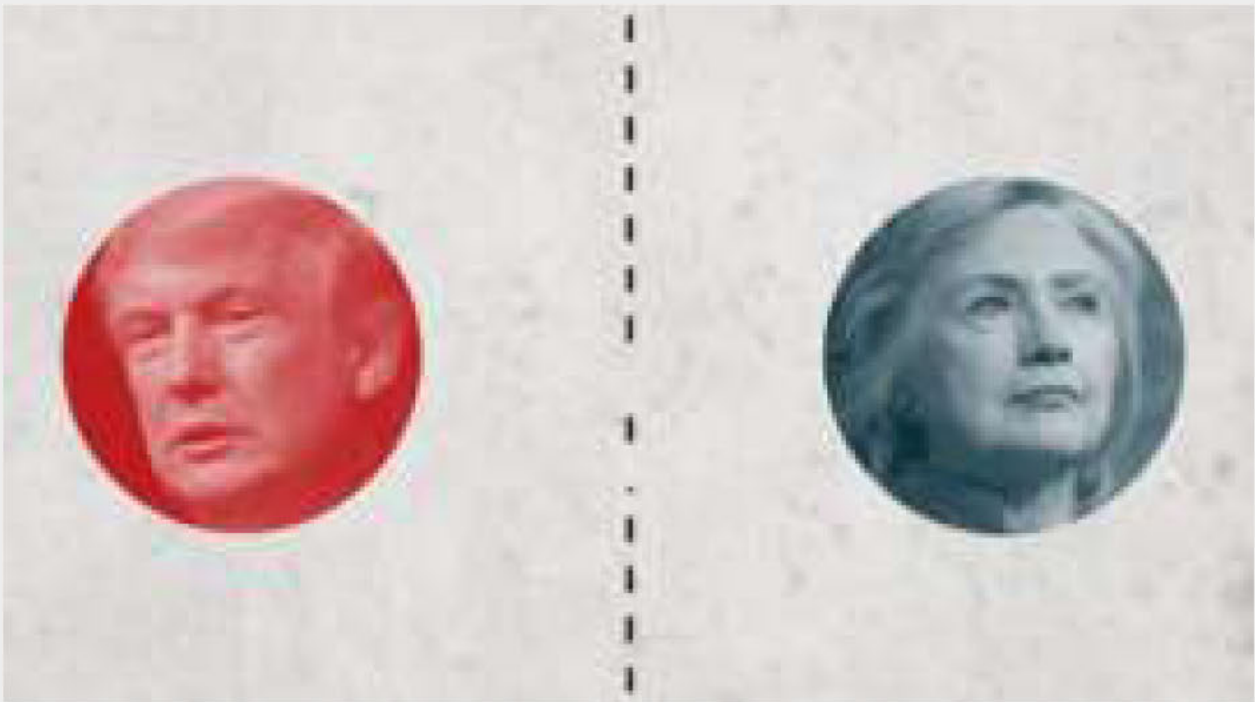
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New Challenges for Video Servers: Performance of Non-Linear Applications under User Choice

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Abstract

This paper outlines a framework for classifying video application types according to linearity and user-choice response constraint. It then presents the first analyses of video server performance under various non-linear video application loads.

1. Video applications

In this paper, we examine the characteristics of non-linear video applications and investigate the effects of non-linear usage on the video server. A significant body of work has been published in recent years in the area of *video-on-demand*. However, when one considers next generation video applications, the need for *non-linear* video services becomes apparent. New applications which provide users with access to video as a first-class data type impose a much different system load on the video server than video-on-demand applications. In this paper, we outline a framework for classifying video application types according to patterns of user access and then provide simulation results which show video server performance relative to that classification of video applications.

We are particularly interested in studying the load that applications which treat video as a first-class data type impose on the server. To that end, we classify video playback patterns according to *linearity* and *user-choice response constraint* characteristics.

1.1. Linearity

The term *non-linear* refers to those applications in which there is more than one typical ordering of video frames delivered to clients. Existing video-on-demand applications playback video sequences in a fixed, predetermined order. There may be exceptions, such as fast-forward or rewind functions, but they comprise a very small portion of the system load. Server operations for video-on-demand playback are relatively easy to schedule because future data accesses are highly predictable.

Other types of digital video applications have less pre-

dictability. Many, such as the CAETI Internet Multimedia Library (<http://www.videolib.princeton.edu>), combine linear playback of video segments with non-linear access. For example, a *video presentation* comprised of sections from many video sources includes a balance of linear and non-linear video delivery. *Navigating/browsing* through a large collection of video titles requires a larger degree of non-linear video service. *Video walk-throughs* (visualization applications which generate a video representation of a structure or scene on the fly from an image database) require, perhaps, the greatest degree of non-linear service. Each of these types of applications presents different demands to a video server [2].

1.2. User-choice response constraint

During the execution of a non-linear application, the sequence of displayed video frames may be grouped into *video playback units* such that all frames within a playback unit are logically sequential. The non-linear playback consists of a sequence of (relatively unrelated) linear playback units. User-choice response constraint refers to the existence and magnitude of the deadline corresponding to the initiation of playback unit $i+1$ after the completion of unit i . If the playback unit initiation is unconstrained (such as navigation, perhaps), the application is termed *non-real-time*. Applications similar to video walk-through, in which each playback unit must be delivered within a deadline relative to the completion of the last unit, are termed *real-time*. Real-time non-linear applications may be further classified as tight or loose depending on the magnitude of the inter-unit deadline.

2. Experiments

In order to begin investigating the effect that various application classes have on the video server, we have selected several models of user behavior and developed a detailed event driven system simulator to model a typical digital video library (DVL).

The storage subsystem of the simulated DVL is an array of homogeneous disks. The disk model we employ is

intended to represent commonly available magnetic disk drives. The modelled disk capacity is 4 GB, the nominal data rate is 5.76 MB/s, and the full stroke seek time is 22.275 ms. In order to isolate the delivery consistency portion of quality of service, the server operating system immediately admits all requests. The display start-up response latency is set to a value of 0.5 seconds. Delivery of video data is demand driven, but the server operating system video buffer manager maintains a 1 MB buffer for each client. When the buffer for a particular user falls below half full, the buffer manager attempts to refill the buffer by submitting the appropriate block requests to the disk scheduler (which employs CSCAN disk scheduling). The details of the experiments including the user population modelling techniques may be found elsewhere [1].

2.1. Non-real-time non-linear

We investigated video server performance under three different non-real-time client models, or loading conditions. The primary characteristics of the different client models, FastDVL, SlowDVL, and VoD, are the title selection distribution and the request duration distribution.

The FastDVL model represents a moderately non-linear usage pattern such as might be the case when a number of clients are displaying video presentations. The SlowDVL model represents a lesser degree of non-linearity which models user loads similar to a number of clients navigating through the DVL. The VoD model simulates a hypothetical video-on-demand environment.

The video data in our digital video library is arranged as fifty 30 minute titles in which each title possesses a constant bit rate of 2 Mb/s and 30 fps frame rate. The smallest unit of video data which may be requested from the server (a *video block*) is 32 kB and the data pertaining to a given title is striped across all available disks where the striping unit is 16 blocks. Stripes pertaining to different titles are interleaved on a given disk.

2.2. Real-time non-linear

We simulate a video walk-through application as an example of the real-time non-linear class. Note that the simulated operation of the video walk-through library is significantly different than the moving image video library. In the walk-through simulation, each of the 12 "titles" is a lattice graph where each node represents a particular view (frame) in the virtual space represented by the title. A client of the walk-through library executes a (random) walk of nearest neighbors in the graph.

Because the video frames may be accessed in many different orders, each frame is stored independently. Each frame is assumed to be compressed to 64 kB, and each title is assumed to be a lattice of 256 frames by 256

frames. The block size remains 64 kB, the striping unit is one block, and data stripes from different titles are not interleaved. These are very modest parameters for this type of application.

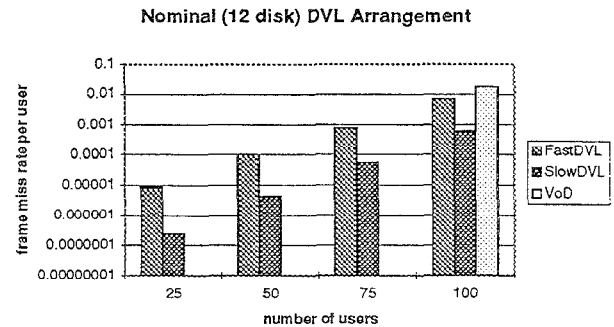


Figure 1. Non-real-time performance.

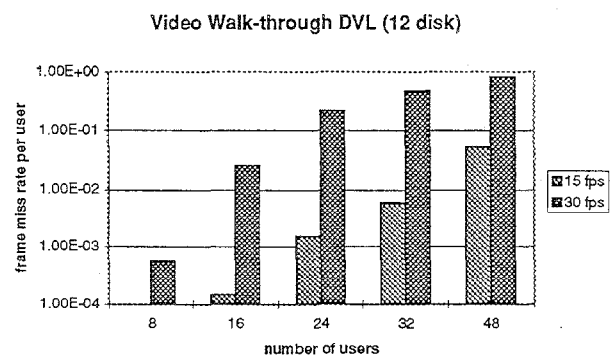


Figure 2. Real-time performance.

3. Conclusions

Our results indicate that the FastDVL user type presents the heaviest load to the system for small numbers of users. However, we discovered that the performance of the video server (measured in frame miss rate per user) degrades faster for the VoD type than the SlowDVL type and also degrades faster for the SlowDVL than the FastDVL type. Further, real-time non-linear delivery appears to be a much more difficult problem than non-real-time as only 10-20% as many users can be supported for this type of application as for even our most aggressive non-real-time user model. Clearly, video server performance is strongly related to application type.

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The Princeton Video Library of Politics

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Political scientists use video as a primary source material. Today, video collections are hard to access—either the scholar must travel to the site of the collection or pay large copying fees and wait several weeks after selecting material from a brief textual description. Even after the material is acquired, it is hard to manipulate: it is difficult to search through large volumes of material to find the relevant items; there are no mechanisms for browsing through a particular clip to find the most important material; and it is difficult or impossible to annotate the material with scholarly notes. Video library techniques developed for political science studies will also be directly useful in other scholarly disciplines as well as a variety of commercial applications.

We are designing the Princeton Video Library of Politics (PVLP) as a testbed for digital libraries which provide video-intensive, multimedia source material to library patrons. PVLP is a collaborative effort both within and beyond Princeton. Within Princeton, participants include the Departments of Electrical Engineering and Politics, the Woodrow Wilson School of School of Public and International Affairs, and the Center for Computing and Information Technology, with consultation by the Princeton University Libraries. Nationally, Siemens Corporate Research and Advance, Inc. are research collaborators.

Scholarly research, such as that done by political scientists, provides a challenging domain for digital video library research because scholars are very demanding users of libraries. Scholars require libraries to collect and catalog large amounts of material, since each individual scholar needs different pieces of material. They need to collect not just well-documented material—encyclopedias and books in the textual domain, network news programs in video—but also less-structured primary sources—manuscripts and notes in text, outtakes and internal White House recordings in video. Since scholarship seeks to find evidence to support new ideas and to make new connections between ideas, scholars need to be able to navigate through large collections. Scholars must sift through large amounts of material to find potentially interesting material, then scan preliminary selections more thoroughly; both searches through large amounts of material and browsing through smaller selections are very difficult using traditional video techniques. Political scientists consider the relationship between image and sound to be a central topic of study; any video library must provide tools which give weight to both the audio and picture tracks of a video and provide

fusion tools which help library patrons navigate through multimedia material.

Video is an extremely challenging source material for digital libraries: the material is not in textual form, requiring new techniques to free both librarians and scholars from the need to watch moving image material in real time; and video data requires extremely high bandwidth which must be delivered at the deadlines imposed by the video frame rate, requiring careful consideration of algorithmic and architectural efficiencies to be able to support large collections and user populations. Video also provides new opportunities for scholars: automated search and browsing schemes will help scholars make much more effective use of video sources, helping them find new material and make connections between pieces of the collection which they could not make using present video techniques.

Our project addresses new techniques to solve these critical video library problems:

Computer-assisted cataloging—Cataloging of moving image material is time-consuming and expensive because the material must be viewed in real time. We are working on browsing techniques for catalogers, including elimination of redundant key frames and fusion of audio and picture track information. We will also study feature extraction algorithms which can identify faces, backgrounds, etc.

Indexed search—Scholars must be able to search through sequences identified from the on-line catalog as potentially interesting to narrow the search to topics which may not be index terms in the general catalog. Since video sequences in their raw form—a series of pixels—are not sufficiently abstract for library operations, appropriate descriptions must be extracted to help organize, search, and navigate the data. We propose to study descriptions extracted from the picture track and are augmented with audio track and available textual information, such as the closed captioning track or separate synopses. Video database queries will be formulated in terms of both syntactic features, such as edges, corners, or region shapes, and semantic features, including faces and backgrounds and geometrical relationships among the features. Such data must be modeled in the database for query. In this project, we propose to develop query formulation mechanisms to support a variety of video attributes, from alphanumeric data to visual and aural features. We will also develop access methods which can support the retrieval of voluminous video data and search over the audio and picture tracks as well as over annotations.

Browsing—Browsing is a critical element of scholarly study. New browsing mechanisms are needed to reduce the time required by scholars to evaluate material during library searches. Existing browsers do not sufficiently integrate information from the audio and picture tracks. Since scholars must often navigate through long clips or large quantities of material, we will develop new techniques for hierarchical browsing, which uses key frame classifications (generated automatically or provided by the patron) to cluster related frames. We will also use existing speech recognition algorithms as components of new audio-visual browsers.

Distribution—High-quality video requires both high-performance network connections and terminals capable of decoding compressed video at the required rates. We believe that an important aspect of scholarly

video library research is the development of low bit rate delivery techniques which provide adequate service to political scientists who, unlike Cold War-era nuclear weapons labs, do not have unlimited funds for communication and computational equipment. Even if the present goal of providing high-speed network connections to every school within ten years is met, that will still provide a large window of inequity between institutions based on funding. Current video libraries encourage inequities in access through large charging fees or the need to travel to the library site; digital video libraries should discourage, not encourage that trend. Existing low bit rate coding techniques, such as model-based coding, were developed for talking-heads style videoconferencing and are not well suited to the range of images encountered in our testbed collection.



PRESS RELEASES

Major League Baseball in RealNetworks Online Deal

Baseball - 28 Mar 2001

RealNetworks®, Inc. (Nasdaq: RNWK), the global leader in Internet media delivery, and MLB Advanced Media, LP (MLBAM), the interactive media and Internet company of Major League Baseball (MLB), today announced a three year agreement to make RealNetworks the exclusive platform for a broad range of MLBAM's online services, including live audio webcasts of all MLB games, and a customizable, on—demand, archival, video highlight service.

According to the two companies, the groundbreaking agreement represents the largest Internet deal in the history of professional sports, and is intended to make subscription services a central part of their efforts to improve the way fans listen to and watch Major League Baseball over the Internet. This audio and video offering marks the first time so rich an array of multimedia interactive baseball programming has ever been made available on any medium.

Audio webcasts for all regular season MLB games will be available by subscription only through MLB.com and Real.com. The audio webcasts will be enhanced with MLBAM's synchronized game statistics and pitch—by—pitch animation.

In addition, RealNetworks and MLBAM plan to offer subscribers the ability to search for and create customizable video highlights of daily game coverage — providing a flexible way for baseball fans and fantasy—league enthusiasts to compile and review footage of their favorite teams and players on a daily basis. By providing archival access to every pitch from every game, this personalized video service will let individual subscribers choose the exact game highlights they want to watch. It will be available from MLB.com and Real.com,

through RealPlayer® GoldPass®, the premium Internet subscription service launched by RealNetworks last August.

Under the agreement, all multimedia Internet content offerings from MLB will be provided exclusively in RealNetworks' formats.

'RealNetworks' partnership with Major League Baseball and MLBAM — offering full game audio, synchronized statistics, customizable video and condensed game playback content — will provide baseball fans worldwide with a resource for online entertainment that is second to none,' said Rob Glaser, Chairman and CEO, RealNetworks, Inc. 'Like the cable television industry did so effectively in the 1970s, RealNetworks is now opening up the Internet as the next mass medium for distributing great sports content. We are methodically building a critical mass of top-tier, web-based sports content — and proving that subscription models on the Internet can and will be successful.'

'We are thrilled to be working with RealNetworks to deliver the excitement of MLB action to web fans worldwide,' said Bob Bowman, president and CEO of MLBAM. 'We hope that MLB.com and RealNetworks will set the precedent for the future of online sports entertainment.'

The audio offering will be available to subscribers starting in April of this year. The video highlights are scheduled to be available in May. Additional audio and video—based products and services will also be added in months to come.

Today's agreement supports MLBAM's goal of providing fans the richest, deepest, broadest and most timely baseball content on the Internet. Visitors to the MLB.com site are offered the most accurate and comprehensive baseball news, statistics, history, fantasy, live radio and searchable video, as well as the best in e—commerce. As a result of this agreement, fans will gain unprecedented access to over 4,000 game feeds, including home and away games and foreign language coverage.

The RealPlayer GoldPass service provides web users with access to an exclusive mix of content, premium services, and software. It has quickly emerged as one of the fastest growing subscription services on the Internet, amassing an active subscriber base of more

than 175,000 members in only seven months. In January of this year, the Company expanded GoldPass' exclusive sports offerings with an agreement to provide audio coverage for all National Basketball Association games as well as webcasts of NBA.com TV.

For more details contact:

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Microsoft Delivers Breakthrough Audio and Video Quality With Final Release of Windows Media Audio and Video 8

Posted March 28, 2001 By

REDMOND, Wash., March 28, 2001 — Microsoft Corp. today announced the final release of its breakthrough Windows Media™ Audio and Video 8, the first digital media technology to make possible the real-time delivery of full-screen, near-DVD-quality film content over today's broadband connections. Microsoft® Windows Media Audio and Video 8 delivers a

30 percent improvement in quality compared with the previous version, delivering unmatched quality for narrowband and broadband users. Leading online film and video providers ALWAYSi, CinemaNow Inc., FILMSPEED, IMAX Corp., Intertainer Inc., Kanakaris Wireless and SightSound Technologies have embraced the new technology and are releasing thousands of hours of film content using Windows Media Video 8.

Achieving key benchmarks for the delivery of the highest-quality audio and video in the smallest bandwidth, Microsoft's new compression technology enables the delivery of film content at near-DVD quality across Internet broadband connections at rates as low as 500 Kbps and near-CD-quality audio at 48 Kbps. To demonstrate the quality of the new codecs, Microsoft is showcasing a selection of films, music and videos at <http://www.microsoft.com/windowsmedia/audiovideo8/>.

"To make digital media part of their daily lives, people demand video that approaches DVD quality and music that sounds just as good as their CDs," said Will Poole, vice president of the Windows® Digital Media Division at Microsoft.

"Now that Windows Media Audio and Video 8 cross those critical quality thresholds, companies in the film and music industries can deliver on the promise of offering better digital media experiences to their customers using digital media technology."

The Windows Media Audio and Video 8 codecs are compatible with Microsoft Windows Media Player 7 and 6.4, as well as the new Windows Media Player 7 for Mac, also released today. They offer content owners the benefits of improved quality and lower bandwidth costs while reaching more than 240 million secure Windows Media Players distributed worldwide.

For consumers, the new compression technology delivers a better audio and video experience at all bandwidths. Windows Media Audio 8 nearly triples the audio compression of the MP3 format, making it possible to store almost

three times as much CD-quality music on hard drives and portable devices. All the more than 60 consumer devices that support Windows Media Audio today already support Windows Media Audio 8 and require no technology upgrade.

Industry leaders such as Intertainer are embracing Windows Media Video 8 as they expand distribution of full-length motion pictures over broadband networks to PCs and set-top boxes. With films and television content from studios including Warner Bros., Universal Studios, New Line Cinema, Twentieth Century Fox Film Corp. and DreamWorks SKG, Intertainer has a library of more than 65,000 hours of programming it offers to DSL subscribers. Intertainer and ZoomTown.com, the wholly owned subsidiary of Broadwing Inc., announced yesterday that ZoomTown.com will be the nation's first broadband provider to deploy a video-on-demand service systemwide to more than 40,000 subscribers.

"Intertainer makes its business by delivering a wide selection of high-quality movies over IP networks to consumers' PCs and televisions,"

said Jonathan Taplin, president and CEO of Intertainer.

"Windows Media Video 8 not only exceeds those quality requirements, it lets us do so with less bandwidth so we reach more customers at a lower cost."

New Windows Media Video 8: the Only True Motion-Picture-Ready Video Codec

With its industry-leading quality, broad reach and integrated DRM, Windows Media Video 8 is the best technology for both streamed and downloadable movies. Key features of Windows Media Video 8 include these:

- Near-VHS quality at rates as low as 250 Kbps with 320×240 pixel resolution at 24 frames per second
- Near-DVD quality at rates as low as 500 Kbps with 640×480 pixel resolution at 24 frames per second
- The most widely deployed digital rights management (DRM) technology for protecting streamed and downloaded audio and video content on the Internet

For download-and-play uses, Windows Media Video 8 provides true variable bit rate (VBR) and two-pass encoding. True VBR encoding eliminates the 25-second barrier of other technologies, instead averaging encoding resources over an entire feature-length film and guaranteeing the best video quality, even through extended high-action sequences.

IMAX is now using Windows Media Video 8 for trailers that promote IMAX films at its own Web site (<http://www.imax.com/>) and other sites like WindowsMedia.com (<http://WindowsMedia.com/>).

"IMAX strives to bring the superior quality of The IMAX Experience to the Internet," said Michelle Hagen, vice president of World Wide Film Marketing at IMAX Corp.

"That's why we have relied on FILMSPEED and Microsoft Windows Media Video 8 to create the best-quality imagery that meets IMAX's rigorous standards."

New Windows Media Audio 8 Nearly Triples Music Storage

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Delivering the first-ever near-CD-quality sound at 48 Kbps at about one-third the size of a comparable MP3 file, Windows Media Audio 8 nearly triples the digital music storage on portable devices, micro drives, PCs and CD players that support Windows Media Audio. Download times are also more than 60 percent faster, so consumers can spend more time listening to music.

- Windows Media Audio 8 achieves CD-quality sound at 64 Kbps.
- Windows Media Audio 8 offers near-CD-quality sound at 48 Kbps, comparable to MP3 files encoded at 128 Kbps.
- Windows Media Audio 8 is fully compatible with Windows Media Player 6.4, Windows Media Player 7, Windows Media Player 7 for Mac and the more than 60 consumer electronic devices that support Windows Media Audio.

Peer-to-peer solutions developer CenterSpan Communications Corp. plans to adopt Windows Media Audio and Video 8 to facilitate the purchase and exchange of high-quality, copyright-protected music and video between content providers and consumers. Earlier this week, CenterSpan released a beta version of Scour Exchange™, incorporating the DRM capabilities native to Windows Media.

“As we enter a new phase of digital media and entertainment on the Web, CenterSpan will deliver a service that provides high-quality music and video for customers and secure delivery for content providers,” said Frank G. Hausmann, CenterSpan’s chairman and CEO.

“Windows Media Audio and Video 8 is an outstanding solution that meets both of these critical requirements for our business today.”

Movies Available for Download and Streaming

By reaching key thresholds for delivering high-quality audio and video over realistic connections, the new codecs also are helping to make possible expanded Internet-based content businesses, unleashing a flow of new content for consumers.

Film content providers announcing that they will use Windows Media Video 8 include ALWAYSi, which offers more than 2,000 movies online in Windows Media Format; CinemaNow, with a library of more than 200 films; CinemaPop, with more than 500 films; Intertainer, with rights to 50,000 hours of content; and SightSound, which is distributing 12 movies for Miramax Film Corp. through Internet download. Content from these and other providers is available at WindowsMedia.com (<http://WindowsMedia.com/>).

The breakthrough quality of Windows Media Audio and Video 8 can be experienced on the special preview page at <http://www.microsoft.com/windowsmedia/audiovideo8/> . Visitors can see and hear the following:

- From ALWAYSi, “Storyteller,”

a short film directed by Richard S. Dargan

- From CinemaNow,
"Leprechaun,"
a horror film starring Jennifer Aniston
- From Kanakaris Wireless/CinemaPop,
"Sidekicks,"
starring Chuck Norris and Beau Bridges
- From FILMSPEED,
"To Kill a Mockingbird,"
starring Gregory Peck
- From SightSound and Miramax,
"Guinevere,"
starring Sarah Polley, Stephen Rea, Jean Smart and Gina Gershon

In addition, the preview page will feature the Celta de Vigo vs. Stuttgart soccer match from VideoSports.com; the trailer for "The Score," a new movie from Paramount Pictures starring Robert DeNiro; and the Rick Dees Weekly Top 40 from PrimeNet.

Availability

Content providers can download the new Windows Media Encoding Utility, available today to create audio and video content using Windows Media Audio and Video 8, at <http://www.microsoft.com/windowsmedia/>. Windows Media Audio and Video 8 also will be supported by the Windows XP operating system, the next version of the Windows operating system.

About Windows Media

Windows Media is the leading digital media platform, providing unmatched audio and video quality to consumers, content providers, solution providers, software developers and corporations. Windows Media offers the industry's only integrated rights-management solution and the most scalable and reliable streaming technology tested by independent labs. Windows Media Technologies includes Windows Media Player for consumers, Windows Media Services for servers, Windows Media Tools for content creation, and the Windows Media Software Development Kit (SDK) for software developers. Windows Media Player, available in 26 languages, is the fastest-growing media player. More information about Windows Media can be found at <http://www.microsoft.com/windowsmedia/>.

About Microsoft

Founded in 1975, Microsoft (Nasdaq
"MSFT")

) is the worldwide leader in software, services and Internet technologies for personal and business computing. The company offers a wide range of products and services designed to empower people through great software — any time, any place and on any device.

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Note to editors: If you are interested in viewing additional information on Microsoft, please visit the Microsoft Web page at <http://www.microsoft.com/presspass/> on Microsoft's corporate information pages.

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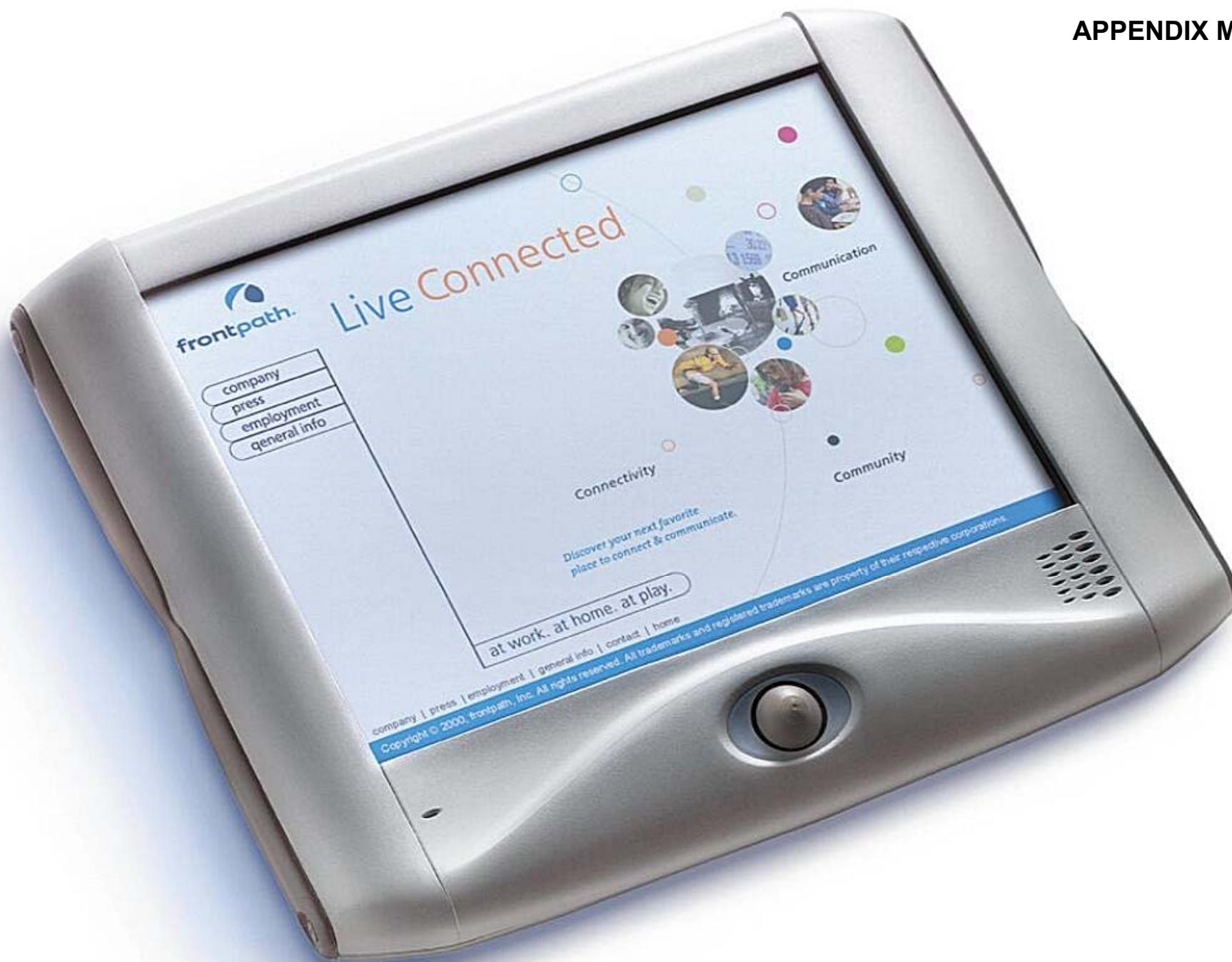
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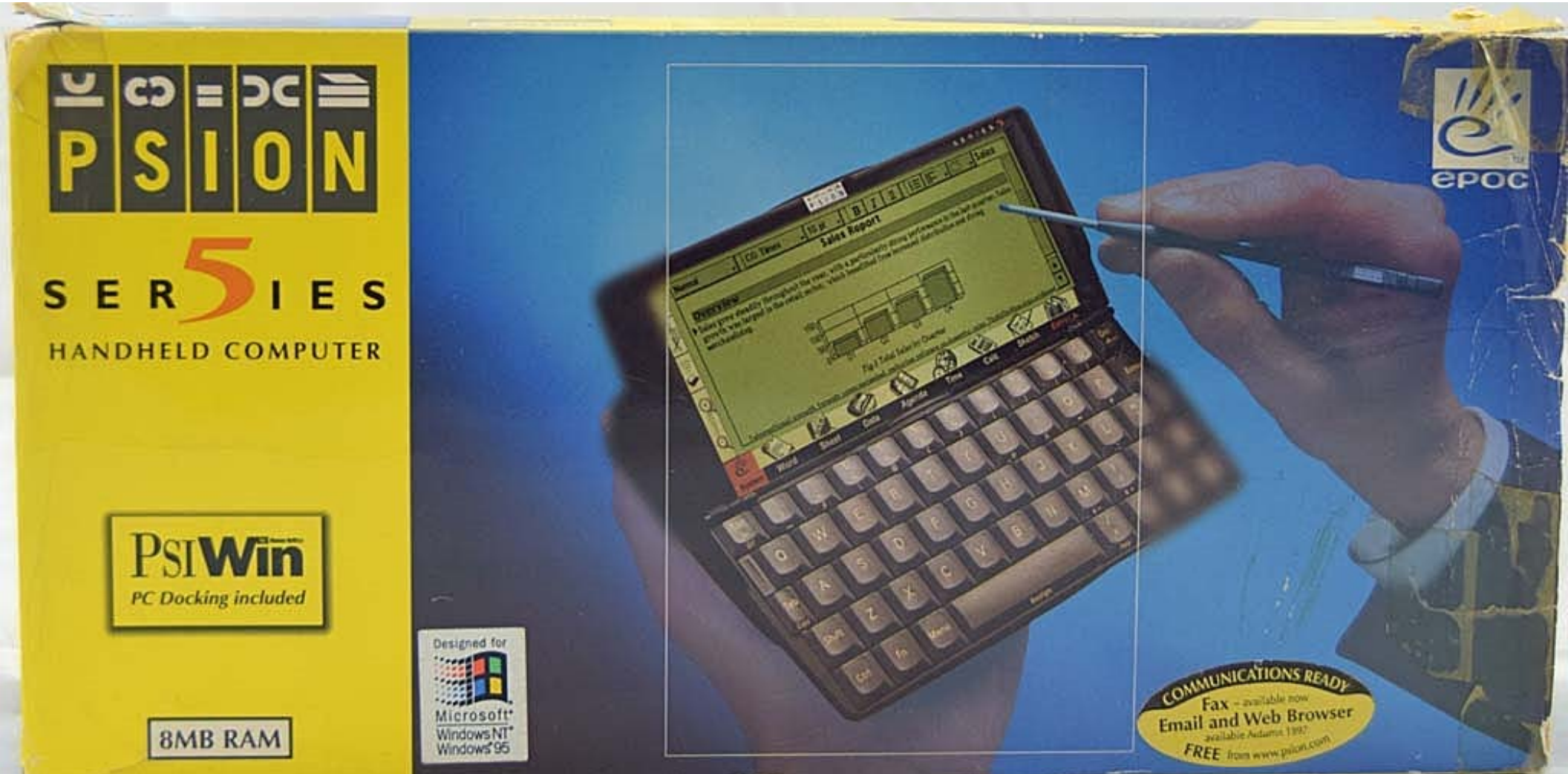
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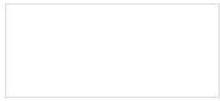
RealNetworks Launches Subscription Service

Final Releases of Real Player 8, Real Jukebox 2 and RealDownload 4 also announced.

By *Ellie Kieskowski*

Posted on August 15, 2000

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RealNetworks today launched RealPlayer GoldPass, a media subscription service. RealPlayer GoldPass will give subscribers access to a combination of software, services and exclusive content, updated monthly.

The subscription service can be purchased for \$9.95 a month, but a consumer must also purchase the premium version of RealPlayer to accompany the subscription service making the initial cost to buy in almost \$40.00.

Over the past four years, RealNetworks has sold premium versions of its RealPlayer, RealJukebox, and RealDownload software to around two million consumers; however, this represents only a fraction of the 140 million registered RealPlayer users. Real will allow the two million consumers who have already purchased RealPlayer Plus to upgrade to the subscription service for a limited time.

Some of the content features that GoldPass subscribers will gain access to are documentaries produced by ABCNEWS.com, On-demand concerts from HOB, and the GoldPass Screening Room for sneak peaks at new feature films. The GoldPass content offerings will also include UFO and Paranormal Video footage from UFO TV, the Sports Illustrated Swimsuit Video and Valve's Team Fortress- a popular multiplayer internet game.

It will be interesting to note how many people buy into this subscription service given the scattered variety of content offered and the price. The announcement of the subscription service was accompanied by the final releases of Real Player 8, Real Jukebox 2 and RealDownload 4.

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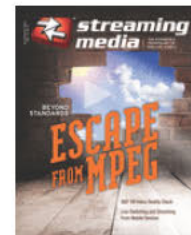
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The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated “dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

IMPORTANT: It is the intent of ReplayTV, Inc. that this product be used in full compliance with the copyright laws of the United States. Recording of copyrighted television programs may violate copyright law and prior permission from copyright owners may be required for certain public performances and certain commercial uses.

WARNING: To reduce the risk of fire or electric shock, do not expose this product to rain or moisture.

NOTE TO CATV SYSTEM INSTALLER: This reminder is provided to call the CATV system installer’s attention to section 820-40 of the NEC which provides guidelines for proper grounding and, in particular, specifies that the cable ground shall be connected to the grounding system of the building, as close to the point of cable entry as practical.

IMPORTANT: Carefully read and follow all the “Important Safety Information” beginning on page ii before proceeding further.

Important Safety Information

Please read all these instructions regarding ReplayTV and retain for future reference. Follow all warnings and instructions marked on ReplayTV.

Read instructions. All the safety and operating instructions should be read before the product is operated.

Retain instructions. The safety and operating instructions should be retained for future reference.

Heed warnings. All warnings on the product and in the operating instructions should be adhered to.

Follow instructions. All operating and use instructions should be followed.

Cleaning. Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a cloth dampened with water for cleaning.

Attachments. Do not use attachments not recommended by the product manufacturer as they may cause hazards.

Water and moisture. Do not use this product near water—for example, near a bath tub, wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool, and the like. Do not expose the product to rain or inclement conditions.

Accessories. Do not place this product on an unstable cart, stand, tripod, bracket, or table. The product may fall, causing serious injury to a child or adult, and serious damage to the product. Use only with a cart, stand, tripod, bracket, or table recommended by the manufacturer, or sold with the product. Any mounting of the product should follow the manufacturer's instructions, and should use a mounting accessory recommended by the manufacturer.



Moving a product-and-cart combination. A product-and-cart combination should be moved with care. Quick stops, excessive force, and uneven surfaces may cause the product-and-cart combination to overturn.

Ventilation. Slots and openings in the cabinet are provided for ventilation and to ensure reliable operation of the product and to protect it from overheating. These openings must not be blocked or covered. The openings should never be blocked by placing the product on a bed, sofa, rug, or other similar surface. This product should not be placed in a built-in installation such as a bookcase or rack unless proper ventilation is provided or the manufacturer's instructions have been adhered to.

Power sources. This product should be operated only from the type of power source indicated on the marking label. If you are not sure of the type of power supply to your home, consult your product dealer or local power company. For products intended to operate from battery power or other sources, refer to the operating instructions.

Grounding or polarization CAUTION: This product is equipped with a polarized alternating-current line plug (a plug having one blade wider than the other). This plug will fit into the power outlet only one way. This is a safety feature. If you are unable to insert the plug fully into the outlet, try reversing the plug. If the plug should still fail to fit, contact your electrician to replace your obsolete outlet. Do not defeat the safety purpose of the polarized plug.

Power-cord protection. Rout power cords so they are not likely to be walked on, rolled over, or pinched by items placed upon or against them, or otherwise subject to abuse, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the product. Do not damage the power cord. Damage to the power cord may cause a fire or shock hazard. When unplugging the power cord, hold it by the plug and remove it carefully.

Outdoor antenna grounding. If an outside antenna or cable system is connected to the product, be sure the antenna or cable system is grounded so as to provide some protection against voltage surges and built-up static charges.

Article 810 of the National Electrical Code, ANSI/NFPA 70 1984, provides information with regard to proper grounding of the mast and supporting structure, grounding of the lead-in wire to an antenna discharge unit, size of grounding conductors, location of antenna-discharge unit, connection to grounding electrodes, and requirements for the grounding electrode.

Lightning. For added protection of this product during a lightning storm, or when it is left unattended and unused for long periods of time, unplug it from the wall outlet and disconnect the antenna or cable system. This will prevent damage to the product due to lightning and power-line surges.

Power lines. An outside antenna system should not be located in the vicinity of overhead power lines or other electric light or power circuits, or where it can fall into such power lines or circuits. When installing an outside antenna system, extreme care should be taken to keep from touching such power lines or circuits as contact with them might be fatal.

Overloading. Do not overload wall outlets, extension cords, and integral convenience receptacles as this can result in a risk of fire or electric shock.

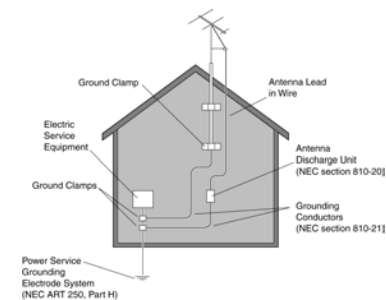
Object and liquid entry. Never push objects of any kind into this product through openings as they may touch dangerous voltage points or short-out parts that could result in a fire or electric shock. Never spill liquid of any kind on the product.

Servicing. Do not attempt to service this product yourself as opening or removing covers may expose you to dangerous voltage or other hazards. Refer all servicing to qualified service personnel.

Damage requiring service. Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:

1. When the power-supply cord or plug is damaged.
2. If liquid has been spilled, or objects have fallen into the product.
3. If the product has been exposed to rain or water.
4. If the product does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions. An improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.
5. If the product has been dropped or damaged in any way.
6. When the product exhibits a distinct change in performance—this indicates a need for service.

Replacement parts. When replacement parts are required, be sure the service technician has used replacement parts specified by the manufacturer or parts that have the same characteristics as the original part. Unauthorized substitutions may result in fire, electric shock or other hazards.



Safety check. Upon completion of any service or repairs to this product, ask the service technician to perform safety checks to determine that the product is in proper operating condition.

Heat. The product should be situated away from heat sources such as radiators, heat registers, stoves, or other products (including amplifiers) that produce heat as well as direct sunlight. If the product experiences sudden changes in temperature, moisture may form inside the product.

Do not place heavy objects on ReplayTV. Heavy objects placed on ReplayTV may cause damage.

ReplayTV Limited Warranty and Software License

Note: For your convenience, SONICblue has established a frequently asked questions section at: <http://www.replaytv.com>. For service assistance or resolution of a service problem, product information or operation help, please contact the SONICblue Customer Care Department:

By phone: 1-800-933-5899

By email: techsupport@replaytv.com

1. **Warranty.** SONICblue Incorporated (“SONICblue”) warrants your 4000 series ReplayTV (the “ReplayTV”) and any included ReplayTV accessories) against defects in material or workmanship as follows:

LABOR: For a period of one (1) year from the date of purchase (“Warranty Period”), if the ReplayTV is determined to be defective, SONICblue will repair or replace the unit, at its option, at no charge, or pay the labor charges to any ReplayTV authorized service facility. After the Warranty Period, the customer must pay for all labor charges.

PARTS: In addition, during the Warranty Period, SONICblue will supply, at no charge, a new or rebuilt ReplayTV units in exchange for a defective units. After the Warranty Period, parts are available from SONICblue authorized service facilities or a ReplayTV Service Center at your expense.

In addition, your ReplayTV carries a 30-day satisfaction guarantee. It may be returned within 30 days of purchase for a full refund (minus any shipping charges). Your ReplayTV must be returned in warranty condition with all original accessories included, in order to receive a refund.

2. **Warranty Service.** To obtain warranty service, you must first obtain an RMA number (Return Merchandise Authorization) from a Technical Support Representative at SONICblue. A Technical Support Representative may be reached at (800) 933-5899. Once an RMA number is obtained, your ReplayTV must be shipped freight prepaid, in either its original packaging or packaging affording an equal degree of protection, to the ReplayTV authorized distribution facility. In order to receive an advance replacement ReplayTV, the customer must furnish a valid credit card number and expiration date. Otherwise, a replacement ReplayTV will be shipped upon receipt of the defective unit.

In addition, all accessories must be returned with the defective ReplayTV. A new or factory refurbished set of accessories will be furnished with the replacement ReplayTV. Failure to return any of the accessory items could result in a delay in receiving the replacement ReplayTV, and/or result in an invoice for the missing accessories.

Important: When calling for an RMA number, please be prepared to answer some basic troubleshooting/setup related questions. It is helpful for you to call when you are in front of your ReplayTV so that you can respond to operational instructions from a ReplayTV Technical Support Representative.

3. Scope of and Limitation on Warranty. This warranty does not cover customer instruction, installation, set up adjustments or signal reception problems. This warranty does not cover cosmetic damage due to acts of God, accident, misuse, abuse, negligence, commercial use, or modification of, or to any part of your ReplayTV. This warranty does not cover damage due to improper operation or maintenance, connection to improper voltage supply, or attempted repair by anyone other than a facility authorized by SONICblue to service your ReplayTV. This warranty does not cover consumables (such as fuses and batteries). This warranty is valid only in the United States and is non-transferable. This warranty is invalid if the factory-applied serial number has been altered or removed from the ReplayTV.

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4. Software License. IMPORTANT -- READ CAREFULLY: By pressing “PLAY” and accepting to continue with the setup process to begin using the software in your ReplayTV, you agree to be bound by this agreement, including the terms that apply to the software license. If you do not agree to the terms of this agreement, you may promptly return your ReplayTV to the point of purchase for a refund of your purchase price, or you may contact SONICblue for instructions on where to ship the ReplayTV, at SONICblue's cost, for a full refund of the purchase price after inspection.

5. Software License Grant; Restrictions. Subject to the terms of this agreement, SONICblue grants you a non-exclusive license, without the right to sublicense, to use all software included with the ReplayTV or subsequently provided to you, and related documentation (together, “Software”) solely for your internal, non-commercial use and solely in connection with your use of the ReplayTV and access to the ReplayTV Service (“RTVS”). The license may only be transferred with the transfer of the ReplayTV on which SONICblue has installed the software and any transferee will be subject to the terms and conditions of this license. You acknowledge and agree that SONICblue may periodically update, modify or enhance the Software remotely through the RTVS, and that any registration or other information provided by you may be used or disclosed by SONICblue pursuant to the terms of SONICblue's ReplayTV Privacy Policy, as that policy may be modified by SONICblue from time to time. You further agree that: (a) if you use of the Software or the ReplayTV with any third party service that is competitive with the RTVS, your product warranty under this agreement will terminate; (b) you will not attempt to modify, enhance, disassemble, decompile, reverse engineer or otherwise attempt to gain access to the source code to the Software; and (c) you will not attempt to remove or unbundle the Software from the ReplayTV.

6. **Ownership.** SONICblue and its licensors own and retain all proprietary rights, including all patent, copyright, trade secret, trademark and other intellectual property rights, in and to the Software and any corrections, bug fixes, enhancements, updates or other modifications to the Software. You acknowledge that the license granted under this agreement does not provide you with title to or ownership of the Software, but only a right of limited use under the terms and conditions of this agreement.

7. **Limitation of Liability.** THE ENTIRE RISK ARISING OUT OF THE USE OR PERFORMANCE OF THE SOFTWARE AND THE PRODUCT REMAINS WITH YOU. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, SONICBLUE AND ITS SUPPLIERS OR LICENSORS WILL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL, PUNITIVE, OR OTHER DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF INFORMATION OR DATA, OR OTHER PECUNIARY LOSS) ARISING OUT OF THIS AGREEMENT OR THE USE OF OR INABILITY TO USE THE SOFTWARE OR THE RTVS, EVEN IF SONICBLUE OR ITS SUPPLIERS OR LICENSORS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. BECAUSE SOME STATES/JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

8. **Termination of Software License.** The licenses for the Software granted under this agreement shall terminate automatically if you fail to comply with the limitations described in this agreement. No notice will be required from SONICblue to effectuate such termination. On termination of the licenses, SONICblue may erase or destroy all copies of the Software on your ReplayTV and you agreed to destroy all accompanying documentation. The obligations (other than the license) of SONICblue and you in this agreement shall survive termination of this agreement. Nothing in this Section 9 shall limit any other remedies that SONICblue may have for your breach of this agreement.

9. **Export Controls; Government Restricted Rights.** You acknowledge and agree that none of the Software or underlying information or technology may be downloaded or otherwise exported or re-exported (i) into (or to a national or resident of) Angola, Cuba, Iran, Iraq, Libya, North Korea, Sudan, Syria, or any other country to which the U.S. has embargoed goods; or anyone on the U.S. Treasury Department's list of Specially Designated Nationals or the U.S. Commerce Department's Table of Denial Orders. By using the Software, you represent and warrant that you are not a national or resident of any such country or on any such list.

The Software is a commercial product, developed at private expense, and provided with restricted rights. Use, reproduction, release, modification or disclosure of the Software, or any part thereof, including technical data, by the Government is restricted in accordance with Federal Acquisition Regulation ("FAR") 12.212 for civilian agencies and Defense Federal Acquisition Regulation Supplement ("DFARS") 227.7202 for military agencies.

10. **Miscellaneous.** This agreement shall in all respects be governed by the laws of the State of California without reference to its principles of conflicts of laws. The United Nations Convention on Contracts for the International Sales of Goods shall not apply to this agreement. You hereby agree that all disputes arising out of this agreement shall be subject to the exclusive jurisdiction of and venue in the federal and state courts within Santa Clara County, California, and you hereby consent to the personal and exclusive jurisdiction and venue of these courts.

If any of the provisions of this agreement are held to be invalid under any applicable statute or rule of law, they are, to that extent, deemed omitted. The waiver of any breach or default, or any delay in exercising any rights shall not constitute a waiver of any subsequent breach or default. This agreement constitutes the complete and exclusive agreement between you and SONICblue with respect to the subject matter hereof, and supersedes all prior oral or written understandings, communications or agreements. This agreement may not be modified except in writing duly signed by an authorized representative of SONICblue.

This product incorporates copyright protection technology that is protected by method claims of certain U.S. patents and other intellectual property rights owned by Macrovision Corporation and other rights owners. Use of this copyright protection technology must be authorized by Macrovision Corporation, and is intended for home and other limited viewing uses only unless otherwise authorized by Macrovision Corporation. Reverse engineering or disassembly is prohibited.

Macrovision U.S. patent nos. 4,631,603; 4,577,216; 4,819,098 and 4,907,093.

Commercial Advance patent nos. 5,333,091; 5,692,093 and 5,696,866. Other patents pending.

COMMERCIAL **ADVANCE**® is a registered trademark of SRT, Inc. A Jerry Iggulden invention licensed in association with Arthur D. Little Enterprises, Inc.

Privacy Policy

Your Privacy is Important to us

Personal television and digital video recording are radically improving the way you watch TV. You are now in charge of your own television viewing experience. Along with that, we want you to know how important your privacy is to us.

At SONICblue™, we believe privacy is a right, not a privilege. In other words, you should expect us to protect your privacy, and you should never have to worry about it. We believe that a strict and clear-cut privacy policy is a key ingredient in growing our company and the personal television industry. This Privacy Policy is our pledge to safeguard your privacy while providing you with the best television viewing experience possible.

This is our Privacy Credo:

1. We see your privacy as a right and not just a privilege.
2. We respect your privacy and are committed to maintaining the privacy of your personal information.
3. We will tell you what information we collect about you and how we use that information.
4. We will give you a choice as to how your personal information will be used.

Sources of Information

To best understand this Privacy Policy, please keep in mind that we gather information from three different sources:

1. www.replaytv.com Web site.
2. Digital video recorders featuring the ReplayTV Service™. These recorders are sold under brand names like Panasonic and also under the ReplayTV brand. All of these recorders feature our ReplayTV Service.
3. Telephone. You may call us and provide us with information.

Types of Information

It is important to know that we collect different types of information. We use each in a different way, as explained below in the Q&A section of our Privacy Policy. The terms defined below are used throughout our Privacy Policy:

1. “Personally Identifiable Information” is private data about you as an individual. Examples of this data would be your name, address, telephone number, email address, and other personal information that identifies you as you. We call this “Personal Information” for short.
2. “Anonymous Information” is information about how you use our Web site and ReplayTV Service without connecting it to your name, address, or other Personal Information. For example, Anonymous Information may describe how many people viewed a particular page on our Web site or how many people recorded the program “Friends” on their ReplayTV digital video recorders, without connecting that Information to the identities of those people.
3. “Technical Status Data” can be classified either as error events and maintenance status events.

Privacy Policy Q&A

Q: What information does SONICblue collect from www.replaytv.com Web site?

A: When you visit certain areas of www.replaytv.com, we may ask you to register by providing Personal Information. For example, if you buy a product, enter a contest, or subscribe to a mailing list from our site, we will ask you for certain Personal Information in connection with that transaction.

We also collect Anonymous Information from the Web site, including which pages you look at and other similar data. As do most Web sites, www.replaytv.com uses “cookies.” A cookie is a small data file that a Web site can send to your browser to be stored automatically on your computer. Cookies are commonly used to track your visits to a site so you don't have to log in on every page and to analyze how you use the site. This allows Web site operators to serve you better.

When you register your ReplayTV unit at www.replaytv.com, we collect Personal Information. Our practices regarding the collection and use of this information are described below in the sections about your digital video recorder usage.

Q: How does SONICblue use the information it collects from the www.replaytv.com Web site?

A: We may use Personal Information collected through the Web site to complete a transaction you request. If you purchase a ReplayTV product, the Personal Information collected for that transaction will be used to fill your order, get the product to you and bill you correctly. SONICblue may also use your mailing address, telephone number or email address to alert you to special offers, updated information and new services. If you don't want SONICblue to contact you, you may opt-out as discussed in the next question and answer below.

Anonymous Information collected through our Web site is used for maintenance, monitoring and marketing uses, but Anonymous Information will not be linked to you without your permission.

Q: What choices do I have regarding the collection and use of information from the www.replaytv.com Web site?

A: When you submit Personal Information at our Web site, you can opt-out of receiving information from SONICblue about ReplayTV and related products, promotions, and services. You may also set your Internet browser to reject cookies to limit the collection of Anonymous Information from our Web site, but this may affect your ability to use some parts of our Web site.

Q: What information does SONICblue collect about my digital video recorder use?

A: When you purchase a ReplayTV digital video recorder, we ask you to register the product so we can provide you with the best possible service. You may register online at the www.replaytv.com Web site or by telephone. During registration, we ask you for Personal Information, including your name, address, phone number, email address, and the serial number of your ReplayTV digital video recorder.

The ReplayTV digital video recorder is connected to your television and an Ethernet connection. During system setup and registration, we learn about how you have connected your ReplayTV digital video recorder to your entertainment system and the programming signal sources available to you (antenna, cable, and/or satellite). We also learn about where you are located, and use this information to determine what television channels and schedule are available to you. Each day, the ReplayTV digital video recorder contacts SONICblue to download a current TV schedule for you.

Once your ReplayTV digital video recorder is set up and registered, it collects certain Anonymous Viewing Data, such as which programs you record, which features you use, and other similar data about your use of the ReplayTV Service. If other people in your household use your ReplayTV recorder, Anonymous Viewing Data will also be collected as a result of their use of the unit. The ReplayTV digital video recorder stores this Anonymous Viewing Data on its hard drive under an automatically generated identification number that will not be linked to your name or other Personal Information without your permission. During the daily download of your TV schedule, the collected information is transmitted to SONICblue and is anonymously stored in a secure server and is not associated with any Personal Information.

Q: How does SONICblue use the information it collects about my digital video recorder use?

A: Personal Information collected during registration of your ReplayTV digital video recorder may be used for diagnostic purposes. We can use it, for example, to see if your ReplayTV unit is working properly. We can also use it when you contact our Customer Care agents so they can help you with any service-related problems, and for warranty eligibility and fulfillment purposes. Again, this information is not linked to Anonymous Information without your permission.

Anonymous Viewing Data is used to tailor the ReplayTV Service to your preferences, including providing you with advertisements that may be of interest to you, and to provide service enhancements to you. With your permission, we may also use Anonymous Viewing Data to diagnose and correct problems with your digital video recorder or your ReplayTV Service. In keeping with this Privacy Policy, Anonymous Viewing Data is not linked to you, and will not be linked to you without your express permission.

Q: What choices do I have regarding the collection and use of information about my digital video recorder use?

A: Registration of your ReplayTV digital video recorder is not required to use the unit.

From time to time, we may send all of our customers information about our products and services that we consider essential to providing you the ReplayTV Service, including information about software upgrades, changes to the service, technical or administrative issues, legal matters, or other similar information. Users of our products and services are not able to opt-out of these announcements. At present, users also cannot opt-out of the collection of Anonymous Viewing Data.

Q: Does SONICblue share my information (gathered from either my use of the www replaytv.com Web site or digital video recorder) with any third parties?

A: SONICblue will not share your Personal Information with third parties without your consent, except in the very limited circumstances outlined in the next question and answer below. Your Personal Information is not otherwise sold, marketed or shared with third parties without your permission. Anonymous Information, including Anonymous Viewing Data, may be shared with third parties for analysis or marketing purposes. For example, this information may be provided to advertisers or marketers who may use it to target advertisements to your particular interests. Because it's anonymous, this information is not linked to you, and will not be linked to you without your express permission.

Q: Are there any special circumstances that may require my information (gathered from either my use of www replaytv.com Web site or its digital video recorder) to be shared with third parties?

A: SONICblue may disclose Personal or Anonymous Information if required to do so by law or in the good faith belief that such action is necessary or appropriate to conform to the law or comply with legal process served on SONICblue, to protect and defend the rights or property of SONICblue, the ReplayTV Service or our viewers, whether or not required to do so by law, or to protect the personal safety of our viewers or the public. SONICblue reserves the right to contact appropriate authorities and disclose Personal or Anonymous Information to them at its discretion when it appears that individuals using our products or services are engaged in activities that are illegal or violate the ReplayTV Service Terms of Service.

Should SONICblue merge with or be acquired by another company, or if the business unit providing your service were sold to another company, then customer information maintained by SONICblue, including Personal and Anonymous Information, may be transferred to and used by the resulting combined company. From time to time we may also share Personal Information with third parties who perform certain services and functions on our behalf. These parties only have access to the Personal Information they need to perform their functions and we require them to use the information only in connection with the services they provide for us.

Q: Can I correct the information collected about me?

A: SONICblue believes in and supports your right to access and edit the Personal Information you have provided us. To do so, simply contact SONICblue at 800-933-5899 and we will make changes that you request.

Q: Is all of my information kept securely?

A: SONICblue has security measures in place that are designed to protect your information. All Personal and Anonymous Information is stored on physically secured servers. Access to this information is strictly limited to individuals with a legitimate reason to have access and who have signed agreements that prohibit the unauthorized use or disclosure of such information. In addition, all of SONICblue's stored information is firewall protected against unauthorized "hacks" into our systems. While we cannot guarantee that loss, misuse or alteration of your data will not occur, we work hard to prevent such occurrences.

Q: Does SONICblue collect personal information about children?

A: We are very concerned about the safety and privacy of children. Therefore, SONICblue will not knowingly collect Personal Information from anyone under the age of 13.

Q: Does SONICblue collect personal information about the shows that I share with other ReplayTV 4000 users or shows that I record?

A: No, when sending a show from one ReplayTV 4000 to another, the ReplayTV Service does not track or receive notification of which show is being sent or which shows you record.

Q: How can I find out about changes to this Privacy Policy?

A: We will update this policy as our business and services expand and change. We will update this policy to provide you with information about how we treat Personal Information collected through this new service.

Updates to this policy will be posted on our Web site, and sent to your ReplayTV digital video recorder, but in most cases will not be sent to you directly. We encourage you to review this policy periodically to review any changes that have been posted.

One thing that will never change at SONICblue is our commitment to your privacy.

Q: What if I have other questions?

A: If you have any questions or comments about our use of Personal Information, Anonymous Information or about this Privacy Policy, please contact us at 800-933-5899 or via e-mail at privacy@replaytv.com. We will be happy to give you more information.

If you have a complaint about our use of Personal or Anonymous Information, please let us know. We will promptly investigate and will comply fully with the legal and regulatory supervisory authorities responsible for enforcing our adherence to the privacy principles stated above.

FCC and Industry Canada Compliance

This section describes the requirements for compliance with Federal Communications Commission (FCC) Rules and Industry Canada CS-03 standard.

FCC Registration and Requirements

The following paragraphs describe requirements and information based on FCC rules.

FCC Rules, Part 15

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna;
- Increase the separation between the equipment and receiver;
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Company Name: SONICblue, Inc.

Address: 2841 Mission College Blvd., Santa Clara, CA 95054-1838

Telephone: 800-933-5899

CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

FCC Rules, Part 68

1. This equipment complies with FCC Rules, Part 68. On this equipment is a label which contains, among other information, the FCC Part 68 registration number.

2. The Federal Communications Commission (FCC) has established Rules which permit this device to be directly connected to the telephone network. Standardized jacks are used for these connections. This equipment should not be used on party lines or coin phones.
3. If this device is malfunctioning, it may also be causing harm to the telephone network; this device should be disconnected until the source of the problem can be determined and until repair has been made. If this is not done, the telephone company may temporarily disconnect service. All repairs should be performed by ReplayTV, Inc. or an authorized agent. It is the responsibility of users requiring service to report the need for service to ReplayTV, Inc. or to one of our authorized agents. Service can be facilitated through ReplayTV Customer Care.
4. The telephone company may make changes in its technical operation and procedures; if such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes. You will be advised of your right to file a complaint with the FCC.
5. If the telephone company requests information on what equipment is connected to their lines, inform them of:
 - a. The telephone number to which this unit is connected.
 - b. The ringer equivalence number: REN: 0.01B
 - c. The USOC jack required: RJ11C.
 - d. The FCC Registration Number: MKAUSA-42040-DT-T

Items (b) and (d) are indicated on the label. The Ringer Equivalence Number (REN) is used to determine how many devices can be connected to your telephone line. In most areas, the sum of the REN's of all devices on any one line should not exceed five (5.0). If too many devices are attached, they may not ring properly.

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Chapter One: Introducing ReplayTV

After you've experienced the exciting new world of personal television in your own home, you'll never watch plain old television again. No videotapes. No hassles. No compromises. With ReplayTV, it's easy to quickly find and automatically record your favorite television shows, so you can watch them whenever you want—on your schedule, not somebody else's. Also, ReplayTV is the first digital video recorder (DVR) that allows you to share content between multiple units in a home network. You can even send your recordings over the Internet with friends and family who are using ReplayTV.

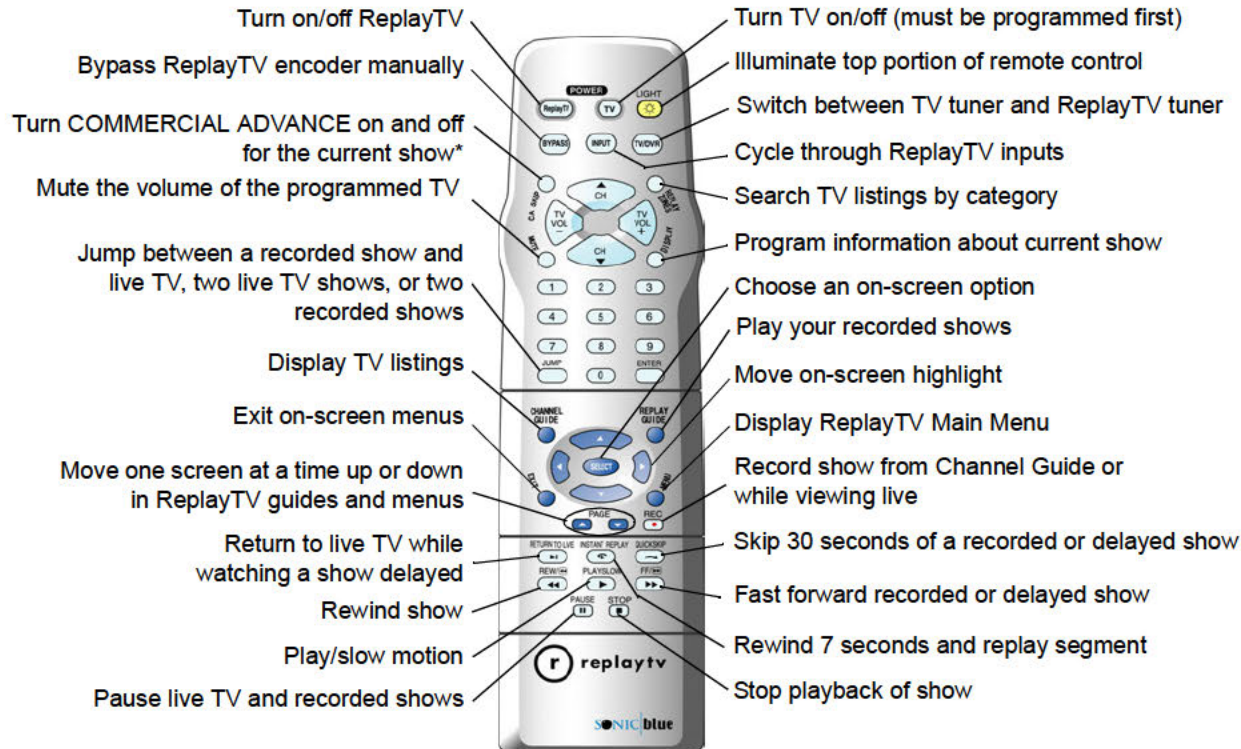
ReplayTV. There's always something good on.

Visit www.sonicblue.com/replaytv for the latest documentation.

Feature highlights

- ReplayTV is broadband enabled, so you can send your recordings to other ReplayTV 4000s via Ethernet on your home network and on the Internet. The Ethernet connection is also used to download Channel Guide information via broadband. *It must be connected at all times.*
 - Note:** Although it is technically possible to watch a show from one ReplayTV on multiple remote ReplayTV units on your home network at the same time, for best results, it is recommended that the video stream be sent to one ReplayTV at a time.
- Transfer digital photos from your PC to your ReplayTV to create slide shows and personalized screen savers.
- Use the COMMERCIAL ADVANCE feature to skip commercial messages during playback of recorded and delayed shows.
 - Note:** COMMERCIAL ADVANCE lets you decide whether or not to watch commercial messages during playback of a recorded television broadcast. If you enable the feature, it will skip most commercial messages. You can turn it off or on at any time.
- Jump past commercials or recorded scenes you don't want to watch with Quick-Skip™.
- Locate shows that you want to watch without searching through pages of program schedules. With the Find Shows feature, locate shows based on specific titles, actors, directors, and topics.
- Create personal channels to automatically record every episode of your favorite shows, or constantly find and record shows that interest you.
- Control live television. Pause or rewind, play in slow motion, or watch an instant replay—all without missing a single scene.

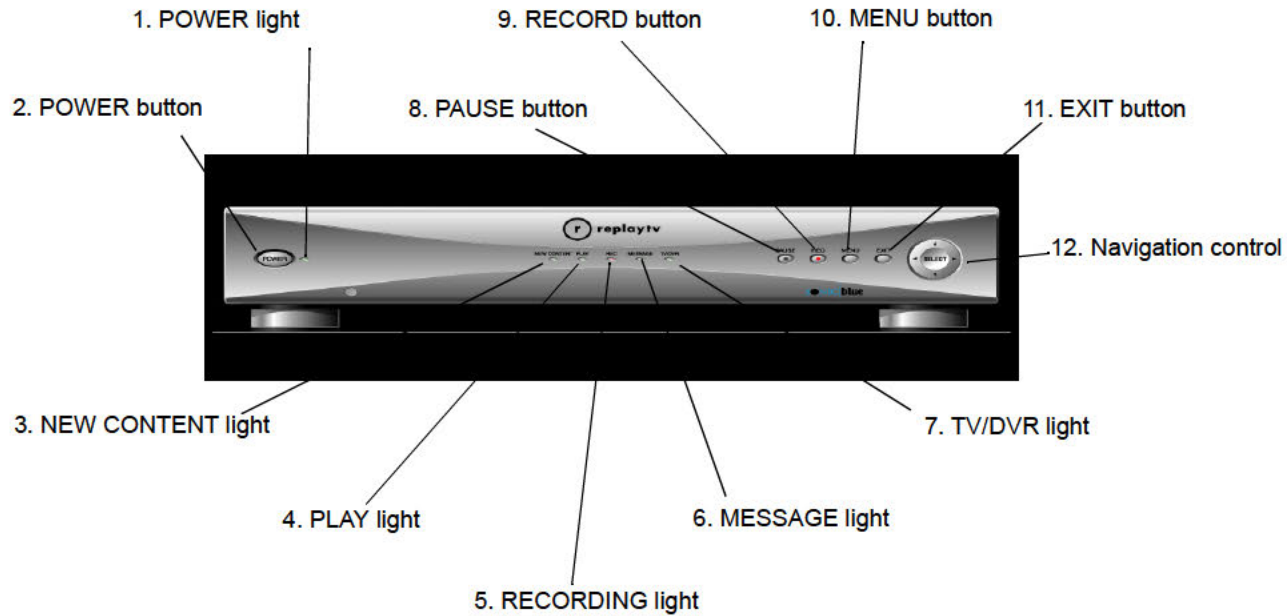
Using the ReplayTV remote control



* This button may be labeled AUTOSKIP or CA SKIP on your remote control. They perform the same function.

ReplayTV front panel

1. **POWER light:** Blinks while ReplayTV is starting up. Lights red when ReplayTV is on.
2. **POWER button:** Manually switches between On and Standby modes.
3. **NEW CONTENT light:** Lights green after ReplayTV finishes recording a show.
4. **PLAY light:** Lights green when ReplayTV is playing a show.
5. **RECORDING light:** Lights red when ReplayTV is recording a show.
6. **MESSAGE light:** Lights green when a new message is received from the ReplayTV Service.
7. **TV/DVR (Digital Video Recorder) light:** Lights green when using the ReplayTV tuner.
8. **PAUSE button:** Pauses playback of recorded show and live TV.
9. **REC (Record) button:** Records selected show from the Channel Guide or while viewing live TV.
10. **MENU button:** Displays the Main Menu.
11. **EXIT button:** Exits on-screen menus.
12. **Navigation Control:** Navigates up, down, left, and right in the on-screen menus. Press SELECT to confirm your selections.



Turning on your ReplayTV

1. Press the POWER button on the ReplayTV remote control.
Or
2. Press the POWER button on the ReplayTV front panel.

Putting your ReplayTV in standby mode

ReplayTV is in standby mode when it is plugged in with the power turned off. Your ReplayTV will record even if it is in standby mode.

1. Press the POWER button on the ReplayTV remote control.
Or
2. Press the POWER button on ReplayTV front panel.

Restarting ReplayTV if it does not respond

If your ReplayTV does not respond to the remote control, press and hold the POWER button on the front of the unit for 10 seconds, then release. ReplayTV will restart. If this doesn't work, unplug the power cord from the electrical outlet for 15 seconds then plug it back in. ReplayTV will restart and power on in a few moments.

Using the Main Menu

Use the Main Menu to access ReplayTV's main features. Press the MENU button to display the Main Menu.

Channel Guide: The Channel Guide is ReplayTV's on-screen program guide. The Channel Guide provides 12 days of current television listings for all of the TV channels you receive. See "Accessing the Channel Guide" on page 20 for more information on the Channel Guide.

Replay Guide: Every show you schedule to record and every recorded show is stored in the Replay Guide. The Replay Guide is also where you play, and delete recorded programs. See "Using the Replay Guide" on page 25 for more information.

Photo Viewer: Use the Photo Viewer to view digital photos copied from your PC to your ReplayTV. See "Using the Photo Viewer" on page 65 for more information.

Find Shows: Use Find Shows to quickly locate shows that you'd like to record using keywords. See "Using Find Shows" on page 34 for more information.

Manual Record: Set up time-based recordings that are independent of Channel Guide programming using Manual Record. See "Using Manual Record" on page 37 for more information.

Replay Zones: Use Replay Zones to quickly find shows within specific categories, such as movies, sports, and sitcoms. See "Replay Zones" on page 33 for more information.

Messages: The ReplayTV Service will send messages about important news, and the latest features and enhancements as soon as they become available. You'll receive a welcome message after you complete the on-screen setup of your ReplayTV.

Setup: Use Setup to customize your ReplayTV. See "Using Setup" on page 8 for more information.



Using Setup

ReplayTV Name: Change the name of your local ReplayTV.

Internet Identity and Address Book: Change your local ReplayTV's Internet identity and manage Address Book entries. See page 59.

Default Record Options: Change the current recording options that ReplayTV uses to record shows.

Default Playback Options: Set default for every recorded show to play back with or without commercials using COMMERCIAL ADVANCE. See page 47.

Network and Input Settings: Update the information you provided during the on-screen setup process, or if you later add or remove A/V equipment.

Video Output Settings: Change the OUT TO TV and VGA output connector settings.

Screen Saver and Pause Screen: Choose which photos are used when the screen saver is displayed and when you press the PAUSE button. See page 63.

Parental Control: Block viewing of shows. See page 23.

Add or Remove Channels: Add or remove channels from ReplayTV's Channel Guide. This feature is handy for removing channels that you don't subscribe to or channels that are inappropriate for some audiences.

Register: Register your ReplayTV with the ReplayTV Service.

Privacy Policy: View the current Privacy Policy.

Chapter Two: Connecting your ReplayTV

This chapter describes how to connect your ReplayTV to your TV and other devices, including your home network. You'll find detailed connection options that are not found on the *Quick Setup* guide. If you haven't already, take a look at the Quick Setup guide before reading this chapter. It is likely that your setup is covered there, along with helpful color diagrams.

Cable overview

You may not need to use all the cables provided with your ReplayTV. Your setup will depend on the components (Cable box, VCR, etc.) you use. The telephone cable is not needed because the ReplayTV 4000 uses an Ethernet connection. During setup, you may be called upon to identify one or more of the following cables:

Coaxial cable

Coaxial cable can deliver the signals broadcast by your cable TV company, or local stations. You can connect the supplied coaxial cable from ReplayTV to your television.

S-Video cable

S-Video cable delivers high quality video signals between ReplayTV and your television. Older-model TVs may not support S-Video. Because S-Video cable only provides the video signal, it must be used in combination with both of the audio plugs (red and white) on an A/V cable.

A/V cable

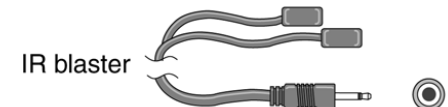
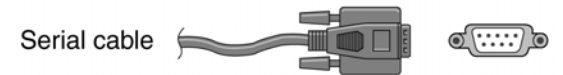
A/V cable delivers audio and video signals between ReplayTV and your television. The red and white plugs deliver stereo audio. The yellow plug delivers video.

Serial cable

Many satellite receivers use serial cables to communicate. Serial cable lets ReplayTV change the channels on your satellite receiver. (The RJH to 9-pin adapter connects to this cable, if it's used.)

IR blaster cable

The IR blaster cable lets ReplayTV change the channels on your satellite receiver or cable box if it does not support serial cable. The IR blaster emitters need to be affixed directly over the IR detector on your satellite receiver or cable box.





9- to 15-pin adapter

If your satellite receiver uses a 15-pin serial cable, you will need to use the 9-pin to 15-pin adapter to connect the satellite receiver to ReplayTV.



RJH to 9-pin adapter

If you have a satellite receiver that uses telephone cable in place of serial cable, you will need to use the RJH to 9-pin adapter to connect the satellite receiver to ReplayTV. RCA models DRD221RD, DRD222RD, DRD223RD, and DS2122RD will all require this adapter.



Ethernet cable

The Ethernet cable is required to use ReplayTV. Make sure its connected to your home network at all times. Channel Guide data is sent over the Ethernet connection. This connection will allow you to connect your ReplayTV 4000 to your home network.



VGA cable (not included)

VGA cable currently delivers the best picture quality and is recommended if your television or monitor supports it. ReplayTV supports both RGB and YPbPr video formats. Refer to your television or monitor user's guide for information about the types of video formats it supports.

Note: Macrovision protected programming will be recorded if you use the YPbPr video setting but cannot be viewed using this setting. You must change the video setting to "RGB" or "None" to view Macrovision protected programming. Select **Video Output Settings** from the Setup screen to change the setting.

Planning your setup

Read this section before incorporating ReplayTV into your entertainment system.

Incorporating ReplayTV into your entertainment system

ReplayTV records and lets you control the television signals you receive.

You can connect a VCR to your ReplayTV and save shows you have recorded to videotape. See “Saving recordings to videotape” on page 43 for more information.

ReplayTV is not intended to record signals sent by DVD players and video game systems. Connect DVD players and video game systems directly to your television, not to your ReplayTV.

Connecting a video camera or VCR to ReplayTV

You can connect a video camera or VCR from its Outputs to the Inputs on ReplayTV and record the content onto ReplayTV using the Manual Record feature. Once recorded onto ReplayTV, you can watch your recorded content, and even send recordings and home videos over the Internet to other ReplayTV 4000 users. Refer to “Using Manual Record” on page 37 for more information.

Checking your satellite receiver

ReplayTV *receives* broadcast signals from satellite receivers via S-video or A/V cables. ReplayTV can *send* channel-changing signals to your satellite receiver via the supplied serial cable or IR blaster. It is recommend that you connect your ReplayTV to your satellite receiver using a serial cable. If your satellite receiver does not use serial cable, please use the IR blaster.

If the remote control for your satellite receiver has a “UHF” label, or if your satellite receiver uses a small antenna, your satellite receiver is radio controlled. ReplayTV does not support radio-controlled receivers. Please check your receiver’s owner’s manual to see if serial or infrared controls are supported.

Connecting ReplayTV to a home network

If you have an Ethernet-based home network, you can connect ReplayTV to your home network using the built-in Ethernet port at 10/100Mbps. This connection will allow you to send shows from one ReplayTV to another ReplayTV via the Internet, stream video from one ReplayTV to another in your home, and transfer photos between your PC and ReplayTV.

An Ethernet connection is needed to download the Channel Guide.

When you turn on ReplayTV for the first time, you will follow the Quick Setup process. During this initial setup stage, ReplayTV will attempt to get an IP address. If one is found, it will be used. If an IP address is not found, a screen will be presented to allow you to enter the network information manually. The required network information is: IP Address, Subnet, Gateway, and DNS Server.

Finding out your computer's network information

ReplayTV needs your IP Address, Subnet Mask, Default Gateway, and DNS Server to use its Ethernet connection.

Note: These steps are for Microsoft Windows 98. If you are using a different version of Windows, you may need to refer to your Windows manual to find how to display your computer's network information.

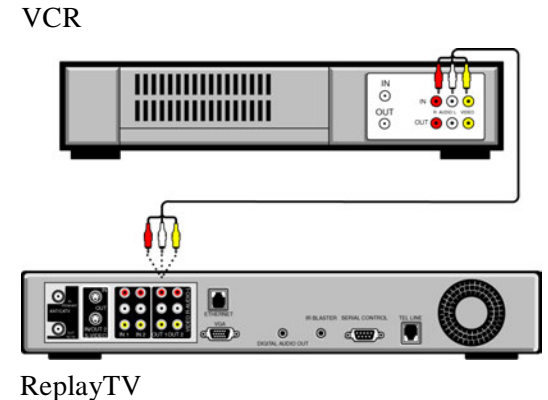
1. Click on the **Start** button.
2. Select **Run**.
3. Type "command" and click **OK**. This will open the MS-DOS prompt window.
4. Type "ipconfig/all" on the command line (at the blinking cursor) and the needed configuration information will be displayed.
5. Type "exit" to close the MS-DOS prompt window when you are finished.

Note: If your computer is behind a firewall, contact your network administrator or ISP for configuration information.

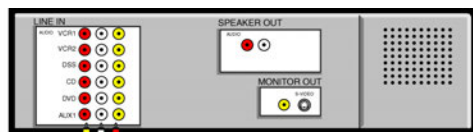
Connecting ReplayTV to a VCR

Connect ReplayTV to a VCR if you want to watch or save your recordings on videotape. Deleting recordings from the Replay Guide will preserve hard drive space.

- Connect an A/V cable from the OUTPUT jacks on ReplayTV to the AUDIO/VIDEO IN jacks on your VCR, matching like colors.



A/V Receiver



ReplayTV



Connecting ReplayTV to an A/V receiver

1. Connect the incoming television signal to your ReplayTV. Refer to the Quick Setup guide for detailed instructions.
2. Connect an A/V cable from the OUTPUT jacks on your ReplayTV to the AUDIO/VIDEO IN jacks on your A/V receiver, matching like colors. Use an S-Video cable if your receiver has S-Video In.

Connecting cable box and satellite receiver controllers

If you connect a satellite receiver or a cable box to your ReplayTV, you will need to attach a controller cable so ReplayTV can change the channels on either of these components. The controller, either a serial cable or an IR blaster cable, will act as a remote control for these devices.

Connecting the serial cable

If your satellite receiver or cable box supports serial cable, use the provided serial cable as a controlling cable. Connect the serial cable to the SERIAL CONTROL connector on ReplayTV and to the serial port on your cable box or satellite receiver. If your receiver uses a 15-pin serial connector, use the supplied 15-pin to 9-pin adapter. If you have a satellite receiver that uses telephone cable in place of serial cable, you will need to use the RJH to 9-pin adapter to connect the satellite receiver to ReplayTV. RCA models DRD221RD, DRD222RD, DRD223RD, and DS2122RD will all require this adapter.

Connecting the IR blaster

Use the IR blaster if your satellite receiver or cable box does not support serial cable.

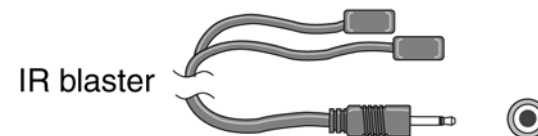
1. Locate the infrared detector on your cable box or satellite receiver.

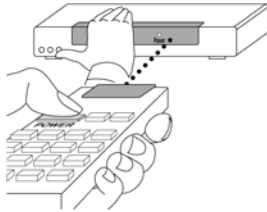
The infrared emitter at the end of the IR blaster must be placed directly over the infrared detector on your cable box or satellite receiver. The infrared detector receives the signals from the remote control.

If the detector on the unit is not labeled, you can usually find it behind a dark, nearly opaque, plastic area on the front of the unit.

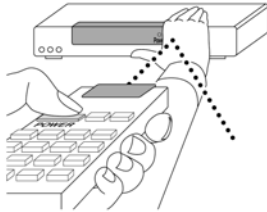
If the infrared detector on the unit is not labeled, follow these steps:

- a. Refer to the owner's manual of your cable box or satellite receiver. It may be shown there.
- b. Look for an area of dark, nearly opaque plastic on the front of the unit. If you find this area, look closely into it. You may be able to see the infrared detector behind it. If it's visible, you should see a small square frame with a reddish area in the center. This is the infrared detector. If you see the detector, skip to "Connect and affix the IR blaster."
- c. Shine a flashlight through the dark plastic area on the front of the unit. If you see the infrared detector, skip to "Connect and affix the IR blaster."
- d. Using the remote control for your cable box or satellite receiver, turn the power on and off. *Don't use the ReplayTV remote control.*
- e. With the remote control in one hand, place the other hand over one section of the front of the unit.





- f. Try to turn the power on and off again. If you succeed, your hand is not covering the infrared detector.
- g. Move your hand to a different place on the front of the unit and repeat steps e and f. Keep repeating in this manner until you can't turn the power on and off. At this point, your hand is covering the infrared detector.



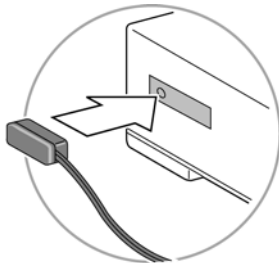
Locating the infrared detector

2. Connect and affix the IR blaster.

- a. Plug the IR blaster into the IR BLASTER connector on the back of ReplayTV.
- b. Peel off the protective cover from one of the emitters on the IR blaster. This will expose the adhesive material on the infrared emitter for placement onto your cable box or satellite receiver.
- c. Affix the adhesive side of the infrared emitter to the dark plastic area directly over the center of the infrared detector.

Note: If you only want ReplayTV to control one device, hide the unused emitter behind the equipment, away from any detectors.

After you have connected the IR blaster, you will need to provide ReplayTV with the setup code number for your cable box or satellite receiver. You will do this during the on-screen Quick Setup setup process.



Affix the IR blaster directly over the infrared detector

Completing the on-screen setup

After completing all of the connections, you will need to complete ReplayTV's on-screen setup.

Note: ReplayTV will automatically search for and find an IP address. If an IP address is not automatically found, you will have to enter it manually. Refer to "Connecting ReplayTV to a home network" on page 13 for details.

During the on-screen setup you will:

- Enter your ZIP code so you'll receive the correct channels for your local area.
- Confirm your video connections.
- Choose the setup codes for your cable box or satellite receiver, so your ReplayTV can change the channels if you have one of these devices connected to your ReplayTV.

Chapter Three: Watching and Recording Television

Your ReplayTV gives you the power to watch television the way you've always wanted. Create your own channels, watch only what you want to watch, and do it all on your own schedule—not someone else's.

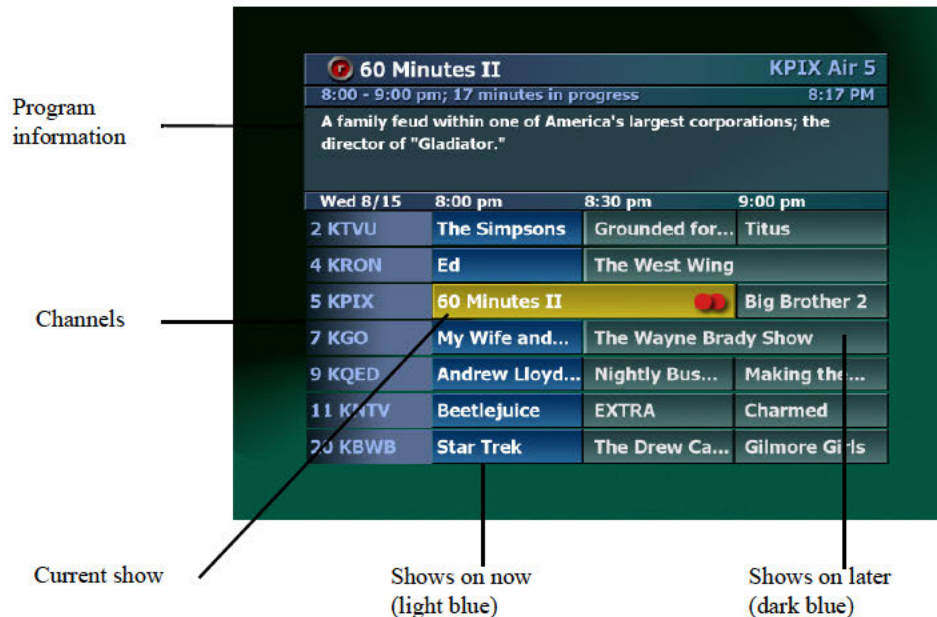
ReplayTV makes recording your favorite shows easy. Your ReplayTV lets you quickly find and record single shows, continuously record every episode of your favorite shows, and record shows based on themes you create or from Replay Zones—categories of shows organized and updated by the ReplayTV Service.

By taking advantage of the Ethernet connection, you can send your recordings to other ReplayTV 4000 users over the Internet. And if you have more than one ReplayTV 4000 on your local network, you can watch a show in one room that was recorded in another room.

Please note: Although your ReplayTV does not need to be on to record television, your cable box and/or satellite receiver must remain on.

Accessing the Channel Guide

The Channel Guide is an interactive, on-screen program guide that lists 12 days of television programming for all of the channels you receive. Your ReplayTV downloads the latest Channel Guide information from the ReplayTV Service each day. As long as you keep an active Ethernet line plugged into ReplayTV, you'll always have 12 days of the most current listings available.



Program information: When available, program information can include show title, scheduled airtime, episode title, FCC rating, episode description, and actors' names.

Program information includes the time the show ended. ReplayTV will display up to 24 hours of previously broadcast programming. If you missed a show, you can select it in the Channel Guide and instruct ReplayTV to search for all the episodes that are scheduled to air. Then, you can schedule ReplayTV to record a future airing of the show.

Channels: Indicates the broadcast station for each particular channel.

Shows: Shows that have been broadcast appear grey. Shows that are on now are light blue. Shows that are airing in the future are dark blue.

Using the Channel Guide

1. Press CHANNEL GUIDE on the ReplayTV remote control.

Or

2. Press MENU, then select **Channel Guide**.

Navigate through the Channel Guide by pressing the UP, DOWN, LEFT and RIGHT ARROW buttons. Notice the program information changes to display the information for the currently highlighted show.

- To jump ahead 12 hours, press the FF button.
- To go back 12 hours, press the REW button.
- To move one screen at a time, press the PAGE ▲ / ▼ buttons or the CHANNEL ▲ / ▼ buttons.
- To go to a channel, enter the channel number and press the SELECT button.
- To tune to a channel, highlight the channel and press the SELECT button.

Watching a show that is currently airing

1. Press CHANNEL GUIDE.
2. Highlight a light blue show.
3. Press SELECT.

ReplayTV will tune directly to the channel you selected unless another channel is currently recording.

Channel Guide options

Depending on the type of channel you have selected, the following options may be available when you press SELECT with a channel highlighted:

Record this show: Schedule the selected show to record.

Change record options: Adjust the recording options.

Turn off record: Turn off a scheduled recording.

Find all episodes: Locate all episodes of the show that are scheduled to air.

Tune to channel "X": Tune your television to the highlighted channel.

Exit: Exit the Channel Guide pop-up menu.

Viewing other show information

You can see what's on a current channel and see what's on other channels while watching live TV by doing the following:

- Press the RIGHT ARROW button to see information about the show you're currently watching. Press the RIGHT ARROW button repeatedly to view information about future shows on the current channel.
- Press the UP ARROW button to see what's on the next channel and the DOWN ARROW button to see what's on the previous channel.

Note: To clear the display, press EXIT or wait about 15 seconds.

Watching shows blocked by V-Chip technology

Although ReplayTV supports V-Chip technology, your TV controls the actual V-Chip settings. Your TV may display a message that the current program is blocked. If you want to watch or record a show that is blocked, you will need to unlock the parental control on your TV. Refer to your television owner's manual for more information.

Watching shows with closed-captioning

ReplayTV records closed caption information. To view the closed captioning for a live or recorded show, enable the feature as you normally would on your TV.

Parental Control

Parental Control offers you the ability to block video and audio of live TV shows or recorded shows based on the show rating or content. In addition, it allows blocking of specific channels.

To access Parental Control:

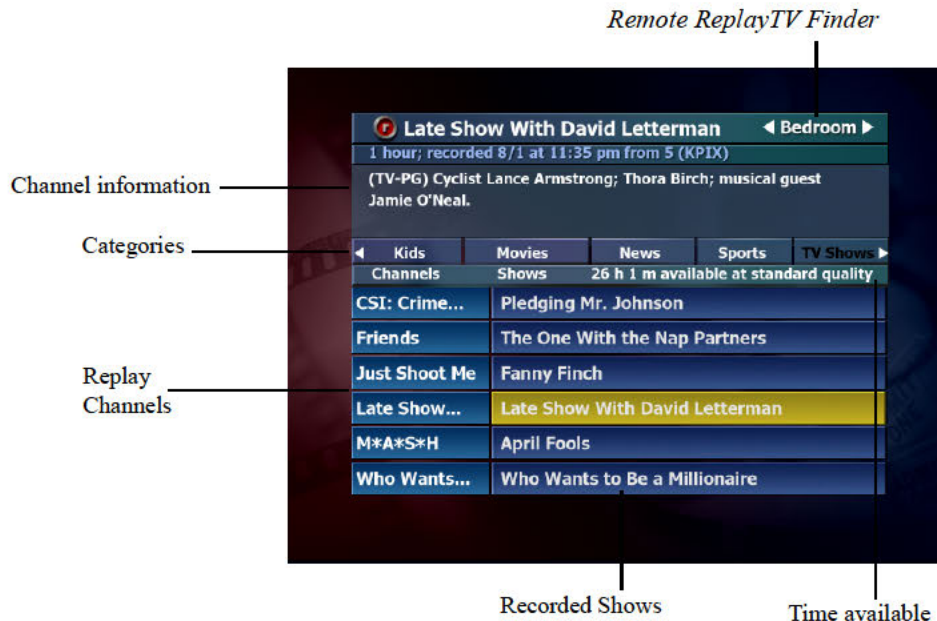
1. Press MENU on the ReplayTV remote control.
2. Select **Setup**.
3. Select **Parental Control**.

A screen will be displayed where you will be able to create or edit your 4-digit PIN (Personal Identification Number). Once you have created a new PIN or entered the correct PIN a new screen will be displayed with the following options:

- **Ratings and contents settings:** Allows you to choose which movie ratings, TV ratings, and content to block. Also, unrated shows can be blocked. Info Screens with definitions of all movie and TV ratings are easily accessible.
- **Change channel restrictions:** Blocks specific channels. Channel blocks have priority over “rating” and “content” blocks. If, for instance, you unblock a channel, you remove all blocks until you change to another channel. All blocks would again be active when you return to the channel.
- **Turn ON Parental Control:** Turns Parental Control on/off.
- **Change PIN:** Displays a screen where the PIN can be edited.
- **Exit:** Exits the Parental Control screen.

Using the Replay Guide

Think of the Replay Guide as your personal television station, broadcasting only the shows you want to watch. You can find every show that your ReplayTV has recorded in the Replay Guide. From the Replay Guide, you can schedule, play, and delete recorded programs. ReplayTV also allows you to place your recorded shows into Categories, either predefined or that you create, for easy management.



Remote ReplayTV Finder: View and play shows from other in-home networked ReplayTV 4000s. This is only available if more than one ReplayTV is on your network. See page 56.

Program information: When available, program information about the show is displayed.

Categories: Choose from provided Categories or create your own to store and organize your recorded shows. See “Category options” on page 26.

Replay Channels: The channel associated with scheduled and recorded shows. Replay channels control how shows are recorded. See page 43.

Recorded Shows: Shows that have been recorded. Every show that your ReplayTV records or has scheduled to record can be found in the Replay Guide. See page 27.

Available Recording Time: Displays the amount of recording time currently available at the default record quality.

- **Navigating the Replay Guide:**
 1. Press REPLAY GUIDE on the ReplayTV remote control.
Or
 2. Press MENU, then select **Replay Guide**.

Navigate through the Replay Guide by pressing the UP, DOWN, LEFT and RIGHT ARROW buttons. When navigating through shows within a category, notice the program information changes to display the information for the currently highlighted show.

Use the UP and DOWN ARROW buttons to move among **Channels and Shows, Categories**, and the **Remote ReplayTV Finder**. You can also use the JUMP button to quickly go to and from each area within the Replay Guide.

Note: If there is only one ReplayTV on the network, the Remote ReplayTV Finder will be inaccessible.

Category options

Rename category: Change the name of a category.

Create new category: Add a new category to the Replay Guide.

Move left: Move the category to the left.

Move right: Move the category to the right.

Note: The **All Shows** category contains every show ReplayTV records and cannot be deleted.

Watching a recorded show

1. Press **REPLAY GUIDE** on the remote control.
2. Select a category.
3. Highlight the show.
4. Press **SELECT**.
5. Select **Play** or **Play from beginning**.

Replay channel options

Depending on the type of channel you have selected, the following options may be available.

Change record options: Adjust the recording options.

Rename channel: Create a new name for the channel.

Change category: Move the selected Replay channel to another category.

Find all episodes: Locate all episodes of the Replay channel.

Delete: Delete the selected Replay channel.

Exit: Exit the Replay channel pop-up menu.

Replay channels

Every show you record becomes a Replay channel and is stored in a category you choose. Show-based and single-record channels store recordings of specific shows. Zone- and Theme-based channels store recordings based on common Zone or keyword themes. Understanding the difference between Show-based recordings and Zone or Theme-based recordings is the key to making sure your ReplayTV records what you want to see most.

Guaranteed and non-guaranteed recordings

Think of recording space on your ReplayTV like a parking lot. Guaranteed recordings are given reserved parking spaces as soon as they are scheduled. Non-guaranteed recordings do not get reserved spaces and have to find a place to park. Non-guaranteed recordings park in reserved spots, but they will be promptly towed if a guaranteed recording needs to park. After all, the non-guaranteed recording was parking in the guaranteed recording's spot.

Recording priorities

If you have created many Replay channels, it is possible that eventually two scheduled recordings will conflict with each other.

The following recording priorities are numbered from highest priority to lowest:

1. Guaranteed Single-record and Show-based recordings

If a change in television schedules puts guaranteed Show-based channels into a recording conflict with each other, the Replay channel created first will be recorded.

2. Guaranteed Zone- and Theme-based recordings

If two or more Guaranteed Zone- or Theme-based recordings start at the same time, the show airing on the lowest-numbered Channel Guide channel will be recorded.

3. All non-guaranteed recordings

If two or more non-guaranteed recordings overlap recording times, the show that starts first will be recorded.

If two or more non-guaranteed recordings start at the same time, Show-based recordings take priority over Zone- and Theme-based recordings.

4. Non-guaranteed Single-record and Show-based recordings

If two or more non-guaranteed Show-based recordings start at the same time, the show airing on the Replay channel created first will be recorded.

5. Non-guaranteed Zone- and Theme-based recordings

If two or more non-guaranteed Zone- or Theme-based recordings start at the same time, the show airing on the lowest-numbered Channel Guide channel will be recorded.

Show-based and Single-record channels

Guaranteed Show-based channels record every time a show is on at or near the time you specified, on the channel you specified. Recorded Show-based episodes will be recycled to make room for a new episode when the channel is full.

Single-record channels will not be recycled until you delete them.

Non-guaranteed Show-based channels behave exactly like guaranteed Show-based channels except:

1. Non-guaranteed Show-based channels will not record if recording space does not permit.
2. Non-guaranteed Show-based channels will be recycled if a guaranteed recording needs space.

If you set a Show-based channel to record all episodes, the oldest episode will be recycled to make room for a new episode when the channel is full.

Zone-based channels

Guaranteed Zone-based channels are configured to hold a specific amount of programming (1/2 hour, 2 hours, etc.). Twenty-four hours after being recorded, the oldest program will be recycled to make room for a new program when the channel is full.

Non-guaranteed Zone-based channels behave exactly like guaranteed Zone-based channels except:

1. Non-guaranteed Zone-based channels will not record if recording space does not permit.
2. Non-guaranteed Zone-based channels will be recycled if a guaranteed recording needs space.

Theme-based channels

Guaranteed Theme-based channels are configured to hold a specific amount of programming (1/2 hour, 2 hours, etc.). Twenty-four hours after being recorded, the oldest program will be recycled to make room for a new program when the channel is full.

Non-guaranteed Theme-based channels behave exactly like guaranteed Theme-based channels except:

1. Non-guaranteed Theme-based channels will not record if recording space does not permit.
2. Non-guaranteed Theme-based channels will be recycled if a guaranteed recording needs space.

Recording tips

To get the most out of your ReplayTV, follow these recording tips:

- **Guarantee shows you don't want to miss**

If you absolutely do not want to miss a show, make sure it is scheduled as a guaranteed Single-record or guaranteed Show-based recording.

- **Record in High quality sparingly**

The High quality setting provides the highest quality picture, but uses the most recording space. Recording in Medium quality should be adequate for most of your recording needs. The High quality setting is best used for sporting events, fast-action movies, and other shows where picture quality is vital.

- **Delete shows after you watch them**

To increase the likelihood of your non-guaranteed shows being recorded, delete shows from the Replay Guide after you watch them. The more available space, the more shows your ReplayTV can record.

Replay Zones

You can quickly and easily find what's on TV, organized in user-friendly categories, in ReplayTV's Replay Zones. Zone-based channels can hold a specific amount of programming (1/2 hour, 2 hours, etc.).

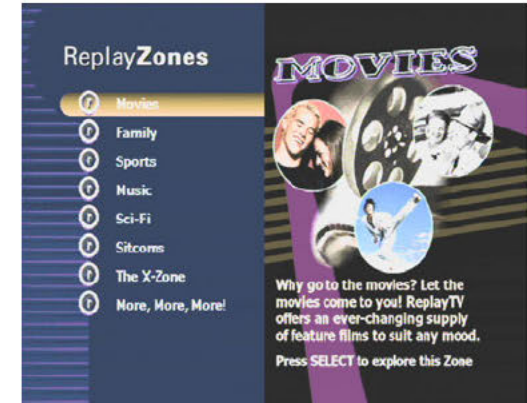
Non-guaranteed Zone-based channels behave exactly like guaranteed Zone-based channels except:

- Non-guaranteed Zone-based channels will not record if recording space does not permit.
- Non-guaranteed Zone-based channels will be recorded over if a guaranteed recording needs space.

Note: See “Guaranteed and non-guaranteed recordings” on page 28 for more information.

To record a show from a Replay Zone:

1. Press REPLAY ZONES on the ReplayTV remote control.
2. Select a **Replay Zone**.
3. Select a **category**.
ReplayTV will search through your channel listings for shows appropriate to the channel.
4. Select **Create the “Zone Channel.”**
5. Set Record Options. Refer to “Setting Record Options” on page 38 for more information.
6. Select **Done**. Your show will be recorded at the scheduled time.



When setting Zone-based Record Options, be sure to **Keep** enough time to record the shows you expect the Zone to find. For example, if you only keep 30 minutes in the Science Fiction Zone channel, the channel will never record a two hour broadcast of *The Matrix*.

Using Find Shows

Your ReplayTV can search through the Channel Guide looking for shows so you don't have to. Find Shows is the perfect feature for those times when there's a show you want to record, but don't know what time or channel it is on. You can also use it to find when your favorite show will air next. You can also use Find Shows to search for a show based on a topic, interest, hobby, show title, or favorite actor or director. Theme-based channels record a specific amount of programming (1/2 hour, 2 hours, etc.) based on keywords that you choose.

1. Press MENU on the ReplayTV remote control.
2. Select **Find Shows**.
3. Enter one or more keywords.
4. Select **Done**.
5. Set Find Shows options.
6. Select **Done**.

ReplayTV will search through your channel listings for shows appropriate to the keyword. If you use multiple keywords, only shows appropriate to both keywords will be listed. Select **Change search options** if you want to change the keyword or search categories.

7. Select **Create the "Keyword(s)" Theme Channel**.
8. Set Record Options. Refer to "Setting Record Options" on page 38 for more information.
9. Select **Done**. Your show will be recorded at the scheduled time.

Recording shows

- **To record the live show you are watching:**
 1. Press RECORD on the ReplayTV remote control.
 2. Set Record Options. See “Setting Record Options” on page 38 for more information on the Record Options.

- **To record a single episode of a show:**
 1. Press CHANNEL GUIDE.
 2. Highlight an upcoming show.
 3. Press RECORD.

- **To record multiple episodes of a show:**
 1. Press CHANNEL GUIDE.
 2. Highlight a show.
 3. Press RECORD.
 4. Press RECORD again.

See “Resolving conflicting recordings” on page 36 if you see a Record Conflict message when setting up a recording.

Recording dots

Solid red dots represent guaranteed recordings.

Hollow dots represent non-guaranteed recordings.

One red dot appears next to a show if your ReplayTV is scheduled to record a single episode; **two red dots** appear if your ReplayTV is scheduled to record all episodes.

Gray dots represent suspended recordings.

See “Recording tips” on page 32 for more information.

Resolving conflicting recordings

ReplayTV allows you to choose what will be recorded when attempting to record a show at the same time as a previously scheduled recording.

When recordings conflict, a Record Conflict screen will appear with the following information:

- A message will indicate that a conflict has been detected between a currently scheduled recording and the new recording you're setting up.
- If you choose to record the new recording, the previously scheduled recording(s) will be cancelled based on the following rules:

<p>New single recording/Scheduled single recording: In this case, the scheduled recording will be cancelled, removing it from the Replay Guide.</p>
--

<p>New single recording/Scheduled repeating recording: In this case, only one instance of the repeating recording will be cancelled.</p>

<p>New repeating recording/Scheduled single recording: In this case, the scheduled recording will be cancelled, removing it from the Replay Guide.</p>

<p>New repeating recording/Scheduled repeating recording: In this case, the scheduled repeating recording will be cancelled for the remaining days currently in the Channel Guide and the conflict will reappear. You may want to see if one of the shows is on at another time.</p>

Note: Gray dots represent suspended repeating recordings.

Using Manual Record

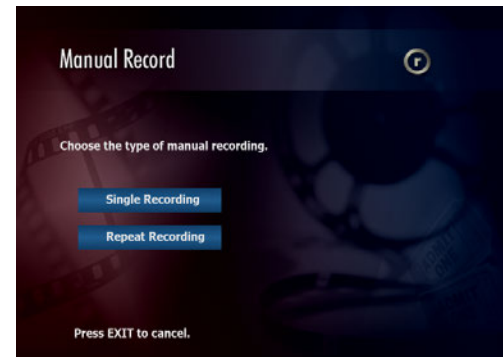
With Manual Record, you can record shows that do not fit into normal programming blocks, such as sporting events, music videos, 24-hour news streams, or when you only want to record a few minutes of a show. This feature also allows you to record your home videos from a video camera or VCR so you can watch them using ReplayTV. And, if you know another ReplayTV 4000 user, you can send your home videos to friends and family.

Recording by date, time and channel

Select **Manual Record** from the Main Menu and follow the on-screen instructions. You will be asked to choose single or repeat recording, date, time, and channel. You will also be able to record from an input other than the current input.

Recording and sharing home videos from a video camera or VCR

1. Select **Manual Record** from the Main Menu and choose **Single Recording**.
2. Set the date and time you want the recording to begin. Continue to the screen where you choose which channel to record from, and press DISPLAY.
3. Choose the input source that the video camera or VCR is connected to. See “Connecting a video camera or VCR to ReplayTV” on page 12 for more information.
4. Turn on your video camera or VCR before the scheduled recording time you set up.
5. ReplayTV will begin recording at the scheduled time you set up. Once the recording is completed, go to the Replay Guide to watch your video. See “Sending shows” on page 60 to send your videos to other ReplayTV 4000 users.



Setting Record Options

There may be times when you want to adjust the Record Options for a specific show. For example, you might want to record action movies or sporting events at higher quality than television shows.

When you record a show while watching it, or select a show to record in the Channel Guide, you will be asked to set the Record Options. See “Changing the Default Record Options” on page 40 for more information on ReplayTV’s Default Record Options.

To change Record Options, highlight the setting and press SELECT or the LEFT or RIGHT ARROW buttons on the remote control.

Record Options settings

Record Quality: Choose **Standard**, **Medium**, and **High**.

- **Standard:** Uses the least amount of recording space, but records at a level that is not recommended for shows with many fast action scenes.
- **Medium:** Offers excellent picture quality but uses more recording space than Standard quality recordings.
- **High:** Provides the highest quality recording but uses the most recording space.

Notice that the recording space (hours and minutes available) changes as you adjust the recording quality. The higher the recording quality is set, the less recording space is available for recording. To conserve space, use the High setting sparingly, for example to record fast-action shows where quality is vital.

Guaranteed: Choose **Yes** and **No**. Yes means space will be reserved for this show. No means the show will record only if space is available and it does not conflict with a guaranteed show.

Store in Category: Select a category, either predefined or that you create, to store the recorded show.

Create new Category: Create a new category for storing recorded shows.

Record All Episodes: Choose **Yes** or **No**. Yes will set your ReplayTV to record the show every time it is broadcast. No will set your ReplayTV to record only one episode.

Keep: (If you select **Record All Episodes**) **Yes**, you will need to set how many episodes your ReplayTV should keep before the most current episode is recorded over the oldest episode.

More Options

Access **More Options** from the Record Options screen to ensure a program will be recorded in its entirety, even if it runs before or after its scheduled time, or if the broadcaster's schedule does not match perfectly with ReplayTV's Channel Guide. You can also choose which days a show will record to minimize conflicts.

Extending recording time: Some shows don't always start and end at their scheduled times. Set the amount of time you want ReplayTV to record before or after the scheduled show airs. Options range from one minute to 240 minutes.

Adjustable Recording Days: Set recording days. Checked boxes indicate the days of the week the show will be recorded.

- To change More Options settings:
 1. Highlight a Replay channel in the Replay Guide.
 2. Press the SELECT button.
 3. Select **Record Options**.
 4. Select **More Options**.
 5. Adjust the settings.
 6. Select **Done**.

Changing the Default Record Options

If your ReplayTV does not require you to set record options when you schedule a show recording, the show will be recorded using your Default Record Options.

1. Press MENU button on the ReplayTV remote control.
2. Select **Setup**.
3. Select **Default Record Options**.
4. Adjust the options.
5. Select **Done**.

Canceling a recording

- **To cancel a recording before it starts:**

1. Press CHANNEL GUIDE on the ReplayTV remote.
2. Highlight the show you want to cancel.

You'll know it's set to record because at least one red dot will appear next to the show.

3. Press SELECT.
4. Select **Turn off record** from the on-screen menu.

- **To cancel a recording in progress:**

1. Press STOP on the ReplayTV remote and follow the on-screen instructions.

- **To delete a recorded show in your Replay Guide:**

1. Press REPLAY GUIDE on the ReplayTV remote.
2. Highlight the show you want to delete.
3. Press SELECT.
4. Select **Delete**.

Preserving an episode of a show

If you have scheduled ReplayTV to record all episodes of a particular show or to record a Zone- or Theme-based channel, eventually the most current episode will be recorded over the oldest episode. ReplayTV lets you preserve episodes to prevent them from being recorded over before you watch them.

- **To preserve a recording:**
 1. Press REPLAY GUIDE on the ReplayTV remote.
 2. Highlight the show you want to preserve.
 3. Press SELECT.
 4. Select **Preserve this episode**.

If recording space permits, the show will be moved from its current Replay channel and saved in the Replay Guide.

Saving recordings to videotape

Your ReplayTV is not intended to be used as a long-term storage device. You can free up more recording space by transferring your recordings to videotape and watching them on your VCR.

Before saving a recording to videotape, make sure your VCR is connected properly to your ReplayTV. See “Connecting ReplayTV to a VCR” on page 14 for more information.

- **To save a recording to videotape:**

1. Turn on your VCR.
2. Insert a videotape into your VCR.
3. Press REPLAY GUIDE.
4. Highlight the recording you want to save to videotape.
5. Press SELECT.
6. Select **Save to VCR**.
7. Select **Continue** to start the countdown.
8. Press Record on your VCR.

Note: While the recording is being saved to videotape, do not press any buttons on the ReplayTV remote control. On-screen displays will be recorded if they appear.

Chapter Four: Controlling Television

ReplayTV gives you the power to control live television. You can pause shows whenever you want, rewind live broadcasts, create your own slow-motion replays, and bypass unwanted programming 30 seconds at a time.

And of course, these great features also work with shows that your ReplayTV records.

Controlling live television

The moment you turn on your TV, ReplayTV automatically begins recording and temporarily preserves the recording on its hard drive. ReplayTV will continue to record even if you delay the broadcast by using the pause, rewind, or Instant Replay features. Recording only stops when you change channels and begin watching a different show.

Pausing live TV and recorded shows

ReplayTV's pause feature lets you attend to interruptions without missing a moment of your favorite show. You can pause whatever you're watching, whether it's a live television broadcast or a recorded show in the Replay Guide. When you pause a live broadcast, ReplayTV will continue recording it on the hard drive, so you won't miss a single moment.

1. Press PAUSE on the ReplayTV remote control.
After you press PAUSE, an on-screen message will appear to indicate the remaining pause time available.
2. Press PLAY to continue playing the program from the point you paused.
or
3. Press RETURN TO LIVE to return to the live broadcast.

Pause options include:

Press DISPLAY to view program information.

Press EXIT to remove the on-screen display.

Press FAST FORWARD to use the frame advance feature.

COMMERCIAL ▶▶ ADVANCE®

If you ever wanted to watch TV without commercials, then COMMERCIAL ADVANCE is what you've been waiting for. COMMERCIAL ADVANCE is a feature that allows you to choose whether to skip most commercial messages during playback of recorded shows. Commercials are still recorded with COMMERCIAL ADVANCE enabled, though you now have the choice to watch them or not—automatically.

Commercials will not be skipped during the first and last two minutes when playing back recorded shows. This is to prevent confusion when playback is first started. Additionally, shows delayed within a few minutes of the live broadcast will not skip commercials, even if COMMERCIAL ADVANCE is enabled. You can still watch recorded shows with commercials by turning COMMERCIAL ADVANCE off.

Note: Due to variations in the video stream while using a standard antenna, there may be instances when the COMMERCIAL ADVANCE feature will not properly detect commercials.

Setting COMMERCIAL ADVANCE default

Follow these steps to set your default to play back each show commercial free. If you do this, you won't have to enable COMMERCIAL ADVANCE for each individual show.

1. Press MENU on the ReplayTV remote control.
2. Select **Setup**.
3. Select **Default Playback Options**.
4. Set the **Skip commercials** option to **Yes** to enable the COMMERCIAL ADVANCE feature.



Show Popup menu

Turning COMMERCIAL ADVANCE on and off for individual recorded shows

Follow these steps to turn COMMERCIAL ADVANCE on and off for individual recorded shows.

1. Highlight a show in the Replay Guide and press SELECT to display the show's pop up menu.
2. Highlight the **Skip commercials** option and press SELECT to check or uncheck the show.
3. Select **Play** or **Play from beginning** and the show will be played with or without commercials, depending on the setting you chose.

Turning COMMERCIAL ADVANCE on and off while watching a show

To switch between skipping and viewing commercials while watching a show, press the AUTOSKIP or CA SKIP button on the remote control. Keep in mind that the following still apply:

- Commercials will not be skipped during the first and last two minutes when playing back a recorded show.
- Shows delayed within a few minutes of the live broadcast will not skip commercials.

Using Rewind and Fast Forward

ReplayTV gives you the power to Rewind or Fast Forward through both live and recorded programs. When using Rewind and Fast Forward, remember how your ReplayTV works: ReplayTV is always recording, but recording will stop, and then start again, whenever you change channels. You cannot rewind a program to a point before you started watching it, nor can you fast forward a program to a point beyond the live broadcast.

- **To use Rewind while watching a show:**
 1. Press REW (Rewind) for 1x rewind.
 2. Press REW again for 2x rewind.
 3. Press REW again for 4x rewind.
 4. Press REW again for 16x rewind.
 5. Press REW again for 20x rewind.
 6. Press PLAY, STOP, or FF (Fast Forward) to stop rewinding.

- **To use Fast Forward while watching a show:**
 1. Press FF (Fast Forward) for 1x fast forward.
 2. Press FF again for 2x fast forward.
 3. Press FF again for 4x fast forward.
 4. Press FF again for 16x fast forward.
 5. Press FF again for 20x fast forward.
 6. Press PLAY, STOP, or REW (Rewind) to stop fast forwarding.

Using Multispeed Slow Motion

ReplayTV lets you watch both live and recorded programs in multispeed slow motion.

- **To use Multispeed Slow Motion while watching a show:**

1. Press PLAY for 1x slow motion.
2. Press FF for 2x slow motion.
3. Press FF again for 3x slow motion.
4. Press REW (if in 2x or 3x slow motion) to move back one slow motion speed.

- **To stop Multispeed Slow Motion:**

1. Press PLAY to playback at normal speed.
Or
2. Press RETURN TO LIVE to return to the live broadcast.

Using Frame Advance

Frame Advance lets you watch live or recorded programs a single frame at a time. This is a great feature for fast-moving scenes, such as sporting events, when you want to slow things down and see every frame.

- **To use Frame Advance while watching a show:**

1. Press PAUSE.
2. Press FF to advance a single frame.
3. Repeatedly press FF to advance frame-by-frame.

- **To stop Frame Advance:**

1. Press PLAY to resume playback at normal speed.
Or
2. Press RETURN TO LIVE to return to the live broadcast.

Using Instant Replay

The Instant Replay feature lets you jump back seven seconds during a live or recorded show. It's the perfect way to ensure you don't miss a single word of dialogue in your favorite movie, or if you want to watch a great play over again at the touch of a button.

You can also use the number buttons to jump back a specific number of minutes. For example, pressing the numbers 1-0 and then the INSTANT REPLAY button will jump back exactly 10 minutes.

- **To use Instant Replay while watching a show:**
 1. Press INSTANT REPLAY on the ReplayTV remote control.
 2. Press RETURN TO LIVE if you want to return to the live broadcast.

Using QuickSkip

You can use the QuickSkip feature to quickly jump 30 seconds ahead during live or recorded shows. QuickSkip is perfect for jumping past commercials and undesired scenes without having to watch them as you would using fast forward. QuickSkip can only be used during live broadcasts if you are watching the show delayed by more than 30 seconds.

You can also use the number keys to jump ahead a specific number of minutes. For example, pressing the numbers 1-0 and then the QUICKSKIP button will jump ahead exactly 10 minutes.

1. Press QUICKSKIP.
2. If you jump forward too far, simply press INSTANT REPLAY to jump back.

Using Jump

Use Jump to move quickly between the channel you are currently watching and the last channel displayed. This includes jumping between two recorded shows and a recorded show and a live show. You can also Jump to an exact point in a recorded show.

- **To use Jump while watching a show:**
 1. Press JUMP to move to the last channel displayed.
 2. Press JUMP again to return to the channel you were watching.

You can also go to an exact point in a show using JUMP. For example, to go to the ten minute mark in a show, press the numbers 1-0 and then the JUMP button.

Chapter Five: Networking

By connecting your ReplayTV to your home network, you can send a recording from one ReplayTV to another ReplayTV via the Internet and watch a show in the bedroom that was recorded in the living room. You can also transfer digital photos between your PC and ReplayTV by installing the ReplayTV Photo Transfer Software for Microsoft®

Windows Explorer available at www.sonicblue.com/replaytv.

ReplayTV must have its own IP address, which means you will need at least two IP addresses; one for your PC and one for ReplayTV. To attain this your home network must have one of the following scenarios:

1. A DSL or Cable modem that supplies more than one IP address.
2. A DSL or Cable modem and a router.

Note: For best performance, it is recommended that you have an upstream connection of at least 128k. Internal and external network activity can affect transfer time. Your DSL or Cable modem connection should supply this connection speed.

Playing shows from another in-home ReplayTV

If you have more than one ReplayTV in your home on your network, you can play shows from another ReplayTV by remotely accessing its Replay Guide. Each ReplayTV on the network must have a unique name (Living Room, Kid's Room, Master Bedroom, etc.). You can choose from the list of default names or create your own. Select **ReplayTV Name** from the Setup menu if you want to rename your ReplayTV.

Note: Although it is technically possible to watch a show from one ReplayTV on multiple remote units at the same time, for best results it is recommended that the video stream be sent to only one ReplayTV at a time.

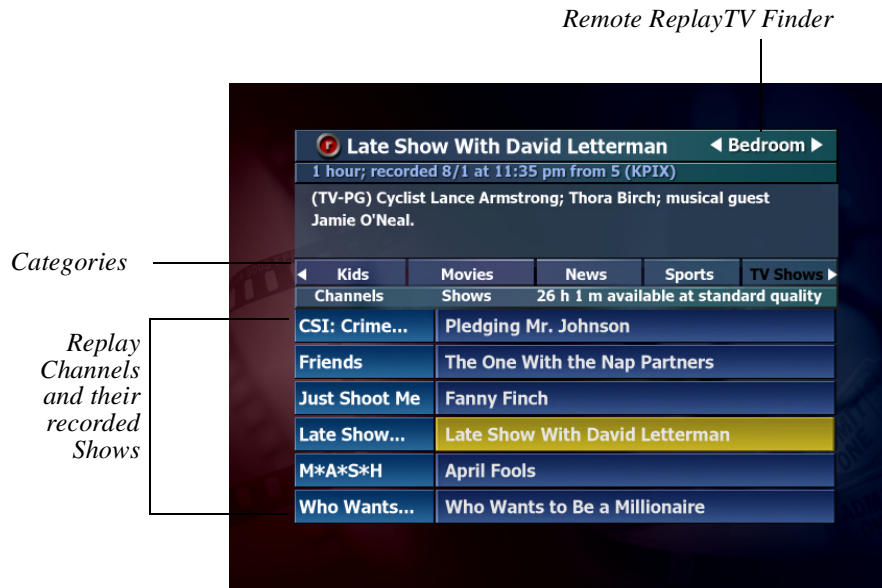
In addition to browsing remote guides, you will be able to:

- Play a show on a remote ReplayTV from your local unit.
- Delete a show on a remote ReplayTV from your local unit.

Local/remote Replay Guide selection

If more than one ReplayTV exists on the network, you will see left and right arrows next to the ReplayTV name in the upper right hand corner of the Replay Guide. This is called the **Remote ReplayTV Finder**. From here, you can access other networked ReplayTVs in your home.

Note: If there is only one ReplayTV on the network, the left and right arrows will not be displayed next to the ReplayTV name.



To access a remote ReplayTV:

1. Use the UP ARROW or JUMP button to move to the Remote ReplayTV Finder.
2. Use the RIGHT and LEFT ARROW buttons to choose a remote ReplayTV that is connected to the network.
3. Access the category you want to browse.
4. Use the DOWN ARROW or JUMP buttons to access the shows in the category.
5. Highlight a show you want to watch and press SELECT.

Operations on remote shows

Play: Plays the selected show from its current point.

Play from beginning: Plays the selected show from the beginning. This option will only be available for remote shows that have already been played on this ReplayTV.

Delete: Deletes the selected show.

Note: If the selected show is currently recording or being played by another user, you cannot delete the show.

- Pressing STOP while watching a remote show that is currently recording will stop playback but not stop the recording.
- A show that is being played by another user cannot be deleted from the Replay Guide.

Sending recordings to other ReplayTV users

ReplayTV allows you to send recordings—including shows you record and home videos—to other ReplayTVs over the Internet. To send a recording to another ReplayTV user you must first enter their Internet Serial Number in your Internet Address Book.

Adding other ReplayTV users to your Internet Address Book

1. Get the Internet Serial Number from the other user. (The Internet Serial Number is the 15-digit number on the Internet Address Book.)
2. Select **Setup** from the Main Menu and choose **Internet Identity and Address Book** from the Setup screen.
3. Select **Add Entry** from your Internet Address Book.
4. Using the number buttons on the remote control, enter the Internet Serial Number of the other ReplayTV on the **Add Entry to Internet Address Book** screen, then select **OK**.

The remote Replay will be contacted, followed by a screen confirming the addition. If successful, you can now send your recordings to the added ReplayTV.

Sending shows



The **Send show** option on a show's pop up menu will be available after a show has completed recording.

1. Highlight the show you want to send and press SELECT.
2. Select **Send show** from the pop up menu. A new screen entitled Select Show Recipients will appear. This screen contains a list of all users in your Address Book. The list will contain the names of other ReplayTVs you have added to your Internet Address Book and their ReplayTV name and Internet Serial Number.
3. Check the box next to the user you want to send the show to.
4. Select **Send**. If all information is correct, confirm the send.

Using the Received category

Shows that have been sent to you from other users are stored in the **Received** category. Selecting a show will display the sender's name and information about the show. You cannot view the show until you choose to accept it.

1. To accept a show, highlight the show and press SELECT.
2. Select **Accept show** to initiate transmission to you.

If the sender has deleted the show, a message will be displayed stating that the show is not available. If the sender deletes the show while it is being transmitted, the transmission will be cancelled. The show title bar will be a different color when the transmission is complete.

Note: The standard show menu options will be available after the download starts.

Accessing the Internet Address Book

1. Press MENU.
 2. Select **Setup** from the Main Menu.
 3. Select **Internet Identity and Address Book** from the Setup screen.
- The first time you enter the Internet Address Book you will be prompted to name your ReplayTV. This screen will display your ReplayTV's Internet Serial Number and prompt you to enter a name to identify your ReplayTV on the Internet. This name is different than its in-home network name. After entering a name, the Internet Address Book will open.

The Internet Address Book has the following options:

Add Entry: This option lets you add a friend's Internet Serial Number to your Address Book so you can send recordings to each other. Selecting this option displays a new screen where you will be prompted to enter the Internet Serial Number of the entry you wish to add. Once entered, your ReplayTV will contact the remote ReplayTV to retrieve its name and the entry will be added to your Address Book.

Change Internet Identity: Selecting this option lets you change the name of your ReplayTV and specify the port number of your router's firewall that will allow others to send you shows.

To change the ReplayTV name:

- Type in a new name for your ReplayTV using the on-screen keyboard. Your ReplayTV's name will not be updated in a remote ReplayTV's Address Book until the next time that unit is contacted.
- The port number is one that you have programmed on your router to open and allows access to your ReplayTV so friends can send you shows directly. Please refer to your router manual for instructions on Port Routing.
- The available range of port numbers must be 00000 or within 01024 and 65535.

Screen saver and pause screen

The screen saver and pause screen feature on the Setup menu allows you to display your digital photos when the screen saver is activated or when you press the PAUSE button. To use your photos, you need to copy them from your PC to your ReplayTV via your LAN (Local Area Network) using the ReplayTV Photo Transfer software. See “Installing ReplayTV Photo Transfer” on page 64. The photos are stored in the Photo Viewer once you have copied them to your ReplayTV.

Your ReplayTV is equipped with an Ethernet port to connect to your LAN.

There is a default screen saver if you don't want to use your own photos. The screen saver will be activated if there is no input from the ReplayTV remote control or front panel and the following circumstances apply:

1. Live TV is stopped or paused for 10 minutes.
2. A ReplayTV screen (Main Menu, Channel Guide, etc.) is displayed on the screen for 10 minutes.

To access the screen saver and pause screen settings:

1. Press MENU.
2. Select **Setup** from the Main Menu.
3. Select **Screen Saver and Pause Screen** from the Setup menu.
4. Choose which screen saver or pause screen you would like to use.
5. Select **Done**.

Installing ReplayTV Photo Transfer

ReplayTV Photo Transfer is compatible with Windows 98, 98SE, ME, and 2000 and can be downloaded from www.sonicblue.com/replaytv.

The installation process will place a ReplayTV icon on your Window's desktop. Double-click the icon to open a window where all ReplayTVs on the network will be listed. At the end of the installation, you will be able to view and print a "readme" file which explains how the ReplayTV photo hierarchy works.

Note: You can create folders inside the "Photos" folder but not inside of those folders. Each folder can hold a maximum of 200 jpeg photos.

To transfer your photos to ReplayTV, simply copy your photos into the folders that you have created. Each folder (and its accompanying photos) is considered a separate slide show and can be named appropriately: for example, "Fishing" or "Vacation."

The slide show feature is controlled with the Photo Viewer, accessed from the Main Menu. See "Using the Photo Viewer" on the following page.

Using the Photo Viewer

1. Press MENU on your ReplayTV remote.
2. Select **Photo Viewer** from the Main Menu.

Note: You may see a warning message that explains the proper location to store your photos. It will also direct you to a “readme” file for further instruction.

The Photo Viewer will open, listing your available slide shows.

Select the slide show you want to play and press the SELECT or PLAY button on the remote to start playback. The photos in the slide show will be displayed in alphabetical order. The slide show can be controlled by the remote control functions listed below.

FF and REW: Speed up and slow down the presentation.

QUICKSKIP: Move to the next slide.

INSTANT REPLAY: Go back to the previous slide.

PAUSE: Pause the slide show.

STOP: Return to the Photo Viewer.

EXIT: Return to the Photo Viewer.

Note: If PLAY is pressed after STOP, the slide show will begin again from the stopping point.



Appendix A: ReplayTV Remote Control

Appendix A provides instructions for programming the remote control to operate your television and handy remote control shortcuts. To see a diagram of the ReplayTV remote control refer to “Using the ReplayTV remote control” on page 3.

ReplayTV remote control

The ReplayTV remote control is pre-programmed to operate your ReplayTV. It can also be programmed to operate your TV.

Programming the ReplayTV remote to operate your TV

While holding down the TV POWER button, press the two number buttons for the TV you want to control. Don't remove your finger from the TV POWER button when pressing the numeric buttons. TV setup codes are provided on the following page.

Note: The remote only controls the TV's power and volume.

TV setup codes

The following table lists the setup codes for compatible TVs.

Television	Codes
Fisher	10
GE	03
Gold Star	15, 16, 17
Hitachi	12
JVC	11
Magnavox	05
Mitsubishi	07, 13
Panasonic	01, 02
Quasar	01, 02
RCA	03
Samsung	14
Sanyo	10
Sharp	06, 07

Television	Codes
Sony	08
Sylvania	05
Toshiba	09
Zenith	04

Remote control shortcuts

Channel Guide

- To jump ahead 12 hours, press the FF button.
- To go back 12 hours, press the REW button.
- To move one screen at a time, press the PAGE ▲/▼ buttons or the CHANNEL ▲/▼ buttons.
- To go to a channel, enter the channel number and press the SELECT button.
- To tune to a channel, highlight the channel and press the SELECT button.

On-screen keyboard

- To move to the next screen after typing a keyword, press the REC button.
- To erase a character, press the REW button.
- To insert a space, press the FF button.

Show-watching shortcuts

- To go to a specific time within a recorded show, enter the time (for example, 02 to go to the second minute in the show), then press the JUMP button.
Note: Jump times must always be entered in minutes. For example, to jump ahead 1 hour and 10 minutes, type 70 then press JUMP.
- To skip ahead a specific amount of time, enter the time in minutes then press QUICKSKIP.
- To go back a specific amount of time, enter the time in minutes then press INSTANT REPLAY.

Slide show control

- SELECT or PLAY: Start slide show playback.
- FF and REW: Speed up and slow down the presentation.
- QUICKSKIP: Move to the next slide.
- INSTANT REPLAY: Go back to the previous slide.
- PAUSE: Pause the slide show.
- STOP: Return to the Photo Viewer.
 - **Note:** If PLAY is pressed after STOP the slide show will begin again from the stopping point.
- EXIT: Return to the Photo Viewer.

Appendix B: Troubleshooting

If installation was a breeze, setup was a snap, and something is still not right, try the troubleshooting tips on the following pages.

If all else fails, contact ReplayTV's Customer Care Team.

Telephone: (800) 933-5899

E-mail: techsupport@replaytv.com

Troubleshooting

Problem	Solution
<p>ReplayTV is connected to my TV, but I don't see the Quick Setup screen.</p>	<ul style="list-style-type: none"> • Confirm that the correct line input is selected on your TV. (Press the TV/Video button on your TV to cycle through inputs.) • Confirm that ReplayTV is not in standby mode by pressing the ReplayTV button on the remote control. Verify that the red POWER light on the unit is illuminated. • If you are using an A/V receiver in your setup, verify that the input source is the same as the output source going to your television. For example, if you are using an S-Video output to connect your ReplayTV to an A/V receiver, you will need to use an S-Video output to connect your A/V receiver to your TV. This is a limitation of most A/V receivers.
<p>When setting up ReplayTV, the correct cable company does not appear as a menu item in Setup.</p>	<ul style="list-style-type: none"> • Contact ReplayTV Customer Care by phone at (800) 933-5899. Please provide the following information: 1) Complex name (if applicable), 2) Community, 3) State, 4) Cable Provider's Name, 5) Cable Provider contact information, and 6) Problem description. In most cases, the correct information can be added to the ReplayTV Service database within 48 hours.
<p>The ReplayTV remote does not respond when I press a button.</p>	<ul style="list-style-type: none"> • Replace the batteries in the remote control with 2 new AA batteries.
<p>When I select a channel in the Channel Guide, the channel number does not change on my satellite receiver or cable box.</p>	<ul style="list-style-type: none"> • If you're using an IR blaster connection to control channel changing, verify that you have affixed the IR blaster directly over the IR detector on your cable box or satellite receiver. • Confirm that you have selected the correct IR code for your cable box or satellite receiver.

Problem	Solution
When I select a channel in the Channel Guide, I get a blue screen that states “no video source.”	<ul style="list-style-type: none"> • Confirm that you subscribe to the channel in question. • Verify that the A/V connections from your cable box/satellite receiver to ReplayTV are correct. • Verify that all your components are turned on.
When selecting a channel in the Channel Guide, I get a solid blue screen.	<ul style="list-style-type: none"> • Confirm that you have the correct input source specified in Setup. Press MENU. Highlight Setup and press SELECT. Choose Network and Input Settings.
When selecting a show from the Channel Guide, I get a screen that fades to black.	<ul style="list-style-type: none"> • Typically, this is caused by a weak video source. Contact Customer Care for further suggestions at (800) 933-5899.
I'm having problems changing channels.	<ul style="list-style-type: none"> • If your original remote control required an Enter button press when changing channels, press the ENTER button on the ReplayTV remote control after you enter the channel number.
My cable box sometimes fails to change channels when using the ReplayTV remote control.	<ul style="list-style-type: none"> • If you are using the IR blaster, your cable box receives IR commands from both the ReplayTV remote and the IR blaster. Some cable boxes can be confused by this. You can block the commands from the ReplayTV remote control by affixing an opaque covering around the area where you have placed the IR emitter on your cable box. Don't cover the IR emitter.
ReplayTV does not respond when I press buttons on the remote control. Or, the image on my television screen is “frozen.”	<ul style="list-style-type: none"> • Press and hold the POWER button on the front of ReplayTV for 10 seconds, then release. ReplayTV will reboot in a few moments. • Unplug the power cord from the electrical outlet for 15 seconds then plug it back in. ReplayTV will restart and power on in a few moments.

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VHF/UHF IN/OUT (RF)	IN(1)/OUT(1)
VIDEO/AUDIO IN (STEREO) (RCA)	2 LINE
VIDEO/AUDIO OUT (STEREO) (RCA)	2 LINE
S-VHS IN/OUT (S-JACK)	IN(1)/OUT(1)
TELEPHONE JACK (RJ-11)	YES
IR BLASTER PORT	YES
ETHERNET PORT	YES
IR BLASTER	YES
SERIAL PORT (9 PIN)	YES
DIGITAL AUDIO PORT	YES
VGA PORT (480 P)	YES
POWER	120V/60Hz
DIMENSIONS	430mm x 88mm x 353mm



Rio Digital Audio Receiver User Guide

About the User Guide

The Rio Receiver User Guide includes the following sections:

[Introduction](#)

[Getting Started](#)

[Installation:](#)

[The Rio Connector](#)

[The Audio Receiver Manager Software](#)

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[Troubleshooting](#)

[Frequently Asked Questions \(FAQs\)](#)

[Rio Receiver Specifications](#)

[Warranty](#)

[Regulatory Information](#)

[Glossary](#)

[Contacting Customer Care](#)

Navigating and printing the Rio Receiver User Guide

The online Rio Receiver User Guide is in Adobe Acrobat (.PDF) file format.

NOTE: We strongly recommend that you use Adobe Acrobat version 4.0 — available on the CD-ROM — to view and print the Rio Receiver User Guide.

Click [links](#) (blue underlined text) to jump to another location in the document or to a location on the World Wide Web.

Acrobat Toolbar icons



Click the Show/Hide Navigation Pane icon in the Acrobat toolbar to show the Navigation Pane Window and bookmarks in the left column. Bookmarks are links to the contents of the User Guide. Click any bookmark in the list to jump to the page in the User Guide that contains the topic.



Click the Print icon in the Acrobat toolbar to print the User Guide. The size of the User Guide is optimized for printing—to save trees.



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Parts of the software provided with the Rio Receiver™ are covered by the GNU General at www.gnu.org. Under the terms of the license we are required to provide the source code for these components. Source code is provided on CD-ROM in addition to the standard locations.



All other product names may be trademarks of the companies with which they are associated.

First Edition, December, 2000.

Part Number 75550124-002



Introduction

Congratulations on purchasing the Rio Digital Audio Receiver, the simple solution to turning your personal computer into your personal digital audio jukebox. The Rio Receiver streams music from your PC to any room in your house by simply plugging into an available phone jack. It works with your existing speakers and uses your home's existing phone lines to transfer MP3 or WMA music files and playlists anywhere in your house. Download music from the Internet onto your PC, create Playlists of your favorite CDs, and enjoy them with your Rio Receiver.



Package Contents

- Rio Digital Audio Receiver with power cord
- Rio Digital Audio Connector (optional)
- Rio Digital Audio Remote
- 15' standard phone cord
- 6' standard phone cord
- 6' RCA cable
- Rio Receiver Installation CD
 - Audio Receiver Manager software
 - Online manual
 - Adobe Acrobat

System Requirements

- Intel ® Pentium ® 200 MHz MMX or higher CPU
- 32MB RAM
- 16MB free hard drive space
- CD-ROM drive
- PNA networking or Ethernet networking for PC
- Windows 98, 98SE, 2000, Millennium



Safety Information

This product was designed to meet the requirements applicable to the following Directives:

- Low Voltage Directive (72/23/EEC) as modified by amending Directive (93/68/EEC) thereby covering the standards of IEC 950 / EN60905 2nd Edition, 1991+Amd.1, 1992+Amd.2, 1993+Amd.3, 1995+Amd.4, 1996. *Safety of Information Technology Equipment*
- EMC Directive (89/336/EEC) as modified by amending Directive (93/68/EEC) EN55022: A2;1997, EN50082-1: 1992 *Radio Interference and Generic Immunity*

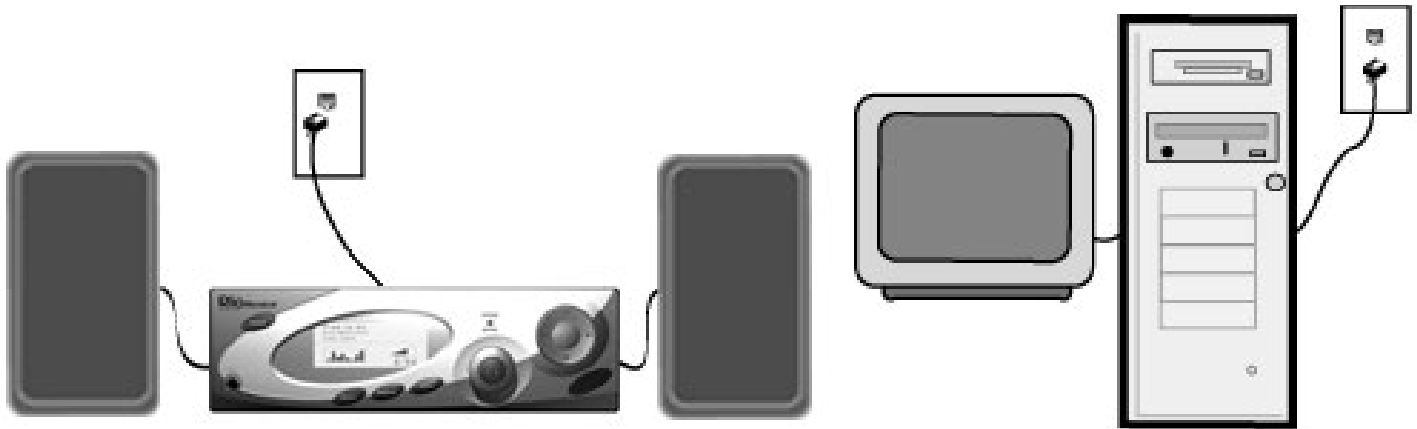
! IMPORTANT SAFETY INSTRUCTIONS

- No Data transmission cables should be connected or disconnected during a thunderstorm.
- Do not open the housing of this product when it is connected to the PSTN, Communication Networks, and/or Local power.
- Use this device only in environments where temperatures don't exceed 95°F.
- Always ensure proper ventilation is possible during use.

CAUTION: To reduce the risk of fire, use only No. 26 AWG (standard phone cord) or larger telecommunication line cord.

Attention courant dangereux à l'intérieur, mettre l'appareil hors tension, déconnecter ethernet et débrancher la ligne téléphonique avant de retirer le couvercle de l'appareil.

Aucun service après-vente pour les pièces détachées à l'intérieur.



Getting Started

You will need the following items in order to install your new Rio Digital Audio Receiver:

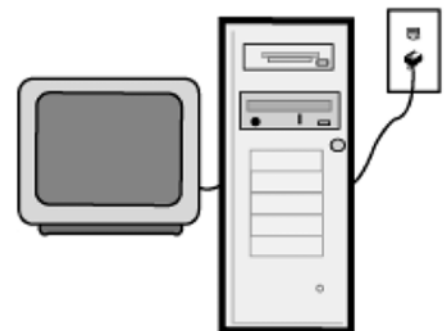
- The Rio Digital Audio Receiver
- The Rio Digital Audio Connector (Optional: If you do not have an existing Home PNA or Ethernet network.)
- 2 Phone cords or Ethernet cable
- Speakers
- 6' RCA cable (Optional: If you choose to plug the Rio Receiver into your home theater system.)
- The Rio Receiver Installation CD
- Your Windows Operating System Installation or Recovery CD

Installation

NOTE: If adding the Rio Receiver to an existing [Home PNA](#) or [Ethernet network](#), skip [The Rio Digital Audio Connector](#) section. Go to [The Audio Receiver Manager Software](#) section instead.

The Rio Digital Audio Connector

1. Remove the computer case and insert the Rio Connector into an available [PCI slot](#). The PCI slots are the white slots at the back of your computer case and they require that you screw the bracket into the computer frame. Make certain the Rio Connector is firmly seated in the PCI slot before replacing the cover on the PC.
2. Plug the included 6' phone cord into the Rio Connector port marked **Line** and into the nearest phone jack. This allows you to use your home phonelines as a network between your PC and your Rio Receiver.
3. Turn on your PC and start Windows. Windows will display a **New Hardware Found** screen and notify you that it has found the Rio Connector.
4. If prompted, place the Rio Receiver Installation CD in the CD-ROM drive and click **Next**. This will prompt Windows to select the Rio Connector's driver from the CD.






NOTE: You should keep your Windows Installation or Recovery CD handy as you may be prompted to load drivers from it.

5. Windows will finish installing the Rio Connector.

The Audio Receiver Manager Software

NOTE: (For pre-existing Home PNA or Ethernet networks only.) Before installing the Audio Receiver Manager software, it is required that all HPNA or Ethernet network connections be made and working correctly so that the Audio Receiver Manager software can properly configure the Rio Receiver's network connection. See the HPNA or Ethernet hardware manufacturer's documentation for instructions on how to install and configure your network.

1. Insert the Rio Receiver Installation CD in the CD-ROM drive.
2. When the Rio Receiver splash screen appears, click the **Software Installation** button.
(If it does not automatically run, click the **Start** button in the bottom left corner of the desktop and then **Run**. Type in *D:\Setup.exe* and click **OK**. If your CD-ROM drive is a letter other than D, replace D with that letter.)
3. Click the **Rio Software** button. The **Installation Wizard** screen will appear.
4. Click **Next**.
You will be prompted to read through the Audio Receiver Manager software license agreement
5. Click **Yes**.
When you are prompted to select the destination folder for the program, we recommend leaving it at the default folder (*c:\Program Files\Audio Receiver*), but you can change the destination folder by clicking the **Browse** button and pointing the installation program to your preferred destination.
6. Click **Next** and then click **Finish**.

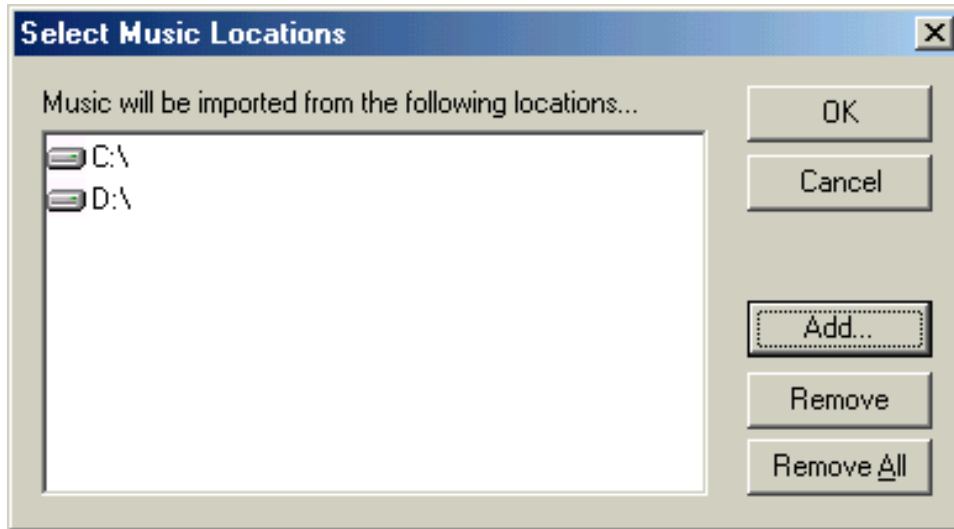
The Audio Receiver Manager will place a red musical note icon  in the PC's system tray in the right bottom corner of the desktop and then prompt you with the following message.



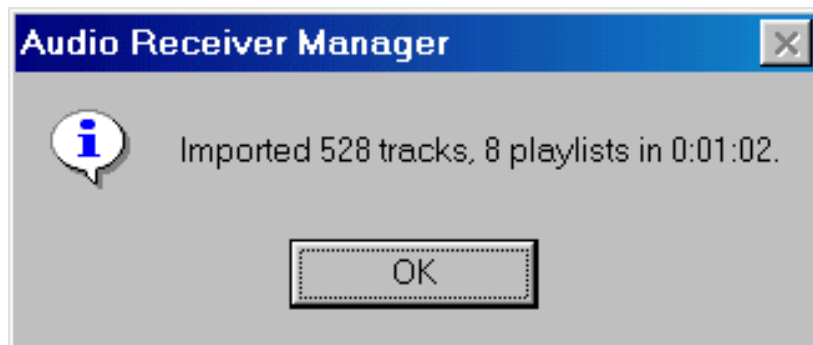
7. Click **OK**. The **Select Music Locations** screen will come on with a list of the hard drives located on your computer.




- Click **OK** and let the Audio Receiver Manager search all of the hard drives, folders, and files on your computer for your digital music files or select the specific hard drives and/or folders that you want the Audio Receiver Manager to search.



Use **Add**, **Remove**, and **Remove All** to adjust where the Audio Receiver Manager searches for your music and click **OK** to start the search. When it finishes searching for music, the Audio Receiver Manager displays the following message with the number of tracks and playlists that it located if any exist:



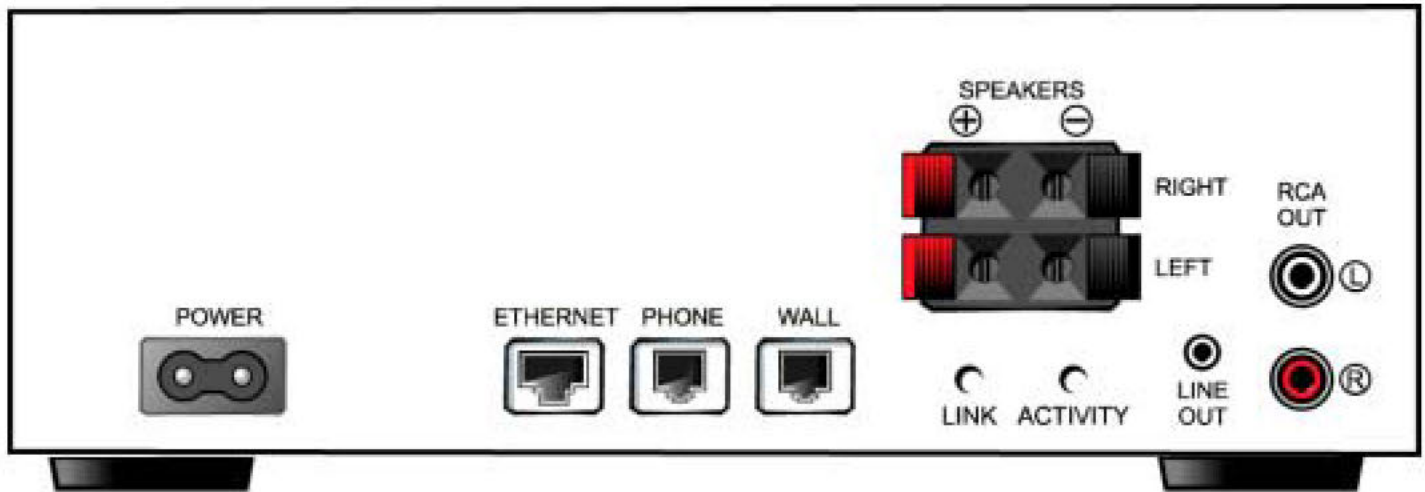
- Click **OK** to close the program.

The Audio Receiver Manager software will display a blue musical note, , in the computer's System Tray at the bottom of the screen when the network connection has been made between your server computer and the Rio Receiver.

A red musical note will appear in the System Tray if no connection is made.

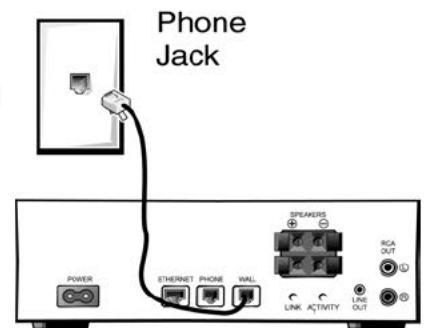


The Rio Digital Audio Receiver



1. Connect the Rio Receiver to your network.
 - a.) **Home PNA Network.** In the room where you are going to station the Rio Receiver (i.e. your living room, bedroom, or kitchen) plug one end of the included 15' phone cord into the nearest phone jack and the other end into the back of the Rio Receiver in the port marked **"Wall"**. This allows your Rio Receiver and your computer to communicate via your home phone lines.

WARNING: If your residence uses different phone numbers on different phone jacks, both the Rio Receiver and the Home PNA card installed in the computer must be plugged into the same phone number in order to connect. You can check this by plugging phones into both jacks to see if you can communicate over the single line.

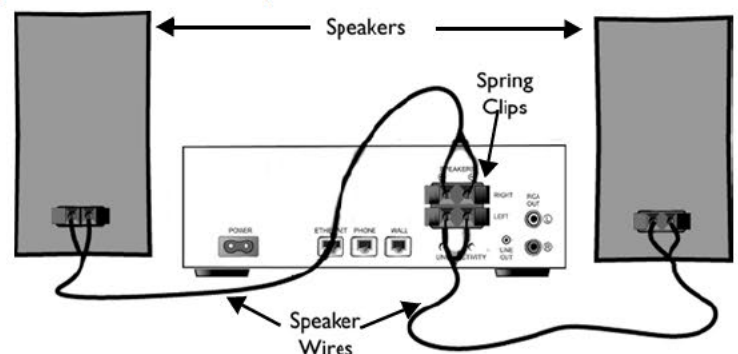


NOTE: You can plug your phone, answering machine, fax, or satellite dish into the port marked **"Phone"** to continue using that phone jack with your other devices.

OR

- b.) **Ethernet Network.** Plug one end of an Ethernet cable into the back of the Rio Receiver in the port marked **"Ethernet"** and the other end into your network hub.
2. Connect the Rio Receiver to your speakers or to your home theater system.

- a.) If you are going to use your Rio Receiver as a stand alone unit you will need to connect powered or bookend speakers to it to hear your music. Connect the speaker wires from your left speaker to the red and black spring clips marked "Left" on the back of the Rio Receiver. Connect the speaker wires from your right speaker to the red and black spring clips marked "Right" on the Rio Receiver. The Rio Receiver and its remote will now control the volume levels of the speakers.

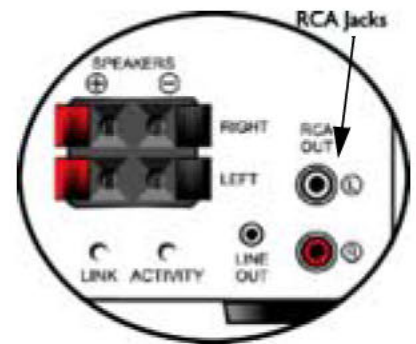




NOTE: It is also possible to plug powered speakers into the Line Out jack located on the back of the Digital Audio Receiver.

OR

b.) If connecting the Rio Receiver to your home theater system, use the included RCA cable, which has a red and a white RCA connector at each end. Plug the red RCA connector to the red jack and the white RCA connector to the white jack on your stereo receiver. Plug the other end's red RCA connector to the red jack and the white RCA connector to the white jack on the Rio Receiver.



NOTE: When used with a stereo receiver, neither the Rio Receiver nor its remote control the volume level as the speakers are plugged into the stereo receiver.

3. Plug the Rio Receiver power cord into the back of the Rio Receiver and into nearest power supply.
4. Push the **Power** button on the Rio Receiver or on the remote. The Rio Receiver's liquid crystal display (LCD) will display:



The Rio Receiver locates the server PC and the database of music files stored on that PC. If the Rio Receiver does not find your PC, check the [Troubleshooting and FAQ](#) sections of the manual for tips to correct this.

5. When it has finished querying your PC, the Rio Receiver will display the first song in the digital music file database on your PC. It is now ready to bring your music to you.

Song Title	Artist
Artist	
Album	
128 K MP3 Random	0:21



Using Your Rio Receiver

The Display

When powered on, the Rio Receiver's Liquid Crystal Display or LCD is backlit for easier viewing. It displays the status of the unit, as well as the Playlist, Artist, and Song information for the music you are playing. The LCD will assist you in selecting new music to listen to.

In playback mode, the LCD shows:

- **Track Information** — The Song title, Album title, Artist name, bit rate of encoding, and the total time of the song are encoded in the digital music file in the [ID3 Tag](#) and read by [Gracenote](#) and the Rio Receiver.
- **Bit Rate Indicator** — The amount of compression used to encode the song.
- **Track Time** — Time remaining/time elapsed in the song.
- **Repeat Indicator** — Shows if a song is set to repeat, if all songs are set to repeat or if no songs are set to repeat.
- **Random Indicator** — Shows if the Receiver is set to shuffle the songs in play.

Song Title	Artist
<hr/>	
Artist	
Album	
128 K MP3 Random	0:21

Menus and Buttons

The buttons on the face of the Rio Receiver include:

- Power
- Repeat
- Random
- Volume Select
- Menu
- Joypad (Play/Pause, Fast Forward, Rewind, Stop)



Using the Repeat and Random buttons

Pressing the Repeat button:

1. Once repeats all of the songs in selected play location.
2. Twice repeats the song currently playing.
3. Three times turns off the feature.

Pressing the Random button:

1. Once shuffles the songs in the selected play location.
2. Twice turns off the feature.



Using the Volume Select in Normal and Menu Modes

In **Normal Mode** the Volume Select on the Rio Receiver adjusts the Audio Settings:

- Volume
- Balance
- Bass
- Treble

When the Menu button is pressed, the Rio Receiver is in **Menu Mode** and the Volume Select can:

- Select Playlists.
- Choose music by Artist.
- Choose music by Genre.
- Choose music by Album.
- Select individual songs by Title.
- Adjust Audio Settings.
- Adjust Display Settings.



Adjust Audio Settings in Normal Mode

- Turning the **Volume Select** to the right will increase the volume level, while turning it to the left decreases the volume level.
- To adjust the Balance of the Receiver's music output through your speakers, press the **Volume Select** twice and then turn it to the left or right to adjust the balance levels accordingly.
- To adjust the Bass level, press the **Volume Select** again and then turn it to the left or right to raise or lower the Bass level accordingly.
- To adjust the Treble level, press the **Volume Select** again and then turn it to the left or right to raise or lower the Treble level accordingly.

Adjust Audio Settings in Menu Mode

1. Press the **Menu** button to access the Menu Options screen.
2. Highlight **Change Audio Settings**.
3. Press the **Volume Select** to enter that choice.
4. Scroll through the options (Volume, Balance, Bass, Treble) and highlight the setting you wish to alter. Press the **Volume Select** to enter that choice.
5. Turn the **Volume Select** left or right to adjust the settings to meet your preferences.
6. Press the **Menu** button again to exit Menu Mode.

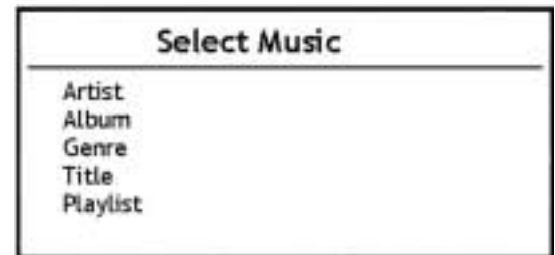
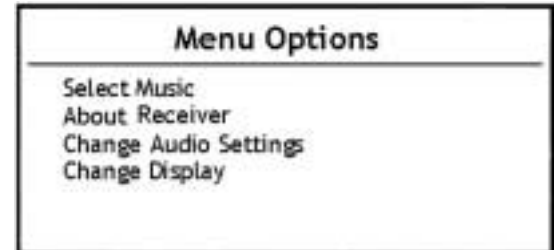


Choose Music in Menu Mode

To Select Existing Playlists:

1. Press the **Menu** button to access the **Menu Options** screen.
2. Turn the **Volume Select** left or right to scroll through the options.
3. Highlight **Select Music** and press the **Volume Select** to choose that option.
4. On the **Select Music** screen highlight **Playlist** and press the **Volume Select** to choose that option.
5. Scroll through the playlists, which are listed alphabetically, on the **Playlists** menu until you highlight the desired playlist.
6. Highlight **Play All Music** and press the **Volume Select** to play all of the songs in that playlist.

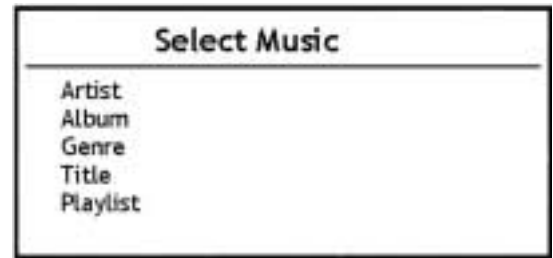
NOTE: Pressing the **Random** button will cause the Rio Receiver to shuffle all of the songs in the playlist.



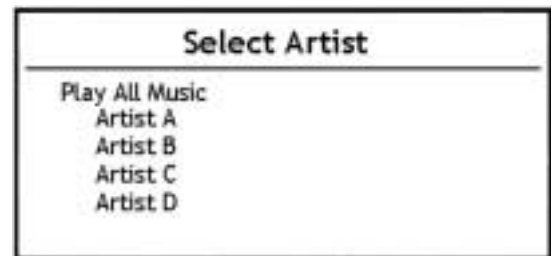


To Select Individual Songs:

1. Press the **Menu** button to access the music menus.
2. Turn the **Volume Select** left or right to scroll through the menus.
3. Highlight **Select Music** and press the **Volume Select** to choose that option.
4. On the **Select Music** screen scroll through the options and choose whether you want to sort music by Artist, Album, Genre, Title or Playlist by highlighting your choice and pressing the Volume Select. For example: Highlight **Artist** and press the **Volume Select**.



5. On the **Select Artist** screen select which artist you want to listen to from the alphabetical list of artist names by highlighting your choice and pressing the **Volume Select**.



6. The screen title will be that of the Artist you chose. Scroll through the list of songs, provided in alphabetical order, by that artist and highlight the song you want to play. Press the **Volume Select** to play that song.



The Joypad Controls

- Play/Pause (▶)** — Press once to play the first song in the current selection. Pressing the Play/Pause button while a song is playing will pause the song and the song title in the display will blink to indicate that it is in Pause mode.
- Fast Forward (▶▶)** — Press once to skip to the next track or hold it down to Fast Forward through the track you are currently listening to.
- Rewind (◀◀)** — Press once to return to a previous track or hold it down to Fast Rewind through the track you are currently listening to.
- Stop (■)** — Press once to stop. This resets the Rio Receiver back to the beginning of the current track.





The Rio Remote

Power — Turn the Rio Receiver on and off.

Menu — Press once to access the control menus.

Volume — Press up to increase and down to decrease the speaker volume.

Select — Scroll through the menus on the LCD by pressing the up and down arrow buttons.

Enter — Press once to enter in your choices.

Cancel — Press once to cancel the current mode the Rio Receiver is in.

Random — Press once to shuffle songs in selected play location. Press again to turn off this feature.

Repeat — Press once to repeat all of the songs or twice to repeat the song currently playing. Press again to turn off this feature.

List — Create and recall playlists on the Rio Receiver using the Alphanumeric Numbers.

Search — Press to search for an album, artist, genre, song title or playlist using the Alphanumeric Numbers.

Alphanumeric Numbers — Use these numbered and lettered buttons with the Search and List features to find selections by their title or number.

Play/Pause (II ▶) — Press once to play a song. Pressing the Play button when a song is in play will pause the song and cause the title to flash.

Fast Forward (▶▶) — Press once to skip to next track or hold it down to fast forward through the current track.

Rewind (◀◀) — Press once to return to previous track or hold it down to rewind through the current track.

Stop (■) — Press once to stop the current song.

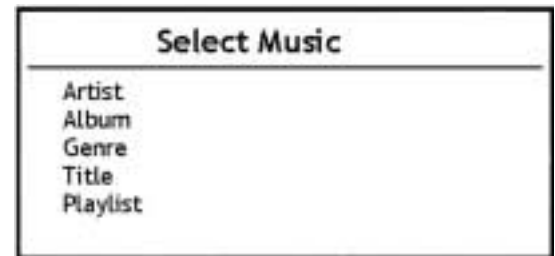
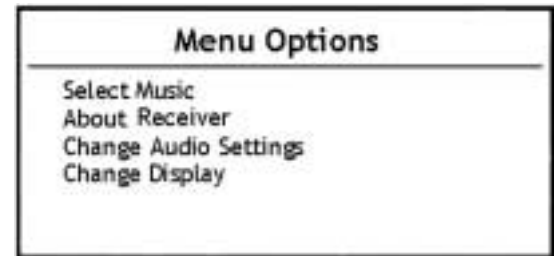




To Select Playlists with the Rio Remote:

1. Press the **Menu** button to access **Menu Options** on the Rio Receiver's LCD.
2. Press the **Select** button up or down to scroll through and highlight options.
3. Highlight **Select Music** and press **Enter**.
4. On the **Select Music** screen highlight **Playlist** and press **Enter**.
5. On the **Playlists** screen scroll through the playlists, which are listed in alphabetical order, with the **Select** button and highlight the desired playlist. Press **Enter**.
6. Highlight **Play All Music** and press **Play** to play the songs in that playlist.

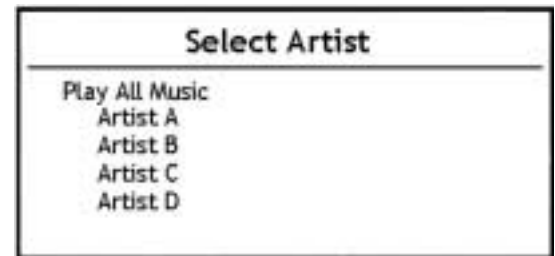
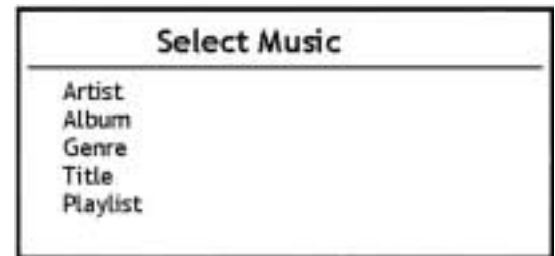
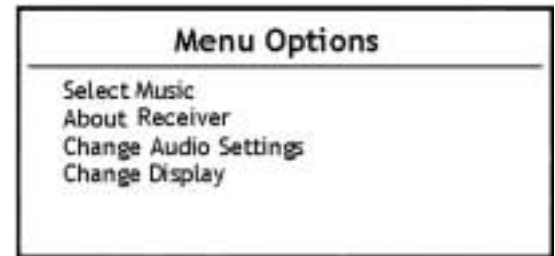
NOTE: Pressing **Random** will cause the **Digital Audio Receiver** to shuffle all of the songs in the **playlist**.





To Select Individual Songs with the Remote:

1. Press the **Menu** button to access **Menu Options** on the Rio Receiver's LCD.
2. Press the **Select** button up or down to scroll through and highlight options.
3. Highlight **Select Music** and press **Enter**.
4. On the **Select Music** screen highlight **Artist** and press **Enter**.
5. On the **Select Artist** screen scroll through the alphabetical list of artists with the **Select** button and highlight the desired artist name. Press **Enter**.
6. Highlight **Play All Music** and press **Play** to play all of the songs by that artist or highlight an individual song and press **Play** to play only that song.



To Search for Music with Alphanumeric Buttons:

1. Press the **Search** button:
 - a.) Once for Title.
 - b.) Twice for Artist.
 - c.) Three times for Album.
 - d.) Four times for Genre.
2. Press the **Alphanumeric buttons** that correspond to the Album, Artist, Genre, Playlist or Song Title, you are searching for.

For example: To find songs by the group U2:

1. Press **Search** twice to search by Artist.
2. Press the **8** button. All Artists that start with TUV will display.
3. Press the **2** button. This will narrow down the search to all Artists with the first letter of TUV and the second letter of ABC or the number 2 in the name.
4. Highlight **U2** and press **Enter**.



Create and Recall Playlists with the List Button

To create playlists:

1. Press the **Menu** button to bring up the **Select Music** screen.
2. Select the Artist, Album, Genre or Playlist menu.
3. Highlight the specified selection you want to play (For example: Album > Album Title).
4. Press **List** and press a **number** to preset the selection. The numbers 00-99 are available for use.
5. Press **Enter**.

To recall a preset playlist:

1. Press **List**.
2. Type in the **number** or browse through the presets displayed with the up and down buttons.
3. Highlight the desired preset and press **Enter**. The preset playlist will then play music from your selection.



Advanced Features

Accessing digital music stored on other computers on the network

To access digital music files stored on another computer on the network you must:

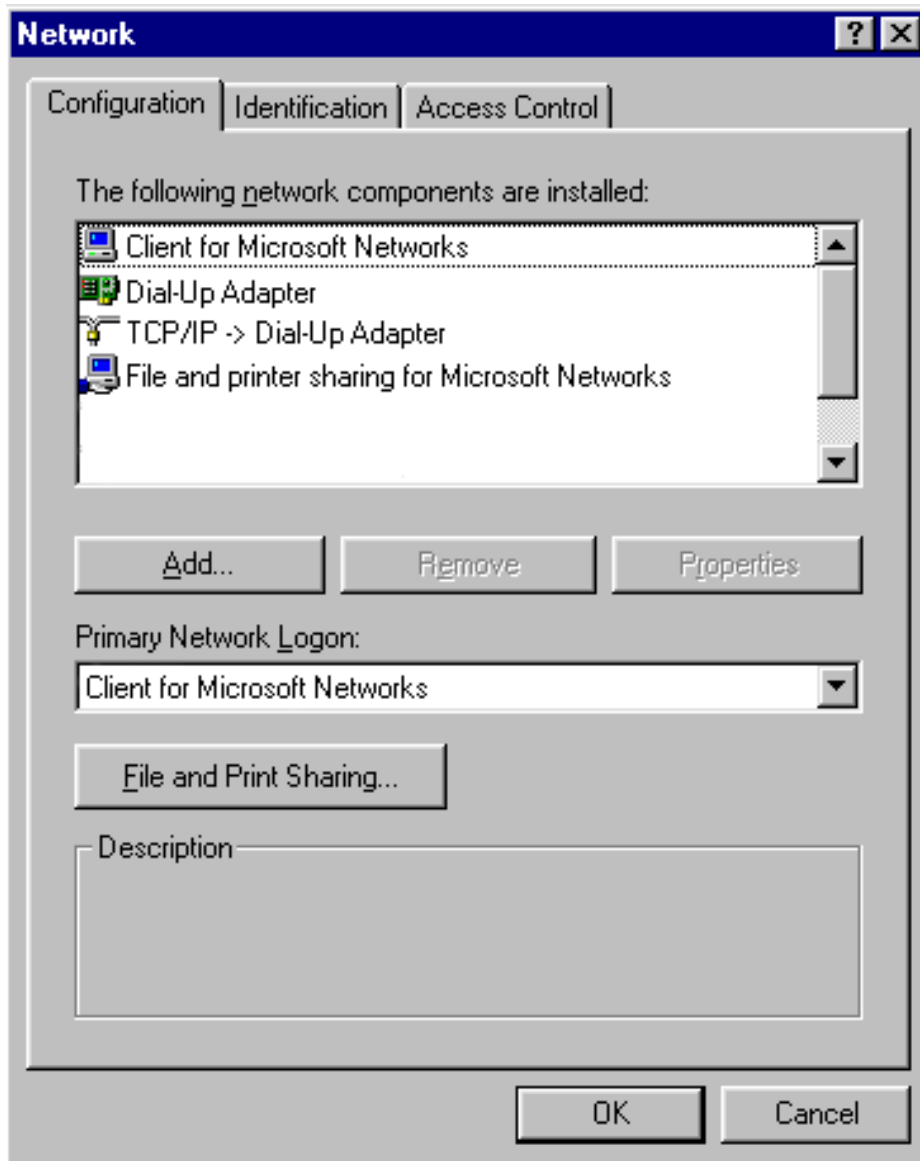
1. Turn on File Sharing.
2. Share the folder where the files are stored.
3. Set up the Audio Receiver Manager to search the other computer's hard drive for digital music files.

NOTE: We recommend that you only store your digital music files on the Receiver's server PC. Playing digital music files located on a computer other than the server PC through the Receiver, can negatively impact the performance of both the PCs and the network. This is because files are activated on the PC where they are located and then streamed through the network to the server PC and then to the Receiver.

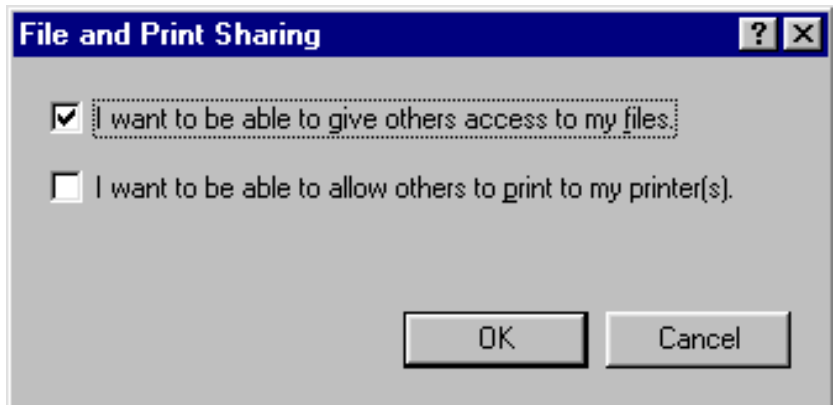
Turning on File Sharing

WARNING: If you own a cable modem or are connected to the Internet via DSL, enabling File Sharing may allow computers outside your network on the Internet to see and access your computer and any files or folders you share. Therefore we recommend that you contact your Internet Service Provider (ISP) or network administrator for assistance in configuring your system to guard against such access.

1. Right click on **Network Neighborhood** and select **Properties**.



2. Click the **File and Print Sharing** button.
3. Put a check mark in the box next to the statement **I want to be able to give others access to my files.** by clicking your mouse in the check box.
4. Click **OK**.
5. That computer is now visible to other computers on your network and to the Rio Receiver.

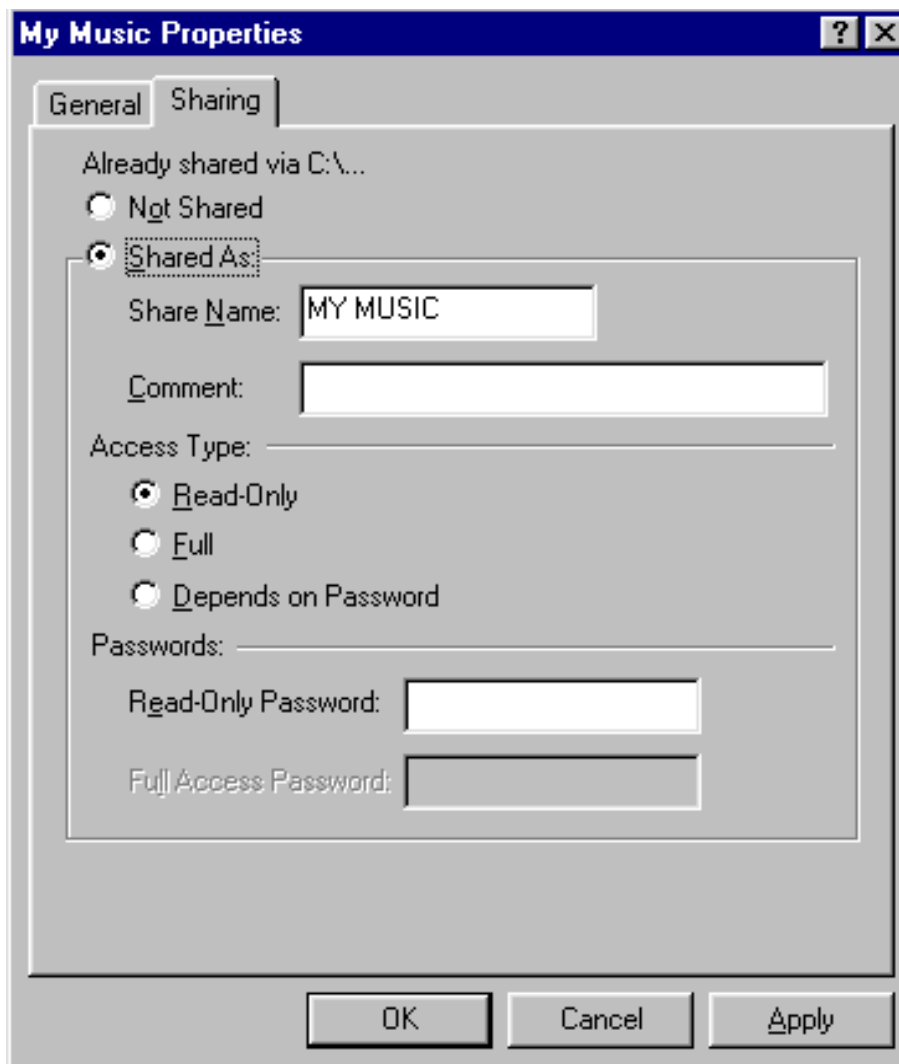




Sharing File Folders

To share a particular folder in which digital music files are stored:

1. Open **Windows Explorer**.
2. Right click on the folder containing the music files you wish to share For example: **My Music**. Select **Sharing**.



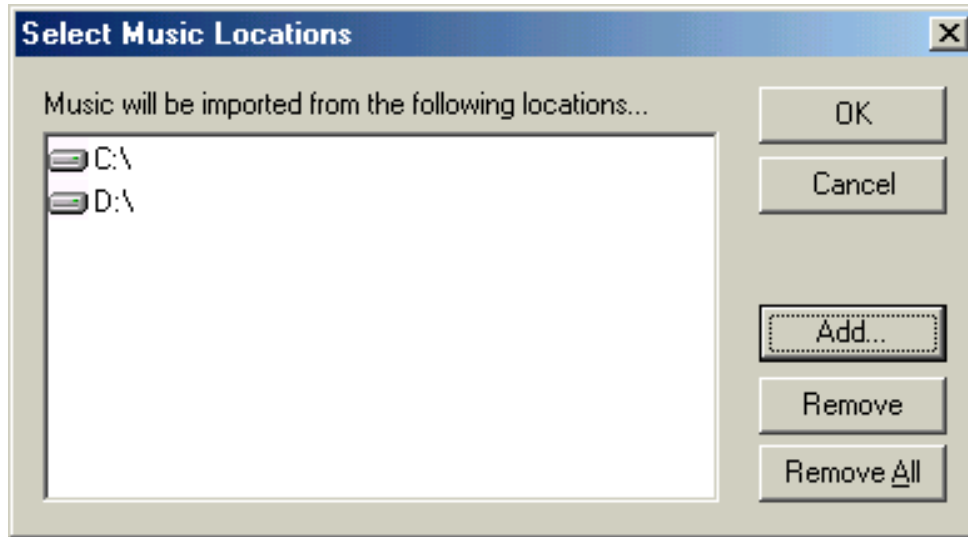
3. On the **My Music Properties** window select **Shared As** by clicking on the empty circle next to it.
4. Select the **Access Type** you wish to give to others.
5. Click the **OK** button to finish. Now the music folder is available to the Rio Receiver and to other computers on the network.

NOTE: You can choose to set passwords for Read-Only or Full Access to control access to this folder or leave them blank so that the folder is available to any other machine on the network. For more information on Sharing files and folders, check **Windows Help**.



Configuring the Audio Receiver Manager to find music on other computers.

1. Right click the Audio Receiver Manager icon on the system tray at the lower right hand side of the screen. A window will pop up with options.
2. Select **Import Music**. This will launch the Audio Receiver Manager software and allow you to manually configure its settings.



3. Click the **Add** button to add hard drives or folder locations to be searched. A Windows Explorer window will pop open, displaying the available hard drives and folders on your server computer as well as **Network Neighborhood**.
4. Click on the **+** sign next to **Network Neighborhood** to display the available computers on the network.
5. Click on the **+** sign next to the computers you want to access for music to display their shared hard drives and folders.
6. Click the hard drive or folder you want to search and click the **OK** button. Your selection will now appear in the **Select Music Locations** folder.
7. Click the **OK** button. The Audio Receiver Manager software will then search those drives and update its music database. When it finishes, the Audio Receiver Manager will display a message stating that it has added new tracks and playlists.
8. Click the **OK** button to exit.

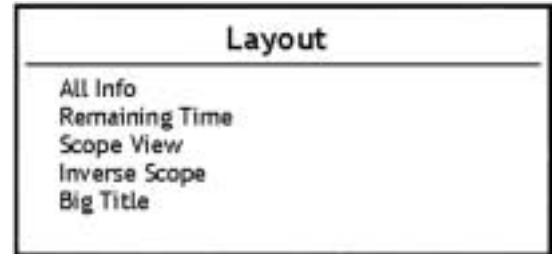
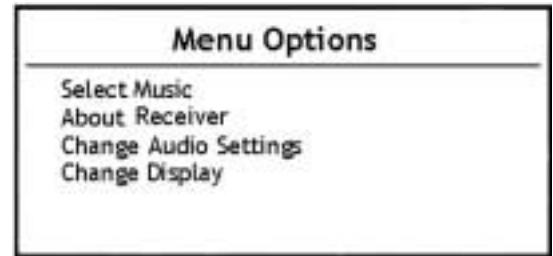
To Remove Search Locations:

1. Right click the Audio Receiver Manager icon on the system tray at the lower right hand side of the screen.
2. Select **Import Music**.
3. Highlight the hard drive or folder you want to eliminate from the search in the **Select Music Locations** window.
4. Click the **Remove** button.
5. Click the **OK** button. The Audio Receiver Manager runs its search and displays a message stating that it has added tracks and playlists.
6. Click the **OK** button to exit.



Configuring the Receiver's LCD

1. Press the **Menu** button on the Rio Receiver or on the remote.
2. Select **Display Settings**.
3. Press the **Volume Select** on the Rio Receiver or the **Enter** button on the remote.
4. On the **Display Settings** screen highlight **Select Layout**.
5. Press the **Volume Select** on the Rio Receiver or the **Enter** button on the remote.
6. On the **Layout** screen choose 1 of 5 different layouts:
 - All Info (default)
 - Remaining Time
 - Scope View
 - Inverse Scope
 - Big Title
7. Press the **Volume Select** on the Receiver or the **Enter** button on the remote.



NOTE: The Rio Receiver will maintain your layout choice as long as it remains plugged into a power source. If unplugged, the Rio Receiver will revert to the default LCD screen.



Troubleshooting Steps

Problem: Rio Receiver can not connect to server.

Troubleshooting measures:

- 1.) Ensure that the Audio Receiver Manager software is loading properly on the server computer. Verify that there is a blue music note icon in the system tray, indicating that the Audio Receiver Manager software has been installed correctly and it sees the Rio Receiver.
- 2.) Verify that the [Audio Receiver manager software is set up properly](#).
- 3.) If you are using firewall software like Zone Alarm, you may need to add the IP Address of the Rio Receiver as a freindly IP Address.
- 4.) Check for the link light on the Rio Receiver, the hub (if you are using one), and/or the Ethernet card.
- 5.) Check to make sure you have the cables plugged in correctly.
- 6.) After checking the connections and that the software is running, restart (unplug and replug) the Rio Receiver and allow it to search for the server again.
- 7.) If the Receiver still does not find the server, try connecting the Rio Receiver directly into the network card on one system to rule out any issues with wiring.

NOTE: If directly connecting an Ethernet card to the Rio Receiver, you may need to use an Ethernet crossover cable.

Problem: The Rio Receiver reports an error on the display.

Troubleshooting measures:

Errors that are reported on the Rio Receiver display are typically indicative of server connection issues.

- 1.) When an error is received, power down the Receiver.
- 2.) On the server computer double click the **Audio Receiver Manager icon** (music note icon in system tray).
- 3.) Click **Tools** and **Import Music**.
- 4.) Click **Add** and specify the location of the music files you wish to use with the folder browser that appears.
- 5.) Click **OK**. The software will import your music tracks.
- 6.) Click **OK** when it is finished.
- 7.) Restart your Rio Receiver and let it redetect the server.
This should resolve the issue that inspired the error message.



Problem: The Volume Select on the Rio Receiver doesn't work.

Troubleshooting measures:

- The **Volume Select** on the Rio Receiver will only function when bare wire speakers are connected directly to the device. This uses an amplified signal and allows you to change the volume levels from the Rio Receiver.
- To change the volume levels on speakers connected via the other outputs on the Rio Receiver, you will need to adjust the volume on the powered speakers (1/8" LINE OUT jack) or on the connected Stereo Receiver (RCA OUT Jacks).

Problem: Selected WMA tracks aren't being added to the playlist.

Troubleshooting measures:

WMA files can have built-in file protection. This allows distributors to add features such as expiration dates to downloaded tracks. If one or more WMA tracks are not added correctly when you Import Music, this is most likely caused by a limitation of the file that was added by the distributor. If your WMA files are protected, you will not be able to play them on your Rio Receiver.

Problem: When selecting Next Track on the device, it does not advance to the next track and playback is stopped/paused.

Troubleshooting measures:

This happens when you have reached the end of a selected playlist. There are several causes for this that can appear as a premature interruption of music playback.

- When you navigate the Rio Receiver's menu and choose **Select Music**, there are a variety of options. To choose an extended playlist, choose the **Play All Music** selection from whatever menu option you choose (Album, Artist, and so on.)
- When you are unable to use **Next Track** without having the player stop, this usually is caused by only choosing a single track to play. If you choose **Title** from the **Select Music** menu option and only choose one song, that will be the only track in the playlist. You will need to select **Play All Music** to navigate through the tracks using **Forward** and **Reverse**.

Problem: I can't verify if the server computer is connected to the Rio Receiver.

Troubleshooting measures:

- 1.) Check the Rio Receiver display to see if it detects and is connecting to the server. Try to navigate the menu on the Rio Receiver and select songs.
- 2.) Double click the **Audio Receiver Manager icon** (music note in the System Tray). If the musical note is blue, it is communicating with the Rio Receiver. There should be a Rio Receiver icon present in the display window that resembles a Rio Receiver device.
- 3.) If the Rio Receiver icon is active (full outline and sharper colors) the server computer has successfully connected to the Rio Receiver. If the icon is grayed out (no icon outline and faded colors) or if no icon is present, the server computer is unable to communicate with the Rio Receiver. Check network connections and power the Rio Receiver off and on.



Problem: Title track and time counter are too small to see or difficult to read.

Troubleshooting measures:

The display settings can be modified to suit your preferences.

- 1.) Click **Menu**.
- 2.) Click **Change Display**.
- 3.) Click **Select Layout**.

There are a variety of display features. Choosing **Big Title** from this menu option will increase the font of the information display.

You can also choose **Adjust Contrast** on the **Display Settings** menu. Depending on the lighting in your room, adjusting the contrast from this menu option can make the display easier to read.

Problem: I am unable to get the Receiver working with a 10/100 Ethernet connection.

Troubleshooting measures:

- 1.) The Rio Receiver connects using a 10 Mb Ethernet port. It is recommended that you use 10 Mb network adapters and equipment with the Rio Receiver. If you are using a 10/100 Mb network device and are having problems connecting to your Rio Receiver, you may need to set your connection speed to 10 Mb.
- 2.) Go to **Start > Settings > Control Panel**.
- 3.) Double click **Network Properties**.
- 4.) Highlight the 10/100 Mb network device under the **Network Component** listing and choose **Properties**.
- 5.) Click the **Advanced** tab in the box labeled **Property**.
- 6.) Choose **Media Type**.
- 7.) Using the drop down menu for **Value** choose **10 Mbps Half Duplex**. (The default value for this field will be **hardware default**)
- 8.) **Apply** these settings and reboot when prompted.
- 9.) Retry your Rio Receiver connection.

Problem: I don't know if the Audio Receiver Manager software is setup properly.

Troubleshooting measures:

- 1.) Verify that there's a musical note icon in the system tray. This is the Audio Receiver Manager icon. It is blue when communicating with the Rio Receiver and red when not communicating properly.
- 2.) Double-click on the **Audio Receiver manager icon** in the system tray.
 When the Rio Receiver is powered on, there will be a Rio Receiver icon in the display window that resembles a Rio Receiver device. If this icon is active (full outline and sharper colors), the server computer has successfully connected to the Rio Receiver. If the icon is grayed out (no icon outline and faded colors), or if no icon is present, the server computer is unable to communicate with the Rio Receiver.
- 3.) Select the **Rio Receiver**, and go to the **Unit** menu. Verify that **Server music to this unit** is checked.
- 4.) Go to the **Tools** menu and select **IP Configuration**.



- 5.) At the top of the window select the **Rio Connector** card or your third party **HPNA** or **Ethernet** card that the Audio Receiver Manager software will be serving music over.
- 6.) Verify that **Make music available on this adapter** is checked.
- 7.) If you have not already done so, go to **Tools** and select **Import Music**. Follow the prompts to import your music.

Problem: I've installed the Audio Receiver Manager software, but there's no musical note icon in the system tray.

Troubleshooting measures:

If there's no musical note icon in the system tray, then the Audio Receiver Manager software is not running. Click **Start > Programs > Startup** to check your **Startup** items for the Audio Receiver Manager software. The software installer may not have added itself to your list of Startup items. Try launching the software manually by clicking **Start > Programs > Audio Receiver**.

If an attempt to launch the Audio Receiver Manager software manually fails, try the following:

- 1.) Verify that the **Rio Connector card**, your third party **HPNA** or your **Ethernet** card is listed in the **Start > Settings > Control Panel > Network**. If there are no network adapters installed, the Audio Receiver Manager software will not start.
- 2.) If you are using Windows Millennium, verify that the [Media Sense](#) feature is disabled.
- 3.) Verify that the [drivers](#) for the Rio Connector card, your third party HPNA or your Ethernet card are installed properly. If any files were skipped during the driver installation, that might cause the Audio Receiver Manager software to fail to launch.
- 4.) Verify that the [IP Address](#) of the Rio Connector card, your third party HPNA or your Ethernet card is not all zeros (0.0.0.0). If the IP address of the adapter is all zeros, then the Audio Receiver Manager software will not start. To resolve this problem, you may need to specify an IP address for that adapter. Please consult **Windows Help** for complete step-by-step instructions on specifying a private IP address.

Problem: The Audio Receiver Manager software says, "No network adapters were detected on this computer. This software requires at least one network adapter to work."

Troubleshooting measures:

There are two possible causes for this error. In both cases, the solution is to reinstall the drivers for the Rio Connector card or your third party HPNA or Ethernet card.

You may encounter this error if the [drivers](#) for the Rio Connector card your third party HPNA or your Ethernet card are not installed. You can verify this by checking the Device Manager under Network adapters and the Network Control Panel.

You may also encounter this error if TCP/IP is not installed for the Rio Connector card, your third party HPNA or your Ethernet card. This can occur if driver installation didn't complete successfully.

Also if you're using Windows 98, there's a limit of 6 instances of TCP/IP in the Network Control Panel. If there were already 6 adapters in the Network Control Panel, then TCP/IP would not install successfully for the Rio Connector card, your third party HPNA card or your Ethernet card.



Problem: How do I disable Media Sense in Windows Millennium?

Troubleshooting measures:

- 1.) Click **Start > Settings > Control Panel**.
- 2.) Double-click **Network**.
- 3.) Click the copy of **TCP/IP** that is bound to the network adapter you want to configure. For example:
TCP/IP: Rio Connector.
- 4.) Click the **IP Address** tab and clear the **Detect connection to network media box** by clicking on it.
- 5.) Click **OK** twice and **Restart** your computer.

Problem: How do I tell what IP Address the Rio Receiver is using?

Troubleshooting measures:

On the Rio Receiver:

- 1.) Go to the **Rio Receiver Menu** and select **About Receiver**.
- 2.) Press the **Volume/Select knob** to enter your selection.

The Rio Receiver software and license information will scroll by followed by the Server IP and the Local IP.
The Local IP is the IP Address for the Rio Receiver.

On the music server:

- 1.) Double-click the **musical note icon** in the system tray.
- 2.) Go to the **View** menu and select **Details**.

The hardware address and IP Address will be listed to the right of the Rio Receiver in the display window.

Problem: How do I verify the drivers for the Rio Connector, HPNA card or Ethernet card were installed properly?

Troubleshooting measures:

- 1.) Click **Start > Settings > Control Panel**.
- 2.) Double-click **Network**.
- 3.) The following components should be present:

Rio Connector Card

TCP/IP > Rio Connector Card

NOTE: If you are not using the Rio Connector Card, substitute the name of the HPNA or Ethernet card you are using. If the Rio Connector Card is the only adapter installed in the Network Control Panel, TCP/IP will be listed by itself without a link to the adapter.

- 4.) If there are duplicates of the components listed above, remove them both and reinstall the drivers.
- 5.) Click **Start > Settings > Control Panel**.
- 6.) Double-click **System**.
- 7.) Click **Device Manager**.
- 8.) Click the **+** symbol next to **Network Adapters**.

The Rio Connector Card, your third part HPNA card or your Ethernet card should be listed here.



Problem: How do I verify the IP Address in Windows 9x on the music server is valid?

Troubleshooting measures:

- 1.) Click **Start > Run** and type in **WINIPCFG**.
- 2.) Click **OK**.
- 3.) From the pulldown menu, select the **Rio Connector, your third party HPNA card or your Ethernet card**.

The IP Address shown should be of the form: **169.254.x.y**, where x and y can be any number from 2 to 254.

NOTE: If your computer is part of a network, its IP Address should be identical to the other computers on the network with the exception of the last number.

- 4.) If the IP Address does not appear like the example given above, follow the directions below to manually set the IP Address.

Problem: How do I manually set the IP Address on the music server?

Troubleshooting measures:

- 1.) Click **Start > Settings > Control Panel**.
- 2.) Double-click **Network**.
- 3.) Click the **TCP/IP** component installed for the Rio Connector your third part HPNA card or your Ethernet card.

NOTE: If there is only one Network Adapter installed, there will be only one instance of TCP/IP.

- 4.) Click **Properties**.
- 5.) On the **IP Address** tab, click **Specify an IP Address**.
- 6.) In the **IP Address** box, type **192.168.0.x** (where x is a number between 2 and 254).

NOTE: the IP Address should be one that is not currently in use by another computer on your network. If your music server is already part of a network, substitute your network's IP range for the one suggested above. If you are using Windows Me, uncheck the Detect connect to network media box.

- 7.) In the **Subnet Mask** box, type **255.255.255.0**.
- 8.) Click **OK** twice, then click **Yes** when prompted to restart your computer.

Problem: The Rio Receiver software is not operating because of an incompatible DLL file. What should I do?

Troubleshooting Measures:

When Microsoft shipped its initial release of Internet Explorer 5.0, it came with a file that had an internal bug. Subsequent Releases of Internet Explorer (5.01, 5.5, etc) provide an older file that works correctly. Microsoft's recommended solution is as follows:

- 1.) From the **Start** menu, point to **Settings**, click **Control Panel**, and then double-click **Add/Remove Programs**.
- 2.) Click **Microsoft Internet Explorer 5** and **Internet Tools**.



- 3.) Click **Add/Remove** to remove and restore the original Internet Explorer settings.
- 4.) Restart the computer.
- 5.) Install **Internet Explorer 5.01**, **Internet Explorer 5.01 Service Pack 1**, or **Internet Explorer 5.5**.
- 6.) For the more savvy computer user, it is possible to install the correct file directly from the shipping Windows Operating System software without re-installing Internet Explorer. The necessary file is named IPHLPAPI.DLL (v5.0.1717.2). It can be found in the following cab file: NET7.CAB Simply extract this file directly to the Rio Audio Receiver software directory. Then start the Audio Manager software.



Frequently Asked Questions

How do I encode, "rip", the music off my CDs so I can listen to them on my Receiver?

There are many encoder programs available on the Web, many of which are free. For example you can go to www.musicmatch.com, www.real.com or www.rioport.com and download the programs that they offer to encode or rip CDs. They include instructions on how to install and use their software, including encoding MP3s, creating and managing playlists, and downloading digital music files from their websites.

NOTE: We encourage you to respect the rights of music artists. Please make sure that you enjoy legally obtained music.

Where can I find digital music files on the Internet?

There are many websites that offer legal copies of digital music for downloading. For example: www.musicmatch.com, www.real.com or www.rioport.com. To download your favorite tunes from the Internet, go to your favorite digital music website.

- 1.) Select the category of music you prefer.
- 2.) Browse through the provided track lists by artist or title, depending on the website.
- 3.) Select the music file you wish to download. Price of the download, artist information, and file size may be included with the song track's name, but if not, clicking on the music file should produce this information.
- 4.) Click **Download**.
- 5.) When the **File Download** screen appears, select **Save this program to disk** and click **OK**.
- 6.) When the **Save As** screen appears, select the destination folder on your hard drive and click **OK**. The music file will then be saved to your hard drive for future use by the Rio Receiver.

How do I create playlists?

- Jukebox programs like those available at www.musicmatch.com, or www.real.com provide step-by-step instructions on how to configure digital music files into playlists. Each program accomplishes this task a little differently, so be sure to read their instructions located under the **Help** menu. For example: RioPort Audio Manager has a **Playlist** button for creating and editing playlists, while Real Jukebox maintains playlists within its **Music Library**.
- See the [Create and Recall Playlists with the List Button](#) section of the manual for instructions on how to use your remote to create music playlists on the fly.

Can I store music on my Rio Receiver?

No. The Rio Receiver streams music from your PC over standard phone lines. All music is stored on the server computer. The Rio Receiver allows you to choose your music from locations on the server computer that you specify.



Can I install the Audio Receiver Manager program on several computers on my home network?

No. The Audio Receiver Manager can only run on one computer at a time. While it is possible to change the server computer in the home, it is not recommended to operate multiple instances of the Audio Receiver Manager on one network.

Can I stream music from other machines in the house?

Yes. You may enable file sharing on the machines in your home network and share music folders you wish to play. You can then add these folders by choosing **Import Music** from the Audio Receiver Manager program and specifying the network folder from which you wish to play your music.

WARNING: If you are connected to the Internet, sharing folders may give others outside of your home access to your files. Please check with your ISP or Internet sharing application software on how to protect your files from outside access.

Why do files that have low bit rates play poorly on my Rio Receiver?

Low bit rates (16-24 KB) are not recommended for encoding music to be played on the Rio Receiver because in order to encode the music so low, much of the music data is lost to the encoded file. For example: If a song has 16 levels of information available in a 128KB file, it will only have 1 or 2 of those same levels in a 16-24 KB file. Therefore the sound quality is poorer.

Sometimes I experience skipping music or brief delays in menu response. What causes this?

When the server computer is sending music to your Rio Receiver, both the server computer and your network connection are using available resources. If the server computer or network connection is in heavy use (gaming, software installation, etc.) skipping music or delayed response times may occur. To reduce the likelihood of this happening, try to avoid heavy use of the server computer while listening to your Rio Receiver.

My Rio Receiver stops playing music if I turn off my computer. What should I do?

The music server is constantly streaming data to the Rio Receiver, where it is buffered and used as needed. The Rio Receiver only stores a few seconds of music before it needs more. If you turn off your computer, the Rio Receiver will run out of music to play and stop. When the music server is turned back on, it is necessary to turn off and on the Rio Receiver to synchronize it with the music server. This is required because the music server may change its network parameter when it reboots.

What kind of speakers can I use with my Rio Receiver?

The Rio Receiver has several speaker connections to give you more options for use with your favorite speaker system. You can:



- Connect your Rio Receiver to a home stereo system using the red and white RCA OUT jacks provided. This will allow you to integrate your Rio Receiver into your home entertainment system.
- Use the spring clips, which are powered outputs, for bare wire bookshelf speakers. The Rio Receiver outputs 10 watts per channel. It is recommended that you choose speakers that have an operating range that include 10 W.
- Use any powered set of speakers using the 1/8" LINE OUT jack provided on the back of your Rio Receiver.

There is a 1/8" stereo jack labeled LINE OUT on the back of my Rio Receiver, what is this for?

This is a line output for powered speakers. You can connect powered computer speakers to the back of your Rio Receiver. This may be especially useful if you are placing the device in a smaller room without access to a stereo receiver or bare wire speakers.

Will the Rio Receiver interfere with my telephone service?

No. While the Rio Receiver uses standard telephone lines to communicate with the host computer, it operates on a separate frequency from your telephone or modem. You can use your telephone line without interference from your Rio Receiver. Subsequently both devices will function properly without interfering with the other.

Why do some songs show multiple entries when I try to select my music on the Rio Receiver?

This can be caused by several reasons.

- The most common reason for this is if a song is present in multiple folders on the server computer and more than one of these folders is selected when importing music. The track will show up multiple times.
- This can also be caused by having the same track present in both .wma and .mp3 format on the server computer. This can be avoided by storing only one instance of each track, in any form, in folders that are imported to your Rio Receiver.

I receive an error message on the Rio Receiver display, what does this mean?

Error messages that appear on the display of the Rio Receiver typically indicate a communication problem between the Audio Receiver Manager software on the server computer and the Rio Receiver.

- 1.) Shut down the Rio Receiver and restart the Audio Receiver Manager software on the server computer.
- 2.) Once the software has reloaded on the server computer, restart the Rio Receiver. The receiver should redetect the server and this should remedy the error message.

Will the Rio Receiver work with any Home PNA network adapter?

Yes. The Rio Receiver is based on Home PNA specification 2.0. This ensures maximum compatibility with Home PNA 1.0 and 2.0 network devices. Your Rio Receiver should work with existing Home PNA network configurations.



Will the Rio Receiver work with 10 Base-T Ethernet network adapters?

Yes. The Rio Receiver supports a 10 Mb Ethernet connector. You can connect your Rio Receiver to an Ethernet hub with standard Category 5 network cable or directly to a host PC using an Ethernet crossover cable.

When I change my Display Settings or Contrast on the Rio Receiver, they are not always saved. Why?

Currently the **Display** and **Contrast** settings will remain the way you configure them until you power off the Rio Receiver. If the Rio Receiver is left on, your custom settings will remain in tact.

Is there any way to make the font of the song title and track time larger?

Yes.

- 1.) Press **Menu**.
- 2.) Highlight **Change Display** and press the **Volume Select**.
- 3.) Highlight **Select Layout** and press the **Volume Select**.
- 4.) Highlight **Big Title** for a larger track time and title and press the **Volume Select**.

The light on my Rio Receiver goes out after a period of time, why is this?

The light on the display is meant to assist you when you are making menu selections. It will activate when you choose menu selections. After you finish making selections, the light will go out. This is to ensure a longer life for your Rio Receiver display.

How does the Rio Receiver know what the album and song title are?

This information is retrieved from the ID3 tag portion of the MP3 file information. The ID3 tag contains all of the track information. If you encode your own MP3 files from existing CD music, be sure to use a 'CDDB' (online CD music title data base) feature for the most accurate track information when using your Rio Receiver.

When I disconnect the Rio Receiver or shut down the Audio Receiver Manager program, the music continues to play for a short time. Why?

The Rio Receiver stores a small portion of the song being played (15-30 seconds) to help eliminate any interruption in your music playback. When the server computer is stopped or a connection is broken, the Rio Receiver will continue to play the current song until this stored portion of the song is played.

Why does my Scandisk program keep restarting when I use the Rio Receiver?

When you want to run Scandisk on your computer, exit the Audio Receiver Manager program and turn off the Rio Receiver. Otherwise, the Rio Receiver will continue to access the computer's hard drive for songs and Scandisk will restart its process from the beginning.



When playing an MP3 file that was encoded using Variable Bit Rate on the Rio Receiver, the rate shows as being “A Fixed Rate”. Why?

Depending on the encoding method for your Variable Bit Rate (VBR) music files, the displayed bit rate may vary. It may show as 32 kb/s or as a fixed average of the bit rate for the selected track.

Why is it that when I try to adjust the volume on the Rio Receiver, the slider moves but the volume does not change?

The volume on the receiver will only affect the volume of speakers connected to the 'bare wire' speaker outputs. If you have speakers connected to the 1/8" stereo jack or the RCA outputs, the volume will be controlled on the powered speakers you are using or the stereo receiver component that you have connected to your Rio Receiver. 'Bare wire' connections are powered, but the other jacks are line outputs for increased audio clarity.

Can I add a new folder to the existing folders that I have previously imported?

Yes, however if you want the Rio Receiver to reflect the changes you have made to your music folders or playlists, you will need to import your music again after the changes have been made.

Why does music in folders I do not select occasionally appear on my Rio Receiver menu display?

The Audio Receiver Manager software scans for databases of common encoding software like Real Jukebox and MusicMatch in addition to the folders you specify. Any songs found in the MusicMatch playlists or the Real Jukebox music database files are added to the Rio Receiver's database.

Why do the speakers continue to play music when I plug my headphones into the front of the Rio Receiver?

Plugging the headphones into the front headphone jack, will not stop playback to the speakers. If you are using speakers connected via the **LINE OUT** or **RCA OUT** connections, you can turn the volume down on the speaker amplifier and then adjust the volume on your Rio Receiver for your headphones. This will effectively mute the speakers, yet provide full volume support for your headphones.

Can I use both HPNA and Ethernet to connect my Rio Receiver?

The Rio Receiver can only operate in communication with a single server computer. Because of this, you should never need to connect both HPNA and Ethernet cables to your Rio Receiver. You will use one or the other.

If I connect multiple Rio Receivers to the same server computer, will they play the same music?

They will have access to exactly the same music files, but it is not required to play the same songs on each device at the same time. You can play different tracks on each Rio Receiver using the same playlists.



Rio Receiver Specifications

Line out:

RL = 10k

- Max. Output Level (1kHz, digital full scale): + 6 dBV (600 Ohms)
- Frequency response: 20Hz to 20kHz +/-0.1dB
- THD (1kHz, -3dBm): 0.005%
- THD (10kHz, -3dBm): 0.003%

Headphone out:

RL = 600R

- Output Level (1kHz, 1% THD): 1.6Vrms typ.
- Frequency response: 40Hz-20kHz +/-0.1dB
20Hz-20kHz +/-0.1dB, -0.8dB
- THD (1kHz, -10dBm): 0.01%
- THD (10kHz, -10dBm): 0.05%

RL = 16R

- Output Level (1kHz, 1% THD): 0.43Vrms typ.
- Frequency response: 100Hz-20kHz +/-0.1dB
20Hz-20kHz +/-0.1dB, -3.3dB
- THD (1kHz, -12dBm): 0.02%
- THD (10kHz, -12dBm): 0.08%

Channel Crosstalk (1kHz) better than -75dB

Power amp out:

RL = 8 R

- Max. Output Power (1kHz, 10 % THD): 2 x 10W
- Nominal Output power: (1kHz, 0.3 % THD) 2 x 8W
- Frequency response: 20Hz - 20kHz + 0.5dB, -1.8dB
- THD (1kHz, 1W): 0.13%

RL = 4 R

- Max. Output Power (1kHz, 10% THD): 2 x 15W
- EIAJ Power * 2 x 25W
- Nominal Output power: (1kHz, 0.3 % THD) 9W
- Frequency response: 20Hz - 20kHz + 0.5dB, -1.8dB
- THD (1kHz, 1W): 0.2%

*saturated square wave output

Channel Crosstalk (1kHz): better than -74dB



General Specifications:

Manufacturer: SONICblue

Model: Digital Audio Receiver

Physical

Width: 9" (228mm)

Depth: 9" (228mm)

Height: 3" (76mm)

Weight 3lbs 7oz (1.67kg)

Power

Voltage: 100-240, 50/60Hz, 1.2A ~



One Year Limited Warranty

Our warranty to you:

SONICblue, Incorporated warrants that your product will be free from defects in materials and workmanship for a period of one year from the date of original retail purchase. If you discover a defect covered by this warranty, we will repair or replace the product at our option using new or remanufactured components. SONICblue's liability is limited solely to the repair or replacement of the defective product. This warranty is extended to the original end user purchaser only and is not assignable or transferable to any other party. Any parts or boards removed in the replacement or remanufacture process shall become the property of SONICblue.

How to obtain service under this warranty:

To obtain service under this warranty, please contact the dealer from whom you purchased this product or SONICblue's Customer Care Center at (541) 967-2450 for return instructions.

The Customer Care hours of operation are:

Monday through Thursday, 5 am to 7 pm, PST

Friday, 5 am to 11 am and 1 pm to 7 pm, PST

Saturday 8 am to 4 pm, PST.

You must deliver the product and the original sale receipt to the dealer from whom you purchased this product or to SONICblue in order to obtain service under this warranty. If you return the product to SONICblue, you must pay for shipping to SONICblue. Our mailing address is:

SONICblue, Inc.

Communications Division

7101 Supra Drive SW

Albany, OR 97321 USA

Product failures not covered by this warranty:

This warranty covers defects in manufacture that arise from correct use of the device. It does not cover damage caused by abuse, misuse, improper modification or repair, moisture, extreme heat or cold, corrosive environments, shipping, or high voltage surges from external sources such as power line, telephone line, or connected equipment. This warranty does not cover wear and tear on covers, housing or wiring. This warranty also does not apply to any product with an altered or defaced serial number.

Limits of liability:

We are only responsible for the repair of this product. We will not be liable to you or anyone else for any damages that result from the failure of this product or from the breach of any express or implied warranties. These include damage to other equipment, lost data, lost profits, or any consequential, incidental, or punitive damages. IN NO EVENT WILL SONICblue BE LIABLE FOR ANY AMOUNT GREATER THAN THE CURRENTLY SUGGESTED RETAIL PRICE OF THIS PRODUCT.

THIS WRITTEN WARRANTY REPRESENTS THE ENTIRE WARRANTY AGREEMENT BETWEEN SONICblue AND YOU. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS LIMITED TO THE TERM SPECIFIED ABOVE. NO WARRANTIES, EITHER EXPRESS OR IMPLIED, WILL APPLY AFTER THIS PERIOD. THIS WARRANTY

APPENDIX Q
One Year Limited Warranty

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MAY NOT BE ALTERED IN ANY WAY OTHER THAN IN WRITING BY AN OFFICER OF SONICblue. This warranty gives you specific legal rights and you may also have other rights, which vary, from state to state. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.



Regulatory Information

Federal Communications Commission (FCC)

The adapter has been tested and found to comply with limits for a Class B computing device according to the specifications in FCC rules Part 15 and Part 68. Operation is subject to the following two conditions:

- 1.) This device may not cause harmful interference, and
- 2.) This device must accept any interference received, including interference that may cause undesired operation.

As an owner /operator of a registered adapter like this adapter, you must comply with FCC rules:

- Before installing your adapter, you must notify your telephone company that you are going to install an FCC registered device. When you contact them, you must provide the FCC registration number and ringer equivalence number (REN) for your adapter; these numbers are located on the adapter's FCC label.

NOTE: The Ring Equivalence Number (REN) assigned to each terminal device denotes an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

- You cannot connect the adapter to a party line or to a coin telephone line.
- You must only connect your adapter to a standard modular telephone jack, type RJ-11.

If your adapter needs repairs, you must arrange for the manufacturer to make them if you are to keep the adapter's FCC registration valid.

If you need to return the product, contact our Customer Care Department to obtain a Return Merchandise Authorization (RMA) number from Technical Support (541-967-2450).

Our mailing address is:

SONICblue, Inc.
 7101 Supra Drive SW
 Albany OR 97321 USA

This equipment, like other electronic equipment, generates and uses radio frequency energy. If not installed and used according to the instructions in this manual, this equipment may cause interference with your radio and television reception.

If you think this equipment is causing interference with your radio or television reception, try turning the equipment off and on. If the interference problems stop when the equipment is switched off, then the equipment is probably causing the interference. You may be able to correct the problem by doing one or more of the following:

- Adjust the position of the radio or TV antenna.
- Move the adapter away from the radio or TV.
- Plug the adapter in a different outlet than the radio/TV uses.



If necessary, consult your dealer or an experienced radio or television technician. You may find this booklet helpful: “How to Identify and Resolve Radio and TV Interference Problems” (Stock No. 004-000-00345-4), prepared by the FCC and available from the U.S. Government Printing Office, Washington, DC 20402. See individual adapters for FCC ID and registration numbers.

Industry Canada (IC)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

NOTE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operation and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user’s satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections, but should contact the appropriate electric inspection authority, or electrician, as appropriate. If necessary, consult your dealer or an experienced radio or television technician.



Glossary

AAC

Advanced Audio Coding (AAC) is one of the audio compression formats defined by the MPEG-2 specification. AAC used to be called NBC (Non-Backward-Compatible), because it is not compatible with the MPEG-1 audio formats. AAC may eventually replace MP3 since it offers better sound quality and greater file compression.

Bit Rate, file compression

Bit rate denotes the average number of bits that one second of audio data will consume. The size of a digital audio file is determined by the bit rate used when encoding the file. The higher the bit rate used, the higher the sound quality and the larger the file size. For example, a bit rate of 128k is usually very close to CD quality, and takes up about 1MB per minute of music. At a 64k bit rate, the sound quality is similar to that of an FM radio

DRM, security

Digital Rights Management (DRM) technologies protect copyright ownership of digital information. DRM became an issue with the rise of MP3 technology and Internet distribution of music. DRM platforms serve as a security “wrapper” around digital audio supporting Internet distribution while at the same time protecting and managing rights related to that digital information.

Codec

Depending on the context and kind of technology involved, codec may be defined in two ways.

In telecommunications, a codec is usually a "coding/decoding" chip used to translate between digital and analog transmissions. A modem uses one to interpret incoming analog signals and converts the digital data stream coming from the computer into analog.

A codec is also defined as a compression/decompression algorithm. Codecs are used to shrink large files or data streams, often for efficient transmission over a network, and then decode them when they are displayed.

The Rio Digital Audio Receiver supports the following digital audio file codecs:

- MP3
- WMA

Encode, “Rip” (a CD)

Encoding, or “ripping”, refers to converting an audio file from a CD-ROM into a compressed digital audio format, such as MP3 or WMA, that may be played on the Rio Receiver, on the computer, or on a portable Rio Digital Audio Player.

Ethernet Network

A common method of networking computers in a LAN. Ethernet will handle approximately 10 million bits-per-second and can be used with almost any kind of computer. Requires the use of a hub and Ethernet cable. signal, but you may get around two minutes of music in that same 1MB of storage space.



Gracenote

Gracenote, formerly known as CD Database (CDDb), is an vast database of CD information that includes disc name, song titles and other information. Gracenote supports hundreds of different third party software CD players. Access to the Gracenote service is offered free of charge to end-users. Visit the [Gracenote website](#) for more information.

Home PNA Network

Enables two or more Windows or Macintosh computers, located in your home or small office, to communicate through your existing phone lines using standard phone cords.

ID3 Tag

This is the part of the encoded MP3 file that contains information about the digital music file such as song title, artist, album title, bitrate encoding, time duration of track, and so on.

MP3

MPEG-1, Layer 3 Audio (MP3) is a compressed digital audio file format. This format allows for near CD quality sound, but at a fraction of the size of normal audio files. MP3 files encoded from CD-ROM may be compressed to under 10 percent of their former size. This digital sound encoding and compression process was developed by the Fraunhofer Institut fur Integrierte Schaltungen and Thomson Multimedia. MP3 uses perceptual audio coding and psychoacoustic compression to remove all superfluous information—more specifically, the redundant and irrelevant parts of a sound signal that the human ear doesn't hear. It also adds a Modified Discrete Cosine Transform (MDCT) that implements a filter bank, increasing the frequency resolution 18 times higher than that of layer 2. MP3 shrinks the original sound data from a CD-ROM with a bitrate of 1411.2 kilobits per one second of stereo music by a factor of 12 down to 112-128kbps, without sacrificing sound quality. The MP3 encoding process is well suited for the transfer of high quality audio files with small file size over telephone or ISDN lines, and over the Internet.

PCI Slot - Peripheral Component Interface

A 32-bit slot found in Pentium Class systems. Generally used by IDE/SCSI controllers, video cards, network cards, video capture boards, and some sound cards.



SDMI

The Secure Digital Music Initiative (SDMI) is a forum of over 130 companies in the fields of recorded audio content, computers, and consumer electronics, for the purpose of developing an integrated method of copyright protection technology that can be used worldwide. SDMI is working to create a framework for preventing improper usage of audio files and to promote legal music distribution services.



WMA

Windows Media Audio (WMA) is the compressed audio format that Microsoft is positioning as a replacement for MP3. WMA may replace MP3 since it offers greater file compression—twice that of MP3—at the same or better sound quality.



Contacting Customer Care

Technical Support - US	Customer Service - US
<p>Hours of Operation: Mon.-Thurs. 5am-7pm PT Fri. 5am-11am 1pm-7pm PT Sat. 8am-4pm PT</p> <p>Email customersupport@riohome.com</p> <p>Telephone 1(541)-967-2450</p> <p>Fax 1(541)967-2401</p> <p>TDD 1(541)967-2451</p>	<p>Hours of Operation: Mon.-Thurs. 6am-5pm PT Fri. 6am-11am 1pm-5pm PT</p> <p>Email customersupport@riohome.com</p> <p>Telephone 1(800)-468-5846 1(541)-967-2450</p> <p>Fax 1(541)967-2485</p>
<p>Technical Support Wizard www.riohome.com</p>	<p>Website www.riohome.com</p>

Rio Product Support

With every Rio product you receive the following support services:

- Unlimited access to the Rio web-based technical information resources, which are available 24 hours a day every day at www.riohome.com . Here you will find up-to-date FAQ files, a knowledgebase search engine, product updates and other useful tools.
- Unlimited email support for the duration of your Rio product hardware warranty period.
- Access to the latest software updates and enhancements for Rio product via our web site.

New Product Support

In addition to the services mentioned above, all retail purchasers of Rio products receive:

- Person-to-person telephone support for the first 90 days of ownership.

To extend support after the expiration of New Product Support, we offer an affordable, fee-based, Extended Service Option. Please see web site for details, at www.riohome.com .