IETF PIM WG Presentation
Verizon's Worldwide SSM Deployment

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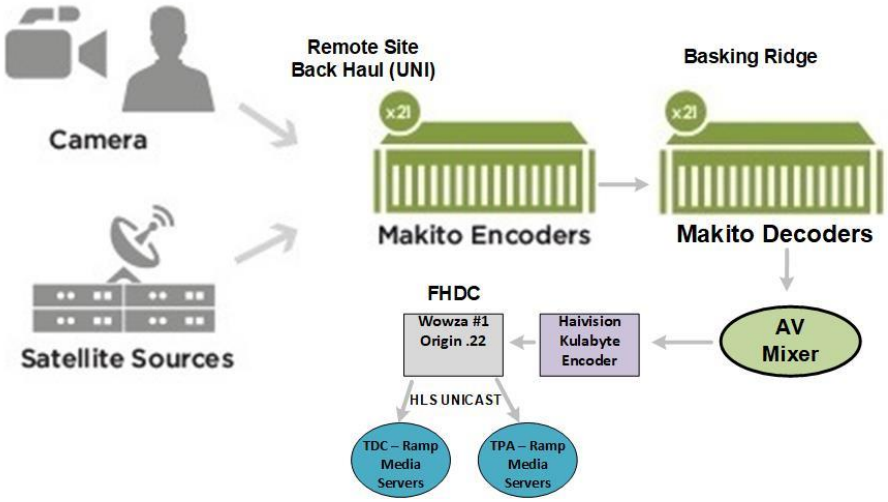
Verizon Enterprise Worldwide Multicast - SSM Multicast Video Delivery – LAN

Source Specific Multicast Architecture (SSM)



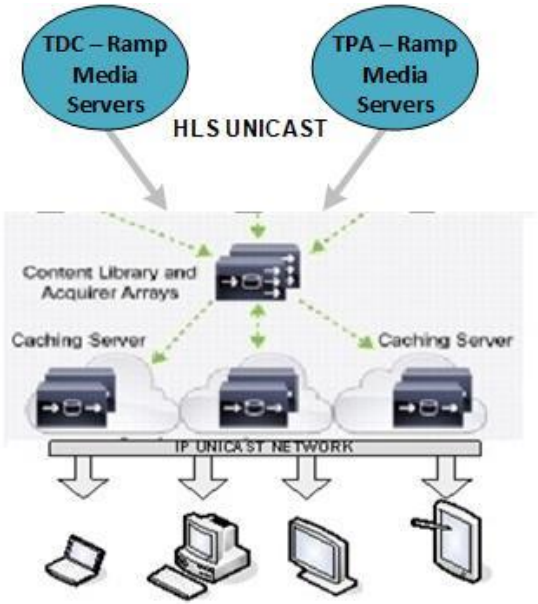
•Streaming pulled by users with the appropriate player information.
•Multicast streams can be monitored for large audience by Ramp Altimeter.
•Multicast has the ability to failover to unicast and utilize the content delivery network in case of network issues.
•Simplified configuration requiring only enabling SSM mode & PIM. Eliminated MSDP & Anycast RP Control plane architecture. **SIMPLE, SIMPLE, SIMPLE**
•Multicast SSM streams can still be monitored for large audience by web applet
•Zero Touch provisioning & 0 MTTR are the many benefits of SSM architecture.

•Encoder /Decoders sit in Verizon Broadcast Centers.

•Using the Verizon worldwide corporate network, the media streams to a sets of media servers across many data centers.

•Data Center "Ramp Senders" multicast sources ingest HLS video from Wowza servers.

•Ramp Senders then source the multicast distribution tree throughout Verizon's worldwide multicast SSM infrastructure that spans the United States, EMEA & APAC for all Verizon employees to view webcasts.



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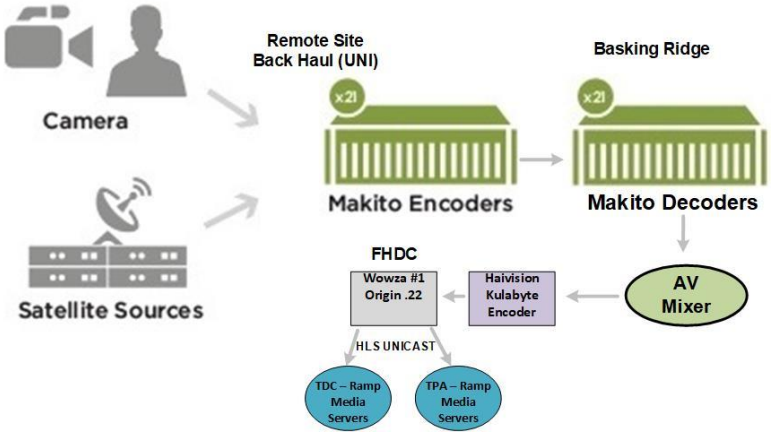
Verizon Enterprise Worldwide Multicast - SSM Multicast Video Delivery – WIFI

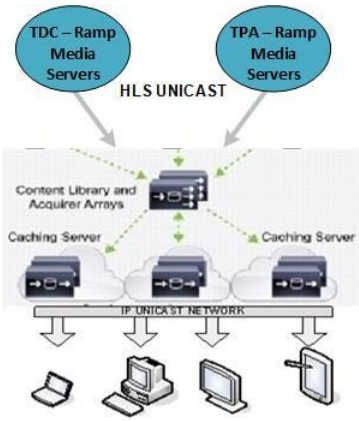
Aruba Controllers – VTEAM - WIFI Tunnel Mode IGMP Snooping enabled



•Aruba controllers with IGMP Snooping enabled supports both ASM & SSM multicast distribution models.

•Using the Verizon corporate worldwide network, the media streams to a set of media servers across many data centers.

•Aruba controllers configured with AP profiles in Tunnel mode with IGMP Snooping enabled now supports “Multicast over WIFI”.
•Multicast over WIFI by default will use the lowest WIFI connection speed to transmit multicast packets for all associated WIFI clients resulting in degraded system performance.
•Aruba Controller – AP’s in bridge mode do not have any optimization capability to improve multicast quality.
•Aruba controllers with AP’s using tunnel mode profile are able to take advantage of video quality improvement with Multicast over Wifi by enabling DMO feature.
•DMO Optimization feature takes the multicast feed incoming to the controller and replicates out unicast feed for each WIFI associated client over the GRE tunnel for Tunnel mode AP’s.
•Cases where Aruba controller is “LOCAL” the DMO unicast replication of the multicast feed out to the tunnel mode AP’s is over the LAN where when the Aruba Controller is in the DC ends up going over the WAN which has to be taken into consideration.



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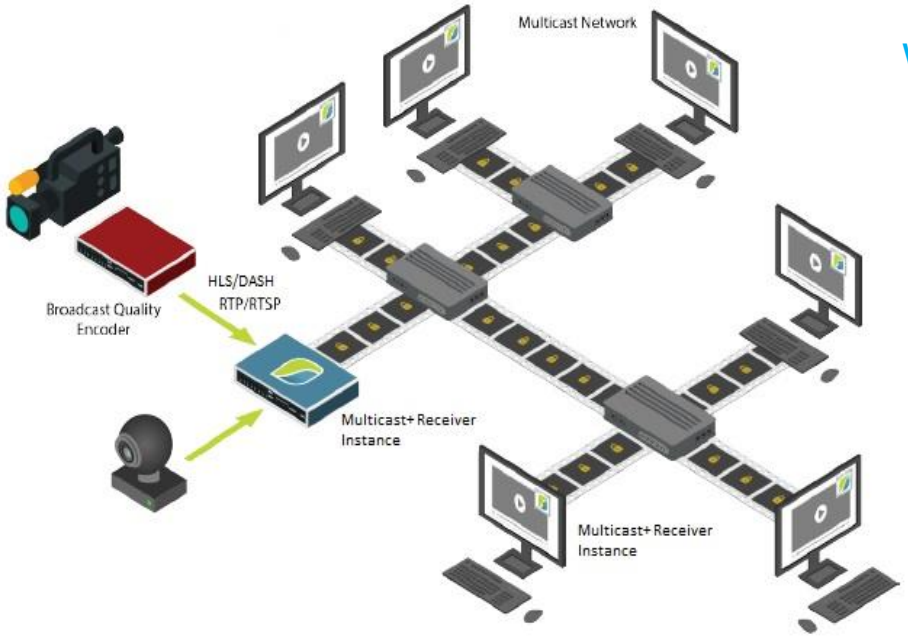
Verizon Worldwide Multicast uses “RAMP” product for SSM Video Delivery

Ramp Multicast Plus Sender (Multicast Source)
Injest HLS stream and encapsulate in UDP wrapper & encrypt payload & RPF forward onto Multicast Distribution Tree



www.ramp.com

SSM Channel –
HA (S,G)
Active/Standby
Or Round Robin
Multiple sources using
Same group

Multicast Plus Receiver:
RampMulticastPlusReceiverService – Agend on endpoint
Ramp Endpoint software removes UDP wrapper and decrypts payload and native HLS (HTTP Live Streaming) in browser’s embedded player using Local Loopback 127.0.0.1.
Note that the Multicast Plus Ramp Receiver interacts with Desktop OS IGMPv2-ASM IGMPv3 SSM and sends the join to the OS which forwards out the NIC so the Multicast distribution tree can be built.

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Verizon SSM Multicat Video Delivery requirements & Challenges with IGMPv3 support for SSM

- **Source OS or appliance used by Verizon that support IGMPV3/MLDv2 for SSM**
  - Windows Server 2008R2 Enterprise for Windows media encoder/decoder
  - Wowza Media Server
  - Haivision HD/SD encoder/decoder Makito & MakitoX
  - Haivision Furnace encoder/decoder
  - Ramp sender source application – www.ramp.com
- **Source OS or appliance used by Verizon that do not support IGMPv3/MLDv2 for SSM**
  - Miscellaneous other source applications
- **Receiver OS or appliance used by Verizon that do support IGMPv3/MLDv2 for SSM**
  - Microsoft Windows 10 & Windows 7
  - Apple Mac
  - Linux flavors
- **Receiver OS or appliance used by Verizon that do support IGMPv3/MLDv2 for SSM**
  - Amino Technologies- Amino STBs for Plasma screen timezone & local content feed
  - Citrix VDI (Virtual Desktop Interface)
  - Chromebooks Android OS
  - Lan School
  - Miscellaneous other receiver applications

- **SSM support source or receiver workaround if IGMPv3 / MLDv2 is not supported by host**
  - IGMPv3 lite / MLDv2 lite host signaling
  - URD host signaling – Special URD TCP intercept URL encoded with S,G channel for subscription formatted so the last hop router can intercept on TCP/465.
  - SSM Map on last hop router => Method utilized by Verizon

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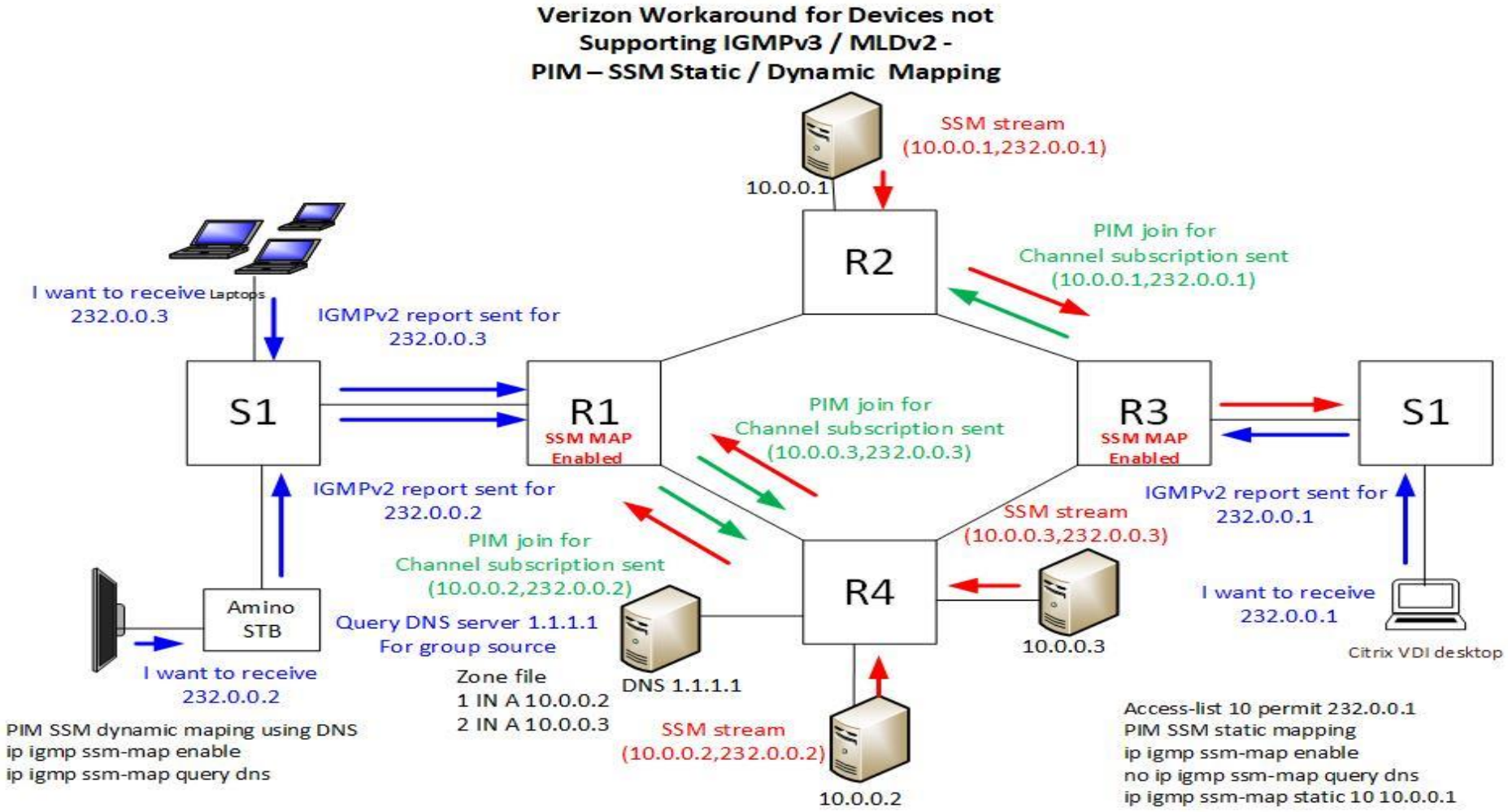
SSM Map workaround for applications not supporting IGMPv3



Debug using static SSM map: IGMP(0): Convert IGMPv2 report (*, 232.0.0.1) to IGMPv3 with 1 source(s) using STATIC

Debug using static SSM map: IGMP(0): Convert IGMPv2 report (*,232.0.0.2) to IGMPv3 with 1 source(s) using DNS

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Verizon use case for ASM versus SSM comparison & Design considerations

ASM (Any Source Multicast)

Pros:

- Original ISM multicast deployment based on RFC 1112 with worldwide adoption
- Network based source discovery using MSDP for inter-domain multicast routing. Receiver can discover sources and join any stream.
- Control mechanisms built into ASM for PIM Anycast RP source register filtering

Cons:

- Complexity with configuration of MSDP mesh and Anycast RP.
- Requires additional control mechanisms complexity on FHR & LHR for sources & receivers.
- Troubleshooting complexity and MTTR(Mean time to recovery) with SPT switchover issues.

SSM (Source Specific Multicast)

Pros:

- Simplified design with control plane PIM & MSDP infrastructure eliminated.
- Addressing flexibility to use 232/8 or other range.
- Receivers & Sources are Source aware with source filtering with channel subscribe & unsubscribe
- Application based source discovery. Control mechanism & security is employed by source server URI landing page as to what GDA's are available to receiver for subscription.
- Source & Receiver source filtering capability for HA GDA using active/standby or round robin SSM channels. SSM subscribe via channel join allows GDA reuse with uniqueness provided by source.

Cons:

- Network based source discovery is not supported. All onus is on application to provide channel subscription details for all available channels. Could be an issue for very large number of sources.
- No administrative scoping for SSM, however can be employed or multicast boundary admin filters.

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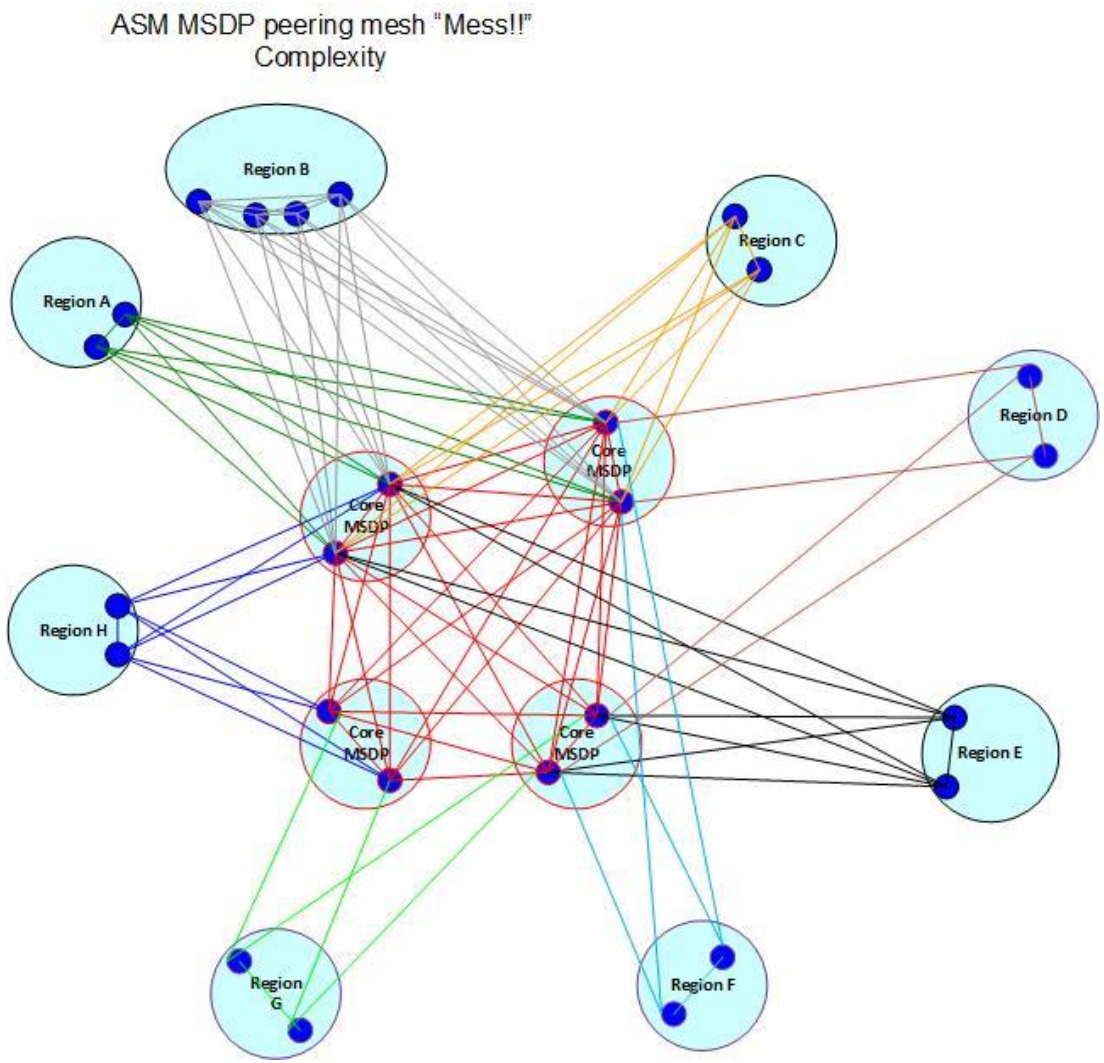
Verizon's ASM MSDP Mesh Complexity – reason to move to a much simpler SSM architecture



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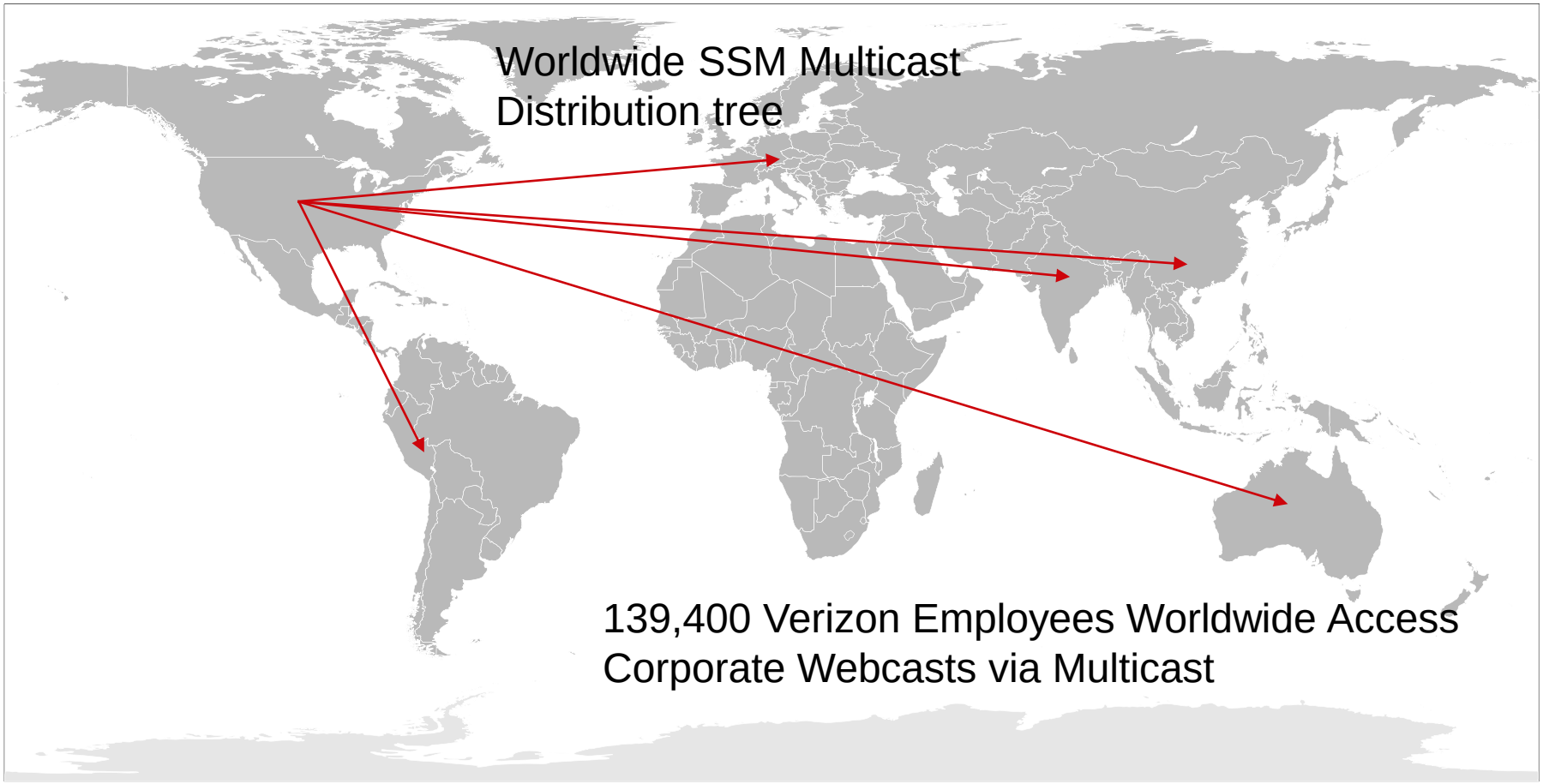
Verizon's Worldwide Multicast infrastructure
SSM (Source Specific Multicast) Distribution tree



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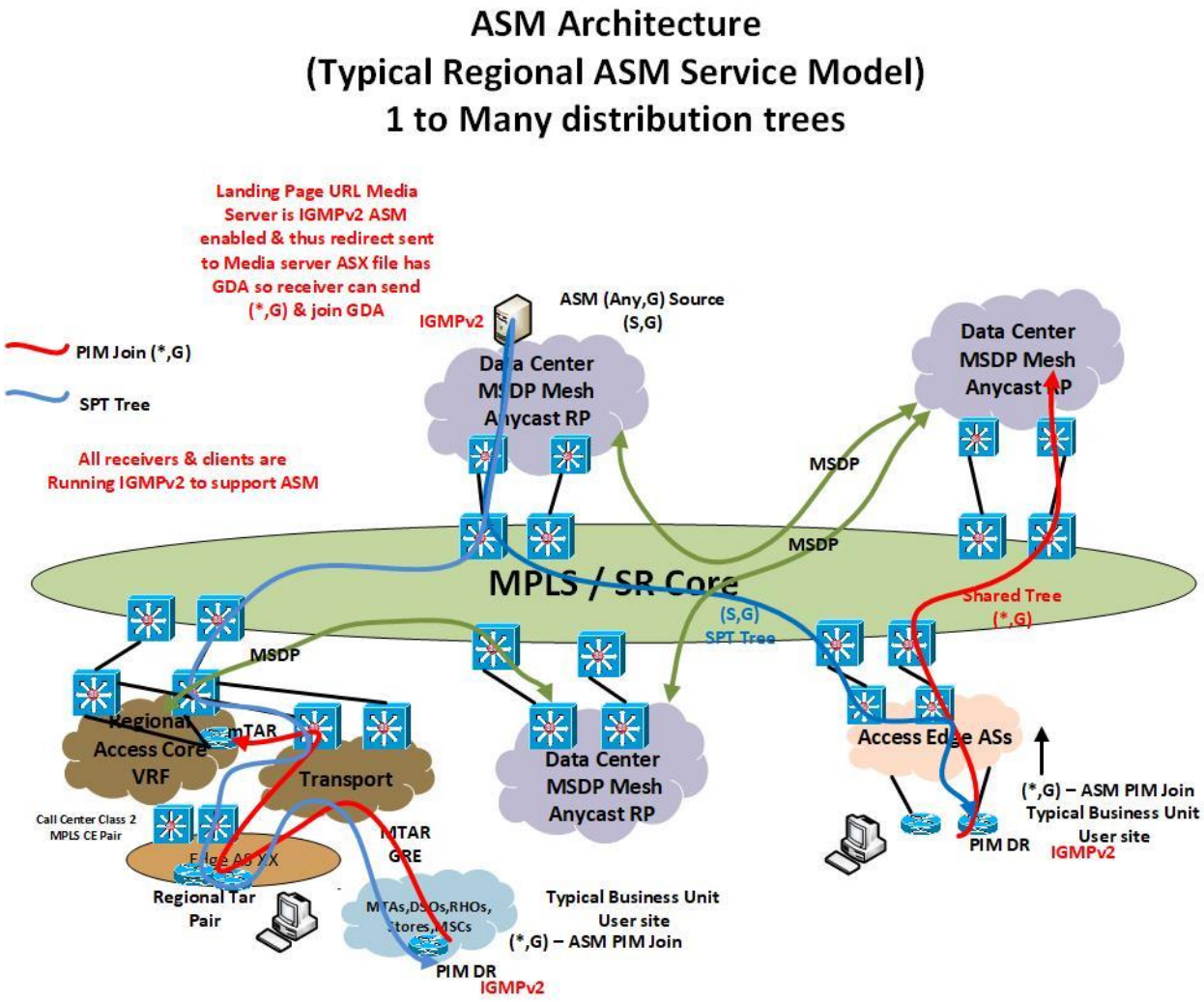
Verizon Worldwide Multicast infrastructure ASM(Any Source Multicast) Service Model



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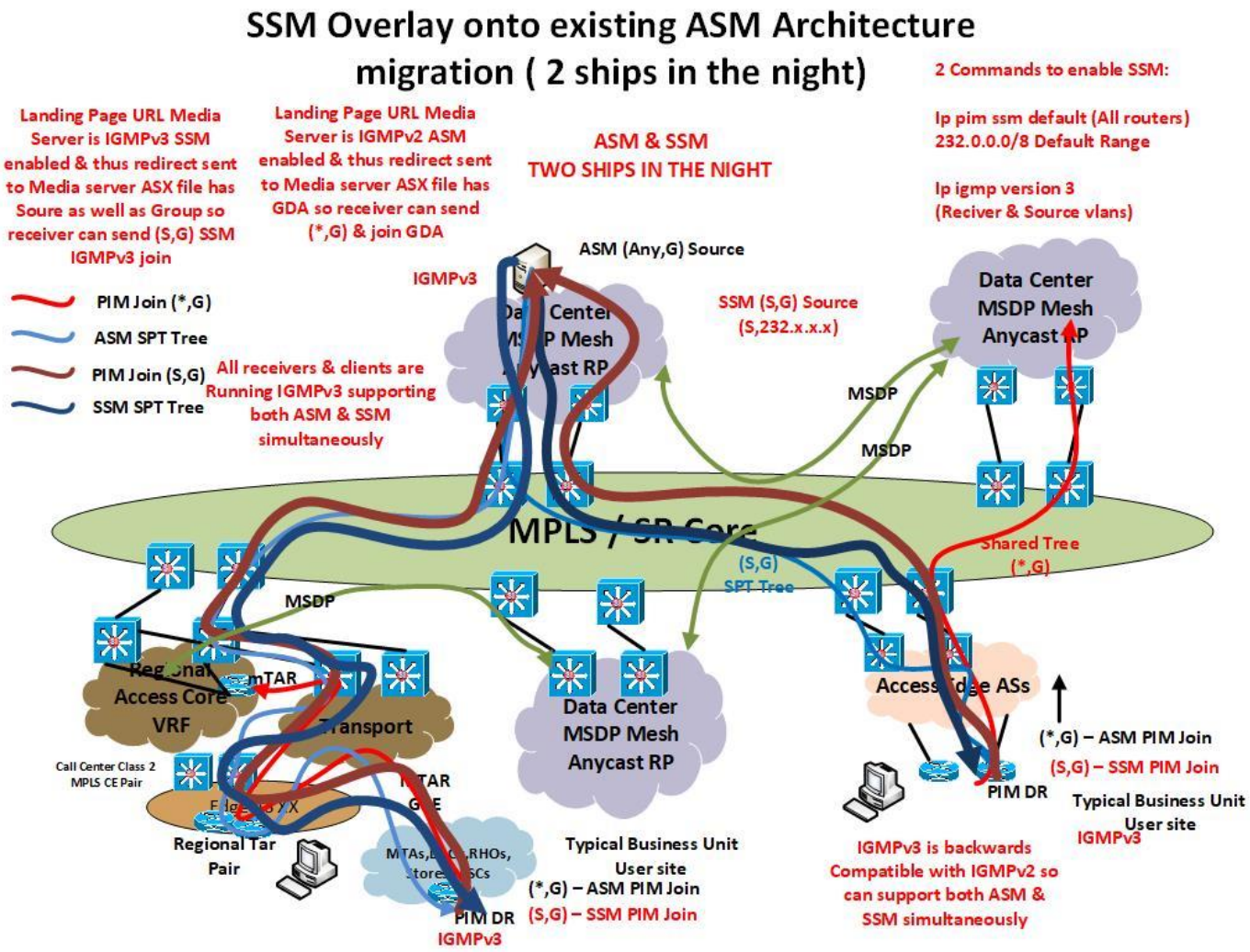
Verizon Worldwide Multicast infrastructure
ASM & SSM Overlay Service Model



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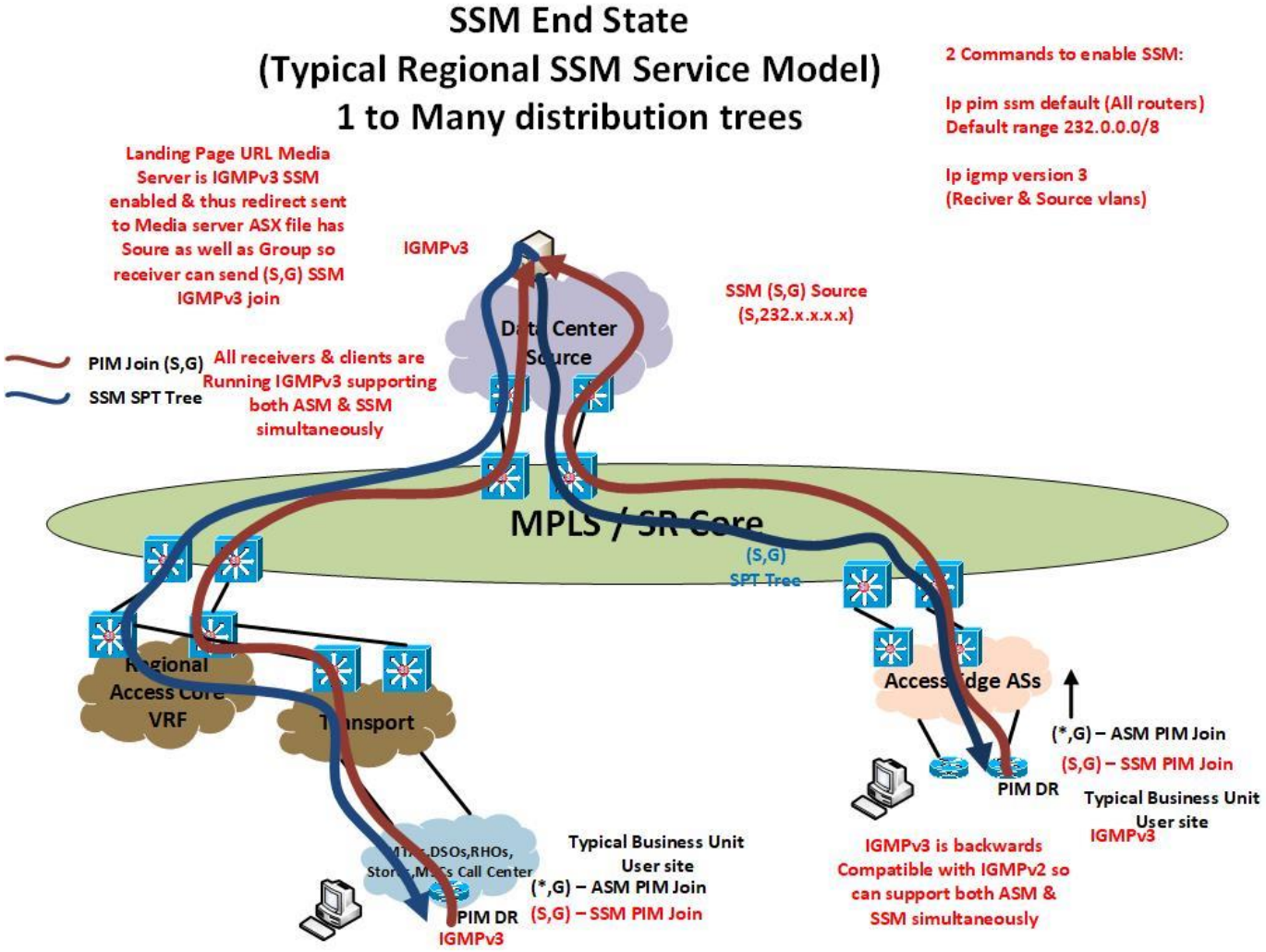
Verizon Worldwide Multicast infrastructure ASM(Any Source Multicast) Service Model



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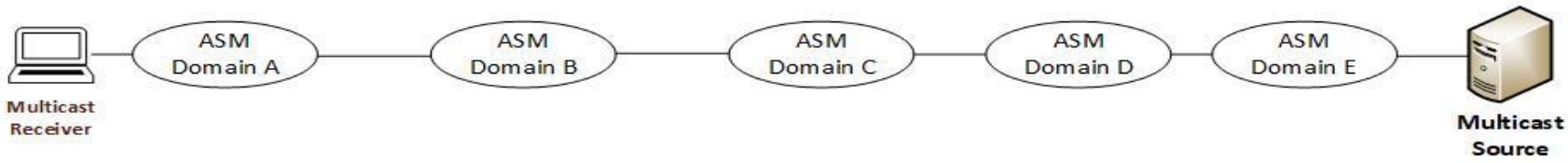
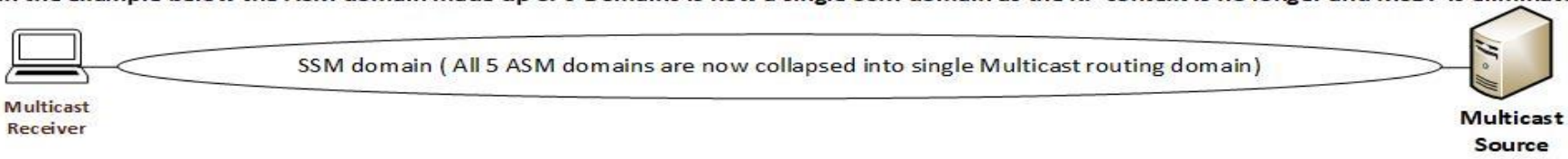
Multicast Inter Domain routing Domain concept comparison between ASM & SSM

If segmentation were desired with SSM similar to an ASM domain how would we accomplish – IETF ??

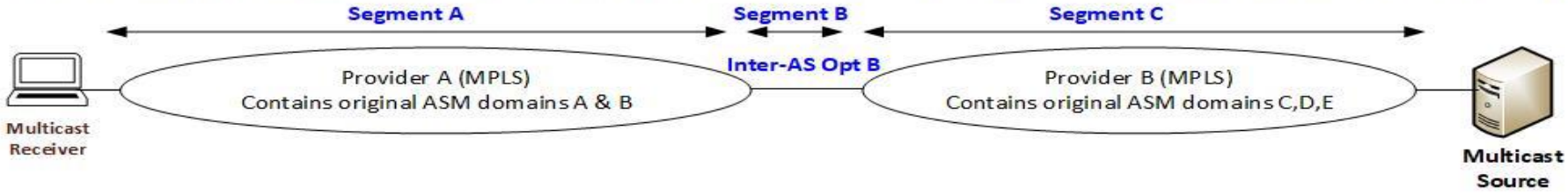
Typical ASM domain with – multiple RP context specific domains inter linked together with MSDP for multicast inter domain routing



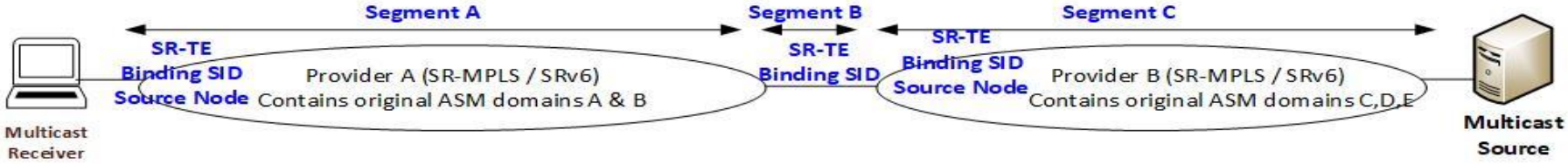
With ASM to SSM conversion the "Domain" concept goes away in the context of an RP – However their maybe cases where inter-domain Context maybe desirable for the multicast distribution trees with SSM.
In the example below the ASM domain made up of 5 Domains is now a single SSM domain as the RP context is no longer and MSDP is eliminated.



One idea of how to create segmentation of the MDT would be from an inter-as (inter domain) perspective would be with MPLS Inter-AS option B if desired



With SR we can accomplish segmentation of the MDT would be from an inter-as (inter domain) perspective with SR-MPLS or SRv6 SR-TE Binding SID



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Use of MP Reach capability SAFI 2 Multicast NLRI for source discovery with SSM

SSM does not support Network based source discovery

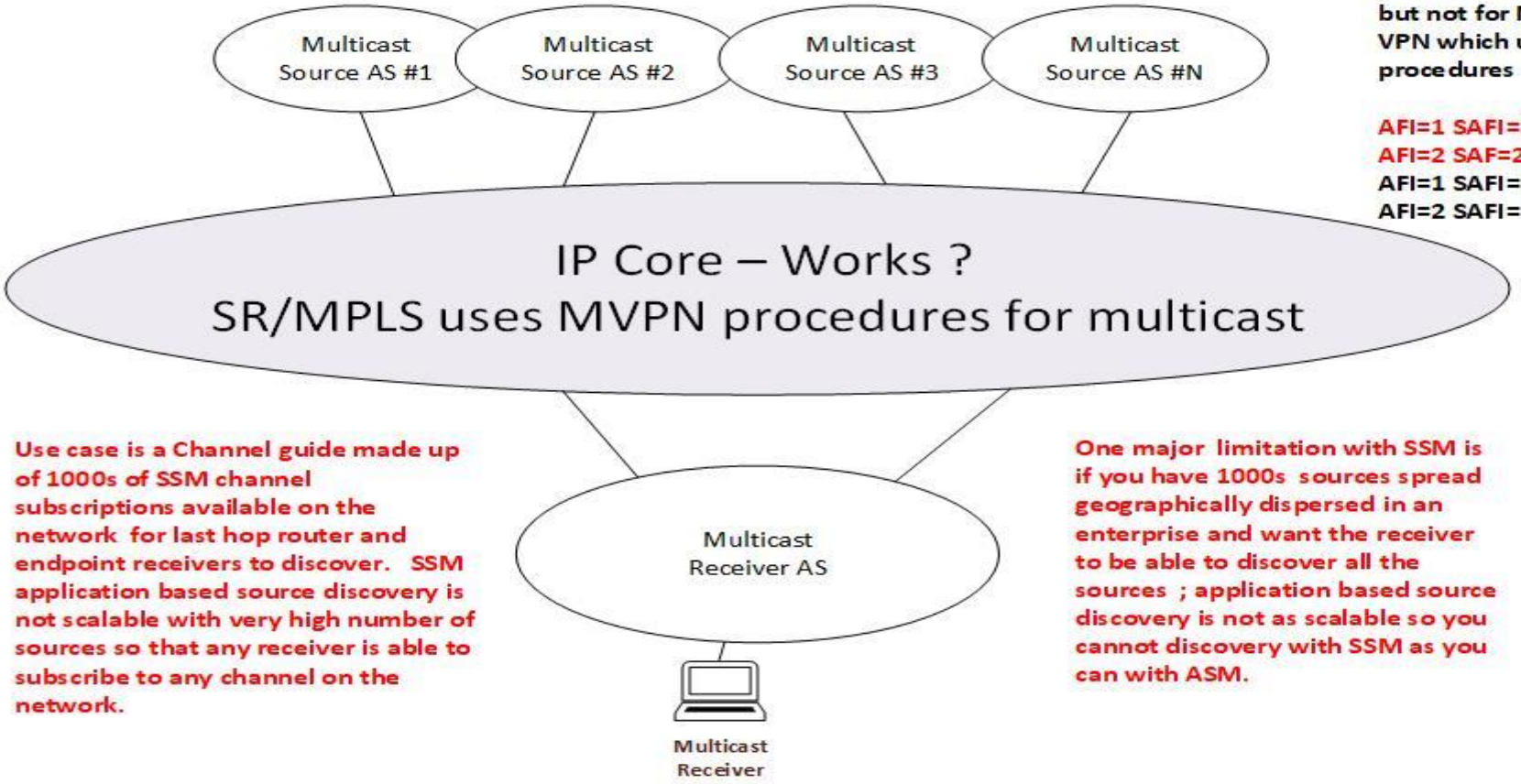
How can we make "network based source discovery" work with SSM??

SAFI 2 Multicast NLRI is generally used for incongruent unicast & multicast topologies with ASM to resolve MSDP peer RPF check failures.

One idea is to enable SAFI 2 on all peers from all source & receiver edges to core to propagate all sources to all receivers.

That could works for IP core but not for MPLS / SR L3 VPN which uses MVPN procedures

AFI=1 SAFI=2 (IPv4)
AFI=2 SAF=2 (IPv6)
AFI=1 SAFI=128 (VPNV4)
AFI=2 SAFI=128 (VPNV6)



Use case is a Channel guide made up of 1000s of SSM channel subscriptions available on the network for last hop router and endpoint receivers to discover. SSM application based source discovery is not scalable with very high number of sources so that any receiver is able to subscribe to any channel on the network.

One major limitation with SSM is if you have 1000s sources spread geographically dispersed in an enterprise and want the receiver to be able to discover all the sources ; application based source discovery is not as scalable so you cannot discovery with SSM as you can with ASM.

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IETF PIM WG RFC's related to Verizon ASM to SSM Migration

RFC 1112 – Host Extensions for IP Multicasting
https://tools.ietf.org/html/rfc1112
RFC 2236 IGMPV2
https://tools.ietf.org/html/rfc2236
IGMPv3 RFC 3376
https://tools.ietf.org/html/rfc3376
IGMPv3 / MLDv2
https://tools.ietf.org/html/rfc4604
RFC 5790 – LW-IGMPv3 / LW-MLDv2
https://tools.ietf.org/html/rfc5790
RFC 4607 SSM – Source Specific Multicast
https://tools.ietf.org/html/rfc4607
RFC 7761 PIM Sparse Mode
https://tools.ietf.org/html/rfc7761
RFC 5110 IP Multicast challenges
https://tools.ietf.org/html/rfc5110
RFC 3618 MSDP
https://tools.ietf.org/html/rfc3618
RFC 4610 Anycast RP using PIM
https://www.rfc-editor.org/rfc/rfc4610.html
RFC 4541 Considerations for IGPv3 & MLDv2
https://tools.ietf.org/html/rfc4541
RFC 6559 Reliable Transport Mechanism for PIM
https://www.rfc-editor.org/rfc/rfc6559.html

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THANK YOU

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