US006848004B1

(12) **United States Patent**
Chang et al.

(10) Patent No.: **US 6,848,004 B1**
(45) **Date of Patent:** **Jan. 25, 2005**

(54) **SYSTEM AND METHOD FOR ADAPTIVE DELIVERY OF RICH MEDIA CONTENT TO A USER IN A NETWORK BASED ON REAL TIME BANDWIDTH MEASUREMENT & PREDICTION ACCORDING TO AVAILABLE USER BANDWIDTH**

(75) Inventors: **Sih-Pin Subrina Chang**, Old Tappan, NJ (US); **Shu-Chen Jeane Chen**, Chappaqua, NY (US); **Keeranoor G. Kumar**, Randolph, NJ (US); **James S. Lipscomb**, Yorktown Heights, NY (US); **Jai Menon**, Croton-on-Hudson, NY (US); **Liang-Jie Zhang**, White Plains, NY (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/447,585**

(22) Filed: **Nov. 23, 1999**

(51) Int. Cl.^{7} **G06F 15/16**
(52) U.S. Cl. **709/232**; 709/224; 709/231; 370/232
(58) Field of Search 709/231, 226, 709/225, 224, 228, 219, 223, 230, 232, 233, 234, 235; 370/229, 230, 231, 477, 431, 232, 233, 234; 719/315, 316, 332

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,548,761 A * 8/1996 Balasundaram et al. 717/159

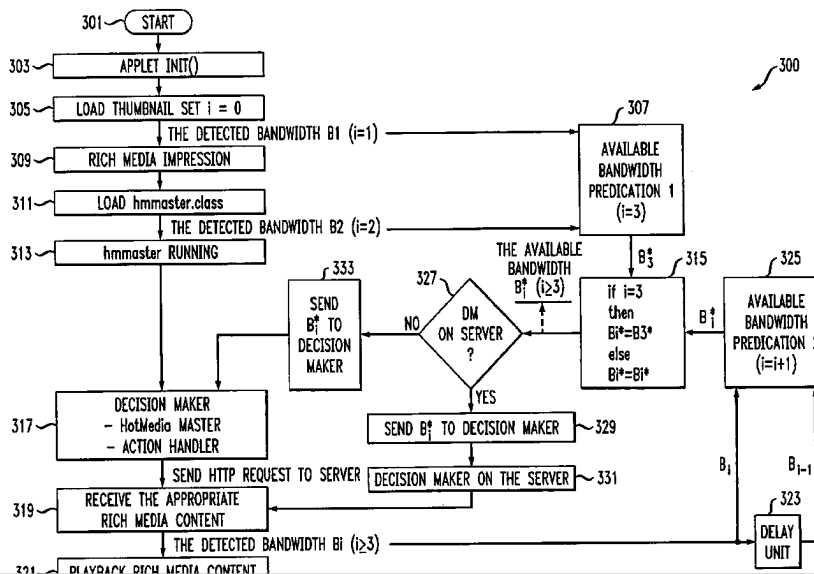|		
5,737,619 A	4/1998	Judson
5,841,978 A	11/1998	Rhoads
5,884,037 A *	3/1999	Aras et al. 709/226
5,918,012 A	6/1999	Astiz et al.
6,272,539 B1 *	8/2001	Cuomo et al. 709/223
6,292,834 B1 *	9/2001	Ravi et al. 709/233
6,363,056 B1 *	3/2002	Beigi et al. 370/252
6,377,989 B1 *	4/2002	Fukasawa et al. 709/224
2003/0101263 A1 *	5/2003	Bouillet et al. 709/225

* cited by examiner

Primary Examiner—William C. Vaughn, Jr.
(74) *Attorney, Agent, or Firm*—David M. Shofi

(57) **ABSTRACT**

A network implementing HotMedia architecture provides real time measurement and prediction of bandwidth for adaptive content delivery of rich media according to available user bandwidth. The rich media file created at the creation station is transmitted by the delivery station to the client station in steaming Java applets having a framework including a thumbnail frame and a media frame. In real-time, the client station detects the bandwidth used by the Java applet; predicts the available bandwidth for next media delivery based on the detected bandwidth and fetches the corresponding sensitive bandwidth media fame from a web server according to a linear or non-linear prediction algorithm resulting in bandwidth sensitive rich media content delivery from the delivery station to the client station for display and user interaction.
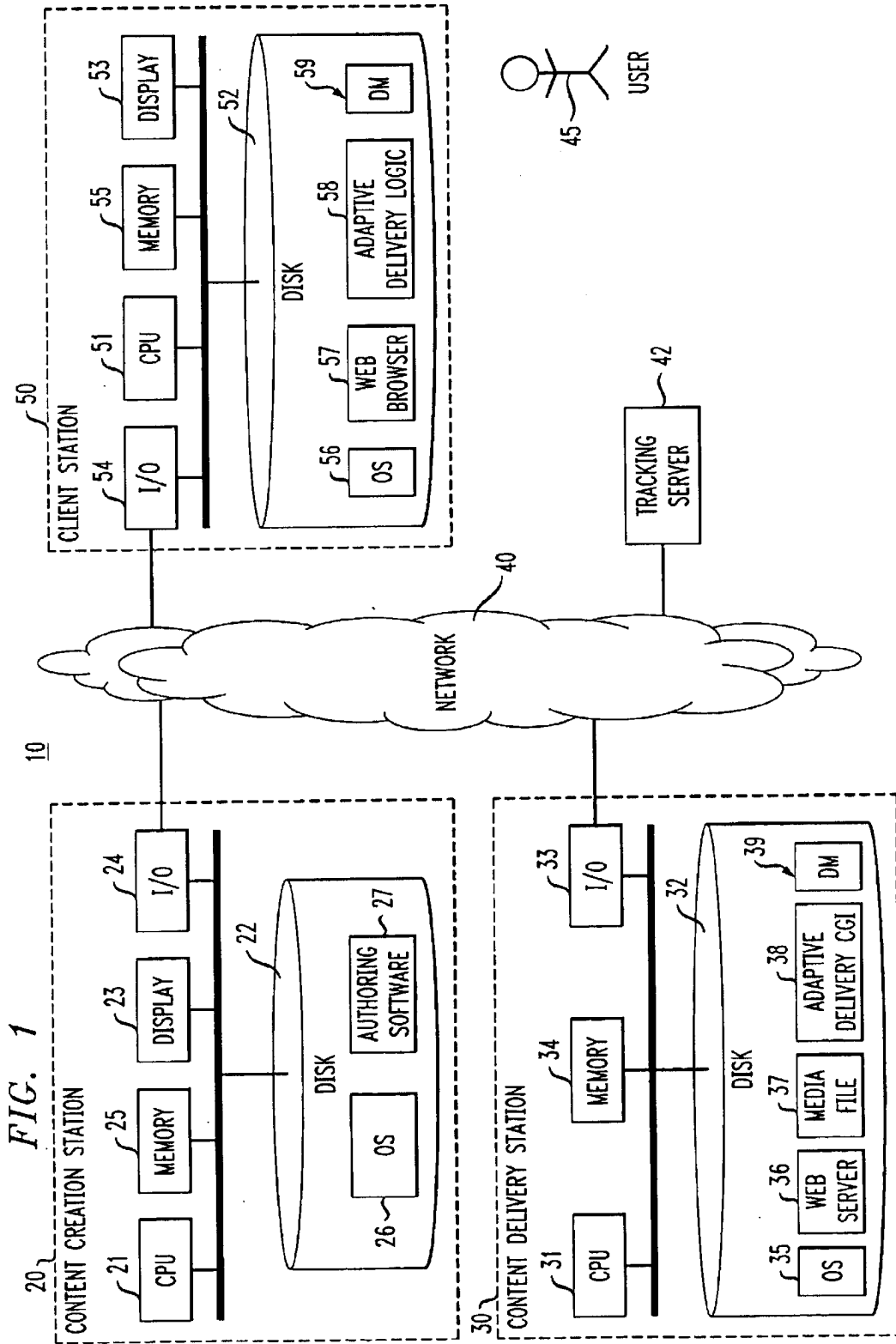
17 Claims, 3 Drawing Sheets

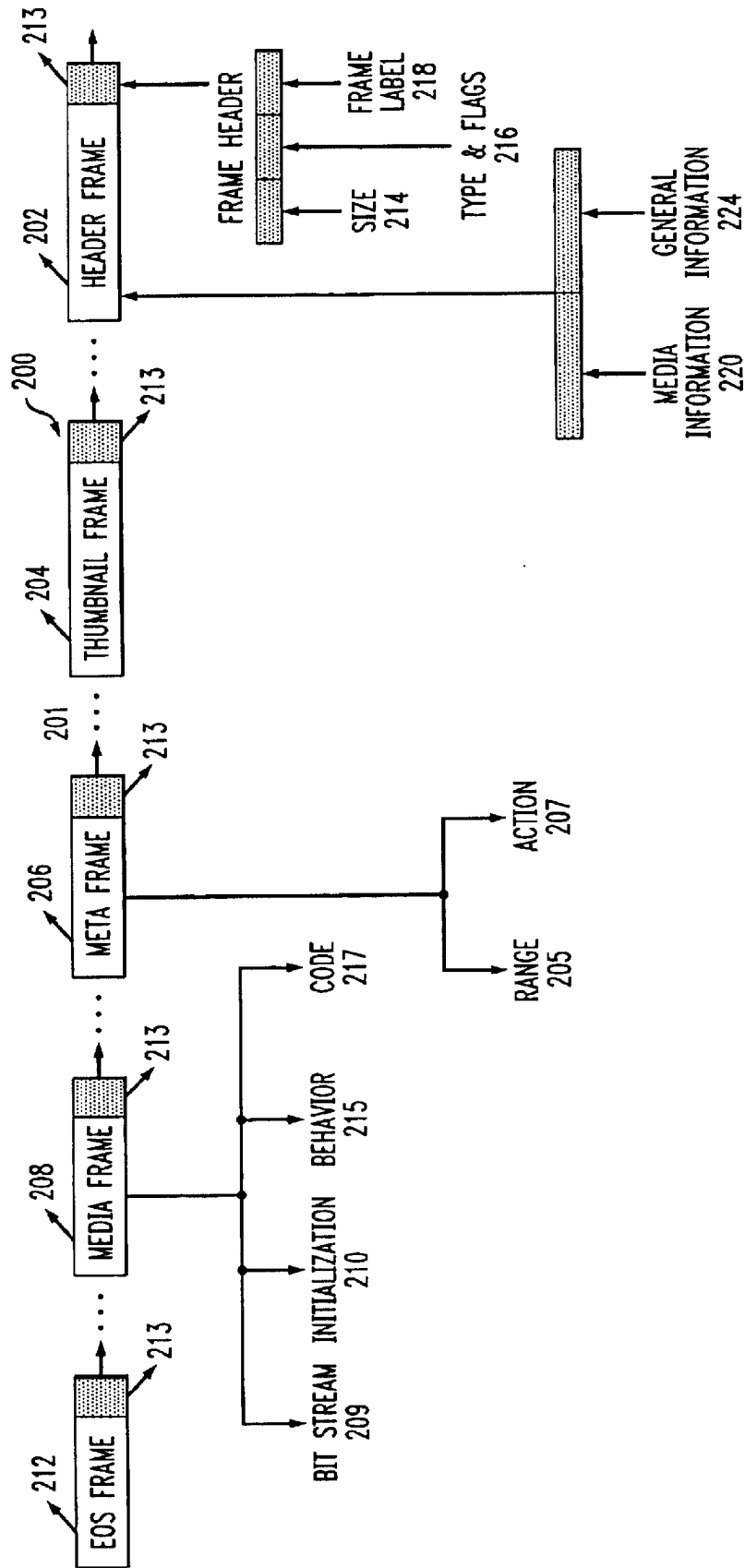*FIG. 1*

FIG. 2

212 EOS FRAME 213

208 MEDIA FRAME 213

206 META FRAME 213

204 THUMBNAIL FRAME 213

200

202 HEADER FRAME 213

BIT STREAM 209
INITIALIZATION 210
BEHAVIOR 215
CODE 217

RANGE 205
ACTION 207

FRAME HEADER
SIZE 214
TYPE & FLAGS 216
FRAME LABEL 218

MEDIA INFORMATION 220
GENERAL INFORMATION 224

FIG. 3

300

301 — START

303 — APPLET INIT()

305 — LOAD THUMBNAIL SET i = 0

THE DETECTED BANDWIDTH B1 (i=1)

309 — RICH MEDIA IMPRESSION

311 — LOAD hmmaster.class

THE DETECTED BANDWIDTH B2 (i=2)

313 — hmmaster RUNNING

307 — AVAILABLE BANDWIDTH PREDICATION 1 (i=3)

325 — AVAILABLE BANDWIDTH PREDICATION 2 (i=i+1)

B_3^*

315 — if i=3 then $Bi^*=B3^*$ else $Bi^*=Bi^*$

B_i^*

THE AVAILABLE BANDWIDTH B_i^* (i≥3)

B_{i-1}

323 — DELAY UNIT

B_i

327 — DM ON SERVER ?

NO

YES

329 — SEND B_i^* TO DECISION MAKER

331 — DECISION MAKER ON THE SERVER

333 — SEND B_i^* TO DECISION MAKER

317 — DECISION MAKER
– HotMedia MASTER
– ACTION HANDLER

SEND HTTP REQUEST TO SERVER

319 — RECEIVE THE APPROPRIATE RICH MEDIA CONTENT

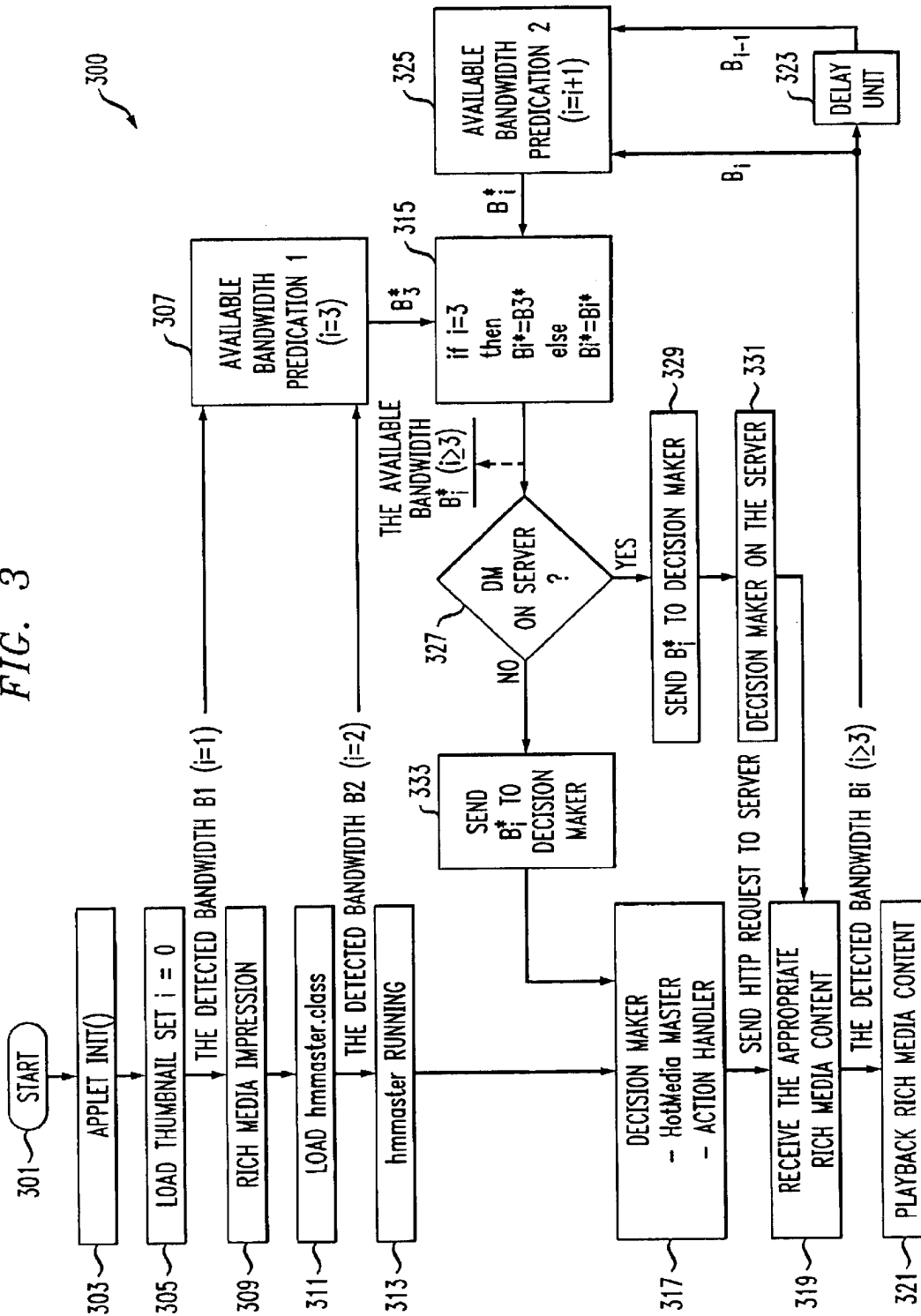THE DETECTED BANDWIDTH Bi (i≥3)

321 — PLAYBACK RICH MEDIA CONTENT

SYSTEM AND METHOD FOR ADAPTIVE DELIVERY OF RICH MEDIA CONTENT TO A USER IN A NETWORK BASED ON REAL TIME BANDWIDTH MEASUREMENT & PREDICTION ACCORDING TO AVAILABLE USER BANDWIDTH

RELATED APPLICATIONS

1. U.S. Pat. No. 6,356,921, issued Mar. 21, 2002, entitled "Framework for Progressive Hierarchical and Adaptive Delivery Rich Media Presentations and Associated Meta Data" (SE9-98-030V).

2. U.S. Pat. No. 6,448,980, issued Sep. 10, 2002, entitled "Personalizing Rich Media Presentations Based On User Response to the Presentation" (SE9-98-028V).

3. U.S. Ser. No. 09/100,419, filed Jun. 20, 1998, entitled "Progressive Interleaved Delivery of Interactive Descriptions and Renderers for Electronic Publishing of Merchandise" (SE9-98-004).

4. U.S. Ser. No. 10/392,055, filed Mar. 19, 2003, entitled "System and Method for Tracking User Interactions and Navigation During Rich Media Presentations" (SE999-006/1963-7334US1).

5. U.S. Ser. No. 09/438,493, filed Nov. 12, 1999, entitled "A System and Method of Enriching Non-Linkable Media Representations In A Network By Enabling An Overlying Hotlink Canvas" (SE9-99-012/1963-7341).

All of the above applications have been assigned to the Assignee of the present invention and are fully incorporated herein by reference.

BACKGROUND OF INVENTION

1. Field of Invention

This invention relates to multimedia network, systems and methods of operation. More particularly, the invention relates to systems and methods for adaptive delivery of rich media content to a user in a network based on real time bandwidth measurement and prediction, according to available user bandwidth.

2. Description of Prior Art

In recent years, there has been a sizeable growth in the use of rich media over the World Wide Web as more and more individuals and institutions are beginning to realize the web's potential in a broad range of applications including electronic commerce, education training, news, etc. Examples of rich media include animation, audio, 3-D, panoramas, and videos. There are two apparent clusters of rich media technology. One at the low end and the other at the high end, which hampers effective deployment of some rich media in Internet based applications. The "low end" cluster comprises static images and simple non-interactive animations (typically animated GIFs) which are easy to deploy and therefore have widespread usage. The "high end" clusters comprises richer and more natural experiences with larger interactivities, such as panoramas, 3-D, streaming audio/video, and composite media (e.g., MPEG-4), but the difficulty of deployment has limited widespread usage. A novel scaleable architecture called HotMedia bridges the gap between the two clusters thereby achieving widespread web penetration. A key feature of the technology is a suitable delivery file format that can contain heterogeneous compositions of media bit streams as well as meta data that defines behavior, composition and interaction semantics. The deliv-

ing in multiple media type contents. At the core of HotMedia client is a smart content algorithm that infers media types from the incoming data stream and fetches the media renderer components, user-interface components and hyper-linked action components, all just in time, resulting in progressive and context driven enrichment of the user experience. Further details related to HotMedia architecture are decribed in U.S. Pat. No. 6,611,812 entitled "Framework For Progressive Hierarchical and Adaptive Delivery Rich Media Presentation and Associated Meta Data", issued Aug. 26, 2003 (SE9-98-033), supra.

Often instances of rich media incorporate links to other presentations to expand a user experience. The process of clicking on a link in a media for transfer to the other presentation is referred to as "hot linking " or "hyper linking" which is further described in U.S. Pat. No. 5,841,978 entitled "Networking Using Steganographically Embedded Data Objects" issued Nov. 24, 1998 and U.S. Pat. No. 5,918,012 entitled "Hyper Linking Time Based Data" issued Jan. 29, 1999. The real power of "HotMedia" is in how the experience is delivered to the user. A dynamic content delivery system to a user should take into account the user's connection speed to enhance the user experience. For example, when a user has experienced reduced bandwidth because of having heavy CPU usage, phone line noise or other web browser instances, the user could receive seamlessly adjusted web content corresponding to the reduced bandwidth. LAN users might get higher quality video clips or audio clips than T1 users, with 56K modem connection user's surfing higher quality images than 28.8K modem users. An adaptive content delivery system according to user connection speed or bandwidth should have the following design goals:

1. An adaptive content delivery framework that expands the scope of information that can be adaptively delivered.

2. A content creation phase that enables individual specification and customizability of information to be adapted to the delivery for every bandwidth sensitive content context.

3. Adaptive content delivery servers requiring neither change to the server code nor changes to content for seamless interfacing.

4. A cascading delivery structure for efficient content delivery as used in the HotMedia architecture.

5. A content delivery system which provides for adaptive delivery disablement for the content.

Prior art related to multimedia delivery systems include the following:

U.S. Pat. No. 5,737,619 entitled "World-Wide Web Browsing with Content Delivery Over An Idle Connection & Interstitial Content Display" by D. H. Judson, discloses a personal computer supporting a graphical user interface and an Internet browser. The computer locally stores retrieves and outputs information objects to reduce waiting time normally associated with downloaded hypertext documents having high resolution graphics. In one embodiment, a web page is displayed on the graphical user interface and has at least one link to a hypertext document, preferably located at a remote server. When the user clicks on the link, the link is activated by the browser to request downloading of the hypertext documents from the remote server to the graphical user interface. While the user waits for a reply and/or as the hypertext document is being downloaded, the browser displays a previously cached information object.

An Internet program "Speed Select" from Match Logic of

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | sales@docketalarm.com | 1-866-77-FASTCASE

fastcase®
Smarter legal research.