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PERFORMANCE NETWORKING

SKYX® MULTICAST FAN-OUT

TECHNOLOGY WHITE PAPER

Introducing SkyX Multicast Fan-Out

Mentat's unique SkyX Multicast Fan-Out, an integral component of the SkyX Gateway, transparently converts TCP unicast connections into reliable multicast transfers. Through the use of common TCP-based applications such as FTP, the SkyX Gateway can deliver a file to every remote location across a wide area network with only a single multicast transfer.

SkyX Multicast Fan-Out is built on the industry-leading SkyX Gateway IP-over-satellite performance enhancement system. Because the SkyX Multicast Fan-Out process is transparent to the end devices, any machine can originate or receive the multicast transfer regardless of operating system and without requiring the installation of any specialized multicast software.

SkyX Multicast Fan-out functionality is ideal for file transfers, cache replication, video file distribution, content delivery networks, database replication, and any other distribution of data or files to multiple users over a satellite link or other wide area network.

The Power of SkyX Multicasting

Computer networking traditionally relies on unicast data transfers which establish point-to-point connections between devices. In situations where the same data is transferred to multiple users, the server must send a copy of the file to each recipient independently. This process is both time consuming and wasteful of bandwidth resources.

In contrast, multicast technology makes it possible for multiple recipients to receive a single data stream. This can be an especially powerful tool for satellite networks or similar architectures where the multicast transfer can take advantage of an underlying link layer broadcast media.

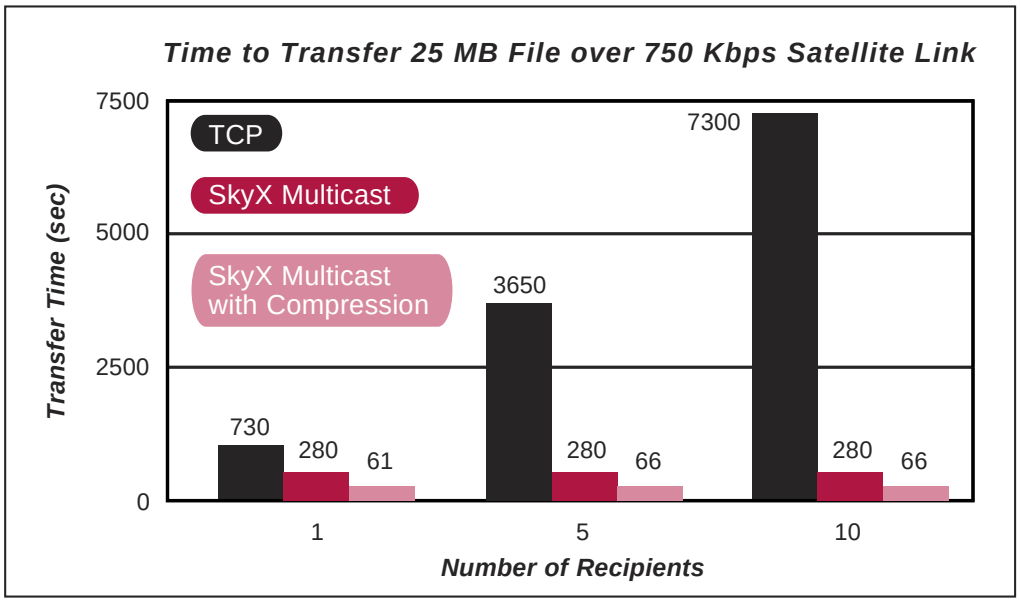
Unfortunately, the only multicast capability built into the Internet Protocol is a UDP-based, unreliable, best-effort service that is only appropriate for real-time streaming applications such as event broadcasting. Because UDP-based IP multicast does not include any mechanisms for detection and retransmission of lost or corrupted data and does not resequence any packets that arrive out of order, IP multicast is not suitable for file downloads and other data transfer applications.

SkyX Multicast Fan-Out offers a simple and convenient solution for reliable multicast over wide area networks. By taking advantage of reliable multicast functionality built directly into the transport layer SkyX Protocol, the SkyX Gateway provides fast, efficient, fully reliable multicast file transfers. Any data that is lost or corrupted is retransmitted, providing transfer reliability and rendering special FEC software unnecessary.

By combining this reliable multicast transmission technology with a transparent fan-out functionality which allows any TCP connection to be converted into a multicast transfer, the SkyX Gateway marries the power of multicasting with the convenience of using FTP or any other TCP-based application.

In addition to the multicast benefits themselves, the SkyX Gateway includes on-the-fly data compression which further increases transfer speeds for compressible data by up to 5 times.

Test data illustrate that SkyX Multicast Fan-Out speeds delivery to multiple clients while slashing bandwidth costs. Over a 750 Kbps satellite link, sequential TCP transfers require 7300 seconds to deliver a 25 MB file to ten remote sites. Using SkyX Multicast Fan-Out, the file is transferred in only 280 seconds, a reduction of 96%. For a compressible file, the transfer time is further reduced to 66 seconds, a 99% improvement compared to TCP.



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How It Works

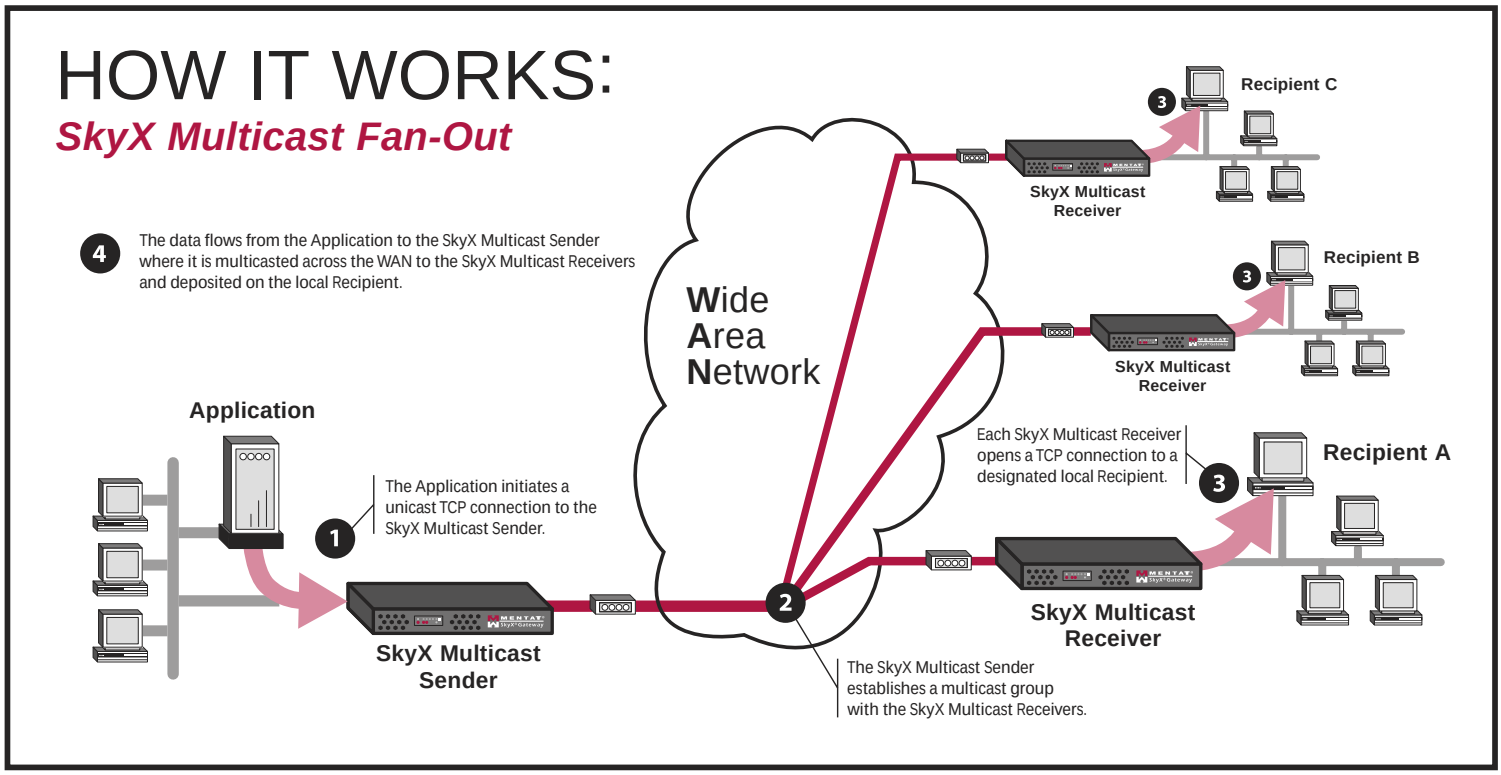
SkyX Multicast Fan-Out functionality consists of two separate multicast bridging facilities: the SkyX FTP Multicast Facility and the SkyX General Multicast Facility. The SkyX FTP Multicast Facility is designed to work specifically with the ubiquitous FTP file transfer application while the SkyX General Multicast Facility transparently mulitcasts any TCP-based application data to multiple receivers. Both services operate in a similar manner.

SkyX Multicast Fan-Out requires a SkyX Gateway XH45 at the hub of a satellite network or other wide area network to act as the *SkyX Multicast Sender*. At each participating remote site, a SkyX Gateway XR10 or XH45 acts as the *SkyX Multicast Receiver*.

A TCP-based *Application* running on any machine, either locally at the same site as the SkyX Multicast Sender, or anywhere across the Internet, initiates a standard unicast TCP connection to the SkyX Multicast Sender. The SkyX Multicast Sender then establishes a SkyX Protocol reliable multicast group with the SkyX Multicast Receivers. At each remote site, the SkyX Multicast Receiver opens a new unicast TCP connection to a designated local *Recipient* or *Recipients*.

Once the connections are established, the data flows over the TCP connection from the Application to the SkyX Multicast Sender where it is multicasted across the wide area network to all SkyX Multicast Receivers. At each remote site, the data is deposited on the Recipient over the local TCP connection. The diagram below illustrates this process.

All three connections (the TCP connection from the Application to the SkyX Multicast Sender, the multicast SkyX Protocol connection over the WAN link, and the TCP connection from the SkyX Multicast Receiver to the Recipient) are independent, reliable connections. Unlike store-and-forward solutions, the three connections operate simultaneously so that as the data is being transferred from the Application, it is immediately multicasted over the satellite link and placed directly on the Recipient.



SkyX FTP Multicast Facility

The SkyX FTP Multicast Facility is designed to provide multicast fan-out functionality tailored specifically for use with FTP, combining the power of multicasting with the convenience of the well-known and ubiquitous FTP utility.

The SkyX FTP Multicast Facility provides the ability to establish FTP connections, transfer multiple files, and obtain control and confirmation information.

To utilize the SkyX FTP Multicast Facility, the user initiates a normal FTP connection to the SkyX Multicast Sender from any machine running an FTP application. The SkyX Multicast Sender then establishes a reliable multicast connection across the WAN link to all SkyX Multicast Receivers. Each SkyX Multicast Receiver opens a new FTP connection to each designated local Recipient using a pre-configured user name, password, and file directory on the Recipient.

Once the connections are established, the FTP "put" command is used to transfer files to the SkyX Multicast Sender where it is multicasted to all SkyX Multicast Receivers and deposited on each Recipient.

At the completion of each file transfer, the SkyX Multicast Sender reports to the FTP application the IP addresses of all Recipients. Multiple files can be transferred in sequence on the same multicast connection.

SkyX General Multicast Facility

The SkyX General Multicast Facility is designed to provide a transparent multicast fan-out facility for any TCP application which transfers data in one direction. Use of this facility requires that the data flow strictly from the Application to the Recipient. This requirement is met by most TCP data push applications with the exception of FTP which utilizes a two-way control channel. The SkyX General Multicast Facility is ideal for applications such as database synchronization and cache replication.

The SkyX General Multicast Facility is configured to provide any number of independent multicast services, each specified on the SkyX Multicast Sender by a unique TCP port number and multicast IP address. On the SkyX Multicast Receiver, each service is mapped to the unicast IP address of a designated local Recipient or Recipients.

The service is activated when an Application initiates a TCP connection to the SkyX Multicast Sender using the service's port number. The SkyX Multicast Sender then establishes a reliable multicast connection across the WAN link using the service's IP multicast group address. All SkyX Multicast Receivers configured to listen to this IP multicast address join the multicast group. Each SkyX Multicast Receiver opens a unicast TCP connection, using the service's port number, to the designated Recipient or Recipients.

Once the multicast group is formed, the SkyX Multicast Sender begins receiving data over the TCP connection from the Application and transmitting it to all SkyX Multicast Receivers in the multicast group. Each SkyX Multicast Receiver then transfers the data to the local Recipient.

The multicast fan-out process is easily made transparent to client/server applications by setting the port number of the service to the Application's normal port number. For example, by creating a service using a database's well-known port number, the database server at corporate headquarters can initiate a synchronization to the IP address of the SkyX Multicast Sender. The SkyX Multicast Fan-Out process will transfer the data to the database client listening on the same well-known port number on each Recipient. Both the Application and each Recipient see only a normal unicast TCP connection using the standard port number, and therefore no changes are required to these applications or the hardware on which they are running.

Individual groups, differentiated by IP multicast group address, are used to specify different local Recipients for each application so that, for example, inventory data is sent to the local database client, cache data is directed to the local proxy cache, and video files are transferred to the local video server.

Network Requirements

SkyX Multicast Fan-Out is easily installed on any network and does not need an extensive IP multicast routing infrastructure. The only requirements are:

- A two-way data connection.
- The routers situated between the SkyX Multicast Sender and SkyX Multicast Receivers need to route or bridge IP multicast traffic, or the SkyX Multicast Sender and Receivers must be located on the same IP subnet.

Applications

SkyX Multicast Fan-out functionality is ideal for a wide variety of reliable multicast applications including:

- **Cache replication:** Transfer cache contents from a parent cache at the network hub to child caches at each remote site, providing end users with the performance of local downloads while reducing network bandwidth requirements and operational costs.
- **Video file transfers:** Reliably multicast large video files from asset libraries to local video servers.
- **Content delivery networks:** Move valuable content to the network edge to improve performance while minimizing backbone bandwidth consumption.
- **Database replication:** Synchronize database, inventory, pricing, and point-of-sale data from the corporate headquarters to local offices quickly and efficiently.
- **Software updates:** Distribute new software releases to all sites in the company.
- **Other:** Multicast any file over satellite or other wide area network to save time, effort, and bandwidth.

About Mentat

The SkyX Gateway is the leading solution for overcoming the limitations of TCP/IP over satellite. ISPs, corporations, governments, and military organizations around the world all rely on the SkyX Gateway to enhance the performance of their satellite networks. As the supplier to Apple, Compaq, Hewlett-Packard, IBM, Lucent, Novell, and Sun for TCP/IP and other high-performance networking software, Mentat has earned its reputation as the leader in performance networking since 1987.

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