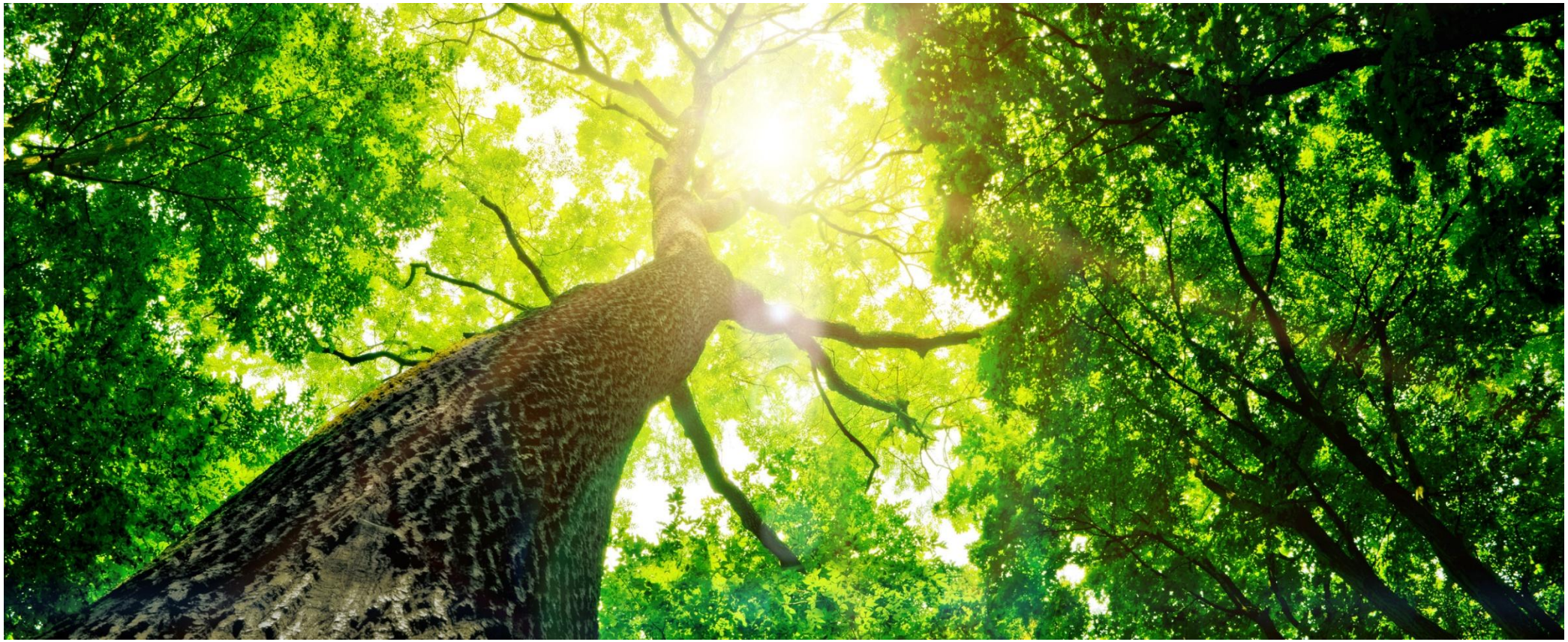


SZOLGÁLTATÁS KÖZPONTÚSÁG AZ OPTIKAI HÁLÓZATI RÉTEGEKBEN
SERVICE CENTIC APPROACH IN OPTICAL NETWORK LAYERS

BARTA PÉTER, ADÁMY ZSOLT, Alcatel-Lucent

Alcatel·Lucent

AGENDA

1. Fixed access: the bandwidth buttle
2. Access and Metro for B2B and Industry: go for MPLS
3. Evolution: SDN/NFV
4. WDM

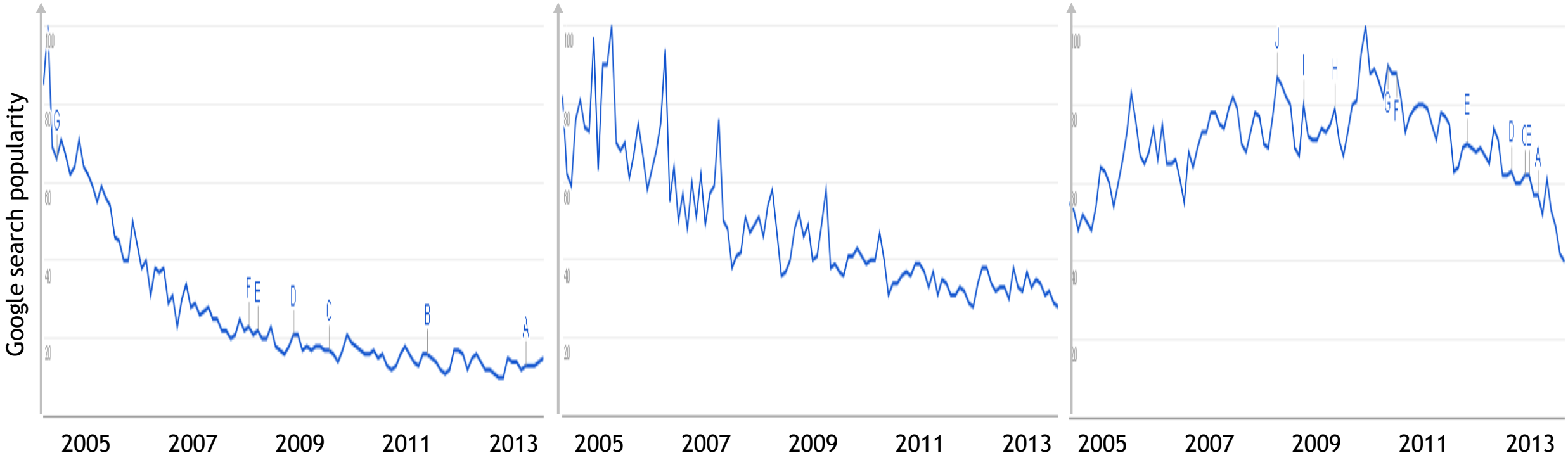
1. Fixed access: the bandwidth buttle

MARKETING MEGABITS STILL WORKS

END-USER INTEREST IN MEGAHERTZ

END-USER INTEREST IN MEGAPIXELS

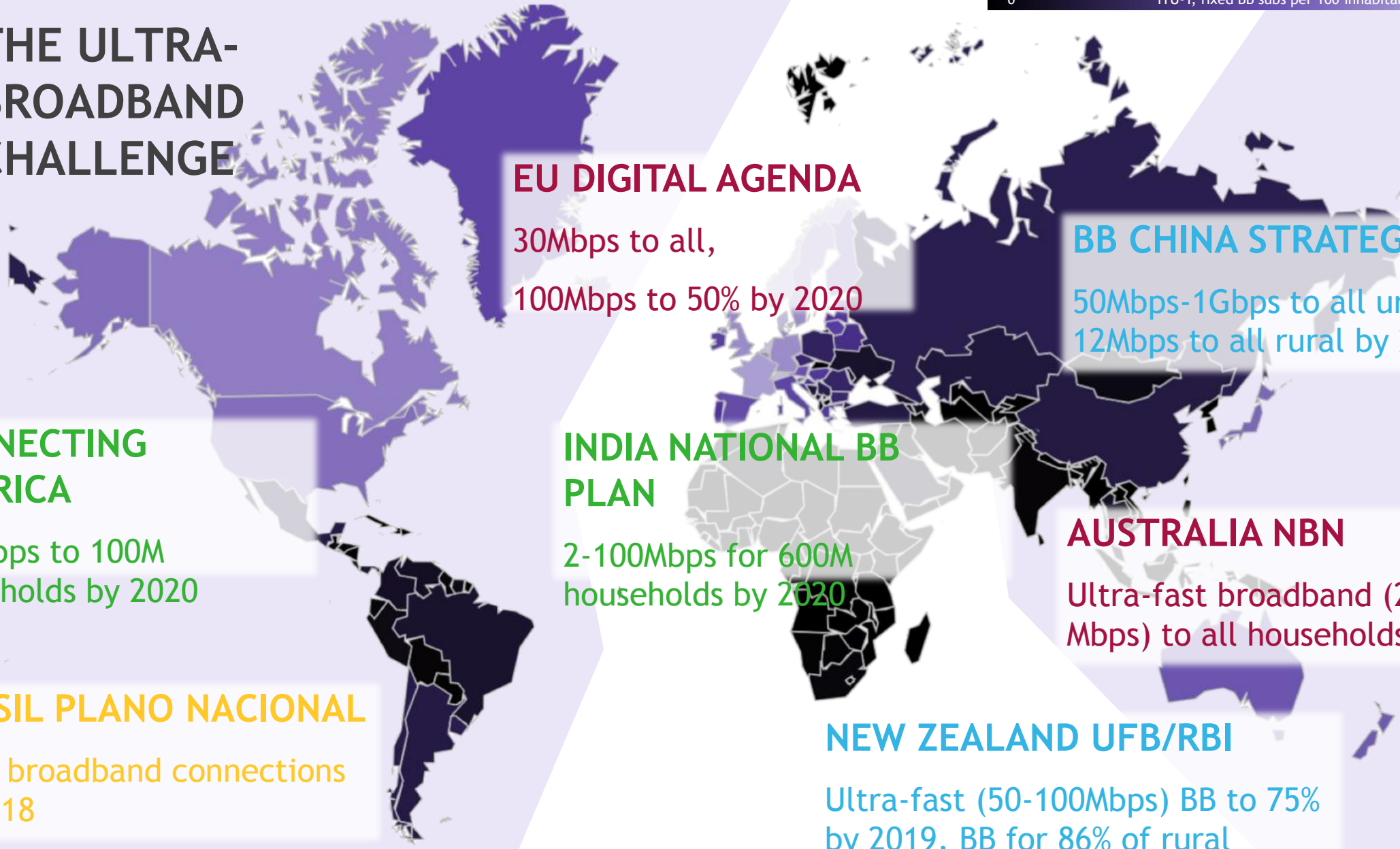
END-USER INTEREST IN MEGABIT



Source: Google Trends

Alcatel·Lucent

THE ULTRA-BROADBAND CHALLENGE



EU DIGITAL AGENDA

30Mbps to all,

100Mbps to 50% by 2020

BB CHINA STRATEGIC PLAN

50Mbps-1Gbps to all urban and 12Mbps to all rural by 2020

CONNECTING AMERICA

100Mbps to 100M households by 2020

INDIA NATIONAL BB PLAN

2-100Mbps for 600M households by 2020

AUSTRALIA NBN

Ultra-fast broadband (25-100 Mbps) to all households by 2019

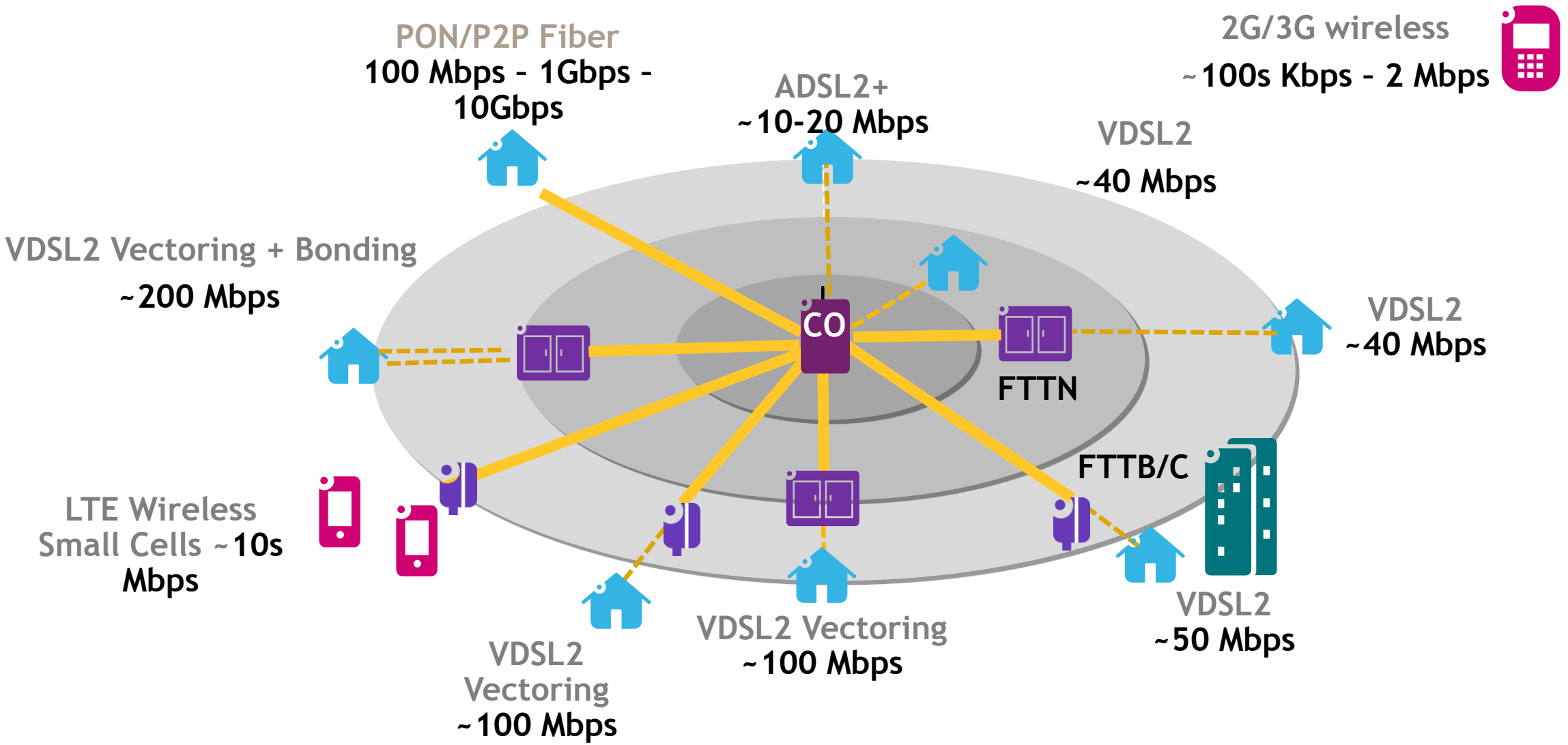
BRASIL PLANO NACIONAL

160M broadband connections by 2018

NEW ZEALAND UFB/RBI

Ultra-fast (50-100Mbps) BB to 75% by 2019, BB for 86% of rural

SOLVING THE BANDWIDTH EQUATION



SOLVING THE BITRATE EQUATION

1 INVESTMENT

- From FTTN (4x) to FTTH (15x)
- The closer to the subscriber, the closer the cost to FTTH

2 TIME TO MARKET

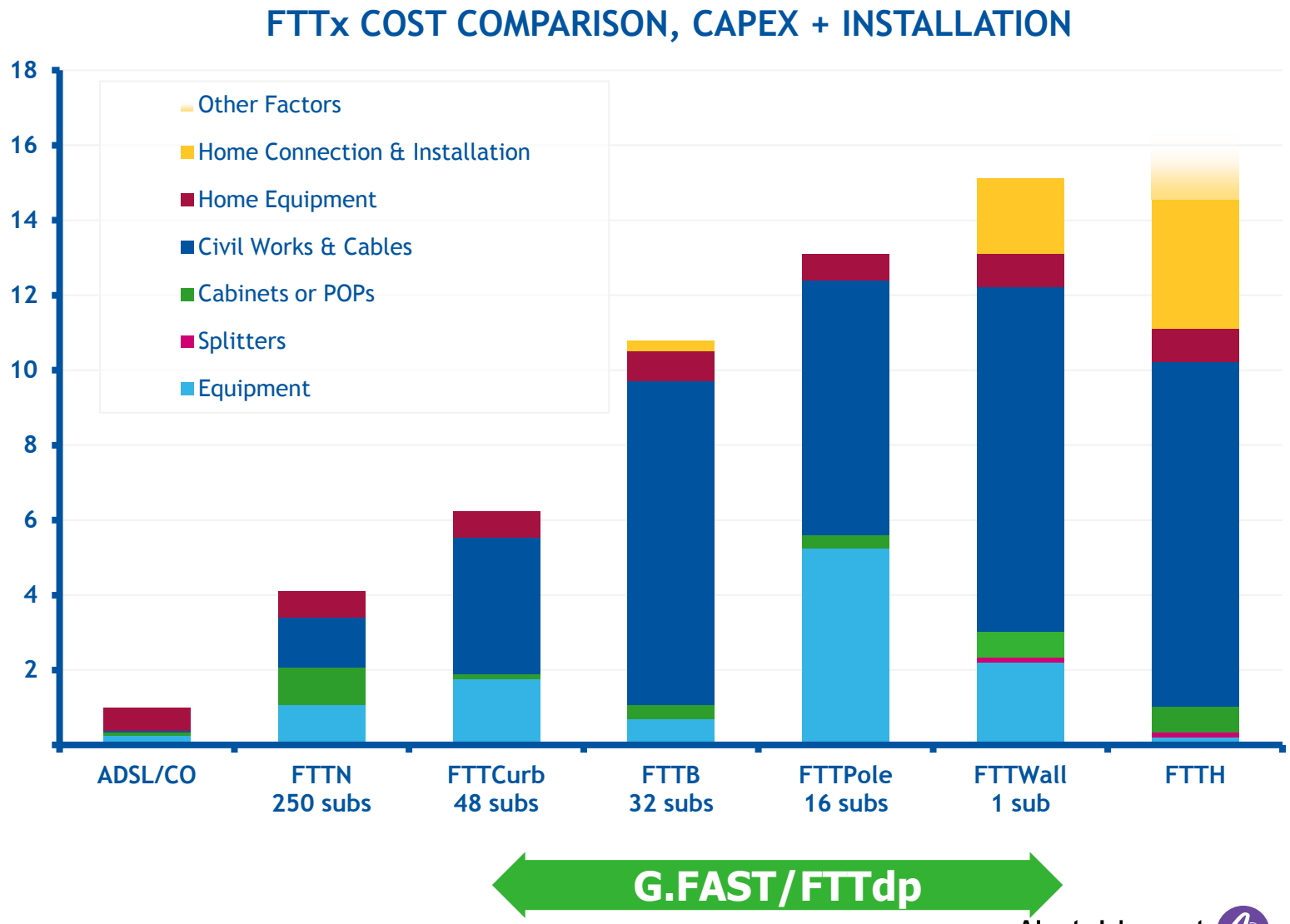
- Deploying FTTH is time consuming
- Re-using existing copper can speed up deployment

3 BANDWIDTH

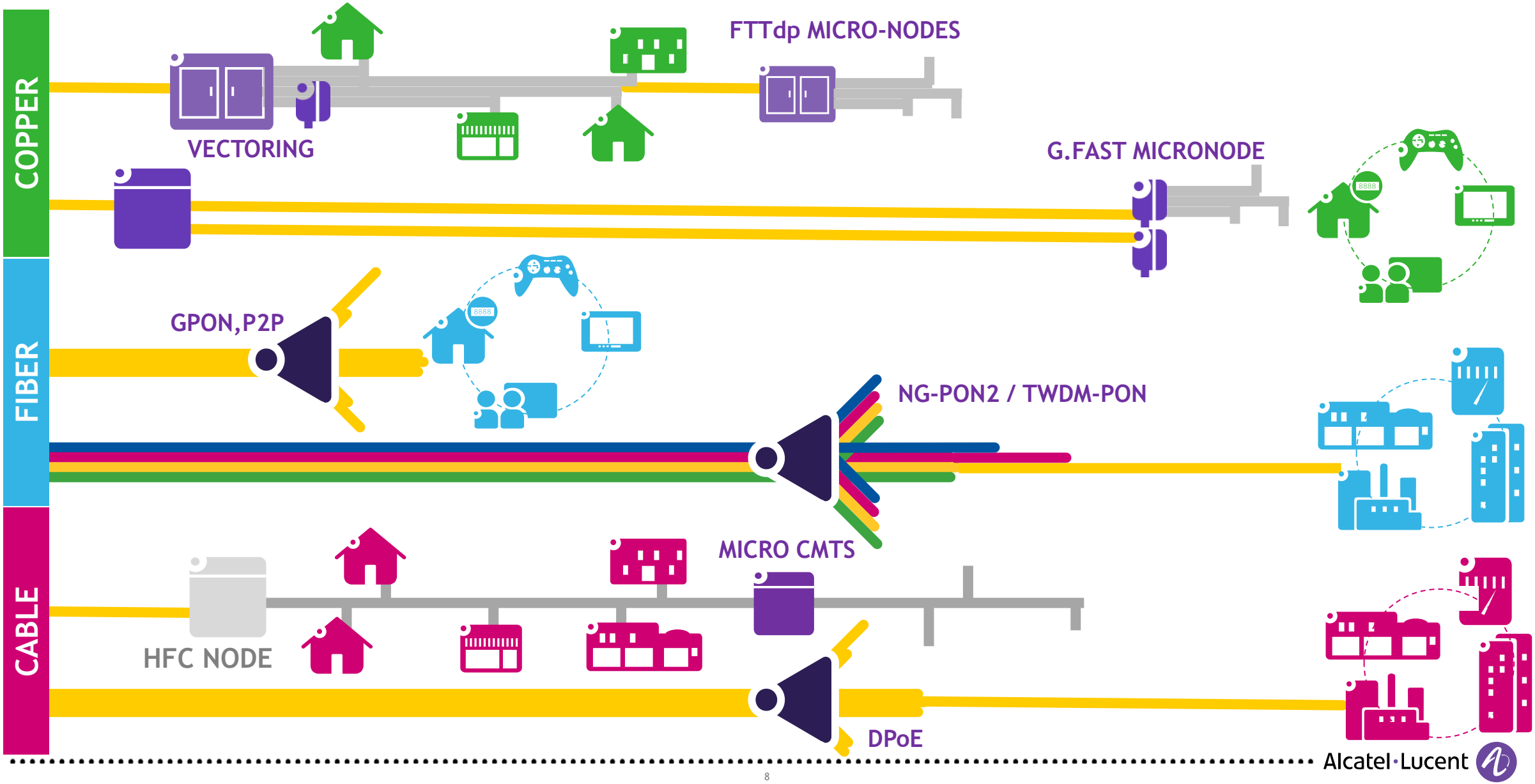
- FTTH: 1G and more
- FTTx: 100M (VDSL2 Vectoring today), G.fast evolution to 100s

4 OTHER FACTORS

- (-) Aerial fiber, existing ducts
- (+) difficulty to enter the home

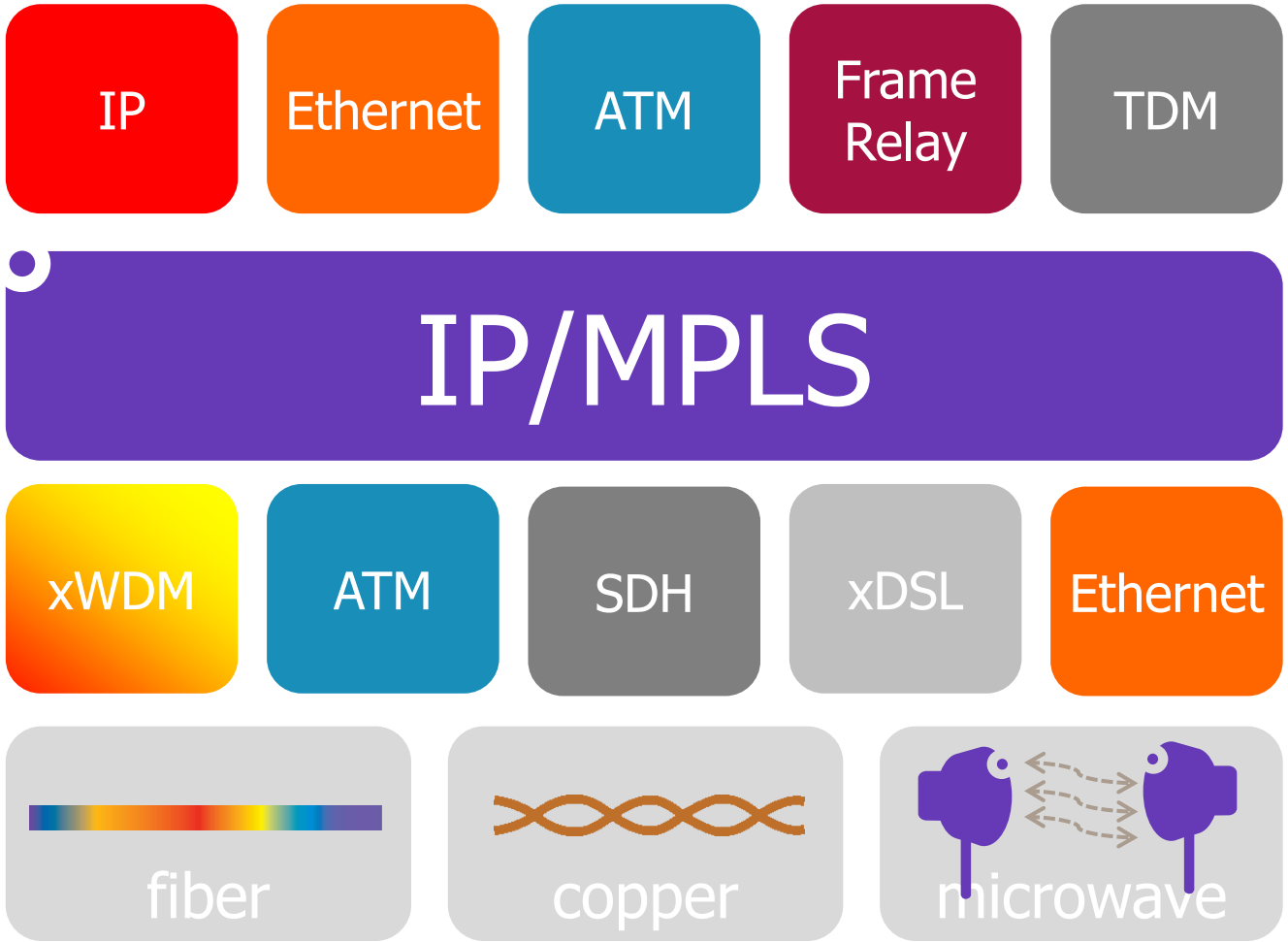


WHAT'S NEXT IN ULTRA-BROADBAND ACCESS TECHNOLOGY?

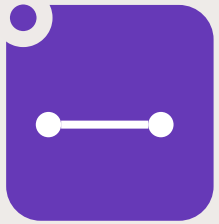
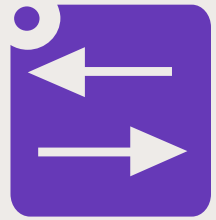
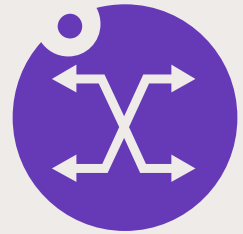
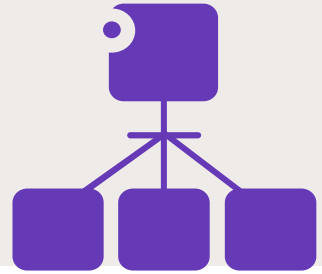


2. Access and Metro for B2B and Industry: go for MPLS

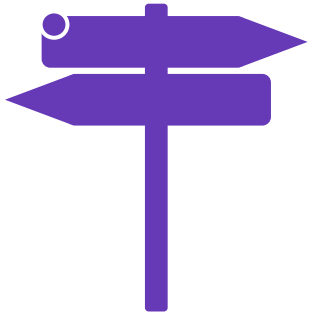
IP/MPLS = TRANSPORT & PROTOCOL AGNOSTIC



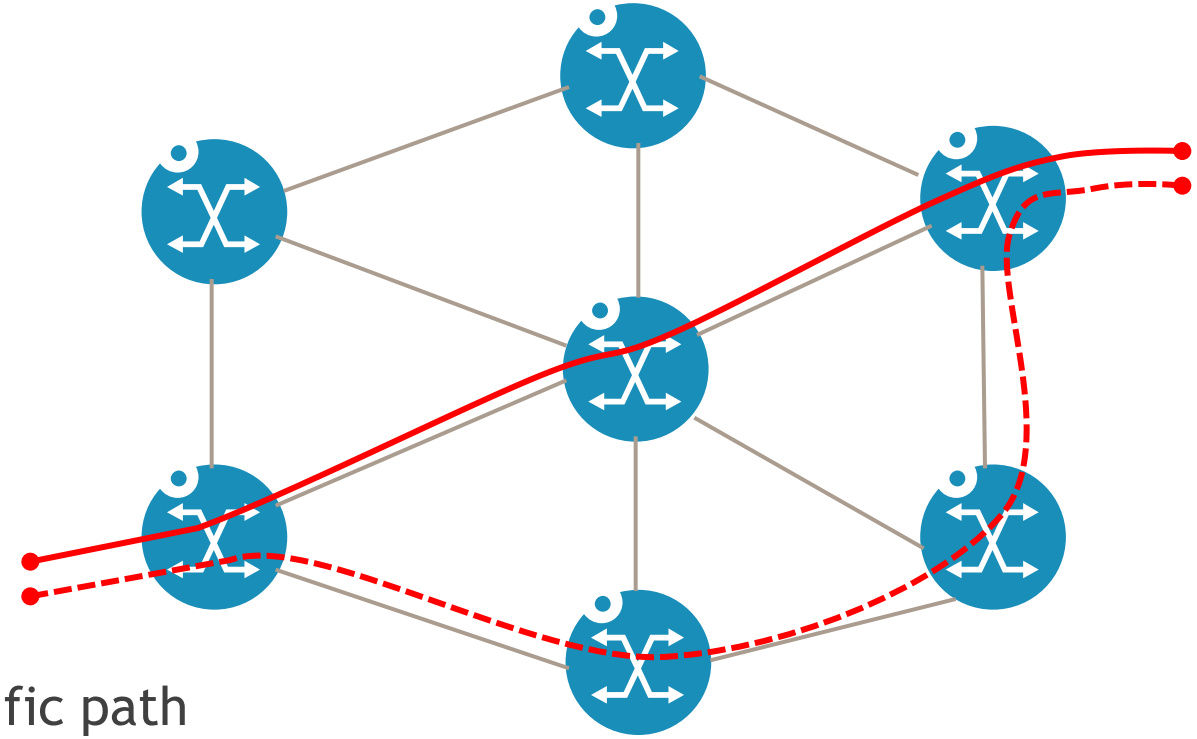
IP/MPLS = SERVICE AGNOSTIC

LAYER 2		LAYER 3	
			
Circuit Emulated Services for legacy traffic like teleprotection, SCADA, railway signaling, GSM-R	Virtual Private LAN Services for point-to-multipoint Ethernet services i.e. for GOOSE, signaling in railways	IP VPN/VPRN services For VoIP services, intranet services, internet connectivity,	Routed IP multicast services
E-pipe services for specific Ethernet protocols, C-pipes for TDM, A-pipes for ATM, F-pipes for FR…	Hierarchical-VPLS services for scaling point-to-multipoint services at L2.	Connectivity through Service Provider services, (Backup services)	Video surveillance, Video conferencing, IP-TV

DETERMINISTIC BEHAVIOR



TRAFFIC
ENGINEERING



MPLS can force specific traffic to follow a specific path

Less critical traffic can use a “loose” path calculated by a routing protocol (OSPF/ISIS)

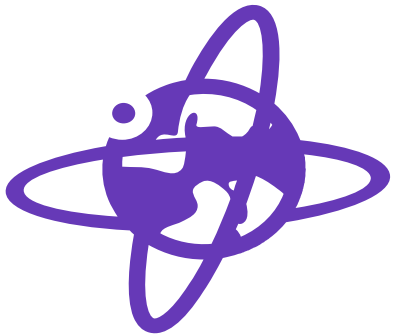
RSVP-TE will allow to ensure bandwidth availability along a path for critical traffic

Carrier Ethernet has no concept of traffic engineering (besides static provisioning)

IP/MPLS can attempt to find an alternate path in case active and standby are failing

MPLS-TP does not support RSVP-TE, CSPF… detours must be manually planned

SCALING



Proof point:

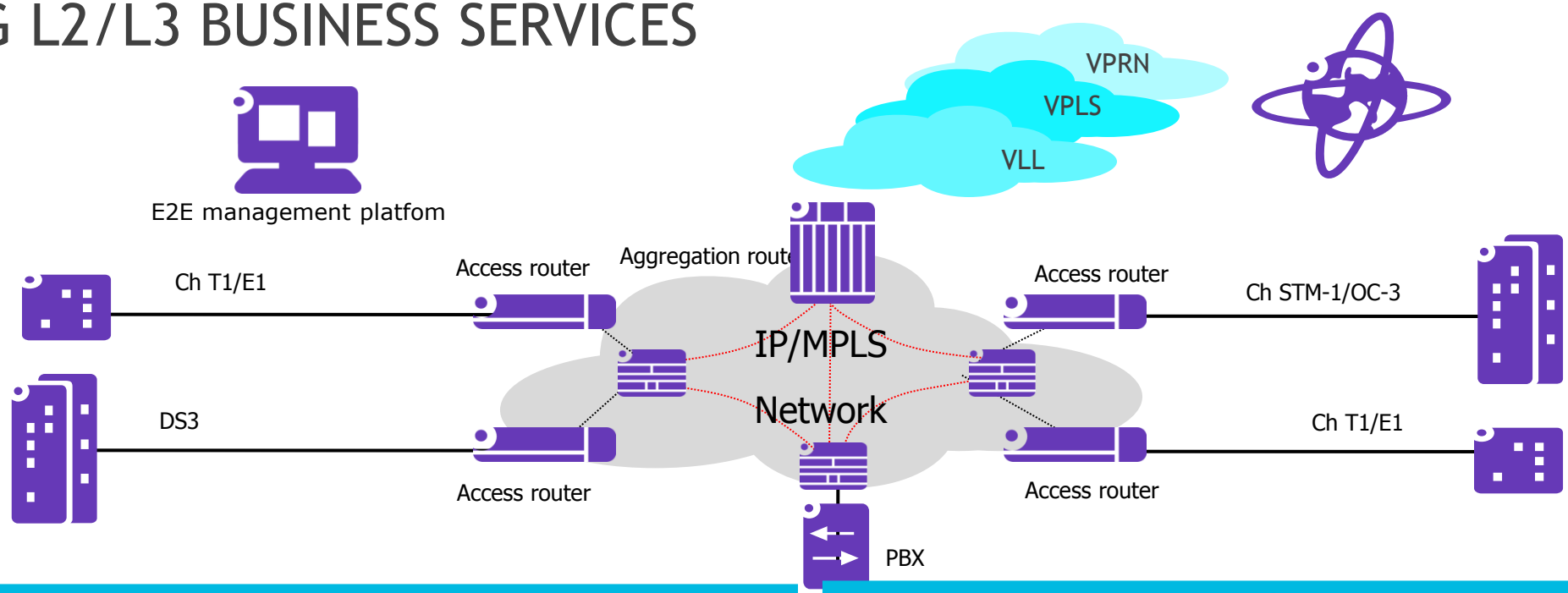
The internet is based on BGP, it scales massively, millions of routes, thousands of routers

Seamless MPLS takes this to the next level:

Hundreds of thousands of (small) access nodes can communicate end-to-end MPLS despite their constrained resources

Convergence times of MPLS networks are deterministic and fixed, those of L2 networks are not, depending on size, topology & protocol used.

MODERNIZING PRIVATE LINE INFRASTRUCTURE:
ADDING L2/L3 BUSINESS SERVICES



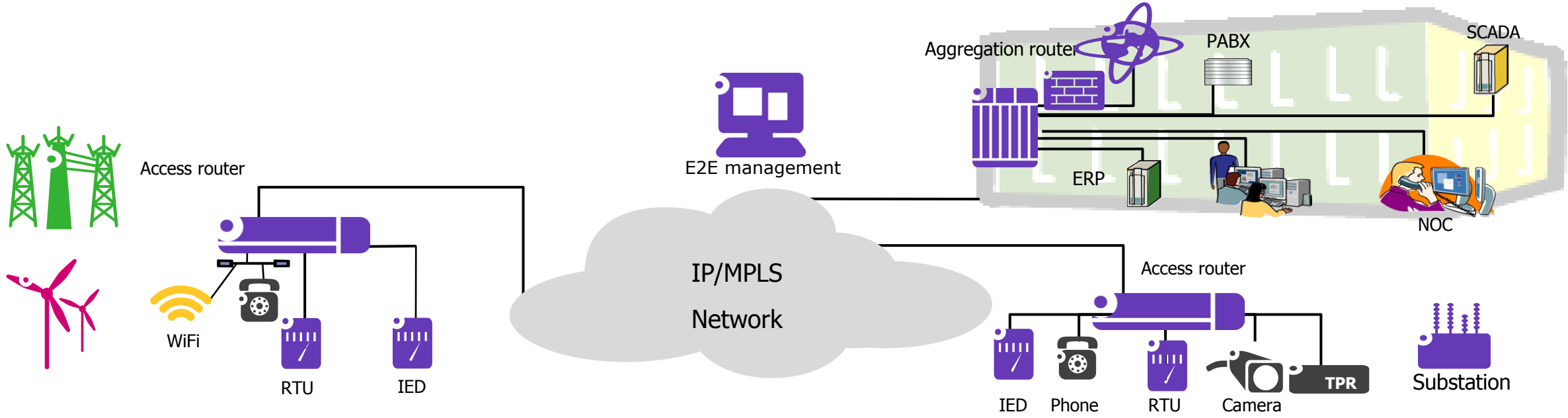
Issues

- Existing data delivery networks are reaching their product End of Life.
- Private line services are still needed but IP and Ethernet centric services are becoming the focus for new revenue
- Need is often pent-up and triggered by an unforeseen event e.g. catastrophic failure

Solution

- Common service model for private line data services (TDM, ATM, FR and PPP).
- Extend the model to deliver Layer 2 and Layer 3 business services
- Common infrastructure used to establish a variety of services for multi-generational technologies.

STRATEGIC INDUSTRY: DISTRIBUTION GRID AUTOMATION



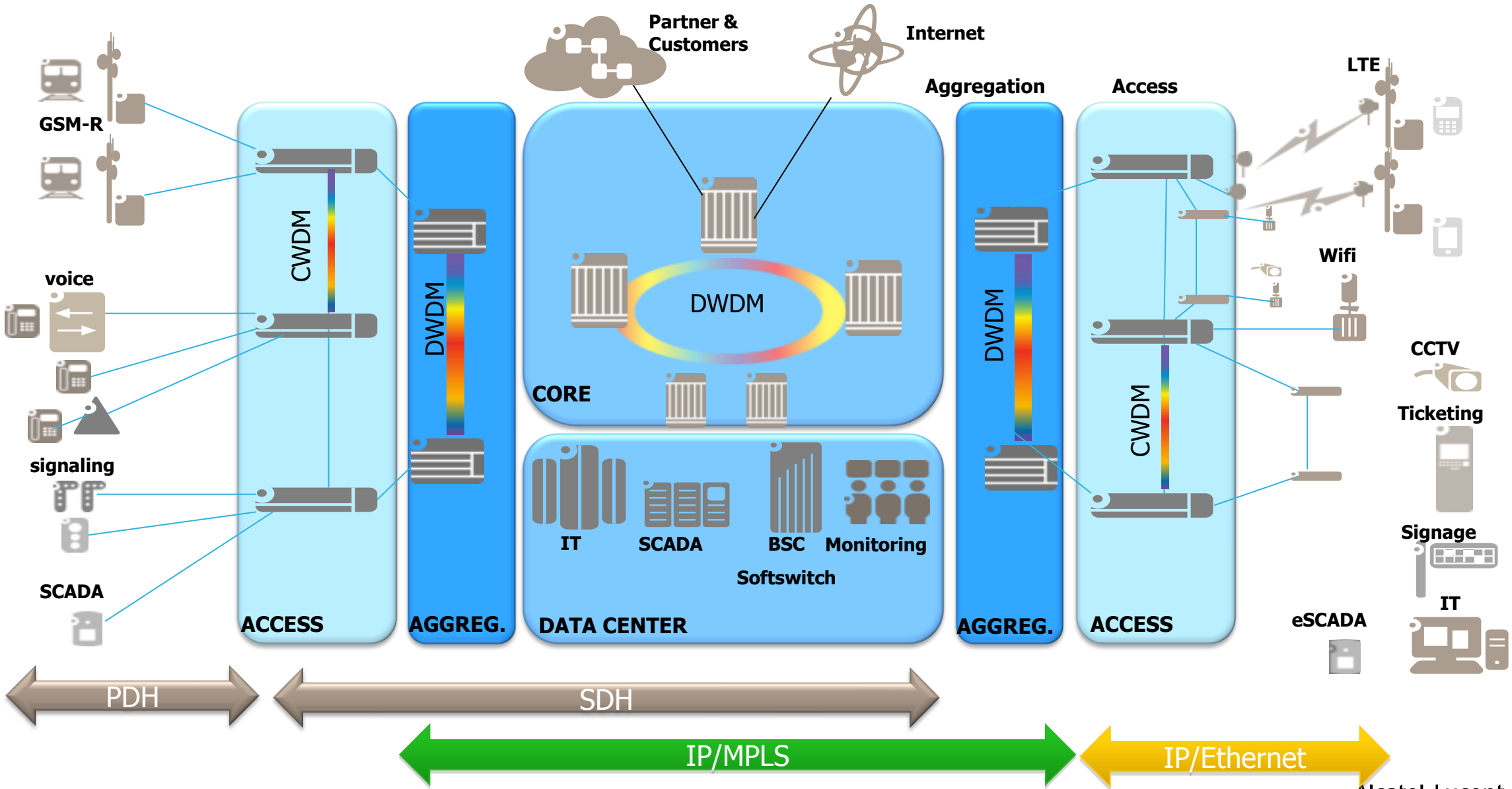
Issues

- Grid modernization requires communication network transformation out to distribution automation and field area networks
- Requires flexibility for various network topologies with high availability communications for mission critical applications and operation
- Needs to be compact, environmentally hardened and support small cabinet/enclosure installations

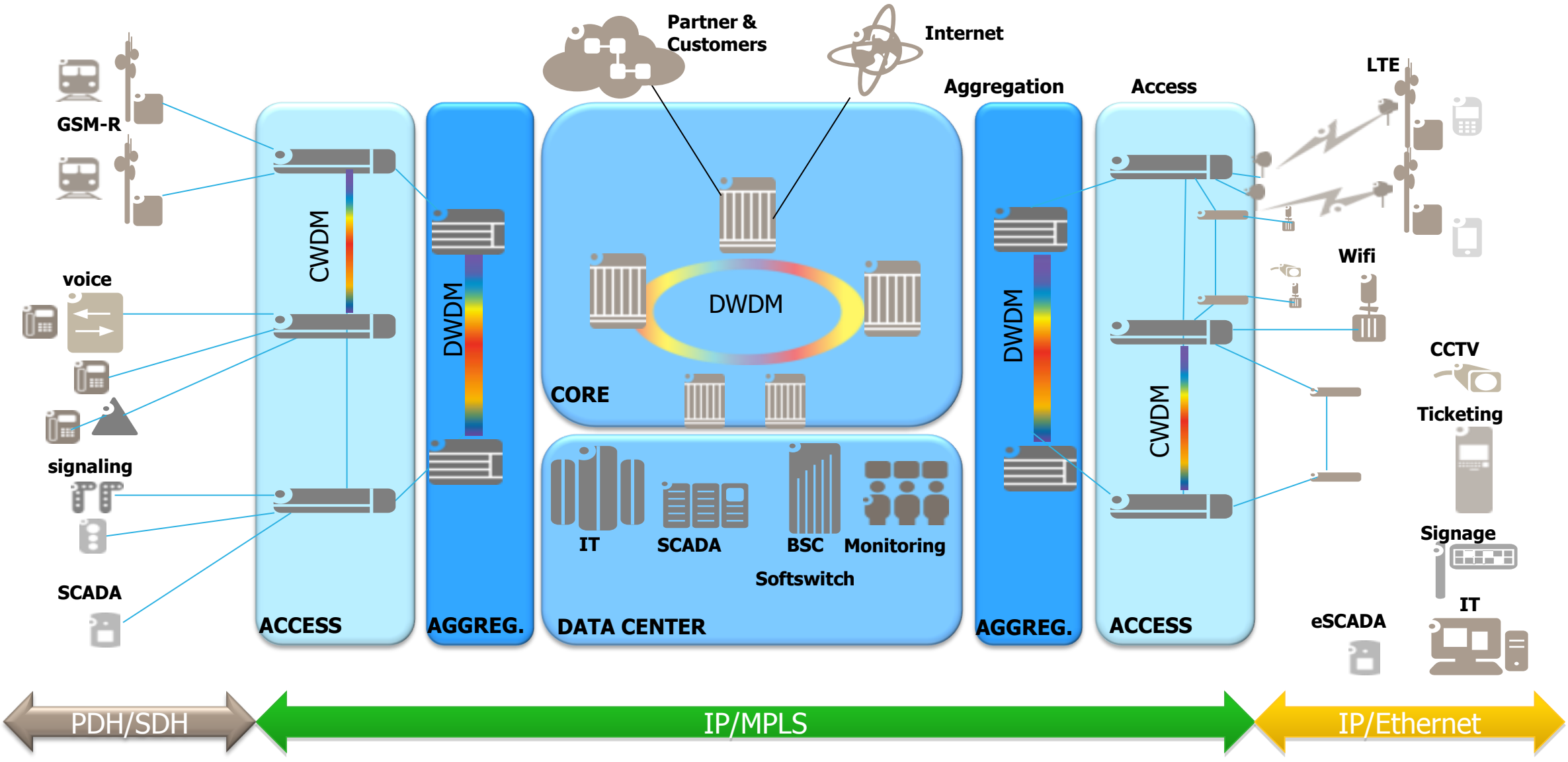
Solution

- Full IP/MPLS router, with advanced service capabilities and MPLS QoS in a IEEE1613/IEC61850 compliant platform
- Seamless support for new IP/IEC 61850-based and legacy based applications
  - Teleprotection GOOSE traffic with VPLS
  - Serial TDM migration for teleprotection and SCADA
  - VPRN/IP multicast/IPv6
- Installation versatility with DIN rail/wall/panel mounting option and high voltage support
- IPSec encryption, Management Plane Protection, High availability, AAA (authentication, authorization, accounting), NAT, ACLs.

MAINLINE RAILWAY NETWORK ARCHITECTURE … THE LEGACY VIEW

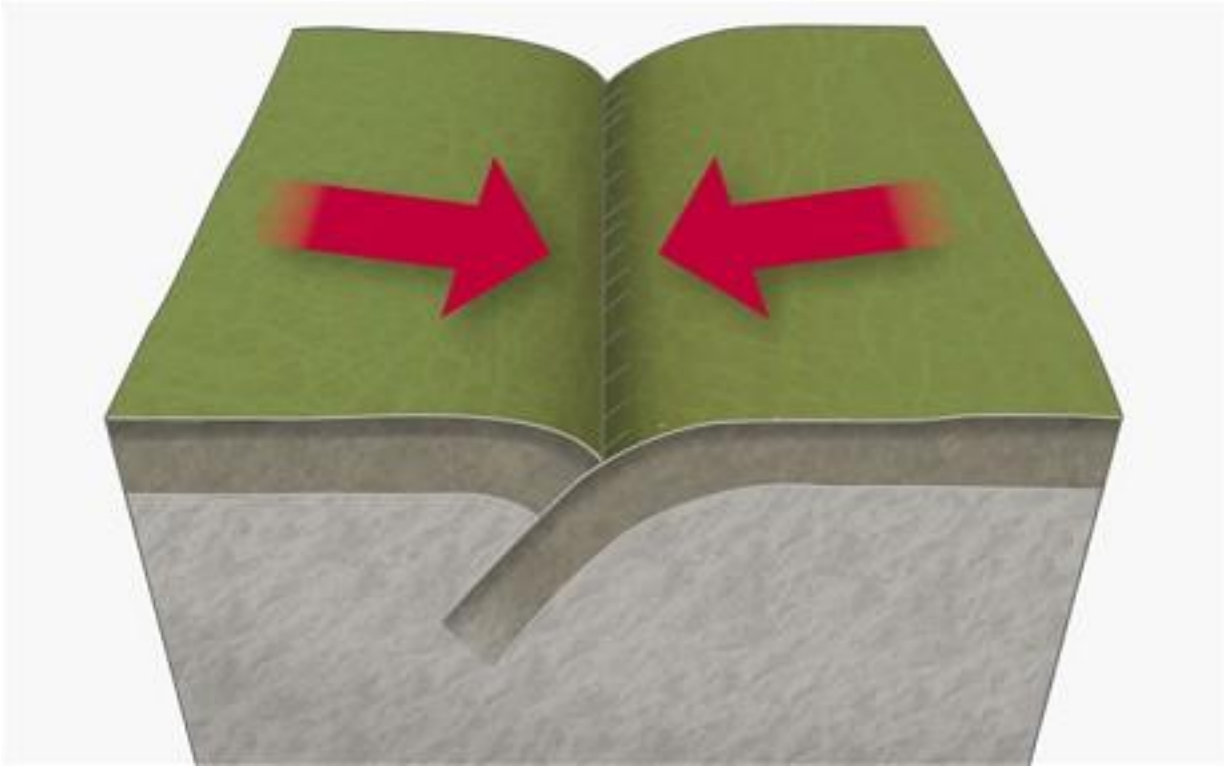


MAINLINE RAILWAY NETWORK ARCHITECTURE … THE ALCATEL-LUCENT VIEW



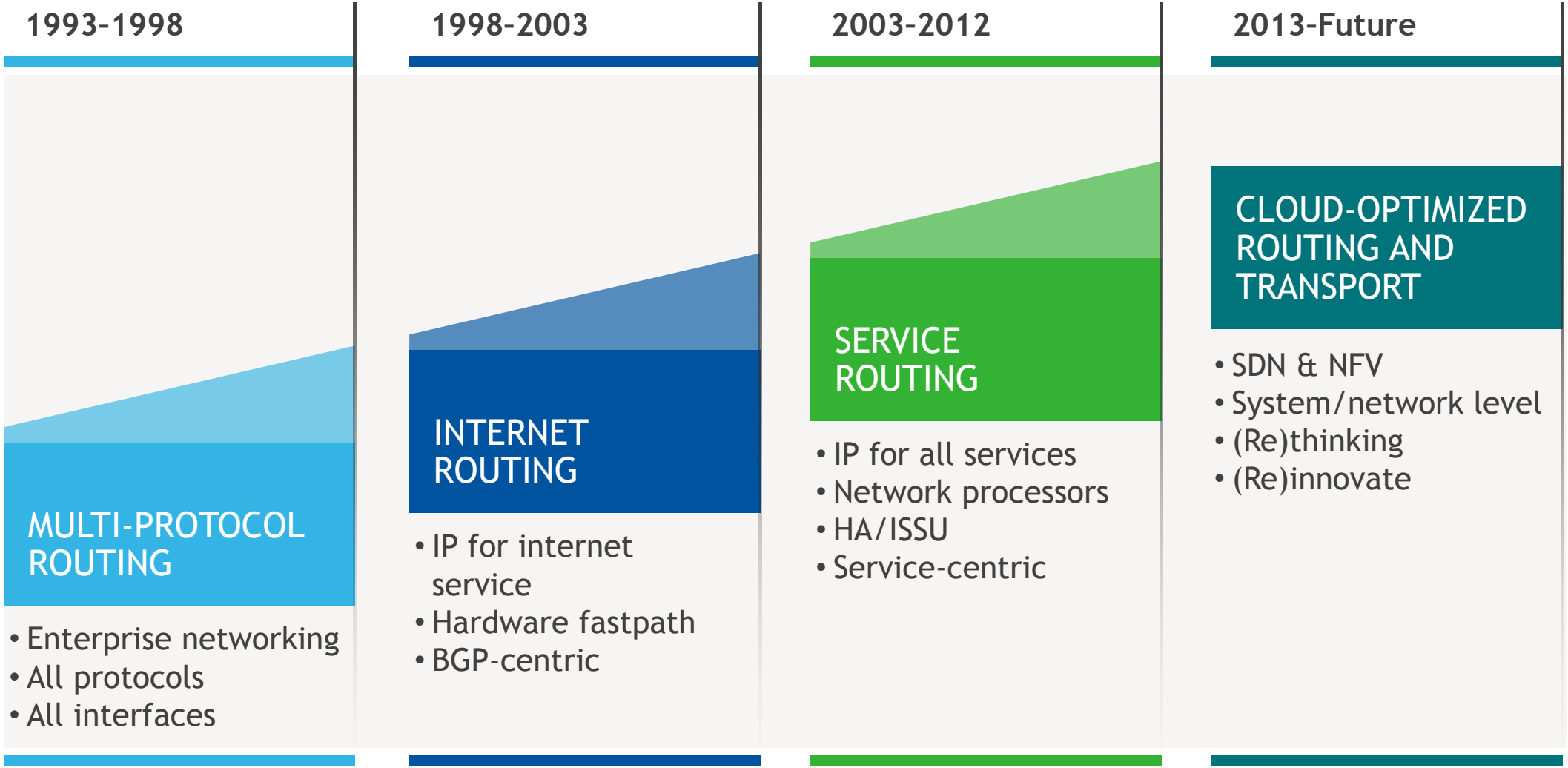
4. Evolution: SDN/NFV

TIMES ARE CHANGING…

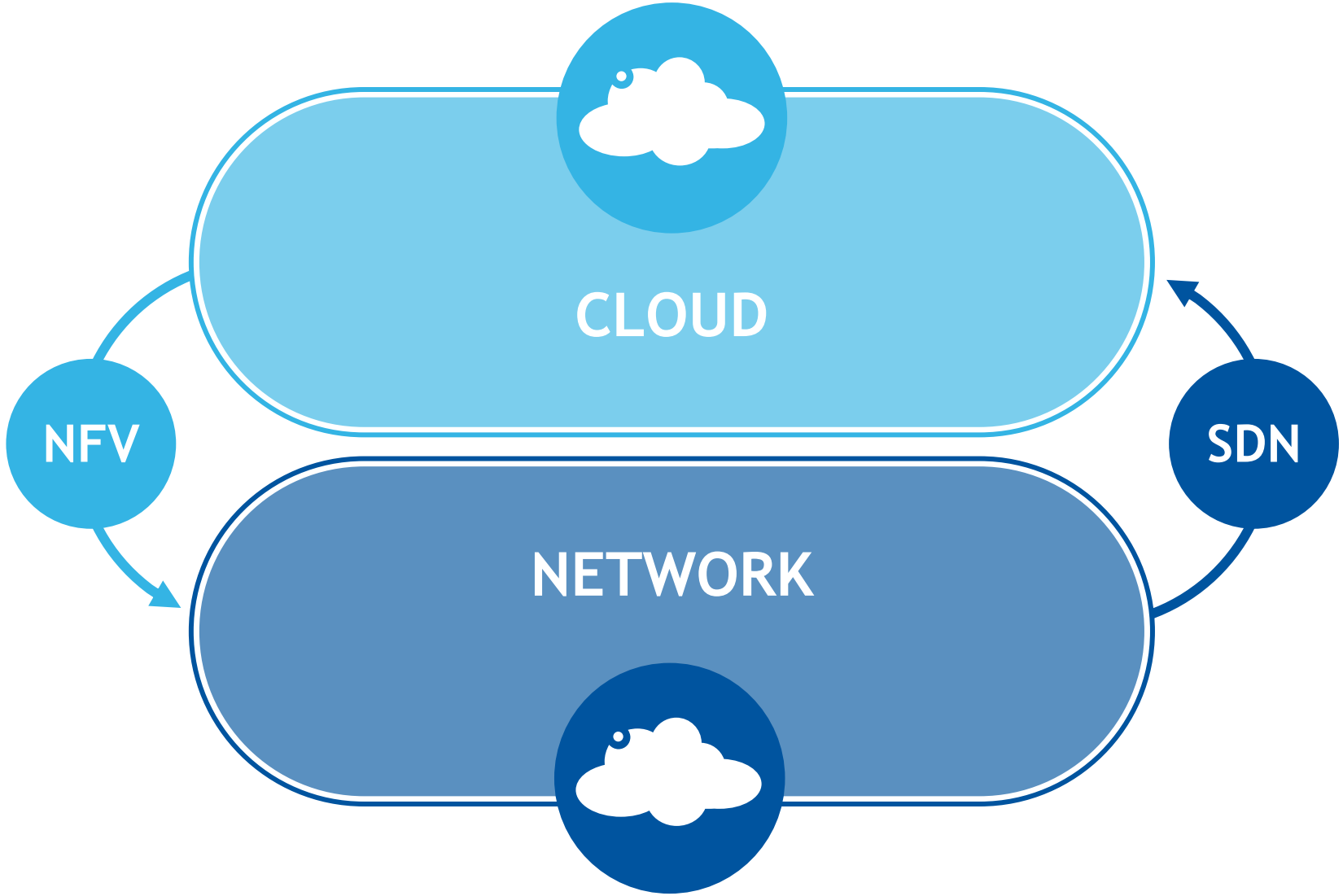


WHAT WILL THE NEW NETWORK LANDSCAPE LOOK LIKE WITH THE CONVERGENCE OF CLOUD AND NETWORKS, IT AND IP?

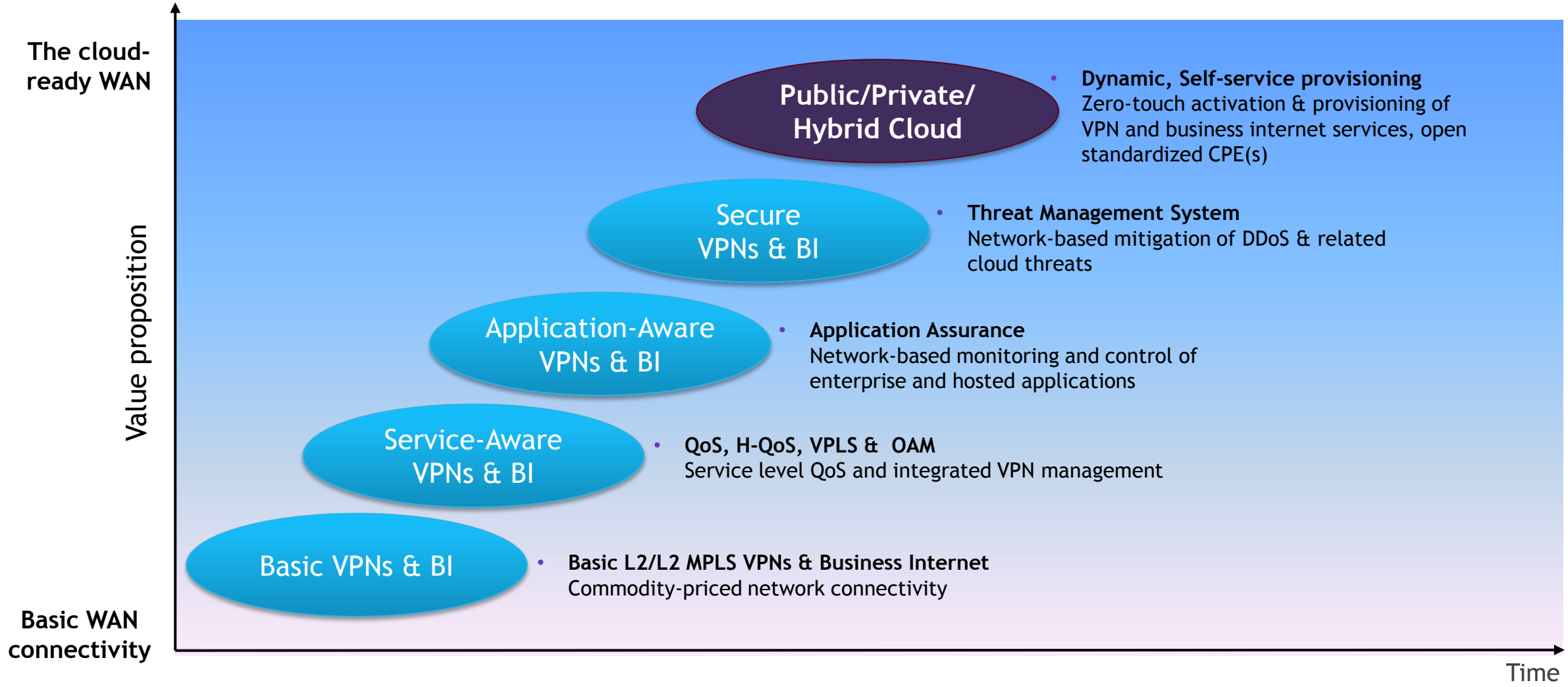
THE SHIFT TO A NEW ERA



NETWORKING THE CLOUD & CLOUDIFYING THE NETWORK



THE EVOLUTION OF VPN NETWORK SERVICES



A RANGE OF VPN SERVICE OPTIONS TO OPTIMIZE END USER CONNECTIVITY AND EXPERIENCE

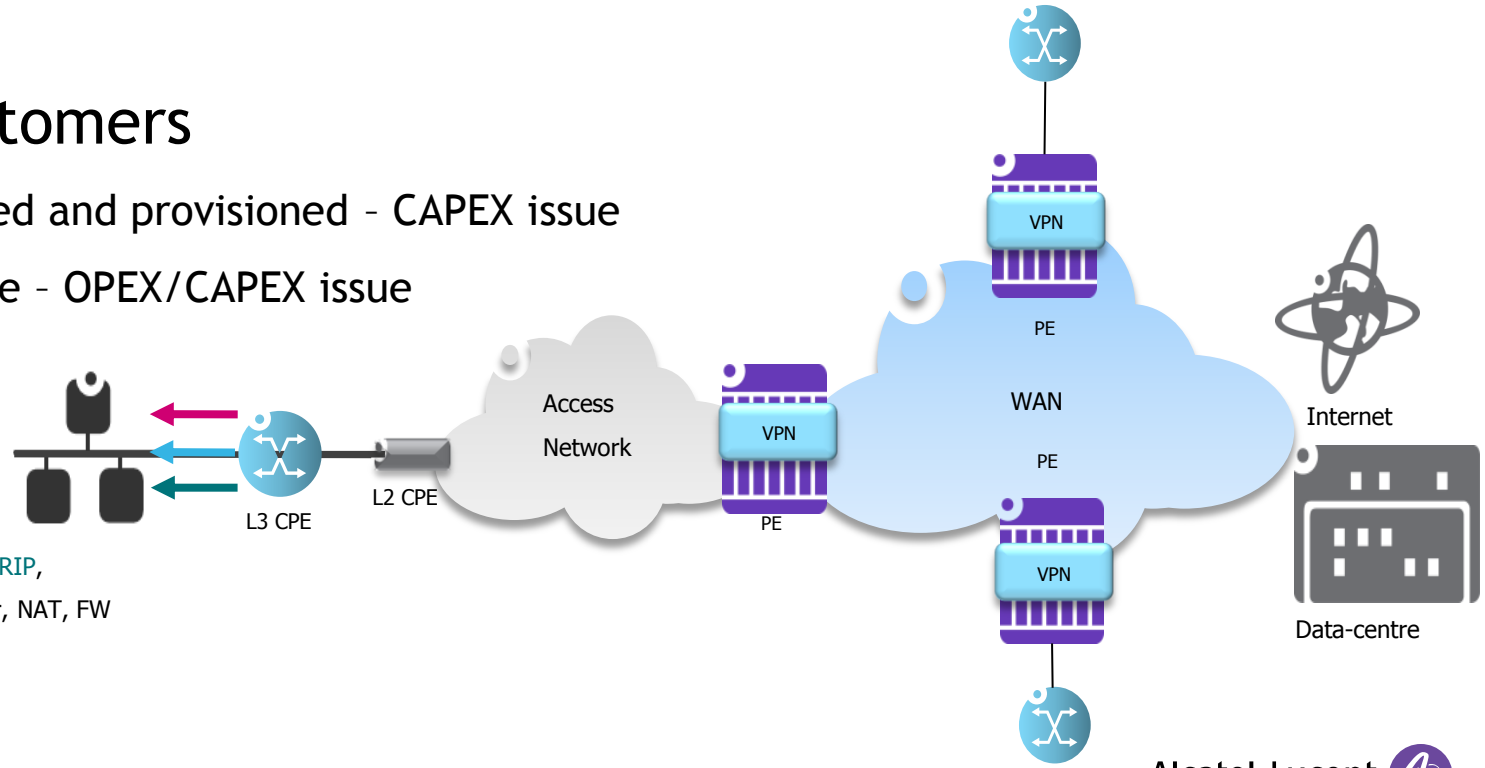
TRADITIONAL VPN APPROACH – L3-CPE/L2-CPE
CURRENT DEPLOYMENT OVERVIEW

Present mode of operation

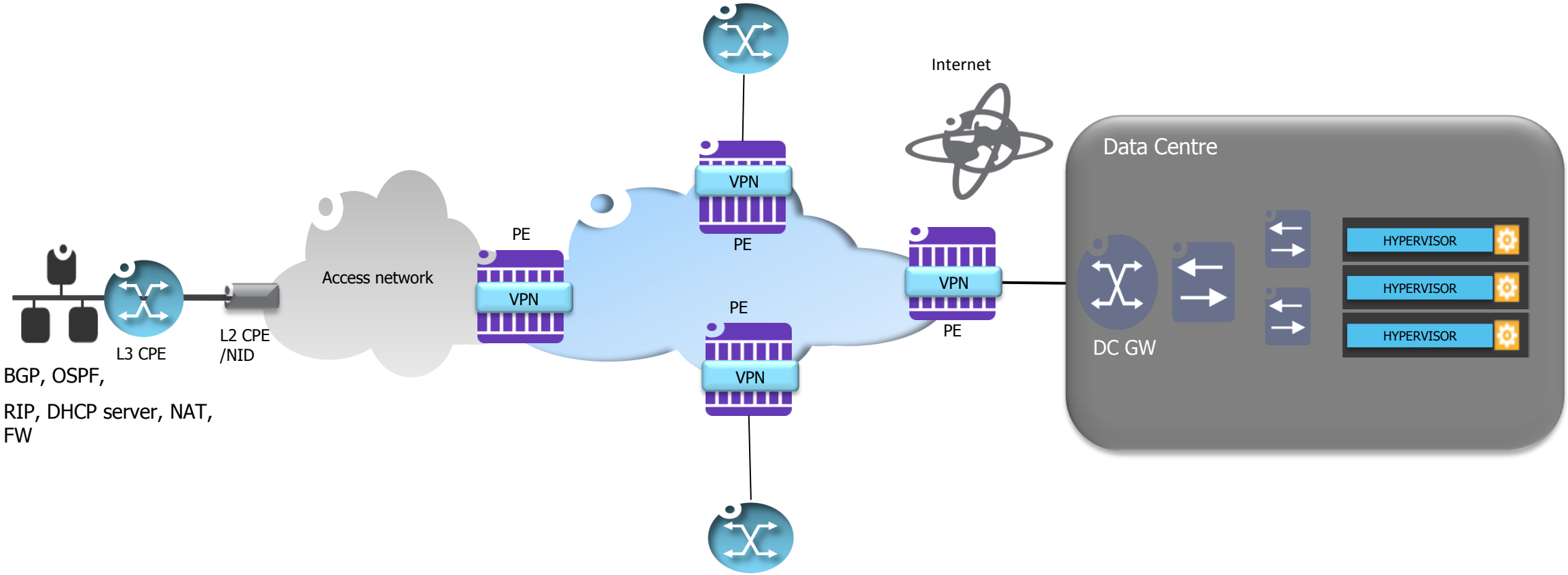
- A L3 service offering will usually involve either the customer taking a managed CPE from the provider, or the customer own the L3 CPE with some agreement from the provider on how to interconnect
- A second L2 CPE is most often deployed to provide connectivity from the customer site to the PE where the L3 service is provided

Enhancements requested by customers

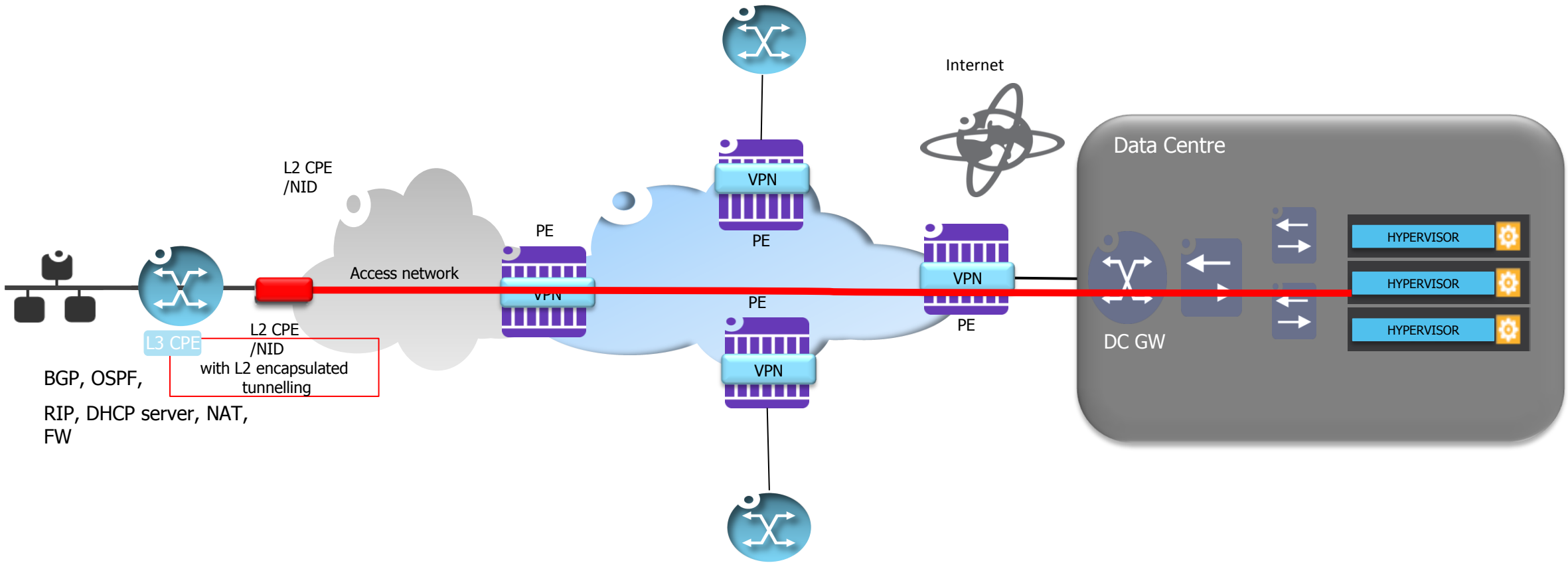
- For a Single service, two CPEs are deployed and provisioned – CAPEX issue
- Up sell from L2 to L3 requires CPE upgrade – OPEX/CAPEX issue
- Management simplification – OPEX issue
- CPE inventory is too high – OPEX issue
- Self-service capabilities – Business
- Hybrid Cloud Services - Business



FROM: TRADITIONAL L3-CPE+L2-CPE
TO: L3 CPE PROVIDED AS A VIRTUAL FUNCTION IN PE



FROM: TRADITIONAL L3-CPE+L2-CPE
TO: L3 CPE PROVIDED AS A VIRTUAL FUNCTION IN THE DATACENTER



ROUTING GOES VIRTUAL – A VNF FOR SDN

nuagenetworks

Virtualized Services Platform (VSP)

Virtualized Services Directory (VSD)

Virtualized Services Controller (VSC)

Virtual Routing & Switching (VRS)

5. WDM

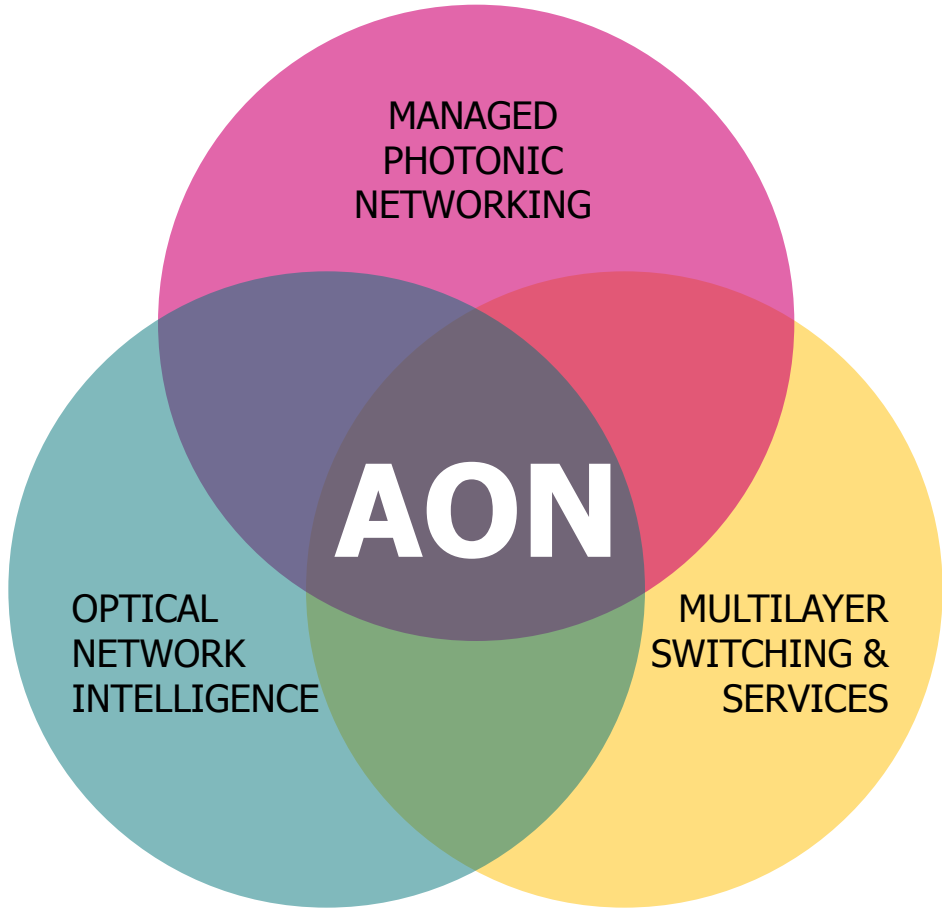
FlexGrid
Data Center Interconnection

FlexGrid

Data Center Interconnection

AGILE OPTICAL NETWORKING
MOVING TOWARD CLOUD SERVICES DELIVERY

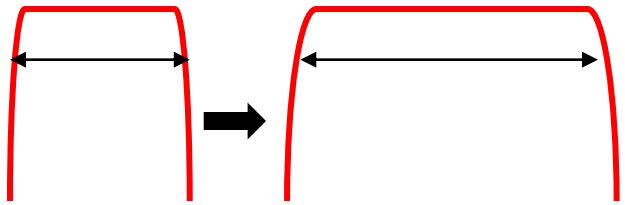
NETWORK PHOTONICALLY AT 100G AND BEYOND



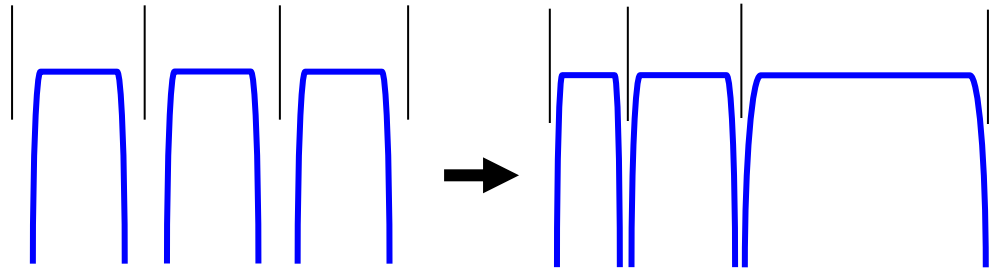
ACCELERATE SERVICE DELIVERY AND AUTOMATE OPERATIONS

GROOM FLEXIBLY TO DELIVER SERVICES AT MOST ECONOMICAL LAYER

FLEXIBLE GRID



Flexible Bandwidth



Flexible Grid

Fix grid used today doesn't aligns with neither the bit rate nor the distance of a particular service

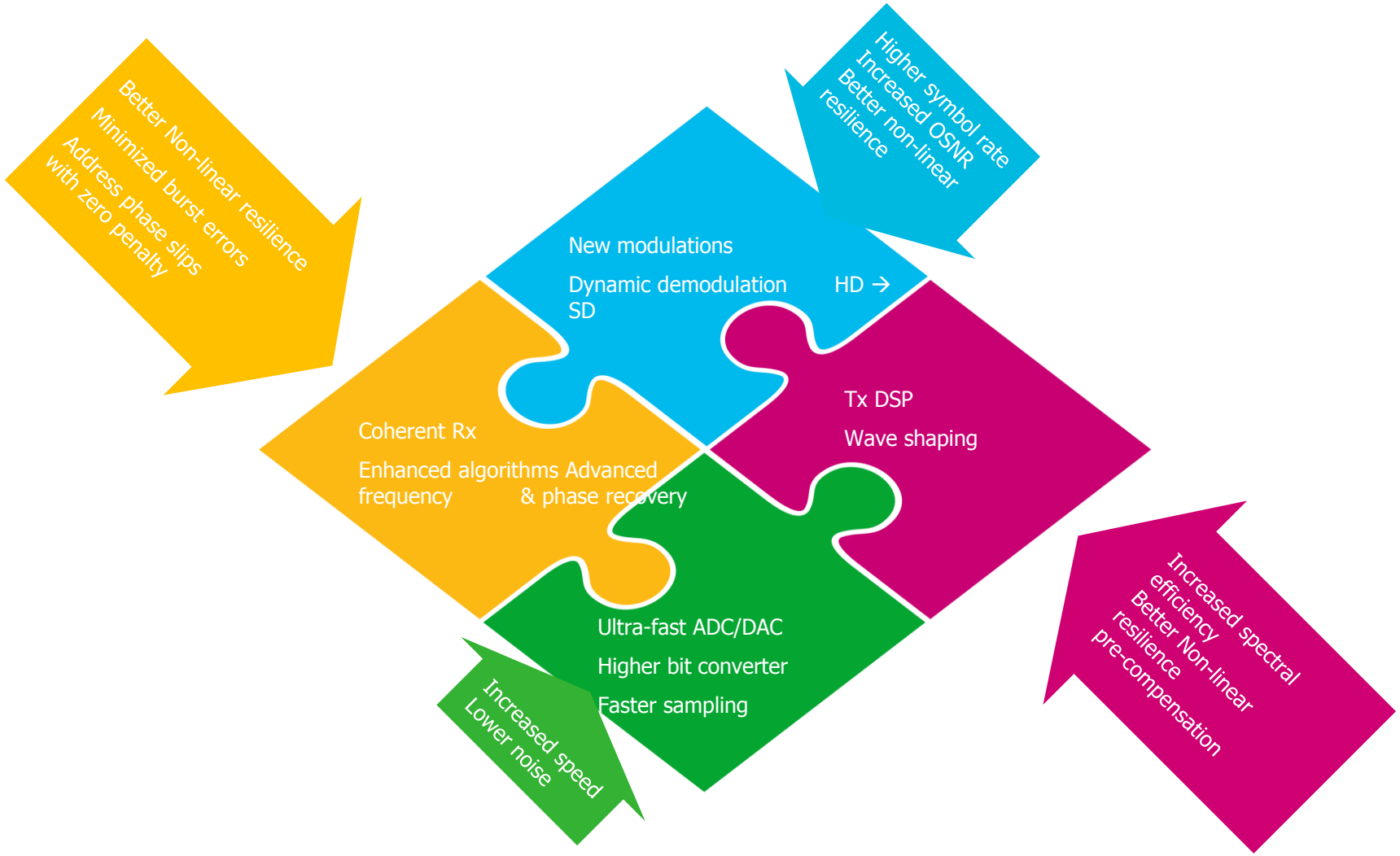
For optimal operation (both utilization and reach) it should be wider or narrower as defined per channel individually

Adjustable channel width (i.e. FlexGrid) for the optimal transmission

- actual channel is a multiplier of a relatively small base spectra unit (e.g. 12,5GHz) (today typical fix grid is 50GHz)
- individual channel width can be defined as per the particular need of a given service
- Hw supporting this feature is necessary to implement in the line systems (e.g. FlexGrid ready WSS)

Transponders need to support FlexGrid, too in order to take its benefits

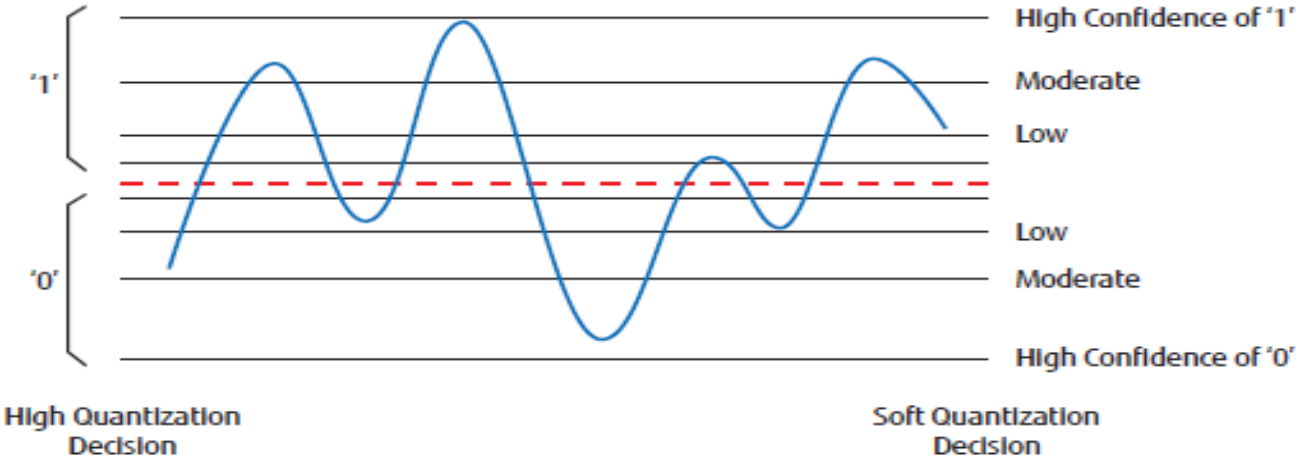
400G PHOTONIC SERVICE ENGINE



Edge of Technology in Optical Transmission

Soft Decision (SD) FEC

- Soft-Decision Forward Error Correction (SD-FEC) is a user provisional Forward Error Correction option
- SD-FEC provides more net coding gain (10.5 dB, +2.2 dB) than previous generation FEC, thus allowing for better engineering rules of the channels transported over a DWDM system.
- SD-FEC also supports a “legacy mode” (AFEC) for interworking with the earlier generation cards
- Line bit rates are higher with SD-FEC than with Legacy so to enable for the overhead (e.g. 129.28.. Gbps for OTU-4)

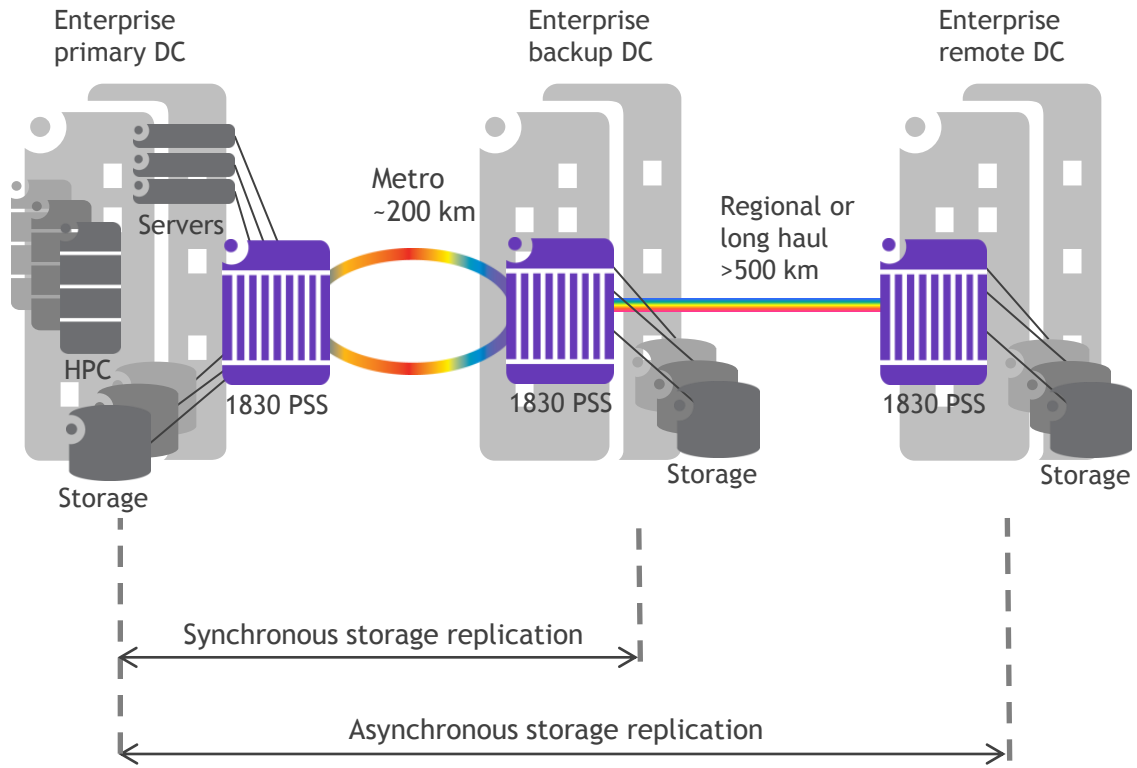


FlexGrid

Data Center Interconnection

FINANCIALS SYNC AND ASYNC STORAGE APPLICATION

- Financials applications in metro:
  - Business continuity
  - Disaster recovery
  - Mirroring
  - Workload rebalancing
  - Local and remote read/write (async storage)
- Financials applications requirements:
  - Primary and backup DC across MAN to provide disaster recovery and meet SOX regulatory measures
  - Typically point-to-point topologies over dark fiber
  - Zero loss for mission-critical data
  - Lowest latency for HFT
  - High availability
  - Security and privacy requirements

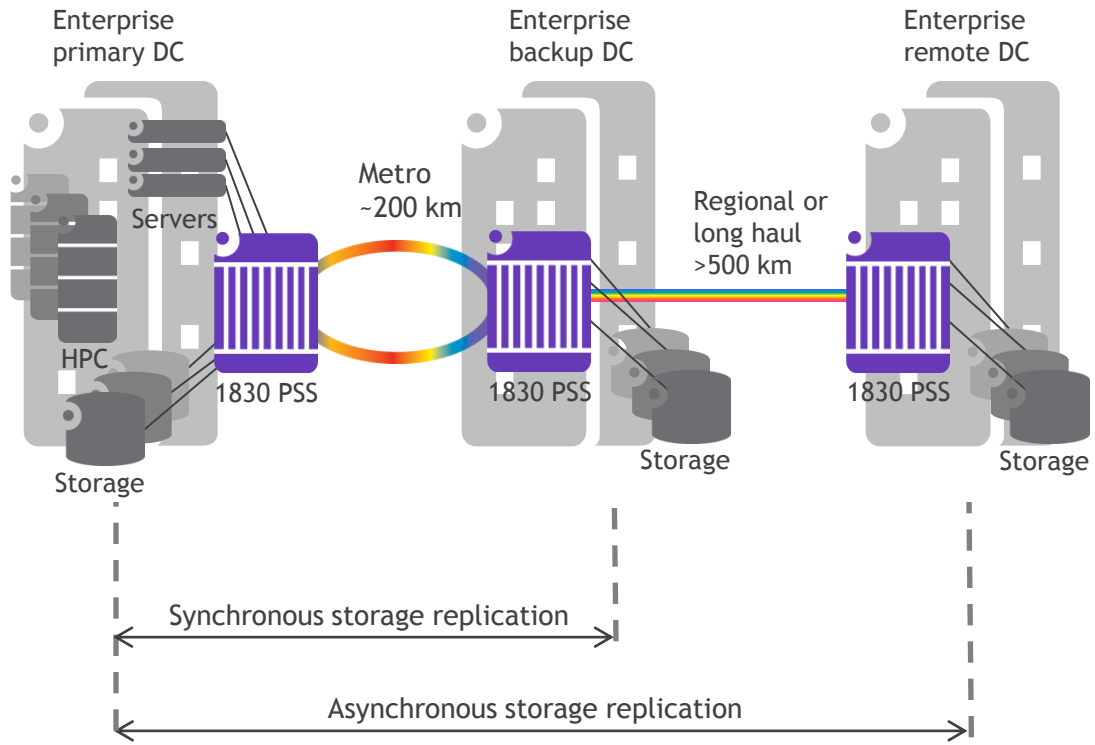


- Typical interfaces: mainly Fiber Channel
- Typical bitrates:1/2/4/8/(16) FC
- Key feature: completely transparent transmission beside the possible lowest delay
- Hence 10Gb total capacity exceeded in many cases realization through WDM is more and more often (both C- and DWDM suitable)

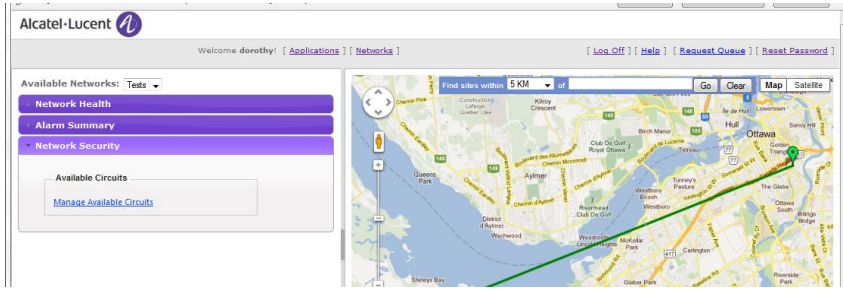
SPEED OF LIGHT INSIDE AN OPTICAL FIBER LIMITS SYNCH STORAGE REPLICATION TO < 150KM

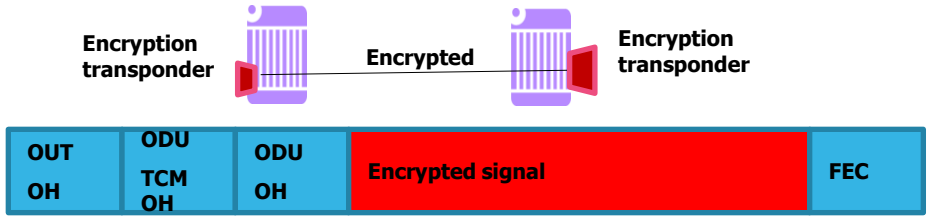
Delay considerations

- Majority of the e2e delay comes from the travelling time of the light in the fiber itself which measures to 5us/km
- Due to this max. distance is limited:
  - in case of synchronous data center interconnection: ~150 km
  - in asynchronous case: ~ 500km
- Within the WDM devices iteself in fact only the electrical domain casuses delay i.e. transponders
- Majority of transponder delay comes from error correction process (FEC)
- Hence distances are short less powerfull FEC is enough or even switching off the FEC is possible
- Typical transponder delays
  - *nxus w/o FEC (equals to 1-2 km fiber)*
  - *nx10us w/ FEC (equals to 3-20km fiber)*
    - *weak FEC: 15-30 us, powerful FEC: 50-100us*

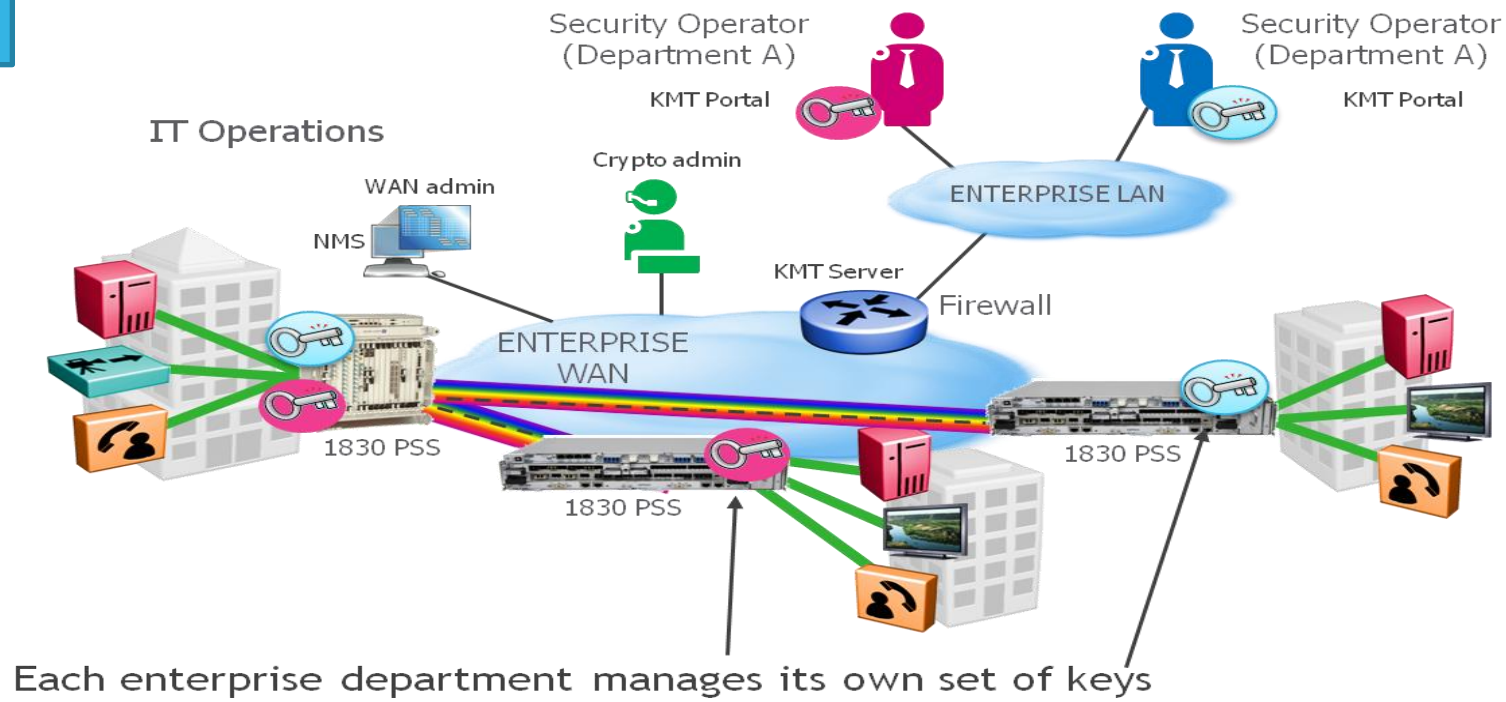


L1 DATA ENCRYPTION
PROTECT, DETECT AND MITIGATE SECURITY THREATS





- LOW LATENCY L1 HARDWARE ENCRYPTION
  - Encryption delay: ~1us (equals to 200m of fiber)
- AES256 CYPHER ALGORITHM
- END USER CONTROL OF ENCRYPTION KEYS
- FIPS/CC COMPLIANCE



PROTECTS DATA IN-FLIGHT THROUGH THE DETECTION AND MITIGATION OF SECURITY THREATS

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