

CORECAST ARCHITECTURAL OVERVIEW

ENTERPRISE CONTENT NETWORKING

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PREFACE

The following white paper highlights the features and benefits of deploying Fantastic's COREcast technology for intelligent, scalable, and manageable content delivery over private enterprise networks. It assumes a general understanding of network architecture and IP protocols, as well as a working familiarity with streaming and caching technologies. Please refer to the glossary in Appendix A for a better understanding of some of the terminology used within this document.

This document is targeted at IT/MIS Departments, Technology Managers and Systems Administrators interested in learning more about COREcast technology for any of the following purposes:

- Deploying scalable IP video on demand
- Deploying live streaming video in unicast and multicast scenarios
- Caching on-demand content
- Managing content distribution and delivery across heterogeneous enterprise network environments
- Deploying an enterprise content delivery network (eCDN) to support a wide range of rich media applications, such as e-learning, corporate broadcasts, training on demand, Enterprise Information Portals (EIP's) and much more.

For more information on COREcast technology and Fantastic's Corporate Solution, please refer to our website at www.fantastic.com.

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INTRODUCTION

The demand for rich media is growing fast…

Many large companies today are faced with increasing demand for rich media applications running over their private corporate networks. According to Jupiter Media Metrix, the market for enterprise streaming media (the most common form of rich media today) will reach $2.8 Billion by 2004. This demand is being driven by business units clamoring for better ways to train and communicate with employees. HR and training departments are demanding streaming video and other media-rich content to conduct more efficient employee training and education. The corporate communications department needs to broadcast live CEO presentations to all employees worldwide. The marketing department wants to provide the field sales force with streaming video presentations to execute product launches and updates. The list continues to grow…

Most companies are not prepared…

Most corporate networks in their current state cannot support these bandwidth-intensive applications. Live broadcasts can be disappointing for the viewer and wreak havoc on the corporate network. Rich media content saturates network bandwidth and interferes with mission-critical applications. For these reasons, IT departments often restrict or prohibit streaming media over the corporate network.

Regardless, leading companies recognize they must forge ahead with rich media applications to enhance corporate communications. Live broadcasts, video on demand, and other rich media applications have the potential to dramatically reduce costs and improve productivity. This is particularly true for large, dispersed organizations. Today, there might only be one department requesting streaming video, but eventually, all departments will want to use rich media applications to train and communicate with employees, partners and customers worldwide.

An enterprise content delivery network is the answer…

The answer for these leading companies is simple: build a scalable content delivery network for the enterprise to handle both current and future needs. Enterprise content delivery networks (eCDN's) are the foundation for a holistic approach to content networking for the enterprise. Content networking is the dynamic delivery of rich content by linking applications with a distributed network of intelligent servers and distributing requests across the network to maximize performance

.

Unfortunately, few vendors today offer a solution that addresses the unique requirements of content networking across the enterprise. Most are re-cast versions of Internet caching and streaming technologies geared for public, Internet-based content networking for an external audience. They can be expensive, complicated to deploy, and require a huge amount of administration and support from internal IT staff.

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Enterprise customers need a content networking solution that satisfies the following requirements:

- Reliable, scalable and secure
- Leverages existing network infrastructure without requiring major upgrades
- Optimizes network bandwidth for web caching and streaming media without jeopardizing mission-critical applications
- Ensures the highest quality of service for all users accessing content over the network
- Easy to deploy and manage

Fantastic satisfies all enterprise content networking requirements…

Fantastic is the leading provider of enterprise content delivery networks (eCDN's), enabling Global 2000 companies to leverage TV-quality streaming video, media rich e-learning and other bandwidth-intensive applications over their private IP networks. Fantastic's COREcast™ technology is an overlay architecture enabling corporations to effectively perform content distribution, delivery, and management behind the firewall in a reliable, secure and scalable environment.

Fantastic's "inside-out" approach leverages a content networking strategy from the core of the network to the edge, enabling organizations to satisfy all target audiences with high-impact streaming media and high-performance web sites, anytime and anywhere. Fantastic leverages an ecosystem of World-class partners to help companies maximize their content networking investment and dramatically improve corporate education and training programs. Ultimately, our customers benefit from reduced training costs, higher productivity and reductions in overall network bandwidth requirements.

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SECTION ONE - COREcast TECHNOLOGY OVERVIEW

COREcast is Fantastic's comprehensive solution for content distribution, delivery and management within private enterprise networks. The COREcast overlay architecture consists of an integrated set of distributed, zero-maintenance servers that perform caching, storage and streaming functionality. The COREcast system manages content at the core of the network while intelligently and dynamically delivering content from the edge of the network thereby accelerating intranet/extranet performance and preserving upstream bandwidth for mission-critical applications. The result is scalable rich media delivery, bandwidth efficiency and total control over the network.

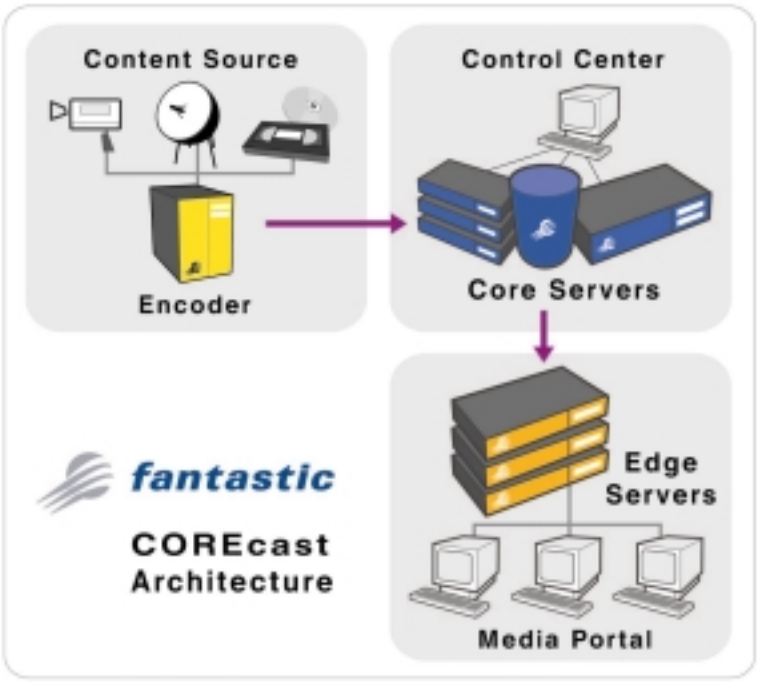


FIGURE 1 – FANTASTIC'S COREcast SOLUTION

This technology allows corporations to put rich media, audio, video, and web objects, closer to the end user in an efficient, easy to manage solution. The solution employs multiple, geographically distributed edge content servers placed behind the corporate firewall on fast, switched (10/100 Mbps) LAN segments. These servers can run several different types of applications, including Real Networks® Real® Servers (and Proxies), Microsoft® Windows Media® Servers and Apple® QuickTime® servers. Also, HTTP caching functionality enables web objects to be cached and delivered locally.

There are three main components and one optional component integrated into the COREcast solution, which will be described in the following sections:

- Master Control Server (**MCS**)
- Central File Repository (**CFR**)
- Edge Content Server (**ECS**)
- Rich Media Encoder (**RME**)

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The Master Control Server - MCS

The Master Control Server (MCS) is the heart of the COREcast solution. The MCS is responsible for management of all content distribution, collection of real-time network data, edge server health monitoring, and user access information. In addition, the MCS is responsible for housing the central database, where all the collected data is stored.

The MCS is usually co-located in the company's central data center, or at the hub of the company's Wide-Area Network (WAN), or wherever there is adequate power, cooling, and security available.

The MCS is the heart of the COREcast solution. On-board the MCS are the following programs:

- ***Central Database*** – An SQL database where all of the network, network device, content, user, and usage information is stored.
- ***ECS Monitor*** – A program that keeps track of the various edge servers distributed throughout the network. The ECS Monitor keeps track of server statistics (CPU, memory, disk, process, etc) and stores that information in the central database. The ECS Monitor continually measures network conditions and analyzes network links to determine available bandwidth, latency, and a host of other metrics. The ECS Monitor is responsible for aggregating these network statistics and relaying it to the Edge Content Servers distributed throughout the network.
- ***Content Distribution Manager*** – The Content Distribution Manager (CDM) is a set of programs designed to schedule and distribute content from the Central File Repository (CFR) to the Edge Content Servers (ECS). The CDM checks each ECS in the network to determine what content packages (or content channels) get distributed, based on pre-determined policies assigned to each ECS. The CDM has intelligence built-in to detect and refresh stale content, manage package distribution, and to automatically schedule and deliver content based on time-of-day, network load, network bandwidth availability (or any other pertinent network criteria defined by the client network administrator), and is linked to the user authorization engine to authenticate and allow access to users.
- ***Message Server*** – A program that allows the MCS and the ECS devices in the network to communicate with each other and the Central Database.
- ***Path Manager*** – A decision-making layer that chooses the best path to a particular IP address based on metrics collected by the ECS devices, which delivers and stores this data in the central database.
- ***Redirector*** – The Redirector accepts requests from the various end user media players (Real, Windows Media Player, and QuickTime) and using information from the Path Manager, re-directs the user to the best (closest, least loaded) Edge Content Server. A separate component of the Redirector provides re-direction services to HTTP cache requests in a similar manner.
- ***COREcast Control Center*** – A Web-based application that allows network administrators to control all aspects of the COREcast environment, including database management, ECS management, content management, content delivery scheduling, channel management, and user management. It contains an easy-to-use graphical user interface (GUI) and comes with everything needed to manage the entire COREcast environment.

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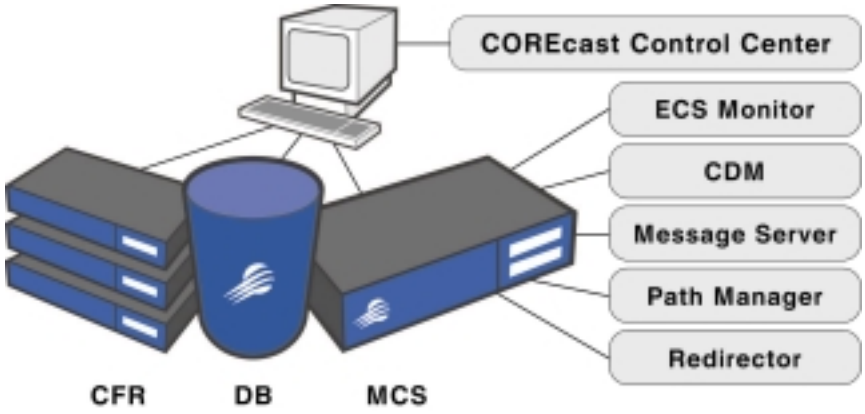


FIGURE 2 – NETWORK CORE COMPONENTS

The Central File Repository - CFR

The Central File Repository (CFR) is the disk farm where all content for the entire network of Edge Content Servers is stored. In most COREcast installations, the CFR can co-reside on the MCS server. In this case, the CFR is arranged as a fast, wide, SCSI-3 RAID disk farm, with enough capacity to satisfy the content storage requirements for the entire network with room to grow designed in.

No special software resides on the CFR; therefore, IT departments that run a variety of local attached or network disk storage solutions can use those solutions as the COREcast CFR. These include:

- Local-attached RAID storage residing on any server
- Network-Attached Storage (NAS)
- Storage-Area Network Solutions (SAN)
- Network File System (NFS) disk
- Any local or network disk that can grant Read/Write access to the MCS

It is not critical that the CFR have the *fastest* disk storage solution because the content is never served from the CFR directly to any end user. The CFR simply is a content repository that is used to populate the Edge Content Servers. The MCS copies files from the CFR into the ECS, and the ECS then serves the content to the end user.

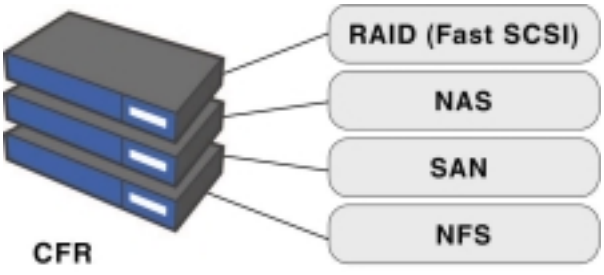


FIGURE 3 – CFR CONFIGURATIONS

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The amount of storage configured into a CFR depends on different variables. First, there should be enough online storage available to accommodate the amount of content (in megabytes) that will be made available to the entire network. Next, some amount of disk space should be allocated for growth. Fantastic recommends that at least 25% additional free disk space be available. For example, if your total content storage amounts to 100MB, there should be an additional 25MB of free storage available for new content. If you are considering mirroring your online disk space, your storage requirements will double. In the above example, if your total online storage is 125MB (100MB used + 25MB free) then you will need a total of 250MB (125MB x2) to mirror (or back up) your online storage.

There are many methods for mirroring online storage, the most popular method is using one of the available RAID controllers and implementing a RAID 1 mirroring configuration. Some of the advantages of the RAID 1 solution are:

- 100% redundancy means that no rebuild is necessary in case of a disk failure
- Certain RAID 1 configurations can sustain multiple simultaneous disk failures
- Inexpensive (vs. more complex RAID designs, such as RAID 5, 10, and 53)
- Simplest RAID subsystem storage design

There are other methods of providing a mirrored disk environment both available as Open Source code and proprietary methods designed and sold by Brocade, EMC and others. Fantastic recommends using whatever method is best suited for your environment based on cost, features and performance. Fantastic's technical consultants can assist you in recommending a solution.

The Edge Content Server - ECS

The Edge Content Server (ECS) is designed to provide corporations with multiple, self-contained content services, including streaming (Real, Windows Media and QuickTime), FTP, HTTP caching, and IP and device management services.

Fantastic recommends supporting hardware to include high-speed 10/100 Base-T Ethernet port upgradeable to dual or quad 10/100 Ethernet ports or a single Gigabit Ethernet port, Pentium III processors up to 933MHz in single or dual configurations, and hot-swappable Ultra 160 SCSI hard drives. The ECS is designed as a self-organizing and self-actualizing server; that is, they plug into the LAN without prior configuration of knowledge of the host network and then configure themselves into the host network.

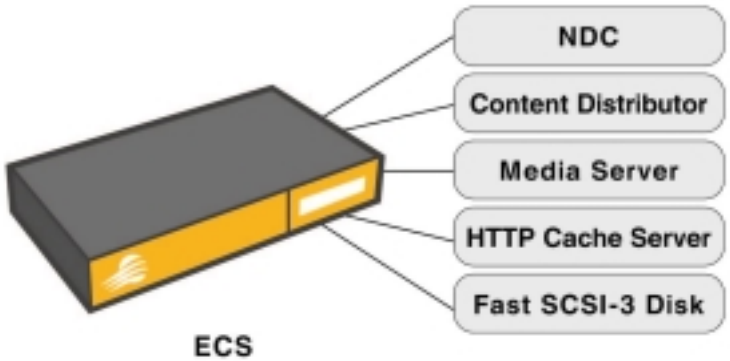


FIGURE 4 – NETWORK EDGE COMPONENTS

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The ECS should be configured according to the number of users that will be accessing the server, the number and types of applications that will be running on the server, and the amount of disk space required to hold the content to be delivered. A sample configuration for an ECS that will be serving Real Networks video streams and HTTP caching, capable of serving up 300 simultaneous 300Kbps streams, and capable of storing up to 500 hours of video would be:

COREcast ECS-300

- Dual Pentium III 933MHz
- 512MB RAM
- 2x36GB Fast/Wide SCSI-3 Disk
- 10/100 Fast Ethernet Interface
- Rack mount enclosure

Each COREcast ECS runs the following services:

- ***Network Data Collector*** – The Network Data Collector (NDC) is comprised of a series of functions that acquires information from the network, such as:
  - IP and Subnet Mask information
  - Hop counts
  - Link speeds (for all links in the path)
  - Link latency
  - Queue depth (for all network devices in the path)
  - Best path from the ECS to the user
- ***Content Distributor*** - A tool that works with the CDM application based on the MCS. The Content Distributor downloads content from the CFR and stores it locally. It also has the capability to download content from the closest ECS if it determines that it is more efficient to do so.
- ***Media Server*** - Can be a Real Server or Real Proxy, a Windows Media Server, or a QuickTime server.
- ***HTTP Cache Server*** - Caches and stores web objects locally.

One of the unique features of the ECS is its true plug-and-play capability. When a new ECS is attached to the host network, it configures itself to the network (using DHCP), locates and logs into the MCS, checks the configuration database in the MCS, and then prepares itself for a download of content. The ECS checks a series of variables, including the time of day, the speed of the slowest path between itself and the nearest CFR (or ECS), and network load before transferring its content down locally. Once the transfer of content is complete, the MCS verifies the content distribution to the ECS, and then marks the ECS as “Administratively Up”, meaning the ECS is ready to serve content.

It is important to note that unless the host network that the ECS is being installed into does *not* support DHCP, no configuration of the ECS is required. In that case, only minimal manual configuration would be required.

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The Rich Media Encoder - RME

The Rich Media Encoder (RME) is a content conversion server that typically resides at the corporate video production center and is an optional component to the COREcast architecture. The RME performs real-time conversion of digital, satellite, and terrestrial broadcast media for scalable streaming delivery across corporate networks. Companies that wish to do their own encoding will require one or more RME servers matched to the type of media they wish to encode and the target format of the streaming media. The RME has the capability of converting content into a variety of streaming formats including Real, Windows Media, QuickTime, and MPEG for distribution in both live and on demand scenarios.

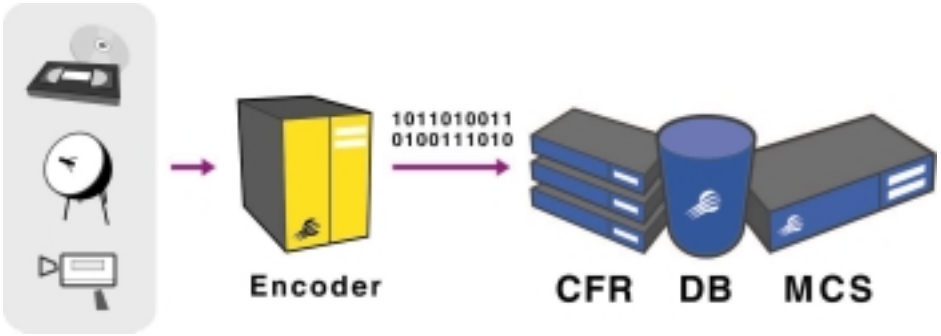


FIGURE 5 – CONTENT CONVERSION

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SECTION TWO – DEPLOYING THE COREcast SOLUTION

The following section describes a prototypical scenario of a COREcast installation on a typical private enterprise network. The network in this scenario consists of a DMZ, three remote offices each with a separate Local Area Network (LANs), collectively interconnected to the corporate campus via a Wide Area Network (WAN). The following diagram depicts a typical private enterprise network with a basic COREcast installation.

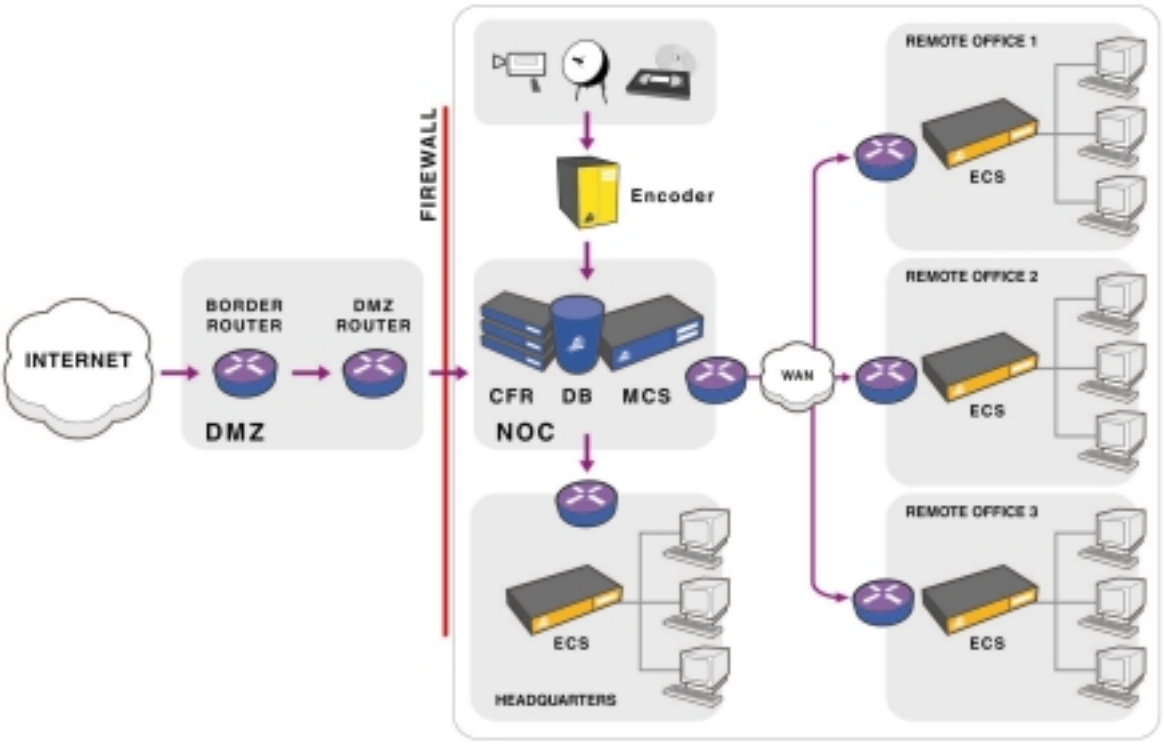


FIGURE 6 – TYPICAL ENTERPRISE NETWORK WITH COREcast INSTALLED

In designing and installing the eCDN overlay network we will take into consideration the following important objectives:

- ***Network Bandwidth Optimization*** – The goal is to optimize network bandwidth for streaming media and other rich content delivery, while ensuring that mission-critical traffic on the network in not impacted in any way. It is important to conserve bandwidth across the dedicated WAN connections from the corporate campus to the remotes offices, which in this example are 1.54Mbps T-1 links. The overarching objective is to push content to the edge of the network and preserve precious WAN bandwidth.
- ***Quality of Service*** – The goal is to provide the highest possible quality streaming media for any user wishing to access VOD (Video on Demand) or live streaming events from their desktops. Also, dramatically improve the speed at which web pages load by efficiently caching Web objects, such as GIF's, JPEG's, Flash®, and other dynamic Web objects locally, as close as possible to the user's desktop.

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- ***Redundancy and Failover*** – The goal is to design failover capability and redundancy that is auto-configurable, auto-failsafe, and imposes little to no overhead on the corporate IT staff. This feature must be able to auto-route the user to the closest, least-loaded, and available streaming/caching server with no intervention on the part of the user *or* the corporate IT staff.
- ***Security*** – The goal is to stream content over the corporate network without compromising its intranet/extranet security and to provide user authentication, content management, and content delivery based on those authentication metrics. When necessary, it must also provide encryption for any content delivered from the CFR to the ECS devices in the network.

COREcast Design Steps

Before placing the COREcast servers on the network, a few simple steps must be followed. Completion of these steps will ensure a trouble-free installation and will guarantee the most efficient operation of the COREcast network.

1. ***Layout the eCDN Overlay Network*** – To layout the eCDN network it is a good idea to have the network maps for the corporate network that shows the locations of the corporate data center, routers, WAN links, WAN link speeds, and the numbers of users and locations of the remote offices.

   For the network diagram in Figure 6, we will assume the corporate headquarters has a data center and a campus of four (4) buildings connected by high-speed Ethernet connections (100Mbps or GigE) and the building LAN's are all 10/100Mbps switched (not shared) connectivity. Each building on the corporate campus has approximately 300 employees, all of which are connected to the LAN, for a total of 1,500 corporate campus users. We will assume that all of the employees will require the use of the eCDN and that we can deliver video streams at 300Kbps to each user on the network.

   The WAN links to all of the remote offices are 1.54Mbps T-1 Frame Relay connections and those links are usually half-full with other types of corporate data traffic (average 50% utilization). We will also assume each remote office has 10/100Mbps switched Ethernet LAN connectivity to the desktop. Finally, we will assume that the LAN's are usually carrying an average of 30Mbps of corporate data traffic, or approximately 30% utilization.

   Our goal is to deploy a COREcast network that can support a maximum of three hundred (300) 300Kbps streams simultaneously at every corporate campus and remote office location. We will assume that both VOD and live streaming will be delivered to the users desktops.

   In a typical installation, the COREcast MCS will be co-located in the corporate data center. We will deploy one ECS in each of the four (4) corporate buildings.

2. ***Configure DNS*** – Before we can install the MCS we must first make an entry for it in the company's DNS tables. Only one DNS entry is required for installation of the COREcast network. The COREcast MCS acts as proxy for

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all media players and for HTTP requests, therefore, the IP address and network name of the MCS must be resolvable in DNS.

A typical DNS entry for the MCS would look something like this:

```
COREcast        IN          A           172.10.120.10   ;eth0
                IN          A           10.0.0.10       ;eth1
                HINFO       MCS         UNIX
wpad            IN          CNAME       COREcast
mcs2000         IN          CNAME       COREcast
```

We will assume that DHCP is enabled for network clients, and as such we will not require separate DNS entries for each ECS installed into the network

3. ***Install the MCS and Configure the eCDN*** – Once the DNS tables have been modified, we can install and power up the MCS. Once the MCS has been installed, the ECS devices can be attached to the network.

   To prepare for content distribution, we will configure each ECS to receive a common set of video streaming files (i.e., that each ECS in the network will be pre-populated with identical content) using the COREcast Control Center application. Since we're allowing each ECS to have a common set of files, no further ECS configuration is required at the COREcast Control Center at this time.

4. ***Install the Edge Content Servers*** – We are now ready to install the ECS appliances. Remember, no configuration is required for the ECS; all that needs to be done is to install the ECS, attach the power cord, attach the Ethernet cord, and power up the server. If your site runs DHCP (the Dynamic Host Configuration Protocol) to serve IP addresses to client machines, the ECS will configure its own IP address and subnet mask, IP gateway, and domain name automatically. If not, a network administrator will need to assign an IP address, domain name, and gateway to each ECS in advance.

   In this example we will be installing a total of four (4) Edge Content Servers, one in the corporate campus building and one in each remote office. It is best to locate the ECS devices in the building server room, where there is adequate power, cooling, and security.

   Once the ECS has booted, it will announce itself to the network by finding the MCS, registering itself, and then coordinating with the MCS to schedule the initial delivery of its content.

   In the example, we have set up the COREcast Control Center to schedule all content delivery between Midnight and 6AM, so the ECS should be ready to begin content distribution services the following morning beginning at 6AM.

5. ***Publish the Content*** – This example assumes the corporate communications department has made streaming video files available for

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publishing to the eCDN. We will assume the corporation has already encoded all files in a particular format (e.g., Real) at a target bit rate (e.g., 300Kbps).

Once again, using the COREcast Control Center's publishing interface, files will be copied from their origin directories into the Central File Repository's directories. Once content is submitted (published) to the eCDN, we can begin to schedule the distribution of the content to the Edge Content Servers.

Setting up scheduling allows the IT staff to choose off-peak network times to publish content (e.g., late nights or weekends). For the purpose of this example, we will tell the COREcast Control Center to publish content from Midnight to 6AM, 7 days a week.

6. ***Ready for Access*** – At this point, COREcast network is ready to deliver content. To access the rich media, a user will click a link on a web page, sending a request to the MCS for a particular media file. The MCS determines on which subnet the user is located in the network and then performs a series of functions, including determining which Edge Content Servers have proximity to the user, network conditions, and available bandwidth on relative network segments. Based on its analysis, the MCS points the user to the optimum ECS and serves the requested media file. The user's media player engages and the media file is active at the desktop.

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SECTION THREE - STREAMING WITH COREcast

The following section describes the various methods of streaming VOD and live video streams with a COREcast solution

COREcast Live Streaming

This section discusses the two basic delivery methods that COREcast supports for streaming live broadcasts to connected clients: splitting streams by means of either (1) TCP or UDP unicasting or IP multicasting, and (2) by pass-thru delivery.

- ***Splitting - Unicasting*** – On networks that are not multicast-enabled, live streams can be delivered efficiently across networks by delivering a single unicast stream from the originating live streaming server (the *origin server)* to COREcast Edge Content Servers that are distributed across the corporate network infrastructure.

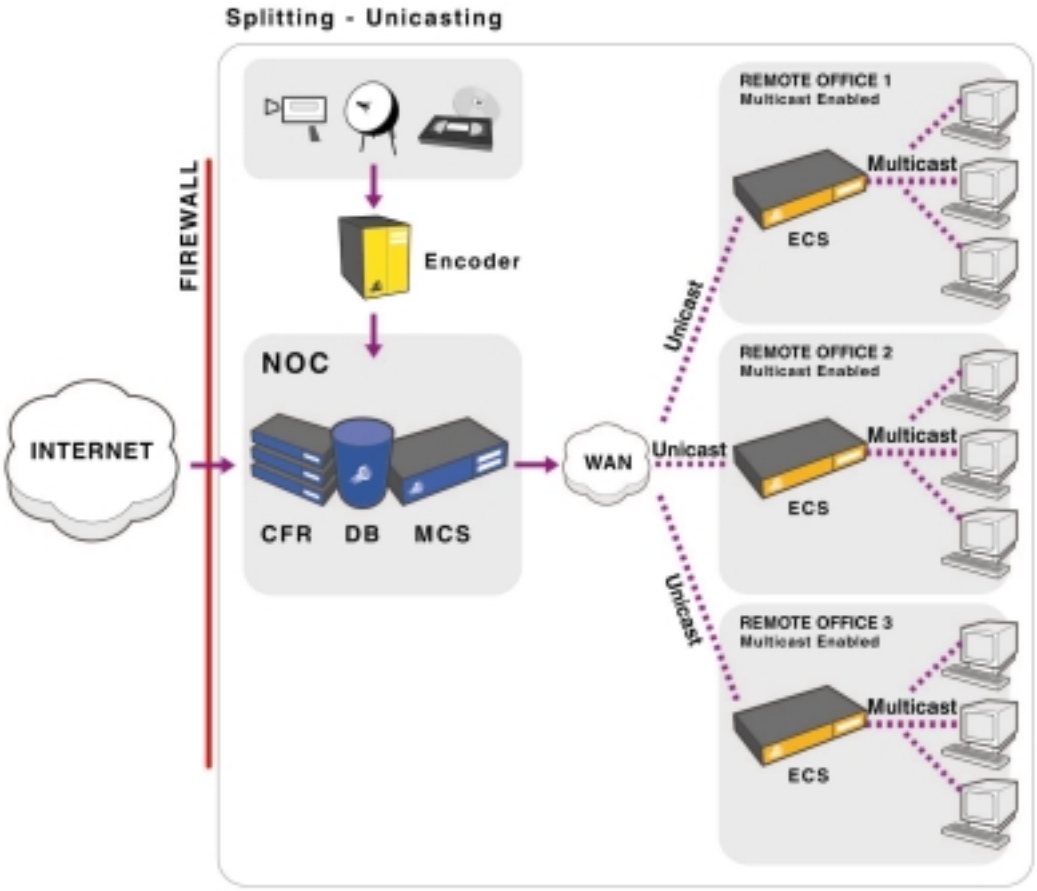


FIGURE 7 – STREAM SPLITTING, UNICASTING

In this process, a user asking for a live stream will be first connected to the COREcast MCS. The MCS will re-direct the user to the closest ECS for delivery of the live stream. Next, the local ECS will initiate a data connection back to the origin server and deliver a single unicast stream to the local ECS. The local ECS

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splits the live stream for any clients connected to it. Subsequent requests for the same live stream are then delivered from the local ECS without pulling redundant streams from the origin server.

In cases where only the local LAN's are multicast-enabled, the COREcast solution is to send a single unicast stream from the origin server to the local ECS devices in the network. Then, the local ECS can rebroadcast the live stream on the multicast-enabled LAN's.

The advantage of splitting is that a single live stream can be sent to each local ECS from the origin server, saving a significant amount of bandwidth on WAN links.

- ***Splitting - Multicasting*** – COREcast supports IP multicasting for live streaming (broadcasts). Two methods are available for this.

  IP Multicasting requires the networks between the MCS and the local ECS devices are multicast enabled, in this case, a multicast stream can be delivered to the local ECS, and the local ECS will then rebroadcast the live stream out to the users.

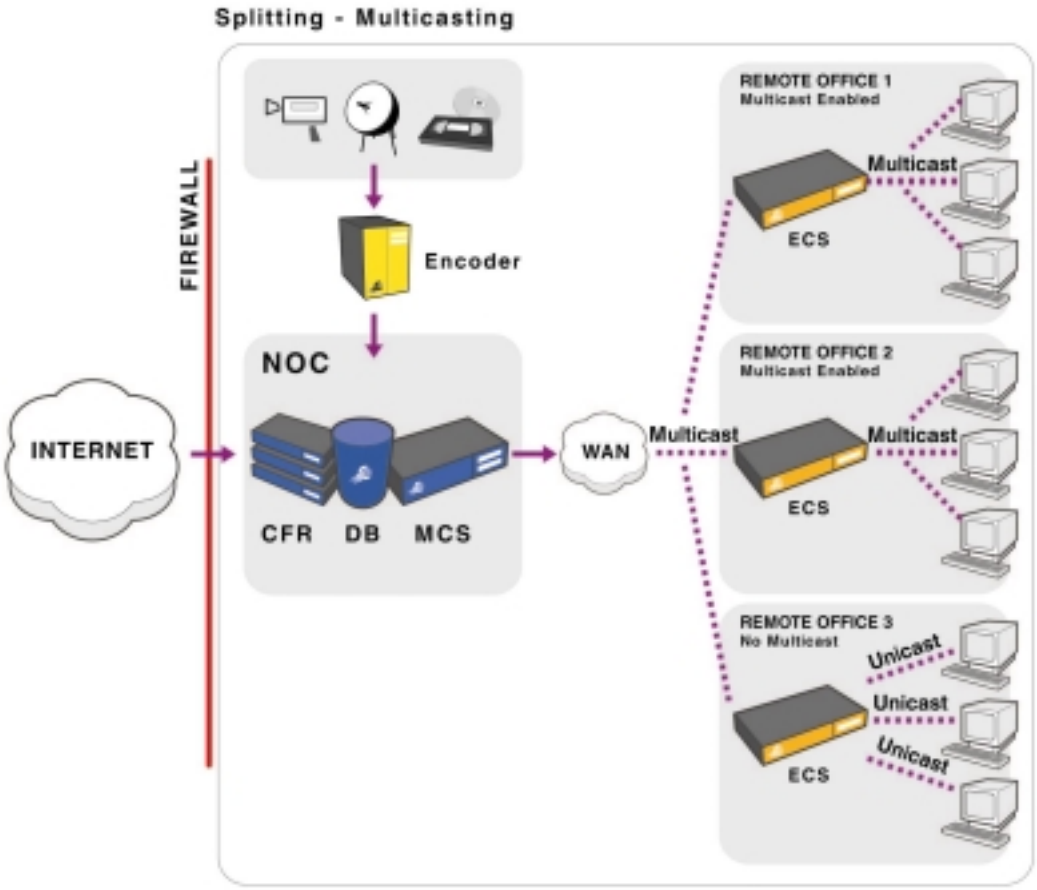


FIGURE 8 – STREAM SPLITTING, MULTICASTING

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- ***Pass-Through Delivery*** – In cases where the live stream cannot be split, the ECS will establish a connection to the origin server for each connecting client.

  Pass-through delivery is the least bandwidth-friendly method of delivering live streams to the desktop. Since a new data connection is made to the origin server for each client requesting to watch the stream, it must be noted that this method of delivery can quickly fill up slower WAN links. As an example, a T-1 connection (1.54Mbps) can only support a maximum of five (5) 300K streams at one time, assuming that there is no other traffic occupying the link.

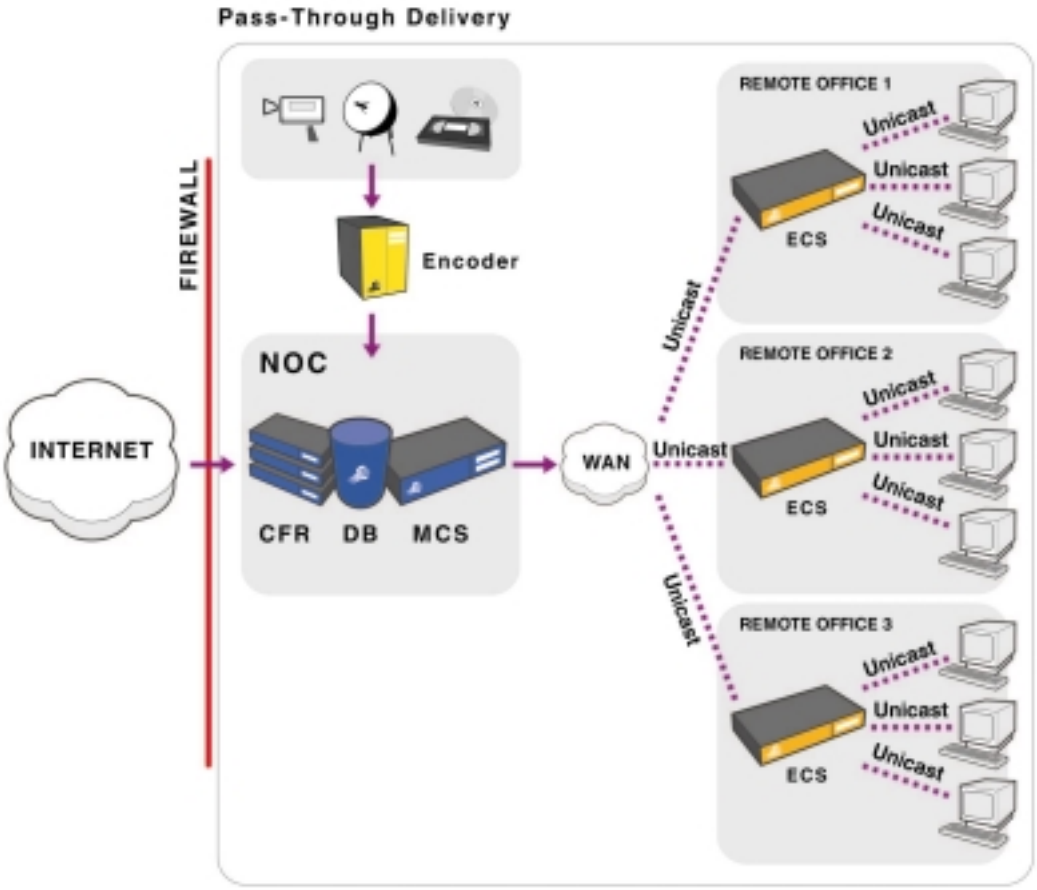


FIGURE 9 – PASS-THROUGH DELIVERY OF STREAMS

COREcast VOD Streaming

VOD, or Video on Demand, is the process of streaming a rich media file from an ECS to a user's media player when the user requests the file. In a COREcast implementation, a user will click a link on a Web page to access a particular rich media file. The request will be routed from the user's PC to the MCS. Based on its analysis, the MCS will then re-direct the request to the closest and best available ECS.

COREcast will stream the file from the ECS using either RTSP (Real-Time Streaming Protocol) or ASF (Active Streaming Format) unicast streams. RTSP is a client-server multimedia presentation control protocol developed by Real Networks, Netscape, and Columbia University. Microsoft's ASF is a file format for storing files on a disk for purposes of streaming.

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SECTION FOUR – FEATURES/BENEFITS OF THE COREcast SOLUTION

The following section describes the principal features and benefits of Fantastic's COREcast solution.

FEATURE	BENEFIT
Intelligent Edge Redirection Technology	*A COREcast Exclusive!* COREcast has the unique ability to dynamically determine optimal delivery path from the "best/closest" Edge Content Server to the user based on a number of different metrics. These include hop count, available bandwidth, network latency, server load, and content availability, thereby optimizing network impact and giving the user the best possible experience. This means that each relative network link in the path is analyzed dynamically to determine from which server the user will receive the requested content.
Automatic Server Failover	Should any COREcast server go down, lose network connectivity, or otherwise become unavailable, the user request is automatically routed to the "next best" server. No user or IT intervention is required.
Automatic Server Redundancy	COREcast servers can assume multiple functions. Any COREcast ECS can act as a content repository for the rest of the eCDN, allowing content to be updated from multiple sources in the network rather than just one. Also, any COREcast MCS can have one or more hot or warm standby servers, meaning that if an MCS should fail a standby MCS can immediately assume content distribution and delivery services without manual intervention. This helps to save network bandwidth while making content updates easier, getting the content to the users faster and more reliably. Also, multiple MCS devices can be deployed in distributed geographies, allowing the "local" MCS to control a set of "local" ECS devices. Any of the MCS devices in the network can assume MOM (Manager of Managers) responsibilities should one of the regional MCS devices go down or otherwise become unavailable.
Dynamic Database Generation	As part of the COREcast technology, a central database is populated with real-time information about the network, the users, the servers, and the content that resides on the COREcast network. Detailed information is kept in the database on virtually every network analysis, user transaction, and server operation, making this a powerful back-end reporting tool. IT departments can leverage

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	this information to analyze eCDN network utilization, content delivery, and user activity and server statistics. Dynamic database generation can use internal network information to determine back-end billing mechanisms for eCDN usage by department. This can be useful to those companies that distribute the costs of their network infrastructure out to their operating departments.
Scalability	The COREcast solution has been designed with small, medium, and large scale deployments in mind. COREcast Edge Content Servers never need manual intervention in any server deployment scenario. A table is dynamically created with each user request tracking historical patterns of delivery paths which is automatically reconfigured should a new server be placed that has a better delivery path for that user base.
Uptime	User always has ability to access content, because the COREcast solution will automatically route their requests to an available server.
Content Prioritization	If any content requested by a user does not reside on the user's "best/closest" server, they are automatically redirected to the "best/closest" ECS which contains the requested content. This re-direction is transparent, without any manual intervention from the user or the IT department.
Automatic Content Updates (Push)	COREcast Edge Content Servers are automatically synchronized by the system based on the content subscriptions for each ECS device. When a difference is detected in the subscription for any subscribed-to channel, only the content required for updating the ECS is sent out rather than the complete distribution. In addition, COREcast uses a technology called “differential copy” to copy only the parts of a partially-copied file that were lost during the original distribution. This preserves network bandwidth while making sure that each content subscription is kept up to date.
Content Distribution and Control	Content can be distributed with a variety of options including time of day, channel subscriptions, content to be distributed, and servers that can or cannot receive the content. COREcast can also measure the progress of content distribution per server/file to measure real-time performance.
Automatic Bandwidth Throttling	The COREcast Master Control Server detects link speeds and available bandwidth on the weakest link and sends content based on a configurable threshold. The delivery speed used by the MCS is generally a percentage of the remaining available

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	bandwidth on the slowest link.
Content Distribution Security	Content delivered across LAN or WAN links can be encrypted, requiring authentication by the ECS for content distribution. This means that content in transit can never be intercepted and by unauthorized users.
Robust Content Delivery	COREcast technology can detect and work with just about any firewall, proxy server, switch or router. This makes for an adaptable and flexible eCDN environment that can guarantee delivery of your content to any point on the network…even to remote users accessing the corporate network via a Virtual Private Network (VPN).
Server Heartbeat and Health Monitoring	The COREcast Control Center application monitors the health of every MCS, ECS, and Encoding Server in the eCDN, making sure that each has plenty of resources and that the server is able to deliver content to the users.
Easy Content Publishing	COREcast allows for a variety of content publishing methods, including local publishing and publishing from remote, third-party content providers. This is all accomplished from the COREcast Control Center application.
Automated Server Maintenance	COREcast servers do their very best to take care of themselves. Most server problems are identified and resolved by the COREcast Control Center application. In cases where human help is required, COREcast alerts the appropriate resources and sends detailed information to aid in the quick resolution of problems on the eCDN.
Powerful Back Office/Management Reporting	Automated data collection around billing based on multiple criteria (e.g., usage, storage, bandwidth consumption) as well as performance (e.g., streaming quality, number of simultaneous users, content accessed by user).
Support for a Wide Variety of Media	COREcast supports Real Server/Player, Windows Media Server/Player, QuickTime Server/Player, and a variety of third-party HTTP caching engines. COREcast can also support document and application delivery from the ECS, making COREcast a content-independent delivery system.
Support for a Wide Variety of Hardware/OS's	COREcast runs on virtually all Pentium-class servers running a variety of operating systems, including NT/2000, Linux (6.x and 7.x), Solaris (Intel and SPARC), HP/UX and A/IX (Fall 2001).

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SECTION FIVE – FANTASTIC SERVICES

Deploying and managing an eCDN overlay network requires some degree of familiarity with content networking. In addition, many companies find that they lack the in-house resources necessary to successfully install and run an eCDN. Fantastic's Professional Services group is prepared to offer both the resources and expertise on virtually any issue related to the successful deployment of an eCDN.

Fantastic's Professional Services group offers consulting and services in the following three areas:

Network Services

Fantastic provides the necessary resources to design and deploy an eCDN that is right for each organization. Our technical project managers work onsite to gather comprehensive information on the state of each client's network and user requirements in order to architect a targeted solution.

- *Network topology analysis* – Carefully examining the network provides valuable information on LAN/WAN architectures, bandwidth availability, and security requirements prior to engaging in the design process.
- *Planning and design report* – Once the information gathering process is concluded, a detailed report is presented of our recommendations on the structure and roll-out plan of the network.
- *Installation and configuration management* – Once the design plan has been approved, Fantastic will deploy a team of network engineers to install the components. Once installed, the system will be completely tested at which point it can be turned over to the client's internal IT department for ongoing management.

Application Services

Fantastic's open architecture supports a variety of streaming and e-learning applications, allowing enterprises to maximize their investment in existing applications, further leverage network infrastructures, improve overall site performance, and deliver compelling video content company-wide.

- *Application integration* – Fantastic's content delivery architecture is compatible with Learning Management Systems (LMS) from leading providers like Saba, Docent, and Learnframe, as well as Web collaboration applications from Centra, Placeware, and WEBEX, and video conferencing systems from Polycomm. Upon installation, our application engineers will work with alliance partners and client system administrators to integrate applications into a common platform for communications and training.
- *Database integration* – Fantastic's MCS operates on a SQL server which can be integrated with incumbent database applications including Oracle, Informix and Sybase to further leverage existing investment.

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- *Digital Asset Management (DAM)* – Fantastic provides basic search and indexing functionality to give control over media assets. For more robust DAM solutions, we leverage solutions from partners like Virage and Excalibur. We offer tools for transcription for overcoming language barriers and Digital Rights Management (DRM) for added security in delivering media to remote users.

Content Services

A robust suite of content services helps organizations maximize their investment in content delivery architecture and increase efficiencies in their corporate communications and training programs. Creating content for the Web is different for broadcast and requires an enhanced skill set.

- *Content creation* – Fantastic offers production services through trusted content partnerships for the generation of compelling content for the Web. Our services include pre-production talent and scripting, lighting, sound and cameras, and post-production editing services in Avid, Premier and Media-100. In addition, we provide animation services in After Effects, Flash and Director.
- *Content provisioning* – Through an ecosystem of content partners, Fantastic helps clients leverage pre-existing content immediately. Our partnerships with e-learning industry leaders, including Keystone, Harvard Business School and NTU, enables us to offer a vast library of education and training curriculum for compliance, technical and soft skills.
- *Live webcasting* – An ideal medium for consistent corporate communications, Fantastic offers a reliable service for executing live broadcasts across the network from live encoding to IP transmission (unicast and multicast). Through CDN partnerships, we can reach an unlimited number of viewers anywhere in the world with the scalability and security client's demand. We also offer hot-writing services for on demand playback after the event.
- *Content conversion* – Optimally encoding audio and video content for streaming transmission is no small task. Our encoding specialists are experts in maximizing quality of content while minimizing file size. We also offer media integration services to synchronize PowerPoint® presentations, graphics and Web pages with audio/video content.
- *User interface development* – Our GUI designers build each client a custom enterprise portal to house all media assets, seamlessly integrating it with the corporate intranet. Branded and designed to match each client's online identity, the portal becomes the focal point for company-wide rich media communications and training.
- *Remote distribution* – Through partnerships with leading content delivery network (CDN) providers, Fantastic expands its reach beyond the firewall to satisfy remote users anywhere in the world.

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SECTION SIX – ROI ANALYSIS

According to Jupiter Media Metrix, internal streaming applications within the enterprise, such as corporate announcements and training on demand, will experience the largest growth in the years to come. Training in particular is outpacing all other streaming application categories because the ROI is clear to enterprises. By moving training online, Training Magazine estimates that companies can cut costs by 50 to 70 percent. In addition, intangible benefits like increased productivity, consistent communications and higher retention of knowledge can create significant competitive advantage for enterprises.

As streaming for internal initiatives gains momentum, intranet-based streaming solutions will become increasingly important to the enterprise community. According to Information Week, 90 percent of IT managers are currently delivering, or are planning to deliver rich media on their intranet, extranet, or VPN within the next twelve months. Jupiter's research shows that 40 percent of enterprises already have a streaming initiative in place. Jupiter expects the intranet content networking segment to experience the largest growth in the streaming industry. This growth is fueled by enterprises seeing the value in internal streaming applications.

To support streaming on the internal network, enterprises must invest in the appropriate infrastructure enhancements. According to Information Week, 42 percent of IT managers feel that their current network infrastructure is currently incapable of handling streaming media. While a variety of products and services currently exist to satisfy this need, enterprises must choose the solution that makes economic sense. Enterprises also must realize that they will need scalable solutions for content distribution and management as the volume they stream increases over time.

In building the business case for a content networking solution, enterprise IT managers must first examine their current situation. Based on the number of employees, volume of content and the nature of the corporate network, companies should determine which solution is right for their unique situation. This can be accomplished by comparing the ROI of each available solution.

To illustrate the process of measuring the return on investment (ROI) of underlying technologies to support streaming internally, we will look at the following three options:

A. **Outsourced Services / Additional Bandwidth Deployment** – Utilize external resources for all content delivery and management, increasing connectivity at each regional office to satisfy demand.

B. **In-house Services / Streaming Server Deployment** – Utilize internal resources for content management, deploying streaming servers on the existing corporate network for content distribution and delivery.

C. **In-house Services / Content Networking Deployment** – Utilize internal resources for content management, leveraging an enhanced corporate network for distribution and delivery of streaming media, as well as all data types.

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Scenario: Consider a small company with 1,000 employees dispersed across 10 regional offices. Each regional office has 50 employees and the headquarters has 500. The CEO wants to do monthly webcasts. In addition, the training department is looking to add streaming video to its online curriculum, and plans to have employees take 4 hours of online instruction per month.

Each regional office is connected to headquarters with a T-1 line capable of handling roughly 1.54Mbps of data transfer. If we assume that during regular business hours the connection is usually at 50 percent utilization, then approximately 750Kbps of remaining bandwidth is available for streaming.

Given that there are 50 users per remote office, assume that only half will view a particular live webcast. Relying solely on existing bandwidth capacity, the organization could satisfy each user with no more than a 28Kbps stream before reaching maximum capacity. Therefore, only the lowest quality option would be available for each office in the current situation. At a 28Kbps data rate, users will suffer from poor video performance.[1]

Intra-office connectivity, on the other hand, is typically not an issue. Most offices are equipped with 10/100 Ethernet connectivity in a switched environment, meaning that users can generally sustain 10Mbps at the desktop. This is far sufficient bandwidth to support TV-quality video at the desktop. In traditional enterprise network environments, bottlenecks occur at the Internet gateway and at links across the WAN. Regardless of the LAN connectivity, users are still limited by upstream connectivity for accessing streamed content.

The challenge for enterprise IT managers is determining the most cost-effective way to satisfy the streaming media needs of each business unit and regional office. Using the above scenario, we will compare the following three options.

Option-A: Outsourced Services / Additional Bandwidth Deployment – *Utilize external resources for all content delivery and management, increasing connectivity at each regional office to satisfy demand*

The initial use for streaming media was largely external, or Internet-based. Corporate earnings announcements, public events and rich media advertising fueled the market for external streaming media and content delivery services. A plethora of vendors emerged to provide turnkey solutions for creating, publishing, distributing, delivering and managing content via the Internet.

Today, enterprise use of streaming media has shifted internally. Naturally, enterprises look to rely on the same trusted vendors providing external services for satisfying both their Internet and intranet streaming needs. Unfortunately, these vendors rely on last-

[1] Streaming media, both live and on demand, is delivered in standard target bit rates, including 16Kbps, 28Kbps, 56Kbps, 100Kbps, 300Kbps, 600Kbps, and 2Mbps. For streaming audio, 16 to 28Kbps is sufficient bandwidth for a high quality experience. Streaming video, on the other hand, requires significantly more bandwidth for optimal performance. Generally, video streams require at least 100Kbps for decent quality, whereas 300-600Kbps can deliver a near TV-quality experience at the desktop. Anything less, renders a choppy, postage stamp-size experience.

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mile connectivity for performance. In the case of an enterprise with a private network, the last-mile is from the ISP to the corporate network gateway. As such, streaming capacity behind the firewall is ultimately determined by available bandwidth at the Internet gateway and on downstream WAN links. Therefore, this “outside-in” approach requires significant bandwidth on the corporate WAN to reach desktop users with quality streams.

In order to satisfy an internal audience with business-quality streaming media, companies should have a minimum of 100Kbps of available bandwidth for each user to experience reasonable video performance. In our example, there is only 750Kbps total available connectivity for all 50 employees in each remote office (only enough bandwidth to satisfy 7 users before reaching maximum capacity). In order to serve only half of the employees with a live webcast, each office would require an additional T-1 line (1.54Mbps). At $1,500 per month (including hardware and service), this would mean $15,000 per month to satisfy all ten regional offices. This does not even include the high start up costs ($2,500-5000 per T-1) and time delays (2-4 weeks) for installing a T-1 line.

Unless enterprises have the necessary in-house resources (i.e., trained staff, internal production studio, editing suite, encoding server, etc.), it makes sense to rely on a trusted vendor to produce a live webcast. This is due to the technically challenging and unforgiving nature of live streaming events. The typical cost of one webcast to 1,000 users would be roughly $20,000 including labor, setup, encoding and distribution via the Internet. We will assume that the broadcast is produced and streamed from the corporate headquarters, so the distribution costs would be virtually eliminated (actually, they would be absorbed by internal network operations expenses), so we can safely reduce this cost to $18,000 per event. The company plans to conduct 2 webcasts per month, so the total monthly webcasting costs would be about $36,000.

Video on demand is the second application being considered in this example. Let’s assume that each employee is expected to watch 4 hours per month of video online as part of their training curriculum. Since the company has decided to outsource all streaming media services, the content would be hosted and streamed externally. One hour of video encoded at 100Kbps requires roughly 45MB (360Mb) of total data transfer. The average cost for streaming is about $0.02 per MB transfer rate per user. This means each user would require roughly $1.00 per hour of video or $4.00 per month (for 4 courses). For 1,000 employees, this would be $4,000 per month for VOD. This does not include any costs associated with production or post-production (filming, editing, encoding, indexing, etc.). This also does not include hosting setup fees (ranging from $1-5,000) and variable storage costs ($100 per GB) incurred by most streaming media service providers.

The total cost for this company to support all of their current rich media requirements is roughly $55,000 per month ($660,000 per year), which includes 2 live webcasts per month and 4 hours of online training per employee per month. Additional webcasts would cost roughly $18,000 each and additional hours of online training would cost $1,000 for delivery to all 1,000 employees. This is not a very scalable or cost-effective solution for a growing organization.

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	Option-A
Number of Employees	1000
Number of Regional Offices	10
Employees per Regional Office	50
Number of Webcasts per Month	2
Cost per Webcast	$18,000
Total Webcasting Costs per Month	***$36,000***
Additional Bandwidth Needed per Office (Mbps)	1.54
Cost for Additional Bandwidth per Month (T-1)	$1,500
Total Additional Bandwidth Costs per Month	***$15,000***
Bandwidth Required for 1-hour of VOD (MB)	45
Cost per MB Streamed	$0.02
Cost of Video Streamed per Hour	$1.00
Number of Hours Per Employee per Month	4
Cost per Employee per Month	$4.00
Total VOD Costs per Month	***$4,000***
Total Costs per Month	***$55,000***

FIGURE 10 – COST SUMMARY: OPTION-A

There are some advantages to outsourcing all rich media services and hosting content externally. For small companies with limited needs and an emphasis on streaming to an external audience, Option-A might make sense. But for companies with internal streaming needs, Option-A would be hard to justify. Most users would be restricted to lower bit rate streaming within the spectrum of 28-100Kbps (depending on the number of simultaneous users), which is not TV-quality. Large amounts of unmanaged streamed content entering the corporate network would cause network congestion, devouring precious bandwidth and interfering with mission-critical applications. There are also security issues with streaming business-sensitive content externally via the Internet. Finally, the variable costs in Option-A are relatively steep, which makes it unreasonable for growing companies.

Pros	Cons
• Low startup costs • No additional IT resources	• Inadequate quality • Security Issues • Not scalable (high variable costs)

FIGURE 11 – OPTION-A ASSESSMENT

Option-B: In-house Services / Streaming Server Deployment – *Utilize internal resources for content management, deploying streaming servers on the existing corporate network for content distribution and delivery*

An alternative to outsourcing all streaming media services to an external provider is to bring everything in-house and manage content delivery behind the firewall. While this addresses the security issues of outsourcing, it requires dedicated resources both in IT

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infrastructure and personnel. Let's take a look at the costs of Option-B compared with Option-A using the same requirements.

Managing streaming media internally will require additional hardware and software for storage and delivery of content across the network. A minimum setup would include one streaming server, installed at the central data center, for storing and delivering content to various remote locations. $15,000 would cover a very basic setup here. This translates to roughly $625 per month with a two-year amortization.

In order to serve regional offices with rich media internally, this company will still need to increase its WAN bandwidth by roughly 1.54Mbps per office; the same as in Option-A. We will assume the cost for this connectivity is the same as in Option-A at $15,000 per month. Without this additional bandwidth, the company could not broadcast live events and would jeopardize the performance of other mission-critical applications across the WAN.

With a streaming server in-house, this company could centrally host training content for on demand access across the network. Also, live content could be easily archived for on demand viewing after the event. Therefore, no additional hosting costs for VOD are incurred with Option-B.

Unlike Option-A, Option-B would require additional personnel for setup and management of the additional WAN connectivity and hardware/software to publish/distribute the content, as well as dedicated resources for delivering and managing all content for various business units. One IT manager and one content/production manager, each at 50 percent utilization should cover this responsibility. If we assume an annual cost per manager of $85,000, then the monthly personnel cost of internal management would cost roughly $7,000 per month.

With a streaming server in-house and a content/production manager, all this company would need to produce live webcasts would be a digital camera, microphone, lighting and misc. equipment ($10,000 total) and an encoding server ($10,000). Amortized over 2 years, it would cost this company less than $850 per month to produce live webcasts internally.

The total cost for in-house streaming media deployment in this scenario is roughly $23,475 per month ($282,000 per year), a monthly savings of over $31,000 ($378,000 per year) or 57% savings over Option-A. Option-B is a more scalable solution with monthly costs declining as additional webcasts and online training content is added. Additional webcasts would require less to produce, and adding online training content would require only additional storage capacity.

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	Option-A	Option-B
Number of Employees	1000	1000
Number of Regional Offices	10	10
Employees per Regional Office	50	50
Number of Webcasts per Month	2	2
Cost per Webcast	$18,000	N/A
Total Webcasting Costs per Month	***$36,000***	***$850***
Additional Bandwidth Needed per Office (Mbps)	1.54	1.54
Cost for Additional Bandwidth per Month (T-1)	$1,500	$1,500
Total Additional Bandwidth Costs per Month	***$15,000***	***$15,000***
Total In-house Personnel Costs per Month	***$0***	***$7,000***
Total Hardware/Software Costs per Month	***$0***	***$625***
Bandwidth Required for 1-hour of VOD (MB)	45	45
Cost per MB Streamed	$0.02	$0
Cost of Video Streamed per Hour	$1.00	$0
Number of Hours per Employee per Month	4	4
Cost per Employee per Month	$4.00	$0
Total VOD Costs per Month	***$4,000***	***$0***
Total Costs per Month	***$55,000***	***$23,475***

FIGURE 12 – COST COMPARISON: OPTION-A AND OPTION-B

Option-B is preferable to Option-A in terms of overall cost. Option-B is also a more secure way to delivery content because all content is protected by the corporate firewall. With additional bandwidth, Option-B should not overload the network, at least in the short term. In terms of performance, however, Option-B is still limited. A centralized server has limited capacity, both in the number of users it can support and the amount of content it can store. Also, serving all users across the enterprise from one central server is likely to uncover bottlenecks across the WAN. TV-quality video requires at least 300Kbps and this would require 3 times the additional WAN bandwidth, making both Option-A and Option-B cost-prohibitive.

Pros	Cons
• Secure • Relatively scalable • Less costly than Option-A	• Inadequate quality • Resource-intensive • Questionable reliability

FIGURE 13 – OPTION-B ASSESSMENT

Option-C: In-house Services / Content Networking Deployment – *Utilize internal resources for content management, leveraging an enhanced corporate network for distribution and delivery of streaming media*

The best way to improve the quality and reliability of rich media delivery over an existing corporate network is with content networking technology. By leveraging an eCDN, there are no additional WAN bandwidth requirements, saving $15,000 per month ($180,000 per year) over Options-A and B. On demand streamed content is either cached or pre-

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populated on edge devices residing at remote office LANs. Live streaming content is multicast or split to edge devices for local delivery. Therefore, streaming media files traverse the WAN only once in their delivery. By tapping into rich bandwidth on the LAN, this solution enables TV-quality video to be delivered to every desktop, company-wide.

An added benefit of content networking is that it can eliminate 20-30% of current HTTP traffic, or an average of 25% percent of the overall WAN usage, by caching static content locally. Therefore, if this company is already spending $25,000 per month on connectivity across the entire WAN, this would generate an immediate savings of over $5,000 per month or 21%.

TRANSPORT	MONTHLY BANDWIDTH (KB)	MONTHLY COST	% HTTP TRAFFIC	% SAVINGS WITH CACHING	BANDWIDTH RECOVERED (KB)	MONTHLY SAVINGS
Links 1-2	256	$5,000	75%	25%	48	$938
Links 3-6	4000	$10,000	80%	25%	800	$2,000
Links 7-10	4000	$10,000	90%	25%	900	$2,250
Total	**8256**	**$25,000**			**1748**	**$5,293**

FIGURE 14 – WAN BANDWIDTH SAVINGS ESTIMATE

Although the caching capability of a content networking solution is effective in reducing HTTP traffic across the WAN, most important for IT is the cost avoidance of additional bandwidth for deploying rich media on the internal network. Companies can expect to spend $1,500 per month (the cost of a T-1 line) per remote office for additional bandwidth required to deliver both live and on demand streamed content (periodically) over existing networks by using traditional delivery methods (like Option-A and B). For this company, it would represent $15,000 per month or $180,000 per year in additional WAN bandwidth costs.

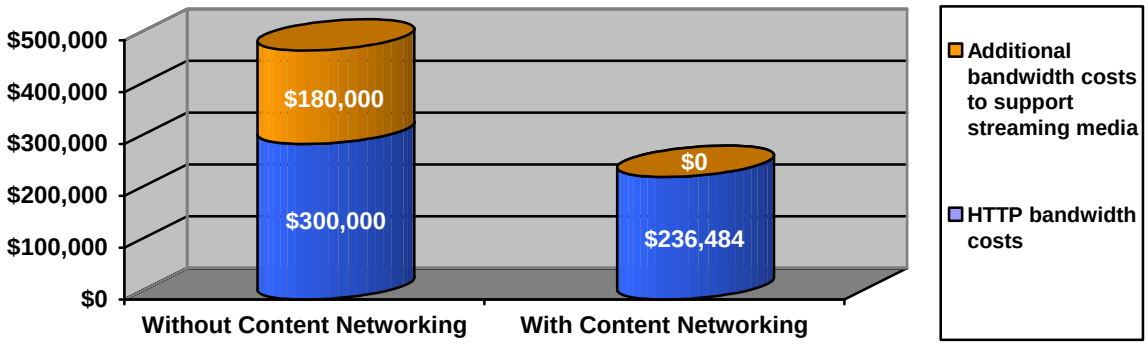


FIGURE 15 – ANNUAL NETWORK BANDWIDTH COSTS (TOTAL)

Not only does content networking significantly reduce the delivery costs of streaming media behind the firewall, it guarantees much higher quality of video. It provides speedy delivery of on demand and static content like VOD, web pages and graphics and improves the scalability and performance of live broadcasts through splitting and

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multicasting. Content networking also improves the overall performance of the host network by freeing upstream WAN links from congestion, thereby preserving the integrity of mission-critical applications.

For Option-C, we will assume that equipment is purchased to produce live webcasts in-house with costs consistent to Option-B. Likewise, there are virtually no additional costs for deploying on demand training content. Hardware and software costs, however, are more expensive in this scenario. The company can expect to spend roughly $100,000, amortized over two years, or about $4,150 per month, for a complete content networking solution inclusive of all hardware, software and content management tools.

Personnel costs for ongoing management are equivalent to Option-B at roughly $7,000 per month. It is important to note, however, that the added intelligence of some content networking solutions provide a high degree of automation, requiring less IT management personnel for setup and ongoing management.

Option-C is considerably less expensive than both Options-A and B. The total cost for in-house deployment in this scenario is only $12,000 per month ($144,000 per year), a savings of about $11,500 per month ($138,000 per year) or nearly a 50% savings over Option-B. Option-C is a fraction of the cost of Option-A (about 80% less). Cost savings of Option-C do NOT even factor in the additional $5,000 savings per month generated from caching. If these savings were accounted for, Option-C would have a monthly net cost of $7,000. Unlike Option-A and B, Option-C requires no additional WAN bandwidth. Option-C is also the most scalable solution with monthly costs declining as additional webcasts and online training content is added.

	Option-A	Option-B	Option-C
Number of Employees	1000	1000	1000
Number of Regional Offices	10	10	10
Employees per Regional Office	50	50	50
Number of Webcasts per Month	2	2	2
Cost per Webcast	$18,000	N/A	N/A
Total Webcasting Costs per Month	***$36,000***	***$850***	***$850***
Additional Bandwidth Needed per Office (Mbps)	1.54	1.54	0
Cost for Additional Bandwidth per Month (T-1)	$1,500	$1,500	$0
Total Additional Bandwidth Costs per Month	***$15,000***	***$15,000***	***$0***
Total In-house Personnel Costs per Month	***$0***	***$7,000***	***$7,000***
Total Hardware/Software Costs per Month	***$0***	***$625***	***$4,150***
Bandwidth Required for 1-hour of VOD (MB)	45	45	45
Cost per MB Streamed	$0.02	$0	$0
Cost of Video Streamed per Hour	$1.00	$0	$0
Number of Hours per Employee per Month	4	4	4
Cost per Employee per Month	$4.00	$0	$0
Total VOD Costs per Month	***$4,000***	***$0***	***$0***
Total Costs per Month	***$55,000***	***$23,475***	***$12,000***

FIGURE 16 – COST COMPARISON: OPTION-A, OPTION-B AND OPTION-C

The biggest benefit of Option-C is the low cost combined with superior performance. Streaming media is served locally from edge content servers instead of from centrally

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located streaming servers, as in Option-B. This optimizes overall network efficiency, lowering congestion and preserving bandwidth. It also provides the only platform for delivering high bit rate streaming (300Kbps to 2Mbps), which is “TV-quality”. Users will appreciate a much better viewing experience. Option-C is highly scalable, allowing for organizations to grow rapidly and add additional content without incurring much additional cost. In most cases, companies will find the payback time is less than one year.

Pros	Cons
• Highest quality and reliability • Secure • Massively scalable • Lowest cost option • Network safe (bandwidth aware)	• Initial capital outlay

FIGURE 17 – OPTION-C ASSESSMENT

Option-C is clearly the best choice for this company. Managing streaming media operations internally with a content networking solution offers the lowest overall cost and the highest quality and reliability. In addition, it lowers the total cost of network ownership by reducing server load and bandwidth utilization across the WAN.

Fantastic is providing the infrastructure necessary for enterprises to leverage streaming video and other rich media applications, behind the firewall, in a secure and scalable environment. The intelligence of COREcast provides a new level of functionality, never available before, allowing it to make policy-based decisions for optimal content distribution and delivery according to real-time network conditions. This provides a high degree of automation and adaptability, requiring less IT resources for the operation. COREcast requires roughly half the setup and management resources compared to other content networking solutions.

Gartner Group estimates that 85-percent of enterprises that deploy video over IP for corporate communications and training will realize a positive ROI in less than one year. But in order to reap the rewards, companies must first invest in the underlying infrastructure to support internal streaming applications. Gartner concludes, enterprises that neglect to make the appropriate network upgrades will fail in their efforts.

Although bandwidth costs are decreasing, adding connectivity to support streaming is not a scalable solution, especially as content demands grow. According to Information Week, 56 percent of IT managers feel that additional bandwidth is *not* the solution for enabling streaming media, whereas 82 percent feel that content networking technologies are the answer.

In deploying an enterprise content delivery network, or eCDN, enterprises must evaluate technologies based on their ability to satisfy the unique dynamics that exist behind the firewall. Unfortunately, most enterprise content networking products available today, were originally designed for large-scale Internet use by service providers. The problem of repurposing these products for the enterprise, is that they are inherently complex,

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expensive and even excessive, technologically. Furthermore, they require a high degree of configuration and support. Jupiter Media Metrix finds that the cost to manage a staff internally to support most systems far outweighs the investment in the technology itself.

A recent report on ROI from Streaming Media Inc. reveals that the high staff and equipment costs associated with streaming represent a need for automation. Therefore, enterprises should not only evaluate products based on price and performance, but also on the degree of automation provided for installation, device management, content distribution and content delivery. This will ultimately yield the highest return on investment and enable the greatest success.

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APPENDIX A – GLOSSARY

A

AIX - AIX is an open operating system from IBM that is based on a version of UNIX. AIX/ESA was designed for IBM's System/390 or large server hardware platform. AIX/6000 is an operating system that runs on IBM's workstation platform, the RISC System/6000.

Apache - Apache is a freely available Web server that is distributed under an "open source" license. Version 2.0 runs on most UNIX-based operating systems (such as **Linux**, **Solaris**, Digital UNIX, and **AIX**), on other UNIX/**POSIX** -derived systems (such as Rhapsody) and on **Windows 2000**.

appliance - An appliance or "network appliance" is a term used to denote a network device that literally embodies the term “plug and play”. Network appliances are generally devices which attach to a host network and begin operating without the need for manual intervention.

application - The term *application* is a shorter form of application program. An application program is a program designed to perform a specific function directly for the user or, in some cases, for another application program. Examples of applications include word processors, database programs, Web browsers, development tools, drawing, paint, image editing programs, and communication programs. Applications use the services of the computer's operating system and other supporting applications.

application integration - Application integration is the process of bringing data or a function from one application together with that of another application program. The result of integration may be a new application with its own user interface or the capability of a desktop or mainframe application to handle data and include capabilities borrowed from other applications.

authentication - Authentication is the process of determining whether someone or something is, in fact, who or what it is declared to be. In private and public computer networks (including the Internet), authentication is commonly done through the use of logon passwords. Knowledge of the password is assumed to guarantee that the user is authentic. Each user registers initially (or is registered by someone else), using an assigned or self-declared password. On each subsequent use, the user must know and use the previously declared password.

B

bandwidth – In digital systems, bandwidth is expressed as data speed in bits per second (bps). Thus, a modem that works at 57,600 bps has twice the bandwidth of a modem that works at 28,800 bps. Generally speaking, bandwidth is directly proportional to the amount of data transmitted or received per unit time.

BPS – In data communications, bits per second (abbreviated bps) is a common measure of data speed for computer modem and transmission carriers. As the term implies, the speed in bps is equal to the number of bits transmitted or received each second.

broadcast - Also see unicast and multicast.

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In general, to broadcast is to cast or throw forth something in all directions at the same time. On the Internet, certain Web sites deliver original or redistributed broadcasts from existing radio and television stations, using streaming sound or streaming video techniques, to Web users who visit the Web site or "tune it in" using a special program such as RealPlayer

Broadcast should not be confused with unicast, a transmission to a specific receiver; multicast, a transmission to multiple specific receivers (as in e-mail to a distribution list or a Web transmission over the MBone network to a specific group of receiving addresses); or anycast, a transmission to the nearest of a group of routers, used in Internet Protocol Version 6 (IPv6) as a technique for chain-updating a group of routers with new routing information.

browser - A browser is an application program that provides a way to look at and interact with all the information on the World Wide Web.

C

cache - A cache (pronounced CASH) is a place to store something more or less temporarily. Web pages you request are stored in your browser's cache directory on your hard disk. That way, when you return to a page you've recently looked at, the browser can get it from the cache rather than the original server, saving you time and the network the burden of some additional traffic. You can usually vary the size of your cache, depending on your particular browser.

Computers include caches at several levels of operation, including cache memory and a disk cache. Caching can also be implemented for Internet content by distributing it to multiple servers that are periodically refreshed. (The use of the term in this context is closely related to the general concept of a distributed information base.)

cache server - A cache server is a server relatively close to Internet users and typically within a business enterprise that saves (caches) Web pages and possibly FTP and other files that all server users have requested so that successive requests for these pages or files can be satisfied by the cache server rather than requiring the user of the Internet. A cache server not only serves its users by getting information more quickly but also reduces Internet traffic.

CDN - (Content Delivery Network). A vastly distributed network of servers interconnected to transmit large amounts of multimedia files (audio, video, animation, image and text files) over public Internet Protocol (IP) networks. This network enables content providers to more efficiently distribute bandwidth-intensive files to individual users, but faces challenges in delivery to multiple simultaneous users within a corporate environment.

client - A client is the requesting program or user in a client/server relationship. For example, the user of a Web browser is effectively making client requests for pages from servers all over the Web. The browser itself is a client in its relationship with the computer that is getting and returning the requested HTML file. The computer handling the request and sending back the HTML file is a server.

client-server - Two computer systems linked by a network or modem connection in which the client computer uses resources by sending requests to the server computer.

content - An abundant amount of well-presented subject information organized for interesting and useful access. Content can be any web object (HTML, GIF's, JPEG's)

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Flash animations, live audio and video, and audio and video that has been encoded and stored for Video on Demand (VOD).

content delivery - Content delivery (sometimes called *content distribution*, *content distribution delivery*, or *content caching*) is the service of copying the pages of a Web site to geographically dispersed servers and, when a page is requested, dynamically identifying and serving page content from the closest server to the user, enabling faster delivery. Content delivery can also be defined as the servicing of any type of content (see “content”) from a server to a user.

content management system - A content management system (CMS) is a system used to manage the content of a web site or any server that has content. Typically, a CMS consists of two elements: the content management application (CMA) and the content delivery application (CDA). The CMA element allows the content manager or author to manage the creation, modification, and removal of content from a server. The CDA element uses and compiles that information to update the content servers. The features of a CMS system vary, but most include publishing, format management, revision control, and indexing, search, and retrieval.

core - A networking term referring to the center of any Internet Protocol (IP) network. In reference to a private IP network, or intranet, files that reside at the core are stored and distributed internally at the Local Area Network (LAN) level. Rather than accessing content from the "edge" of the Internet, end users have access to content locally from the "core" of a controlled corporate network. This bypasses Internet congestion, eliminates firewall issues and preserves bandwidth, thereby increasing quality, performance and security of content delivery.

corporate portal - Many corporations are building and, in some cases, rebuilding their Web sites along the model of the enterprise information portal, a model that emphasizes the exploitation of a company's information resources. A corporate portal can be internal (an intranet), a public site, or, with appropriate safeguards, both combined.

D

data center - In a company, data center is a term sometimes used to describe the central data processing facility and/or the group of people who manage the companies' data processing and networks.

DHCP - Dynamic Host Configuration Protocol (DHCP) is a communications protocol that lets network administrators manage centrally and automate the assignment of Internet Protocol (IP) addresses in an organization's network.

digital - An electronic technology that generates, stores, and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. Data transmitted or stored with digital technology is expressed as a string of 0's and 1's. Each of these state digits is referred to as a bit (and a string of bits that a computer can address individually as a group is a byte). Before Digital technology evolved there was analog.

Digital video - Digital video is the key to content when streaming media. Digital video is an alternative way of storing or distributing video. Digital video is usually converted from an analog video source. A digital video signal is represented in '1's and '0's, whereas an analog video signal is represented by a fluctuating voltage signal that is stored on magnetic tape. This difference is similar to the difference between analog audio and digital audio.

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DMZ - In computer networks, a DMZ (demilitarized zone) is a computer host or small network inserted as a "neutral zone" between a company's private network and the outside public network. It prevents outside users from getting direct access to a server that has company data. (The term comes from the geographic buffer zone that was set up between North Korea and South Korea following the war in the early 1950s.) A DMZ is an optional and more secure approach to a firewall and effectively acts as a proxy server as well.

DNS - The domain name system (DNS) is the way that Internet domain names are located and translated into Internet Protocol addresses. A domain name is a meaningful and easy-to-remember "handle" for an Internet address.

DRM - Digital rights management (DRM) is a type of server software developed to enable secure distribution - and perhaps more importantly, to disable illegal distribution - of paid content over the Internet.

E

edge - A networking term denoting the outermost layer of an Internet Protocol (IP) network. Files are either temporarily or permanently stored at this level to shorten the Internet delivery path to the end point. In most cases, quicker access to Internet-based content is achieved, but corporations are hindered by a unique set of barriers. Firewalls and inter-office connectivity bottlenecks limit the effectiveness of "edge networking" for delivering content to the corporate desktop.

edge content server – a server designed specifically for the delivery of content to end users, usually located at the “edge” of the network. In the enterprise, the edge is defined as the Local Area Network (LAN).

encoding - The conversion of data into digital format and compressing it into a manageable file. For example, converting an analog sound signal into digital data for storing on a server is one use for encoding. Similarly, analog or digital video signals can be converted, or encoded into digital video that can be stored and streamed from content servers.

enterprise - In the computer industry, an enterprise is an organization that uses computers. A word was needed that would encompass corporations, small businesses, non-profit institutions, government bodies, and possibly other kinds of organizations. The term *enterprise* seemed to do the job.

eCDN - (Enterprise Content Delivery Network) A network similar to that of a CDN, but specially equipped to combat corporate delivery challenges by transmitting audio, video, animation, image, and text files over private Internet Protocol (IP) networks. Delivering bandwidth-intensive content in this manner eliminates Wide Area Network (WAN) bottlenecks. Corporate end users are served glitch-free content directly from the local source and access rich media files residing on the Local Area Network (LAN).

enterprise information portal - The enterprise information portal (**EIP**) is a concept for a Web site that serves as a single gateway to a company's information and knowledge base for employees and possibly for customers, business partners, and the general public as well.

In one model, an EIP is made up of these elements: access/search, categorization, collaboration, personalization, expertise and profiling, application integration, and security.

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- **Access/search:** Access/search allows a user to get all the information needed (but no more) in the desired context. For example, a loan officer does not need marketing information to approve a loan. An EIP makes sure the loan officer gets only the information needed.
- **Categorization:** An EIP categorizes all information so that it is delivered to the user within the context needed (think of the subject structure on Yahoo)
- **Collaboration:** An EIP allows individuals to collaborate regardless of geographical location.
- **Personalization:** The information provided to individuals using an EIP is personalized to that person's role, preferences, and habits.
- **Expertise and profiling:** Expertise and profiling is essential for the collaboration element of an EIP. Individuals within an enterprise are profiled according to their experience and competencies. If an individual needs to collaborate with others, he can choose those that are qualified for the project.
- **Application integration:** This allows individuals to deliver, access, and share information regardless of applications used.
- **Security:** This provides information to users based on security clearance. The user logs on and is given access only to information that the user is authorized to access.

ethernet - Ethernet is the most widely-installed local area network (LAN) technology. The most commonly installed Ethernet systems are called **10BASE-T** and provide transmission speeds up to 10 Mbps. **Fast Ethernet** or **100BASE**-T provides transmission speeds up to 100 megabits per second and is typically used for LAN backbone systems, supporting workstations with 10BASE-T cards. **Gigabit Ethernet** provides an even higher level of backbone support at 1000 megabits per second (1 gigabit or 1 billion bits per second).

F

fault tolerant – Fault-tolerant describes a computer system or component designed so that, in the event that a component fails, a backup component or procedure can immediately take its place with no loss of service. Fault tolerance can be provided with software, or embedded in hardware, or provided by some combination of the two.

firewall - A firewall is a security device that is used to protect a company from unauthorized access to its servers, networks, and data. A firewall ensures that all communications between an organization's internal network and the Internet conforms to the organization's security policies.

G

GIF – A GIF (the original and preferred pronunciation is DJIF) is one of the two most common file formats for graphic images on the World Wide Web. The other is the **JPEG**.

GUI - A GUI (usually pronounced GOO-ee) is a graphical (rather than purely textual) user interface to a computer.

H

HP/UX – HP-UX is the UNIX-based operating system for the HP 9000 series of business servers from Hewlett-Packard.

HTTP - The Hypertext Transfer Protocol (HTTP) is the set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files) on the World Wide Web. Relative to the TCP/IP suite of protocols (which are the basis for information exchange on the Internet), HTTP is an application protocol.

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I

Internet - The vast collection of inter-connected networks that all use the TCP/IP protocols and that evolved from the ARPANET of the late 60's and early 70's. The Internet connects thousands of independent networks into a vast global Internet.

Intranet - A private network inside a company or organization that uses the same kinds of software that you would find on the public Internet, but that is only for internal use.

IP - The Internet Protocol (IP) is the method or protocol by which data is sent from one computer to another. Each computer (known as a host) has at least one IP address that uniquely identifies it from all other computers on the network.

IP multicasting - A client-server configuration that enables data distribution among multiple sites simultaneously over relatively low bandwidths. This can mean two-way communication between multiple sites, as in videoconferencing, or sending a communication from one site to everyone who has the equipment or connection to receive it. Multicasting is a viable option for large-scale webcast transmissions.

K

Kbps - (Kilobits per second) The rate at which data is sent over a communication line. The typical household modem runs at 56.6 Kpbs.

killer app - A "killer app" is jargon in the computer industry for an application program that intentionally or unintentionally gets you to make the decision to buy the system the application runs on. Fantastic believes that streaming video is the next “killer app” for the Enterprise.

knowledge management - Knowledge management is the name of a concept in which an enterprise consciously and comprehensively gathers, organizes, shares, and analyzes its knowledge in terms of resources, documents, and people skills.

L

LAN – (Local Area Network) A computer network limited to the immediate area, usually the same building or floor of a building.

latency - In a network, latency, a synonym for *delay*, is an expression of how much time it takes for a packet of data to get from one designated point to another.

LDAP - LDAP (Lightweight Directory Access Protocol) is a software protocol for enabling anyone to locate organizations, individuals, and other resources such as files and devices in a network, whether on the Internet or on a corporate intranet.

link - 1) Using hypertext, a link is a selectable connection from one word, picture, or information object to another. In a multimedia environment such as the World Wide Web, such objects can include sound and motion video sequences. 2) In telecommunications, a *link* is a physical (and, in some usages, a logical) connection between two points.

Linux - Linux (often pronounced LIH-nuhks with a short "i") is a UNIX-like operating system that was designed to provide personal computer users a free or very low-cost operating system comparable to traditional and usually more expensive UNIX systems. Linux has a reputation as a very efficient and fast-performing system.

live splitting – A method of data delivery in which a media server serves a single live stream to multiple clients.

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live multicasting – A method of sending a single live stream to multiple clients, rather than sending a separate stream to each requesting client.

M

managed service provider - A managed service provider (MSP) provides delivery and management of network-based services, applications, and equipment to enterprises, residences, or other service providers.

Mbps - (Millions of bits per second) A measure of bandwidth. A unit of information transfer rate. While an ethernet connection can run at 10 Mbps the average household modem still runs at 56.6 Kbps (Kilobits per second).

media player - Generic term used for a software application, which makes it possible to play audio and video files transmitted over the Internet. Client software can be downloaded free of charge, and is used as a plug-in with web browsers like Netscape and Internet Explorer.

message server - A message server is a middleware program that handles messages that are sent for use by other programs using a messaging application program interface (API). A messaging server can usually queue and prioritize messages as needed and saves each of the client programs from having to perform these services.

N

narrowcasting - Transmitting an audio or video program to a selected group; usually special interest programming targeted at a niche audience. Conversely, broadcasting is conducted over larger networks and appeals to a larger demographic.

network - In information technology, a network is a series of points or node interconnected by communication paths. Networks can interconnect with other networks and contain subnetworks.

network address translation - NAT (Network Address Translation) is the translation of an Internet Protocol address (IP address) used within one network to a different IP address known within another network. One network is designated the *inside* network and the other is the *outside*. Typically, a company maps its local inside network addresses to one or more global outside IP addresses and unmaps the global IP addresses on incoming packets back into local IP addresses. This helps ensure security since each outgoing or incoming request must go through a translation process that also offers the opportunity to qualify or authenticate the request or match it to a previous request. NAT also conserves on the number of global IP addresses that a company needs and it lets the company use a single IP address in its communication with the world.

P

protocol - A uniform set of rules enabling computers to connect to one another. Protocols determine the process by which data is transmitted between computing devices and networking equipment. They also define issues such as error control and data compression methods.

pull splitting – A method of streaming media delivery in which the link on the web page lists both the splitter and the source server. When the splitter receives a request for the live audio or video file, it opens a connection to the source server, which then streams the file to the splitter, which, in turn, streams it to the requesting client.

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push splitting – A method of streaming media delivery in which a constant connection is maintained among the splitters and the push source server, resulting in faster connections for the first client that requests a given split stream.

Q

QuickTime - QuickTime is a multimedia development, storage, and playback technology from Apple. QuickTime files combine sound, text, animation, and video in a single file. Using a QuickTime player that either comes with a Web browser or can be downloaded from Apple or the browser company, you can view and control brief multimedia sequences.

R

RealAudio - A file format for audio-only streaming media technology released by RealNetworks, a leading streaming media platform vendor.

RealMedia - Brand name describing file formats, server software, player software, and protocols used by streaming media systems from RealNetworks, a leading streaming media platform vendor.

RealVideo - Describes a file format for audio/video media released by RealNetworks, a leading streaming media platform vendor.

router - On the Internet, a router is a device or, in some cases, software in a computer, that determines the next network point to which a packet should be forwarded toward its destination. The router is connected to at least two networks and decides which way to send each information packet based on its current understanding of the state of the networks it is connected to. A router is located at any gateway (where one network meets another), including each Internet point-of-presence. A router is often included as part of a network switch.

RTSP - (Real-Time Streaming Protocol) a standard method of transferring audio and video and other time-based media over Internet-technology based networks. RTSP is a descendent of UDP.

S

scalability - Scalability is the ability of a computer application or product (hardware or software) to continue to function well as it (or its context) is changed in size or volume in order to meet a user need. Typically, the rescaling is to a larger size or volume.

server - A computer, or a software package, that provides a specific kind of service to client software running on other computers. The term can refer to a particular piece of software, such as a WWW server, or to the machine on which the software is running, e.g., "Our mail server is down today, that's why e-mail is not getting out." A single server machine could have several different server software packages running on it, thus providing many different servers to clients on the network.

Solaris - Solaris is the computer operating system that Sun Microsystems provides for its family of Scalable Processor Architecture-based processors as well as for Intel-based processors.

SQUID - SQUID is a program that cache Web and other Internet content in a UNIX-based proxy server closer to the user than the content-originating site. SQUID is provided as open source software and can be used under the GNU license for Free Software Foundation.

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storage-area network - A storage area network (SAN) is a high-speed special-purpose network that interconnects different kinds of data storage devices with associated data servers on behalf of a larger network of users. Typically, a storage area network is part of the overall network of computing resources for an enterprise.

streaming video - Streaming video is a sequence of "moving images" that are sent in compressed form over the Internet and displayed by the viewer as they arrive. Streaming media is streaming video with sound. With streaming video or streaming media, a Web user does not have to wait to download a large file before seeing the video or hearing the sound. Instead, the media is sent in a continuous stream and is played as it arrives. The user needs a *player*, which is a special program that uncompresses and sends video data to the display and audio data to speakers. A player can be either an integral part of a browser or downloaded from the software maker's Web site.

T

T-1 - A leased-line connection capable of carrying data at 1,544,000 bits-per-second. At maximum theoretical capacity, a T-1 line could move a megabyte in less than 10 seconds. That is still not fast enough for full-screen, full-motion video, for which you need at least 10,000,000 bits-per-second. T-1 is commonly used to connect networks to the Internet. Same as a DS-1.

T-3 - A leased-line connection capable of carrying data at 44,736,000 bits-per-second. This is more than enough to do full-screen, full-motion video. Same as a DS-3.

TCP – Transmission Control Protocol. One of the TCP/IP group of information languages, or protocols. TCP is often more reliable than UDP but is often slower.

TCP/IP - (Transmission Control Protocol/Internet Protocol) The suite of protocols that defines the Internet. Originally designed for the UNIX operating system, TCP/IP software is now available for every major kind of computer operating system. To be truly on the Internet, your computer must have TCP/IP software.

throughput - In data transmission, throughput is the amount of data moved successfully from one place to another in a given time period.

U

UDP - Like the Transmission Control Protocol, UDP uses the Internet Protocol to actually get a data unit (called a datagram) from one computer to another. Unlike TCP, however, UDP does not provide the service of dividing a message into packets (datagrams) and reassembling it at the other end. Specifically, UDP doesn't provide sequencing of the packets that the data arrives in. This means that the application program that uses UDP must be able to make sure that the entire message has arrived and is in the right order.

Unicasting - A client-server configuration that enables point-to-point data distribution. It is a bandwidth-intensive model that requires a separate stream of data per user. Unicasting is typically associated with VOD and pay-per-view distribution models.

URL - A URL (Uniform Resource Locator) (pronounced YU-AHR-EHL or, in some quarters, UHRL) is the address of a file (resource) accessible on the Internet. The type of resource depends on the Internet application protocol.

V

VOD – Video on Demand. A system by which viewers can access and watch video programs on their own computers or television sets at the time they choose.

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W **webcasting –** A broadcast that is delivered over the Internet.

Windows Media Player - The streaming media platform released by Microsoft.

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About Fantastic

The Fantastic Corporation, headquartered in Zug, Switzerland, is a supplier of proven broadband multimedia delivery software solutions allowing businesses to get the right information to the right people at the right time. Fantastic addresses corporations, network owners and content providers that are challenged by the need to aggregate, package, manage, distribute and view ever-growing multimedia content. The Fantastic Corporate Solution starts with the OmniCast product for simple file delivery with the option for customers to migrate to more advanced functionality like Video on Demand, live streaming and interactive training. Fantastic's COREcast technology is a plug-and-play server architecture enabling companies to effectively perform content distribution and delivery, behind the firewall, in a scalable and easy-to-manage environment. Fantastic is a public company, quoted on the Frankfurt Stock exchange using the symbol: FAN.



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