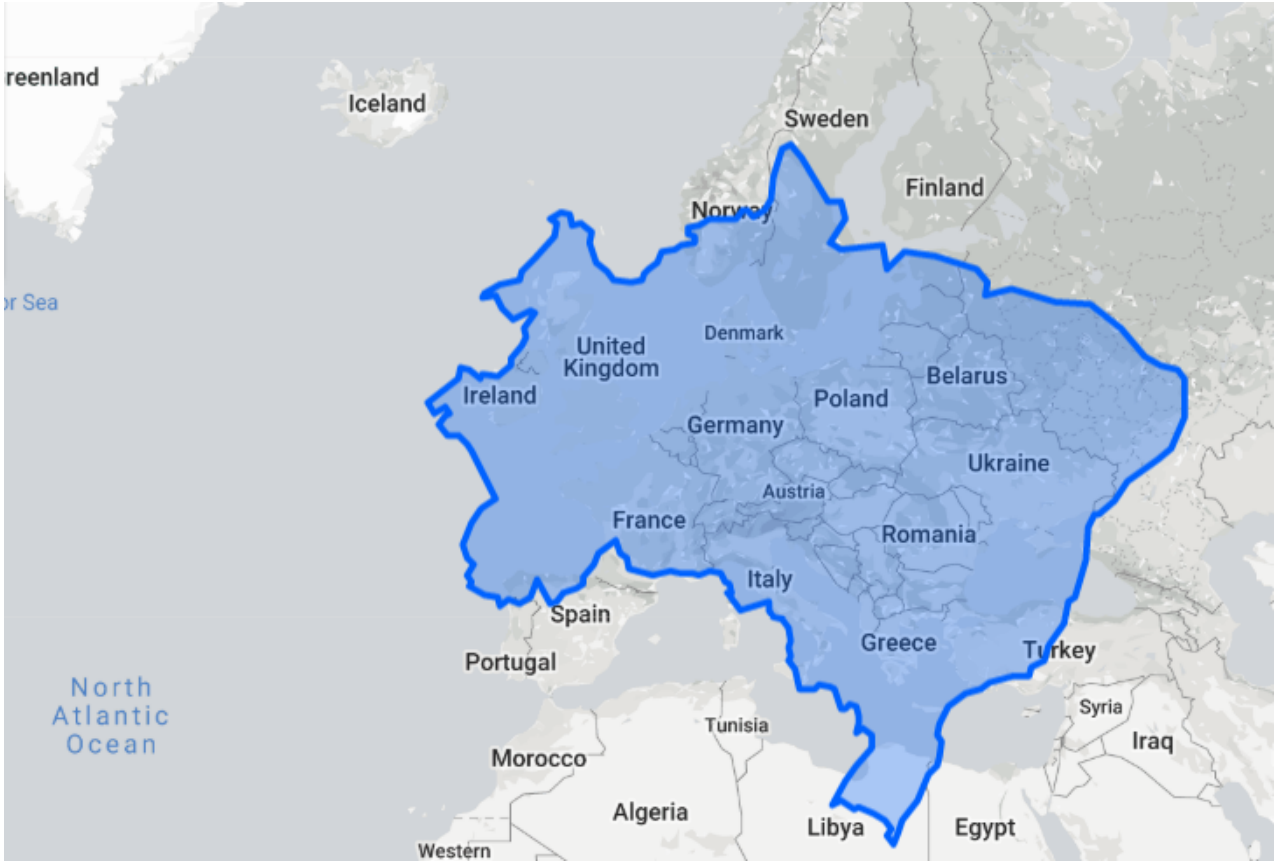
VxLAN in a Regional Service Provider environment

Rajesh Dhople
Sr Director, Product Management
Extreme Networks

Regional Service Provider coverage comparison



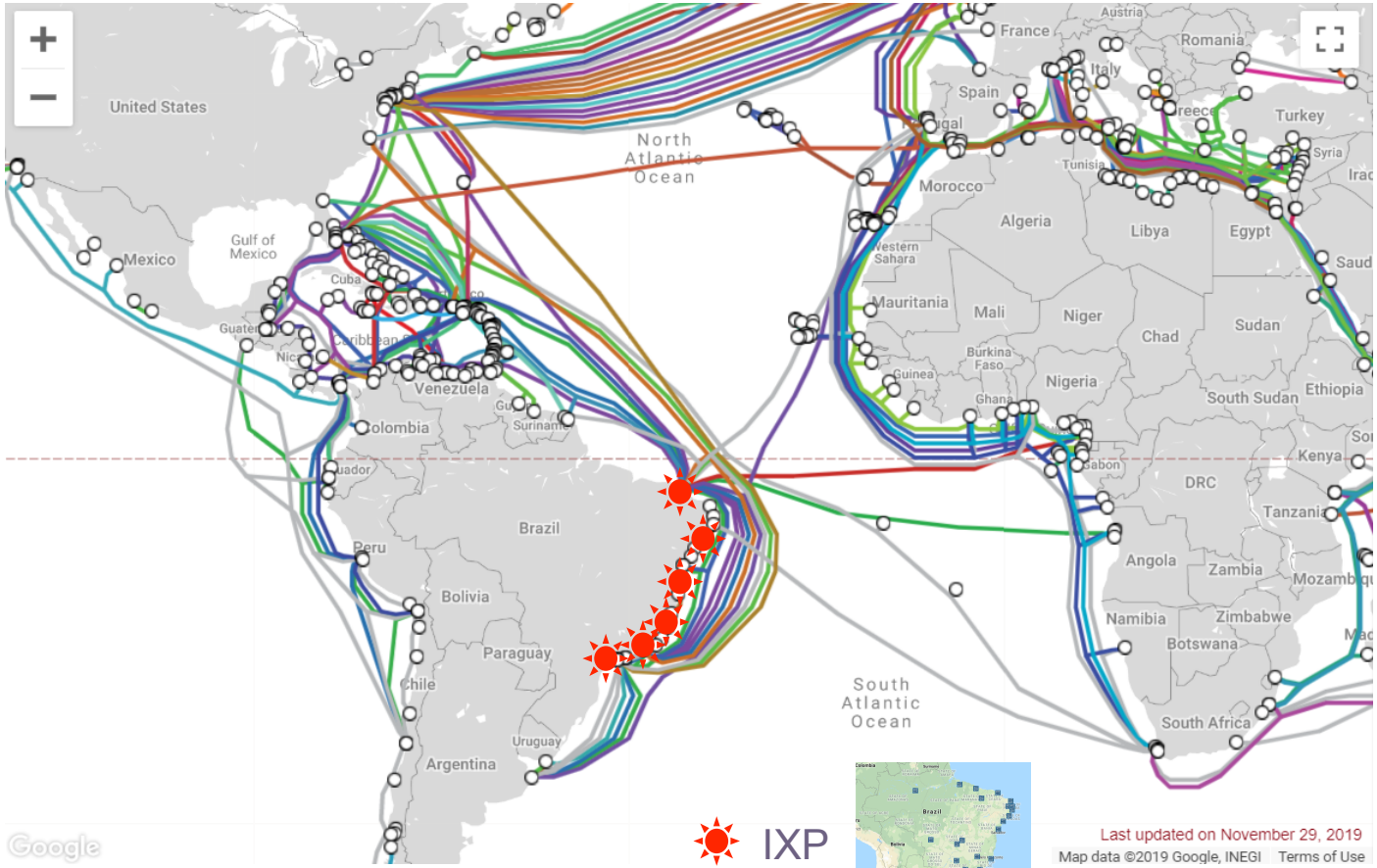
London to Moscow

Stockholm to Athens

Its BIG!

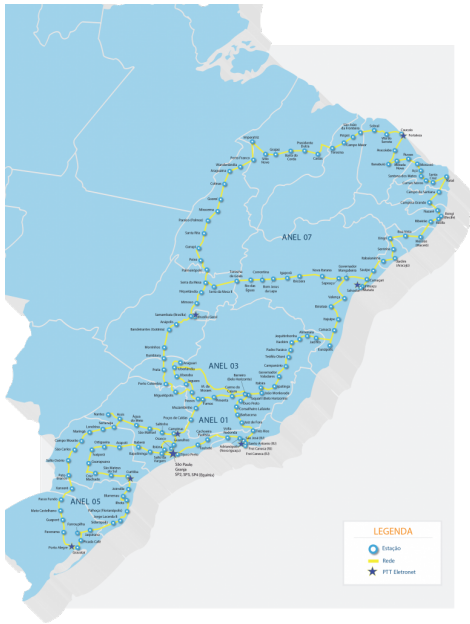
https://thetruesize.com/

Provider networks in Brazil

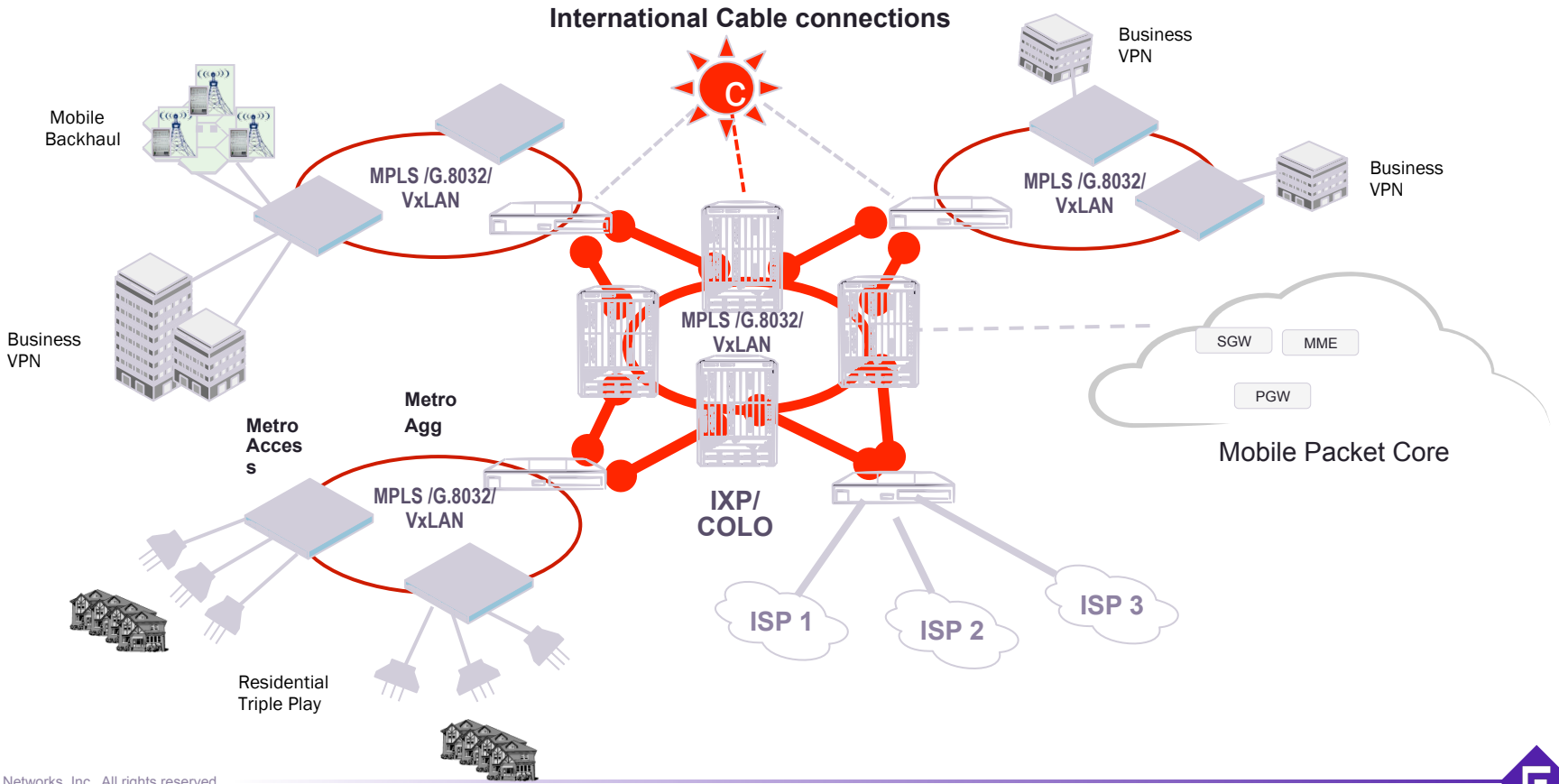


IXP

Regional SP



Connecting IXP/Colo to ISP, Metro, Residential and Mobile



RSP Services

Regional Service Providers (RSP)

Residential Triple Play

Mobile Backhaul

Enterprise Services

RSP

- Primarily Carrier Ethernet services providers
- ISP
- Metro Aggregators

Customers

- Tier 2/3 SPs
- State Networks
- Power Co-ops
- RENs
- Local governments

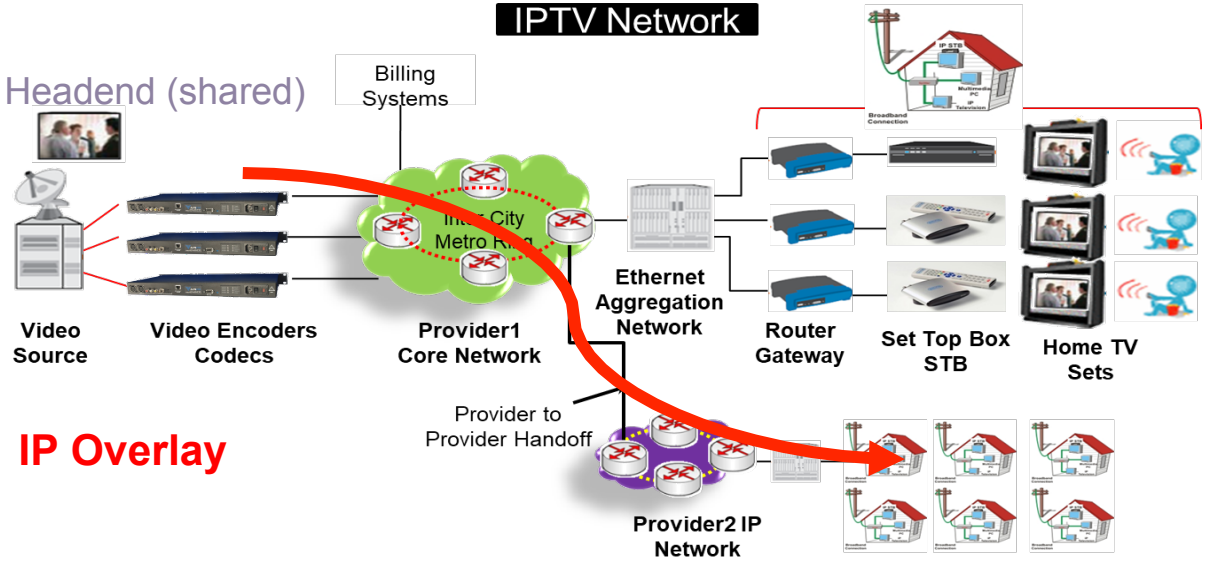
Use Cases

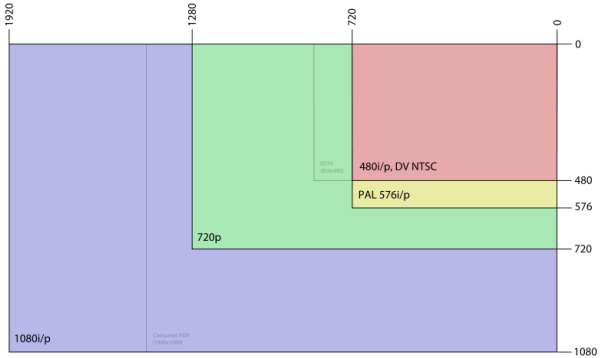
- Residential Triple play (Voice, Video, Internet)
- Mobile Backhaul
- Wholesale Backhaul
- B2B Internet, Voice
- 5G, LTE, VPN
- University connectivity
- Internet Service
- Distance Learning (Video)
- Large File Transfers
- …..

Usage

- IPTV
- OTT
- Point to Point Service
- Point to Multi point Service
- QoS
- Large File Transfers
- …..

IPTV Network





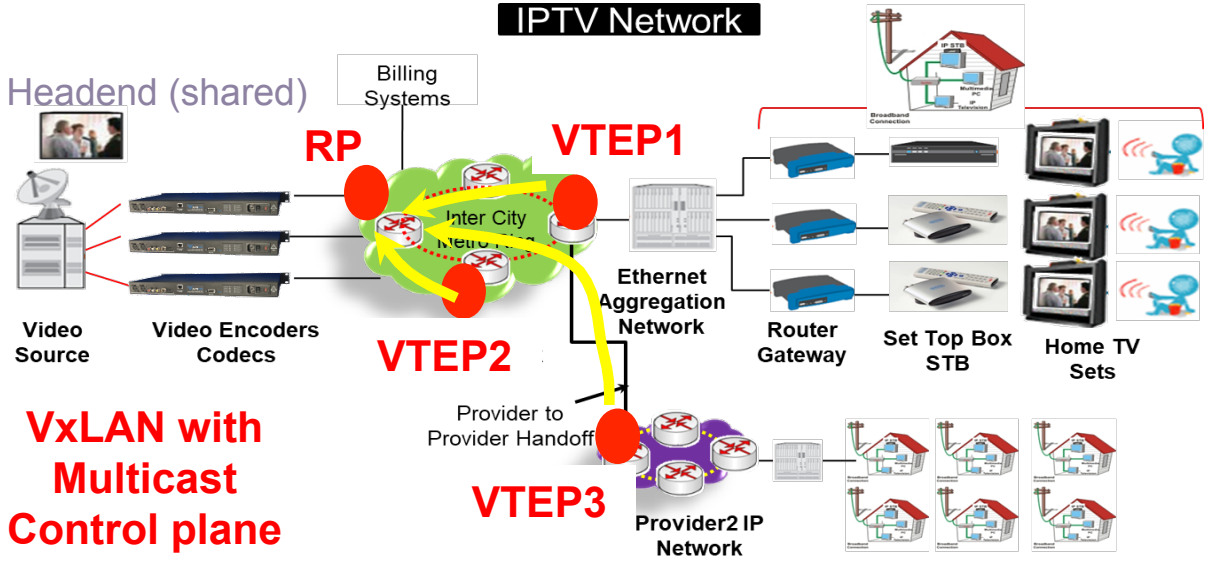
Channel Encoding	Per Channel	Resolution @ Frames/sec
MPEG-2 SDTV	3-6 Mbps	480i @ 29 576i @ 25
MPEG-2 HDTV	14-20 Mbps	1080i @ 25,29,30 720p @ 50,59,60
H.264/MPEG-4 SDTV	1-4 Mbps	1,280×720@68.3 1,920×1,080@30.1 2,048×1,024@30.0
H.264/MPEG-4 HDTV	6-14 Mbps	1280×720 pixels (720p) 1920×1080 pixels (1080i/1080p)

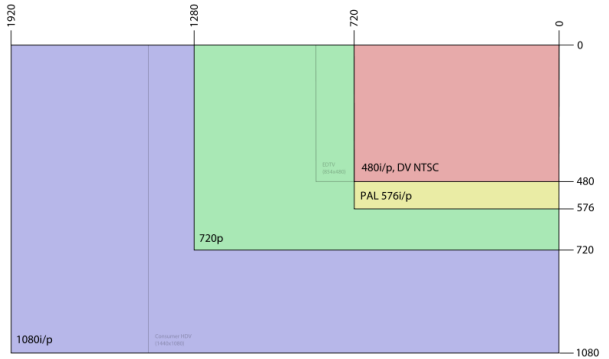
Increase in Video traffic streams

Format	Resolution	Color Depth	FPS	Bandwidth per Stream	10GbE Ports	8Gb FC Ports	40/56Gb Ports
4K DPX	4096 x 2160	10-bit	24	6.4 Gb/s	1	1	1
4K-Full DPX	4096 x 3112	10-bit	24	9.2 Gb/s	1-2	2	1
4K-Full EXR	4096 x 3112	16-bit	24	14.7 Gb/s	2	2	1
4K-Full EXR	4096 x 3112	16-bit	60	36.7 Gb/s	4	5	1
8K DPX	7680 x 4320	10-bit	24	23.4 Gb/s	3	4	1
8K EXR	7680 x 4320	16-bit	24	28.2 Gb/s	3-4	4	1

Bandwidth required for uncompressed 4K/8K video streams

IPTV Network





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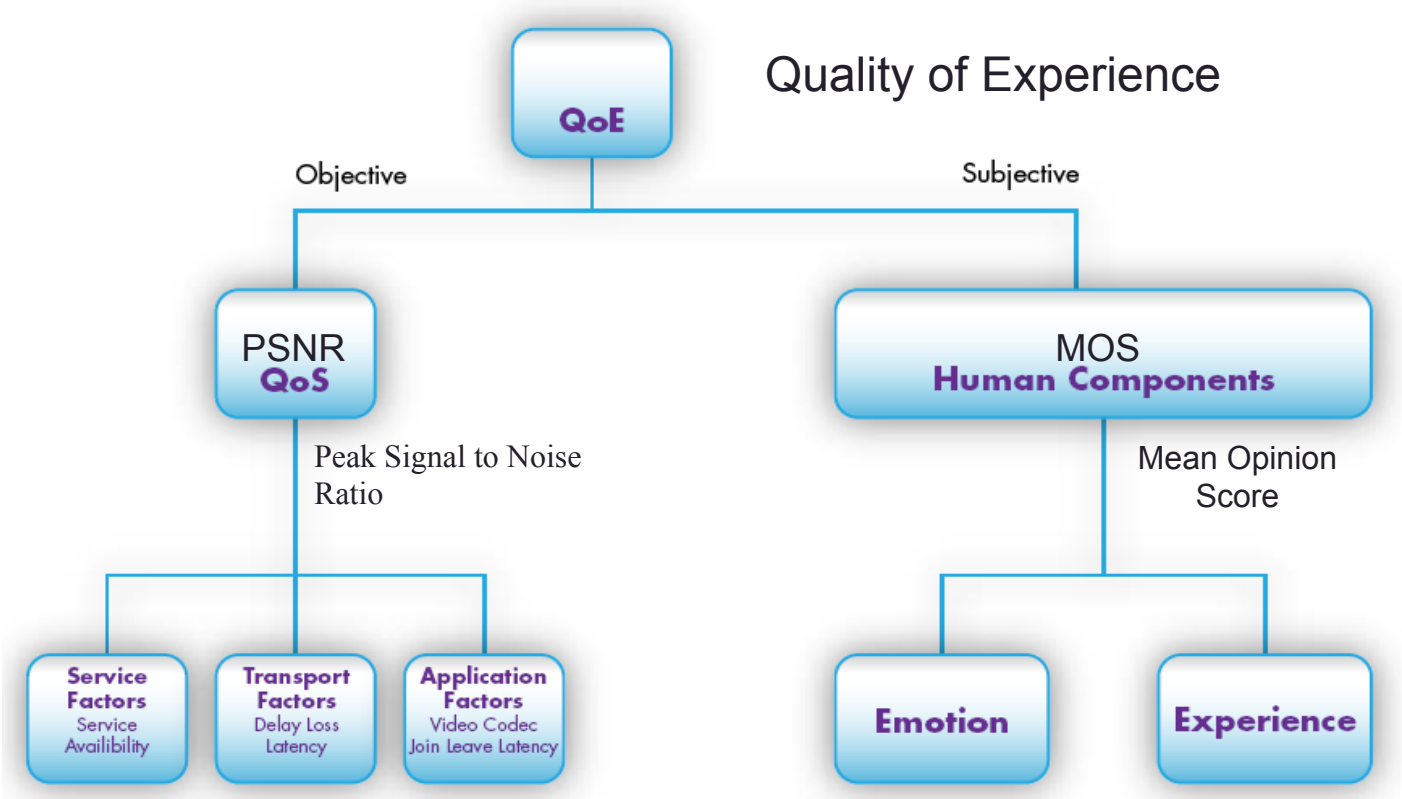
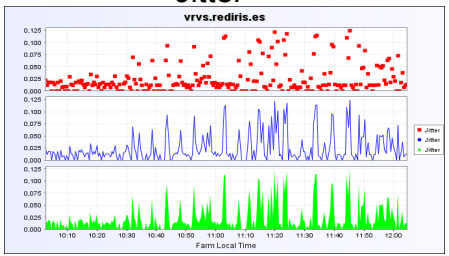
IPTV QoE : ITU G.1080



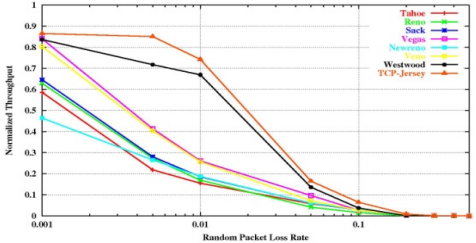
ITU definition of QoE : G.1080

IPTV PSNR : Peak Signal to Noise Ratio

Jitter



Packet Loss



Factors as per ITU FG IPTV-C-0413 :

- codec performance
- frame size
- bit rate
- frame rate
- GOP (Group Of Pictures) structure

0% loss

0.5% loss

5% loss

Audio

ATSC IS191

The sound channel should not lead the video channel by more than 15 milliseconds or lag by more than 45 milliseconds.

- Measured By Test Equipment
- May not be detected by Human Perception after certain levels are reached.

IPTV MOS : Mean Opinion Score (ITU-T P.800)

Effect of Buffering

Picture stops are very annoying

MPEG-2 Packet Loss 0.1%

H.264 packet loss 0.1%

H.264 packet loss 3%

- single frame affected
- At higher rates such as 25 FPS or 60 FPS, this in unnoticeable through human eyes
- Human perception is 16 FPS

Mean Opinion Score (MOS)

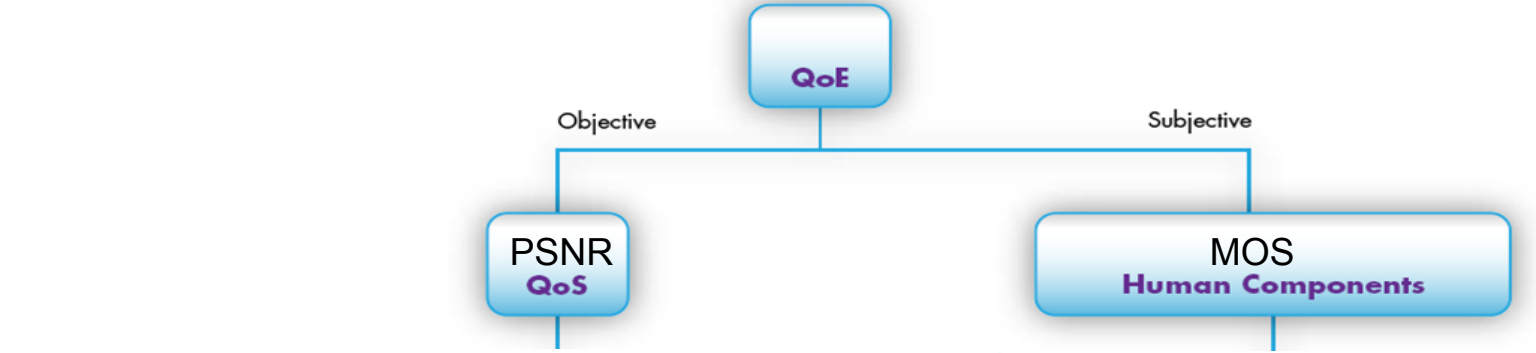
- Human perception
- a.k.a Media Delivery Index (MDI) / Video Quality Index (VQI)
- Delay Factor (arrival time of each packet)
- Media Loss Rate (packets received vs expected)

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very Annoying

- Cannot be measured by Test Equipment
- Relies on Human Perception and Customer Satisfaction

MEASURING MULTIMEDIA QUALITY IN MOBILE NETWORKS WITH AN OBJECTIVE PARAMETRIC MODEL *Ericsson Research, Sweden*

IPTV QoE : ITU G.1080 (cont'd)



Transport Stream Bit Rate (Mbit/s)	Latency	Jitter	Max Duration of a Single Error	Corresponding Loss Period in IP Packets	Loss Distance	Corresponding Average IP Video Stream Packet Loss Rate
3.0	< 200ms	< 50ms	<= 16ms	6 IP packets	1 error event per hour	<= 5.85E-06
3.75	< 200ms	< 50ms	<= 16ms	7 IP packets	1 error event per hour	<= 5.46E-06
5.0	< 200ms	< 50ms	<= 16ms	9 IP packets	1 error event per hour	<= 5.26-06

Recommended Minimum Transport Layer Parameters for Satisfactory QoE for MPEG-2 Encoded SDTV Services

MOS	Pass	Marginal	Fail
Latency (median round-trip)	< 200ms	>= 200ms to <600ms	>=600ms
Jitter (max)	<25ms	>=25ms to <50ms	>=50ms
Packet Loss (%)	<0.5%	>=0.5% to <1.0%	>=1.0%
Packet Loss Size (max # of contiguous packets)	<2	>=2 to <4	>=4
Packet Loss (ms)	<100ms	>=100ms to <200ms	>=200ms
Trick Mode Response Time	<=200ms	>200ms & <= 250ms	> 250ms

Jitter

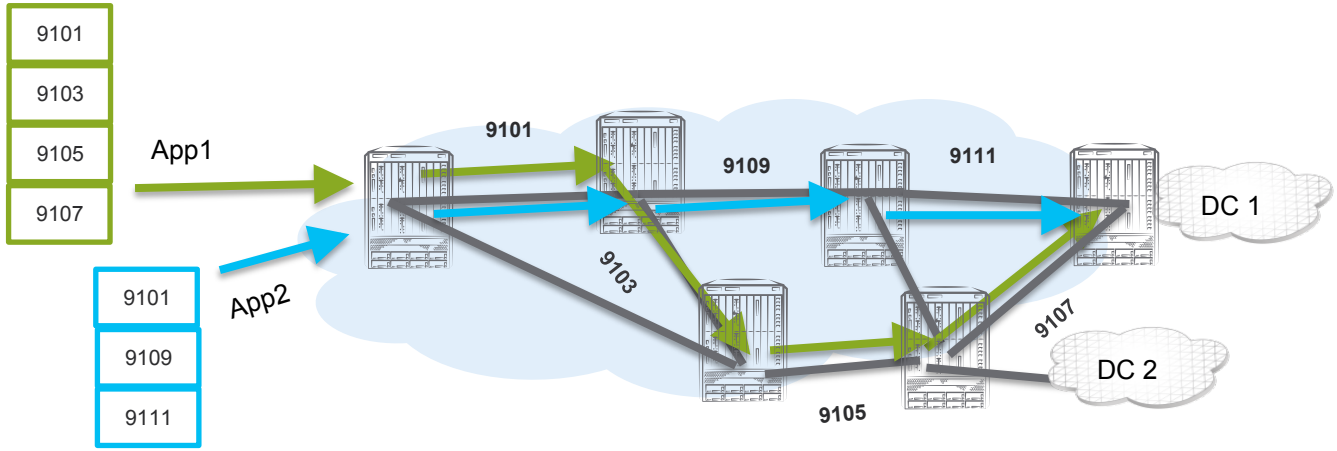
Acceptable PSNR <50ms
Acceptable MOS <25ms

Packet Loss

Acceptable PSNR 9 IP Packets
Acceptable MOS <=0.5%

Mobile Backhaul : Load Balancing

Controlled vs Dynamic, Entropy, Nested….



G.8032

LAG / Port Channels

64 100G ports

6.4 Tbps

MPLS

LSP load balancing

LAG / Port Channels

32 LSP

64 100G ports

204 Tbps

VxLAN

IP ECMP Next Hops

LAG / Port Channels

32 IP NextHops
with 100G ports

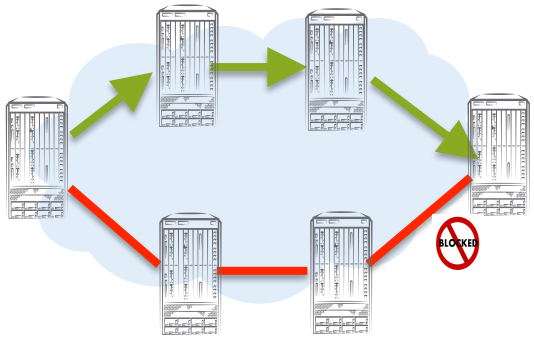
64 100G ports

204 Tbps

Mobile Backhaul : Ring Utilization

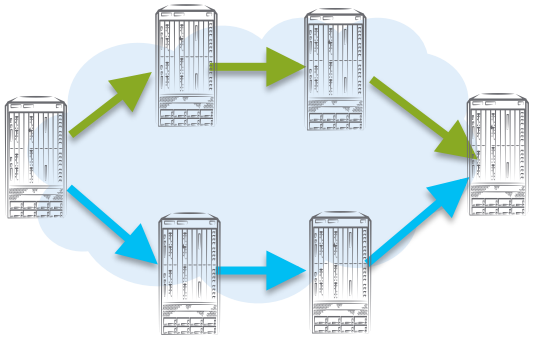
G.8032 vs MPLS vs VxLAN

G.8032



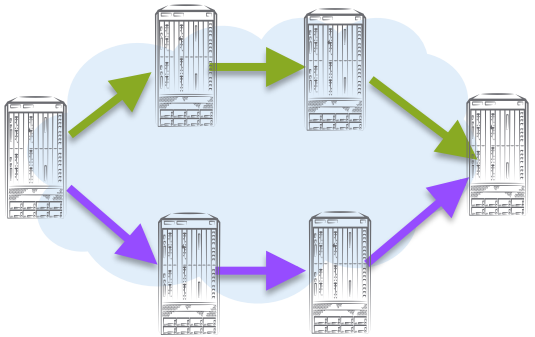
- 50% of ring is not utilized
- All of the network is a single broadcast L2 domain
- Load balancing is only through port channels

MPLS



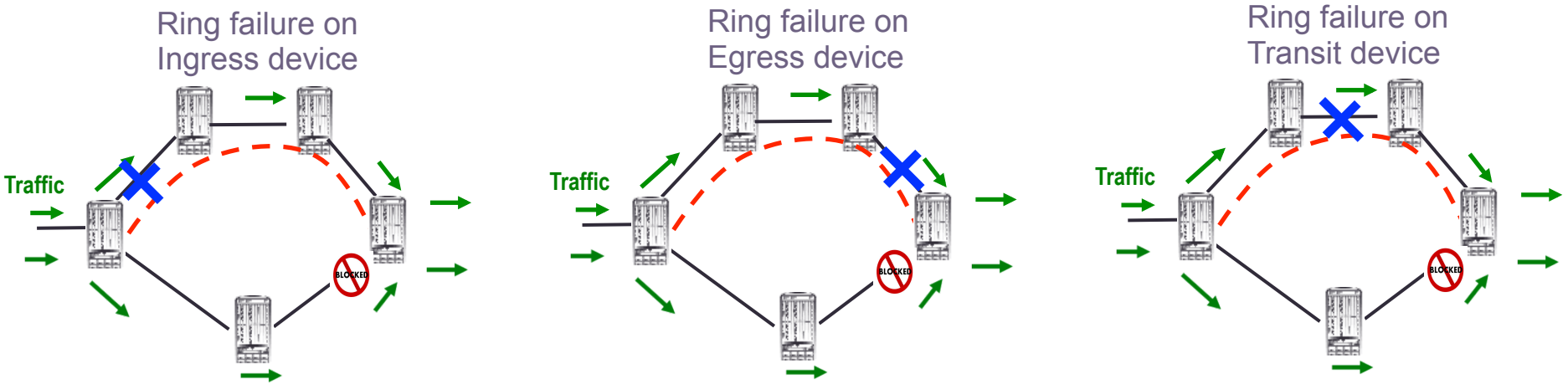
- 100% of ring can be utilized
- Multiple broadcast domains based on VPLS instances
- Option for Point to Point services via VLLs
- True transparent VLL service
- Load balancing via MPLS LSP , port channels

VxLAN



- 100% of ring can be utilized
- Multiple broadcast domains based on IP Subnets
- No option to distinguish between Point to Point vs Point to MultiPoint service
- Load balancing via IP ECMP, port channels

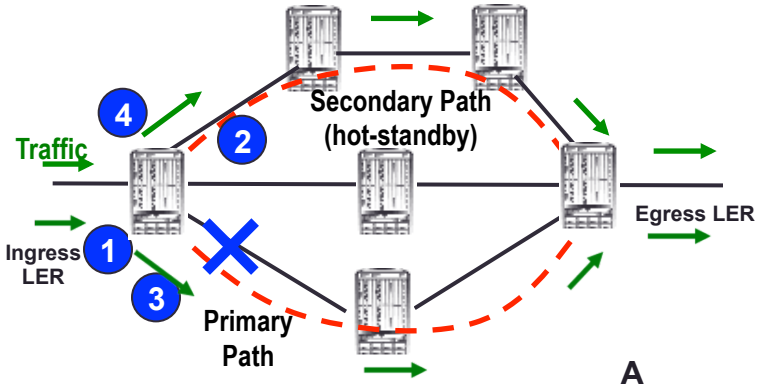
Enterprise Services: Protection mechanism G.8032



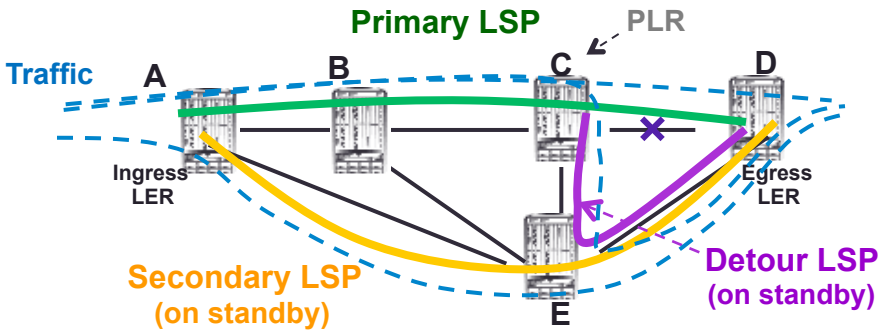
- Ring hello timers are generally in seconds
- Remote fault detection on G.8032 rings is dependent on protocol
- No ability to instantly signal fault to all devices on the ring
- Mac address have to be aged or relearnt to be switched over
- Traffic convergence may vary depending on location of ring failure

Enterprise Services: Protection Mechanisms MPLS

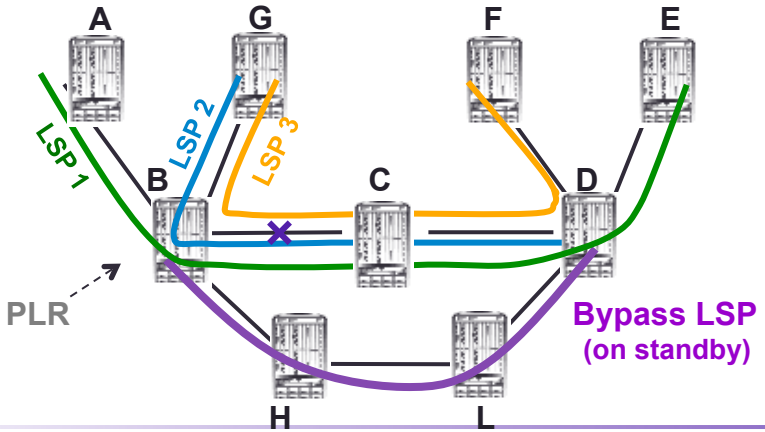
Hot Standby Secondary



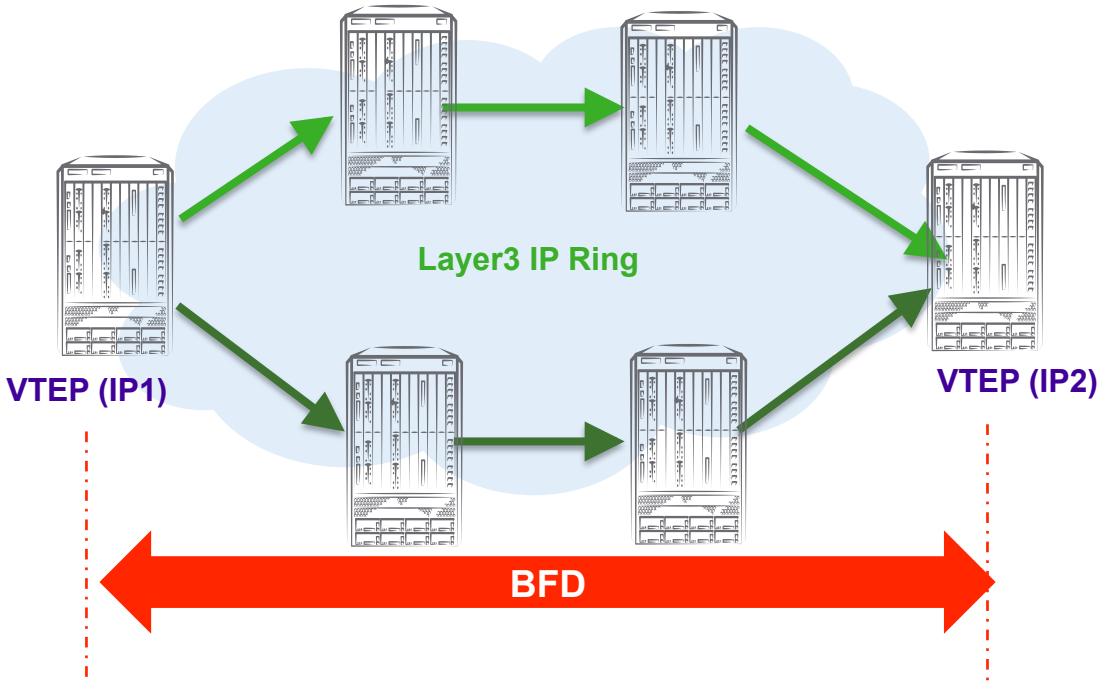
Detour LSP

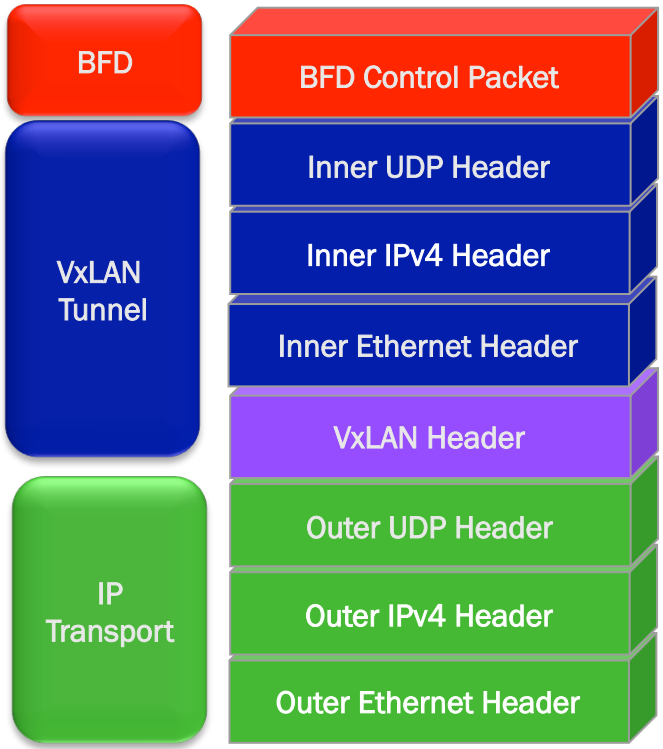


Bypass LSP



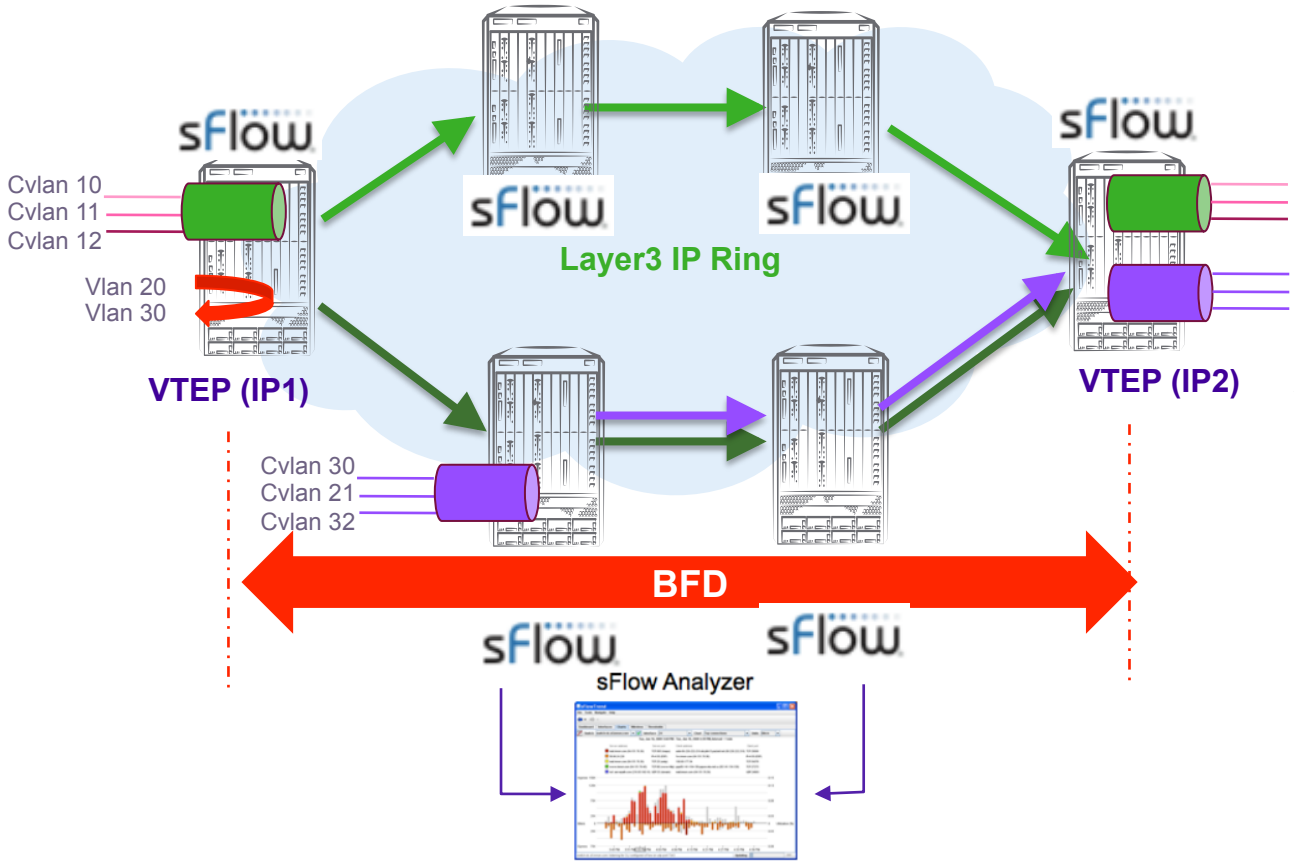
Enterprise Services: Protection Mechanism VXLAN





- VxLAN for BFD is currently in draft (draft09)
- draft-ietf-bfd-vxlan-09
- IP tunnel failover based on Transport IP

MEF Equivalent Services to be considered in VxLAN rings



End to End Signalling for VxLAN tunnels (BFD)

Q-in-Q
- transport vlans
- copy inner tag to outer tag

Local VLLs

Vlan bundling aka MAC VRF

VxLAN extensions to Sflow

Traffic Engineering on VxLAN tunnels

VxLAN over IPv6

Y.1731 Perfomance monitoring

PTP……