It's Time to Rethink What You "Know" About Multicast

Tools Now Exist to Deliver on the Promise of IP Mulitcast for Media Distribution

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Executive Summary

For years, service providers have been attempting to use multicast technology to deliver high-quality video service over the Internet. They see the ability of multicast to scale easily and use bandwidth efficiently as an important tool, which could help them control traffic loads, conserve bandwidth, offer new services, generate additional revenues, and strengthen their long-term profitability.

Unfortunately, there are challenges with the Internet multicast deployment model. First and foremost, multicast protocols have needed to be deployed on every router in the path between sources and receivers. Service providers have also encountered problems when it comes to delivering multicast service reliably over the best-effort environment that is the Internet. Multicast solutions have generally lacked the adaptive bit rate streaming required for broadband video transmission. And finally, as a result of these challenges, a classic chicken-and-egg problem has emerged—which should come first, multicast capable content or multicast capable networks?

Now, however, new technologies have arrived that overcome these previously intractable obstacles. Equipped with this new solution, service providers can achieve widespread deployment of multicast on their broadband networks and, in doing so, turn the promise of multicast into a reality.

Introduction

There is a widespread belief that you can't use multicast technology to deliver high-quality video over the Internet. Chances are that you, like most network engineers and architects, have become so frustrated with the quest for the perfect Internet multicast deployment model that you have given up on the whole idea.

Certainly IP multicast promised to deliver several benefits. Unlike unicast delivery, in which a server replicates a data stream for transmission to all client devices on the network that request it, IP multicast delivery calls for the server to transmit a single data stream into the routing infrastructure. The routing infrastructure then efficiently replicates that data stream so that no router interface ever carries more that a single copy of the stream regardless of how many clients receive it. That difference translates into bandwidth preservation and more efficient traffic flows—which obviously add up to better network performance.

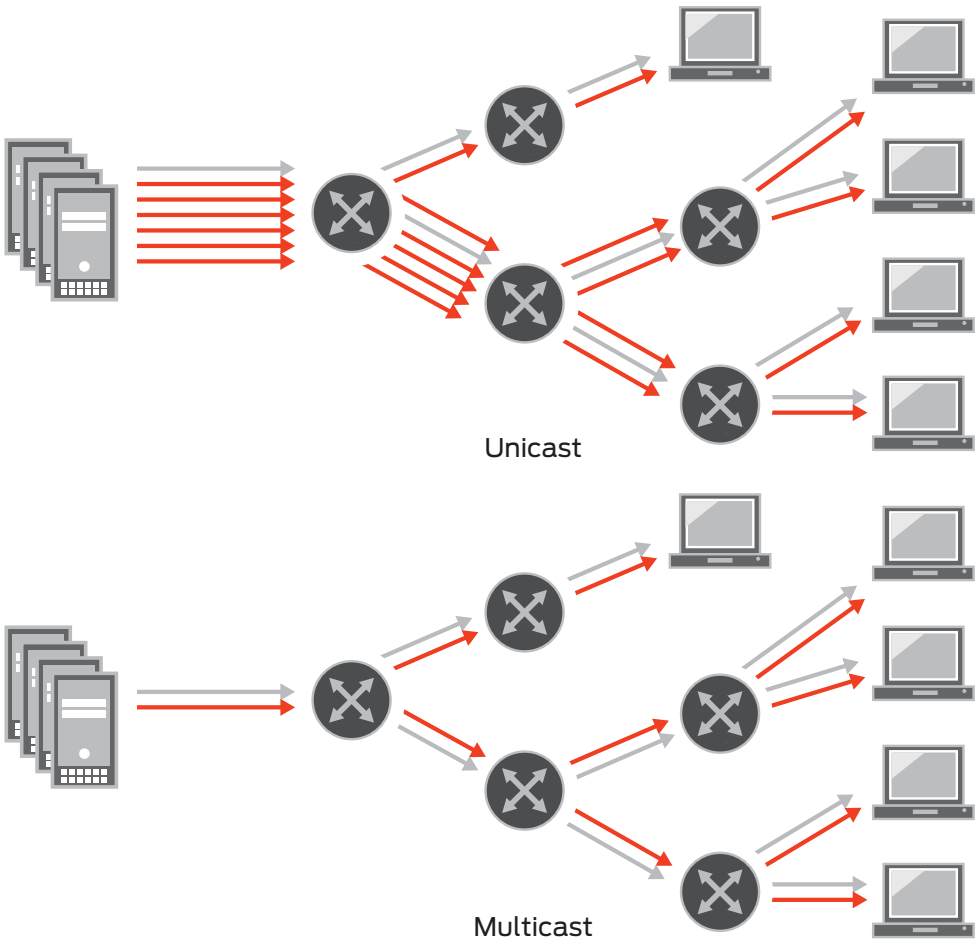

Figure 1: Multicast-unicast blend for quality throughput

But to enjoy these benefits, you have needed to deploy IP multicast protocols on every router in the path. Consequently, IP multicast exists today primarily in small, highly controlled pockets of networks.

However, if you've read Juniper Networks' joint solution brief with Octoshape titled TV Quality, TV Scale, TV Economics via Broadband Multicast, you know that new technologies have emerged which turn yesterday's truths about IP multicast into nothing more than today's myths. Unfortunately, the persistence of these myths is preventing you, along with many other service providers, from deploying IP multicast on the broadband side of the network. As a result, you're missing a huge opportunity to harness the scalability and bandwidth efficiency of IP multicast to deliver video across the Internet to any connected device. You're also missing opportunities to control traffic loads, conserve bandwidth, offer new services, generate additional revenues, capture bigger market share, and strengthen long-term profitability.

The good news is that tools now exist to break through these barriers and deliver on the promise of multicast. Working together, Juniper Networks and Octoshape have produced a solution which makes IP multicast resilient and reliable, enabling you to deploy it on your best-effort broadband network to support the linear distribution of Internet video service. So forget everything you think you know about deploying multicast—you now have the tools you need to build a deployment model that works.

Finally, You Can Make Multicast Work

This solution knocks down all of the barriers which so far have prevented the widespread deployment of IP multicast. As you know, these barriers include the following assumptions, which may or may not have been accurate:

- Every routing device in the delivery path must support IP multicast, which means that if IP multicast is to be ubiquitous, every service provider must decide to offer multicast service.
- It's a big challenge to deliver multicast service reliably in the inherently best-effort environment that exists on the Internet today.
- Broadband video transmission requires adaptive bit rate streaming, which multicast lacks.
- Today's video streaming formats, designed to use progressive download mechanisms, are not inherently multicast capable.
- Interdomain multicast, or multicast peering between Internet service providers (ISPs), requires complex business arrangements and network configurations.
- This is a classic chicken-and-egg problem—which comes first, multicast capable content or multicast capable networks?

To tackle these issues, you need a software solution which basically glues together the video delivery elements in a way that can transparently blend multicast into the distribution chain, but does not require multicast to be everywhere. Using such a solution, you can integrate multicast into your system at your own pace, according to your unique business requirements and, as you deploy multicast, the linear video stream traversing your network simply becomes more efficient.

Octoshape's client/server-based video distribution technology encodes unicast and multicast video streams using multiple simultaneous sources and user datagram protocol (UDP) transport. As the ecosystem "glue," the core Octoshape components of the solution perform the following functions:

1. Ingest traditional streaming formats, which are based on Real-Time Messaging Protocol (RTMP) or HTTP, and transform these into a stream for either unicast or multicast reception.
2. Add a unique resiliency layer which enables the video streams to survive over best-effort networks around the world. Consequently, you do not have to provision for quality of service (QoS) or complex resiliency mechanisms in your network to ensure that multicast can deliver high-quality content reliably.
3. Preserve the multi-bit-rate features of new streaming protocols, thereby accommodating various wireless connectivity speeds and giving individual users on different networks operating at different speeds a buffer-free video experience.
4. Transparently blend unicast and multicast data to give the user a high-quality video experience, regardless of whether the network to which the user's device is connected is multicast capable.

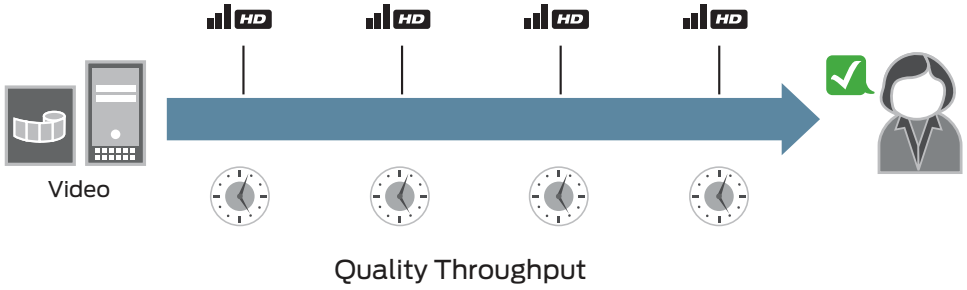

Figure 2. Quality Throughput

Finally, the Octoshape portion of the solution eliminates the complexity of interdomain multicast by creating a multicast content federation. Within this federation, telcos, cable operators, wireless operators, and satellite broadband providers can connect and receive linear content from the Internet via multicast, instead of relying on the traditional unicast content delivery network (CDN) approach.

This solution solves multicast's historical chicken-and-egg problem, clearing the way for multicast to proliferate on the Internet and for you to begin enhancing the quality of your video delivery service while avoiding significant costs.

However you still need additional tools to help you make the transition to multicast, and the Juniper portion of the solution delivers those tools.

AMT—A Transparent Bridge to Full IP Multicasting

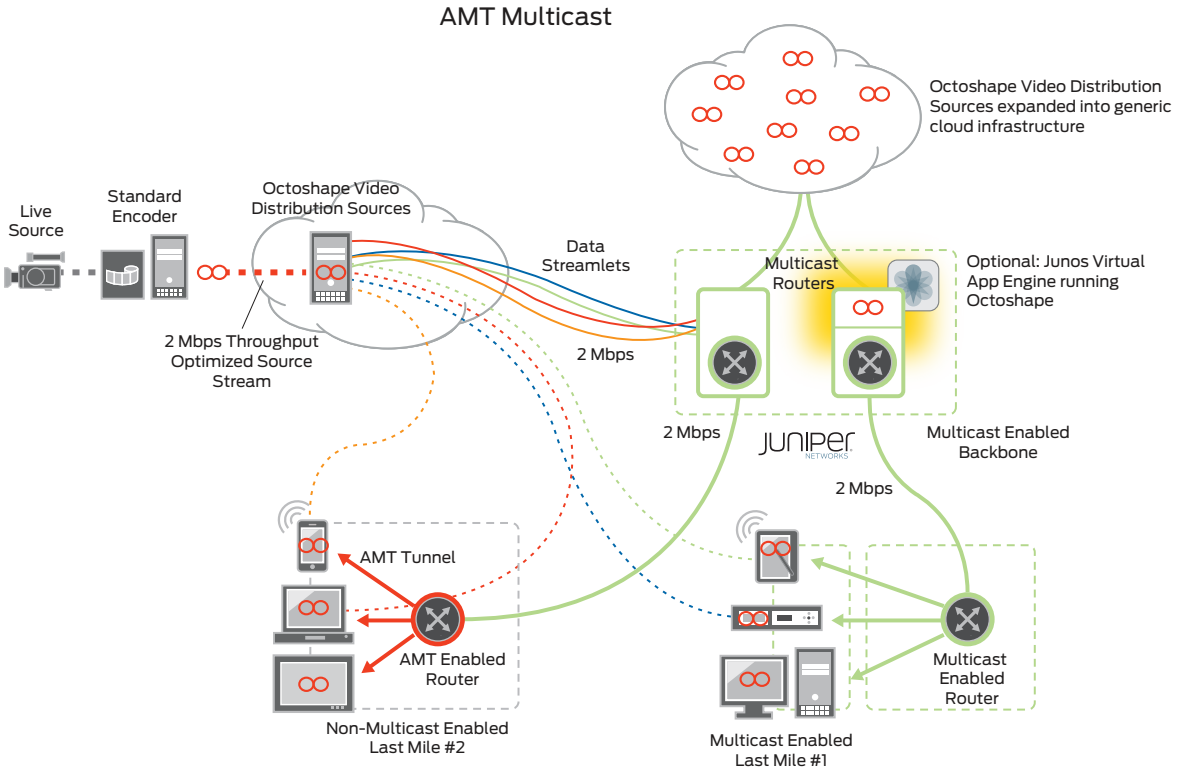

Figure 3. Juniper's AMT for full IP multicasting

Chances are that several devices lie in the path between the multicast source and an individual user's connected device, and any one or all of them can present barriers. For example, the Long Term Evolution (LTE) mobile network, or a particular device such as a home router, may not be multicast capable. Similarly, you may have deployed legacy routers in the path which also are not multicast capable.

Juniper's implementation of Automatic Multicast Tunneling (AMT) technology in its Juniper Networks® Junos® operating system for MX Series 3D Universal Edge Routers overcomes the lack of multicast capability on a given device. If lack of multicast support on any device along the path prevents a particular user from joining a native multicast stream, then an AMT gateway - which is built into Octoshape's powerful and resilient video distribution technology - requests that an AMT - enabled router join the multicast on behalf of the user.

Specifically, AMT establishes tunnels that link users on unicast-only networks with the content they want on multicast-enabled networks. If you operate a multicast-enabled network, you can deploy AMT relays, i.e., AMT-enabled routers, at the edge of the network. As an AMT tunnel endpoint, the AMT relay essentially "translates" native IP multicast content for users on a unicast only network.

Users on the unicast-only network have an AMT gateway—the other tunnel endpoint—on their devices. This gateway, i.e., Octoshape's resilient video distribution technology, uses the "anycast" autodiscovery mechanism to locate the nearest AMT relay and then dynamically initiates an IP multicast tunnel to that relay.

The AMT gateway asks the AMT relay to forward a multicast content stream through the tunnel. Upon receiving the request, the AMT relay joins the multicast content, and the multicast stream is forwarded through the multicast-enabled network to the AMT relay which, in turn, forwards it via the tunnel to the user's AMT gateway.

Thanks to AMT technology, everyone on the network can now receive the signal via multicast, even if multicast is not supported in every part of the network, all the way down to the user. By serving as a transparent bridge that allows users to "hop over" unicast-only networks, AMT resolves the last-mile challenges facing:

- Service providers, who want the maximum return on their capital expenditure investments
- Content providers, who want to minimize the cost they incur for delivery of their content
- Users, who want access to any content, regardless of whether someone delivers that content over a unicast or a multicast infrastructure

Multicast Offers the Best of Both Worlds

Each of the various content delivery methods has an upside and a downside. Although unicast delivery supplies content to every user who wants it, your capital investment cost is linearly related to the size of the audience, whether you're a service provider or a content owner. The servers must be sufficiently powerful to send a duplicate stream to every interested end device, and the links on the network must have enough bandwidth to handle all of the duplicate streams.

If you're a content owner, you prefer broadcast delivery, simply because the transmission cost remains the same, regardless of whether there is one or there are one million end users. Broadcast works well in limited geographic areas or on small networks.

However, on the Internet, which connects millions of networks and billions of user devices, broadcasting traffic to all of those devices is not feasible. Furthermore, splitters, caches, and CDNs/caching merely distribute the problem. Given that there is a cost per user, broadcast delivery is, for all intents and purposes, a nonfunctional business model and a major challenge to live video on the Internet.

Multicast delivery gives you the best of both the unicast and broadcast worlds. Until recently, however, service providers have had little incentive to enable their networks with multicast capabilities, and content owners have had little incentive to produce multicast content.

Fortunately, by enabling a potentially large number of nodes to connect to a multicast provider network, solutions such as the one developed by Juniper and Octoshape can accelerate the deployment of native IP multicast. Now you have what you need to begin delivering scalable, high-quality video and other multicast services, while simultaneously transitioning to a multicast-enabled network.

This joint multicast solution makes it possible for you to start taking advantage of the quality, scale, and economics of delivering traditional broadcast TV over the Internet. By helping you make a cost-effective, scalable, and reliable transition from a unicast to a multicast-enabled network, this solution lets you begin right away to deliver high-quality video content across the Internet to multiple devices and platforms, yet still preserve your bandwidth and control your costs.

AMT Use Cases

Although AMT lends itself to several use cases, three primary ones are over-the-top (OTT) IPTV, mobile, and enterprise.

OTT/IPTV: Traditional providers of cable TV and IPTV services are now replicating these services to broadband connected devices, so consumers can watch video anytime, anywhere, and, equally important, on the devices of their choosing. The solution enables these providers to deliver this content using multicast even if parts of their network don't fully support multicast. Consumers get the highest quality video via a resilient UDP-based transmission, while providers can economically deploy and scale their services via multicast on the best-effort broadband side of the network.

Mobile Video Distribution: Traditional video delivery technologies use TCP for transport, so they do not perform well over latent and "lossy" networks. Because technologies based on HTTP/TCP break large video files into small file downloads which are encoded at variable adaptive rates, video delivery over mobile networks is inefficient and of low quality.

By contrast, the joint solution relies on UDP transport, including a resilient coding scheme which uses the mobile spectrum very efficiently. As a result, the mobile user enjoys a high-quality video experience. With its ability to switch transparently between unicast and multicast sources or between 3G/4G and Wi-Fi networks, video delivered via AMT paves the way for your rapid, transparent adoption of such technologies as evolved multimedia broadcast/multicast service. EMBMS allows you to distribute multicast content very efficiently over your mobile infrastructure.

Enterprise Video Distribution: Video plays an increasingly important role in business communications and overall productivity. The ability to deliver high-quality webcasts and virtual events to a global workforce is a powerful tool for educating corporate resources and sharing valuable business information with both internal and external stakeholders.

By eliminating costly, inefficient traffic duplication, this joint solution makes it simple to deliver high-quality and, if necessary, encrypted video inside the enterprise and over the corporate online network, without disrupting core business functions. The solution eliminates complex, time-consuming, and expensive infrastructure planning, and it does not require the deployment of any hardware. With its support for multi-bit-rate technology and automatic adjustment for strained Internet resources, the solution ensures that each employee receives high-quality video, regardless of the specific conditions of a given office location.

In addition, the solution supports such standard streaming technologies as RTMP, HTTP Dynamic Streaming (HDS), and HTTP Live Streaming (HLS). It also supports delivery to Windows and Macintosh computers via browser embedded players such as Flash, as well as to iPhones, iPads, and Android devices.

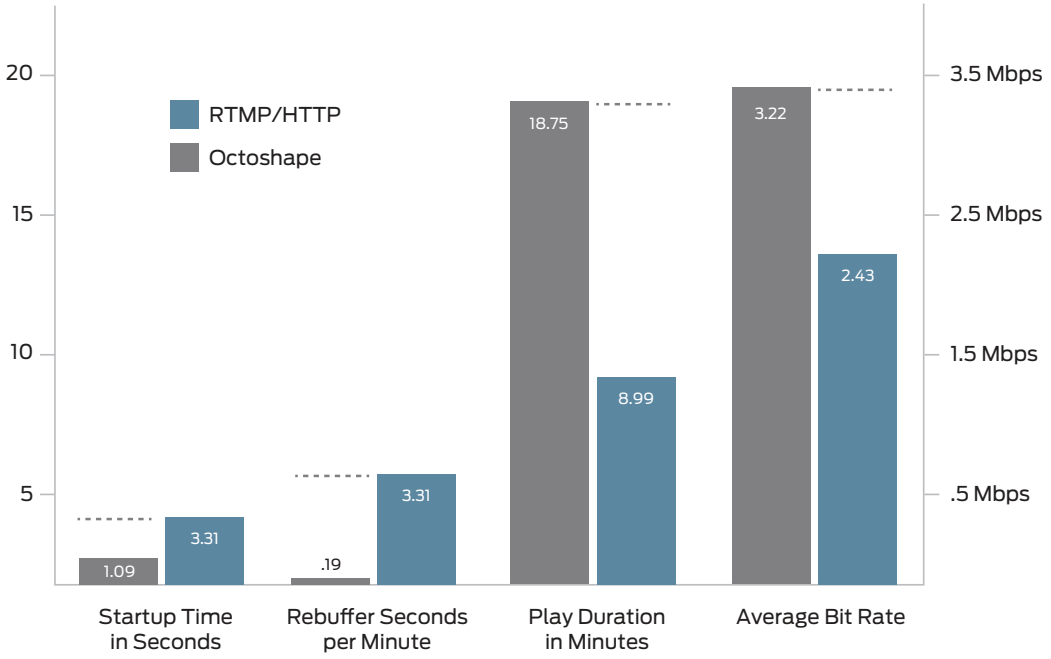

Figure 4. Octoshape-Juniper solution performance metrics

Conclusion—Now You Know the Truth About Multicast

Since its inception, the Internet has evolved to deliver entertainment and information, as well as support commerce. But until recently, it has lacked the technology to deliver live video in a reliable, scalable, and cost-effective way. Now a solution which combines AMT and Octoshape UDP video technology has eliminated the historical roadblocks to multicast. Armed with this solution, you can harness the reach of the Internet to distribute high quality Internet IPTV. And as you do so, you can conserve precious bandwidth, control your costs, and, just as importantly, deploy full multicasting capabilities in your broadband network at your own pace.

About Octoshape

Octoshape provides the cloud based enabling technology required for content owners to deliver online video over best-effort public networks to the largest audiences and with the highest-quality viewing experience. The company is writing the next chapter of content delivery for IPTV.

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

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