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(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**

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(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**

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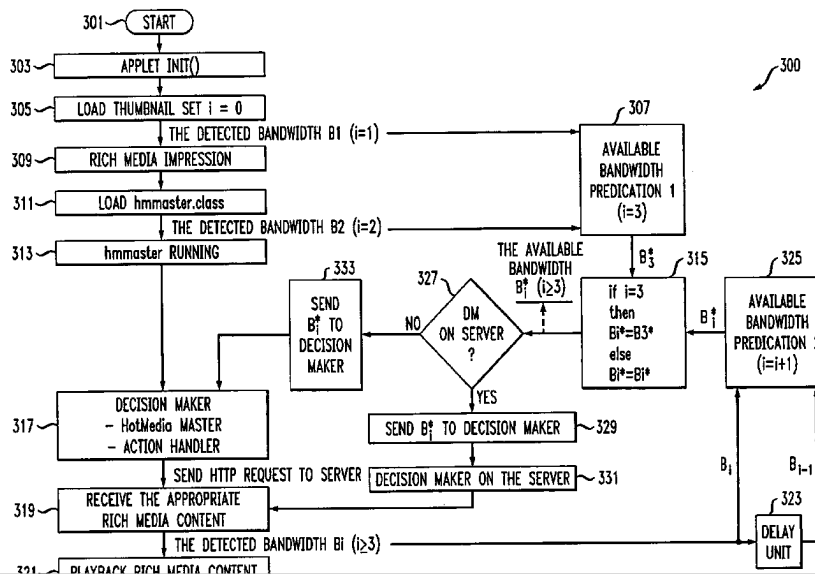
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(57) **ABSTRACT**

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



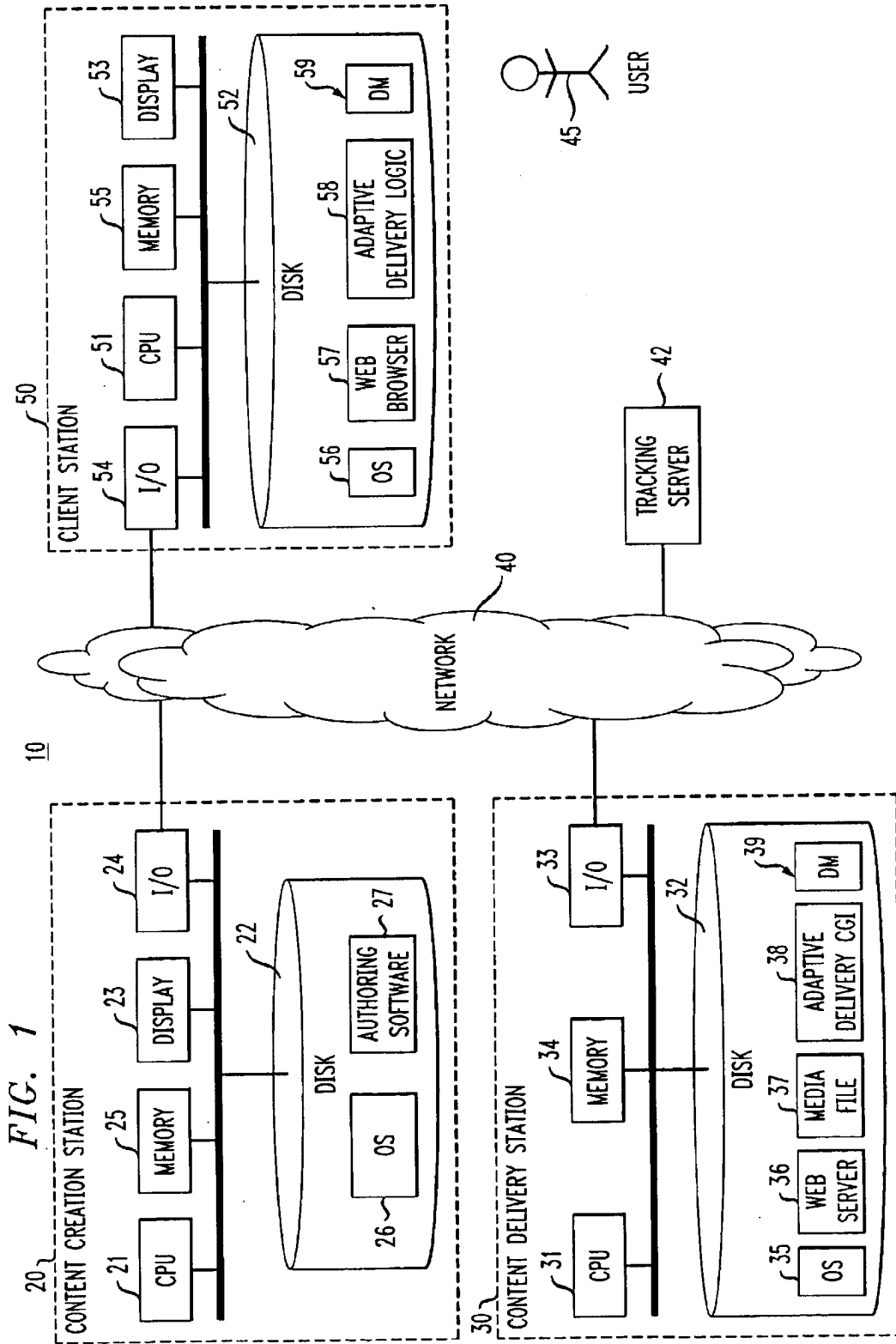


FIG. 2

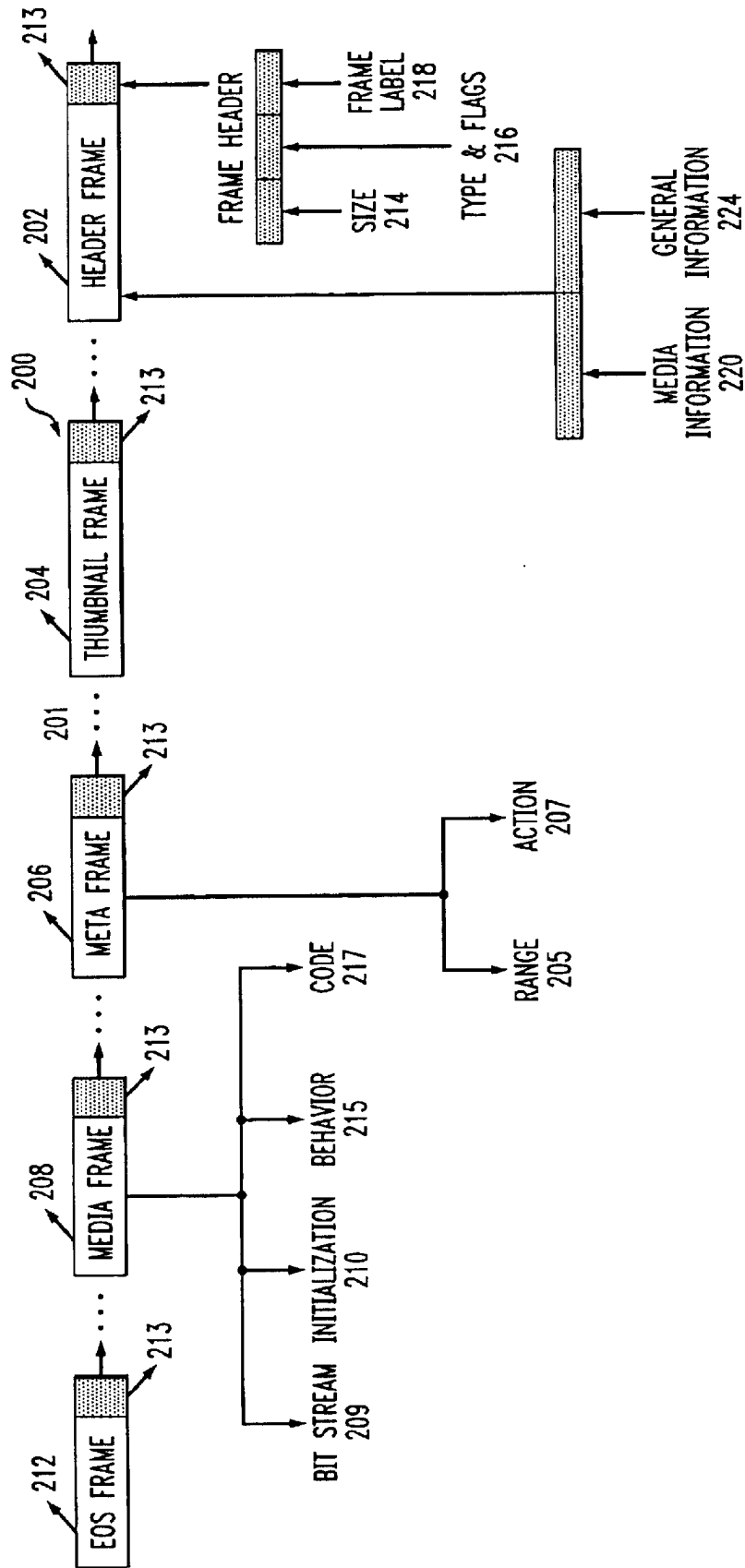
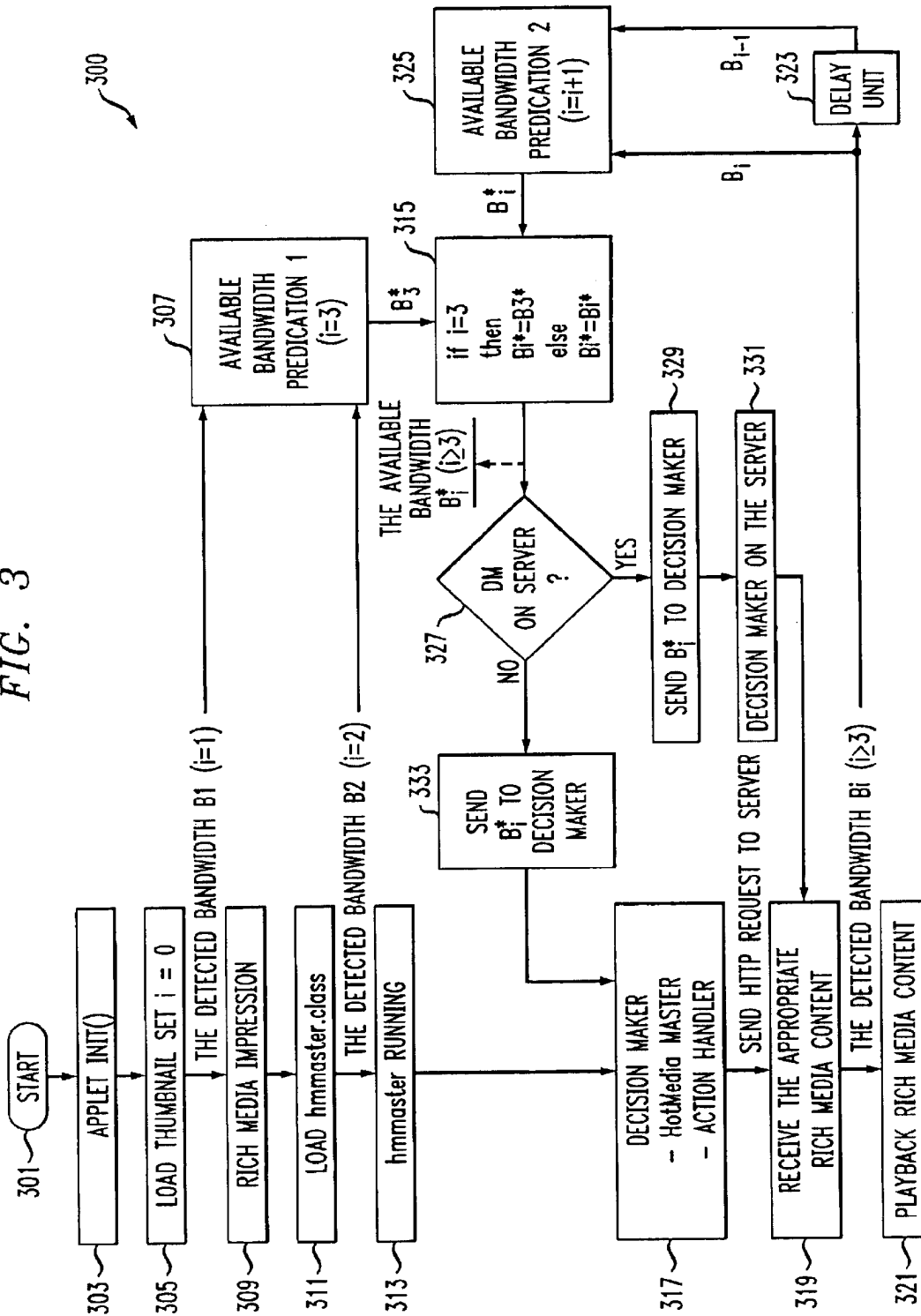


FIG. 3



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 described 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

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