The Case for Standard Real-Time Video

A White Paper
by Nels Johnson

Overview

Networked video is now established on the computer desktop. While not yet broadcast quality in all formats, the technology has nevertheless achieved a solid threshold of acceptability, especially for business communications. Common examples are video conferencing and distance learning, but other applications are also emerging, such as on-site coverage of corporate events and trade shows, and remote monitoring of company assets and engineering projects. Armed with the right combination of hardware and software, businesses can now broadcast high-quality video streams in real time across their entire networks.

Despite these gains, a key issue remains: third-party *helper* software (such as plug-ins) is currently required to view most types of networked video. In other words, the business world is still waiting for standard digital video on corporate intranets and wide-area networks (WANs), including the Internet itself, free of plug-ins and special video players. This white paper explores the barriers to standard real-time video, and how these barriers are being overcome by GTS. Going forward, standardization of networked video in real-time business environments will spearhead acceptance and continued development of streaming desktop video for all users.

Note: throughout this document, real-time video means live digital video streams broadcast over IP networks. The relationship of real-time video to video-on-demand (VOD) of stored video files is discussed below.

Evolving Standards

Throughout the computer industry, barriers to standards stem from the strategies of competing third-party developers. Because network video pioneers needed to recoup development costs quickly, their original products were both proprietary and relatively expensive (specifically the servers). This bred competition from rival pioneers with similar agendas, which further fragmented the market. By their natures, advanced software development and marketing make this scenario inevitable yet essential for getting such products off the ground in the first place. What happens over time is that successful products create *de facto* standards.

Nevertheless, as the networked video industry has now learned, standards are based on business *and* technical merits. This is because IP networks such as intranets, WANs and the Internet are almost pure Darwinian spaces for software and hardware evolution. If a company can create a *new* standard by circumventing the competing *existing* standards, it will enjoy a great advantage. Of course, technical innovation is still possible by any

competitor, driven by ever-faster computers and given that IP-based media is still in its adolescence. But a company who makes a business decision to support a wide range of platforms without plug-ins or players will reap substantial rewards.

As noted above, business communications are the most exploitable and well-heeled market for network video solutions. This is especially true for products that work across multiple platforms without players or plug-ins. Given the appetites in today's highly competitive corporate climates for fast, rich multimedia data feeds, *continued* development of networked video products will be driven primarily by the business communications market segment. GTS understands this model and has positioned its products accordingly. Figure 1 shows the relative positions of the product developers, past and present, in this market.

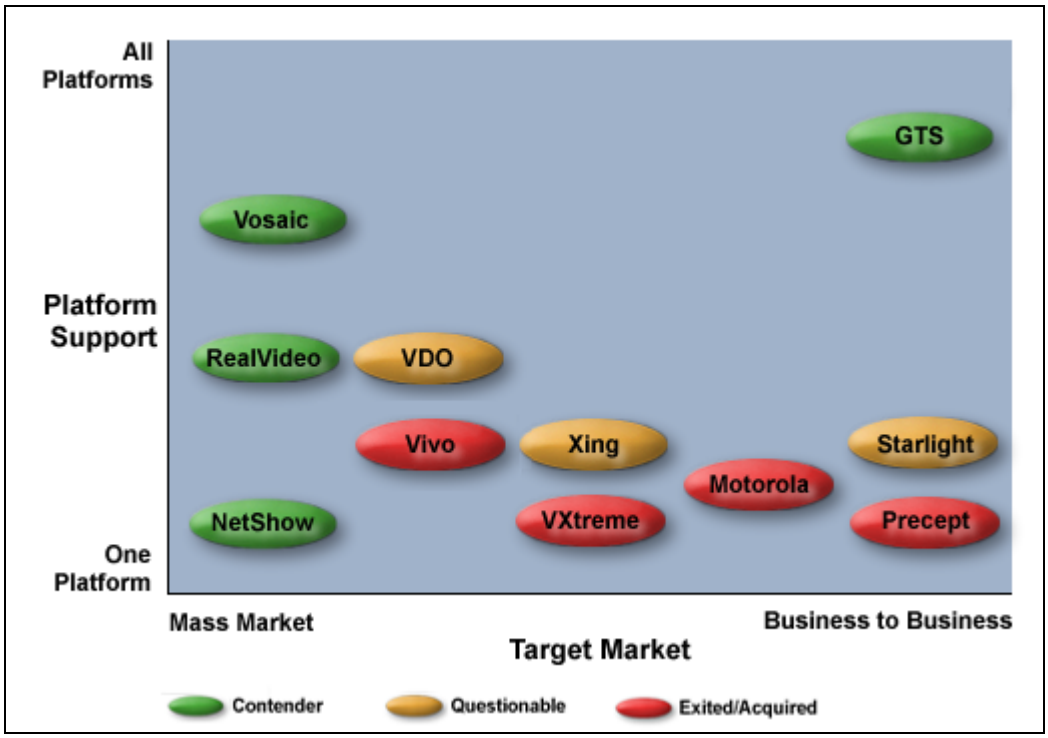

Figure 1. Streaming Video Market

Multicasting

Before profiling the industry competitors, some technical distinctions are necessary. First, *multicasting* technology has now entered the arena. Despite good products, the original multicast software companies were slow to win market share. This was due mainly to lack of support from worldwide network routers, which form the collective backbone of the Internet at large. Because most of the Internet infrastructure is fairly new and rapidly evolving, ISPs are hesitant (or unable) to invest in enabling technology without clear business needs. While multicast technology does promise to reduce packet congestion in

IP networks, the products which employ multicast protocols generally require add-on viewers. Also, virtually all firewalls block multicast traffic, rendering it useless for business-to-business communications.

The alternative to multicasting, called *unicasting*, is the basis for the rest of today's network video technology. While unicasting is often accused of clogging the Internet with redundant IP packets, this is not a serious issue for the business-to-business environments in which GTS products operate (where available bandwidth is much greater). The balance of this paper will therefore cover unicasting technology only—which is where the serious action is. When ISPs worldwide are multicast-enabled, most real-time unicast video providers will be able to integrate multicasting protocols with a minimum of development effort.

Real-time vs. VOD

As discussed in this document, real-time video will be distinguished from VOD on a live vs. stored basis. Real-time video applications generally broadcast video streams digitized from cameras recording live events (or some other "live" stream such as a VCR); like TV or radio, thousands can "tune in" to these broadcasts. VOD applications generally deliver video streams *on demand* to a single user from files residing on mass storage hardware, such as hard drives.

RTSP

Finally, an emerging standard which some argue will have impact on webcasting is the Real Time Streaming Protocol, or RTSP. At this time, RTSP is a proposed draft and is still undergoing revision. It is worth noting that once it becomes a standard, RTSP will be an application-level protocol for the *control* of the delivery of data with real-time properties (such as audio and video). It will *not* define the actual protocol or format for the data to be delivered. As a standard, RTSP is not yet compelling from either a business or a technical perspective. When the RTSP standard solidifies *and* when there are also guidelines for the delivery of the audio/video data itself, it will warrant consideration for implementation by those companies creating standards-based webcasting technologies.

The Current Arena

Despite the youth of the streaming video industry, a shake-out is already underway. The following capsules describe the key players, their strengths and weaknesses (business and technical), and their current positions in the market.

GTS

Launched in 1995, GTS embraces a strategy to attract the greatest number of business-to-business customers: no plug-ins or separate players required. Anyone with a browser that supports Java can enjoy video and audio streams from a GTS server without downloading

ancillary software or precipitating system conflicts sometimes caused by malfunctioning plug-ins and players. Key customers include Sun Microsystems, Oracle, @Home Network, Hewlett-Packard, NASA, National Semiconductor and Argonne National Laboratories. Detailed accounts of GTS' business model and real-time video technology are presented later in this document.

VDOnet

Also entering the market in 1995 with its VDOLive product, VDOnet set the original standard for low bit-rate streaming video on the Web. But it has recently run into trouble. In fact, as of late 1997, the company ceased new product development (but will support existing customers at least for the near future). Although multiple platforms were supported early on (along with real-time video-phones), VDOnet publicly pursued news broadcasters and entertainment networks as opposed to mainstream corporate enterprises. VDOnet does offer a videophone-like product, but it didn't offer performance suitable for business communications. Original customers included PBS, CBS, MTV, CNN and Fox. Microsoft was impressed enough to purchase a substantial stake in the company. For now, VDO's future is uncertain at best.

Xing

Also a pioneer (1995) in streaming Web media, Xing targeted higher bandwidth environments, such as ISDN, with its original StreamWorks video product. This was interesting at the time, given the small existing audience in that bandwidth sector. While the company came on strong in the beginning, with broadcast industry clients like NBC and good cross-platform support (Mac and PC), they ultimately lost momentum. No clear intentions to target business-to-business markets ever seemed to be established. For a while they appeared to be falling back on their MPEG products for local desktop playback (MPEG compression technology figured prominently in their streaming media applications), but now Xing's future in the networked video sweepstakes appears more uncertain than ever.

Microsoft

Microsoft's contribution to this battlefield, NetShow, first appeared in 1996 without much fanfare. The Netshow server and player are separate components from Windows itself, but they are closely tied to the OS and to Microsoft Information Server (IIS) and the Internet Explorer browser. Microsoft's strategy seems to be letting NetShow mature gradually while slowly becoming part of the company's office productivity suite. Occasionally there are broadcast media events promoting NetShow in glamorous environments, but these are just gravy. If NetShow becomes the market leader, it will be because: 1) it gets folded into the retail version of Windows itself, and 2) it works seamlessly with Microsoft Word, Excel, PowerPoint, Explorer and the rest of the MS Office productivity tools in business-to-business environments. Neither of these events have yet occurred. At this time, the basic server and player are still free.

VivoActive

In February 1998 Vivo was acquired by RealNetworks. The main factor that differentiated VivoActive from VDO and Xing at first (early 1996) was its player claimed independence from a dedicated UDP video server. While this provided a good marketing edge at the time, the advantage was lost when the rest of the key players implemented their own brands of HTTP streaming. No formal business strategy seemed evident during Vivo's bootstrap years, except for wanting to win the hearts and minds of independent Web developers. Prior to their acquisition, Vivo had gone into the Web video tools business.

VXtreme

Another later arrival (compared to GTS, VDOnet and Xing) was VXtreme in 1996. This product competed almost head-on with VDOLive, except for a lack of Macintosh support. Insiders at the time felt that VXtreme's technology was superior to VDOLive's, which may explain why Microsoft acquired them in 1997. VXtreme's original product line included a UDP-based server and a client that was simply a plug-in to Netscape Navigator and Microsoft Internet Explorer—a tentative step in the right direction strategy-wise. They also had a distinct business-to-business flavor, based on their demos and promotional literature.

Vosaic

Many analysts have considered Vosaic (formally on product radar in 1997) the next generation of *on-demand* streaming video for the Web. Technically speaking, Vosaic's media server engine manages three separate data streams, dynamically adjusting those streams *at showtime* based on current bandwidth conditions. Multiple platforms are supported, and demos at their Web site demonstrate relationships with Hollywood and the music industry (as opposed to a business-to-business strategy). Their literature suggests significant investment in Java-based media streaming, but the overall strategy here is still unclear. Standalone audio streams are handled with a Java applet—another step in the right direction from a business standpoint. Key customers and partners include Digital Equipment Corporation and OnLive TV.

RealNetworks

While Real Audio debuted in 1995, the first version of RealVideo came to market in 1997. At present, RealVideo is the market leader in Web-based video employing third-party player and server technology. Multiple platforms are supported (Windows, Mac, Solaris), as are both UDP and HTTP streaming. Unfortunately, their high-end servers rely on UDP streaming, which most corporate firewalls prohibit. While business-to-business markets are clearly in their sights, most deployment of RealVideo technology has been in the Internet entertainment markets and on independent Web sites. Also, their player and plug-in must be downloaded, installed and periodically upgraded. Key customers include ABC.com, CBS/Sportsline, Fox News and MSNBC.

Precept Software and Starlight Networks

Precept (1996) was acquired by Cisco in March 1998. Starlight also began offering Web-based products in 1996. Both have been significant competitors in the multicasting arena. The main focus remains high-quality, *scheduled* video for the enterprise (as opposed to the Web at large), including real-time video events. Their product suites utilized installable players and servers, and both companies pursued the business to business market aggressively—with enough success to keep at least Starlight in business so far. In fact, Starlight was broadcasting LAN-based video as early as 1992 in proprietary, non-browser (TCP/IP) format, though it still required helper software. Recently each company introduced VOD technology for low-bandwidth unicast environments. Starlight's customers include high-tech and financial industry clients, such as Hughes and Smith Barney.

Other Players

Several other solutions are worth cataloging here, based on the corporate entities behind them.

QuickTime with QuickStart: Apple had developed some powerful software for the LAN/WAN-based video conferencing market (QuickTime Conferencing), but this now seems all but abandoned. For Web-based video, there is the new version of the QuickTime plug-in (v2.0) which facilitates so-called *progressive downloading*. Even with QuickTime 3.0's new Sorenson Video codec, this is not true network streaming, let alone business-to-business real-time video. Early in 1998, the ISO standards committee selected QuickTime as the official architecture for MPEG-4, but the implications are still unclear.

Indeo Video Interactive 5.0: This is Intel's desktop video *codec* for Windows and the Mac—not an actual server/player product suite. While it does provide high-quality progressive downloading of stored video clips, it is not a competitor in the same league or markets as GTS, RealVideo and NetShow.

Motorola TrueStream: At first, an interesting contender from a major corporation, but not likely to gain significant market share over time. Currently it is not even a separate product.

CubicVideocomm: An ambitious late entry but unlikely to achieve widespread success given the strong, entrenched competition.

Based on their track records, the companies in the list above demonstrate a central issue: understanding one's markets is at least as important as technical proficiency. In 1996, firms like VDOnet, Xing and VivoActive were prominent due to the excitement surrounding the Web itself. Their products were considered technically advanced, despite

marginal media quality, and they had the low bandwidth entertainment markets all to themselves. In retrospect, it is fair to say that these companies were largely propped up with investment and strategic partner money, as opposed to product sales. If they had developed solutions free of players and plug-ins, concentrating instead on business communications opportunities, they might have remained serious competitors.

In 1998, the three serious contenders are GTS, RealNetworks and Microsoft. Again, technical innovation may propel a new competitor to short-term glory, but the business stakes are higher now. Overall video and audio quality are finally acceptable for corporate-level webcasting, and each of these three contenders understands the criteria for success. RealNetworks clearly has what it takes to succeed based on its ongoing dominance of the independent Web site and entertainment / broadcast media markets. How well it will push this advantage into real-time corporate environments is the key question. Microsoft can afford to move slowly in combining NetShow with its office productivity solutions which already permeate today's businesses. As shown below, GTS already makes real-time video so effortless that corporate clients shouldn't need to consider the alternatives.

The GTS Approach

At least two technologies make real-time video possible without plug-ins or standalone players: the Java Virtual Machine (VM) and the multipart/x-mixed-replace MIME type supported by Netscape. As noted, companies such as GTS who exploit such underlying technology enjoy a clear marketing advantage over competitors who rely on browser-based plug-ins and players to process and render video streams. Large corporations who standardize on long-term software solutions are particularly averse to products that require frequent mass updates or re-installation. This aversion is even worse when platform-specific updates are required. As the Java VM and Java technology in general continue to mature on all their established platforms, Java-based video streaming will mature along with it.

GTS exploits Java by streaming JPEG images and audio data from a GTS server to an Java applet on a user's machine. The applet is downloaded first if it is not already present. Because applets execute in the Java VM of all current Web browsers, no additional software is needed for video reception. The applet renders the JPEG image stream (in effect, the video track) along with the audio track right on the Web page. Because the streams are broadcast on port 80 (for HTTP protocol), they are not blocked by the firewalls surrounding most corporate intranets.

In Netscape Navigator, video streaming is implemented with the multipart/x-mixed-replace MIME type for even greater efficiency, although the Netscape Java VM will be utilized as soon as performance equals that of the MIME type. The multipart/x-mixed-replace technique provided the original basis for server-push multimedia on the Web, and was enlisted by GTS to handle image streams rendered as video media.

As Java expands its influence across all personal computer platforms, the potential for GTS product deployment will increase proportionately. Not only will GTS streams work in every browser that hosts the Java VM, but there is already dedicated channel support from Netscape Netcaster and Marimba Castanet. In fact, Sun itself has entered into a joint marketing agreement with GTS.

The GTS Business and Technical Models

GTS' principal market is the *business-to-business* real-time video community. On the corporate campus (intranet), with high-speed LAN connections, GTS performance will equal that of player-based MPEG solutions such as Precept Software's *IP/TV* or Starlight Networks' *StarCast*. Over wide-area networks, and in business-to-business Internet environments, GTS performance will generally surpass that of streaming MPEG products.

GTS offers two primary products: the GTS A/V Server and GTS Proxy Server. Multiple server platforms are supported, including Unix (Sun, SGI and HP) and Windows 95/NT. Figures 2 and 3 show the GTS Server architecture for Unix and Windows.

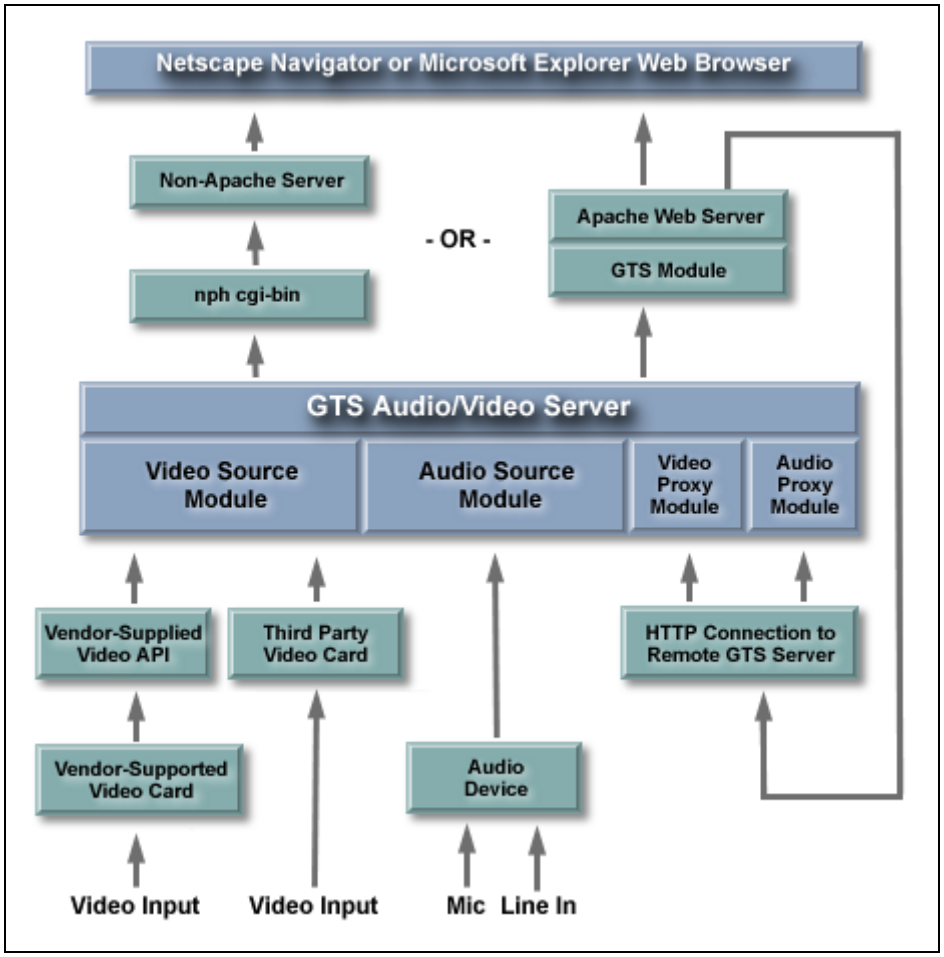

Figure 2. GTS Server Architecture Unix Platforms

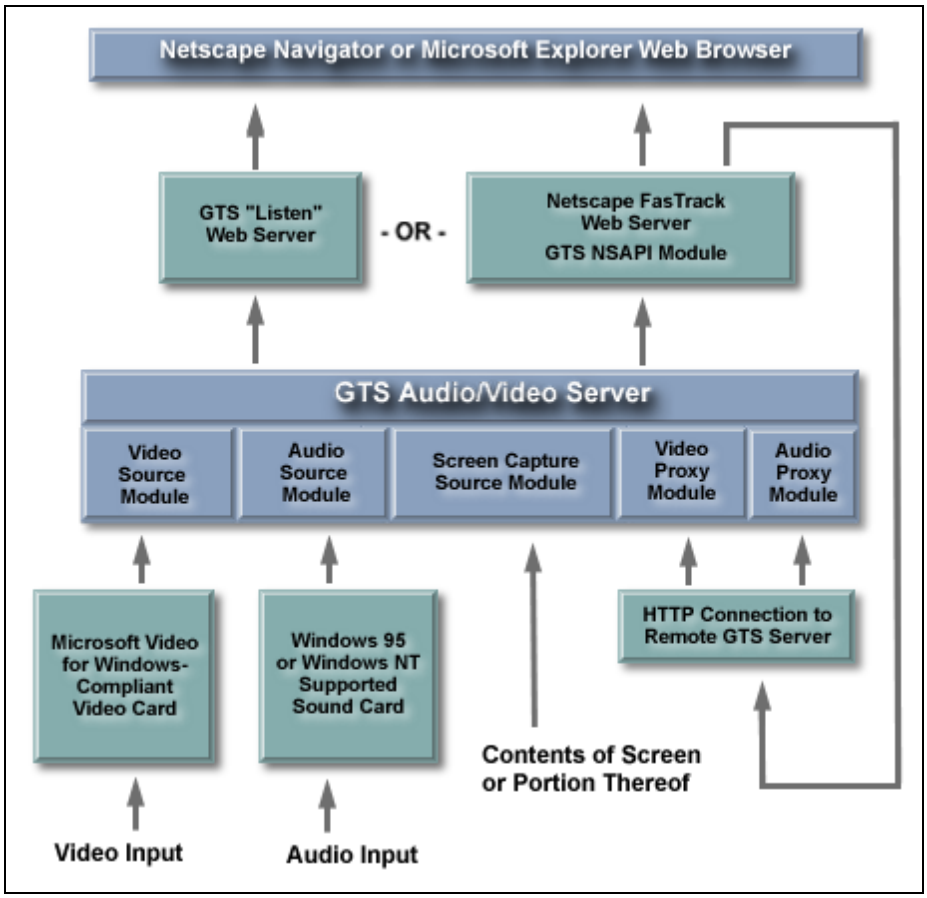

Figure 3. GTS Server Architecture for Windows Platforms

GTS also offers an Internet Broadcast service. For real-time broadcasts, the source audio and video are transmitted to GTS via satellite, microwave, the Internet, or standard phone lines. Any standard digital or analog format can be used for delayed broadcasts (VHS tape, MPEG files, etc.). For customers of the Internet Broadcast Service, GTS manages transmission of the audio and video streams to one or more high-bandwidth Proxy Servers installed by GTS across the Internet. As detailed below, GTS' Proxy Servers take on the bandwidth load for the video and audio elements on the Web page, helping ensure that the company's Web server can accommodate all visitors without running out of bandwidth.

The GTS A/V Server comprises Video and Audio subsystems. No hard-disk I/O is involved in either component—an approach that eliminates both the delays and the CPU demands of frequent disk access. Video rates up to 30 frames per second are supported, depending on the user's network connection speed and the server's video card.

The video component consists of a video card with hardware JPEG compression on Unix or a Video for Windows-compliant video card and software compression under Windows

95/NT, and the GTS video server, which captures the individual frames. Once encoded, the frames are delivered to the GTS Web server for broadcast. Supported cards include:

- *Sun*: Sun Video or Parallax Xvideo Xtra
- *SGI*: Indy or Indigo 2 with Cosmo Compress or Galileo Video
- *Windows*: Any video card that conforms to Microsoft's Video for Windows API on Windows 95/NT
- *HP:* Parallax XVideo700

The audio component of the GTS A/V Server provides 8-KHz audio at 16, 24, 40 and 64 Kbps over 28.8 modems and faster connections. As with the video component, the GTS audio server reads the audio signal from the computer's audio input port and then hands it off to the Web server for broadcast. On the browser side, simple HTML code initiates a Java applet to begin the audio presentation.

Along with the GTS capture driver, the GTS A/V Server package includes the Apache Web server software for the Sun, SGI and HP platforms. For Windows 95/NT, GTS provides an easy-to-use Web server that works with the A/V Server to deliver custom HTML pages which include GTS Java applets. Alternatively, Netscape's FastTrack Web server can use the GTS NSAPI-compliant module to access and broadcast video and audio streams.

The Proxy Server (see Figure 4) reduces backbone network traffic by replicating a single incoming media feed over local links. Depending on the number of users, design of internal network links, and the quality and frame rate desired, a single proxy server can serve up to thousands of users. To handle even greater numbers of users, multiple proxy servers can be run across a network (as GTS does with its Internet Broadcast Service). On all GTS products, access to replicated broadcasts can be controlled based on domain, IP address, and user name. Password protection is also available.

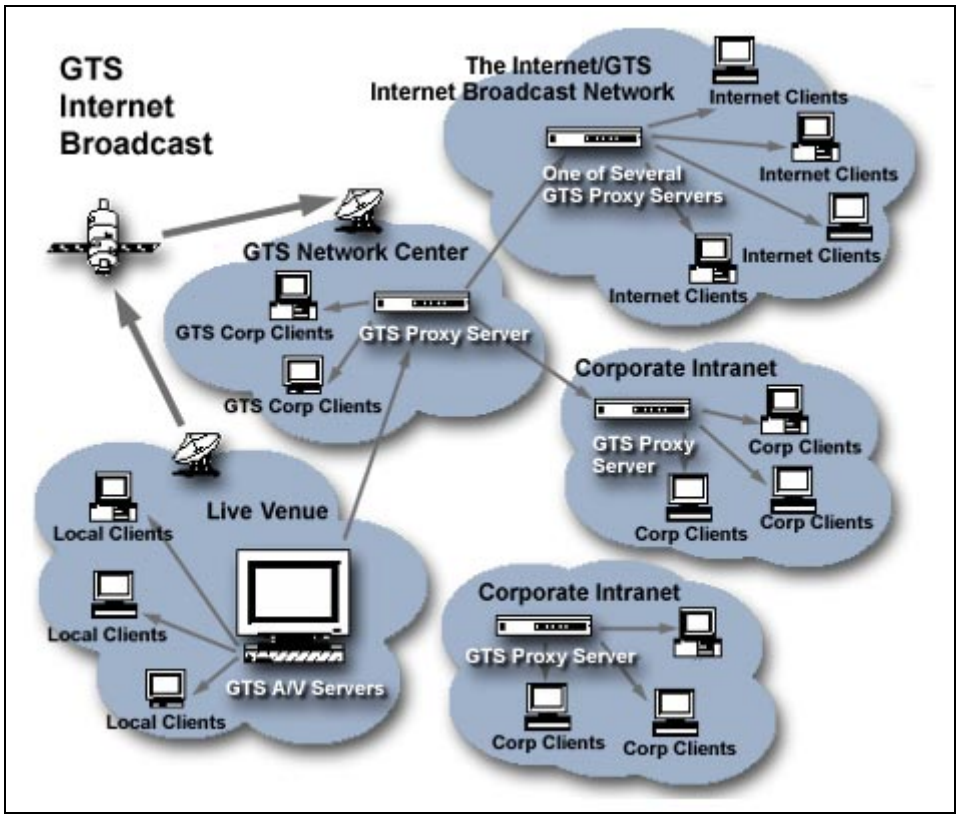

Figure 4. How GTS Source and Proxy Servers Work Together

Working together, the GTS product suite offers the following benefits:

- Multiple simultaneous video and audio bit rates. This feature is useful for delivering different types of video content to users with varying connection speeds, such as a dial-in connection from a laptop PC used by a salesperson on the road, a network computer at a teleworker's home, or a high-end workstation on a corporate intranet.
- Use of proxy servers to replicate video streams for large audiences. As noted, this takes the burden of too many unicast sessions off the original source server, thus increasing scalability and decreasing traffic on the Web or corporate intranet.
- Supported by the Apache and Netscape Web servers. Apache is the most popular Web server currently in operation, with Netscape products running close behind.
- Dynamically scales to each user’s connection speed and processor capability to maximize the viewing and listening experience for each user.
- Incurs an extremely low CPU load on the server side. This is not true for most of GTS’ competitors, including Microsoft and RealNetworks.

- No limit on the number of concurrent audio, video and proxy servers running on the same host. Few competitive products offer this facility. On both source and proxy servers, multiple video and audio sources are supported. In other words, multiple media streams can be digitized and broadcast from the same physical server. This helps reduce hardware and software expenses compared to systems where a higher CPU load may necessitate digitizing only one video and one audio source at a time.

Examples of events from which GTS video streams will likely originate include product launches, keynote addresses, annual shareholder meetings, collaborative research projects, distance learning and remote monitoring stations. Figure 5 is a typical GTS broadcast: a keynote speech from Internet World Spring '98.

(See Figure 5 on next page)

Conclusions

This white paper's goal was to crystallize the issues surrounding the advancement of network video technology, specifically products which broadcast real-time business communication events. As demonstrated, there is an industry shakeout in progress in which RealNetworks, Microsoft and GTS will be the likely survivors. GTS eliminates plug-ins and special players from the equation while supporting nearly all available computer platforms.

GTS is positioned for success because it has identified and targeted the most promising market for real-time video solutions: organizations who regularly provide video coverage of important events to their partners, customers and employees—as well as the world at large via the Internet. As long as Java fuels corporate networks, GTS will enable all consumers to enjoy standard networked video streams in their native Web browsers.

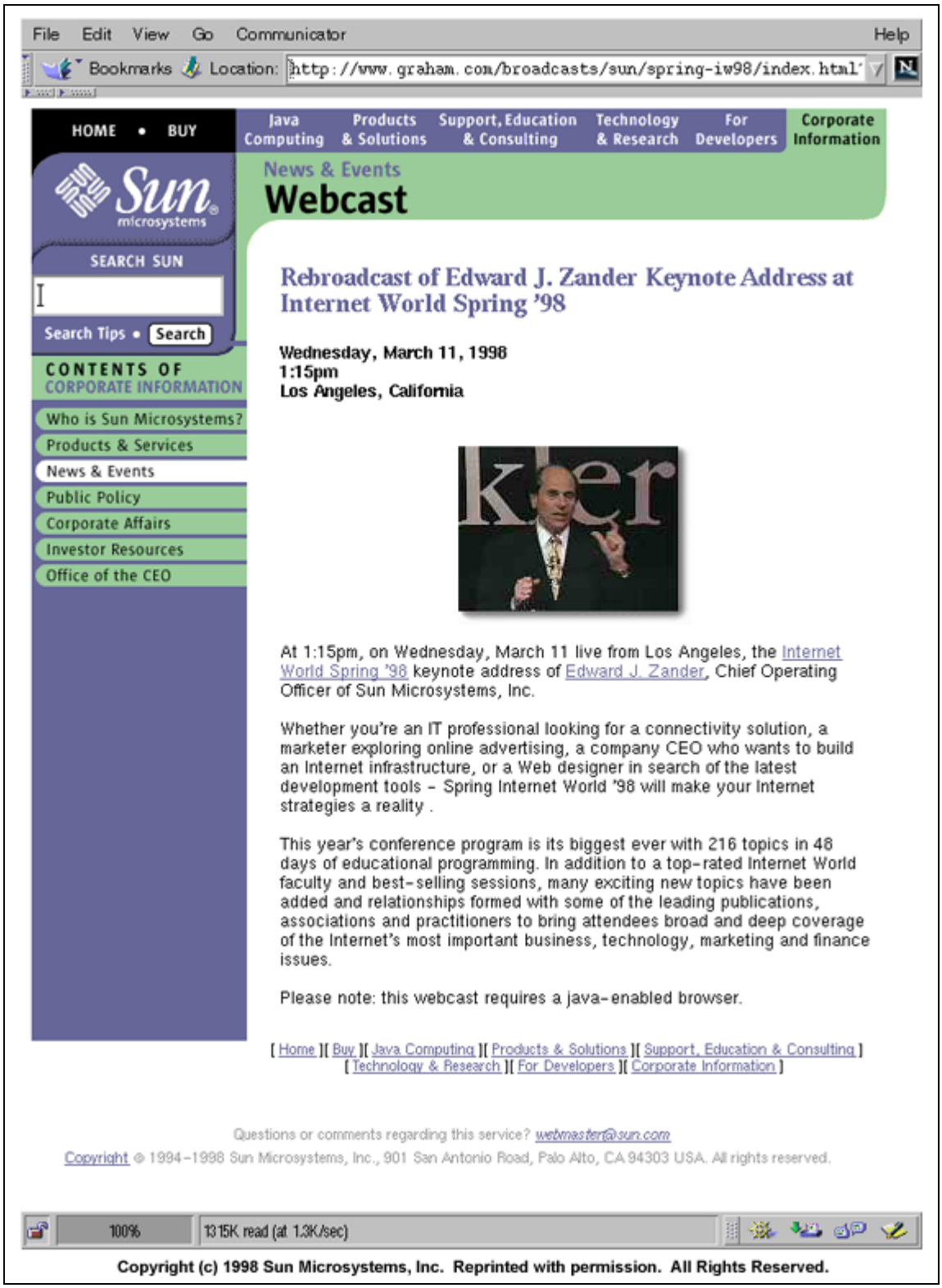

Figure 5. A real-time video webcast.