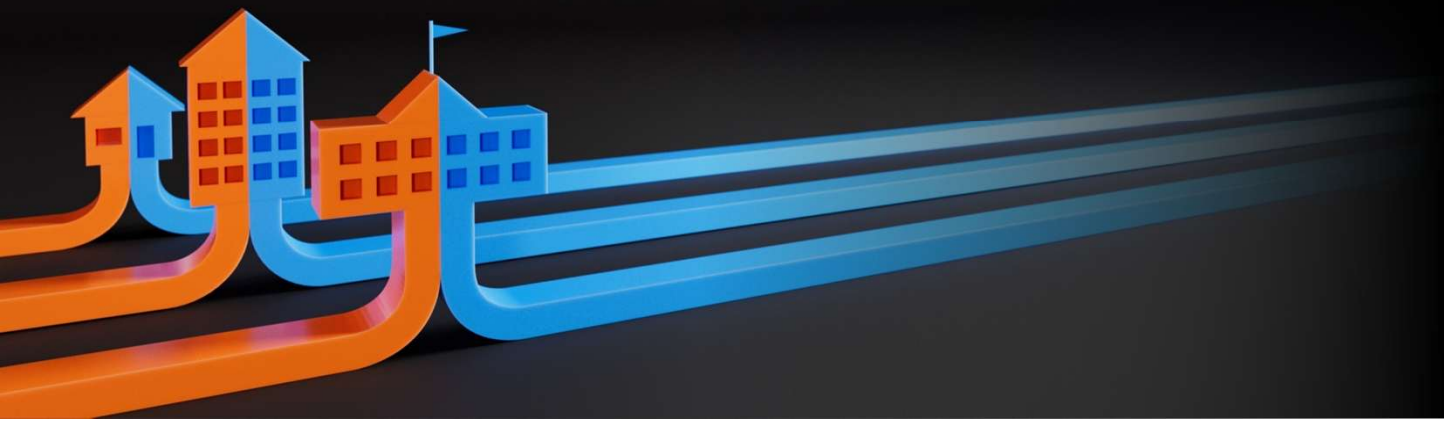
Rishabh Sandhir
Regional Vice President, Sales Engineering
Calix

High Availability Network Architecture



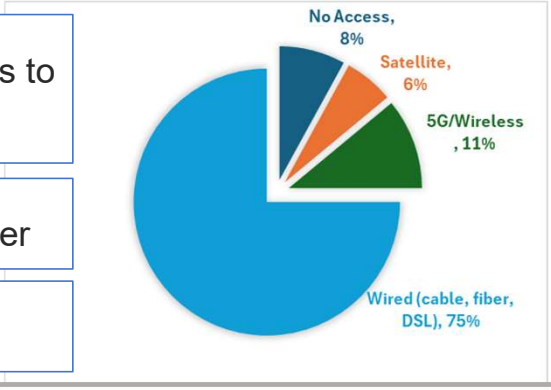
Basic Connectivity vs. Demand for High Availability
for Business Services

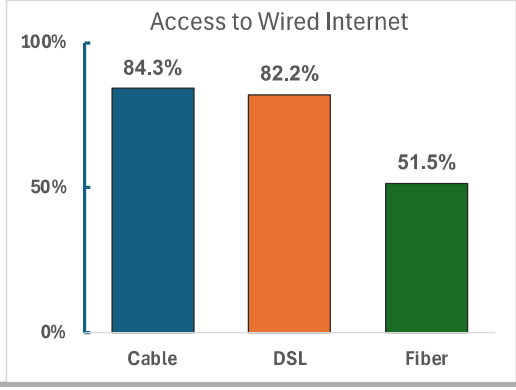
Home Internet connectivity in the US
(Pew Research 2024)

75% of people have access to the wired Internet

51.5% have access to fiber

20% connected to fiber

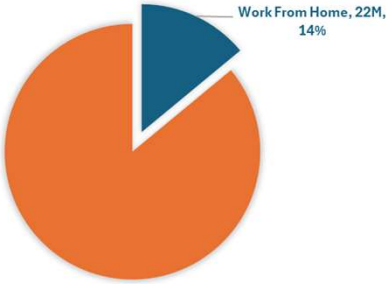


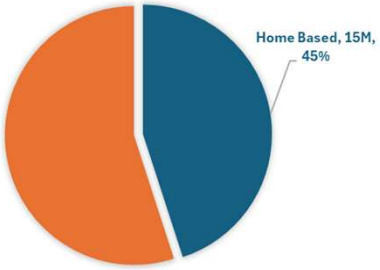


Demand for reliable services
(Pew Research 2024)
(Small Business Association)

22M people work from home

45% of small businesses are home-based (SBA)





SD-WAN Market ***Global***
(*Market Insight*)

27% CAGR
From 2024 to 2032

$7.2B to $69B

Simplify. Innovate. Grow.

Slide 2

1 [@Eddy Boujaoude] I updated the “access to wired internet” chart and ensured automation works. The original slide is hidden

Andre Viera, 2024-10-11T13:34:58.227

High Availability is a Journey

Downtime is Expensive

- Residential Subscribers (to the neighborhood)
  - Best effort is no longer tolerated
- Business Subscribers (to the premises)
  - Lost revenue, point of sale, customer frustration, employee productivity

The average cost across industries for a minute of downtime is about $9,000. *Pingdom*

HA is a Differentiator

- Separate from the pack
  - Speed, best effort
  - Brand, NPS
- Expand into SMB/Enterprise market
- Extremely profitable

Offer Achievable Service Level Agreements

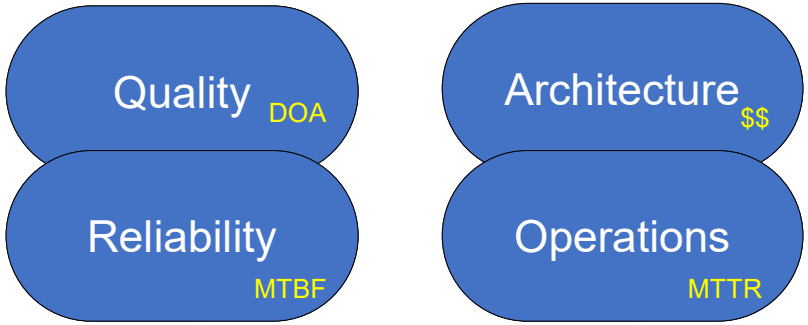
Set Goals & Measure Them

- By Customer profile
- By type of Service
- By location / market

Planned vs. Unplanned Downtime

Five 9's: 525,600 mins/year x (1- 0.99999) = 5.26 mins of downtime per year

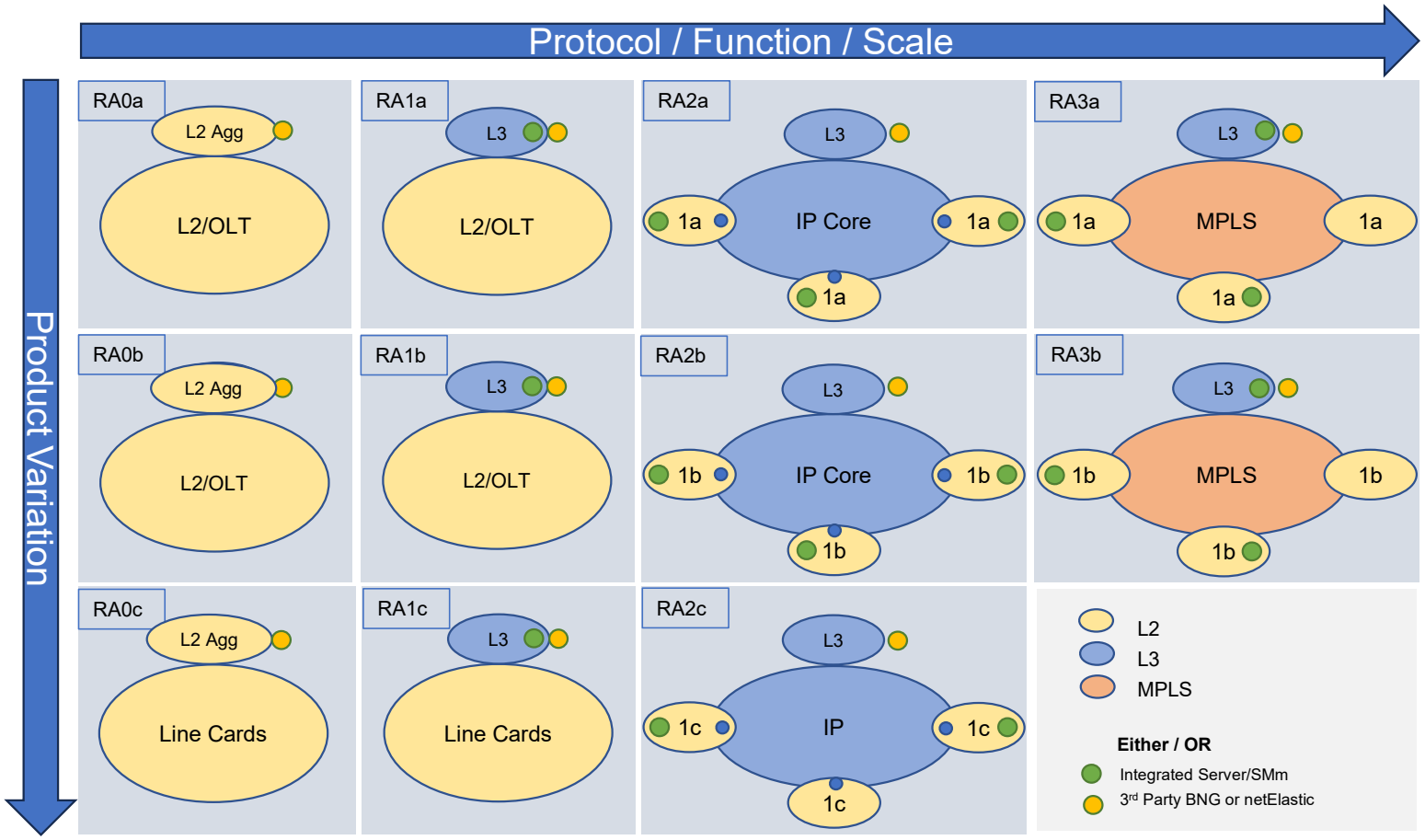
Plan & Achieve Them



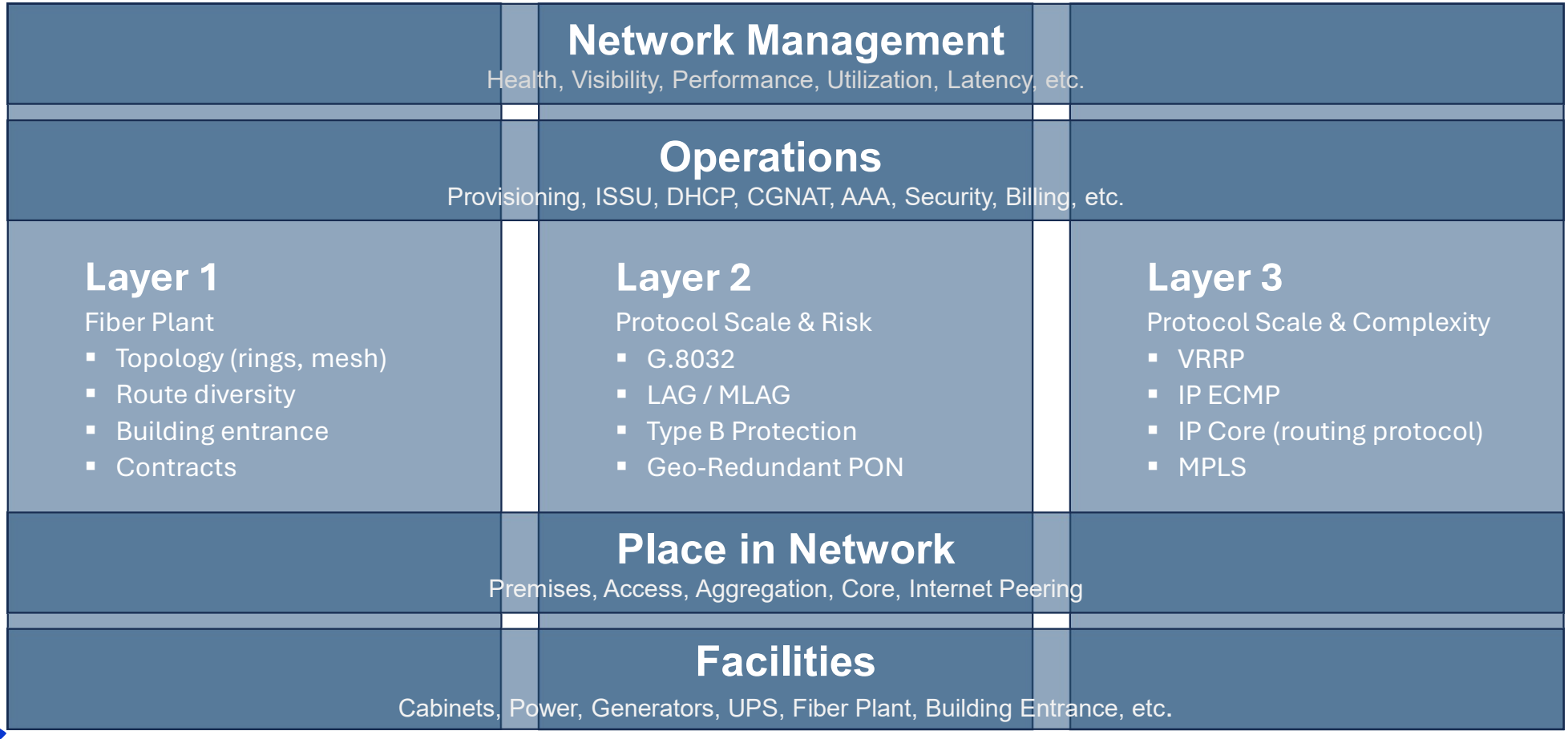
Decisions, Decisions

Simplify. Innovate. Grow.

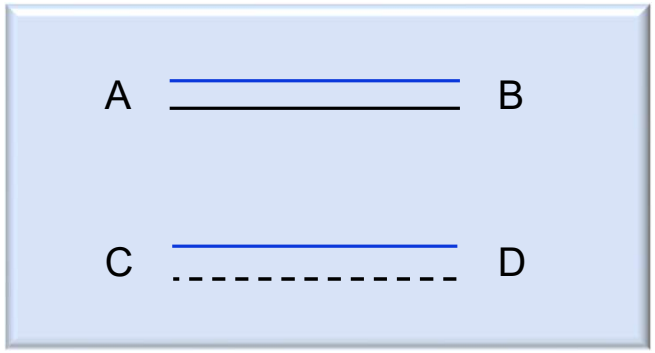
Start with a Reference Architecture Using Common Building Blocks



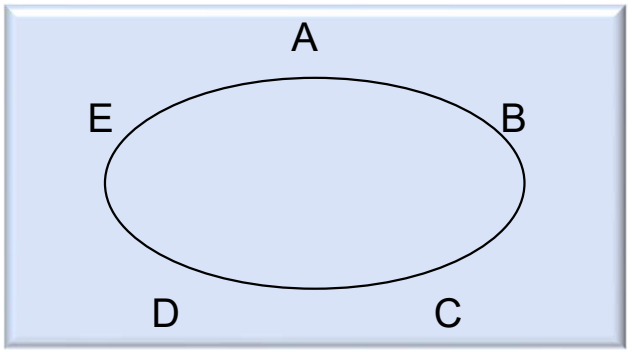
Deployment Interdependencies



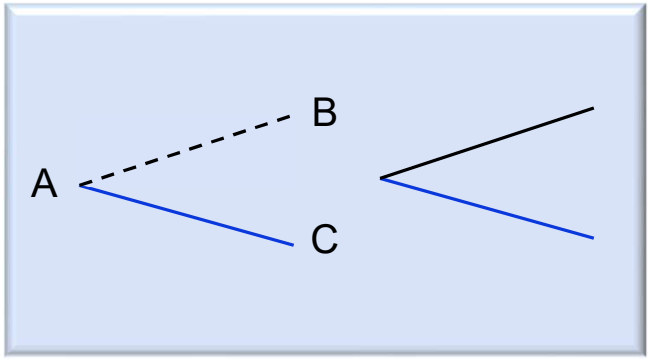
Layer 1 Options: Physical Topology



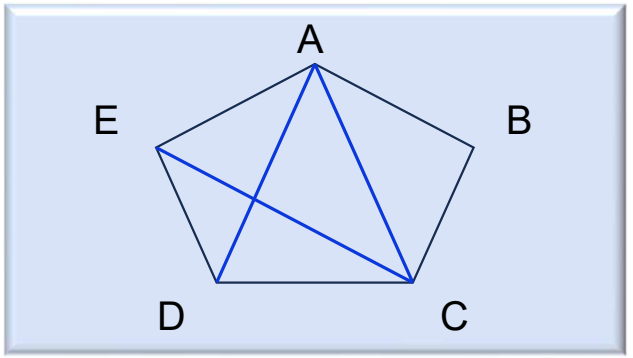
Point to Point



Ring



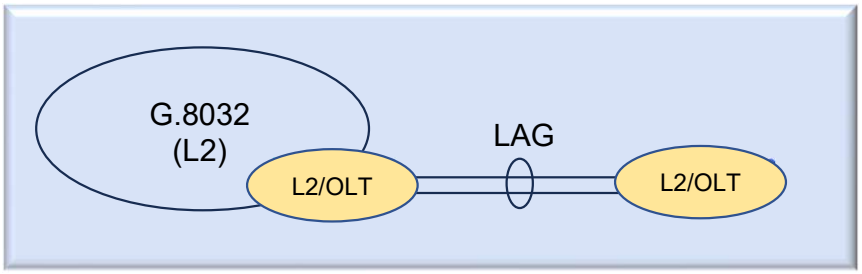
Point to Multi-Point



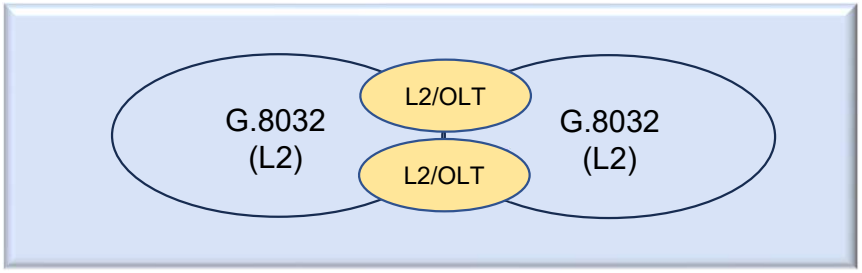
Mesh

Layer 2 Options: Place in Network

Ethernet

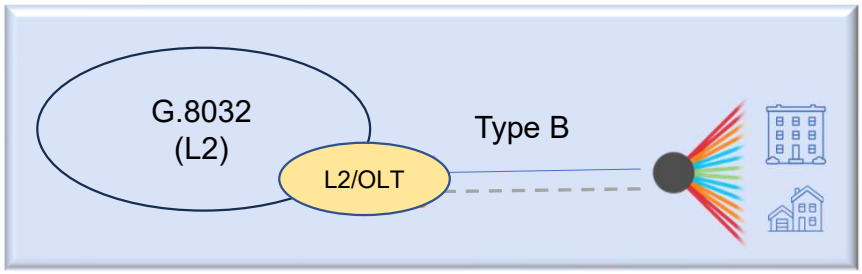


Link Aggregation Group

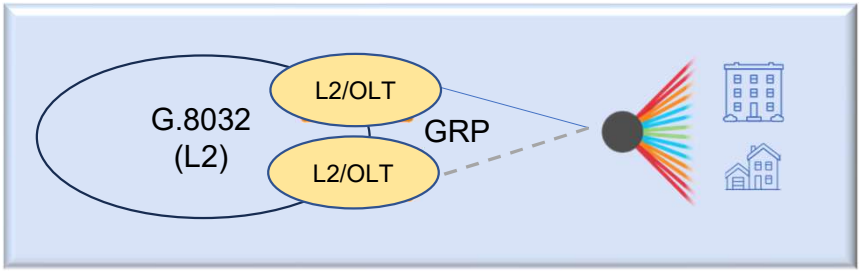


L2 Rings

PON

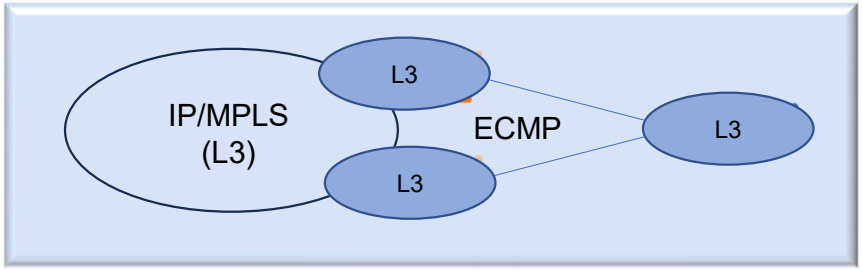


Type B Protection

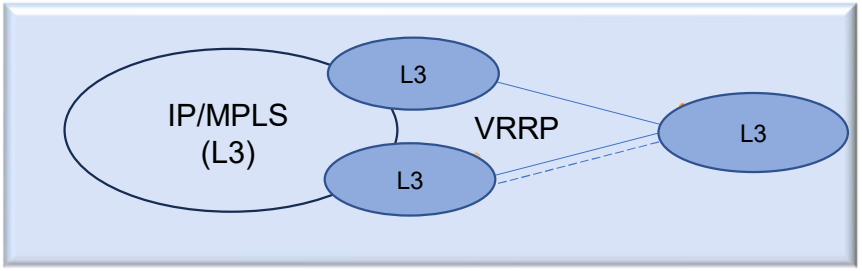


Geo Redundant PON Protection

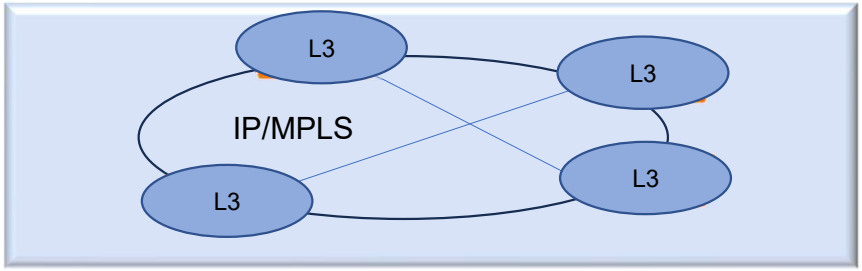
Layer 3 Options: Advanced Protocols



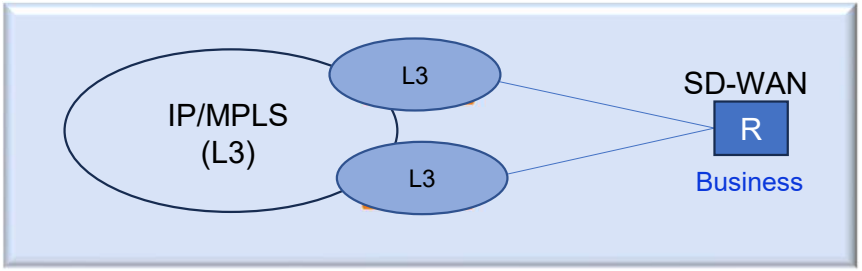
ECMP



VRRP (A/S, A/A)



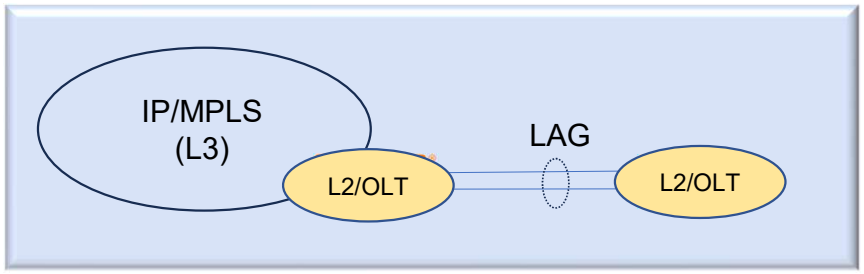
L3 Ring/Mesh Core



Ethernet to Subscriber

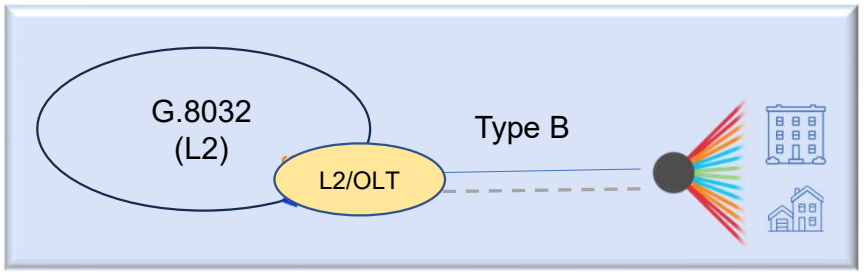
Seamless Operations: In-Service Software Upgrades (ISSU)

ISSU L2/3 (Aggregation)



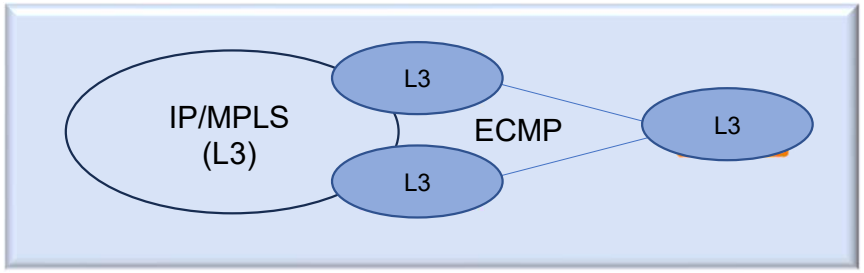
LAG

ISSU L2 (Access)



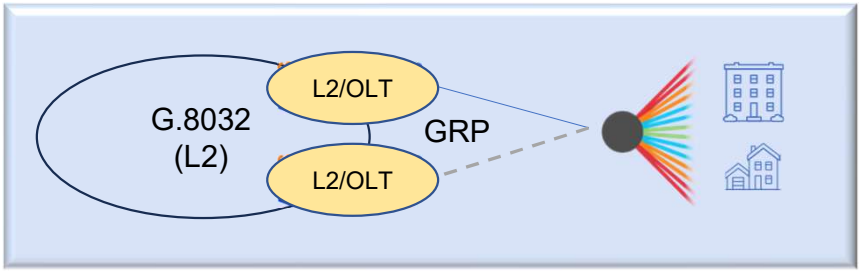
Type B Protection

ISSU L3 (Core)



ECMP

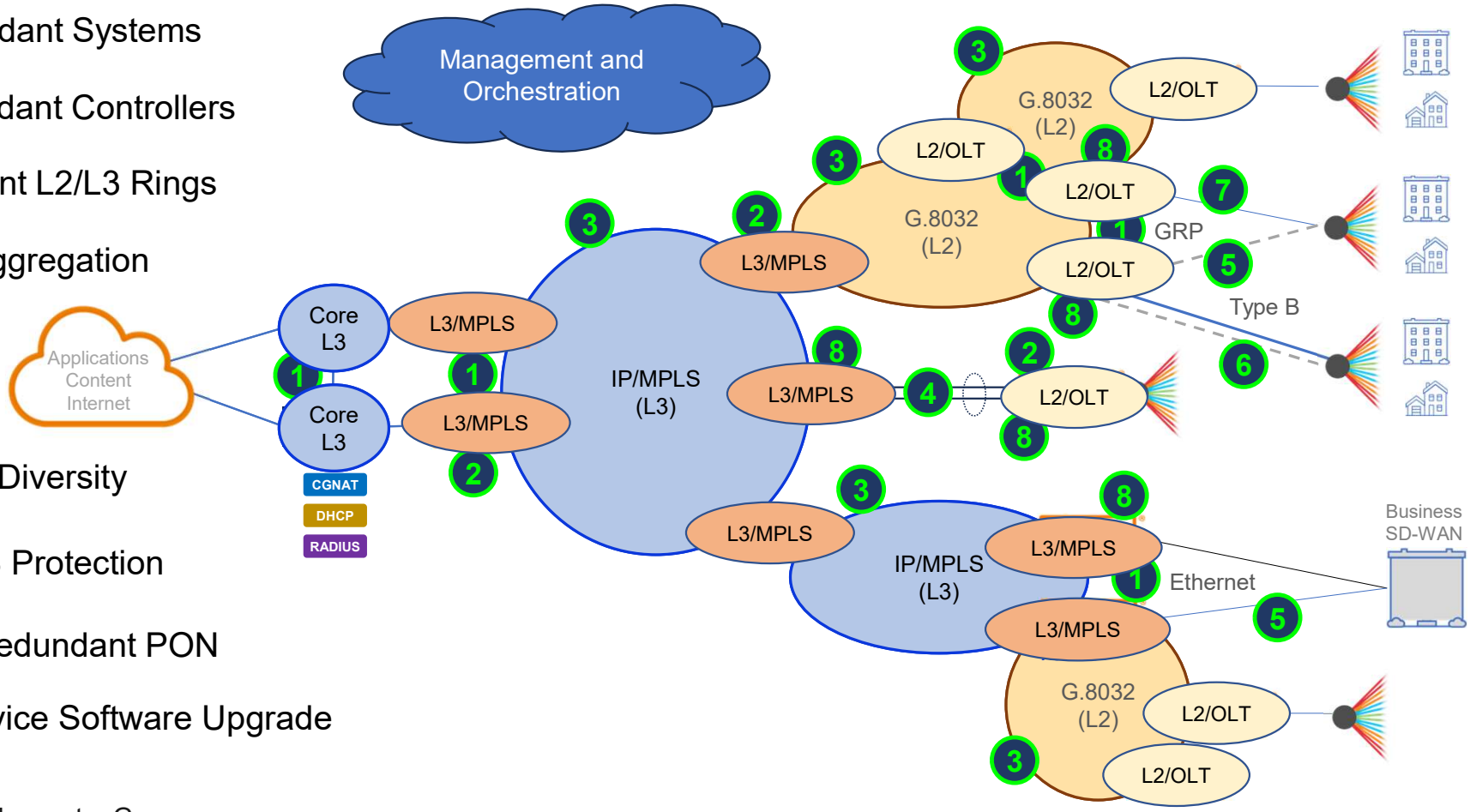
ISSU L2 (Access)



Geo Redundant PON

High Availability Network Architecture

1. Redundant Systems
2. Redundant Controllers
3. Resilient L2/L3 Rings
4. Link Aggregation
5. Route Diversity
6. Type B Protection
7. Geo Redundant PON
8. In-Service Software Upgrade

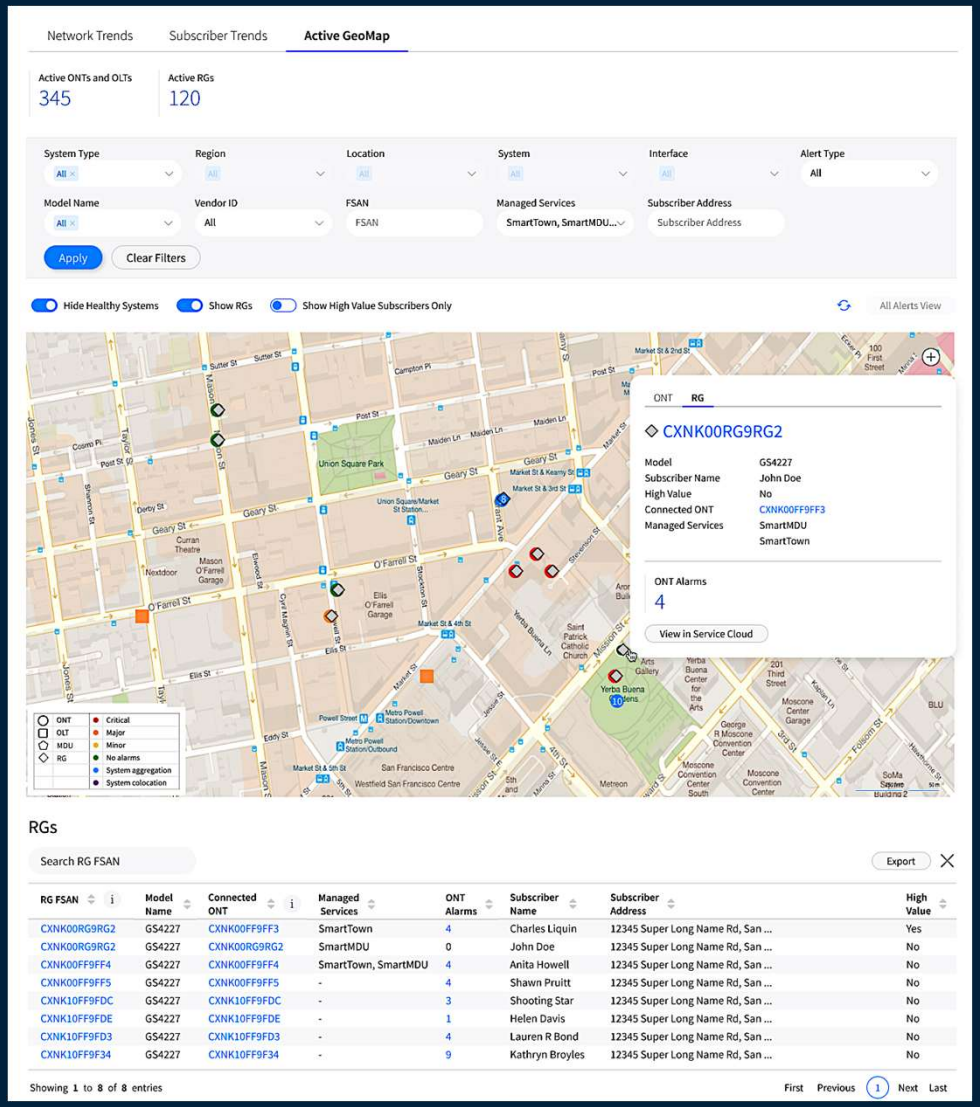


Visualization

Systems
Services
Subscribers

Geo Mapping

- Predictive analytics
- Actionable insights
- Proactive maintenance
- Reduce MTTR



Artificial Intelligence & High Availability Networks

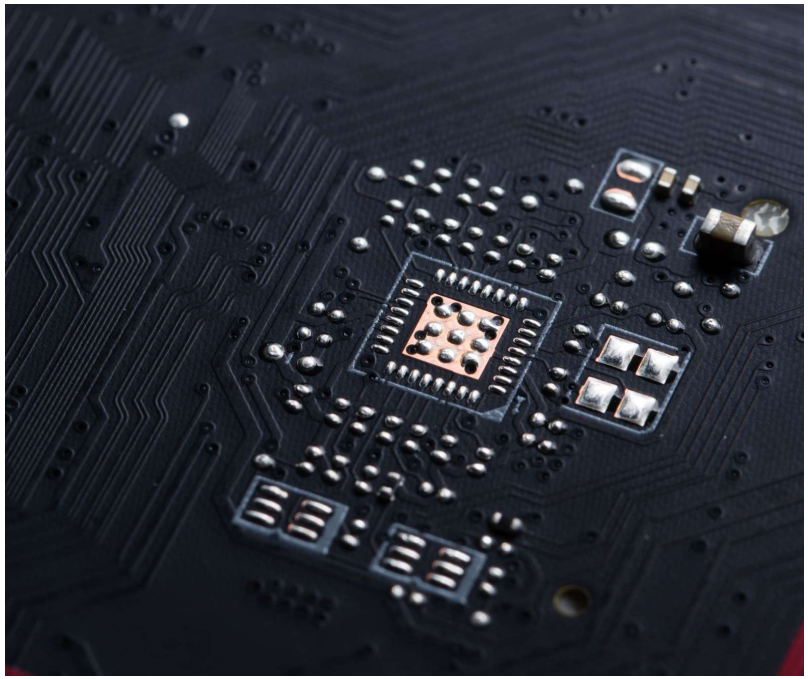
AI for High Availability

Stage 1:

- Leverage embedded AI to predict and prevent network failures proactively
- Utilize machine learning to optimize resource allocation and routing
- Implement AI-driven anomaly detection for faster issue identification
- Automate incident response and decision making to reduce downtime and improve reliability

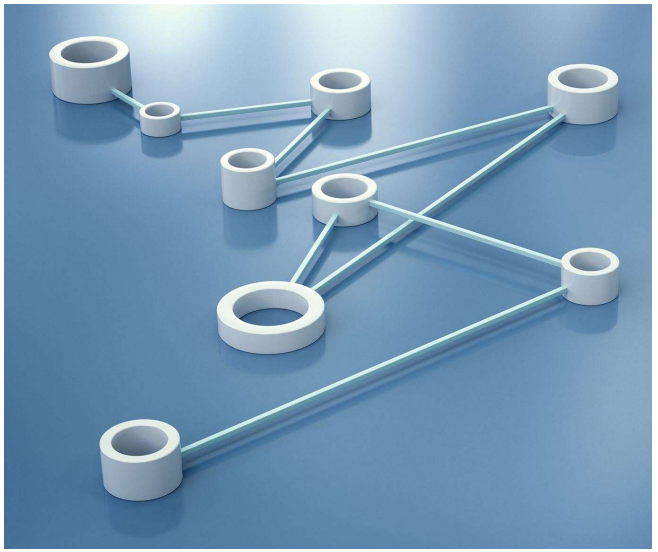
Stage 2:

- Agentic execution within restrictions
- Agentic planning and service optimization



Key Takeaways on High Availability Network Architecture

- High Availability is essential for today's networks.
- HA requires planning, measurement, and advanced technologies.
- Layered design (L1, L2, L3) boosts resilience.
- Visualization and geo mapping enable proactive maintenance.
- In-service upgrades reduce downtime.
- Embedded AI with predictive analytics enhances reliability.



Thank You !