Connecting the Unconnected

With Starlink and Cisco Validated Solution

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Principal Product Manager, Cisco Systems

BRKMSI-1000

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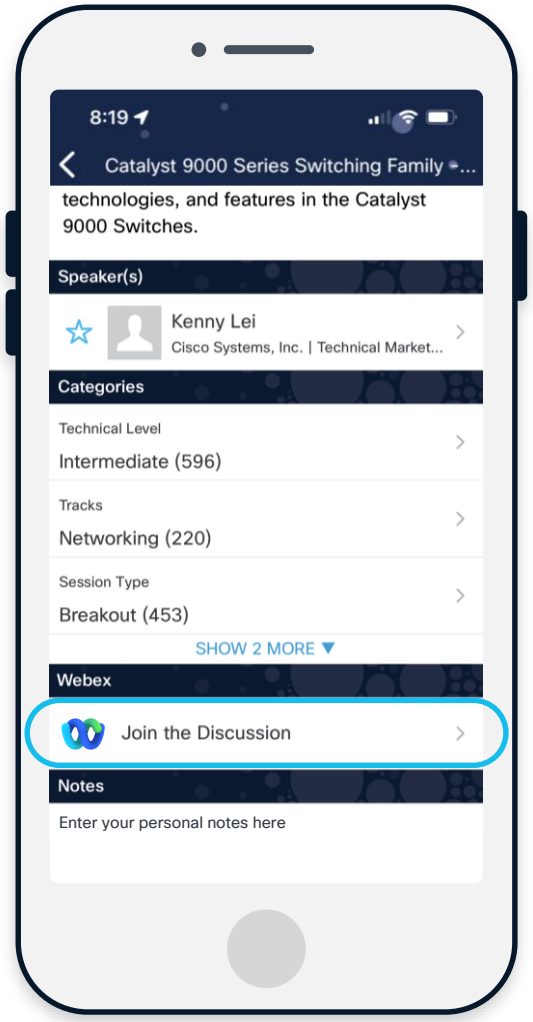


Agenda

01 Introduction to Starlink

02 Starlink Services

03 Cisco Starlink Validated Solution

Key Abbreviations

B2B	Business to Business
BBR	Bottleneck bandwidth and Routing-trip propagation Time
CPE	Customer Premise Equipment
CSR	Cell Site Router
D2D	Direct to Device
EVC	Ethernet Virtual Circuit
GEO	Geostationary Earth Orbit
IoT	Internet of Things
LEO	Low Earth Orbit
MEF	Metro Ethernet Forum
MEO	Medium Earth Orbit
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
NR	New Radio (5G)

NTN	Non-Terrestrial Network
NWPI	Network Wide Path Insight
OMP	Overlay Management Protocol
O-ISL	Optical Inter-satellite Link
PCA	Provider Connectivity Assurance
PCA-UE	Provider Connectivity Assurance User Experience
PE	Provider Edge
POP	Point of Presence
RAN	Radio Access Network
SD-WAN	Software Defined Wide Area Network
SNO	Satellite Network Operator
TAM	Total Addressable Market
TLOC	Transport Locator
TN	Terrestrial Network
UMTS	Underlay Measurement and Tracing Service

Introduction to Starlink

STARLINK

ENGINEERED BY SPACEX

SpaceX was founded in 2003 with the mission to make humanity multiplanetary.

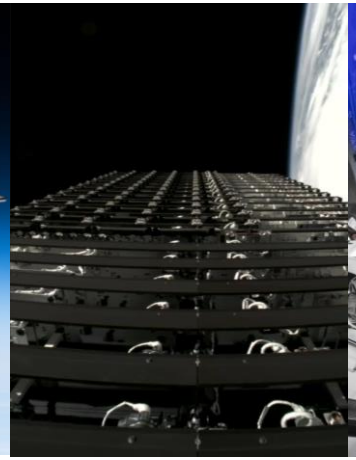
- Leveraging our experience building rockets and spacecraft to deploy the world's most advanced broadband internet system from space
- Deep experience with both spacecraft and on-orbit operations and the only provider with an orbital-class reusable rocket

FALCON 9
2010

FALCON 9 LANDING
2015

FALCON HEAVY
2018

CARGO DRAGON
2019



STARLINK
2019

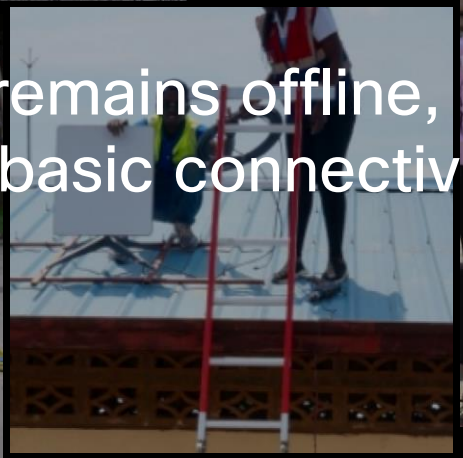
CREW DRAGON
2020

STARSHIP
2021

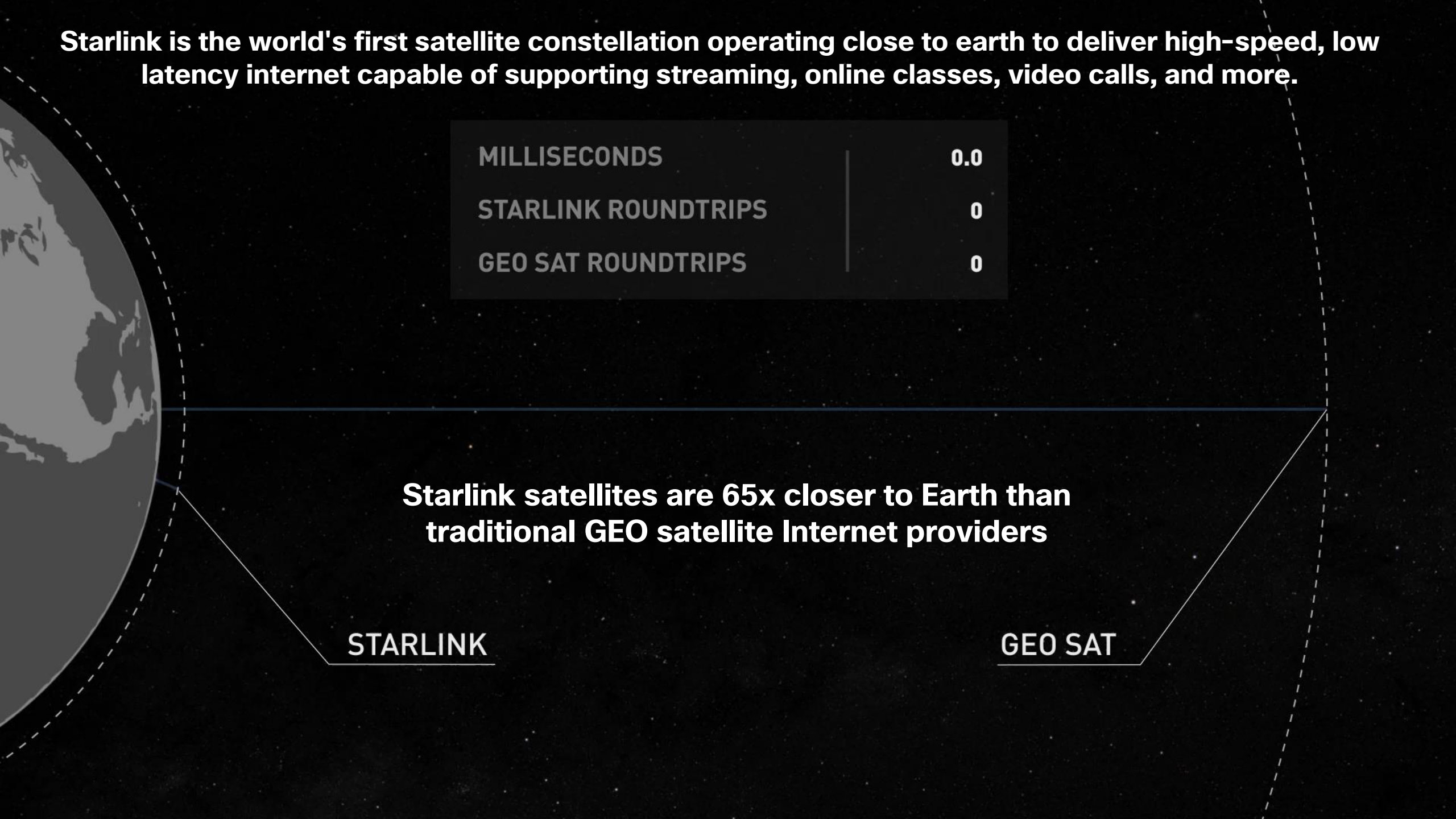
STARSHIP FLT. 5
2024

CONNECTING THE UNCONNECTED

One-third of humanity remains offline, and many users only have basic connectivity.



Starlink is the world's first satellite constellation operating close to earth to deliver high-speed, low latency internet capable of supporting streaming, online classes, video calls, and more.



STARLINK TODAY

7,500+
SATELLITES

5M+
USERS GLOBALLY

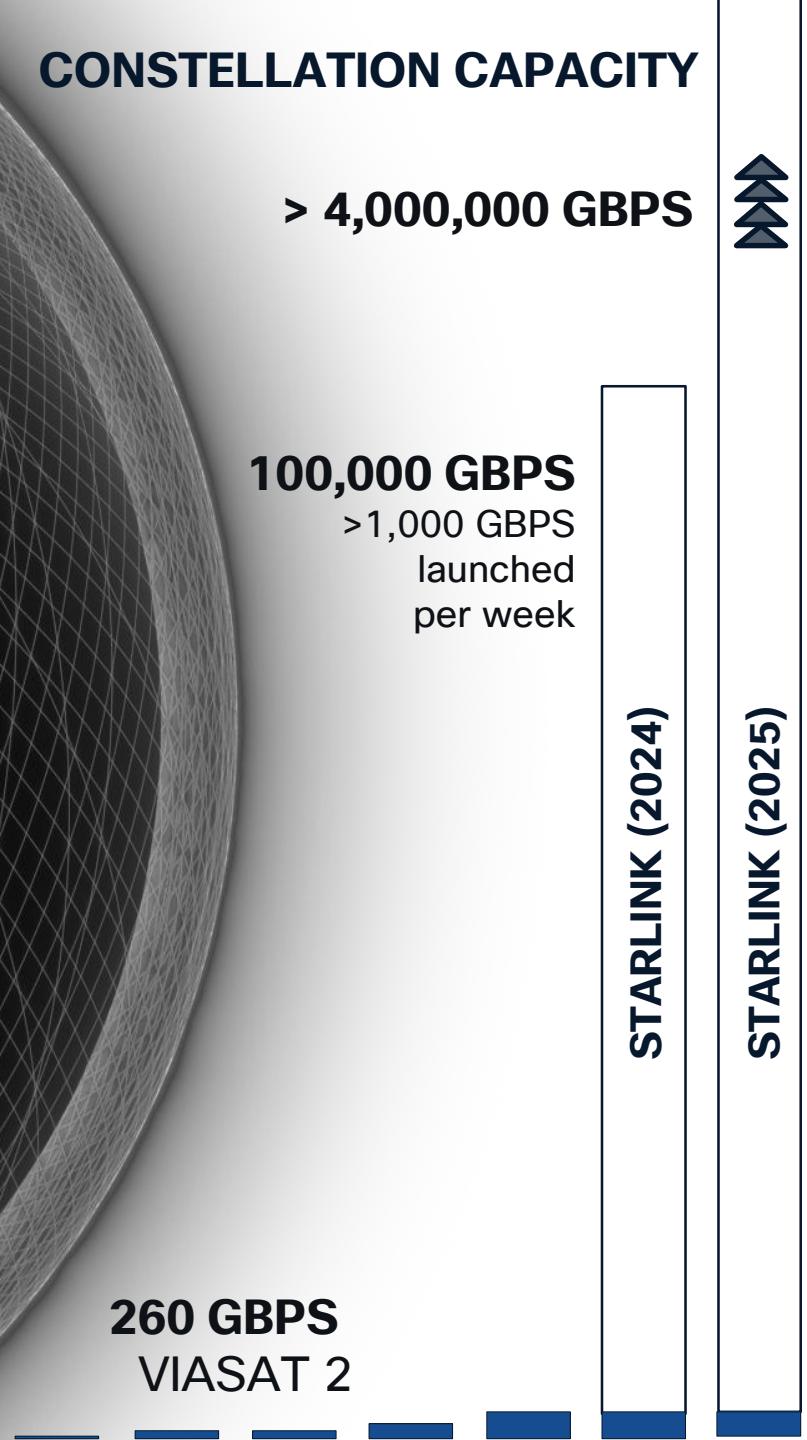
135+
MARKETS LIVE

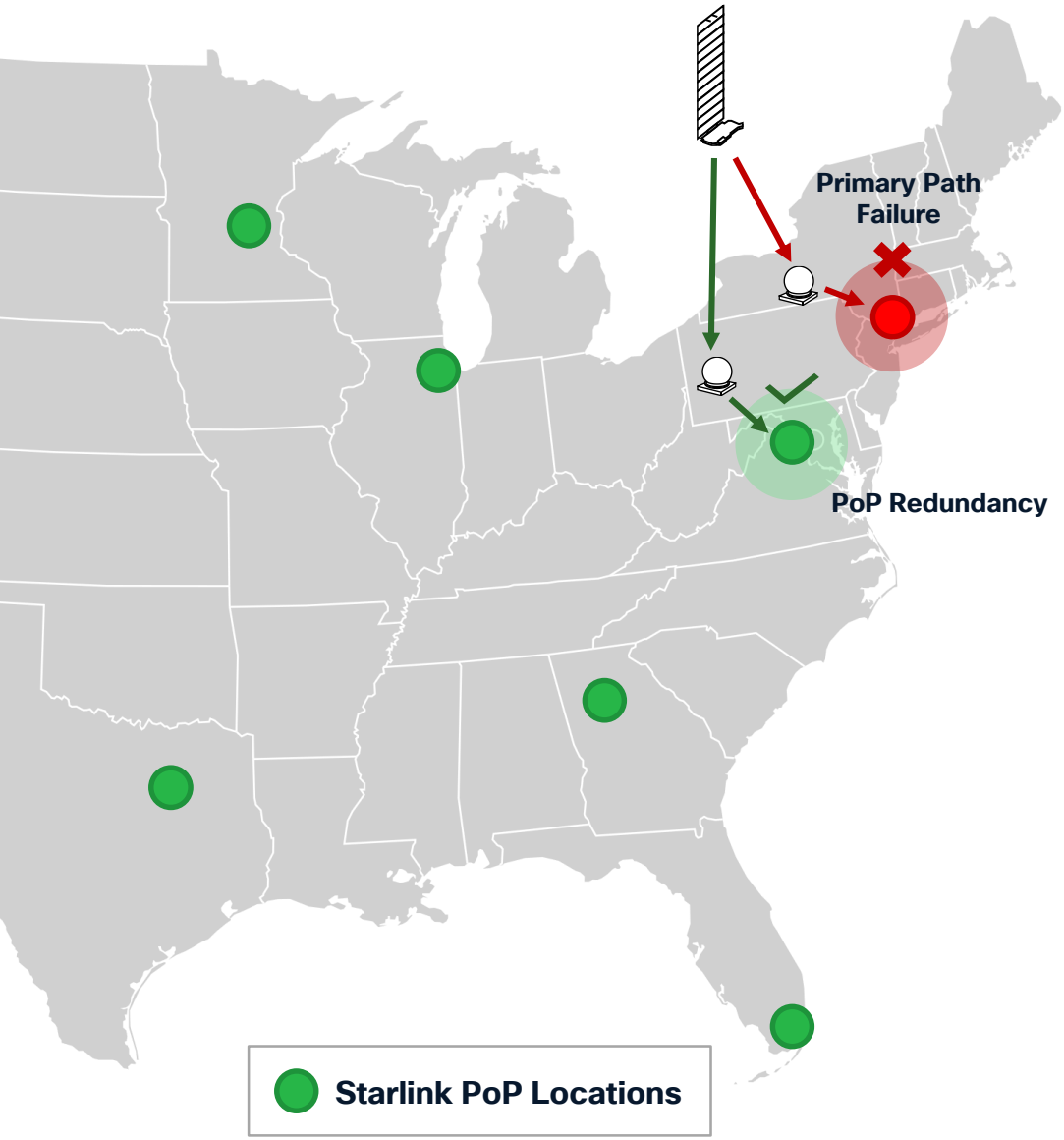
HOW WE GOT HERE

497
COMPLETED MISSIONS

458
TOTAL LANDINGS

425
TOTAL REFLIGHTS





STARLINK OFFERS UNPARALLELED REDUNDANCY

“225 major Internet disruptions were observed globally in 2024, ... cable cuts and power outages were also leading causes.”
-Cloudflare

Immediate fail-over state

When lost connectivity could equal millions in lost revenue, Starlink ensures instantaneous rerouting to another PoP site to avoid service outages.

Redundant, geographically diverse coverage

Starlink provides connectivity in over 135 countries and our coverage is rapidly expanding.

16+ Points of Presence

140+ Gateways Sites

online in North America

43 Points of Presence

310+ Gateways Sites

online globally

STARLINK NETWORK EXPANSION

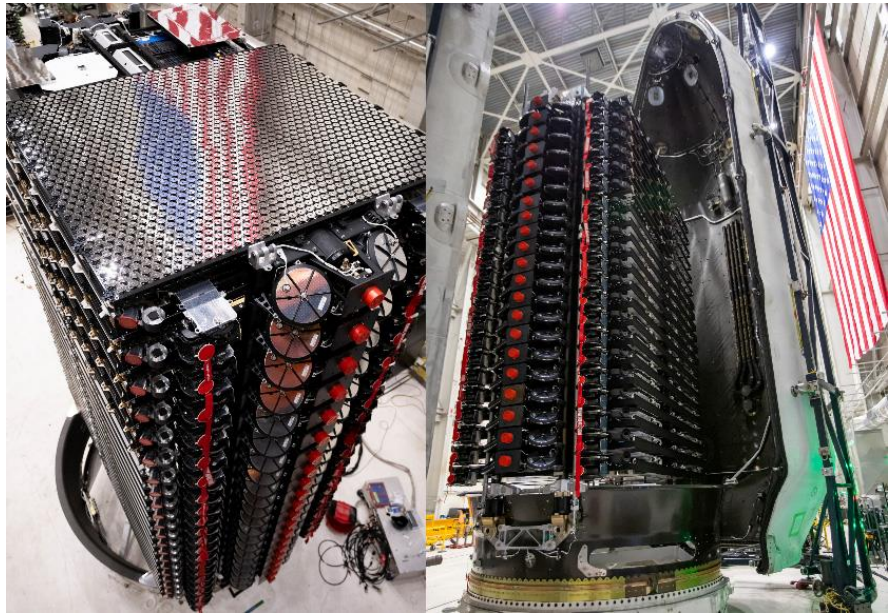
- Continuously improving architecture and satellite manufacturing scale enables higher capacity
- Anti-reflective coating protects view of the night sky once in orbit
- Satellites deorbit at end of life, leaving no space junk behind
- Starship will soon launch our V3 Satellites, adding **60Tbps** of capacity to the network per launch (More than **10x** the mass to LEO orbit)

70+
SATELLITES
added weekly

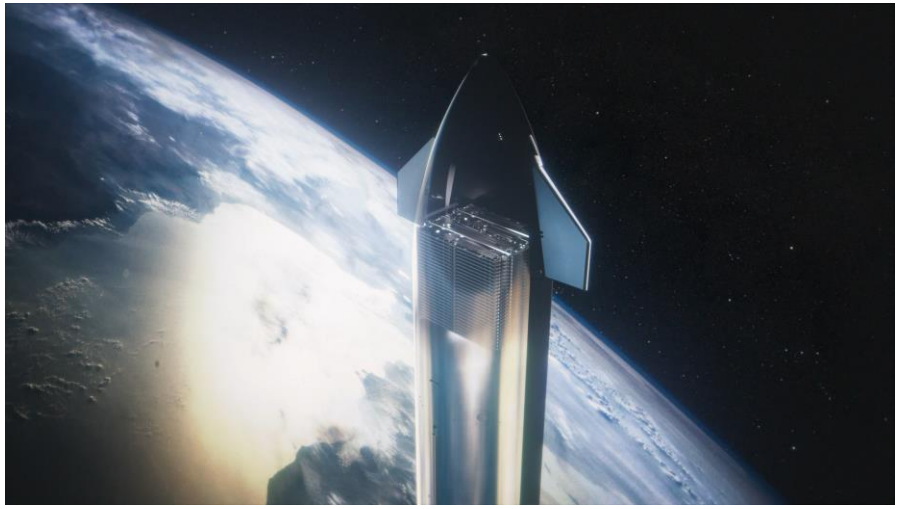
5+
YEARS
satellite service lifetime

90,000+
STARLINK KITS
Manufactured weekly

V2 Mini Satellites, stacked and ready for launch



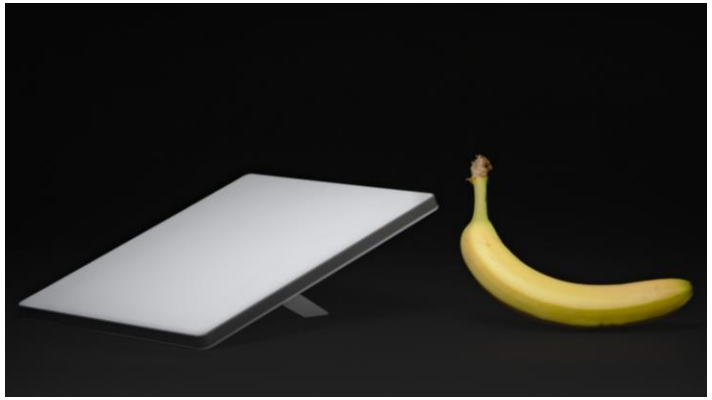
Starship Pez Dispenser releasing V3 Satellites to Orbit



STARLINK KITS

CONNECTING TO THE CONSTELLATION

MINI



STANDARD

PERFORMANCE

GIGABIT SPEEDS AVAILABLE IN 2026

400+

MBPS DOWN
varies by plan, location, and operating conditions

40+

MBPS UP
varies by plan, location, and operating conditions

20–100

MS LATENCY
users far from ground stations may experience higher latency

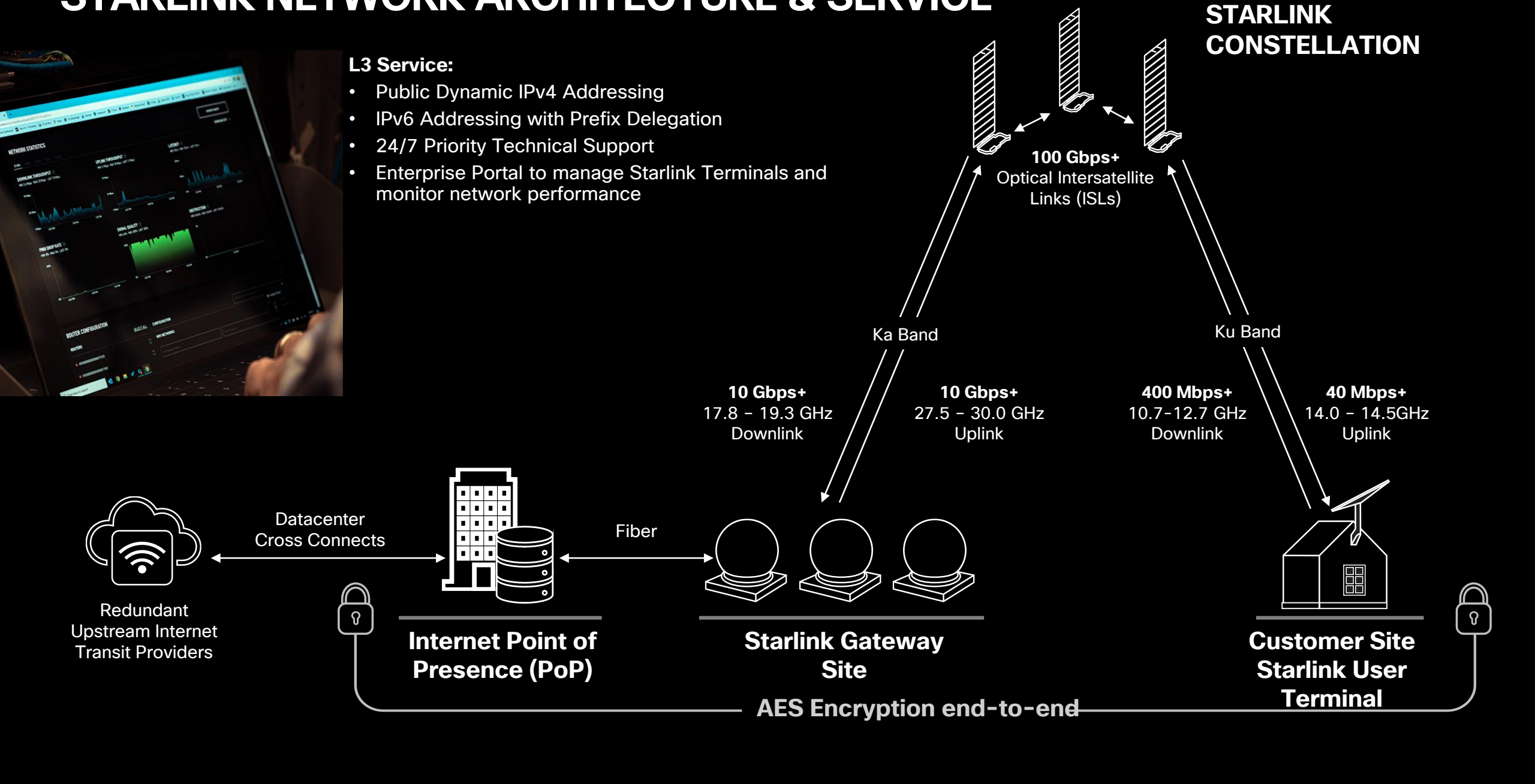
99.9%

Availability SLA
auto-credits users 20% of service cost if failed

STARLINK NETWORK ARCHITECTURE & SERVICE

L3 Service:

- Public Dynamic IPv4 Addressing
- IPv6 Addressing with Prefix Delegation
- 24/7 Priority Technical Support
- Enterprise Portal to manage Starlink Terminals and monitor network performance



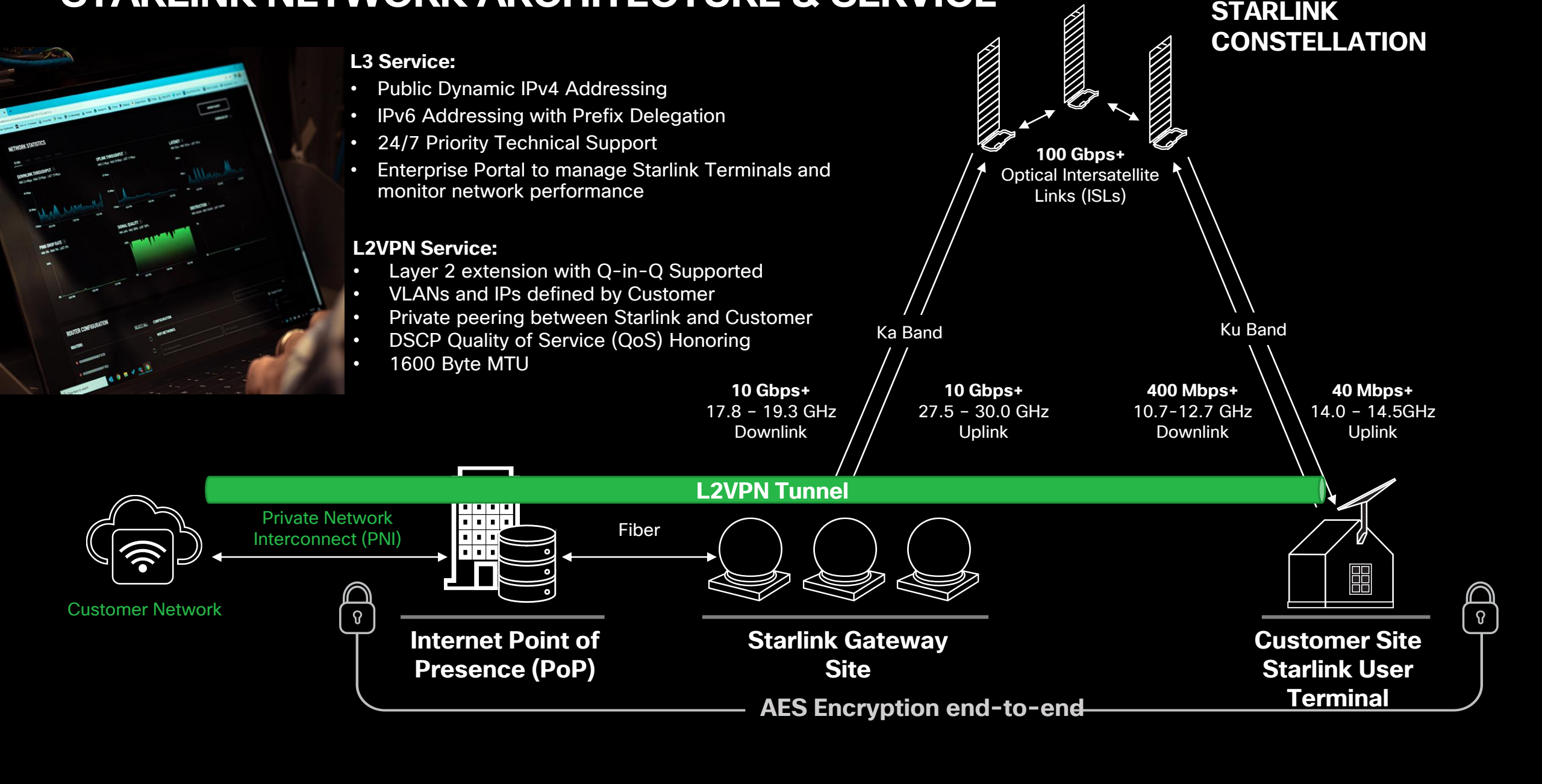
STARLINK NETWORK ARCHITECTURE & SERVICE

L3 Service:

- Public Dynamic IPv4 Addressing
- IPv6 Addressing with Prefix Delegation
- 24/7 Priority Technical Support
- Enterprise Portal to manage Starlink Terminals and monitor network performance

L2VPN Service:

- Layer 2 extension with Q-in-Q Supported
- VLANs and IPs defined by Customer
- Private peering between Starlink and Customer
- DSCP Quality of Service (QoS) Honoring
- 1600 Byte MTU



STARLINK AND CISCO

BETTER TOGETHER

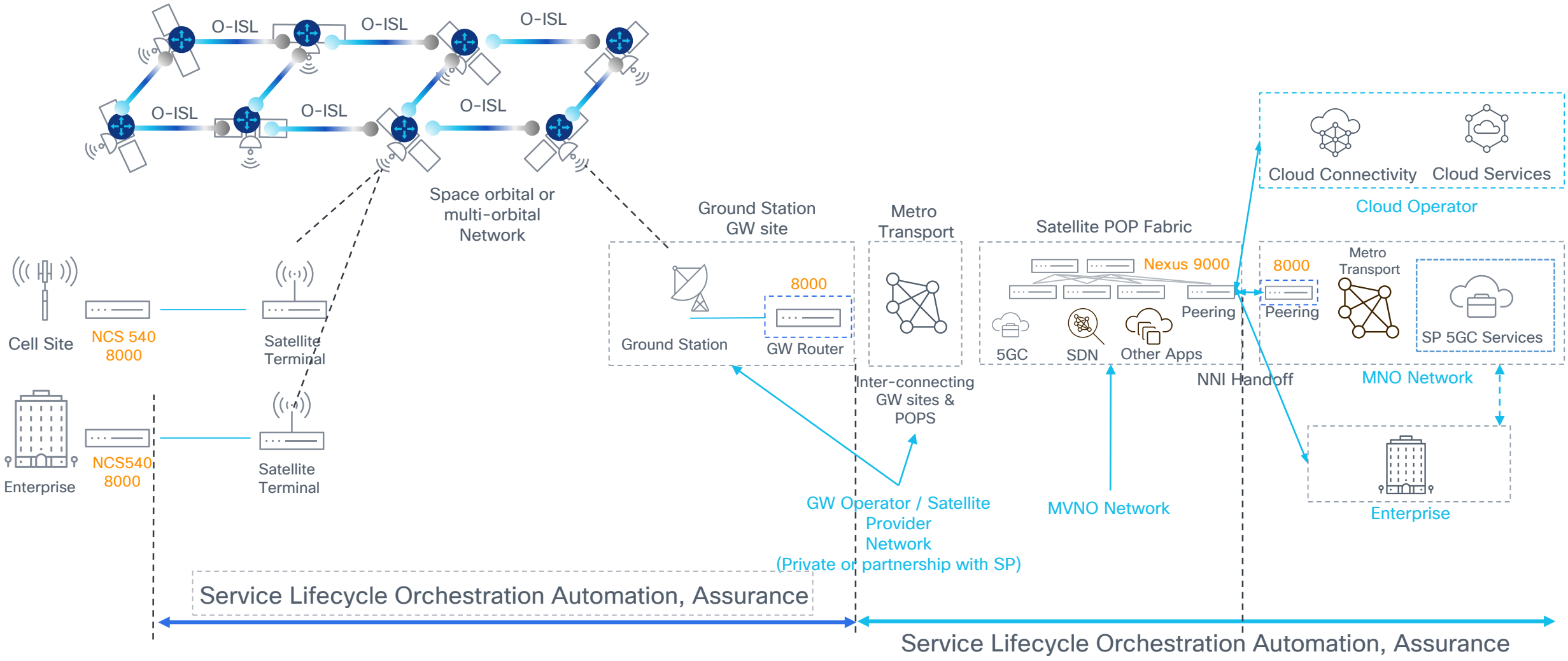
Improved Throughput

Improved Security

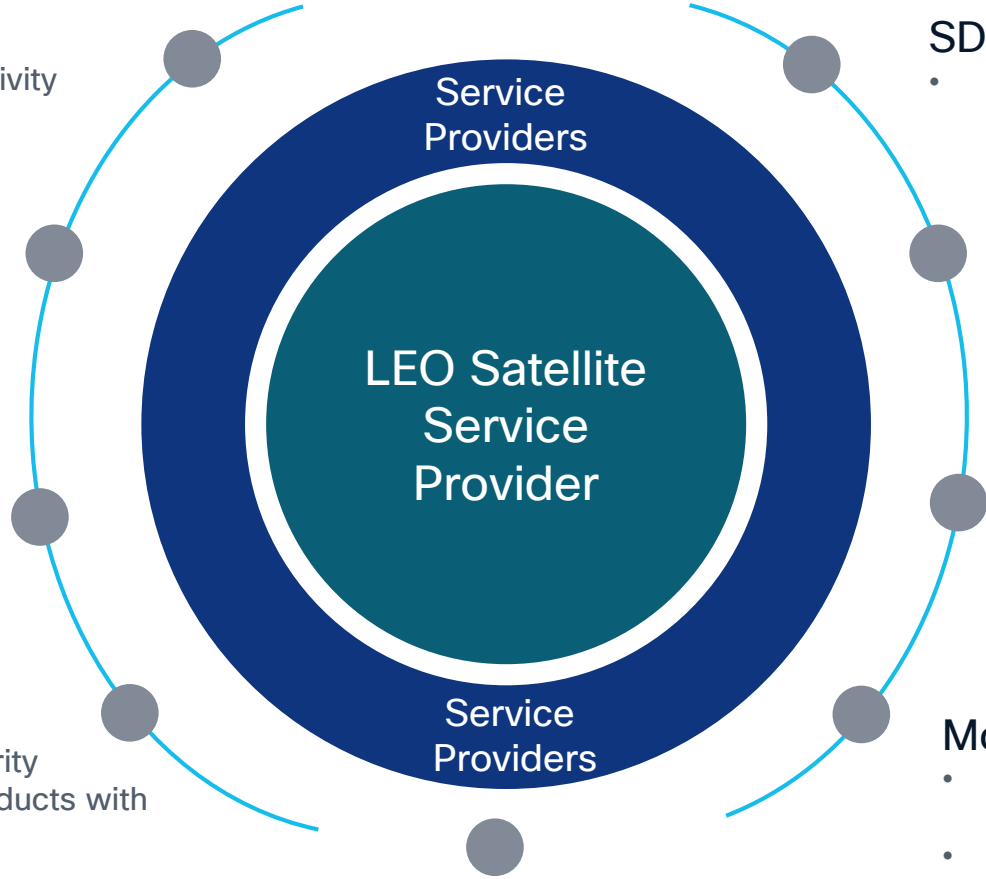
End-to-End Observability

Cisco Starlink Validated Solution

Convergence of Terrestrial and Non-Terrestrial Networks



Cisco Non-Terrestrial Networking Solutions



Private-5G
- Remote site connectivity
- Mobility

SD-WAN Managed Services
- Service on demand

Direct-to-Device / NTN-IOT
- Smartphone services
- Connected Car

Carrier Ethernet Services
- High Scale and mature feature sets
- MEF 3.0 Certified Platform

Mobility Roaming Partnership
- Broad coverage
- Global roaming

Terrestrial Infra services
- Metro Fabric Architecture
- 8000 or Nexus Based DC Fabric
- Mature Peering solution

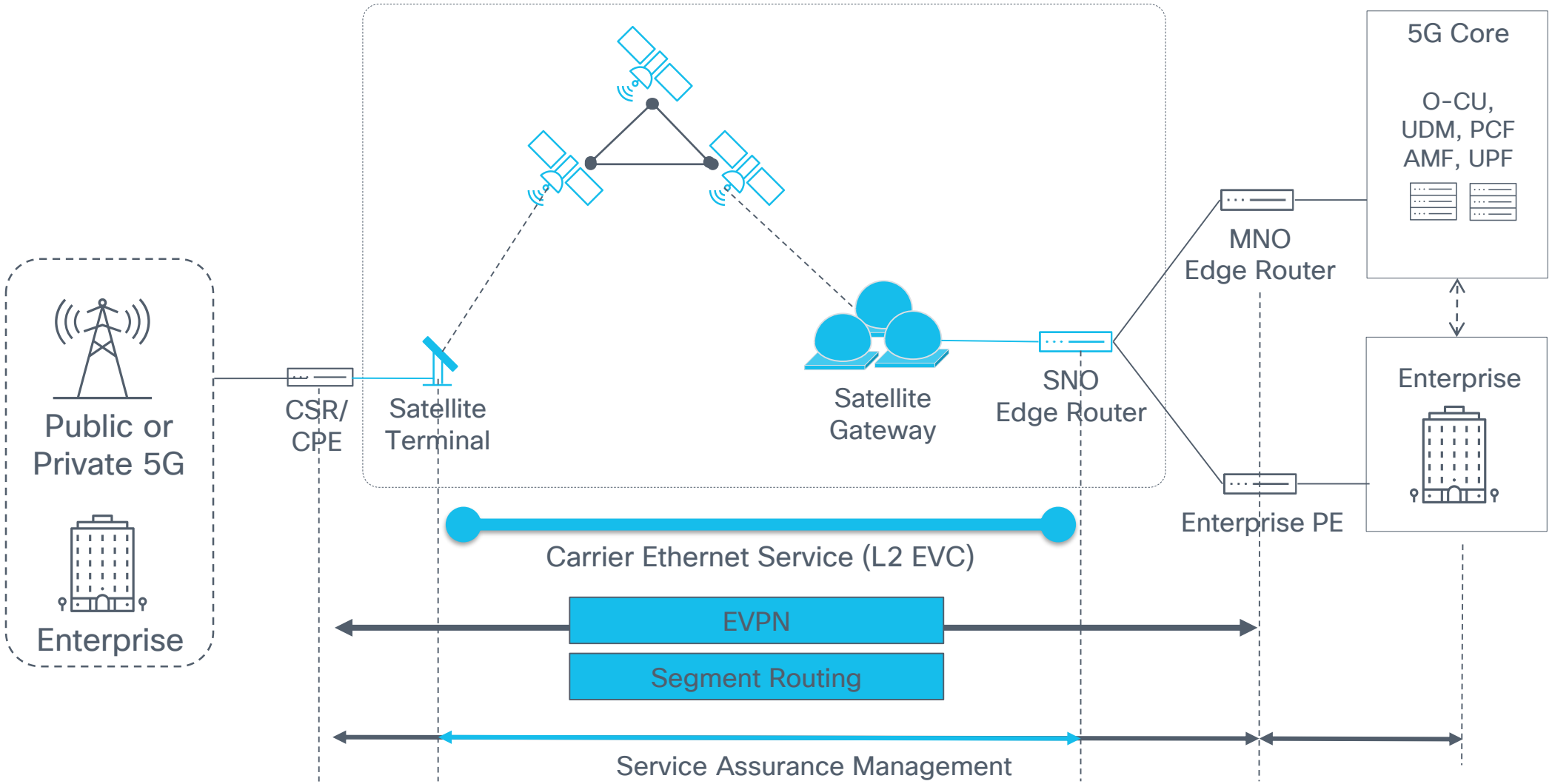
Security
- Post Quantum Security
- Trusted Routing Products with
  - Trust Anchor
  - Secure Boot
  - Secure OS and
  - DDoS protection

Mobile Backhaul
- Cell Site Router with dense 1/10G interface support
- Policy-Based Routing
- Time Synchronization

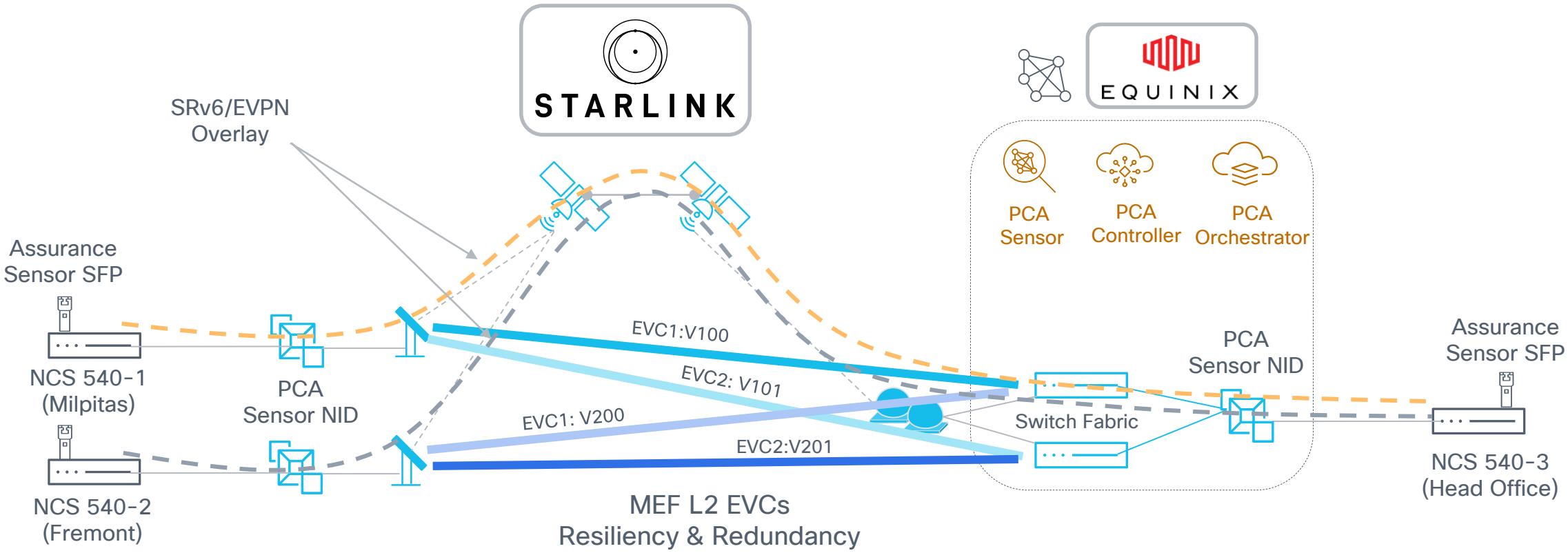
Service Assurance
- Performance visibility across domains with ThousandEyes
- SLA measurement with PCA
- Improve User Experience with PCA-UE

Enterprise VPN & Telecom Backhaul with Provider Connectivity Assurance (PCA)

MEF Layer 2 EVC Service over NTN



Cisco Starlink Lab Topology



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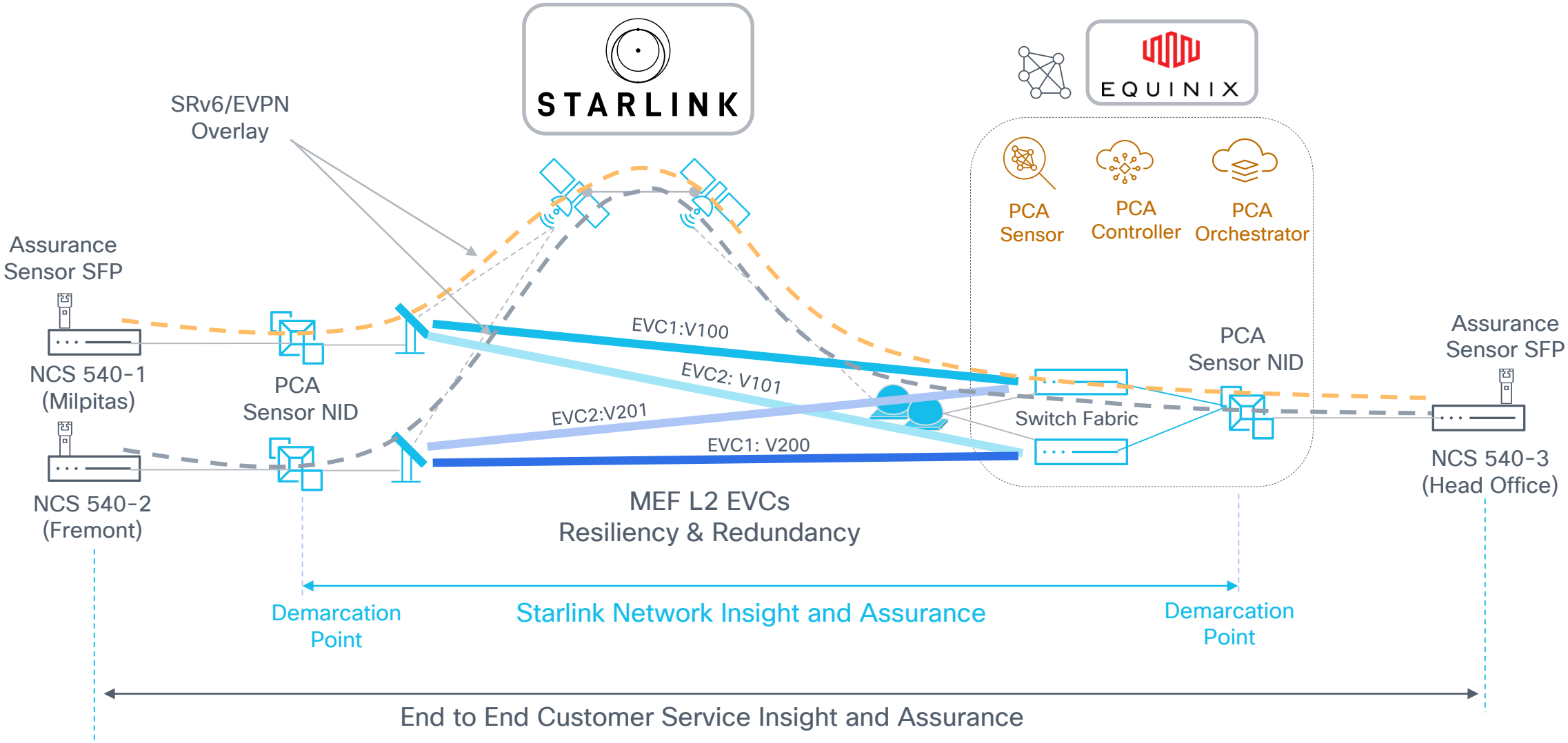
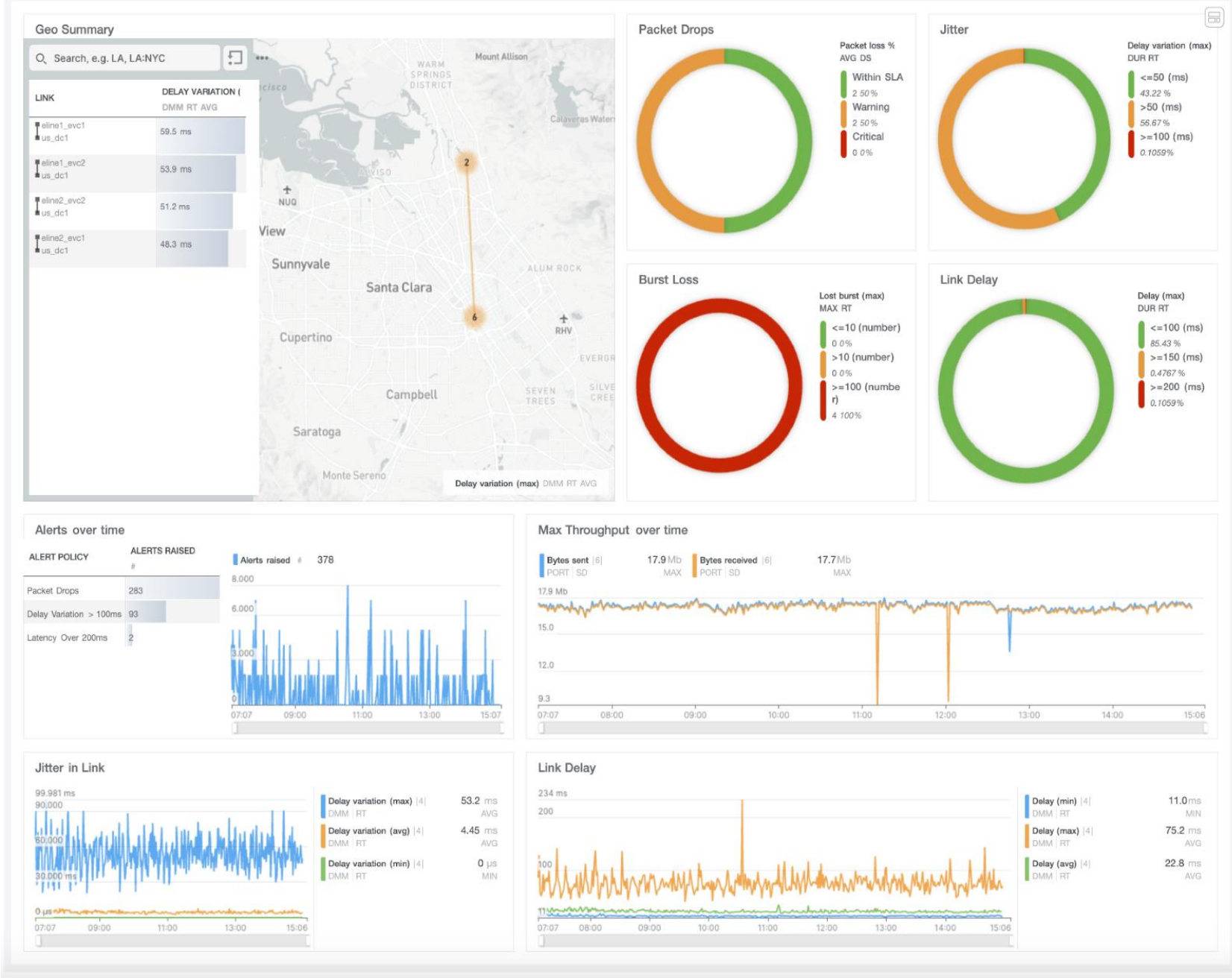
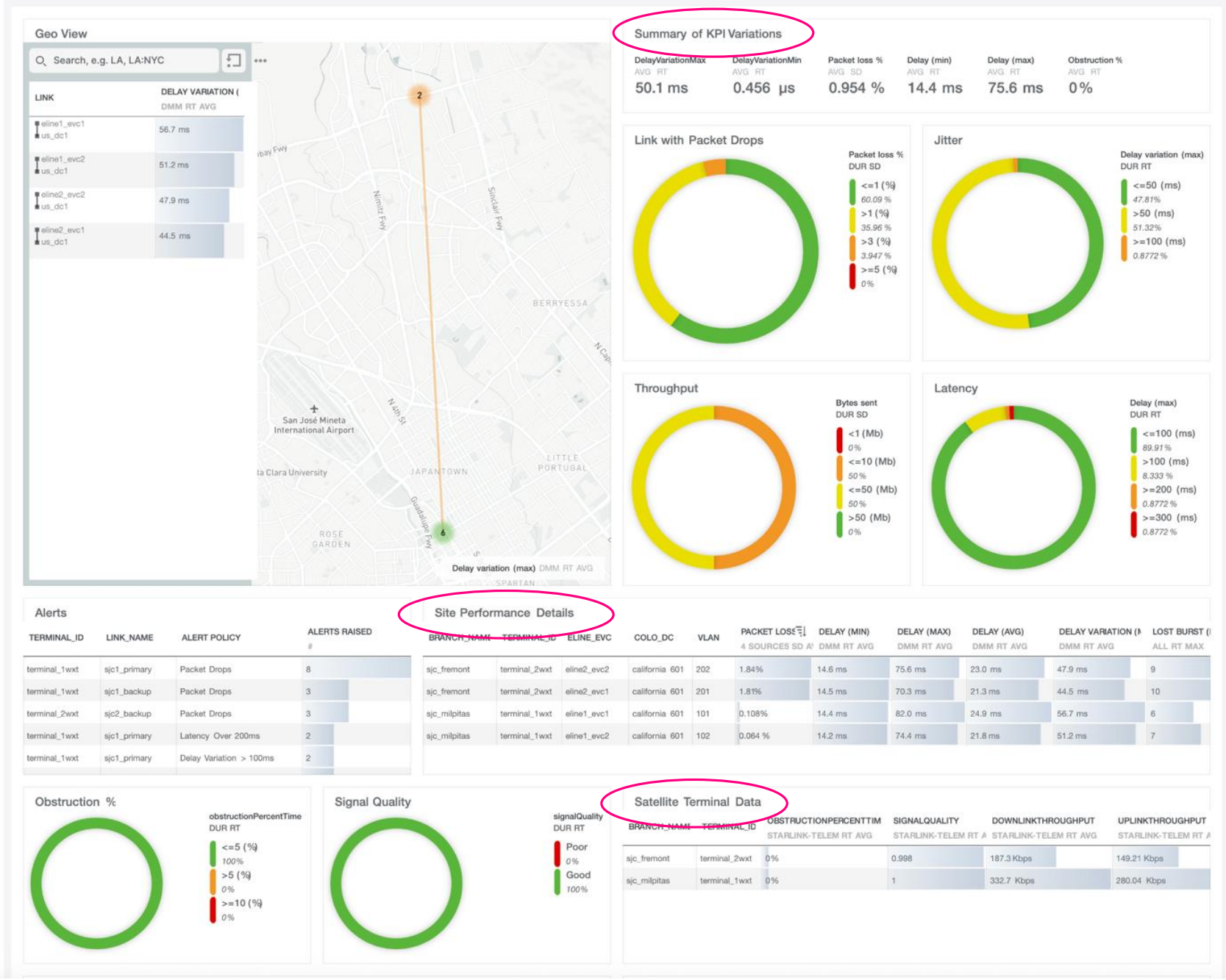


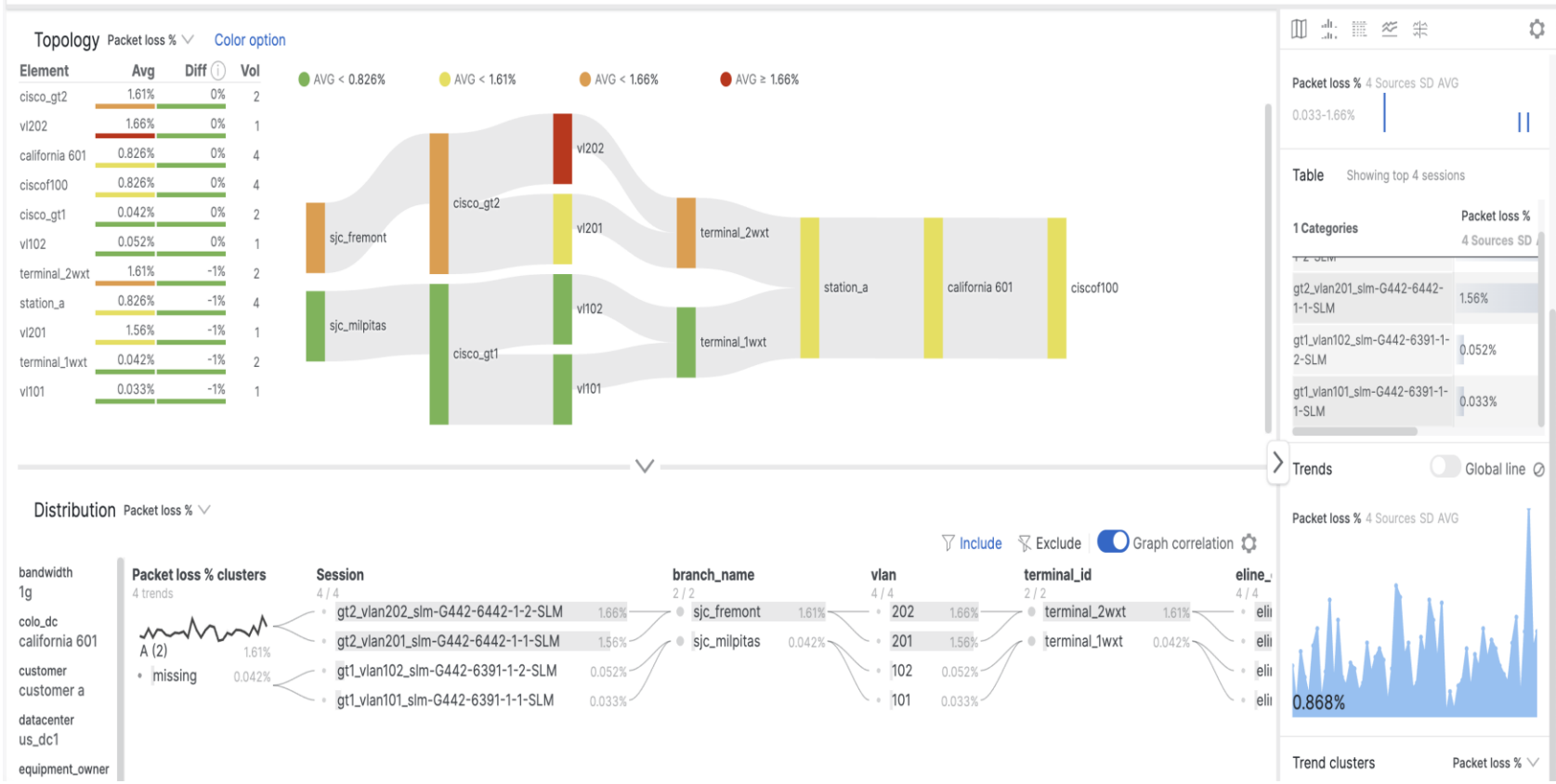
Satellite Network Insight



End-to-End Service Insight



Correlation Analysis on Patterns, Trends, Location data



Cisco NCS 540 and 8000 Series Platforms

Infrastructure Security

- Immutable Hardware Root of Trust
- Secured boot anchored in Hardware
- Session Key Service for Quantum-resistant Security
- Edge Protection: fastest attack detection & Mitigation
- Unique Operation Security features

Platform Advantages

- MEF 3.0 Certified
- Varied connectivity options for terrestrial and non-terrestrial convergence: 1G/10G/25G/50G/100G/200G/400G
- Rich Carrier Grade Features including SRv6/EVPN and Timing Sync and Secure ZTP
- Carrier Grade Scale

Integrated Insight

- SR-PM and SR-IPM
  Network End-point liveness monitoring
- Integrated Packet loss, latency and jitter measurement reduced number of monitoring protocols
- Intelligent Packet Routing and traffic load-balancing

Agile Services Networking

Cisco's vision and strategy

Cisco Validated Design

A network architecture for AI connectivity that enables service providers to monetize the delivery of assured services and networking

AI-powered automation and assurance

Edge Functions

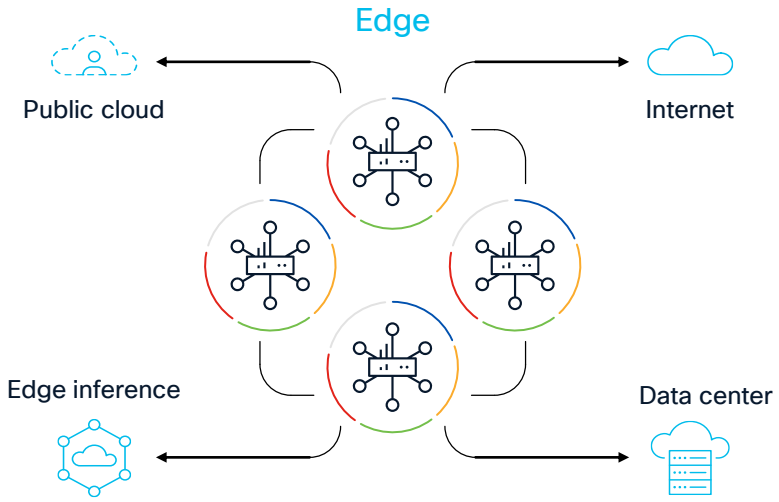
- Business services
- Distributed peering
- Subscriber services
- 5G services
- Security services

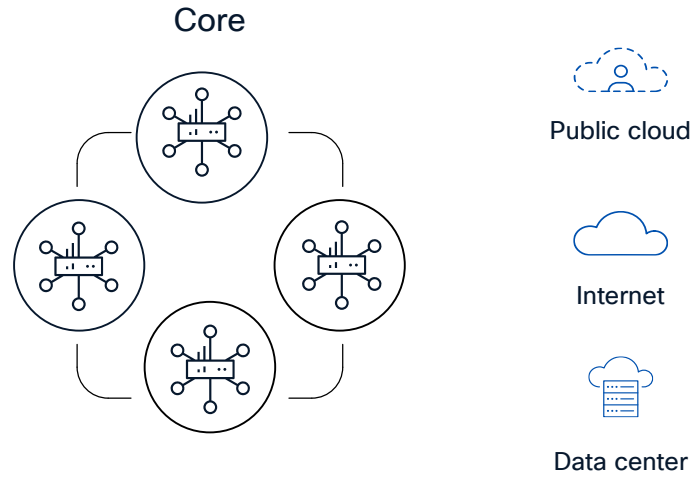
NTN

Mobility

Residential

Enterprise



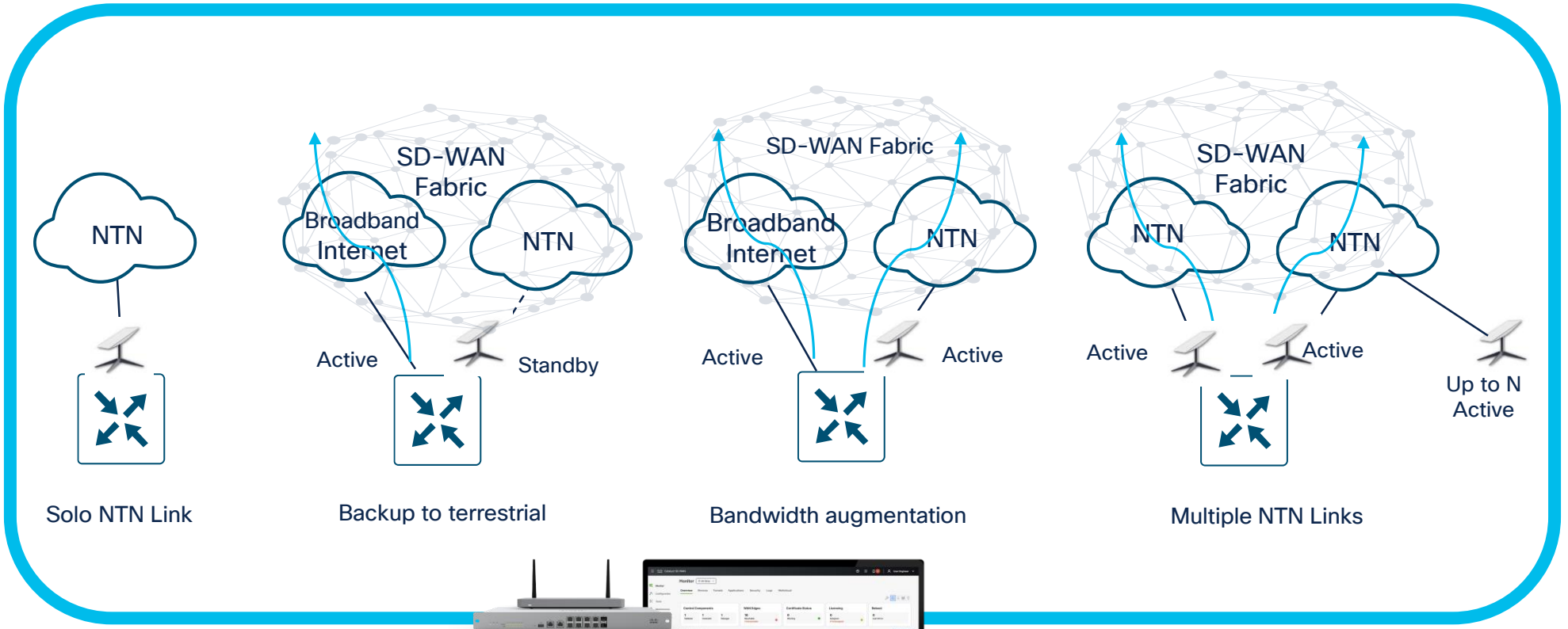


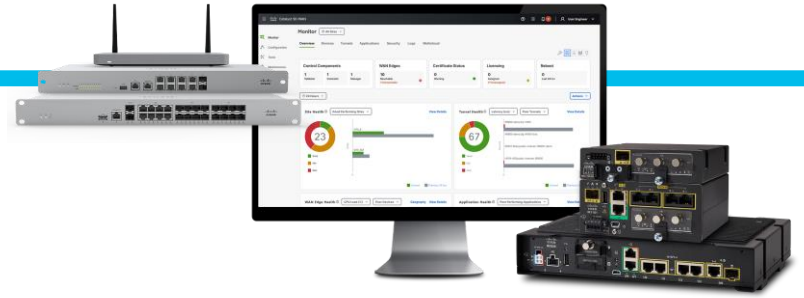
Routed optical networking

Better performance	Simplified networking	Efficient transport	Increased resilience

Cisco SD-WAN with Starlink Broadband Internet

SD-WAN Test Scenarios





Improving Application Experience

Problem

1. LEO satellite networks can experience higher latency and packet loss than traditional networks due to factors like atmospheric interference, satellite handoffs, and network congestion

2. Satellite communication report average packet loss of 1-2%, with occasional spikes up to 4% or more

3. TCP's reliability mechanisms are designed to handle some degree of packet loss, but even 1% packet loss can significantly degrade application performance (70.7% decrease observed)

App-QoE Solutions

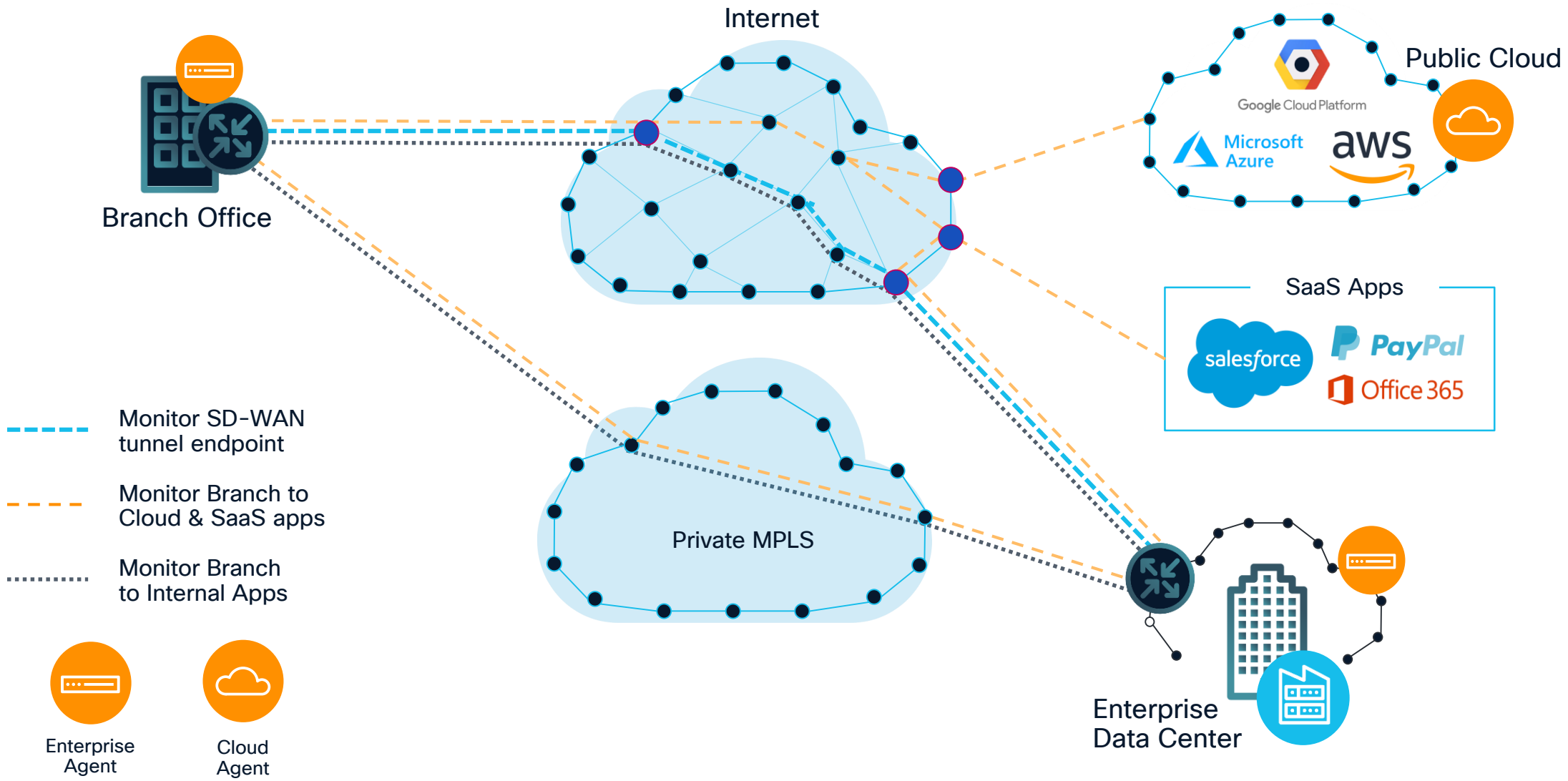
- Application-Aware routing can re-route traffic to terrestrial links (when available) in when packet loss over satellite exceeds a particular threshold of loss or latency
- Packet Duplication policies that replicate traffic flows over multiple links to reduce the impact of loss on a single link
- Forward Error Correction policies that reconstruct lost packets
- TCP optimization policies that proxy local TCP connections and multiplex over optimized (BBR2) connections between WAN edge routers
- Compression policies such as DRE/LZ which reduce the amount of traffic sent over the WAN

Performance Results

Test Name	Single iPerf Flow	Multiple iPerf Flow
TCP Baseline	30-50 Mb/s Download 5-7 Mb/s upload	50-57 Mb/s download 9-12 Mb/s upload
Packet Duplication	50-60 Mb/s Download 5-7 Mbps upload	60-80 Mb/s Download 9-11 Mb/s upload
Forward Error Correction (FEC)	50-80 Mb/s Download 5-7 Mb/s upload	120-140 Mb/s Download 10-12 Mb/s upload
TCP Optimization	150-200 Mb/s Download 5-7 Mb/s upload	220-255 Mb/s Download 15-18 Mb/s upload
FTP Baseline	4.33Gb file in 4min 10 Sec (8.5Mbps)	
FTP DRE/LZ + TCPopt	4.33Gb file in 1min 26 Sec (50Mbps)	

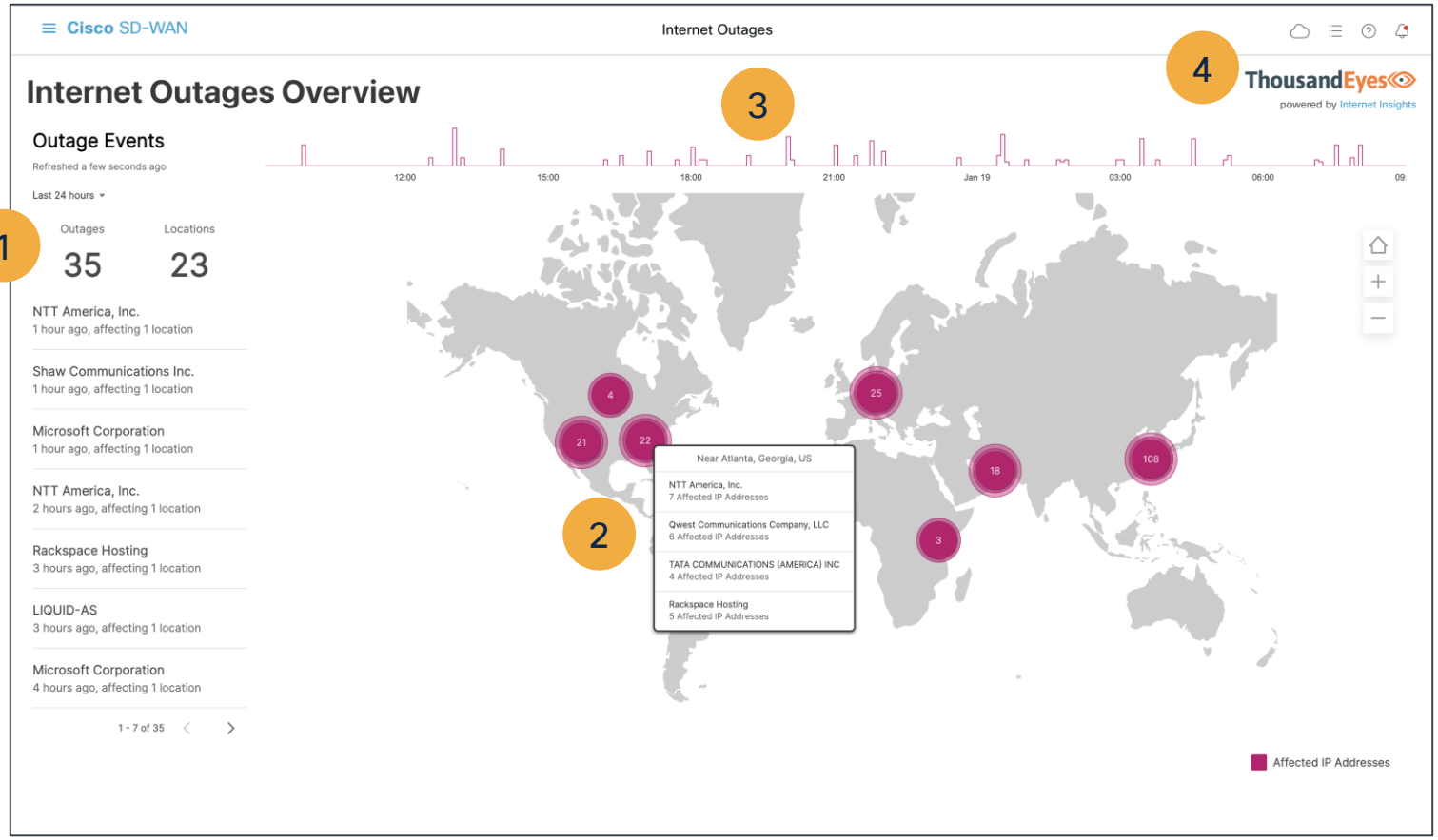
Overlay Visibility with ThousandEyes

SD-WAN visibility needs; beyond the overlay



Internet Outages Overview

Powered by ThousandEyes Internet Insight



Leverage insights on Internet outages to manage user's digital experience

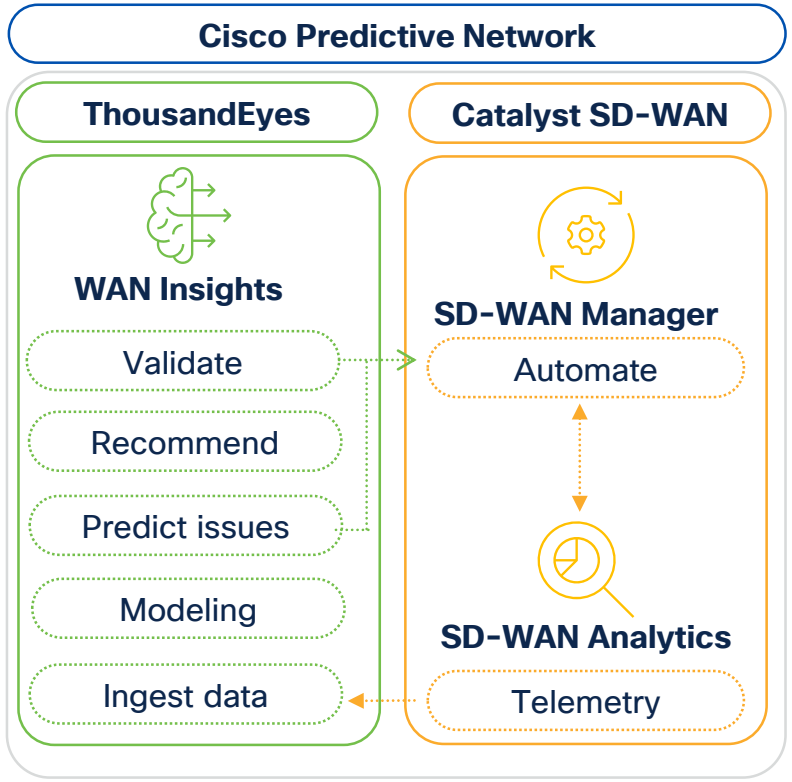
1. Detect ISP outages across the Internet
2. Discover the number of impacted locations and IP addresses
3. Gain insights into historical trends in Internet outages
4. Preliminary insights with SD-WAN Manager; ThousandEyes Internet Insights* for real-time insights into SaaS apps & networks

Predictive Path Recommendations

A Closed Loop Automation

- Predictive Path Recommendations (Powered by Thousand Eyes WAN Insights) generates predictive insights of recommended paths for application by leveraging telemetry from SD-WAN network.

- User can simply click on apply recommendation on SD-WAN Analytics and it triggers closed loop automation on SD-WAN Manager to update the centralized policy to use the recommended path for the specific application.



Underlay Measurement and Tracing Service (UMTS)

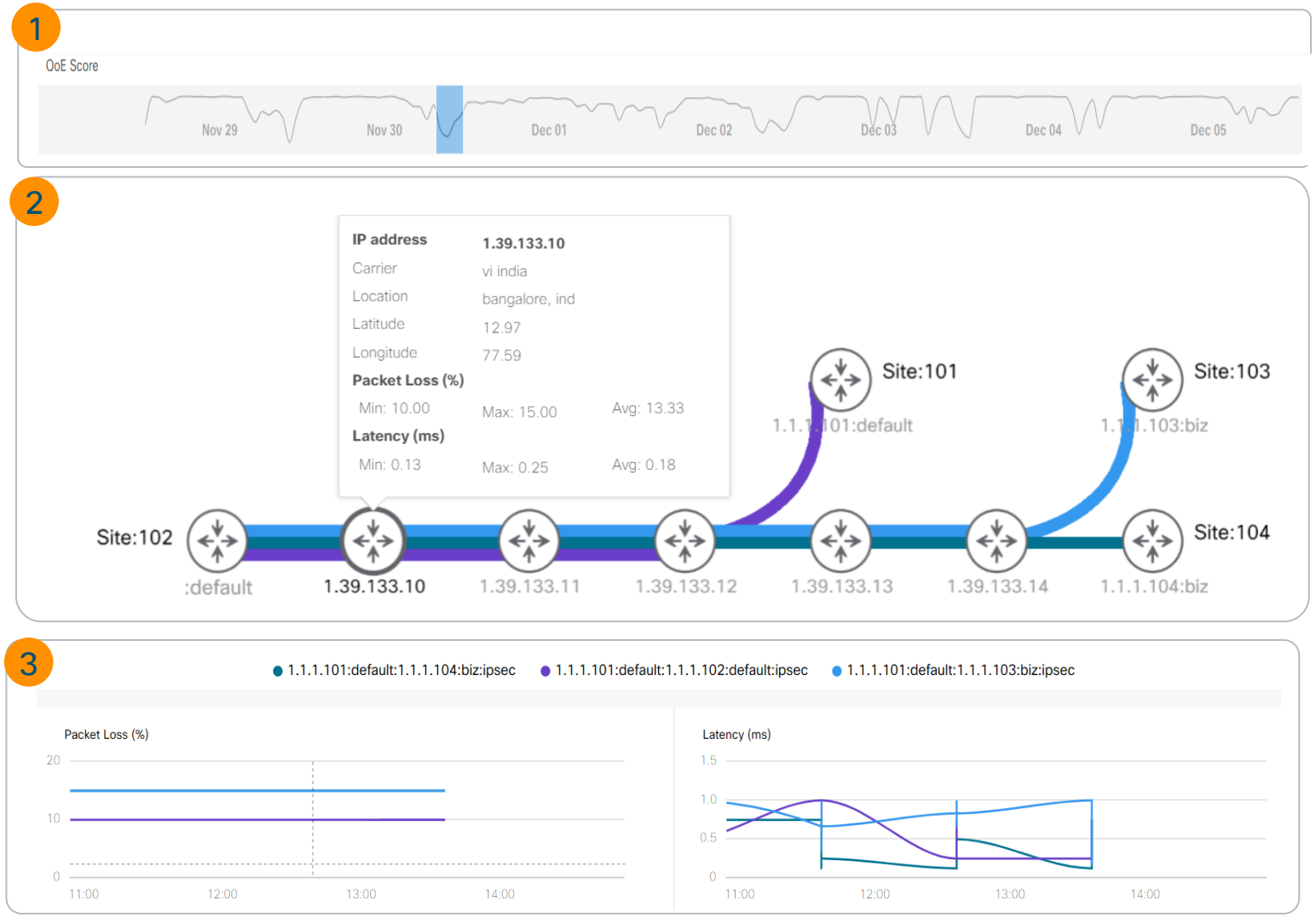
Benefits

Gain visibility into the exact underlay path against SD-WAN tunnel

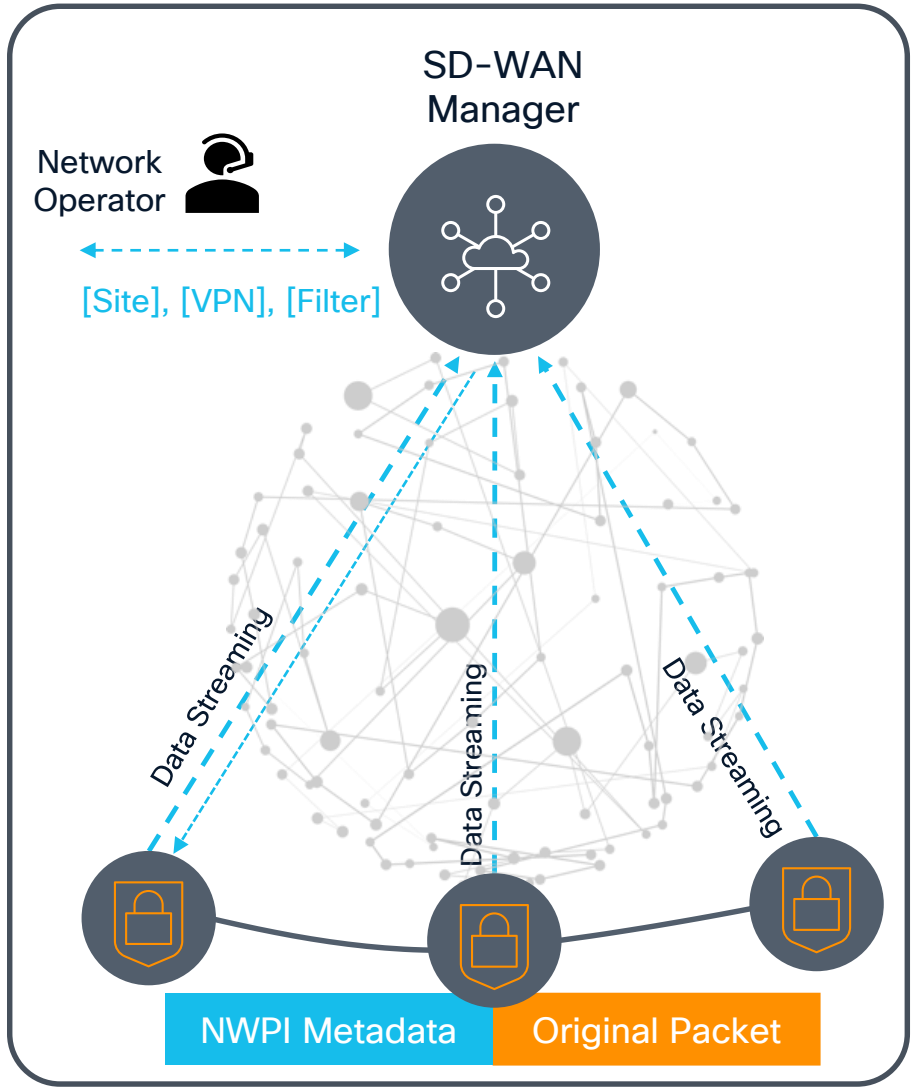
(including hop-by-hop metrics)

Highlights

1. Zoom into the specific time period showcasing drop in application health (QoE) trend line
2. View the hop-by-hop underlay path along with loss and latency metrics at every hop
3. View associated loss, latency besides underlay path



Network Wide Path Insight (NWPI)



NWPI provides network wide insights such as packet trace with network path info, path performance metrics and helps to validate policy design.

- Identifies application performance issues:
  - Flow Asymmetry
  - Bi-directional TLOC color Inconsistence
  - QoS congestion,
  - Local or WAN Interface drops
  - SLA violation
  - Path Change
  - Flow Reset
  - DPI packet classification status (First Packet Match failure etc.)

- Provides complete insight summary
  - Path insight - path selected and what features/policies have determined that routing decision.
  - Application Performance Insight – SLA violations
  - QoS Insight – congestion Alarms
  - Auto-on task can be configured to trigger the trace automatically.

Summary

Cisco validated design with Starlink provides ready to deploy solution

Improves User Experience and service throughput

Simplifies Deployment with network insights

Reduces Risk with enhanced security

Further reading and Learning Map

Cisco Non-Terrestrial Networking
www.cisco.com/go/NTN

Jun 10th | 1:00 pm
BRKSEC-2173
Starlink Security Advanced

Jun 10th | 2:00 pm
BRKNWT-2505
Practical LEOsat Deployments – Technology Use Cases and Outcomes

Jun 10th | 4:00 pm
BRKENS-2611
Deploying Catalyst and Meraki to Support Any User At Any Location

Jun 12th | 1:00 pm
BRKSPG-2046
Unifying On-The-Move Wireless Networks Across 5G, Wi-Fi, and Satellite for Emergency Services using SRv6

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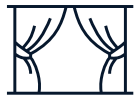

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