The 'Donut Peering' Model: Optimizing IP Transit for Online Video

September 2009

Introduction

"The Internet was not designed to carry data in streams like voice or video but rather small individual packets. However, there are techniques that can be used to optimize the streaming experience for users. By interconnecting and peering with Tier 2 networks and broadband providers on the edge in multiple locations, Mzima ensures that its customers' streaming traffic is more directly routed, reducing packet loss and latency. Additionally, this peering model ensures resiliency through multiple connections with each provider in many locations around the world."
Grant Kirkwood, CTO of Mzima Networks

ARPAnet, the network that was the predecessor of today's global Internet, was created in 1969 and initially consisted of 4 nodes. It was initially designed to transmit data as individual packets that could be taken apart and put back together again in sequence. In order to make this original network work, the discreet networks had to have open communication with one other in order to pass packets between each node. Open communication was the key.

Click below to watch Mzima's CTO Grant Kirkwood present the Story of Donut Peering at the Streaming Media East 2009 Conference.

Today, the Internet consists of tens of millions of nodes. Each data packet needs to travel across multiple networks in order to get to its destination, and the more nodes and networks that the data packets pass through the more likely packets will get dropped, lost or routed over a different path breaking up the sequence and affecting the information received at its end point.

To further complicate matters, interconnecting networks wasn't born from a business or commercial decision; it was a necessary operational function. In order to send information across the Internet, networks needed to be interconnected. The first open interconnection model has developed into the original 'Tier 1' network providers.

What is a Tier 1 Network?

Tier 1 networks are defined as 'Tier 1' simply because they freely peer with all of the other Tier 1 providers. The only criteria necessary to qualify as a Tier 1 provider is that a network must have settlement-free peering with all other Tier 1 networks. There is no other criterion required; it is not based on the amount of traffic, employees, and revenue, how long a network operator has been in business or how much network capacity a company owns.

Once Tier 1 networks peer with one another, the two networks connect together at common points and enter into an agreement to allow traffic to be exchanged on a "settlement-free" basis. This interconnection and settlement-free peering allows these operators to reach any other network on the Internet.

As such, some of the recognized Tier 1 Networks today were the original and oldest networks, such as Alternet. The company was ultimately bought by UUNet which was acquired by MCI and then Worldcom and is now part of the Verizon network family.

The Internet routing tables of today are very different and more complex than they were years ago, when the concept of the commercial Internet and settlement-based peering began. Today, the Internet 'routing table' is made up of about 300,000 individual 'routes' that represent IP address ranges. A Tier 1 network, by definition, is required to peer with all other Tier 1 networks and by definition, doesn't have to pay to route traffic to any of those routes. Therefore, since sending traffic over a Tier 1 peer doesn't cost anything, these providers are actually more motivated to keep traffic within its Tier 1 network peers. But this doesn't help the end-user who is streaming live video from a cable provider. By doing so, Tier 1 Network providers send traffic via routes that are learned through other Tier 1 providers, regardless of performance, flexibility or redundancy. In addition, since routing traffic among peers is free, it is extremely cost effective to sell access, particularly to content heavy users. From this model, we see that Peering can be an effective strategy for reducing IP transit costs, as well as a way to improve performance—but generally not both simultaneously.

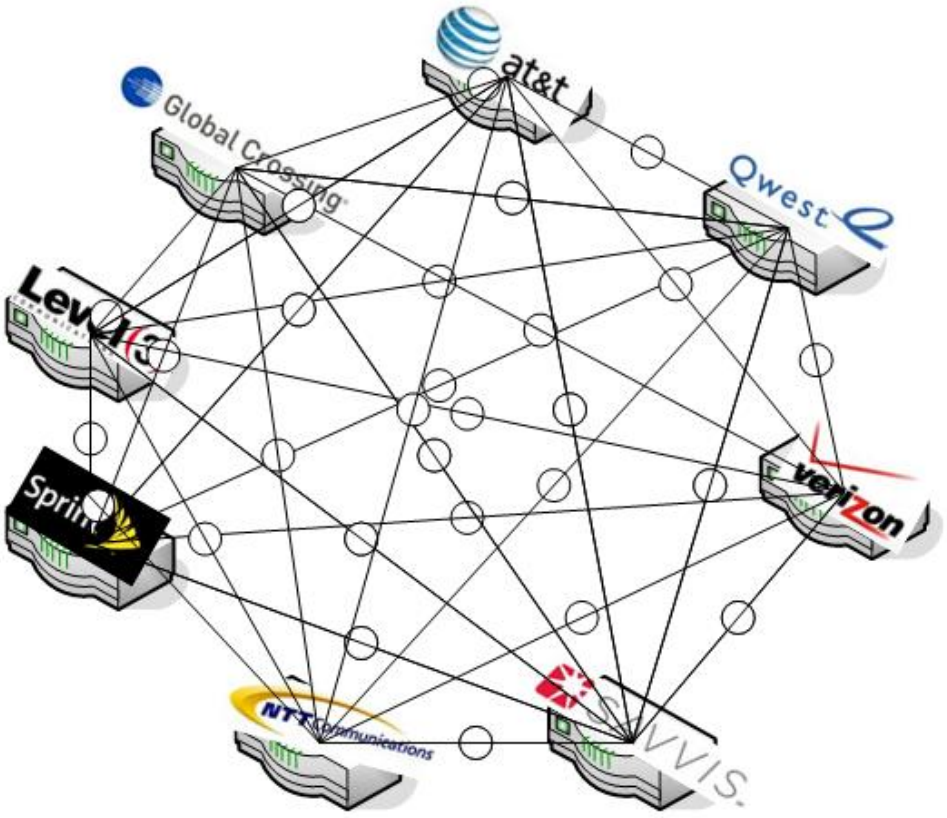
What about those packets? Data packets must travel across networks in order to transmit information. The more networks these data packets must traverse, the more packets can get lost, slowed down or get to their destination in the wrong order – hindering the data connection or transmission. Since video streaming is a constant feed of data, the more networks it must travel to get to its end-user, the more the quality will suffer – it's packet science.

Case In Point: Tier 1 Routing

Here's an example of a Tier 1 network, settlement-free packet transmission. Level 3, a Tier 1 network provider, can send traffic to all other Tier 1 networks for free. The only routes that they know are the routes advertised by its interconnected Tier 1 peering partners and those it knows from its direct customers. An IP Transit provider can only send traffic to routes it has in its routing table, and if it's not there, a provider will have a "hole" in which it can't send traffic. As a Tier 1 network provider, it is generally guaranteed that you will have a complete set of routes; however, you don't have any other options to send traffic except to the other Tier 1 providers that those routes are learned from[1].

So painting a picture here – we have a group of Tier 1 providers, interconnected with each other, dependent upon each other's routing tables to send traffic – settlement free – without any other routing options to consider.

Why do we still think of this as the backbone of the Internet?



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[1] Occasionally peering 'spats' arise due to breech of peering agreements; a recent case in point is Cogent which was 'depeered' by Sprint on October 30, 2008. After working out their differences on November 2nd Cogent was 'repeered.'

But this isn't the backbone of the Internet. There is another ring of service providers that circle the Tier 1 'inner core.' Namely, the Tier 2s are peering together to form the Donut Internet.

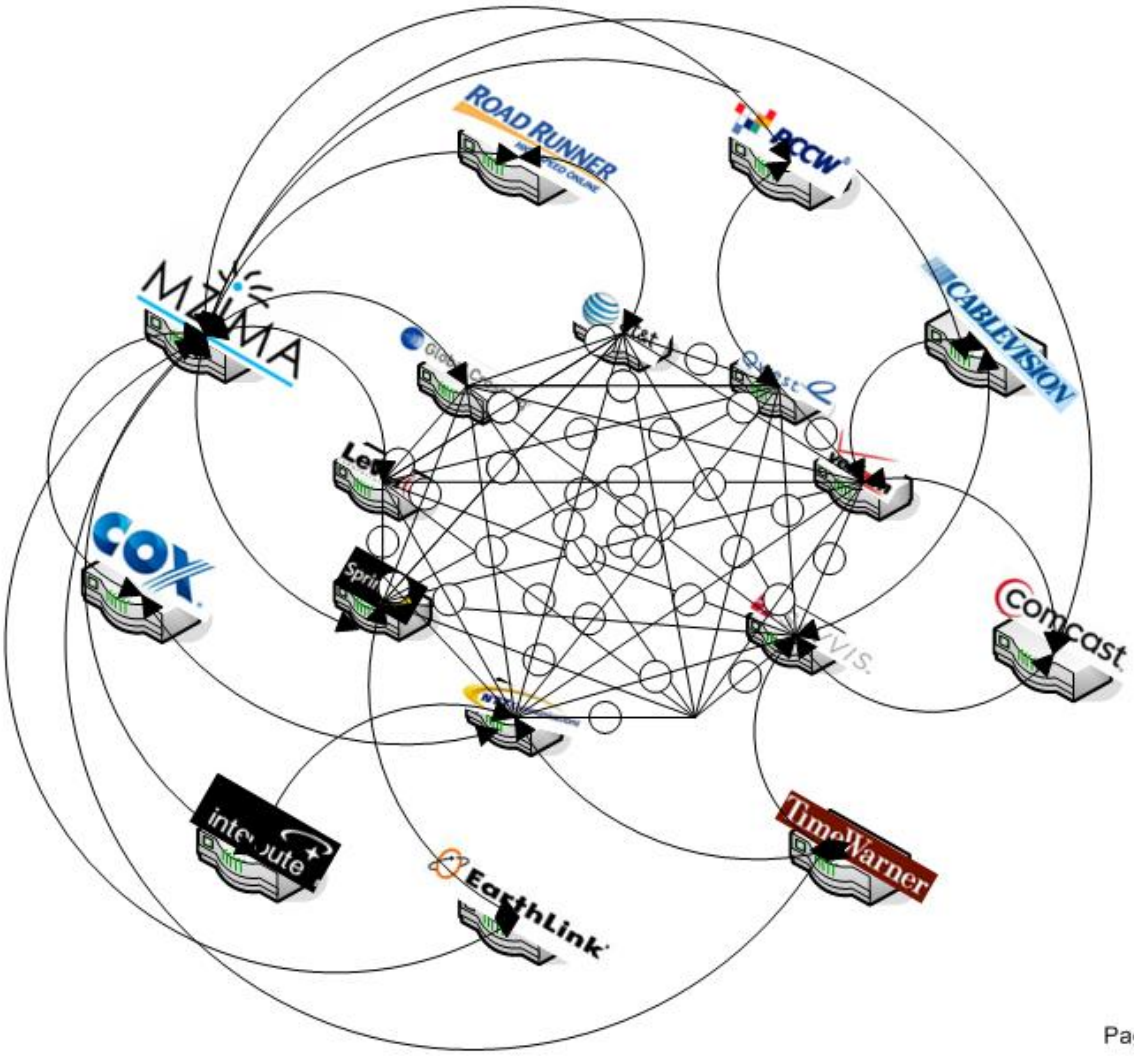
The traditional flow of traffic through Tier 1 networks requires each network to hand-off traffic to one another equally – as previously explained. What this means is that an end-user, let's say a Broadband Provider, wants to get access to data hosted by a Content provider. The data query must first transmit upstream, through the Broadband provider's network (hop 1) then to the Tier 1 provider it is connected to and buying transit from (hop 2) then, most likely to another Tier 1 provider (hop 3) that is directly connected to the Content provider (hop 4) that then access the content servers initially queried by the Broadband provider's end-user. This traditional model of Internet communications relies on the inner-networking infrastructure and peering between the Tier 1 backbone providers who are handing off traffic to one-another, settlement free, leveraging the lowest cost-route available. In the scenario just outlined, the Broadband provider is paying to access the Tier 1 network, as is the Content provider; the only providers that are not exchanging fees are the Tier 1s. So what's in it for the Tier 2 networks if they have to pay for transit anyway?

The Donut Internet

To explain the benefits of the 'Donut Peering' model, we must first define a Tier 2 network. A Tier 2 Network primarily peers with other networks, but still purchases IP transit to reach some portion of the Internet. Tier 2 network providers are the most common providers on the Internet simply due to the ease of connectivity and access to an abundance of other Tier 2 networks. In addition, most Tier 2 networks are closest to the 'edge' or end-users, such as Cable companies and regional ISPs. If we recall, the definition of a Tier 1 network is a network that freely peers with all the other Tier 1 networks. This means that they are generally not willing to peer with networks other than the Tier 1s. So if we take into consideration that Tier 2 network providers are the most common providers, carrying the most amount of data traffic across their networks, and since Tier 2 providers must pay for transit with Tier 1 providers anyway, it makes sense for Tier 2 networks to peer directly with each other, creating a faster, more-direct (and lower cost) path for traffic between the networks to travel. For example, if we consider the traditional flow of traffic, via Tier 1 providers, there are generally at least 2 networks that the data must traverse in order to get to the final end-user. In the Tier 2 example, based on the 'Donut Peering' model, the Broadband provider's end-user would access the network Provider by initiating an internet query (hop 1), directly peering with the Content provider, bypassing the Tier 1 network hand-off and sends the data query directly to the Content provider (hop 2) which delivers it to the end-user (so picture a network connection that doesn't touch the Tier 1 providers at all!). The data takes a more direct path, with less chance for increased packet loss or latency.

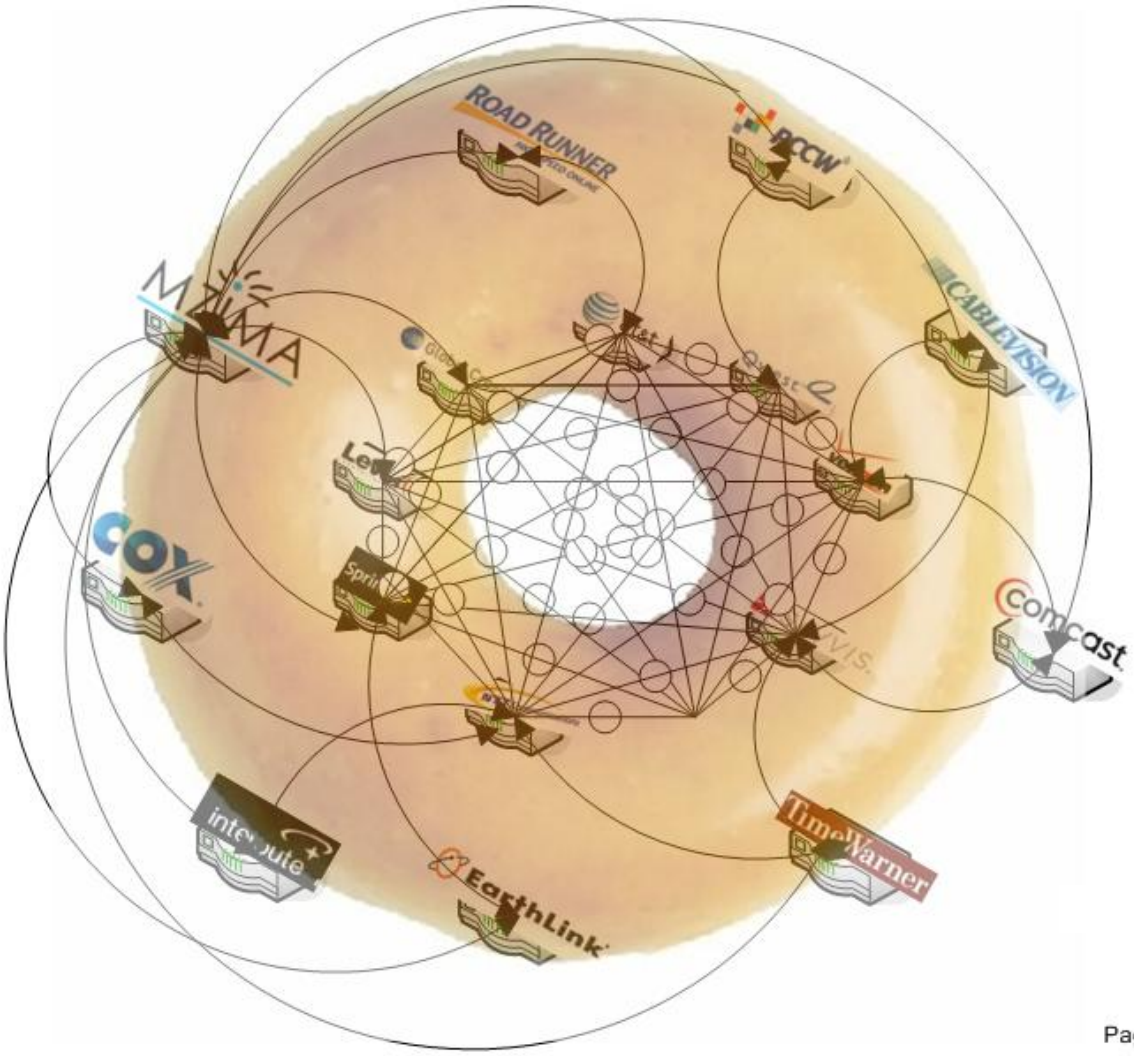
Mzima Networks has focused its business model on creating more efficient peering connections among other Tier 2 providers in order to deliver content and streaming media more efficiently for and between its customers. The company's goal is to connect to as many networks as it can, in as many locations as possible, in order to bypass the Tier 1 'inner circle' as often as possible. This doesn't mean that Tier 1 providers are not necessary, because indeed they are – but more often than not they are NOT the shortest or most efficient route to a destination from a cost and quality stand-point.

The Donut Internet



By interconnecting and peering with Tier 2 providers on the edge in multiple locations, Mzima ensures that its customers' traffic is more directly routed, reducing packet loss and latency. Additionally, this peering model ensures resiliency through multiple connections with each provider in many locations around the world.

How Sweet it is: The Mzima Networks' Donut Peering Model Defined



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This is the Mzima Networks Donut Peering Model.

Most of the content sent by Mzima's network doesn't terminate in the middle core. One could argue that a company such as AT&T has content through its Broadband Access group, SBC, BellSouth and so on. However, the reality is that these acquired companies are actually separate networks with their own ASNs (Autonomous System Number - a unique identifier of an autonomous system on the Internet), own peering policies and are classified as Tier 2 providers that topologically sit on the edge – or outer rim – of the 'donut,' together with companies like Comcast, Time Warner, Cox, Charter and others.

By connecting to all of these networks, Mzima has a large number of options to route its customer's traffic. Mzima also maintains connectivity to multiple Tier 1 providers as well as many of the other Tier 2 providers, ensuring there are no holes in its network routing table, but

rather that there are multiple ways to get to every destination on the Internet. Unless you're a Tier 1 network provider, all other networks must buy transit. Therefore, by choosing to buy transit closer to a packet's destination, the packet has a better, higher quality chance of being received quickly and in its intended order, rather than jumbled and delayed – therefore vastly improving the end-user's experience. Furthermore, the provider or choice has the ability to pick routes based on preference instead of the cheapest cost or closest exit from other Tier 1 peers.

Tier 2 vs. Tier 1 Network Benefits

Mzima, A Tier 2 Network	Traditional Tier 1 Network
Access to multiple Tier 1 and Tier 2 Networks	Only peer with other Tier 1 Networks
Able to connect directly to end-user networks by means of an aggressive peering policy, bypassing traditional backbones	Forced to route data through possibly congested multiple Tier 1 backbones
Unfettered by peering restrictions and network routing inflexibility – can route based on performance, not cost or peering policy	Forced to comply with restrictive peering policies and as a result, often forced to select a longer, more expensive route (longer route = more "hops")
Support calls are sent to an Mzima engineer immediately	Support calls are sent to a "ticket taker" first
Ensuring an Optimized Network Performance is what we do, and we do it well	Weighed down by huge portfolios, trying to sell and support a variety of services to a variety of target customers
With extensive peering to other Tier 2 networks around the edge of the Internet, Mzima utilizes a "donut peering" model to ensure the best possible routing and quality control: find out more on **www.mzima.net/donut**	Forced to peer with other similar Tier 1 networks, thereby peering within the core of the Internet, often forced to select a longer, more expensive routes with more "hops" and less quality

The Mzima Networks Difference

Through its 'Donut Peering' model, Mzima's global reach is substantial. The company is interconnected to over 500 networks representing 90 countries ensuring that its customer's traffic is only 1 network hop away.

Mzima is the only network provider that has used peering solely as a performance tool rather than a cost savings measure. Many other providers have leveraged peering relationships primarily as a cost savings tool. Today, most major Content Delivery Networks and many major Streaming Media Companies buy transit solutions from Mzima. That alone is a testament to the quality of this model and Mzima's solutions.

Case In Point: Babulous, a Streaming Content Provider, Leverages Mzima's Donut Peering Model

The Client

Babulous runs and operates a music website that provides space to independent artists and DJs to showcase their music. The company's Facebook application 'profile song,' is within the top three music applications on Facebook. Babulous users create their own play lists where they can listen to their music from any Internet connection. In order for the company to provide quality-streaming audio for its users, it needed a fast and reliable bandwidth provider. In addition, due to the heavy bandwidth of its application, the company wanted to be as close to the end-user consumer market as possible, without having to operate its servers in multiple locations.

Client Quote:

"A user won't listen to music from any website if it suddenly pauses. Mzima has a very high quality of bandwidth that supports the needs and expectations of our users. We would expand with Mzima and look forward to using them for our future CDN [Content Delivery Network] requirements. The Mzima team has proven it's ready to accommodate our network needs."

-Ali Emami, CEO

babulous

The Solution

The company selected Mzima Networks in its New York facility as its high performance IP bandwidth provider, after carefully reviewing several bids. Babulous selected Mzima for its extensive global peering relationships and optimized Internet backbone architecture that could handle Babulous' critical network performance requirements. "As a music company, we need to stream music to our users without delay or pause," commented Ali Emami CEO of Babulous. "The quality of bandwidth is very important to us and to our users. It creates a highly significant difference in the user experience. A user won't listen to music from a particular website if it suddenly pauses. Mzima's Donut Peering Model, and specifically its ability to send traffic directly to end-user networks, thereby resulting in higher performance, lower latency and fewer hops, ensures a better user experience. This model supports the needs and expectations of our users."

The Results

The Mzima's high performance IP transit is designed specifically for Internet content applications that require the highest level of performance and resiliency. The company designed a completely fault-tolerant backbone network that consists of multiple wide-area rings and distributed metro Network Access Points (NAPs). After many years of hardware testing and implementations, the company successfully operates a dedicated optical transport network that provides transparent connectivity between elements on its IP network, and bypassed traditionally congested Tier 1 networks.

According to Renesys, 80% of Mzima's routes bypass the Tier 1 networks. Instead, traffic is sent directly to the networks that Internet users are connected to, thereby resulting in higher performance by lowering the latency with fewer hops and ensuring a better user experience. Learn more about Mzima's "Donut Peering" concept and how we can optimize the delivery of your traffic at www.mzima.net/donut.

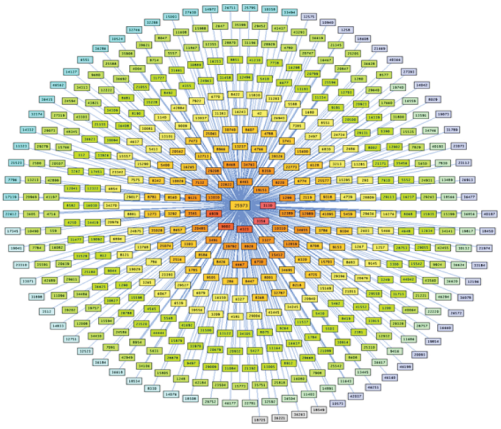
**Data Supplied by Renesys, a neutral Internet Intelligence Authority.*

Not all Tier 2 Networks Are Built the Same

They're not? It takes years to cultivate relationships with other networks, negotiate contracts, establish peering points, locations and interconnections. In addition, as technology continues to transform the way we all do business, understanding technology, its evolution and having a vision on where it can go takes experienced engineers to study and manage its implementation. Mzima's network truly differentiates itself for all of these reasons. Above all, it does not focus on cost-based routing. The network is engineered to select the best, most efficient route, regardless of the cost. This is a truly unique quality that sets the Mzima Network apart from other Tier 2 network providers in the market. The graph below illustrates the Mzima Networks strength efficiently:

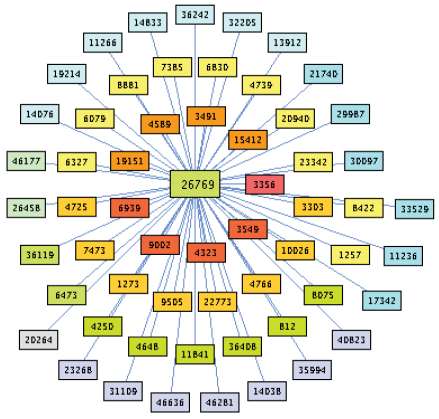
Mzima Networks
Multinational
6 Continents
10 Countries
31 US States / Provinces
26 US Metro Areas
305 Originated Networks
484 Transited Networks
355 Selected Peers

28-day AS Adjacency Graph:



Another Tier 2 Backbone Provider
Local
2 Continents
3 Countries
16 US States / Provinces
14 US Metro Areas
35 Originated Networks
189 Transited Networks
41 Selected Peers

28-day AS Adjacency Graph:

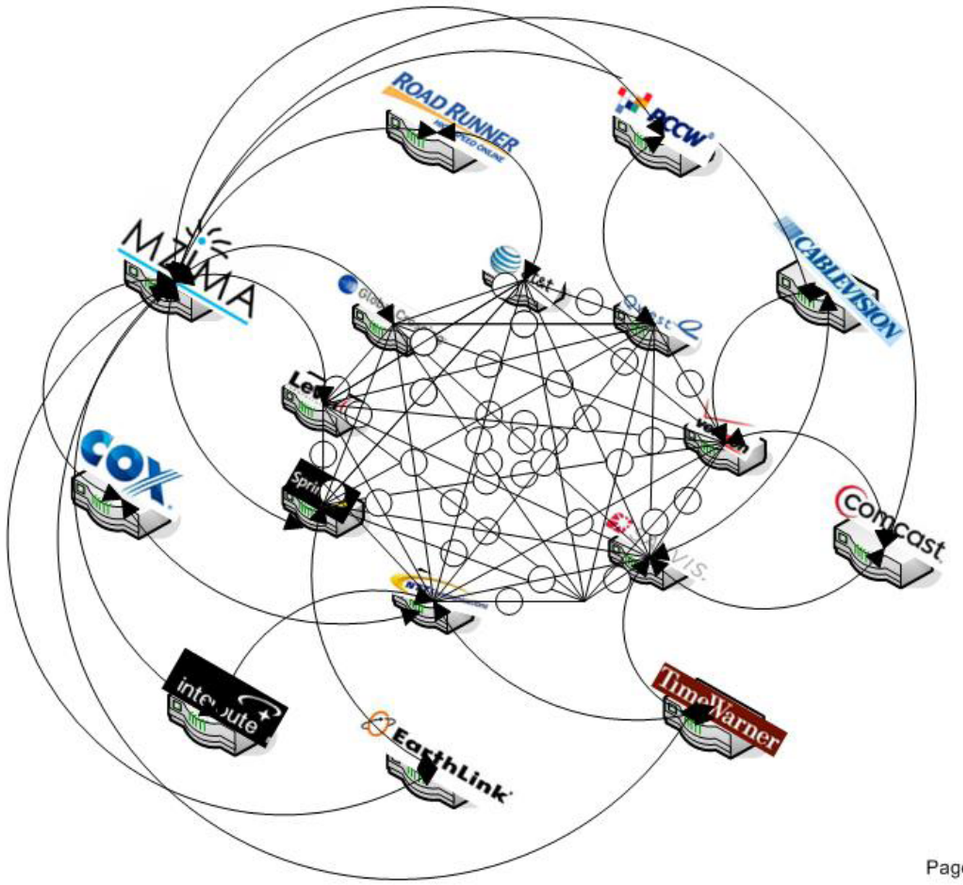


Positioned for Growth

According to ComScore, a global leader in measuring the digital world and preferred source of digital marketing intelligence, Americans viewed a record 16.8 billion videos online in April 2009 alone. This is an increase of 16% since March 2009.

As the online video audience grows at an incredible rate, networks need to be positioned to service this growth. Mzima's growth strategy is in leveraging its access to choice. Mzima has an unequaled number of options to route performance-sensitive traffic through its Donut Peering Model. Additionally, this model ensures resiliency through multiple connections with each provider throughout the world. By interconnecting and peering with Tier 2 providers on the edge and in multiple locations, Mzima offers its customers' more direct routes, reduced packet loss and latency. The Donut Peering Model is the key to a higher quality Internet of tomorrow.

This gives Mzima an unequaled number of options to route performance-sensitive traffic



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For more information, please visit www.mzima.net or email info@mzima.net.