

Evolution of the Transport Network Architecture in the Age of 5G, 6G and AI

cisco Live !

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Webex App

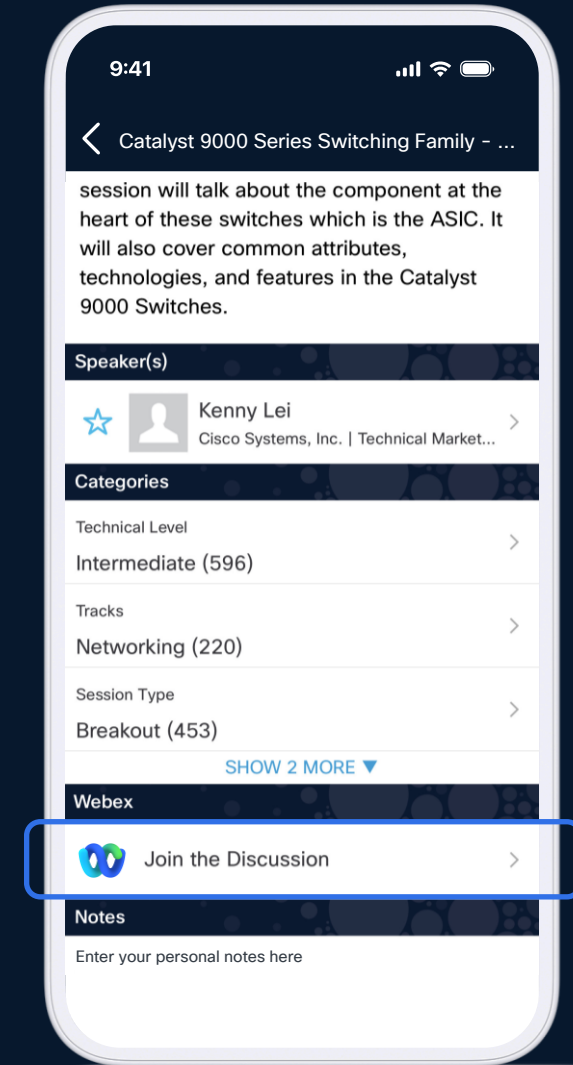
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Webex spaces will be moderated by the speaker until February 27, 2026.



Agenda

01 Industry Trends and Drivers 5G, 6G & AI

02 Architectural and Technology Factors

- AI-RAN and Edge Cloud
- SRv6 and Benefits for xHaul
- Hybrid Synchronization for 5G and Beyond
- NTN / Satellite Integration
- Autonomous Networks, Visibility & Assurance

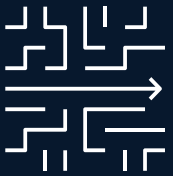
03 Cisco Solution Blueprint

04 Summary

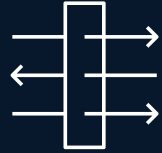
Industry Trends and Drivers

The fundamentals of connectivity

The *objectives* have not changed...



Simplified and
autonomous operations



Increased service
resiliency



Lowest TCO
and carbon footprint



New monetization
opportunities



Unparalleled
customer experience

... but the architectural imperatives and ecosystem have evolved

New requirements
of AI

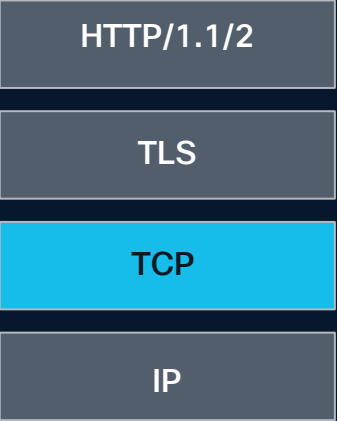
Different service
endpoints

Security is
paramount

Changing Traffic Profiles

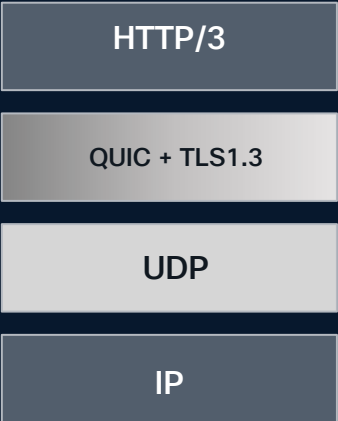
HTTP/3 Stack = UDP+QUIC+TLS

Old App Stack



New App Stack

QUIC - RFC 9000
HTTP/3 - RFC9114



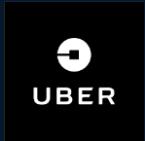
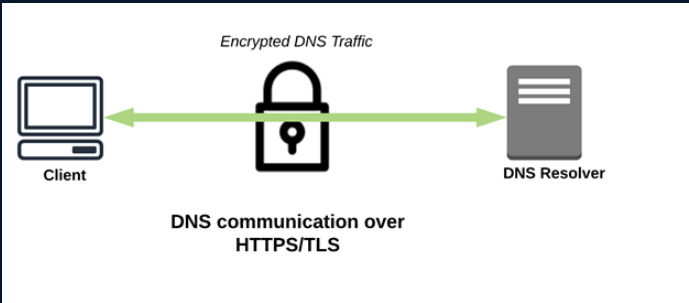
DoH

DoT - RFC7858
DoH - RFC8484



eSNI / ECH

RFC8744



Large Scale Adoption

DoT: DNS over Transport Layer Security
DoH: DNS over HTTPS
eSNI: Encrypted Server Name Identification
ECH: Encrypted Client Hello

Roadmap to 6G

- 5G NR Foundation
- LTE Integration
- Sub-6 GHz with massive MIMO
- FWA
- 5G for Venues and Enterprise

- eURLLC and TSN for IIoT
- In-band eMTC/NB-IoT
- Positioning
- NR in unlicensed band
- IAB
- 5G Broadcast
- 5G V2X side-link multicast

- Enhanced DL/UP MIMO
- NR-Light Reduced Capability (RedCap) for low-complexity IoT
- Non-Terrestrial Network (Satellites)
- Unlicensed/Licensed spectrum in 60GHz
- Centimeter accuracy IIoT with mmwave
- Improved IIoT, Positioning and IAB

- eMBB Enhancements
- Full-duplex MIMO
- Extended Reality (XR)
- NTN Enhancements, Drones
- 5G NR-light enhancements
- AI/ML driven designs
- Broadcast enhancements
- Side-link enhancements
- Sustainability

....
....

6G

Release 20+

Release 19



Release 15

Defines Foundational 5G NR Technology

Release 16

Includes new use cases and industry verticals

Release 17

Technology enhancements and expansion



Release 18

"5G Advanced"
2nd Wave of innovations

5G Advanced and 6G capabilities

Ultimate 5G performance



- Enhanced Massive MIMO
- Reduced handover time
- Improves spectral efficiency
- Non-terrestrial networks (NTN)

New services



- Enhanced URLLC and Extended Reality (XR) support
- 5G RedCap* device support
- Enhanced positioning and time-critical support

Energy efficiency



- Intent-based energy-savings services and functions
- New 3GPP lean methodology

Intelligent automation



- AI-based RAN load management and optimization
- AI-based air interface enhancements
- Improved sensing

* 5G RedCap: Reduced Capability

Is AI traffic moving the needle?

2022

ChatGPT released
5 days, ChatGPT surpassed 1 million users

2024

65% of organizations
regularly use generative AI

2030

120% CAGR increase in
AI-enriched network traffic

1448%

Increase in tokens
processed by AI
models in the last 12
months¹

36x

Increase in AI traffic as
early as 2023-2024³

75%+

Of data creation and
processing at the edge
by 2030, driven by AI
inferencing²

52%

of enterprises see AI-
ready transport as
crucial for SPs to
become key players in
the AI value chain⁴

1: [Openrouter.ai/rankings](https://openrouter.ai/rankings)

2: KPMG

3: [Openrouter.ai/rankings](https://openrouter.ai/rankings)

4: STL Partners

Telco role

“Telcos have an opportunity to serve as the backbone of the AI era (...) the most significant risk may come from inaction, as telcos face the possibility of missing out on their fair share of growth from this latest technological disruption.”

McKinsey, February 28, 2025

Increasing AI Traffic – Characteristics



AI inferencing is needed at the edge, leading to new network requirements



AI drives a disproportional increase in upstream traffic



Every AI request is unique—no content is cached



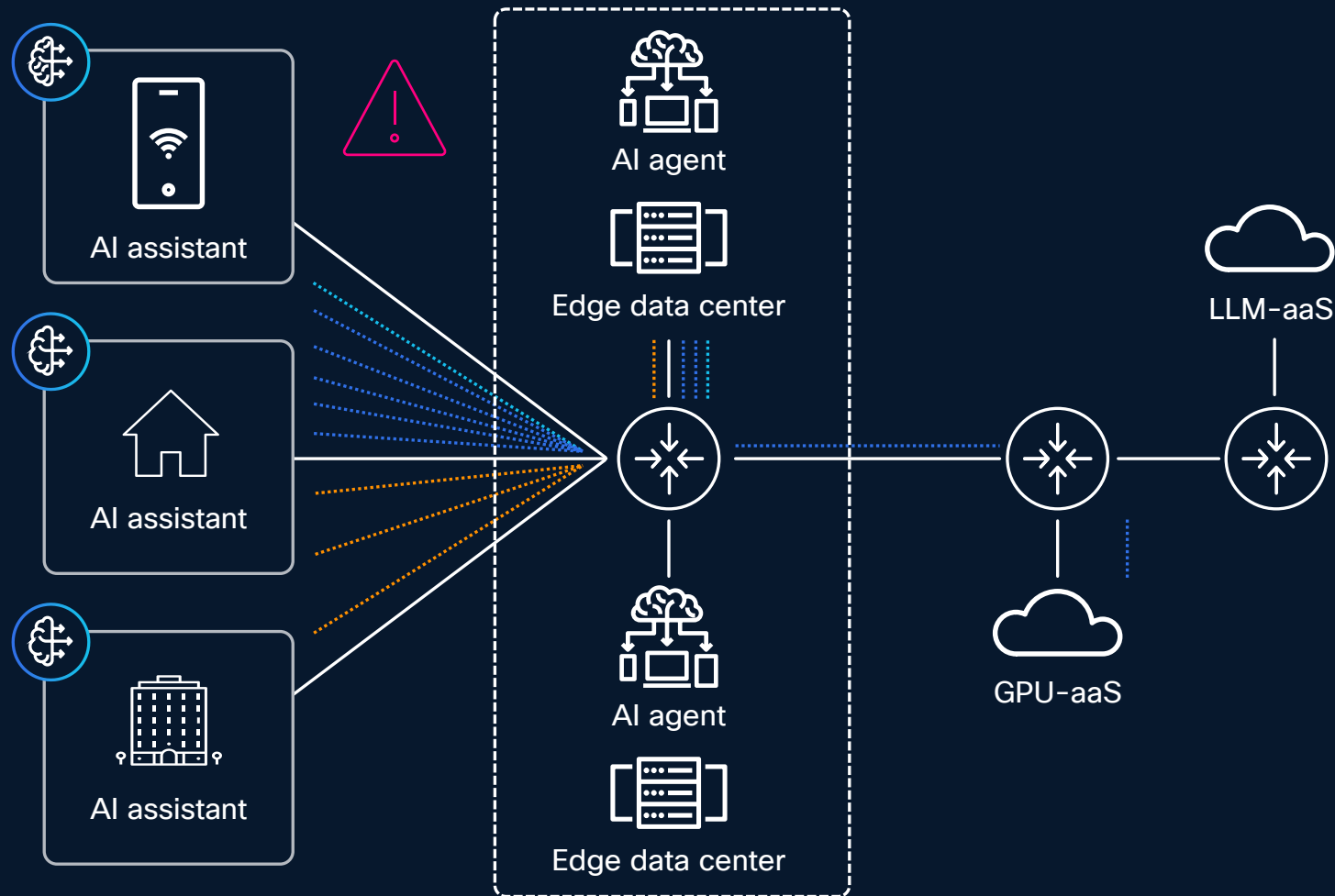
AI requests generate a high volume of tokens



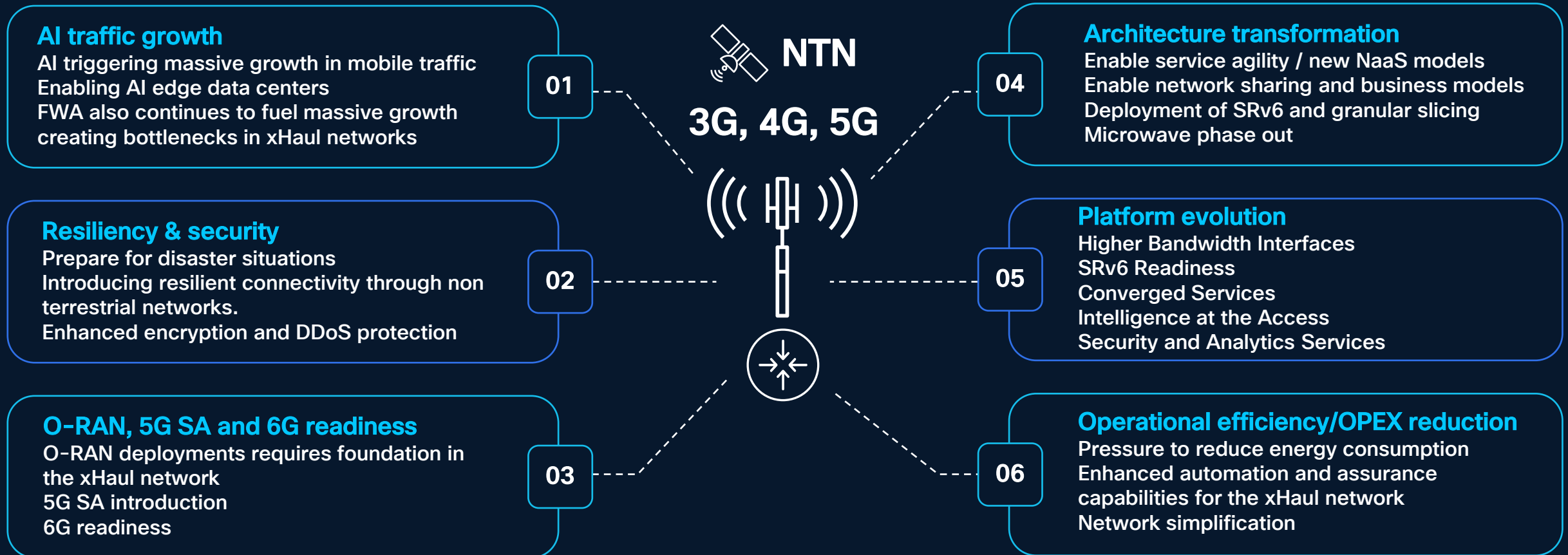
1% packet loss = 50% hit in AI application performance



Agentic AI Traffic – Busy Hour?

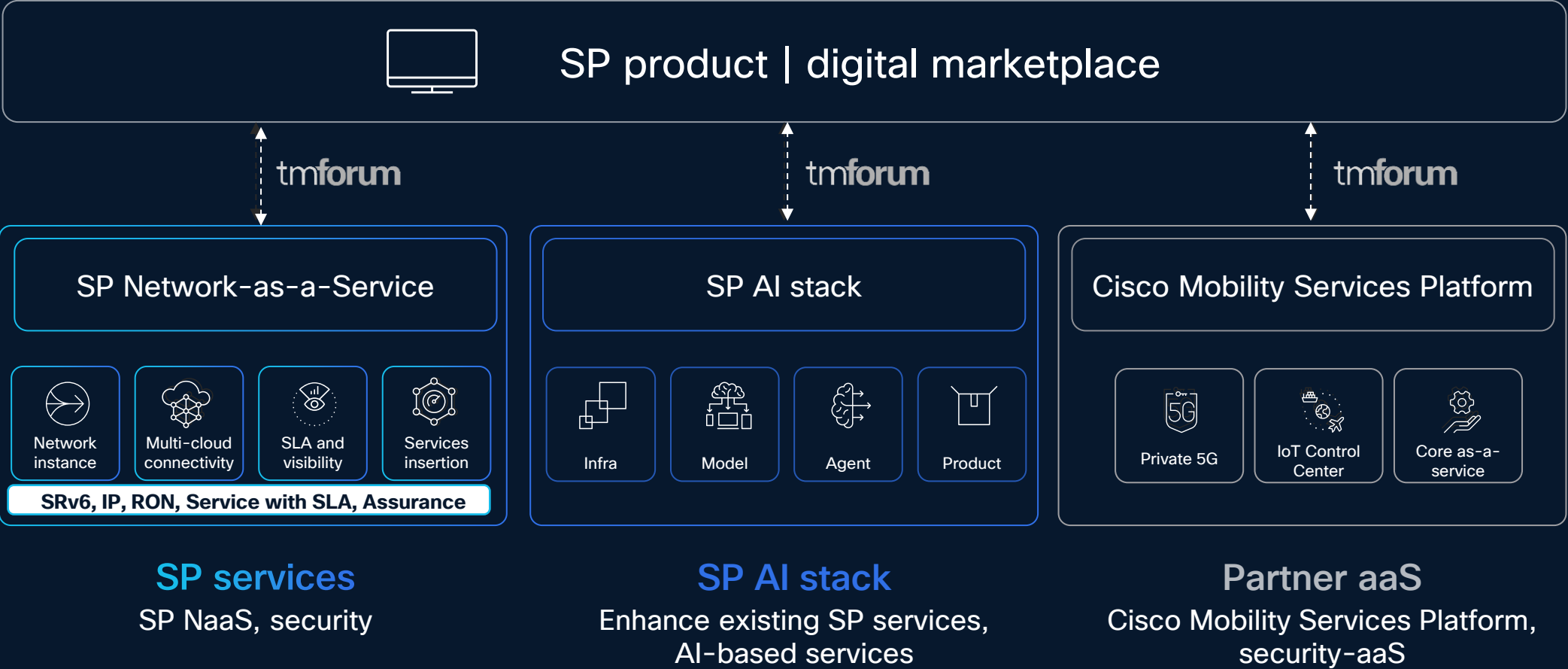


The time to re-think the xHaul architecture



AI-powered services

Combine AI, core assets, and partner value into end-to-end, market-ready solutions



Key pillars for future network readiness

secure, resilient, and autonomous



Architecture

- AI-ready, low-latency, scalable, multi-service, **IP Fabric**
- Optical and NTN integration
- **Edge as function** and seamless DC integration



Capacity

- **10G-400G xHaul** with resiliency
- 100/400/800G in Aggregation/Edge
- 400/800G/1.6T Core and DCI



Simplicity

- **Consistence experience** and capabilities:
- **Silicon, Software, Protocols and Service creation**
- SRv6, SyncE & PTP, BGP + EVPN



Visibility & observability

- Real time **Telemetry** & Streaming Data
- Preventive **Anomaly Detection** & Root Cause Analysis
- Performance and **accuracy assurance**



Automation & security

- Closed-loop management & service **automation (AIOps)**
- Infrastructure and Perimeter **Security** (DDoS, MACSec), **Quantum encryption**

End to End Slicing with SLAs and KPIs

Architectural and Technology Factors

AI-RAN and Edge Cloud

AI for 5G RAN



AI for Networks



- Channel Feedback
 - Improve download throughput, reduce uplink overheads
- Beam Management
 - Improve beam selection accuracy, reduce latency
- Precise Positioning



- Coverage and Capacity optimization
- Optimizes handovers
- Improves energy savings
- New use cases with network slicing



- AI and automation together are key to enable advanced features for 5G SA
- Critical to adopt 6G



5G SA

AI for Transport Network



AI for Networks



• Network Assistance

- Optimize Network
- Improve performance KPIs

• Predictive Maintenance

- Predict network failures
- Reduce downtime
- Improve network efficiency



• Field Tech and Deployment Assistance

- Chatbot or Virtual assistance for support
- Enhance customer experience



• Cost Optimization

- Improves operational efficiency
- Enhance capacity planning
- Drives Energy Savings

• Fraud Prevention

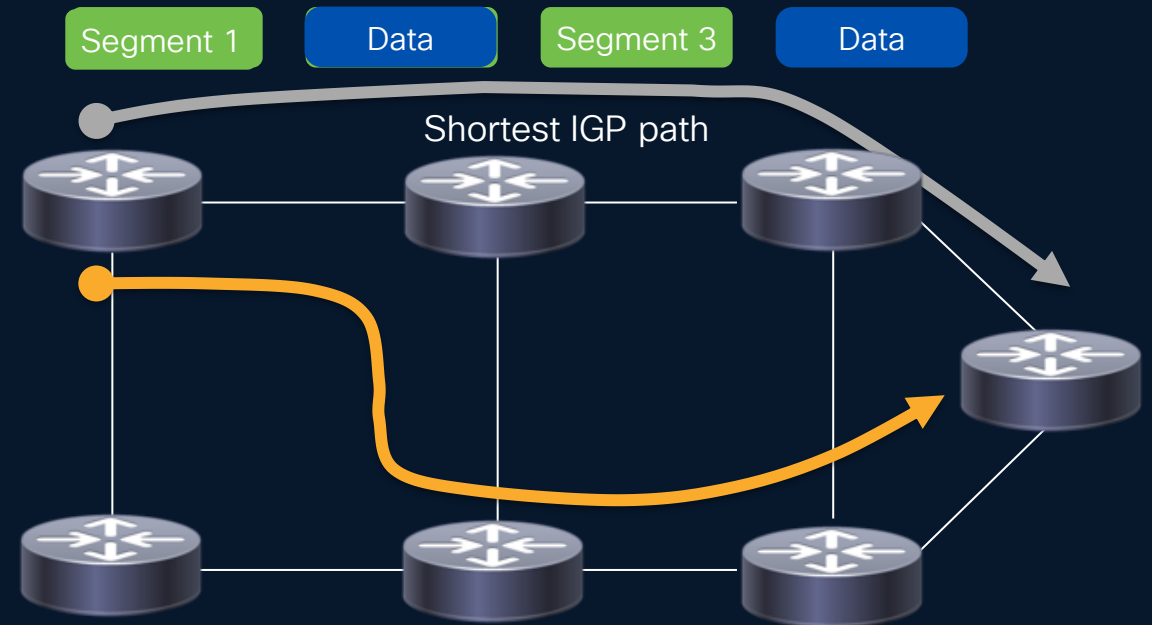
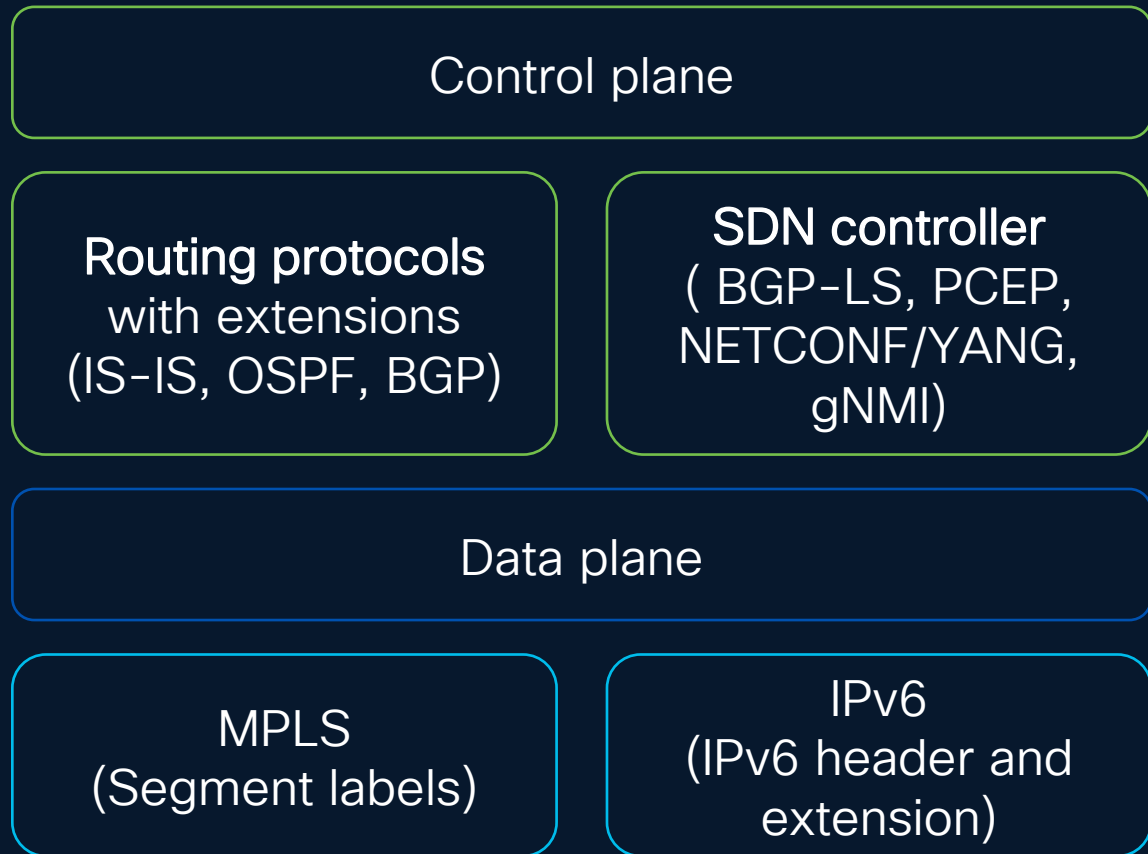
- Vulnerability assessment
- Incident detection and prevention



Segment Routing

Segment Routing

Simplification, reliability – sub 50ms protection – SDN, and more to come



SRv6 uSID: unified multi-domain architecture

Simplification at scale

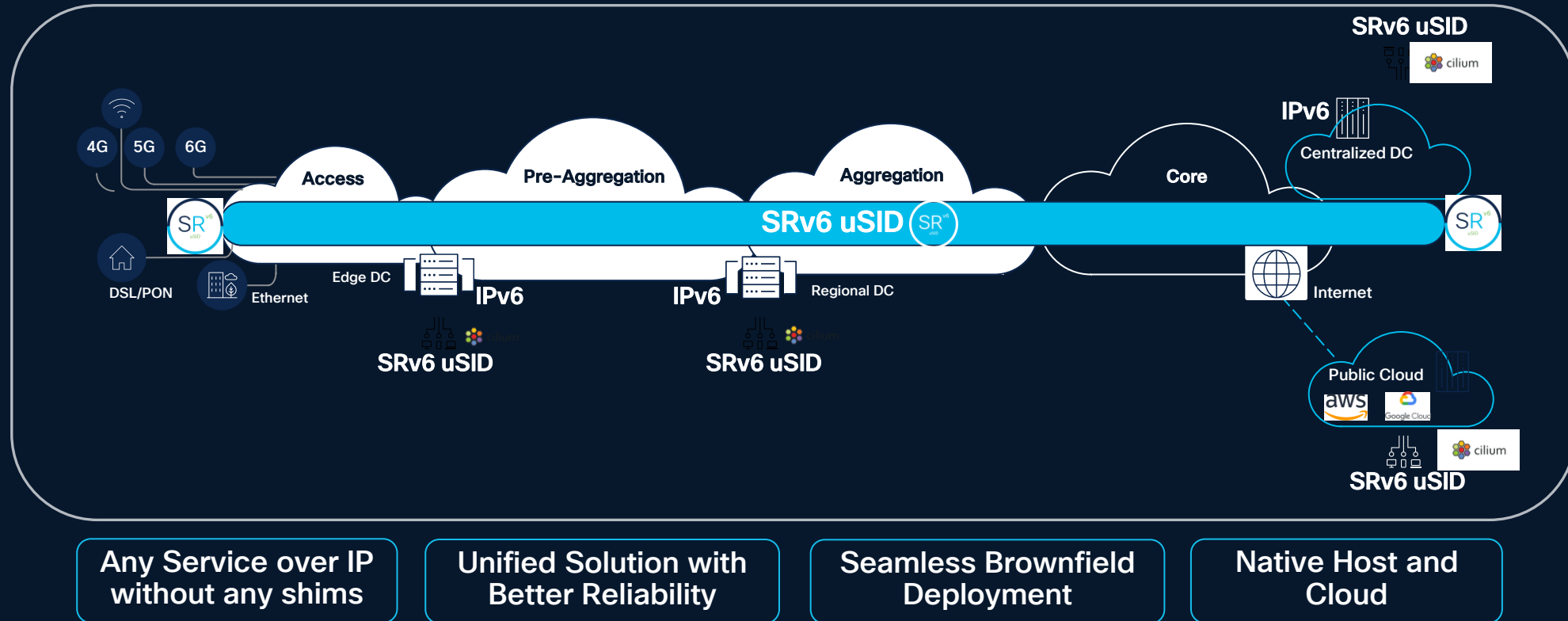
Unified architecture from Access to Data Center at scale

SRv6 extended to CPEs, end hosts and cloud

TI-LFA for fast re-route in any topology

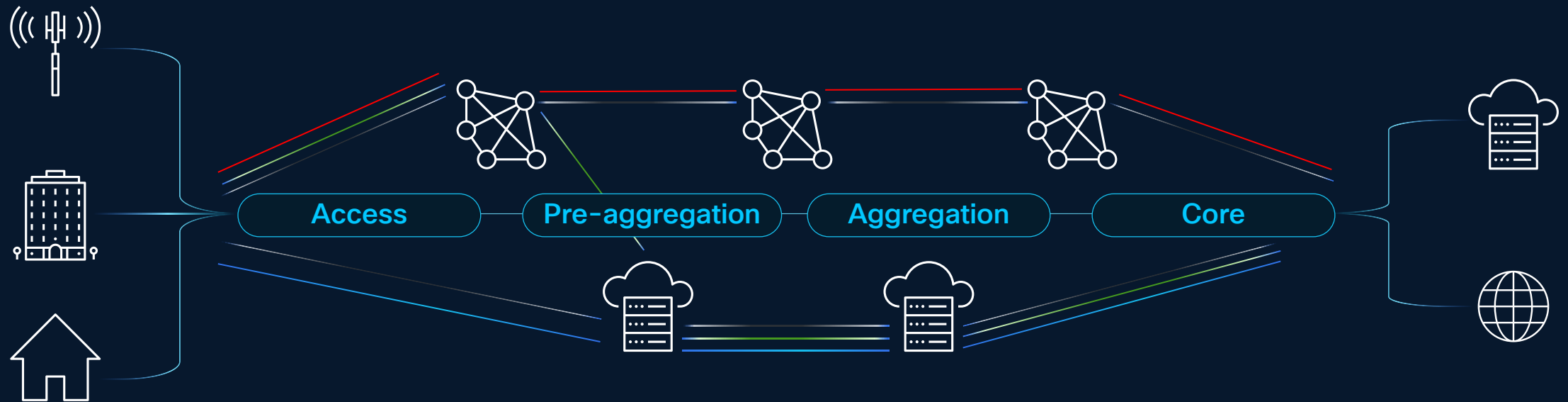
IPM for efficient performance monitoring

Flex Algo to build different paths based on different SLAs



Service Slicing via Segment Routing (v6)

Cisco Segment Routing is the service convergence enabler



Network slices displaying different characteristics

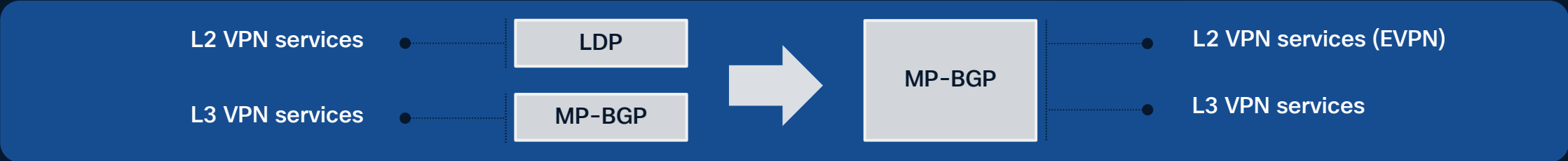
Low latency, disjoint path, macsec path, low energy path

Simplification with SRv6

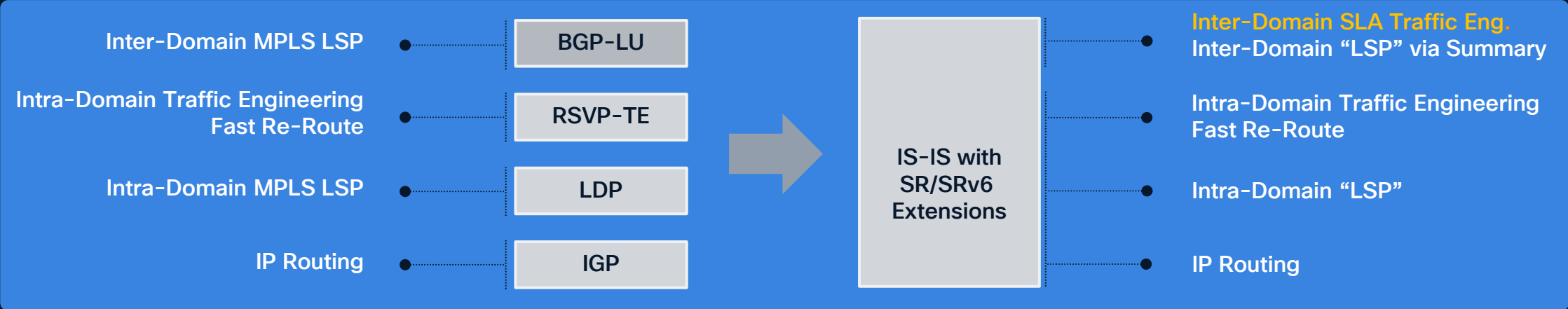


IPv6 Header

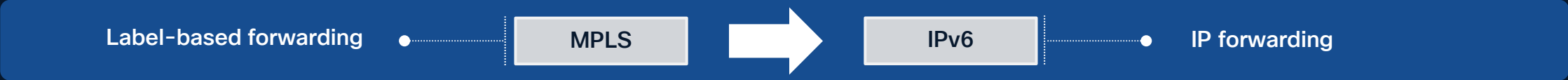
Service Protocols



Transport Protocols



Data-Plane

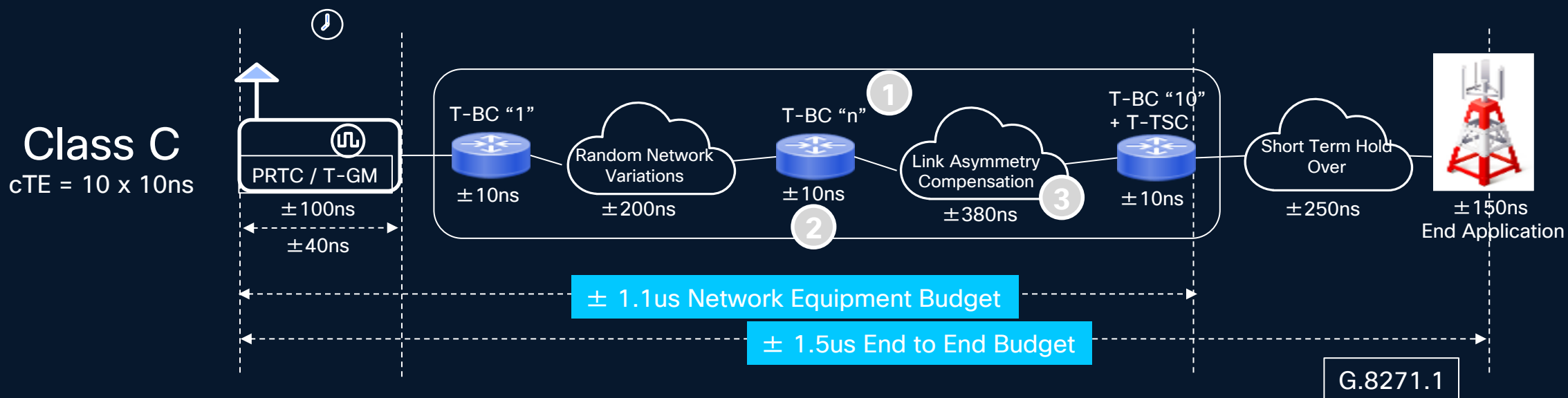


Time Synchronization

Synchronization Design

T-BC Level	Max Total Time Error $\max TE $	Constant Time Error cTE	Dynamic Time Error dTE
Class A	100 ns	± 50 ns	± 40 ns
Class B	70 ns	± 20 ns	± 40 ns
Class C	30 ns	± 10 ns	± 10 ns

G.8273.2



Design Goals:

- Reduce number of hops (distribute T-GMs)
- Increase T-BC accuracy (move to Class C routers)
- Reduce potential link asymmetry
- Hybrid Synchronisation with: G.8275.1 and Synchronous Ethernet

TDD basic 3 μs
 CoMP 1,5 μs
 CA 130–260 ns
 NB-IoT/TX Diversity 65 ns
 Positioning 100 ns
 TSN/XR 100 ns – 1 μs

Precise Synchronization

PRTC-B Receivers with 8000 series

- PRTC-B receivers with dual band use extra bands to compensate for propagation time error
- Allows recovered time accuracy to improve from 100ns (PRTC-A) to 40ns (PRTC-B)
- PRTC-B receivers continues to work when on frequency band is Jammed or Spoofed



Multi-band support
for better accuracy

Improves traceability to
UTC accuracy



Better security
against
Anti-Jamming and
Anti-Spoofing
attacks



Better manages
“Relative Time Budget”
within cluster of radios



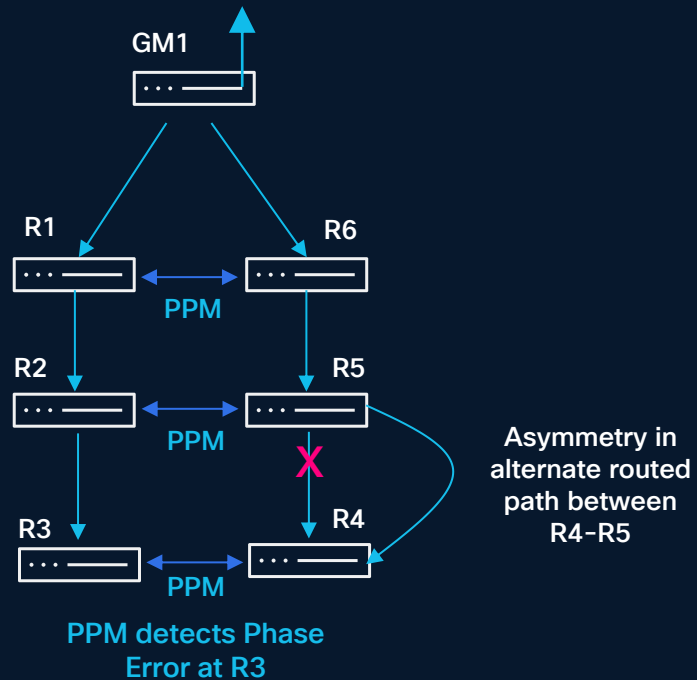
Meet stringent
position tracking and
location accuracy

Enables Public 5G and
Private 5G use cases:
AR/VR, Robotics,
Drones

Passive Port Monitoring & Advanced Port Monitoring

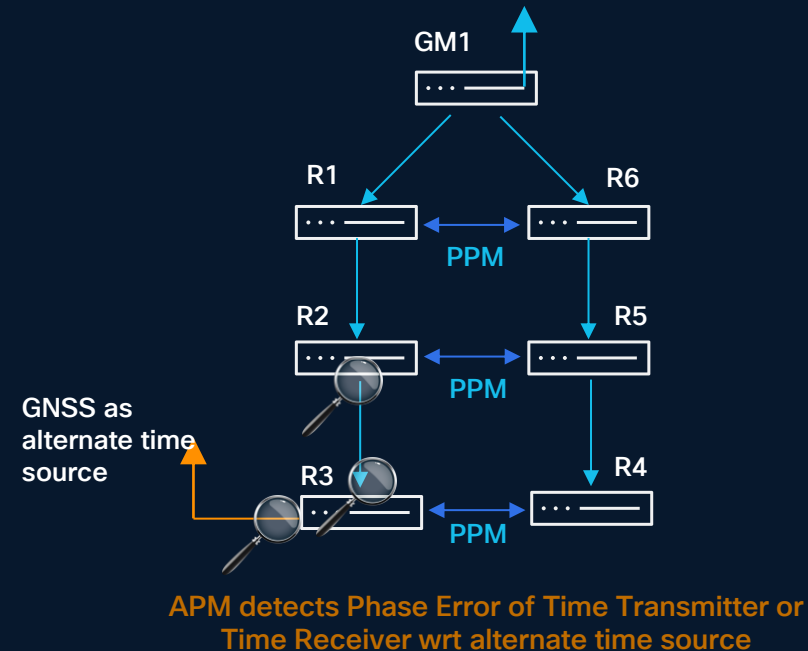
Passive Port Monitoring (PPM)

- Detects anomalies in network (such as asymmetry)
- Path Failures, Link Flaps
- Fiber quality degradation

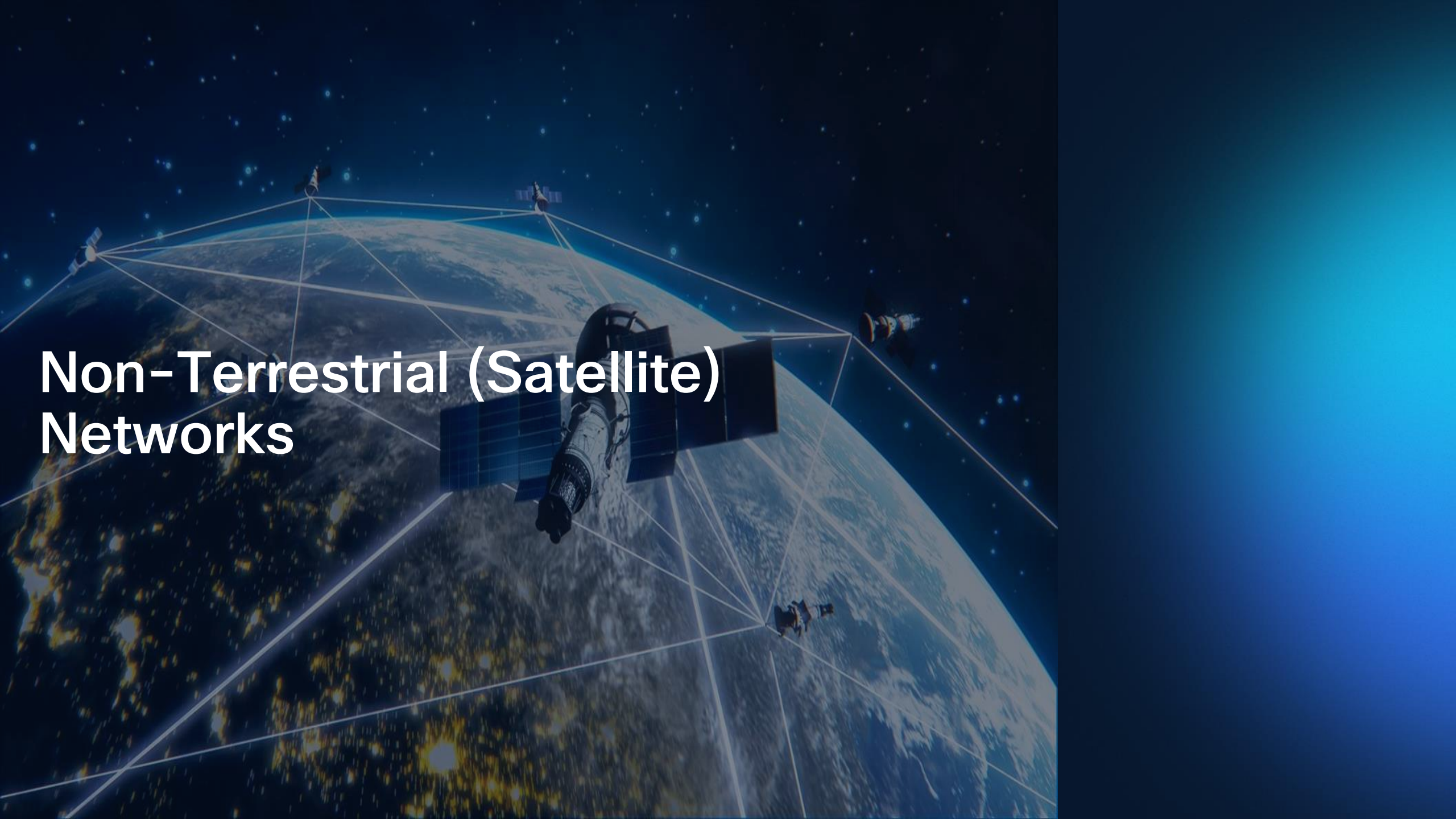


Advanced Port Monitoring (APM)

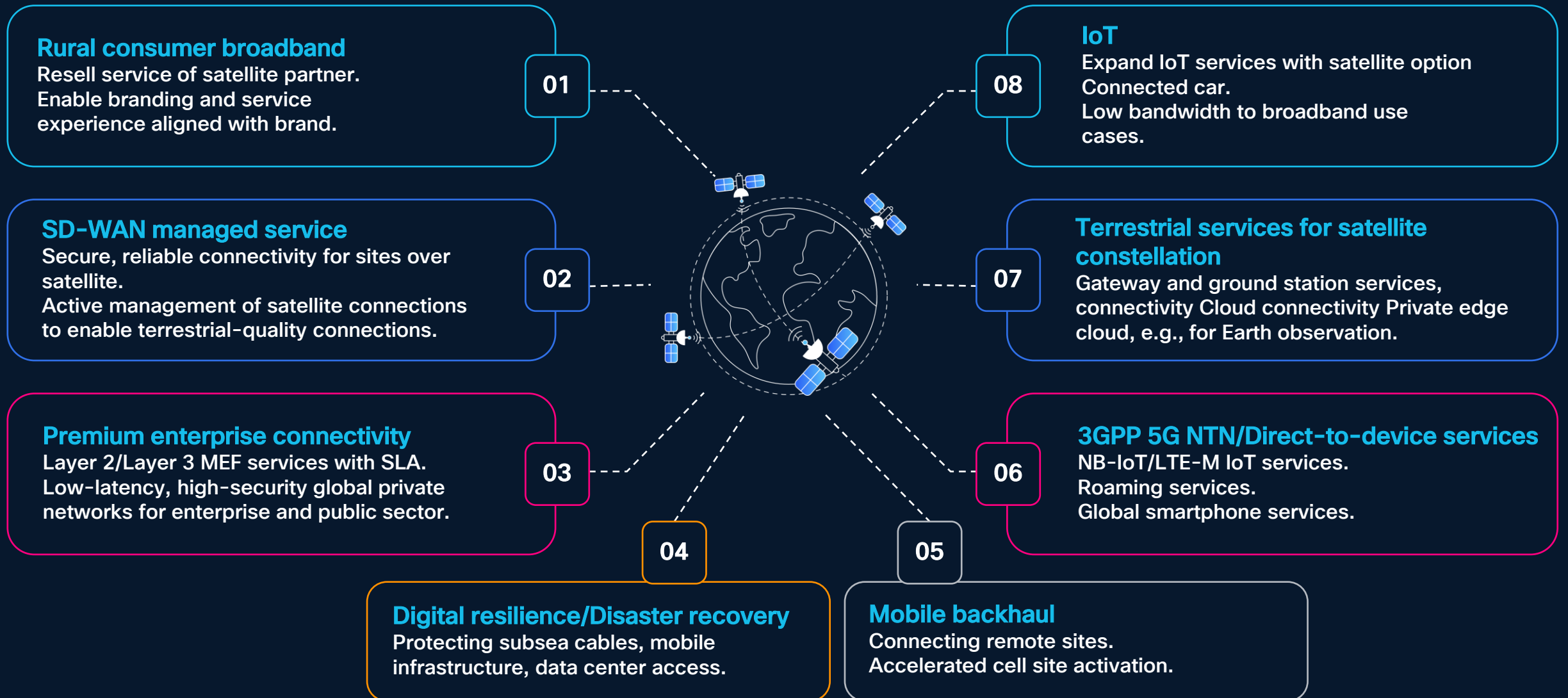
- Annex G (G.8275.1) added “Monitoring alternate time Transmitter time”
 - Extends the basic passive port monitoring
 - Also monitors PTP time error against local GNSS + Virtual Port
 - Helps measuring and tuning production PTP network without using expensive testers



Non-Terrestrial (Satellite) Networks



Key satellite and NTN use cases



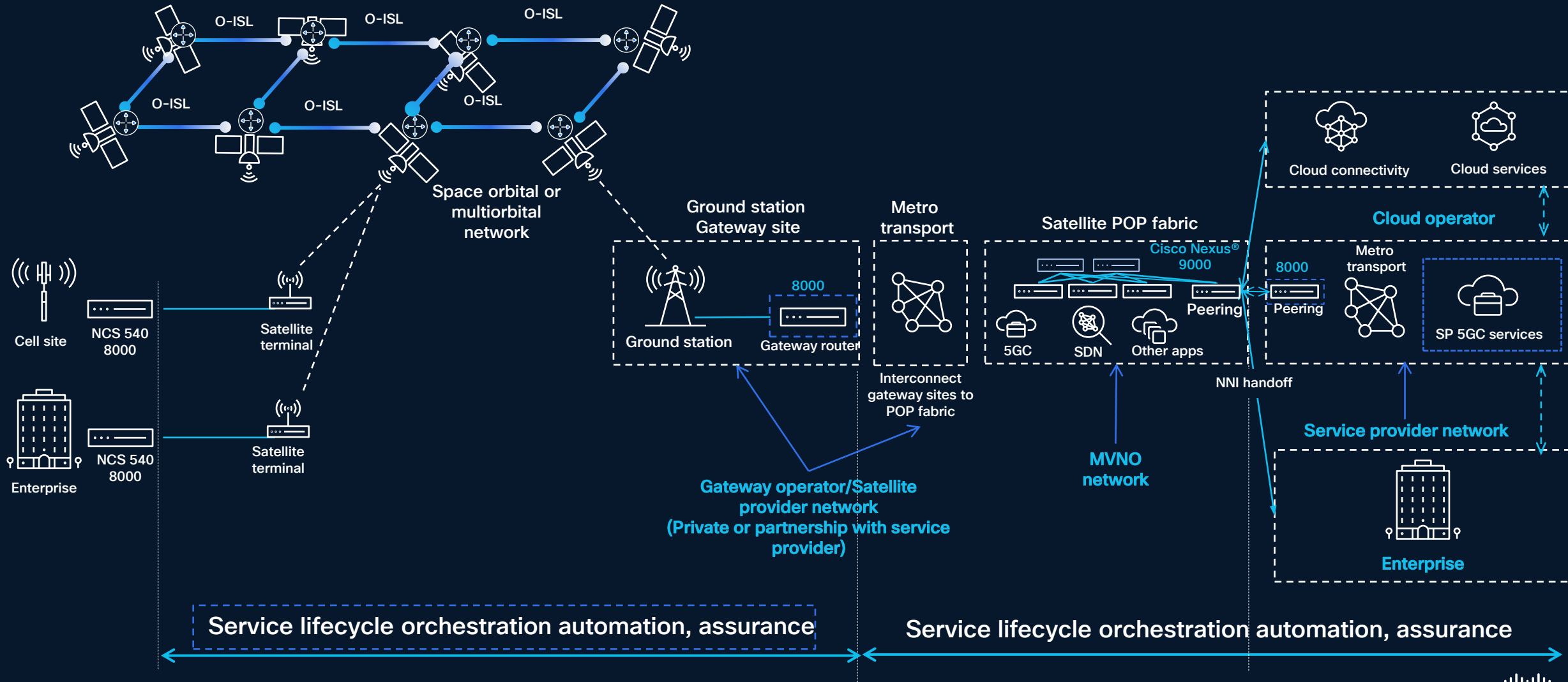
Mobile Backhaul via NTN

Scenarios:

- **Primary Attachment** for Cell Sites: Alternative connectivity is not economically viable (fiber, microwave, etc.)
Typically: Rural locations (mountain, desert, islands) or for temporary sites on venues and emergency situations.
- **Secondary Attachment** for Cell Sites: Network resiliency solutions, where primary connectivity is based on terrestrial and backup via Satellite (Protect against natural disasters, infrastructure attacks or military conflicts)
- **Microwave replacement for Cell Sites via Satellite (OPEX gains):**
https://www.analysismason.com/contentassets/fe62324d72a84464b8542e88e0fff4c7/analysys_mason_remote_satellite_viability_apr_2024_nsi039.pdf
- **NTN Direct / No xHaul use case: Direct to Device (D2D)** – Satellite communication direct to end device



Convergence of terrestrial and Non-Terrestrial Networks



Cisco satellite networking solution component offerings



Routing and switching

- Access routing: NCS 540 and C8K
- Ground stations/POP infrastructure optical, NCS 55xx / C8K
- IOS XRd for space routing



Optical

- Intersatellite link optics
- Ground station connectivity
- Coherent optics



Assurance

- Cisco Provider Connectivity Assurance
- Provider Connectivity Assurance User Experience AIOps (intelligent traffic identification and management)
- SRv6 Integrated Performance Measurement (SR-IPM) for SLA visibility at high rate



IoT/Direct to device

- Mobility Services Platform
- IoT Control Center
- Private 5G



SD-WAN and security

- Enterprise site connectivity
- Security

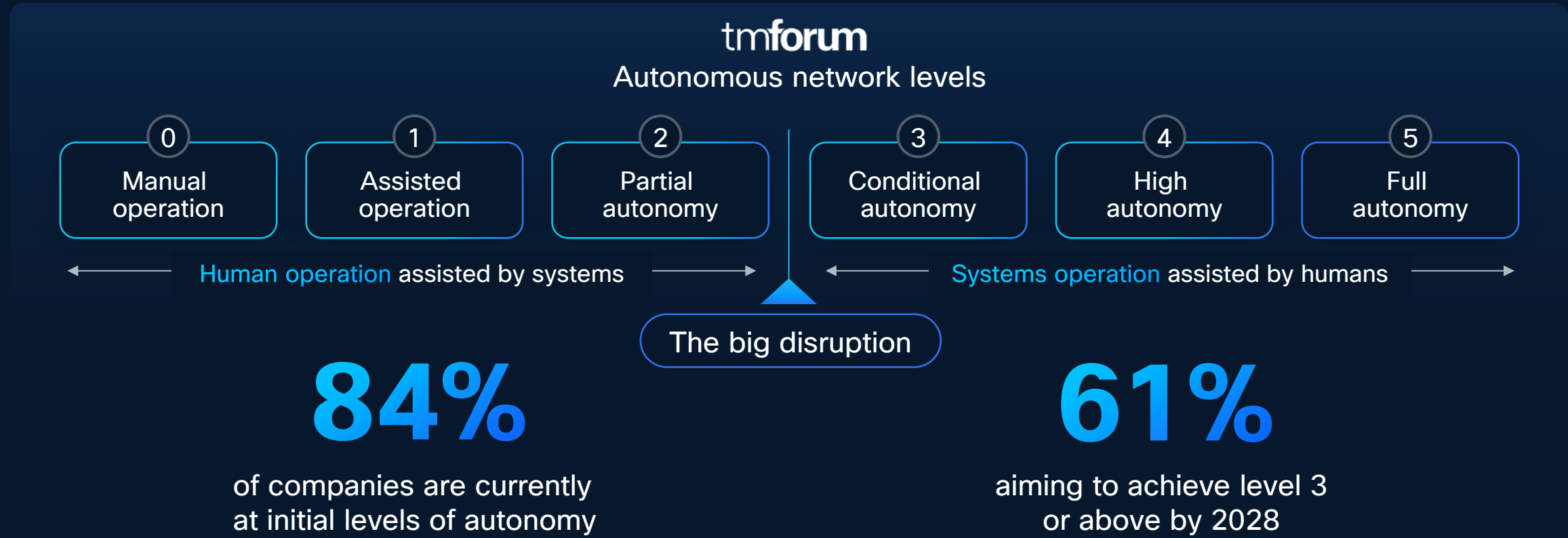


CX Professional Services

- Planning, deployment, and integration professional services for satellite ecosystem
- Consulting services

Autonomous Networks & Visibility & Assurance

Journey and drivers for autonomous networking



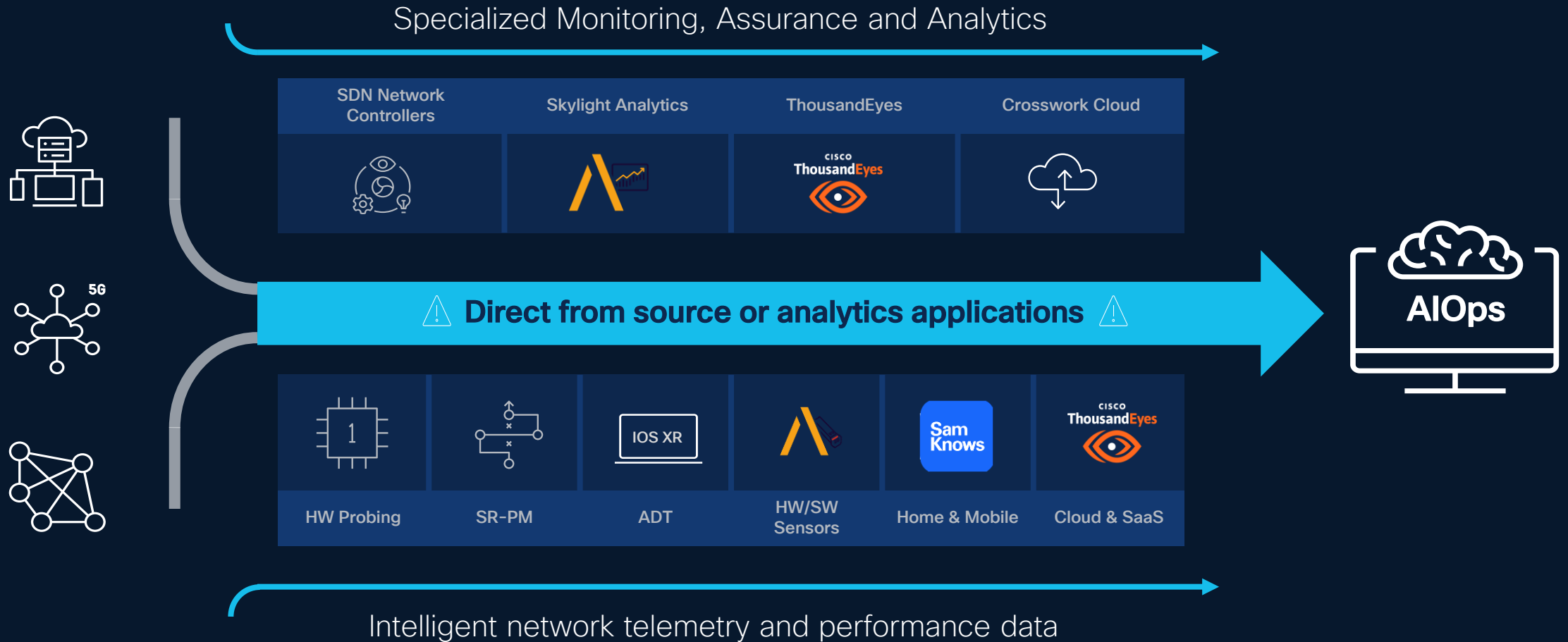
- Network Monetization
- Operational efficiency
- Resource efficiency and energy savings
- Experience excellence

Source: Cap Gemini "Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023-January 2024"

Source: <https://inform.tmforum.org/research-and-analysis/reports/autonomous-networks-exploring-the-evolution-from-level-0-to-level-5>

Automation & Autonomics

Evolving towards AIOps

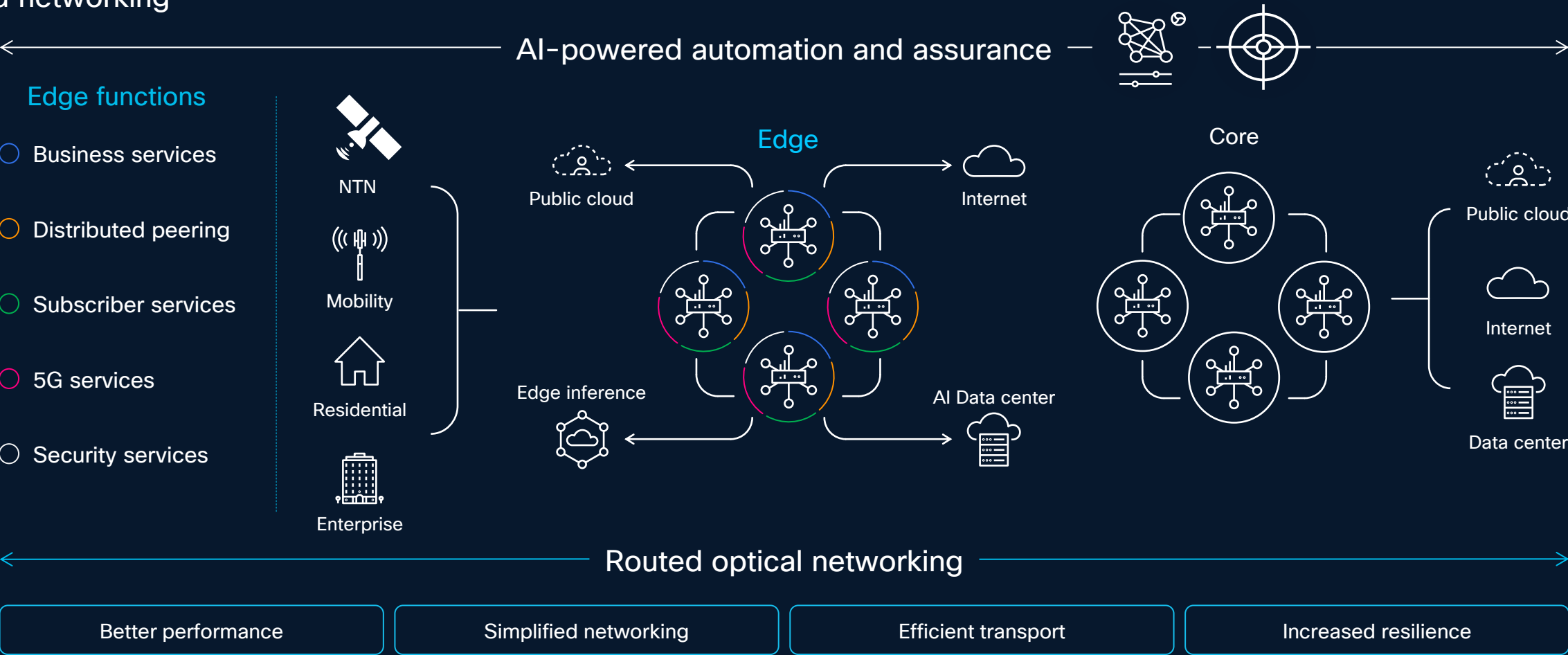


Cisco Solution Blueprint

Agile Services Networking

Cisco's vision and strategy

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



Agile Services Networking: key pillars

Simplify networking for AI connectivity

Flexibly deliver services from locations closer to end-user demand



Service optimization

End-to-end service convergence and network slicing

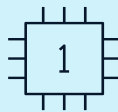
Reduce architecture complexity and cost



IP and optical convergence

Routing platform for network and layer convergence

Simplify networks with systems built from a unified silicon architecture



Programmable silicon

Consistent experience and capabilities across devices

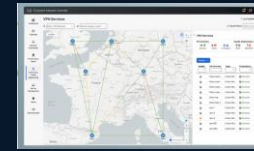
Portfolio innovations to power AI connectivity



Routing infrastructure



IP / optical
convergence



Network programmability



splunk>
a CISCO company

Observability and insight

1

Cisco 8000
Cisco Silicon One

Unparalleled performance, TCO
and operational simplicity

2

Cisco Routed
Optical Networking

Cost and energy savings
with coherent
pluggable optics

3

Cisco Crosswork
Network Automation

SLA differentiation and policy
control across DC, access,
metro, backbone and cloud

4

Cisco Provider
Connectivity Assurance

Real time visibility and insights
for proactive and predictive
experience assurance

Cisco Automation and Assurance Solutions

Cisco Network Automation

- New adapters: Industry’s broadest multi-vendor support
- ML Orchestration & IPv6/SRv6 support
- Service to underlay mapping



Crosswork Hierarchical Controller
Multi-layer, multi-domain IP and Optical hierarchical controller

- Single-VM CNC and KVM support
- Agentic AI Platform and Agents
- Flexible Workflow for Closed-loop

- Single-VM Optical EMS + Controller
- Optical Assurance & Orchestration



Crosswork Network Controller
IP SDN Controller



Cisco Optical Network Controller
Optical Controller



Provider Connectivity Assurance
Multi-vendor Service Assurance

- Digital Experience Assurance
- Telemetry & Performance Prediction
- Topology and ECMP analytics



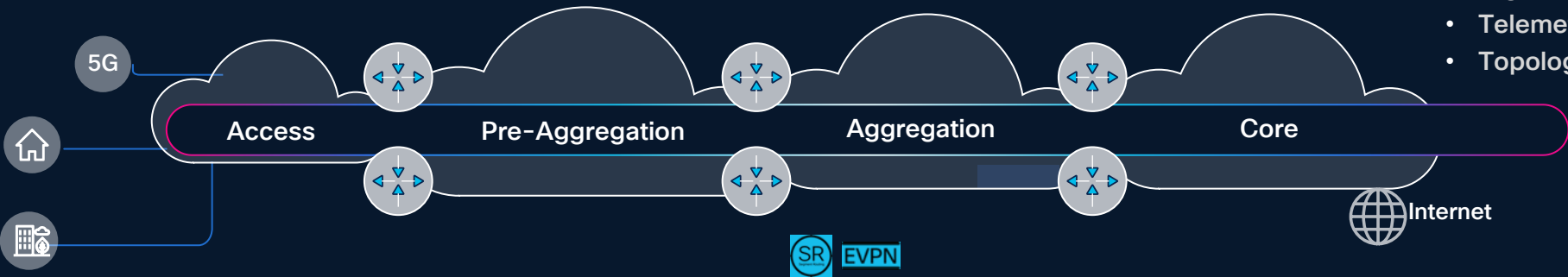
NSO
Brownfield Service Protection



Crosswork Planning
Predictive-AI capacity planning

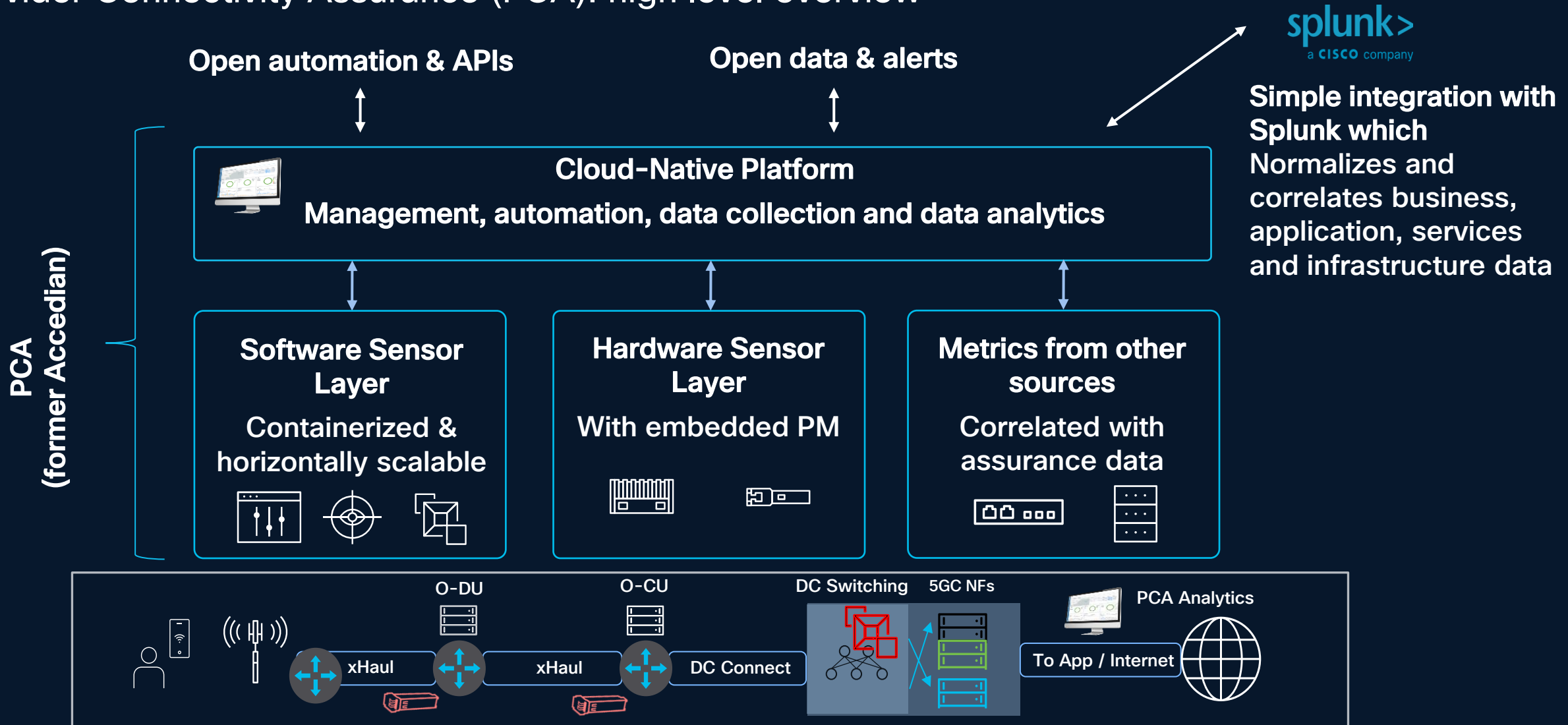


Crosswork Workflow
Fleet Upgrade, Device Onboarding & Golden Config



Network Visibility

Provider Connectivity Assurance (PCA): high level overview

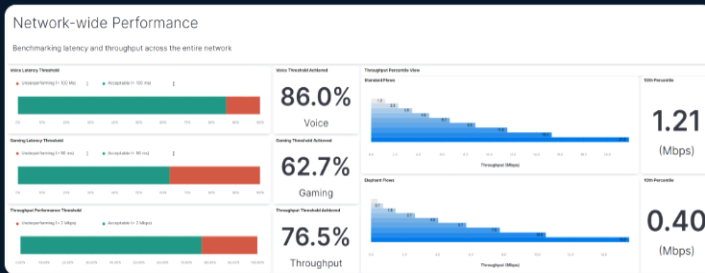


Provider Connectivity Assurance User Experience (PCA-UE)

Using network visibility to enhance Quality of Experience



Network Intelligence



Provides quick access and visualization tools with real-time actionable insights

Characterizes any type of traffic & encap: QUIC, TCP, UDP, GTP, MPLS/SR/SRv6

Provides visibility at per user, flow, application, cell granularity



Network Optimization



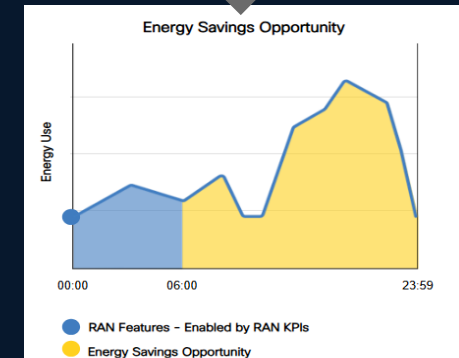
Shapes elephant flows, increasing user throughput in the face of congestion

Increases cell site capacity leading to less frequent spectrum capacity upgrades

Protects real-time traffic e.g. videoconf, collab., when competing with high BW flows



Energy Reduction



For illustrative purposes only

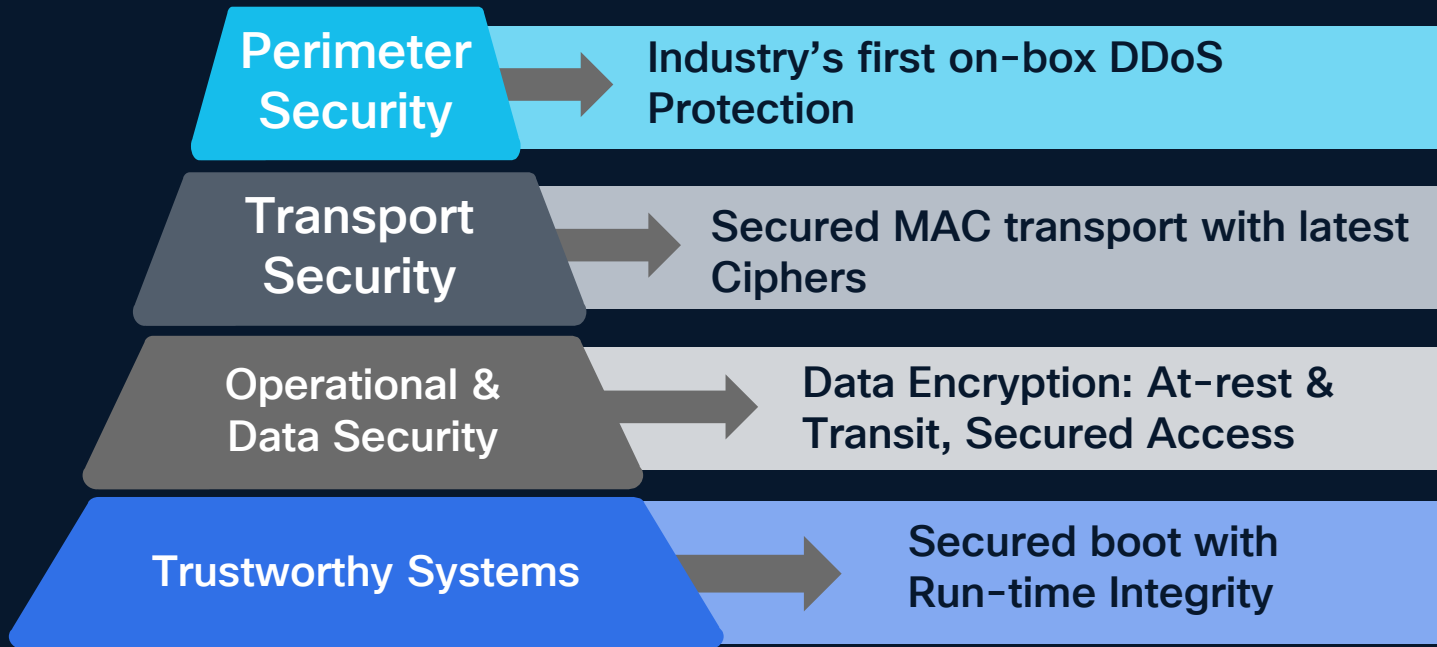
Offers dynamic frequency band switching without impacting user QoE

Sends energy saving recommendation via API to RAN Controller

Provides consistent energy savings when recommendation is implemented

Security Solution

Infrastructure Security



Immutable Hardware Root of Trust



Secured boot anchored in Hardware



Session Key Service for Quantum-resistant Security



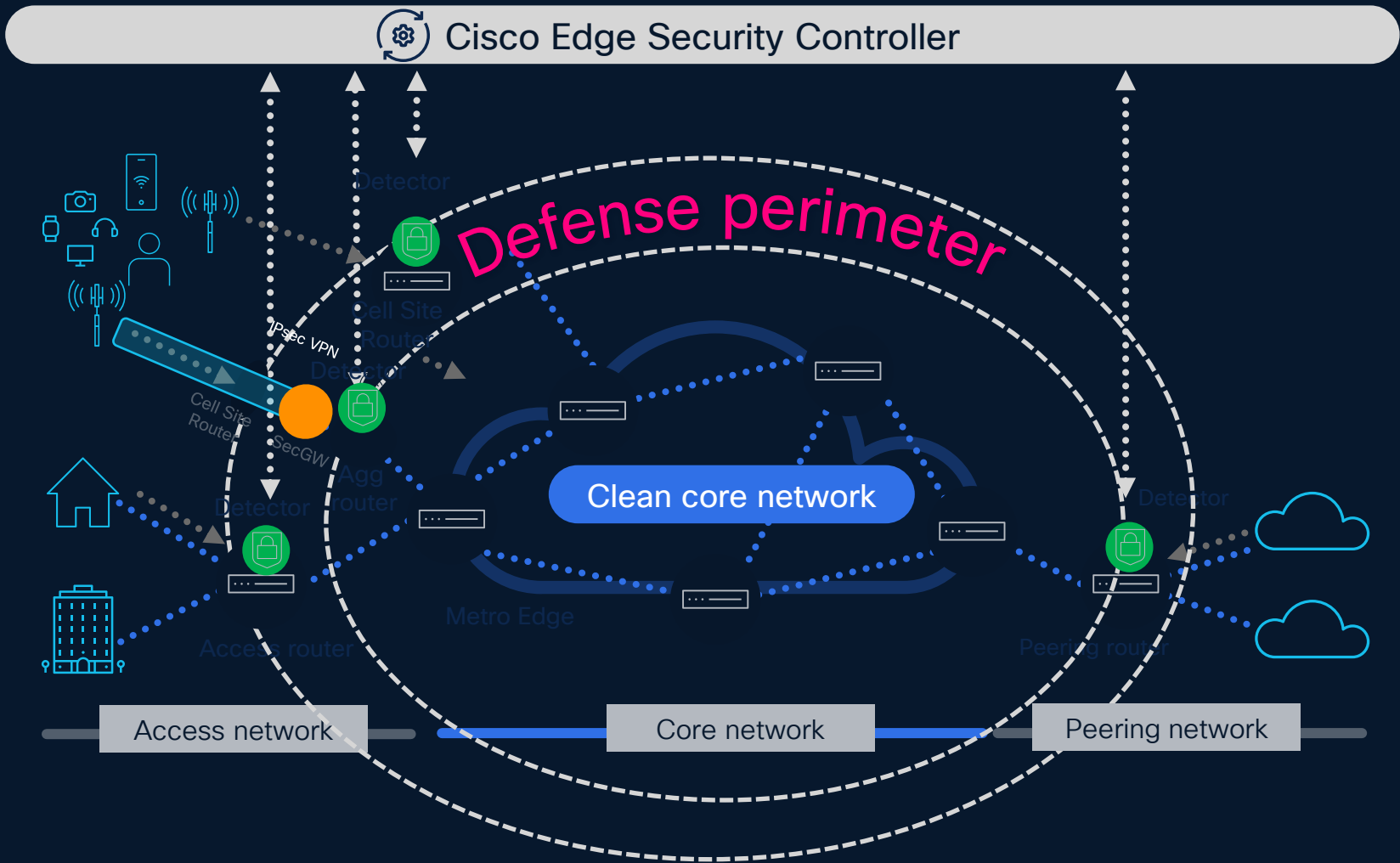
Edge Protection: fastest attack detection & Mitigation



Unique Operation Security features

Security for AI in Telecom Networks

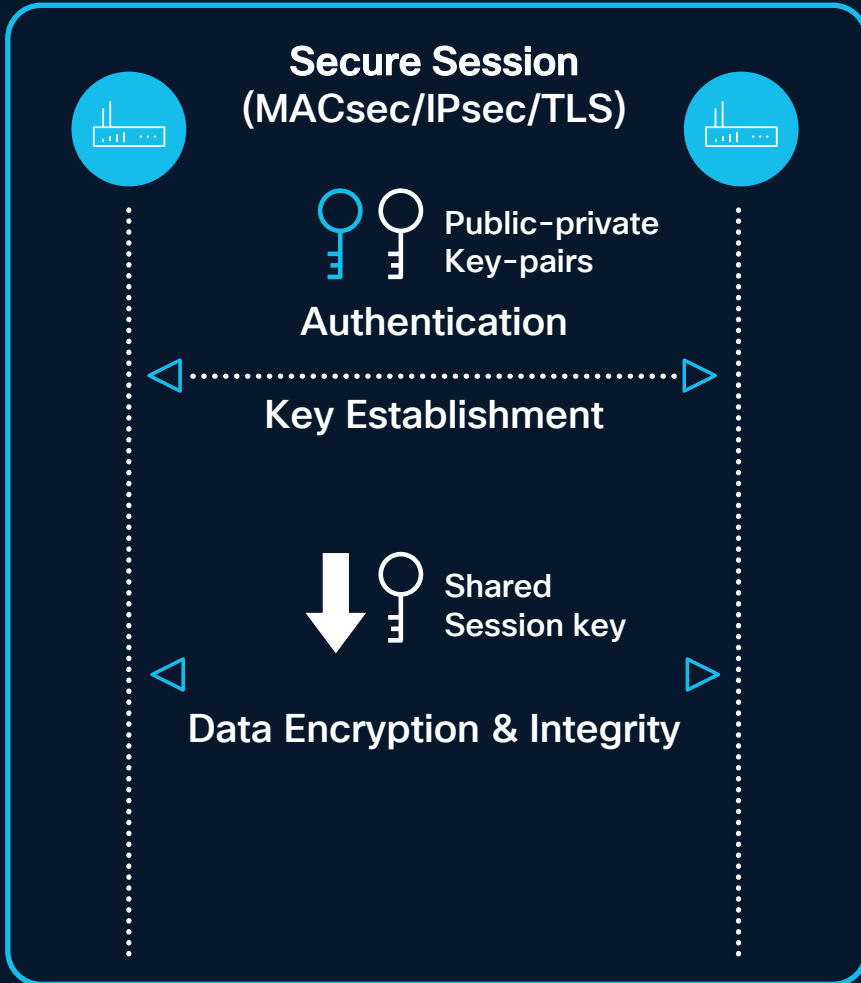
Cisco Secure DDoS Edge Protection



-  **Defense in Depth** – threat free network with secured perimeter
-  **No Dedicated Scrubber**
No Traffic Diversion
Reduced energy & space
-  **Faster Detection**
Zero Day attack mitigation

Quantum computing impact on cryptography

Quantum-resistant?



Asymmetric cryptography

- Based on **mathematically related public-private key-pairs**
- Used for control plane operations
 - Authentication, key establishment
- Examples: RSA, DH, ECC



Large, reliable quantum computers can break RSA, DH, ECC

Symmetric cryptography

- Based on shared key
- Used for bulk data encryption and integrity
- Protection level based on key strength
 - Key size and entropy
- Example: AES-GCM



Symmetric crypto with large and high-entropy keys is resistant to quantum computer attacks

Summary

Cisco Agile Services Networking for xHaul



Simple

Save money

Reduce cost and increase efficiency with a converged infrastructure for flexible service delivery



Resilient

Protect customer experiences

Assure experiences and mitigate risk with AI-powered automation, observability and security



Intelligent

Make money

Monetize network and services capabilities from an architecture optimized for intelligent service delivery

Cisco innovations

Unified silicon architecture, optics, software, automation, security, data / intelligence platform

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Contact me at: apreusch@cisco.com & shajmeri@cisco.com

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