NETWORK DESIGN PROPOSAL

Cyber Division

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The implementation of the IPTV service for customer requirements can be very challenging, we need to update our bandwidth, we need to distribute the best possible video quality, at the same time that, of course, precisely what our end-users appears on the screen be looking and paying for watch. At the same time this inevitably leads us to consider the opportunities our clients have as television providers to develop a strong, efficient, safe and reliable project.

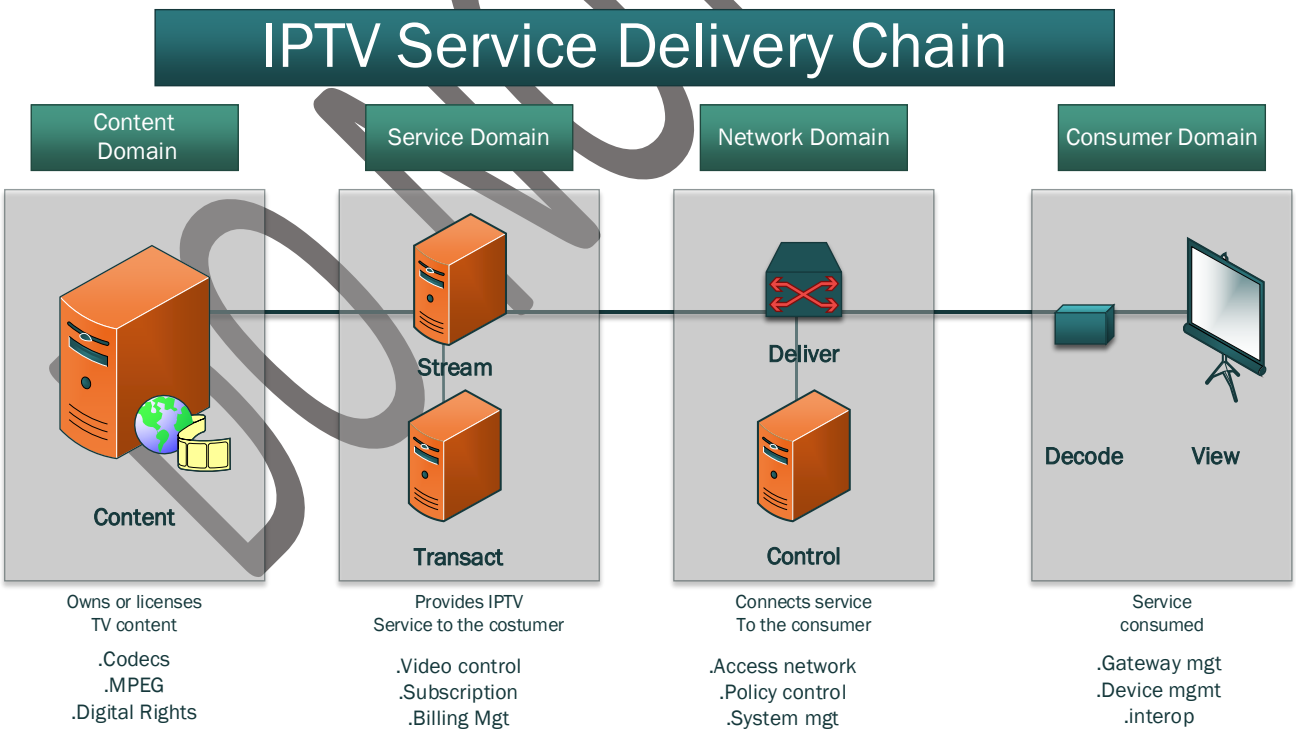
We know that the main objective of our agreement is to satisfy the exponential growth of clients, in addition to the bandwidth requirement.

Pacific Internet Solutions expects that after IPTV is available to subscribers its number of subscribers will increase from the present number of 20,000 to 100,000 over the next 5 years.

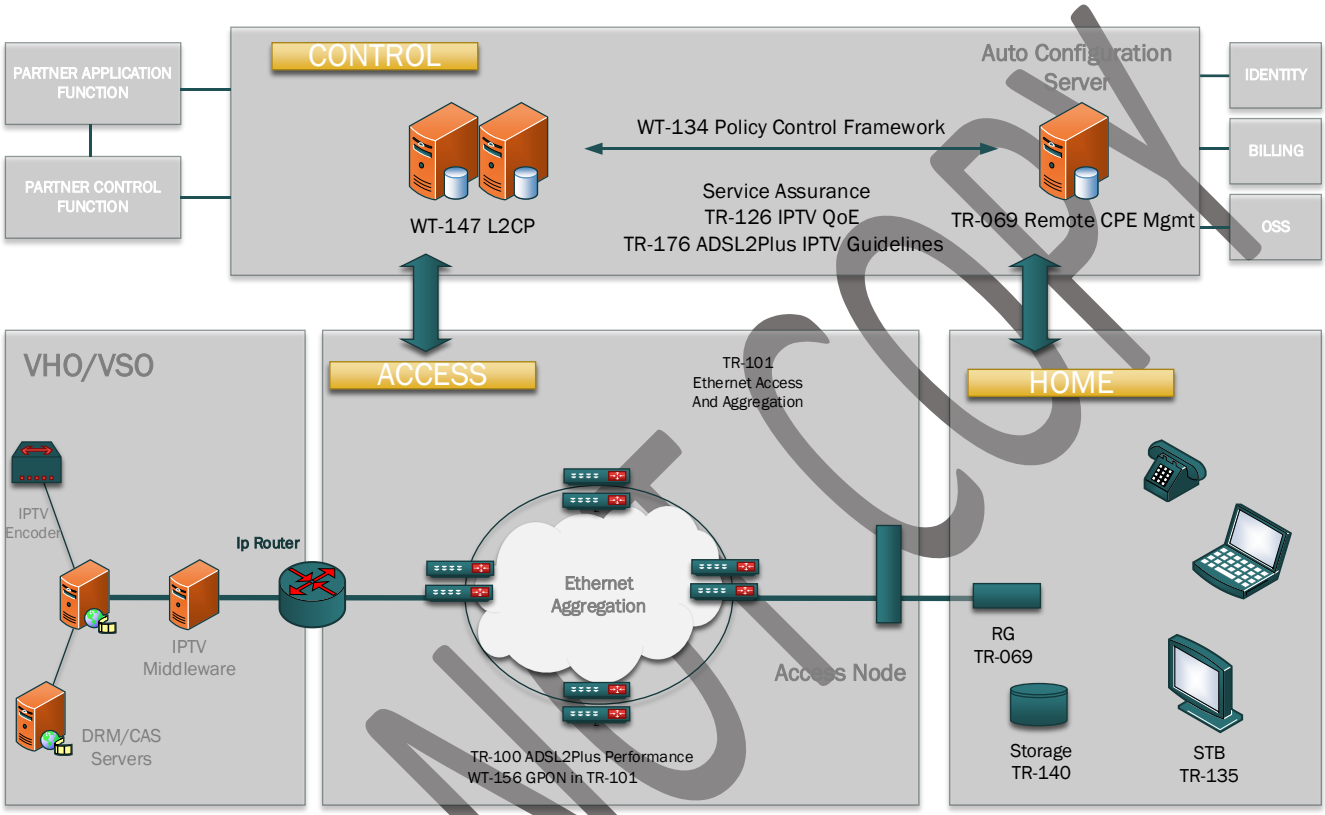
Our network architecture proposal is based on world installation standards that are based on the search for optimization and better distribution and user experience.

That is why we propose, going from the general to the particular, starting with a healthy IPTV service delivery chain based on its 4 domains: Content, service, network and consumer domains. This will give us the peace of mind and the certainty of a good distribution chain as the Broadband forum has discussed and has established it as a guide for a successful installation.

The IPTV Ecosystem



As we mentioned before, and of course still talking about our network architecture proposal, we will base ourselves on the ideas of the Broadband forum, why? Well, because through its Technical Reports (TRs) you have defined requirements for establishing an optimized network and management platform for IPTV. The work of Broadband Forum addresses specific issues in three network realms: BroadbandAccess, BroadbandControl and BroadbandHome that are necessary if the IPTV user is to experience a superior quality experience beyond what is already provided by existing TV delivery methods.



This "Plan" is designed to minimize provisioning and maintenance issues for service and application providers who must support vast and growing requirements of new applications and hardware. With BroadbandSuite, components work together seamlessly, delivering a high-quality consumer experience vital for driving next-generation voice, video, data and mobile services.

These efforts address the following key areas:

_ **BroadbandAccess:** Defines specifications for broadband "agnostic" access network architectures that deliver inherent quality, scalability, resiliency, and inter-working capabilities that enable services to be delivered via multiple business models.

_BroadbandControl: Creates an intelligent, programmable control layer that unifies all next generation network assets and empowers service providers to deliver personalized services that enhance the subscriber experience.

_BroadbandHome: Unifies the home networking environment by establishing a common a set of CPE capabilities as well as automating device activation and configuration in order to simplify the service delivery process.

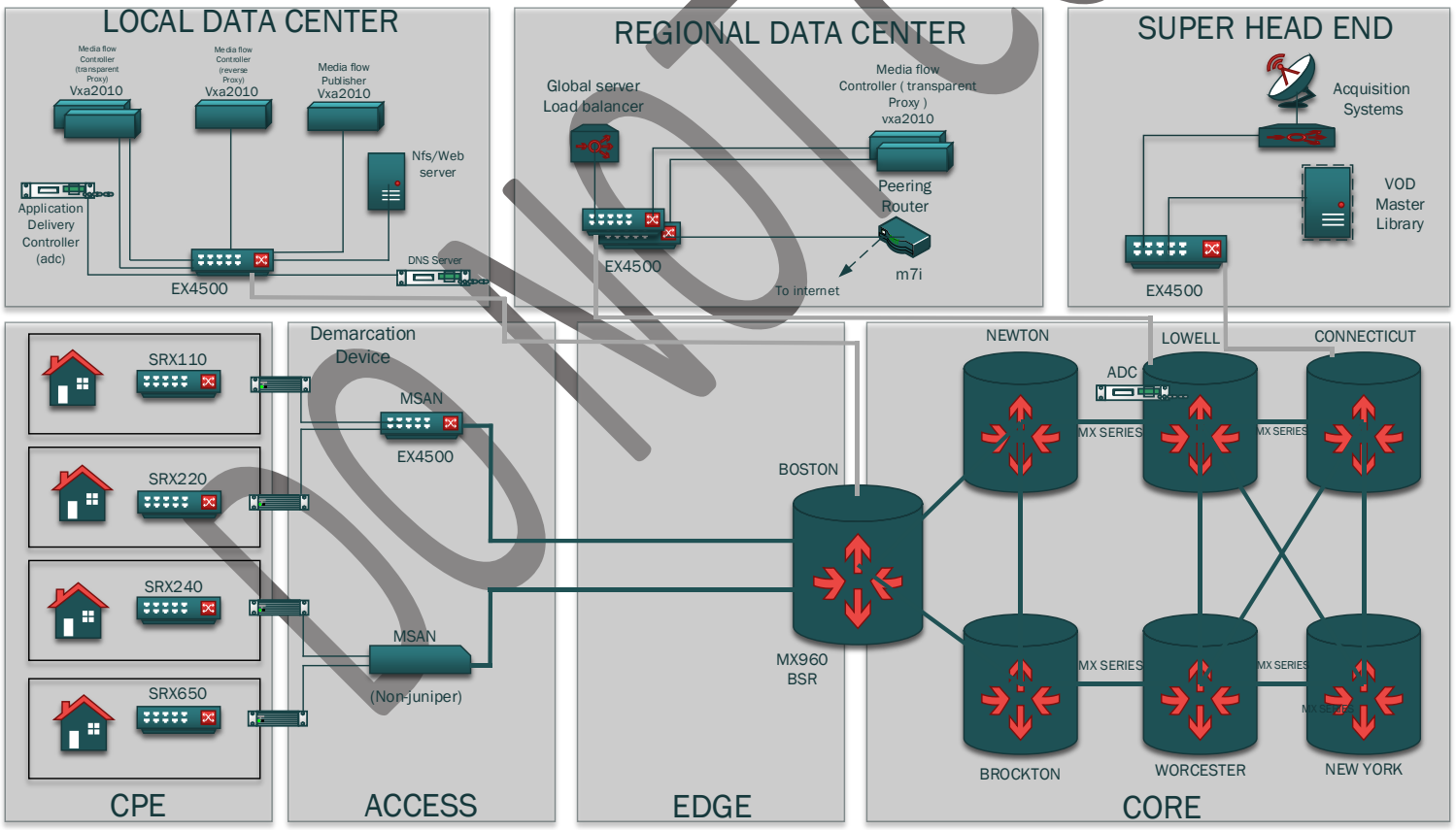
Collectively the BroadbandSuite domains provide an end-to-end transport architecture that gives service providers a solid foundation on wich to deliver next-generation services such as IPTV, while reducing operations costs through automated network operations.

IPTV network network architecture

Having already explained the above at the level of standards, ideas and model, I would now like to go on to detail at the level of devices and connection what is our proposal for the general architecture.

Well, we are thinking of a typical network architecture that is already validated. It should be mentioned previously that our distribution proposal is based on the VPLS model in an MPLS architecture distributed by LSPs signaled by the BGP protocol.

Here is an overview of what architecture with the explanation of the different areas:



The Wan consists of the following domains:

_Core network, which is a multicast-enabled MPLS backbone network.
_The BSRs are MX Series routers that support subscriber management services.
_Access equipment, which includes DSLAMs to support xDSL users, as well as an EX Series Ethernet Switches that support Ethernet-attached subscribers. This network does not include aggregation switches.

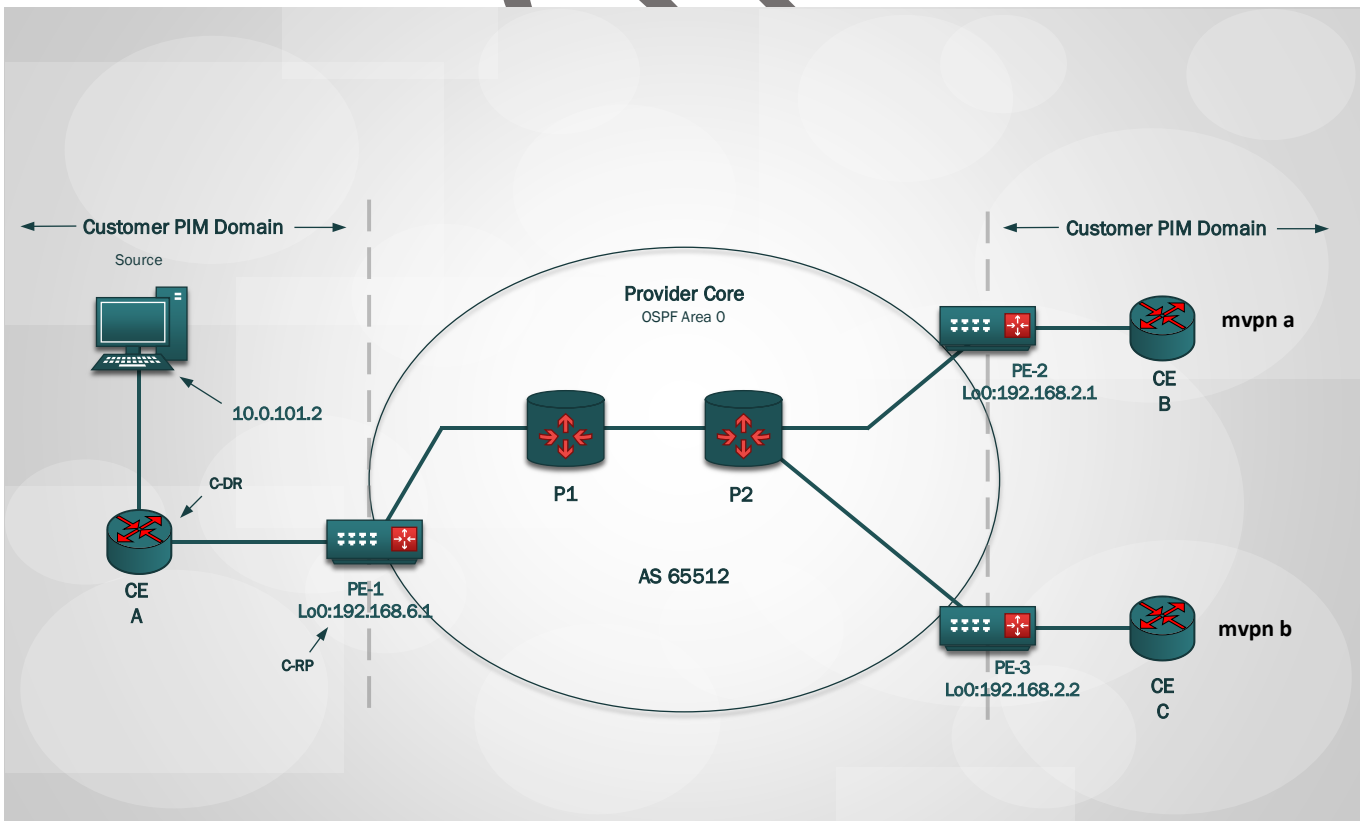
Tiered data centers also represent part of the entire network architecture:

Super Head End (SHE) data center, which is the centralized storage and download point for many types of content, including linear TV. This site is referred to by a variety of other names, including National Data Center.

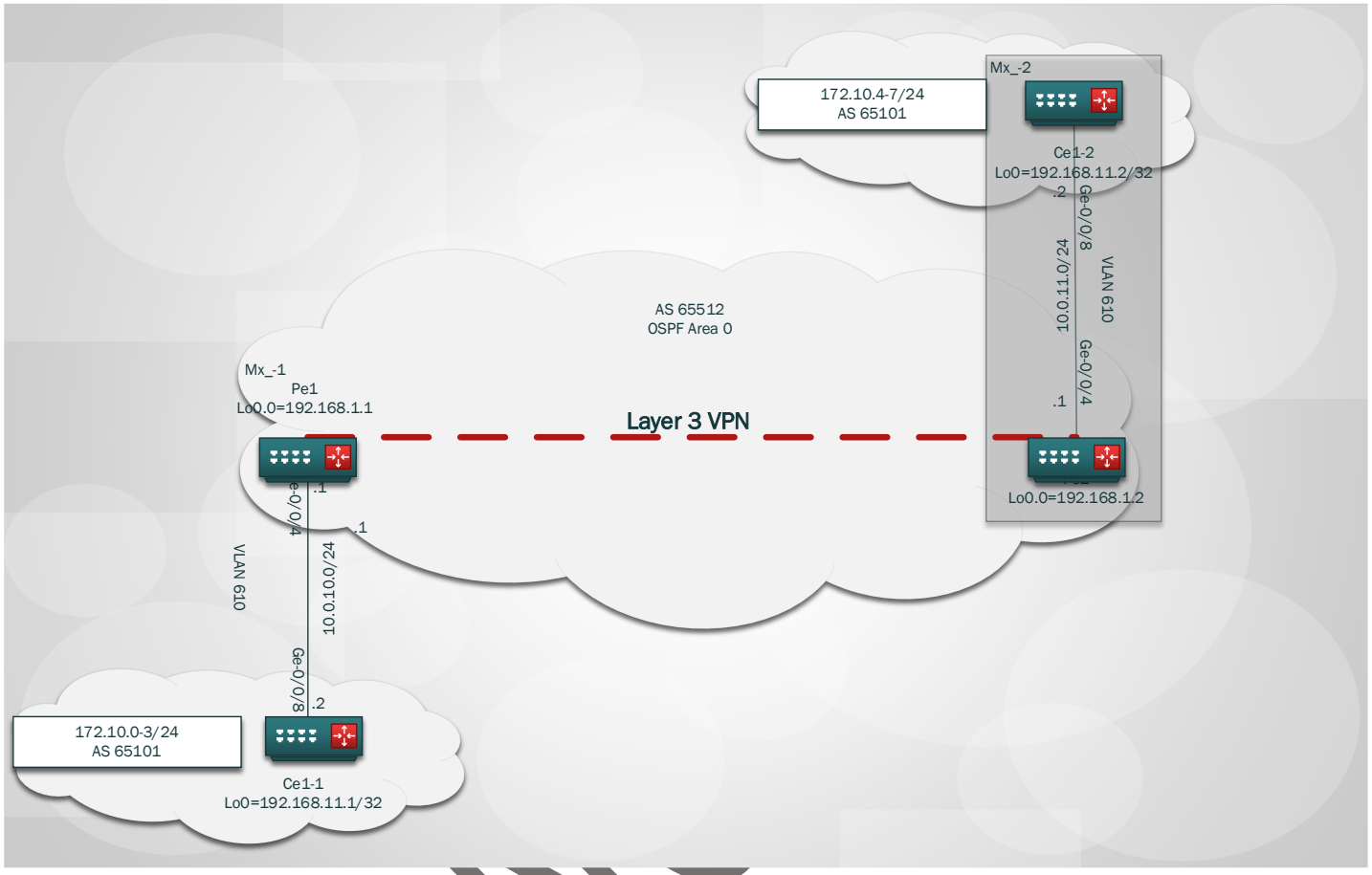
Regional Data Centers (RDCs), which are the primary data centers serving the subscribers. For example, advertisements are inserted into the linear TV stream, and it is this stream that is forwarded to the subscribers. VoIP switches and Internet peering points often reside at this location. This site is also called the Video Hub Office (VHO) or Local Head End (LHE) among other names.

Edge data centers, which primarily consist of aggregation equipment and content caches. These sites also are known as broadband edge (BBE) sites,
Video Service Office (VSO) or Central Office (CO).

In the next diagram, we propose the multicast MPLS network that we will use for IPTV distribution.

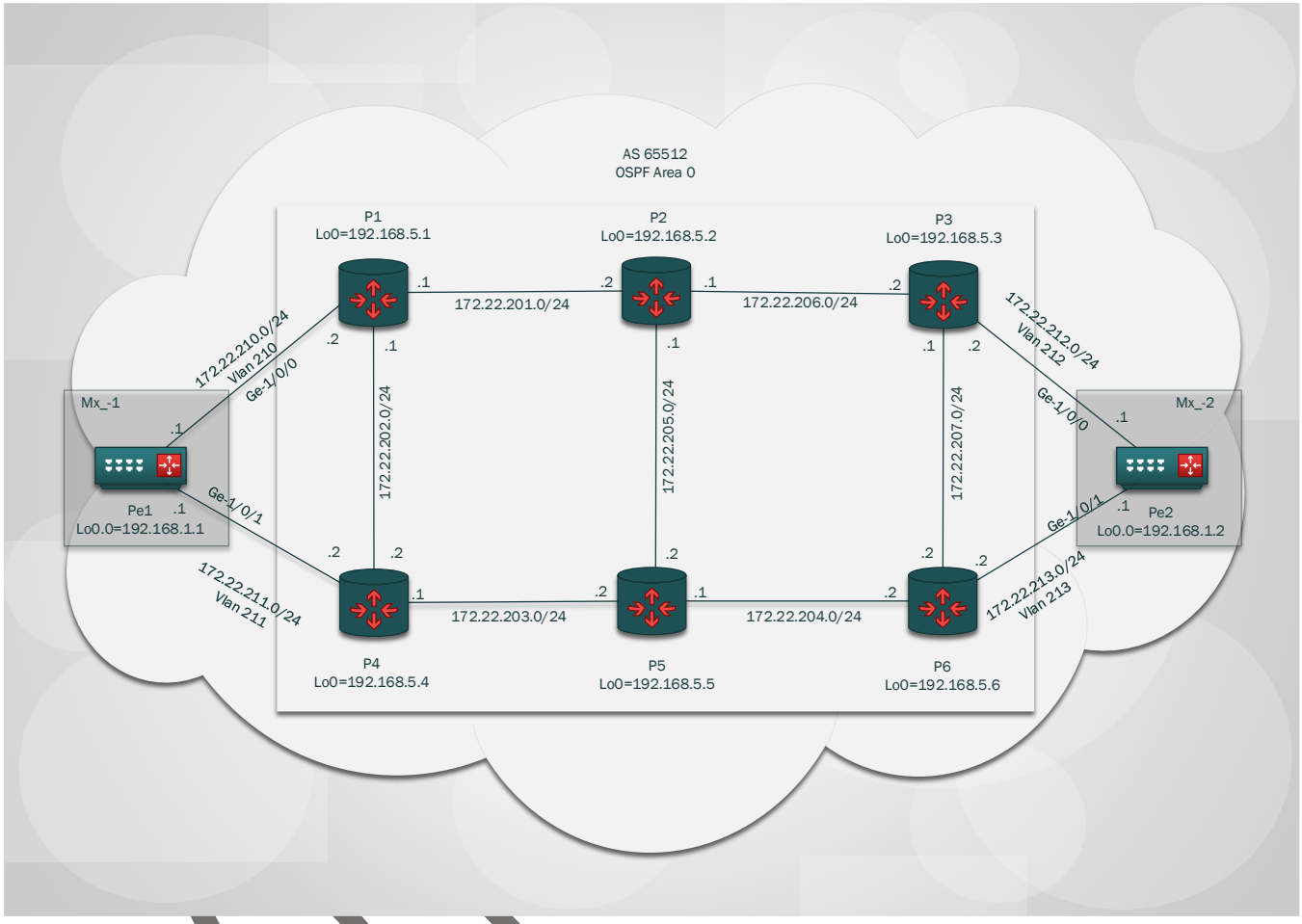


Since we have our network design in a general way, in the following diagram we will focus on the network design and connectivity between the customer edge and the provider edge and we will observe the connection between PE based on a layer 3 VPN.



As we mentioned before the layer 3 VPN, now we propose the following model itself.

This will be the baseline of our MPLS proposal where we will have the routers (P) that will connect the routers (PE) through BGP signaling, and where the LSPs will be configured for effective point-to-multipoint distribution.



Distribution model

To the costumer in the VPLS (virtual private LAN service) model, the provider's network appears to function as a single LAN segment and the administrator does not need to map local circuit IDs to remote sites. The PE device learns MAC address form received layer 2 frames and are dynamically mapped to outbound MPLS LSPs and / or interfaces. In other words it works like a big switch.
What we propose is to work with the VPLS RFC 4761 standard that uses M-BGP to signal. And is that the benefits are several, for example auto-discovery or that it is a scalable protocol which means to handle lots of routes in addition to being designed to work through autonomous systems.

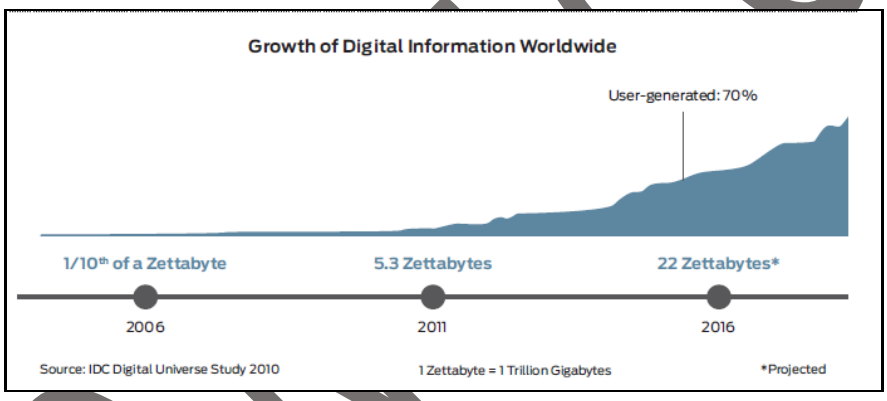
In VPLS, a packet originating within a service provider customer's network is sent first to a customer edge (CE) device (for example, a router or Ethernet switch). It is then sent to a provider edge (PE) router within the service provider network. The packet traverses the service provider network over an

MPLS label-switched path (LSP). It arrives at the egress PE router, which the forwards the traffic to the CE device at the destination customer site. The difference is that, for VPLS, packets can traverse the service provider networks in point-to-multipoint fashion, meaning that a packet originating from a CE device can be broadcast to all the PE routers participating in a VPLS routing instance.

VPLS multihoming enables you to connect a customer site to multiple PE routers to provide redundant connectivity while preventing the formation of a Layer 2 loops in the service provider network. A VPLS site that is multihomed to two or more PE routers provides redundant connectivity in the event of a PE router-to-CE device link failure or the failure of a PE router.

Source of video: Impact/challenges

Fueled by the significant growth in video, the amount of available content is increasing exponentially. In addition to traditional linear television service, VOD and network-based Personal Video Recorders (PVR) provide a seemingly never-ending source of entertainment.

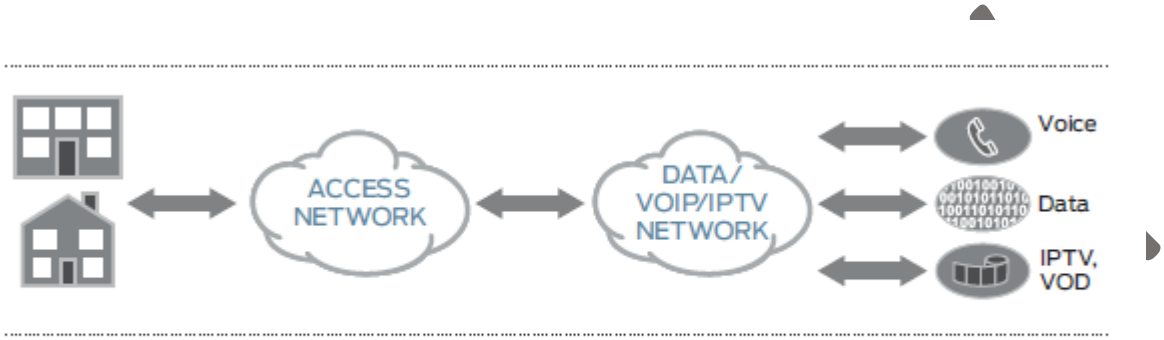


So, if the objective is to distribute good quality video content with a low bandwidth requirement, the best solution and technology that we will use this time will be the multiplay delivery model.

Multiplay supports all services using converged access and core infrastructures. In addition to eliminating the costs associated with operating a second network, this scalable approach supports even High Definition (HD) quality Internet-based video.

Broadband network using data-centric single edge topology (double play)

The multiplay delivery model supports data, VoIP and video as well as emerging services. Unlike triple-play models that dedicate bandwidth to IPTV service, multiplay enables any application to use any bandwidth to the subscriber. Based on Juniper Networks MX Series 3D Universal Edge Router, the dramatic growth in Internet-based video makes this fundamental differentiator more important than ever. The key to a multiplay network is the BSR, which can support multiple services for thousands of subscribers, eliminating the need for separate service-specific networks. In addition, the multiplay model easily supports business and residential broadband service delivery using the same access and core infrastructure.



Broadband network using multiplay-capable single edge (including business services)

NSP are again evolving their networks, this time to support the dramatic growth in video traffic, the shift to Internet-based video and the growth of CDN-based services. As the leaders in high performance networking, Juniper Networks provides a world-class infrastructure that delivers high bandwidth and real-time services, including IPTV, VoIP and videoconferencing.

Of course, we know the challenges and opportunities that our clients have ahead, the implementation of the IPTV service for customer requirements can be very challenging, we need to update our bandwidth, we need to distribute the best possible video quality, at the same time that, of course, precisely what our end-users appears on the screen be looking and paying for watch.
We know that the main objective of our agreement is to satisfy the exponential growth of clients, in addition to the bandwidth requirement.

One of the biggest challenges is the growth of video traffic, VOD and network-based personal video recorders, which cause never ending video traffic.

To this challenge we must add the fierce competition that exists in the market for different IPTV services, for which the challenge also consists of not passing on the costs of a robust bandwidth to the client itself. Therefore, the objective is to reinforce the bandwidth without the client taking charge, since otherwise a video service will not be able to be delivered according to the advantages of distributing high-quality video.

This discussion focuses on two areas. One, the access network has evolved to effectively deliver multiple services, including Internet-based video. Two, content caching reduces costs and improves performance.

Another challenge is multicast delivery. Multicast is critical for broadcasting each channel to customers throughout the network.

So, if the objective is to distribute good quality video content with a low bandwidth requirement, the best solution and technology that we will use this time will be the multiplay delivery model.

Another need is multi-screen delivery of content to PCs, smartphones, tablets and even web-enabled televisions. The idea of delivering each service to a dedicated device is defunct. Linear TV is sent to PCs as well as STBs; TVs have broadband applets to watch Internet-based content; and gaming devices can view walled garden IPTV and Internet-based video, as well as serve their original purpose. Today´s subscribers watch content on wireless devices. At the same time, the consumer should see a common look and feel regardless of the device being used.

To address this growing problem, Juniper Networks Media Flow Publisher simplifies the workflow by performing adaptive stream segmentation, stream packaging, metadata publishing and adaptive stream format translation. The Media Flow Publisher enables network operators and content providers to leverage their existing TV and video encoding infrastructure for adaptive stream production, eliminating the need for specialized encoders and servers.

The need to contain bandwidth requirements while maintaining a high level of costumer experience by providing high quality video and fast channel changes. The following is the solution:

Multicast Admission Control for IGMP Proxy

In this model, the AN will receive and process IGMP joins from each household. Now the BSR is only processing per-AN IGMP and can only make resource determinations regarding the amount of multicast sent over each M-VLAN interface to the AN.

The following figure highlights this model across two households. The BSR keeps a local mapping of multicast groups and their bandwidth. This table can be statically created or dynamically measured.

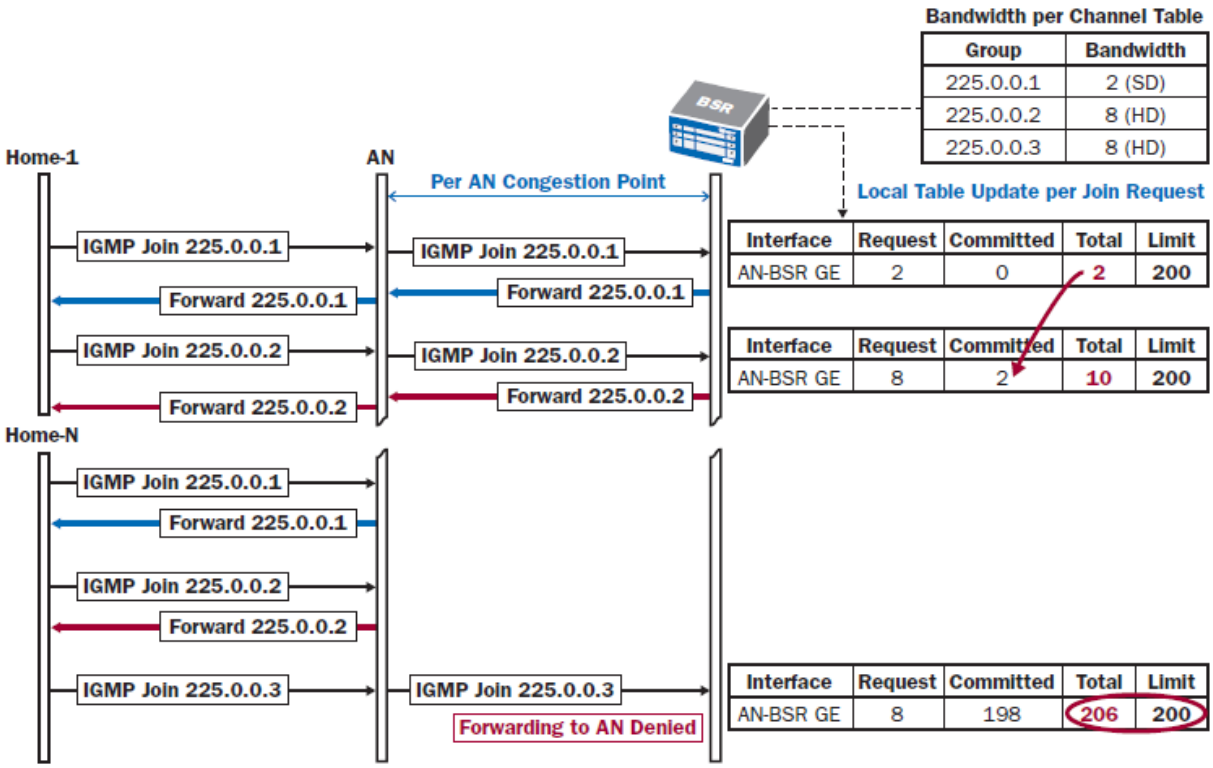


Figure 5: MCAC for Port or M-VLAN Across N Households

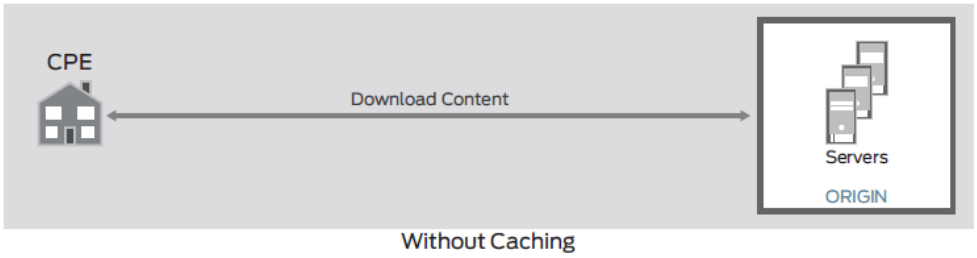
The BSR keeps an admission control resource table per M-VLAN mapping to an AN. In this example each M-VLAN is set with a limit of 200 Mbps of multicast. The M-VLAN limit can be set based on planned traffic engineering values.

As each IGMP join request comes in, the BSR sums the amount of currently committed bandwidth and the request amount. As long as this amount is below the configured limit then the interface is sent a copy of the multicast group. The resource state table is then updated with a new committed rate that includes the new multicast group.

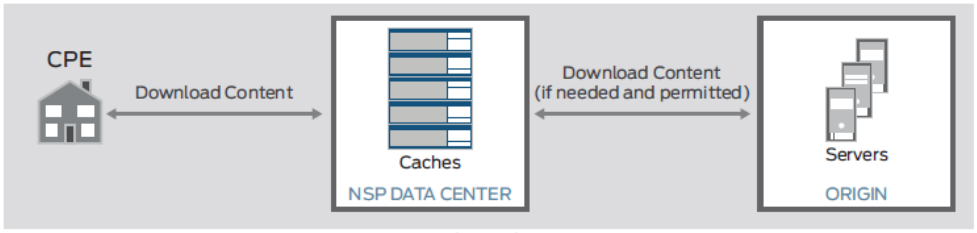
If the limit is exceeded, then the BSR will deny the join request and not send a copy of the multicast out that interface.

Reducing bandwidth requirements: Caching

Caches store content closer to the subscriber. For the subscriber, this reduces the time required to download (or start viewing) the requested content. Caching can also improve audio/video quality by minimizing the chance that packets are dropped or delayed. For the NSP, deploying caches reduces network bandwidth usage by eliminating repetitive downloads for the same content from various clients. This reduces costs by mitigating the growing need for more bandwidth. Overall, caching improves user experience, while reducing costs for the service providers and the content provider.

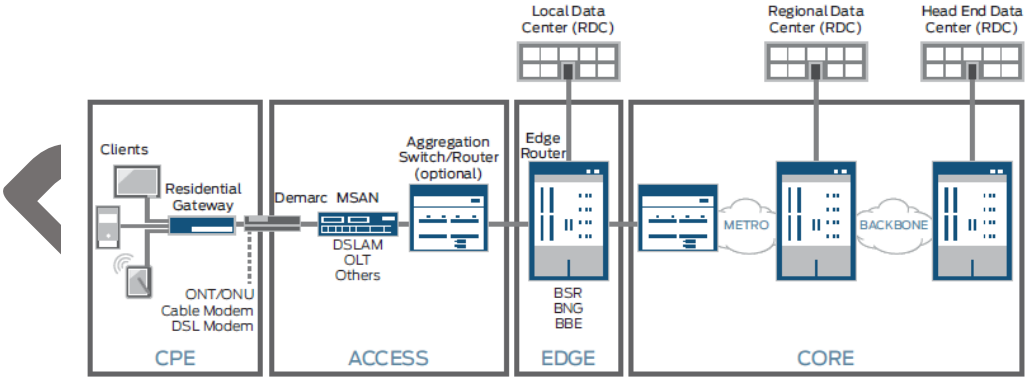


Without Caching



With Caching

The following figure shows us an overview of where the caching process occurs:



In conclusion

As Pacific Internet Solution, our greatest passion and motivation is to maintain a healthy network, with a vision of the future, to take into account every step in which technology at our disposal advances, we know that the challenges are great, we know that subscribers to digital content demand immediate, reliable, safe and easy content.

We firmly believe that this proposal meets all the requirements that the industry thinks of as standard and its implementation will be carried out according to the times and needs that are agreed between all parties.