MSR6 TE Requirements
USA Operators
Domestic Use Cases

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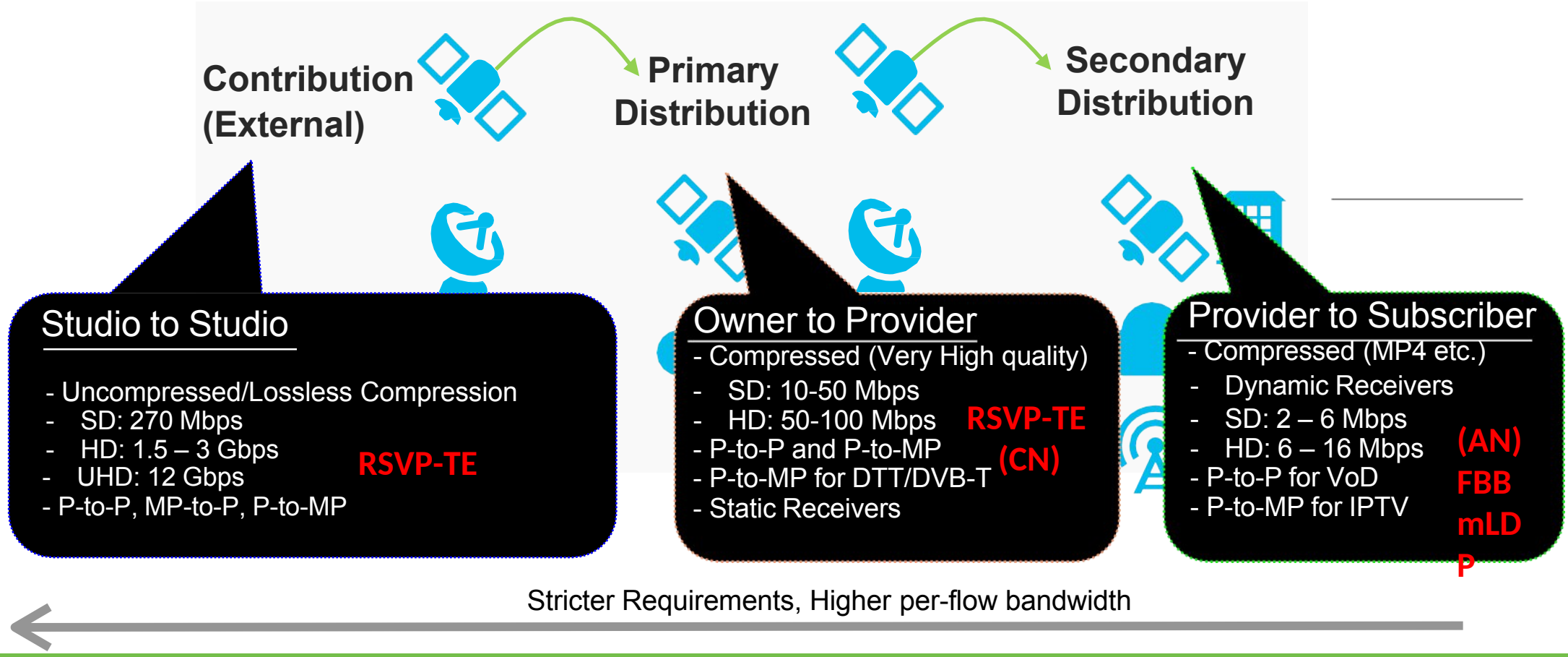
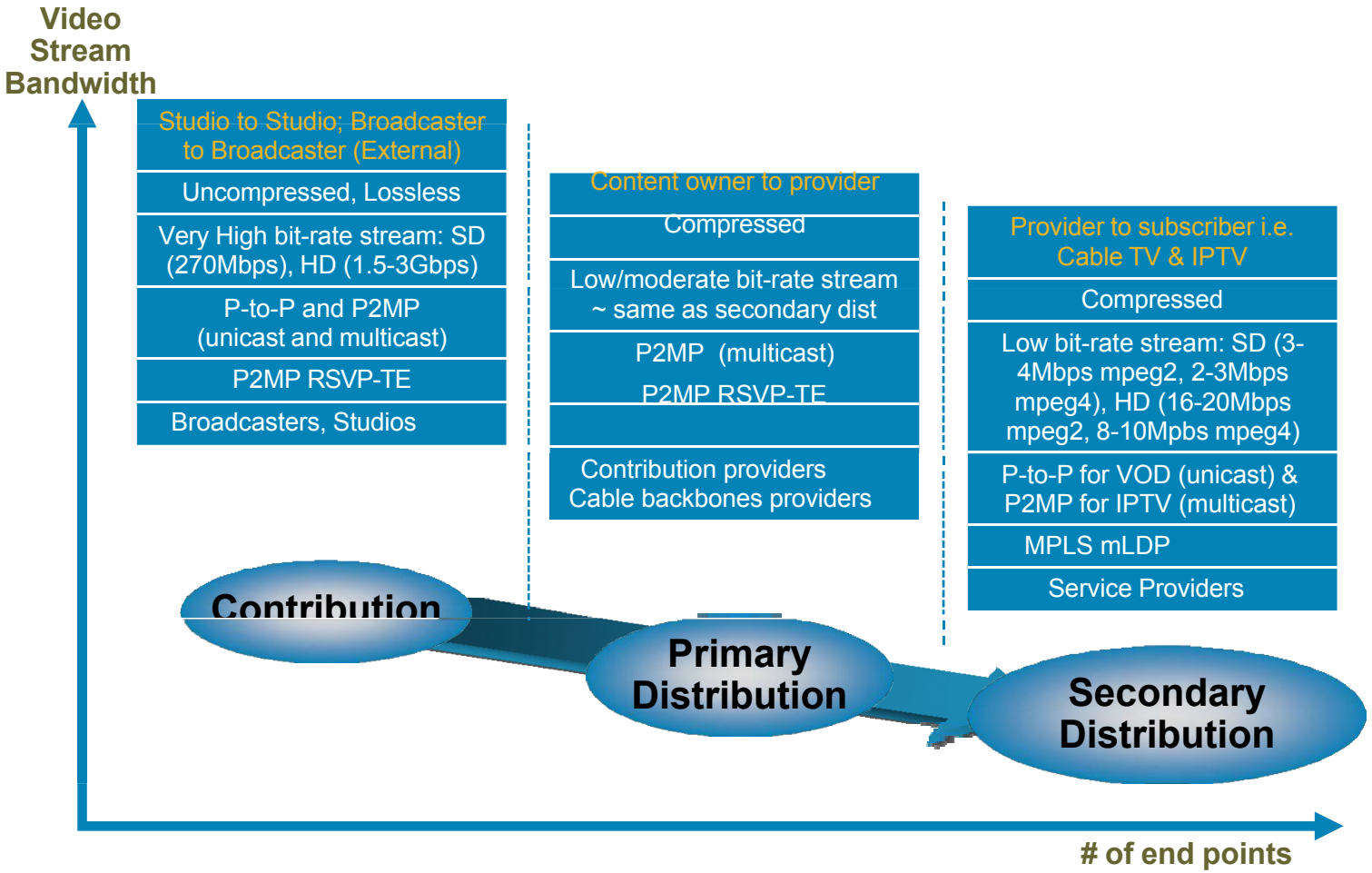
Video Transport Use Cases – Bandwidth/Format

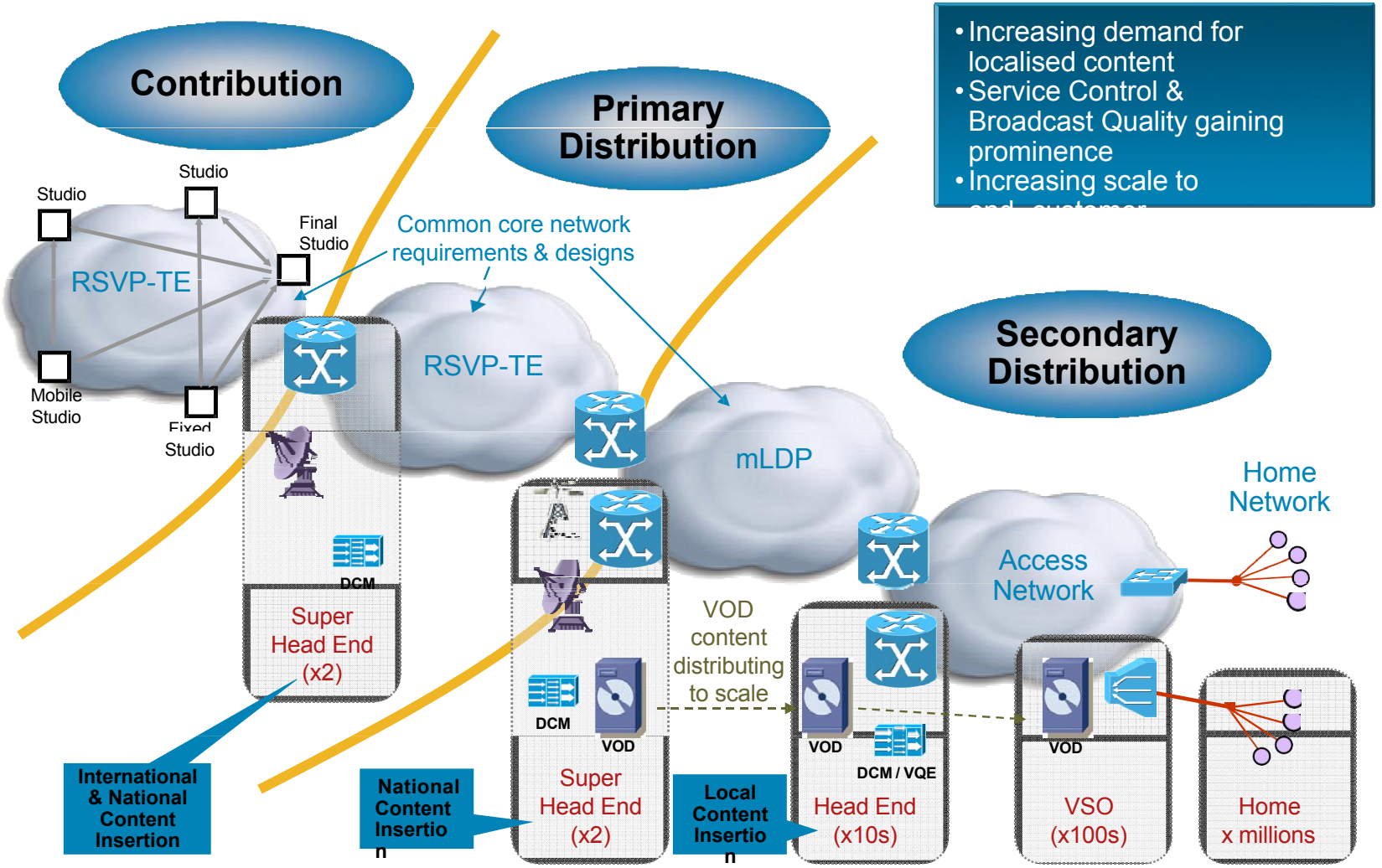


In all cases, point-to-point + multipoint services over Network Transport are required

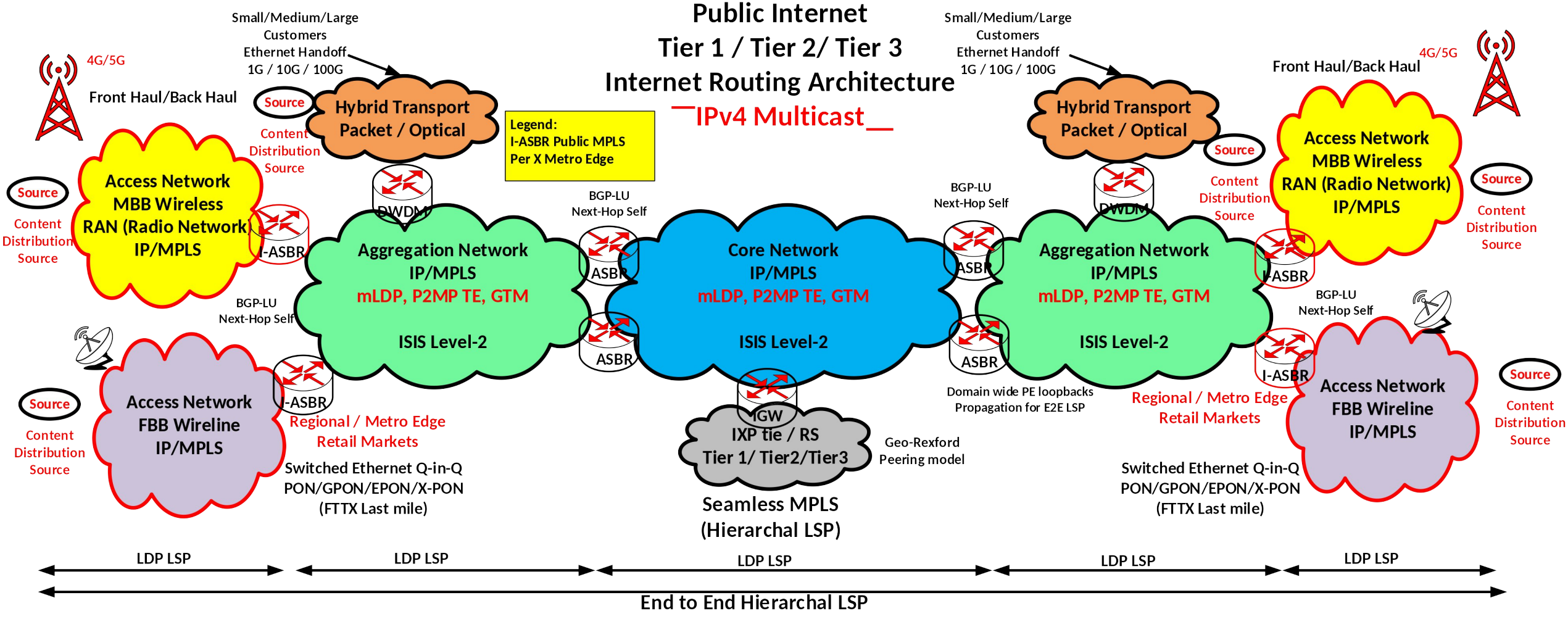
Video Content Delivery Service Providers



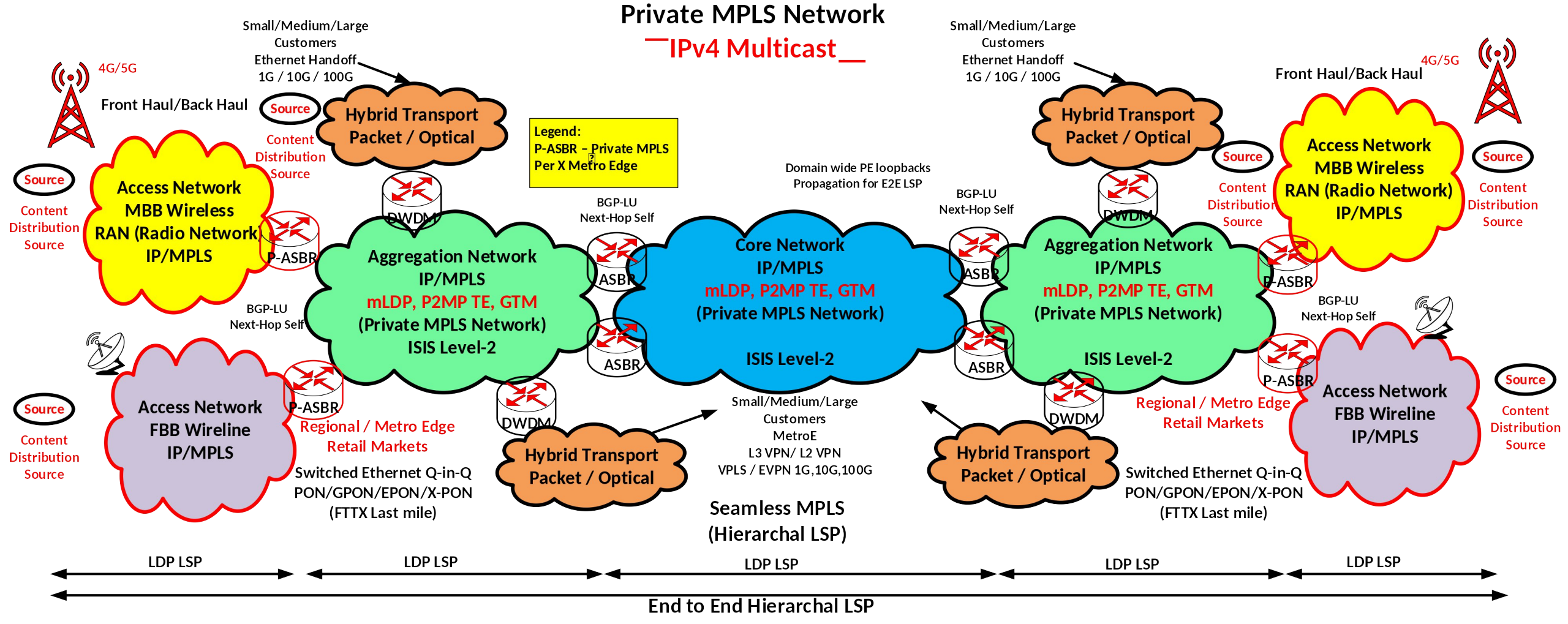
Video Service Providers
Mapping to Broadcast Industry



Public Internet MPLS Network Routing Architecture - USA Domestic Operators - IPv4 Multicast



Private MPLS Network Routing Architecture – USA Domestic Operators - IPv4 Multicast



MSR6 Requirements for IPTV Video Delivery transports

Model	QoE	BW Usage per stream (Y) Where X = MPEG stream bw, Z = FEC o/h, and W = FEC + TR overhead, (W < Z)	Network Complexity	Video End System Complexity	Delay impact
Fast Convergence	Lossy; target < 1 GOP	Working case: Y = X Failure case: Y = X	Low	Low	Zero
MPLS TE FRR	Lossy; < 1 GOP	Working case: Y = X Failure case: Y =>2X	Medium	Low	Zero
MoFRR	Lossy; < 1 GOP	Working case: Y = X Failure case: Y = X	Low	Low	Zero
FC + FEC or MPLS TE FRR + FEC	Lossless	Working case: Y = X * Z Failure case: Fast convergence: Y = X * Z FRR: Y =>2X * Z	Fast convergence: Low Fast reroute: Medium	Medium	High
FC + TR or MPLS TE FRR + TR	Lossless	Working case: Y =2X Failure case: Fast convergence: Y = X FRR: Y =>2X	Fast convergence: Low Fast reroute: Medium	Medium	High
MoFRR + SR	Lossless	Working case: Y = X Failure case: Y = X	Low	Medium	Low
MPLS TE + SR	Lossless	Working case: Y = X Failure case: Y = X	High	Medium	Low
MTR + SR MTR⇔ISIS MT	Lossless	Working case: Y = X Failure case: Y = X	High	Medium	Low

MSR6 Requirements & legacy technologies characteristics to meet?

Characteristic	IP Multicast	MPLS Multicast: RSVP TE	MPLS Multicast: mLDP
Convergence	< ~500ms (< 50ms with MoFRR path separation)	~50ms (FRR)	< ~500ms (~50ms with p2p MPLS LP)
Offload routing	✓ (IGP metric based traffic engineering)	✓	✓ (IGP metric based traffic engineering)
Path separation	✓ (MoFRR)	✓	✓ (MoFRR)
Admission control and bw reservation	✓ (RSVP)	✓	✗
Scalable mp2mp	✓	✗	✓
Initiator	Receiver	Source	Receiver
Application	Ideal for single-source multicasts with many leafs	Ideal for single-source multicasts with few leafs	Ideal for dynamic, receiver-driven multicasts with many leafs
Insertion	Secondary Distribution	Contribution	Enterprise VPN

MSR6 Requirements for Network infrastructure Protection & Resiliency

- **Preferred choice of transport:**

  IP (native multicast/PIM) or MPLS (mLDP and RSVP-TE P2MP)

- **Path selection**

  (dual path) – MoFRR or exposed to

  service Tree cost optimization

  Load-splitting:

  ECMP: PIM and mLDP

  Arbitrary: RSVP-TE (CSPF) ⇔ Required for Triple Play Services

- **Preferred choice of virtualization**

  L2VPN, L3VPN context – or why not…

- …not complete list

MSR6 requirements compare to PIM/mLDP benefits over RSVP-TE P2MP

- Cost of trees (in node/network)

  N = # tailend LSR (#PE)

  PIM/mLDP P2MP: ~1, RSVP-TE P2MP: ~N

  Full mesh of RSVP-TE P2MP LSP: ~(N *

  N) Bidir-PIM/mLDP MP2MP: ~1

  Summary: No scaling impact of N for PIM/mLDP

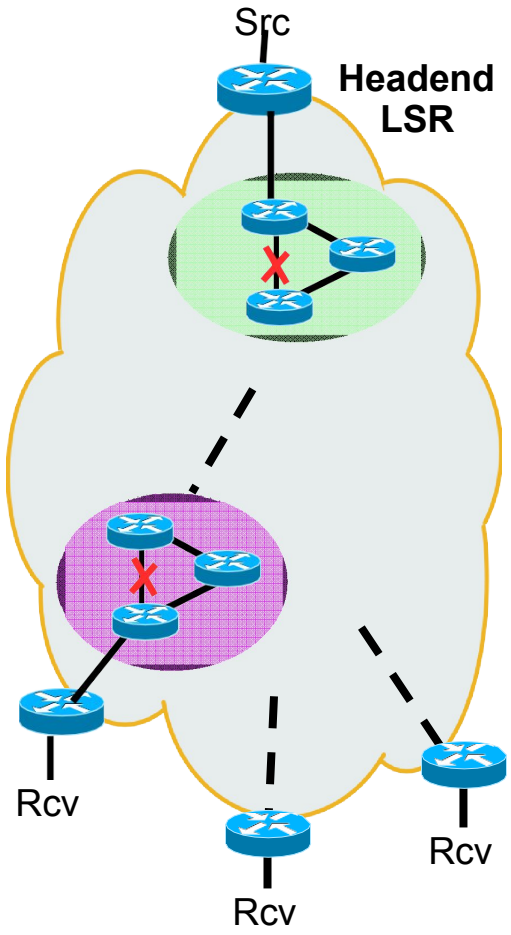
- Locality:

  Affects convergence/reoptimization speed:

  PIM/mLDP: Failure in network affects only router in region (eg: in pink region).

  RSVP: impact headend and all affected midpoint and tailends for RSVP-TE reoptimization.

  Join/leave of members affect only routers up to first router on the tree in mLDP/PIM. Will affect headend and all midpoints in RSVP-TE P2MP.



MSR6 Requirements compare to RSVP-TE P2MP benefits over PIM/mLDP

- Sub 50 msec protection
- Load-split traffic across alternative paths (ECMP or not)

  PIM/mLDP tree follows shortest path, “dense” receiver population == dense use of links

  RSVP-TE P2MP ERO trees (**RED**/PINK) under control of headend LSR.

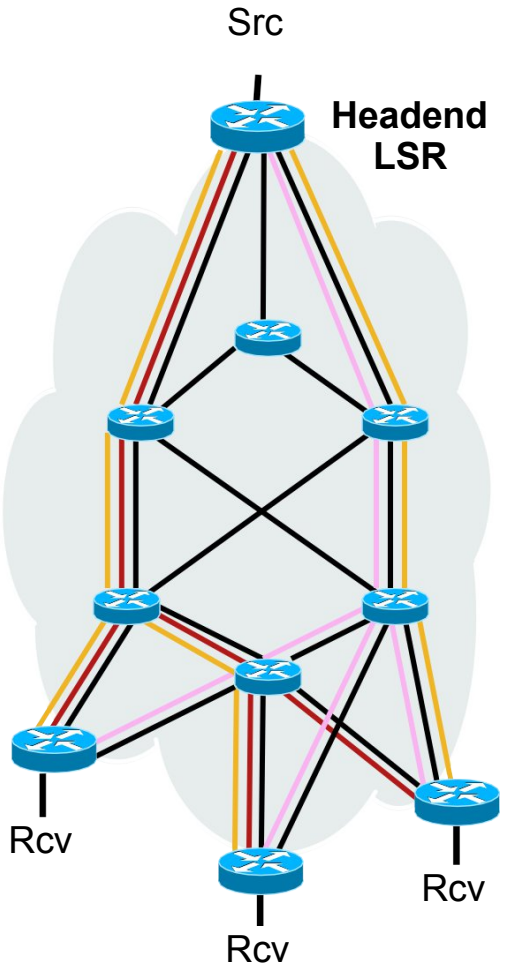
  CSPF load split based on available bandwidth.

  “Steiner tree” CSPF modifications possible
- Block (stop) trees on redundancy loss

  Assume high-prio and low-prio trees.

  With full redundancy, enough bandwidth to carry all trees (with load-splitting)

  On link-loss, reconverge high-prio, block low-prio



MSR6 Requirements for Live-Live Protection

- Live-Live—Spatial Separation

  Two separate paths through network; can engineer manually (or with RSVP-TE P2MP)

  Use of two topologies (MTR)- 2 ISIS MT ??

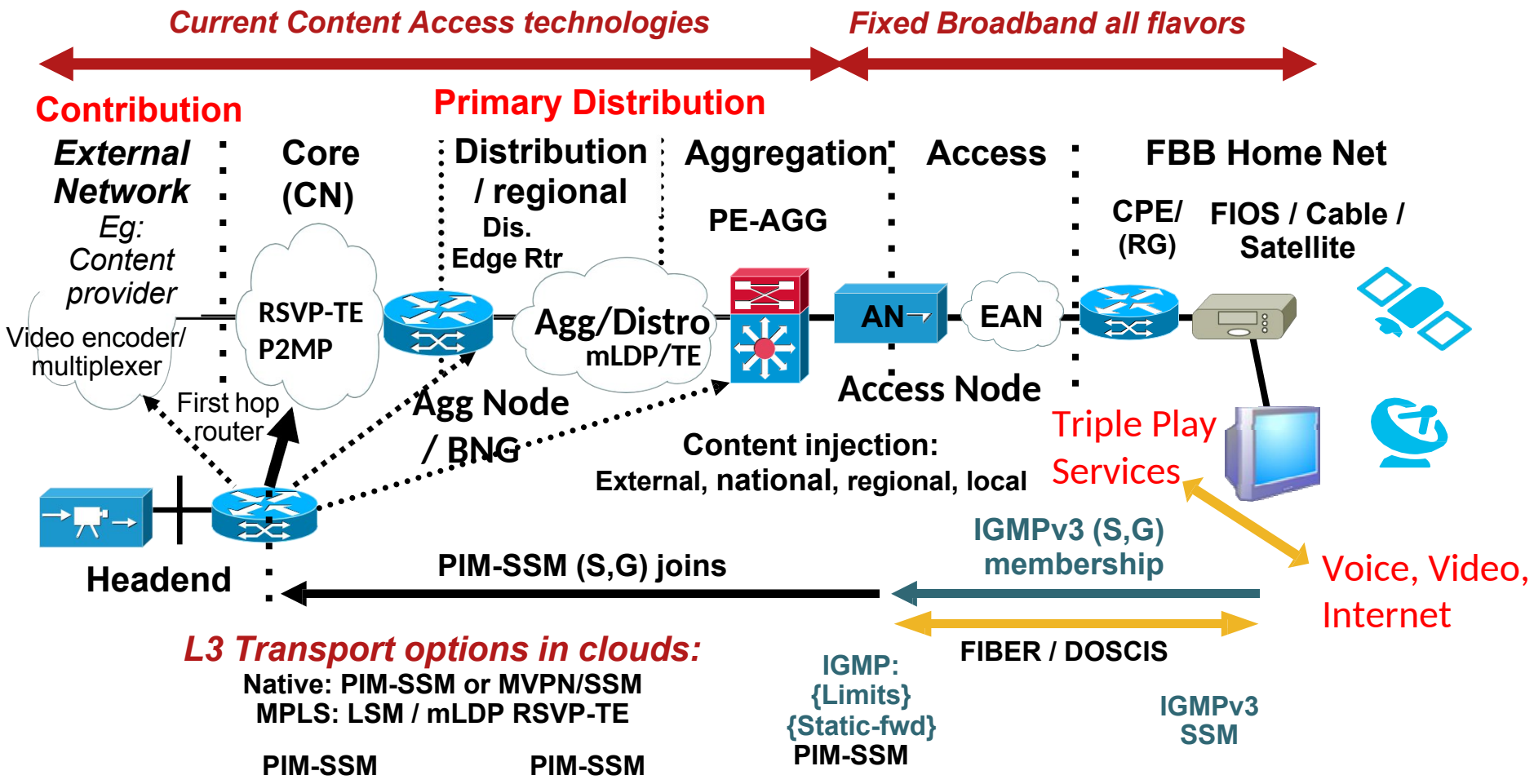
  “Naturally” diverse/split networks work well (SP cores, likely access networks too), especially with ECMP

  Target to provide “zero loss” by merging copies based on sequence number → Similar to DETNET Concept

- Live-Live—Temporal Separation

  In application device—delay one copy—need to know maximum network outage

Legacy Infrastructure Content Delivery End-to-end protocol view



MSR6 Requirements Summary

- Fast Reroute (FRR) Protection ~50ms.
- Engineer separate diverse protected paths
- Scalability of multicast distribution trees
- Live-Live Protection = Lossless, Zero Delay
- Triple Play services

USA Domestic Operators & SRv6 deployment

- Operators understand the benefits of Segment Routing over IPv6 data plane (SRv6), however thus far the deployments have been limited.

Major benefits of SRv6 over SR-MPLS and reasons why USA operators are planning for SRv6 deployments in the future.

- Native SRv6 steering capabilities with SRv6 SRH.
- IPv6 flow label support RFC 6437 for native ECMP load balancing.
- Data Center underlays for NVO overlay is typically “Non MPLS” and most Data Centers are moving quickly towards SRv6 underlay for steering to fabric attached host endpoints for NFV and SFC service chaining.
- IPv6 data plane opens up QOS to use DSCP over MPLS EXP classes.
- MPLS elimination allows for ubiquitous use cases for SRv6.

SRv6 Solutions for Multicast

- There is no exact solution for Multicast for Segment Routing SRv6
- Depending on the requirements, we can choose the best fit from the following options:

1. Deploy traditional Multicast Solutions
   - PIM
   - mLDP
   - RSVP-TE
   - Ingress Replication (IR)
2. TreeSID – a controller based solution – uses Replication SID
3. BGP Multicast & BGP Multicast Controller
3. Bit Index Explicit replication (BIER)
4. MSR6 (New)