Building a Fully Connected, Intelligent World

Advancing Internet Standards: The role of IETF in enhancing IP networking technologies.

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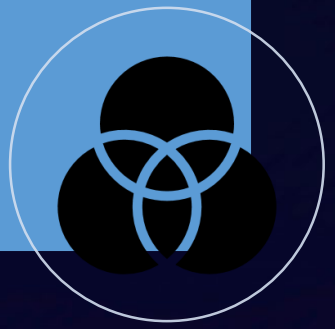
Internet Engineering Task Force (IETF)

- Make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet. [RFC 3935]

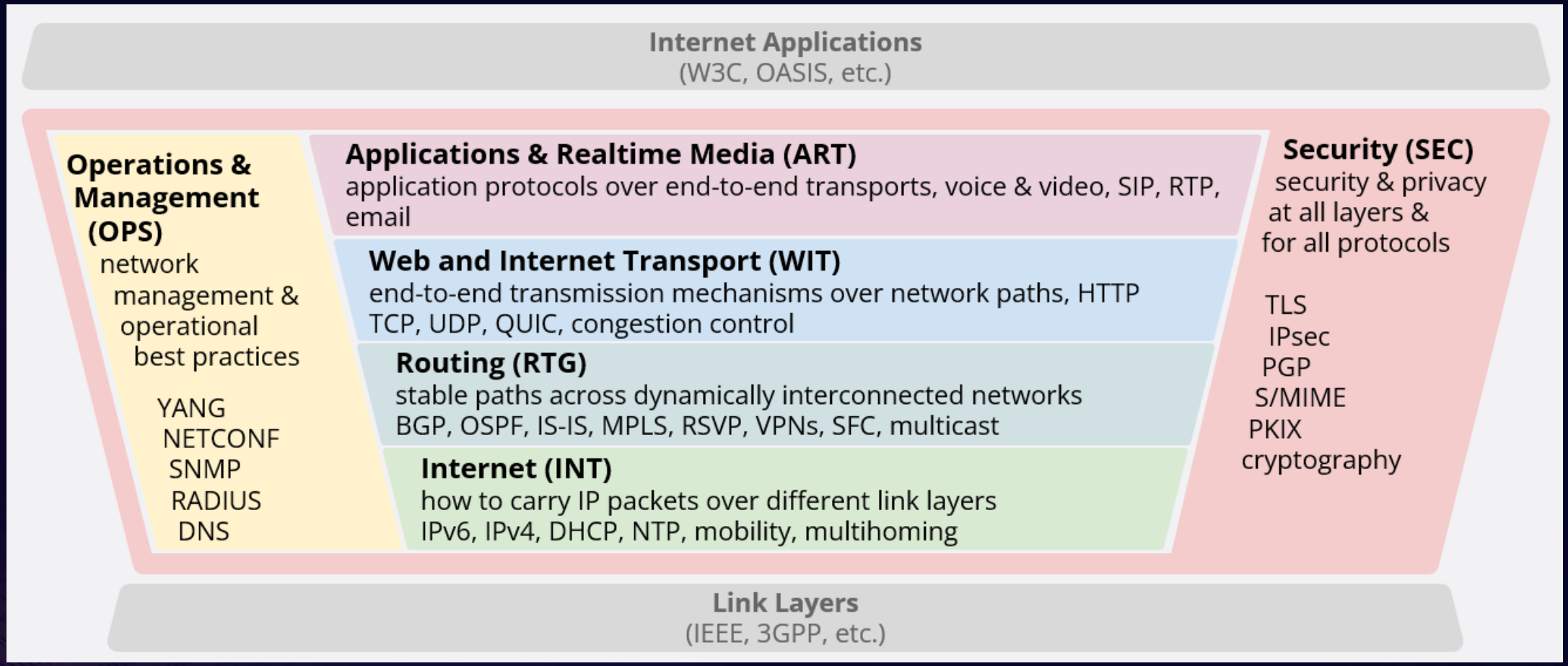
Mission

- Everyone may participate
- Make all work available for free
- Judge contribution on technical merits
- Determine success by voluntary deployment
- Open and transparent Bottom up consensus driven Internet Standards for interoperation

Ethos

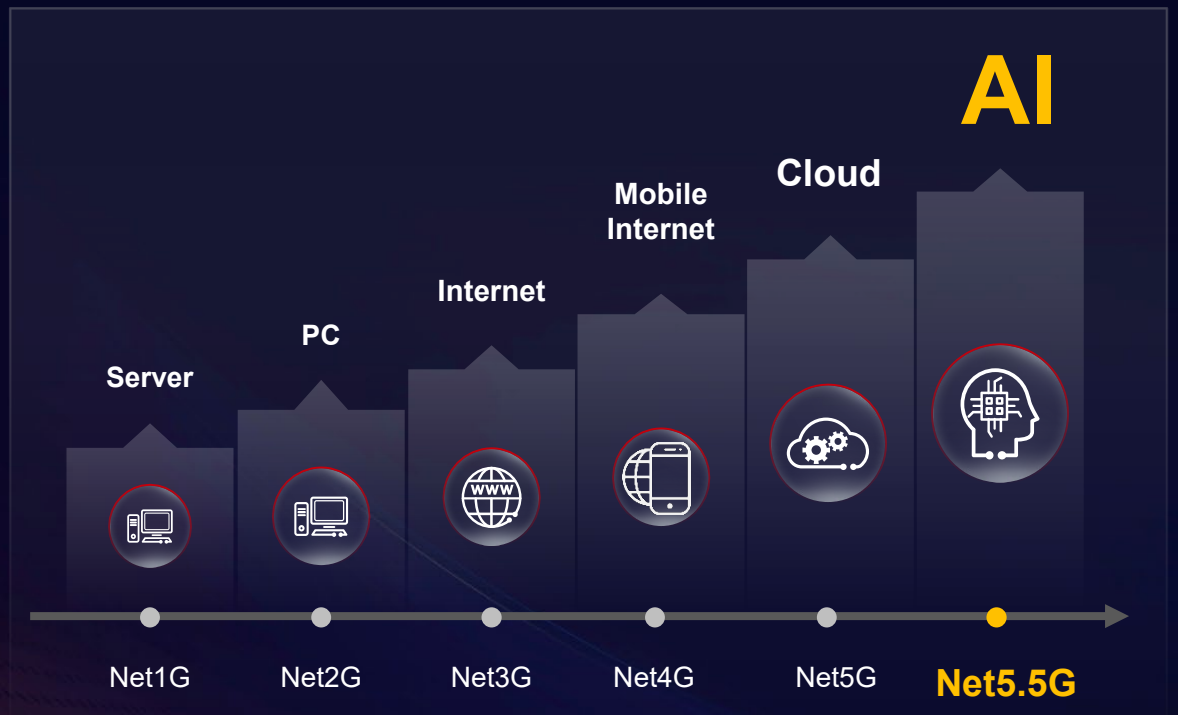


IETF Areas & Key Protocols



Network is the cornerstone in the Intelligent Era

Intelligent Era
Requires a New Generation of IP Networks

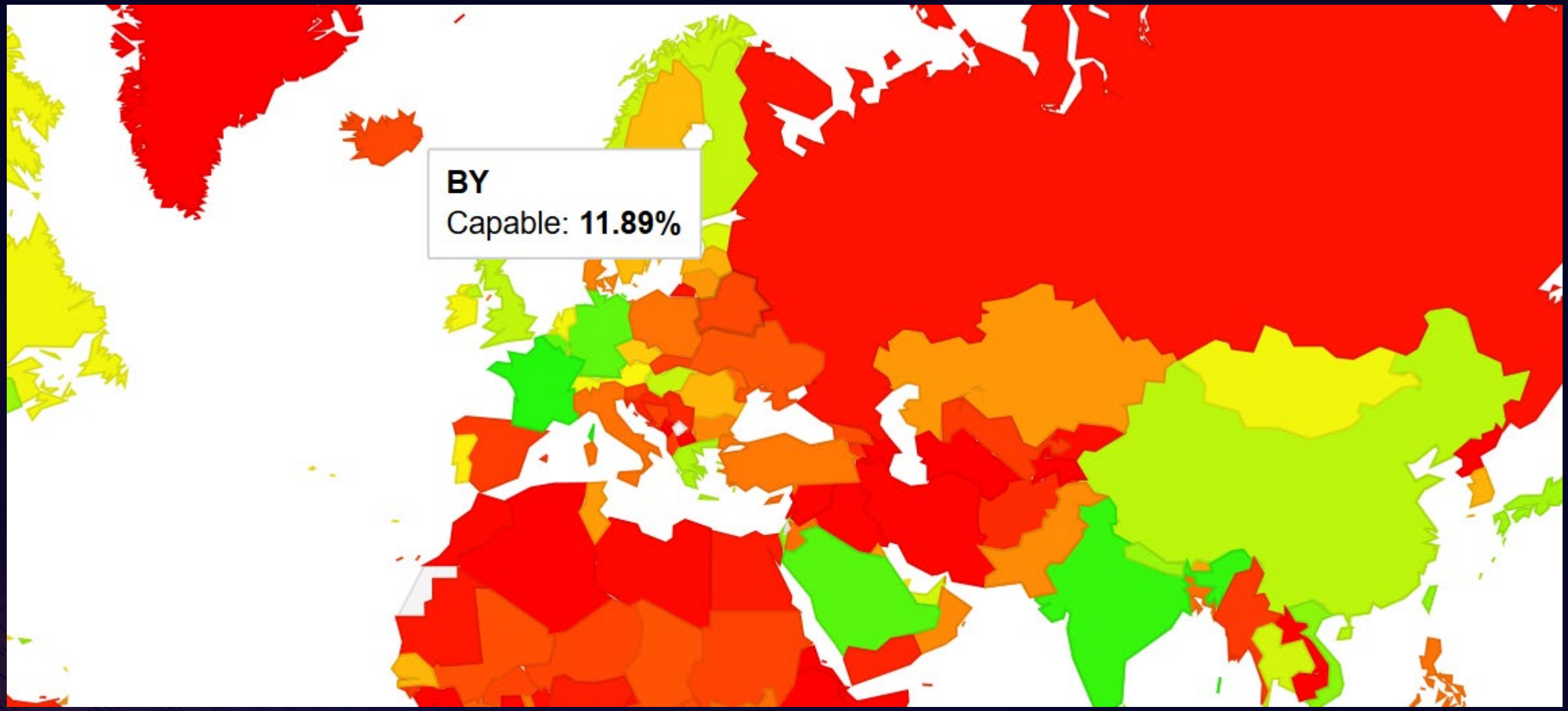


New Generation of IP Networks
Requires a mature protocol standard

- SRv6
- Network Slicing
- Autonomous Networking
- 400GE/800GE

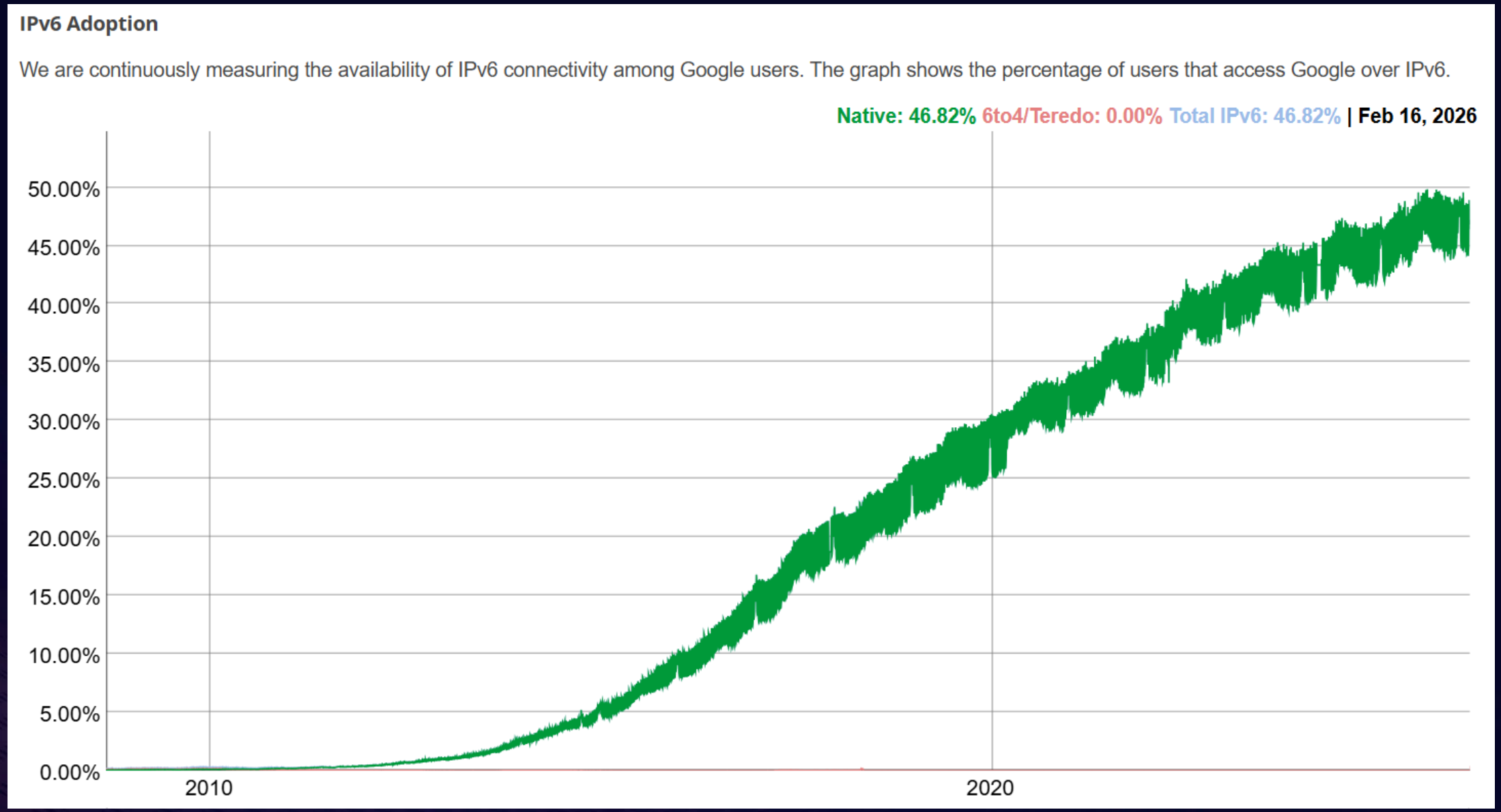
https://stats.labs.apnic.net/ipv6/

IPv6 Adoption

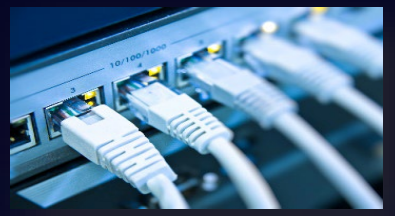


https://www.google.com/intl/en/ipv6/statistics.html

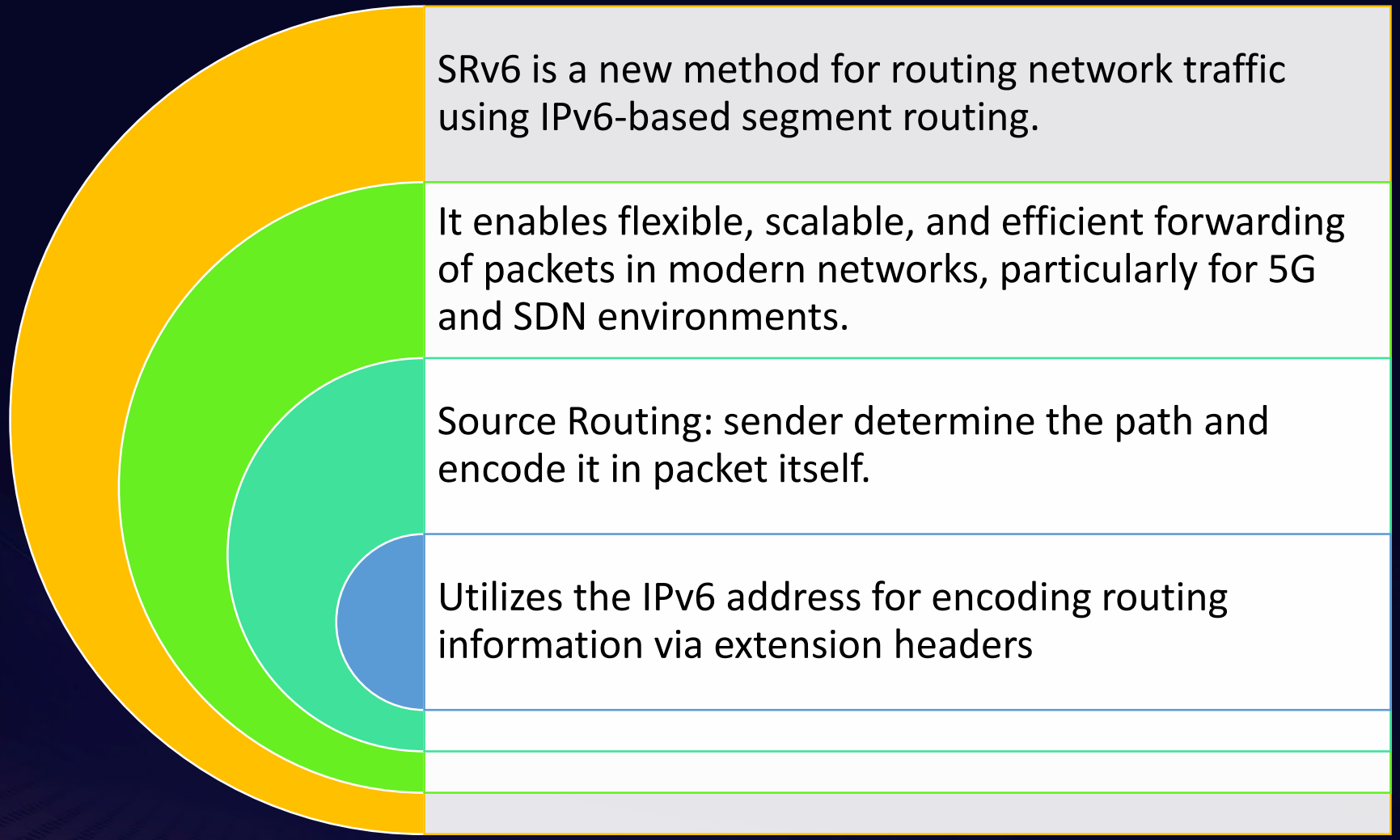
IPv6 Adoption



IP Network Protocol Evolution: SRv6 is here

	IP	MPLS	Segment Routing (SR)
	Reachability	Connectivity & Services	Simplification & Programming
	1980~	*1997~Now*	*2015~next 20 Years*
			
Service	Internet	VoIP, IPTV, VPN	Cloud, 4K, 5G, IoT
Management	Command line	CLI & NMS	SDN, Telemetry
Protocol	IPv4	MPLS, LDP/RSVP-TE VLL, VPLS, L3VPN	IPv6, SR/SRv6, EVPN
	Best-effort	Peer-to-peer	Global Optimal Path

Segment Routing over IPv6 (SRv6)

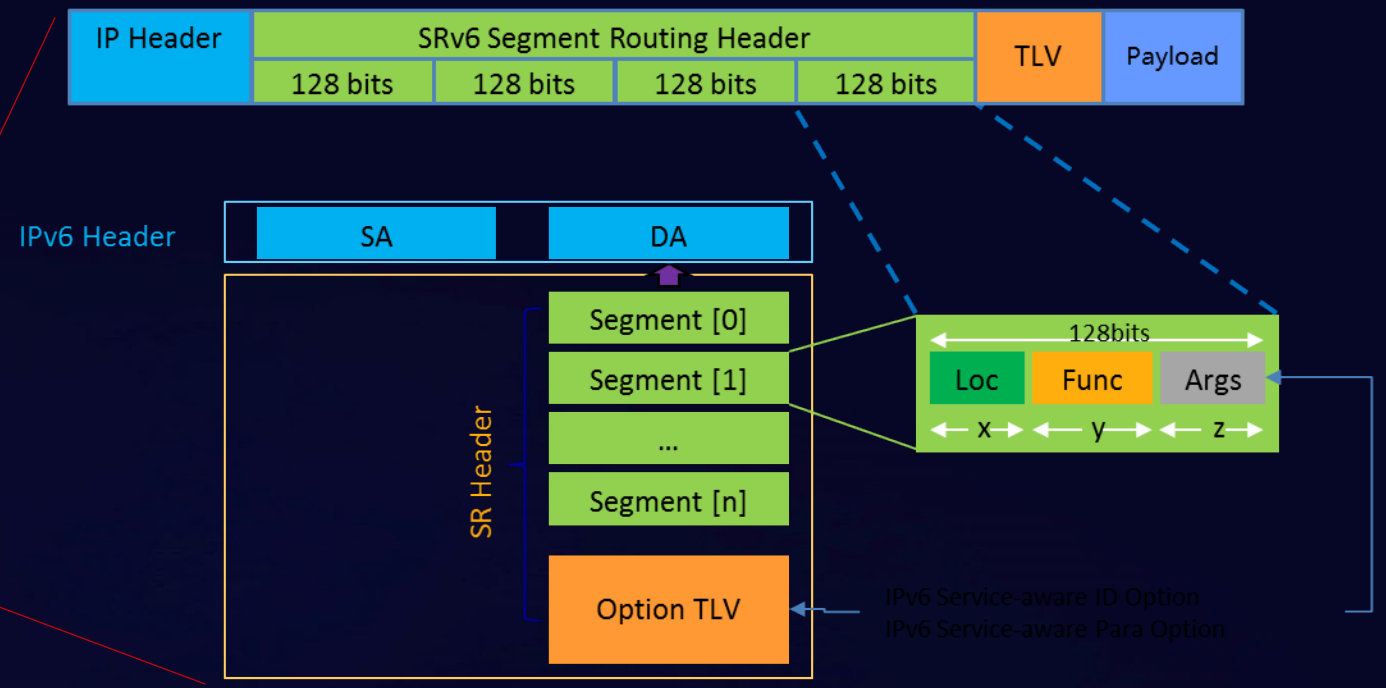


SRH: The IPv6 Extension Header for SRv6

IPv6 Extension Headers

Version	Traffic Class	Flow Label	
Payload Length		Next=43	Hop Limit
Source Address			
Destination Address			
Hop-by-Hop Options Header (Slicing)			
Destination Options Header			
Routing Header/SRH (SID list, iFIT, etc..)			
……			
Destination Options Header (iFIT, APN)			
Payload			

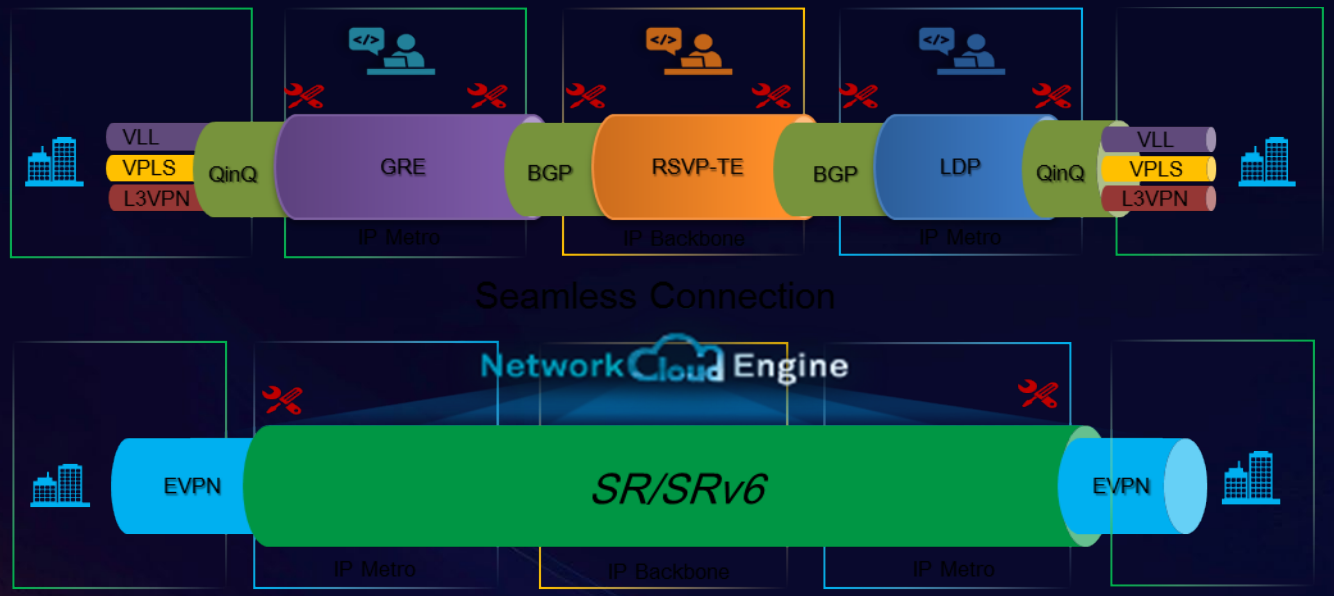
SRv6 SRH: Three Levels of Programming Space



1. **Network Routing Programmability**
2. **Network Behaviors Programmability**
3. **Network Service Programmability**

SRH: The best evolution for Bearer Services

SR/SRv6 Benefits:
Protocols Simplification, Network and Service Programmability



- Easy cross-domain communication
  - Unified data plane – IPv6
  - Few protocols – replace RSVP/LDP
- Large-scale networking
  - Routing Aggregation

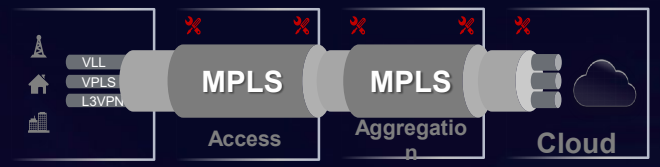
vs. SR-/MPLS

- Incremental deployment
  - Upgrading on demand
- Multi-levels of programming capabilities
  - Flexible segments combination
    - Unified network & service programming
  - Flexible fields of Segment
  - Flexible TLVs combination
- Easy to introduce new features
  - SFC, iOAM, network slicing, low latency, …
- A good foundation for innovations

SRv6: Best Technology for Future-oriented IP Network

Inter-domain Network Communication

Complex Protocols and Cannot extend to other networks



Unified & simplified Protocols

Experience Differentiated Assurance

Un-routable 20-bits label with Limited capacity

Label	EXP	S	TTL

MPLS Header

Programmable Paths & Services

SRv6 Segment List

Programmable segments, enabling service programmability

Locator	+	Function	+	Argument
Location info Reachability		Service function definition		Enhancement

Application-aware Networking (APN)

No solutions(MPLS)

Programmable Applications

SRv6 Optional TLV

Programmable Optional TLVs, enabling application programmability

APP ID
User ID
Net Req.

Service chain TLV

Type
Length
Service Meta

SRv6: Mature Standardization and Rich Eco-system

SRv6 Is a Standardized Protocol

Architecture	• SR Architecture: RFC8402 • SRTE Policy Architecture: RFC9256
Data Plane	• SRv6 Network Programming: RFC8986 • IPv6 SR header: RFC8754
Control Plane	• SRv6 BGP:RFC9252 • SRv6 OSPF: RFC9513 • SRv6 ISIS: RFC9352 • SRv6 BGP-LS: RFC9514
OAM	• SRv6 OAM: RFC9259 • IPv6 IFIT RFC: RFC9343

Vendors already support SRv6

HUAWEI, CISCO, JUNIPER NETWORKS, NOKIA, BAREFOOT NETWORKS, BROADCOM, MARVELL, ZTE, SPIRENT Communications, ixia A Keysight Business, ARRCUS NETWORK DIFFERENT, ...more

EANTC Continuous SRv6 Inter-op Test (2018 – 2023)

Compared to SR-MPLS, SRv6 is simpler, more scalable, and more flexible, provides native support for network functions, and has better integration with cloud services.

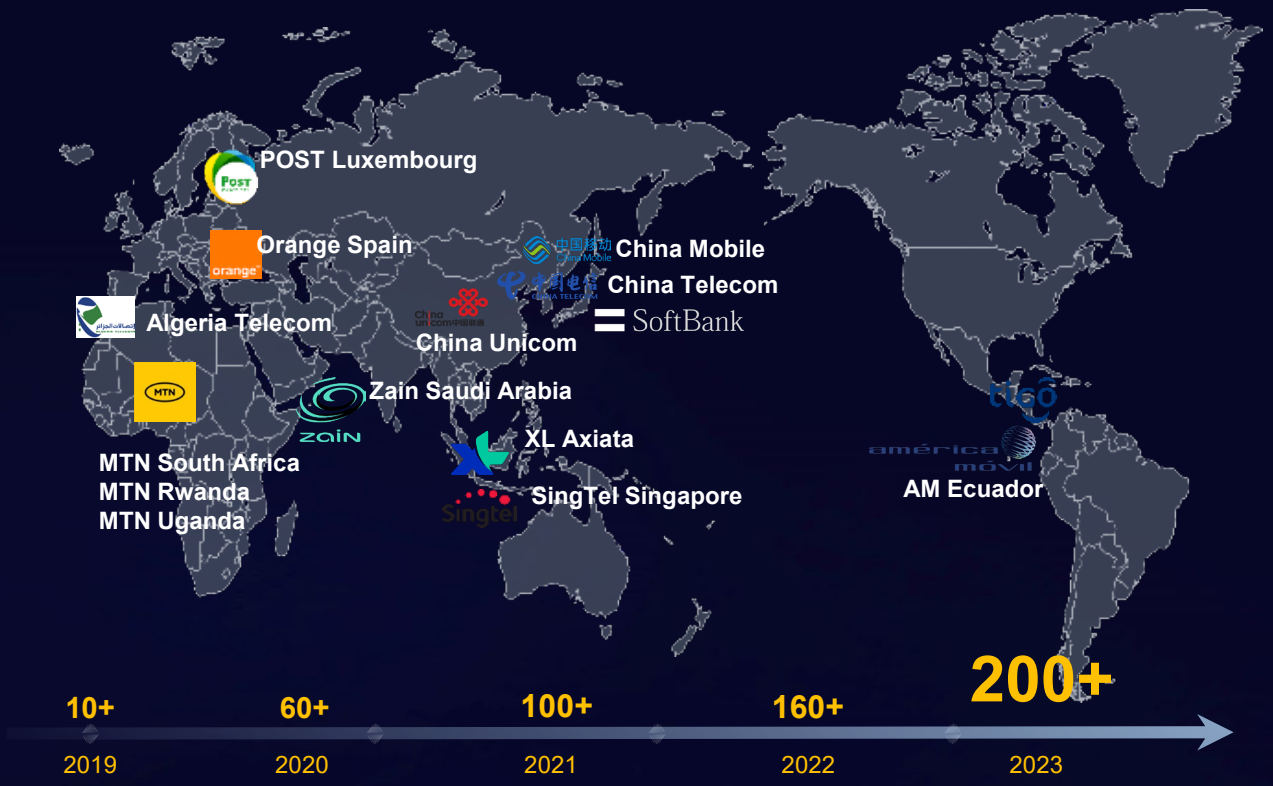
Record-speed Deployment in Global Carriers

Global Carriers Consensus

(Part of the list)

orange	✓ Orange Spain Deployed
T	✓ Lean IP Architecture Released
Telefónica	✓ Brazil VIVO Deployed
Singtel	✓ Singtel, Philippines Globe Deployed
MTN	✓ MTN Widely Deployed
zain	✓ ZAIN Widely Deployed
vodacom	✓ Vodacom Deployed
中国移动 China Mobile	✓ 32+ Provinces Deployed
中国电信 China Telecom	✓ 32+ Provinces Deployed
中国联通 China unicom	✓ 26+ Provinces Deployed

Global SRv6 Cases



Implements SRv6 Dual-Vendor Interworking

Implements SRv6 Dual-Vendor Interworking

Challenges and Requirements

Challenges

Network evolution is complex

IP Network of Orange Spain is built by Huawei, Cisco, Nokia and Juniper.

5G network optimization is complex

Manual optimization based on MPLS/RSVP-TE is complex and takes several days.

Requirements

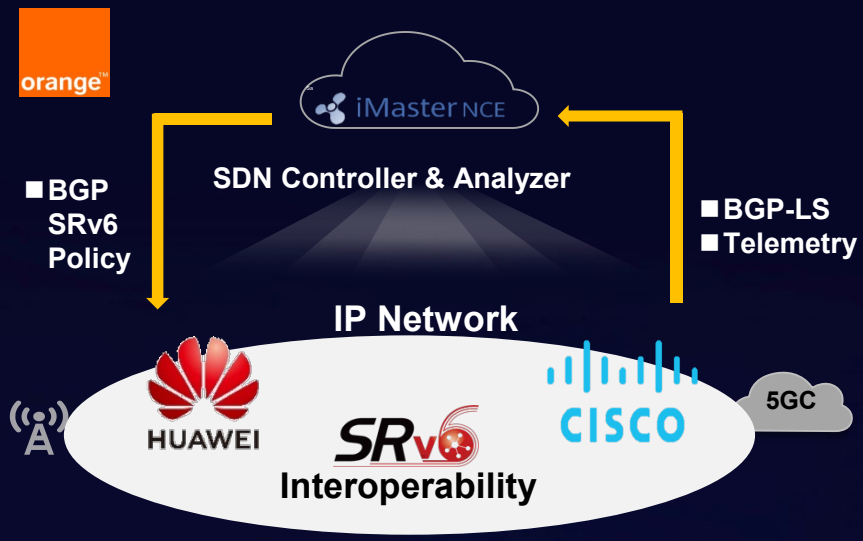
Target network architecture for future

- Future services oriented target network
- Evolvable protocol by multi-vendors

Flexible network optimization

- Easy network optimization

Implement SRv6 interworking



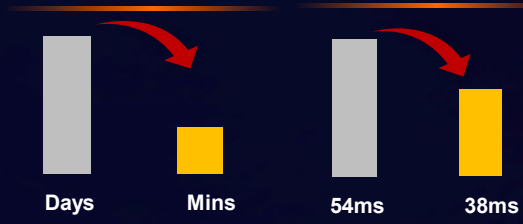
Service	Standard		Interworking
Scope	**Solution**		
5G / LTE SRv6 BE/Policy	**IGP**	IS-IS v6	**Huawei ATN/NE** PE Node, SRv6 Support
2G / 3G MPLS/RSVP-TE	**TOP**	BGP-LS SRv6	**Cisco NCS** P Node, SRv6 Support
	Forward		
	Control	BGP-SR	

SRv6 Benefit: Flexible

SRv6 implements flexible network path optimization on demand.

Automation — Improve O&M efficiency

Optimization



We expect in 2023 that all the equipments will have a renewal.

—— Hector Llorente
IP & Transport Network Manager, Orange Spain

SRv6 based innovations are Accelerating….

Massive Address Space

IPv6

Secure & Efficient Best Effort

IPv6: Road Construction

Reachability

Road Signs

Traffic Jam

IPv6 + Protocol Innovation

AI Innovation

IPv6 Enhanced: Ultimate Driving Experience

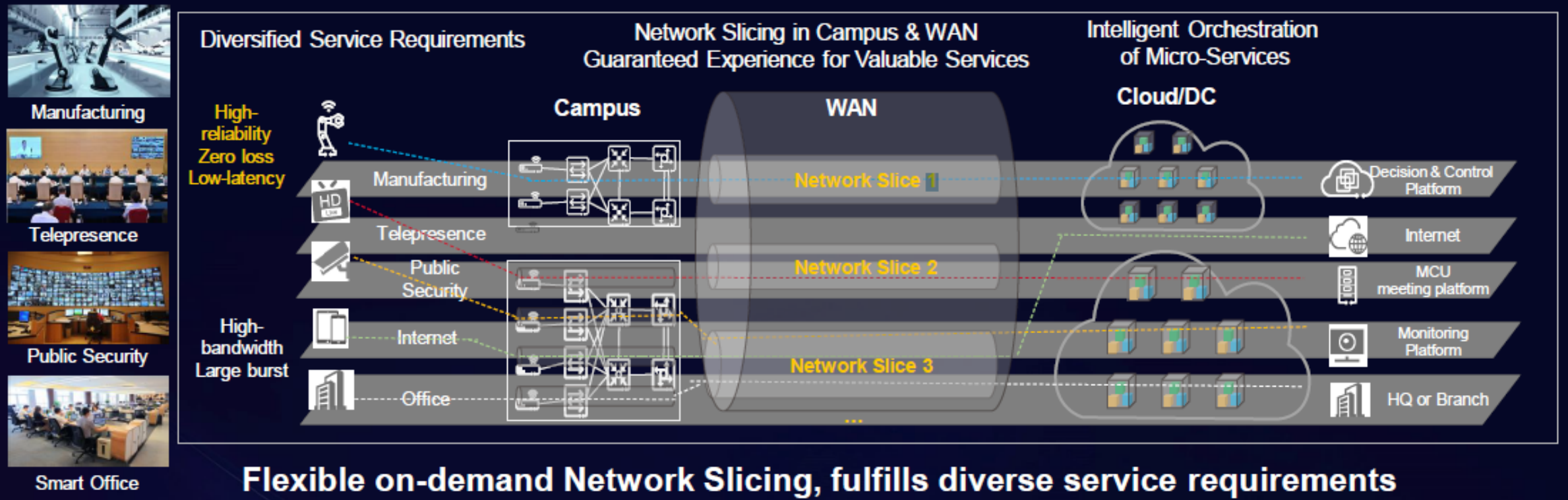
Smart Connection with **SLA guarantee**

High Quality

SRv6 | IFIT | Slicing | AI

Navigator | Dashcam | Dedicated Lane | Self-driving

Network Slicing



Flexible on-demand Network Slicing, fulfills diverse service requirements

Independent Service Operation

- Service customization
- User management
- KPI visualization
- Independent upgrade

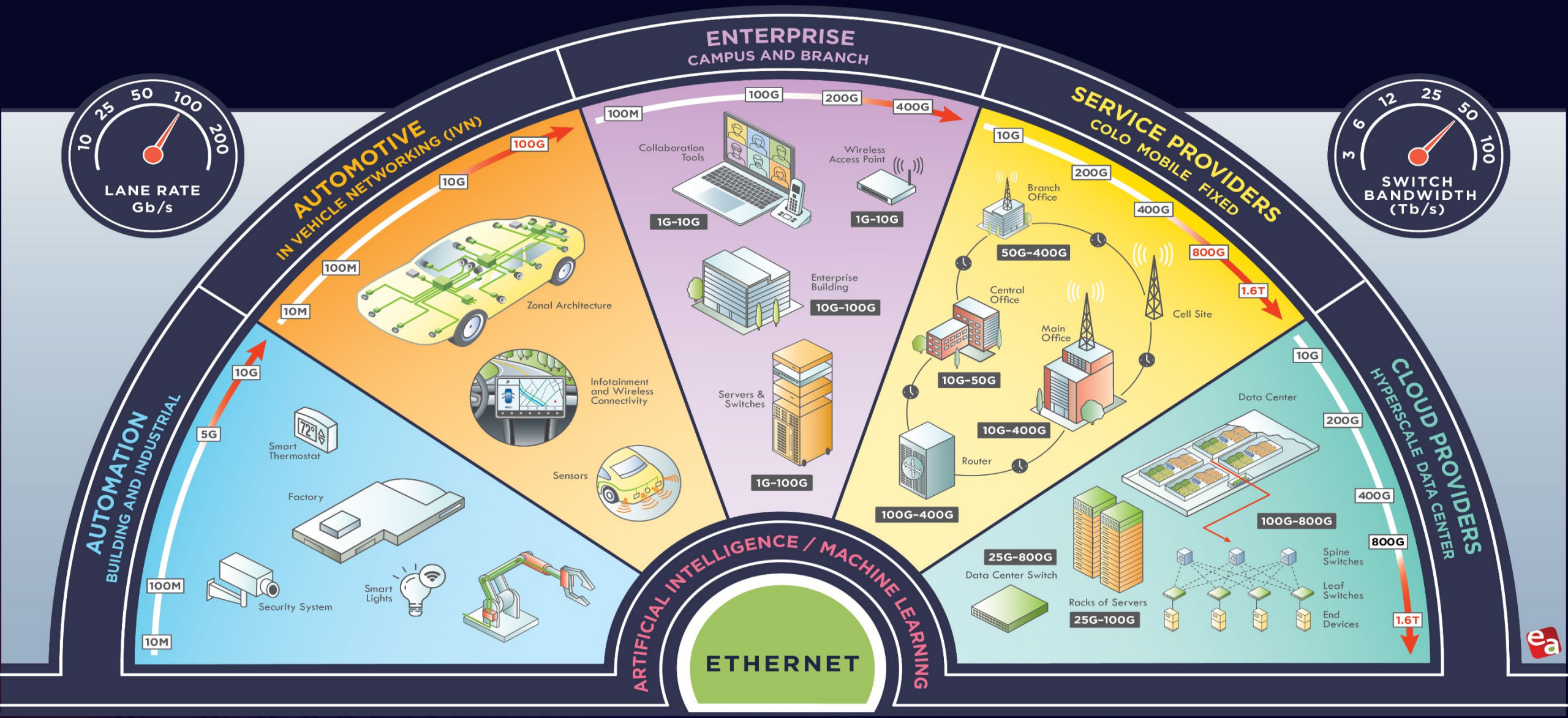
Security Isolation

- Smart grid
- Autonomous driving
- Industrial control
- Game assurance

Assured SLAs

- Ultra-high bandwidth
- Massive connections
- Ultra-low latency
- Ultra-high reliability

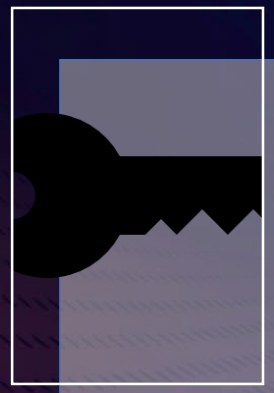
Ethernet Standards: Everything, Everywhere



Key Takeaways…

SRv6 is the foundation for many innovations in networking, enabling advanced use cases like **5G**, **network slicing**, and **edge computing**.

It provides the **flexibility** and **scalability** needed for next-gen networks.



IETF has been pivotal in shaping SRv6 standards, with **Huawei's contributions** playing a key role in advancing its adoption.

SRv6 is the backbone driving the future of **advanced networking**.