
SCTE®
CABLE-TEC EXPO®
FAST FORWARD 2021
ATLANTA, GA
OCTOBER 11-14
SCTE
a subsidiary of CableLabs®
UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
2021 Fall Technical Forum
SCTE® • NCTA • CABLELABS®

SCTE
a subsidiary of CableLabs®

Converged Networks and Mobility

Convergence of Services Using Network Slicing

-A Practical Implementation

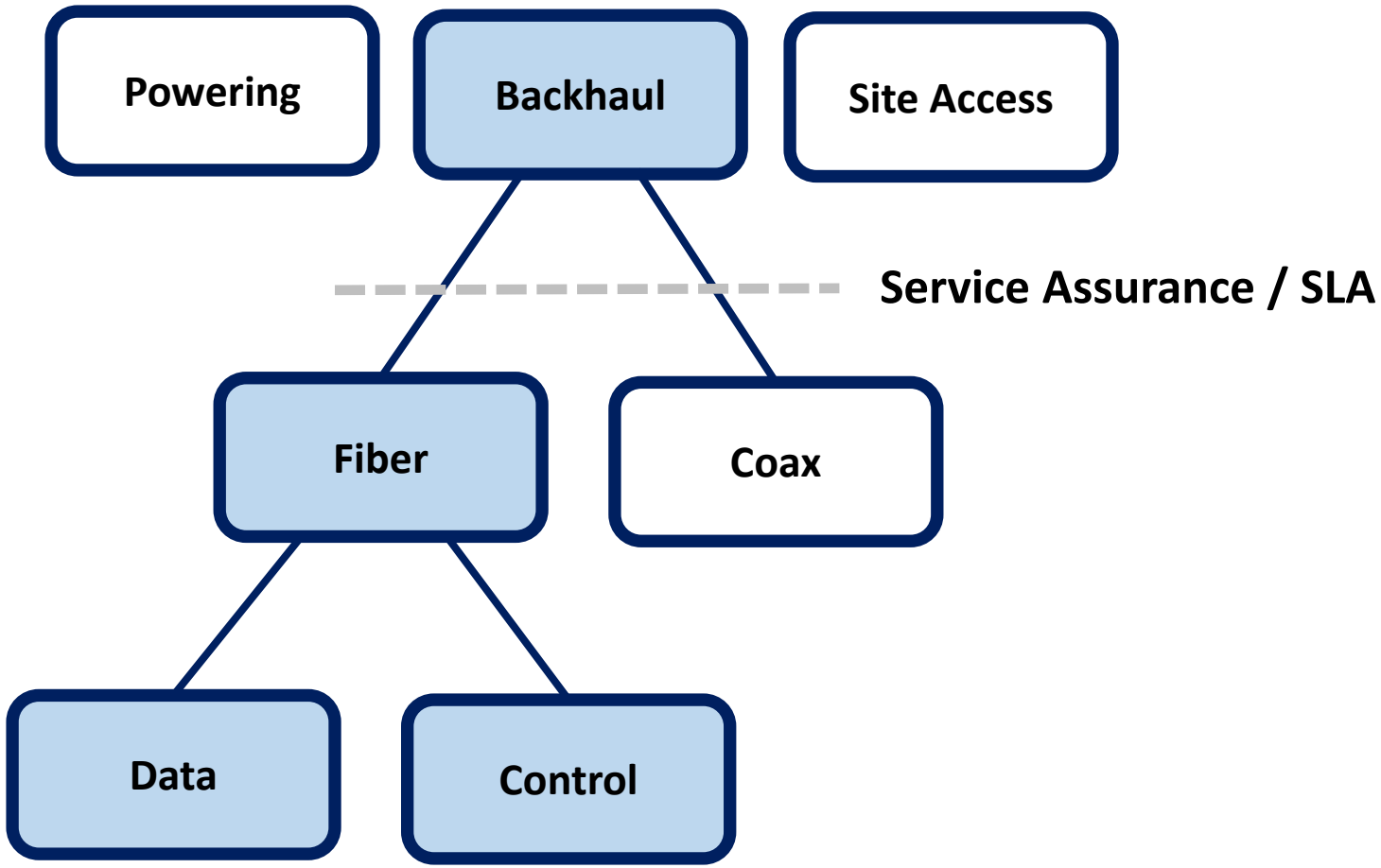
Fernando X. Villarruel

Chief Architect
Ciena

2021 Fall Technical Forum
SCTE • NCTA • CABLELABS

SCTE CABLE-TEC EXPO FAST FORWARD 2021
VIRTUAL EXPERIENCE
OCTOBER 11-14

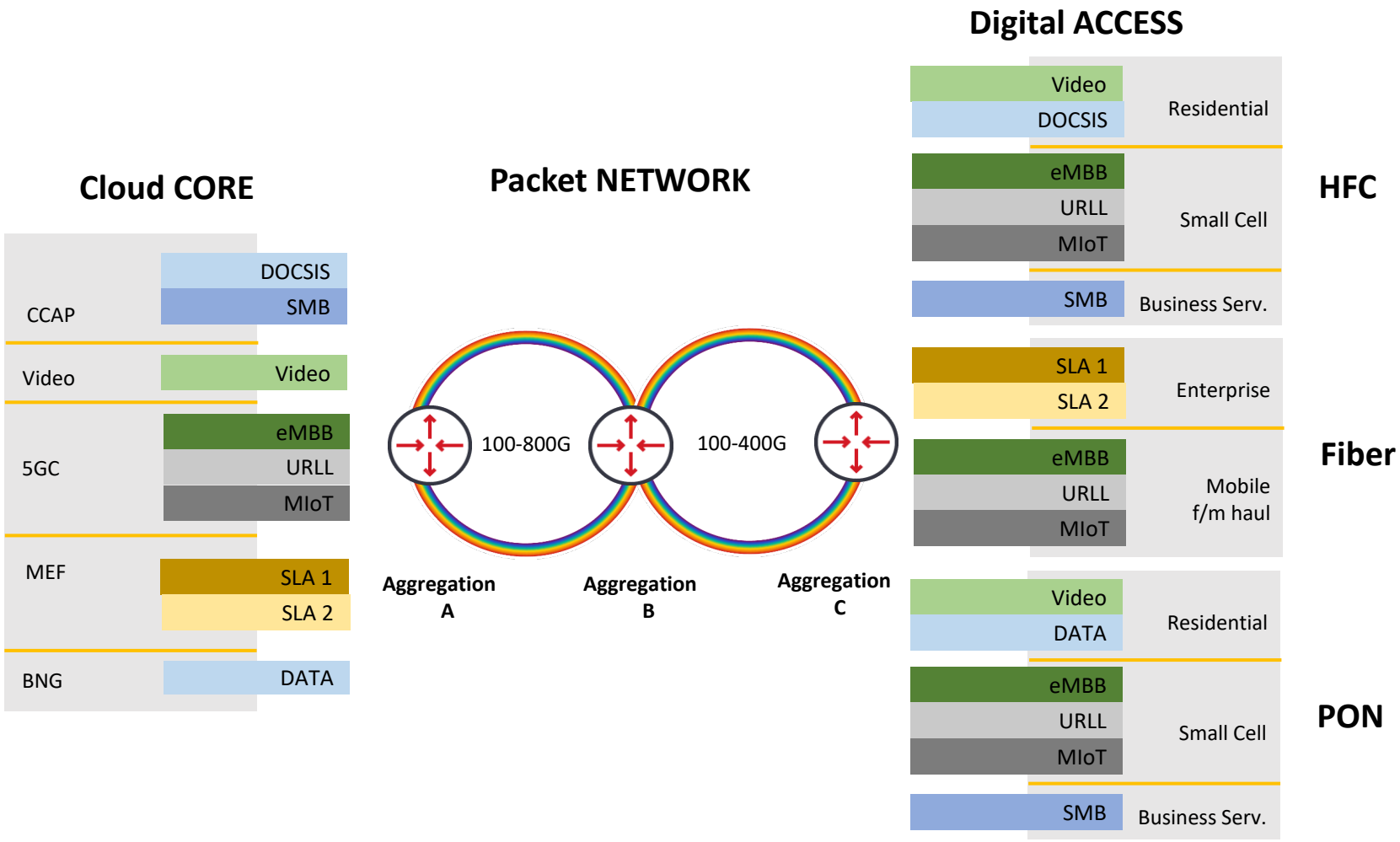
Infrastructure Needs For Convergence



In Focus

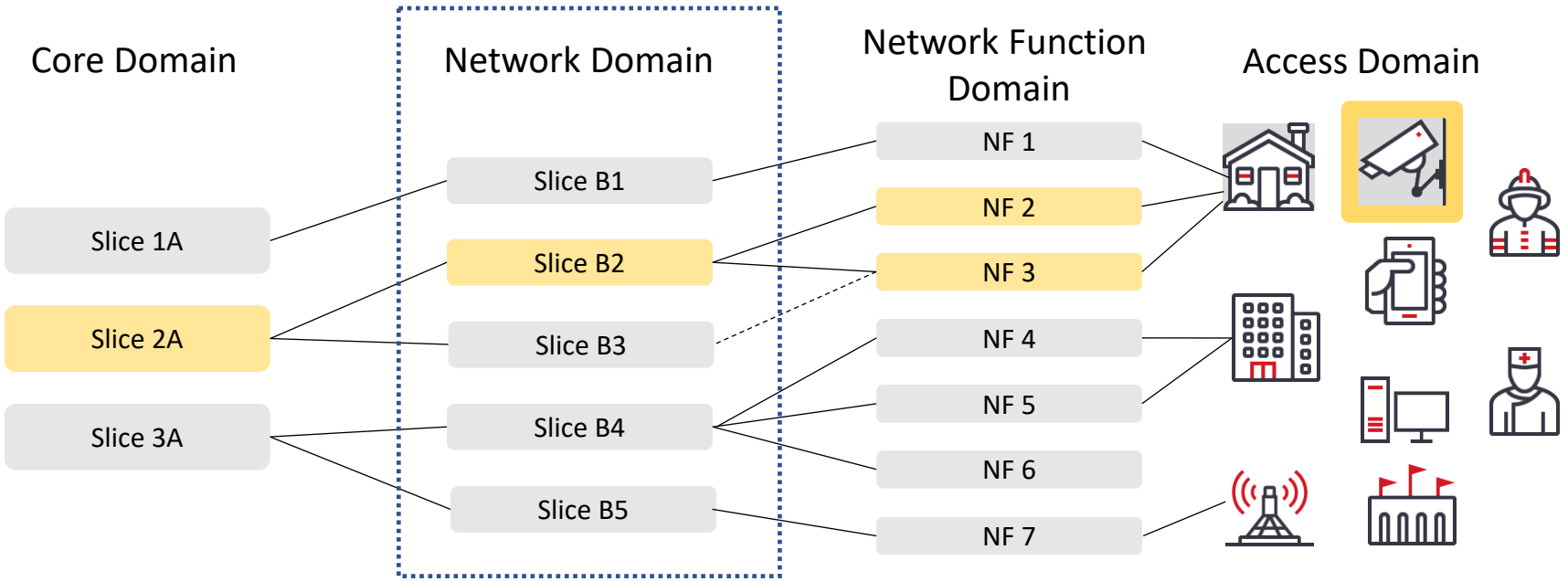
- Backhaul: Multiple services, one network
- Fiber: End-to-end fiber—no coax
- Data: Transmission mechanisms, L2/L3
- Control: organizational structure
- Service Assurance / SLA: ensuring service expectations.

Convergence and Network Slicing



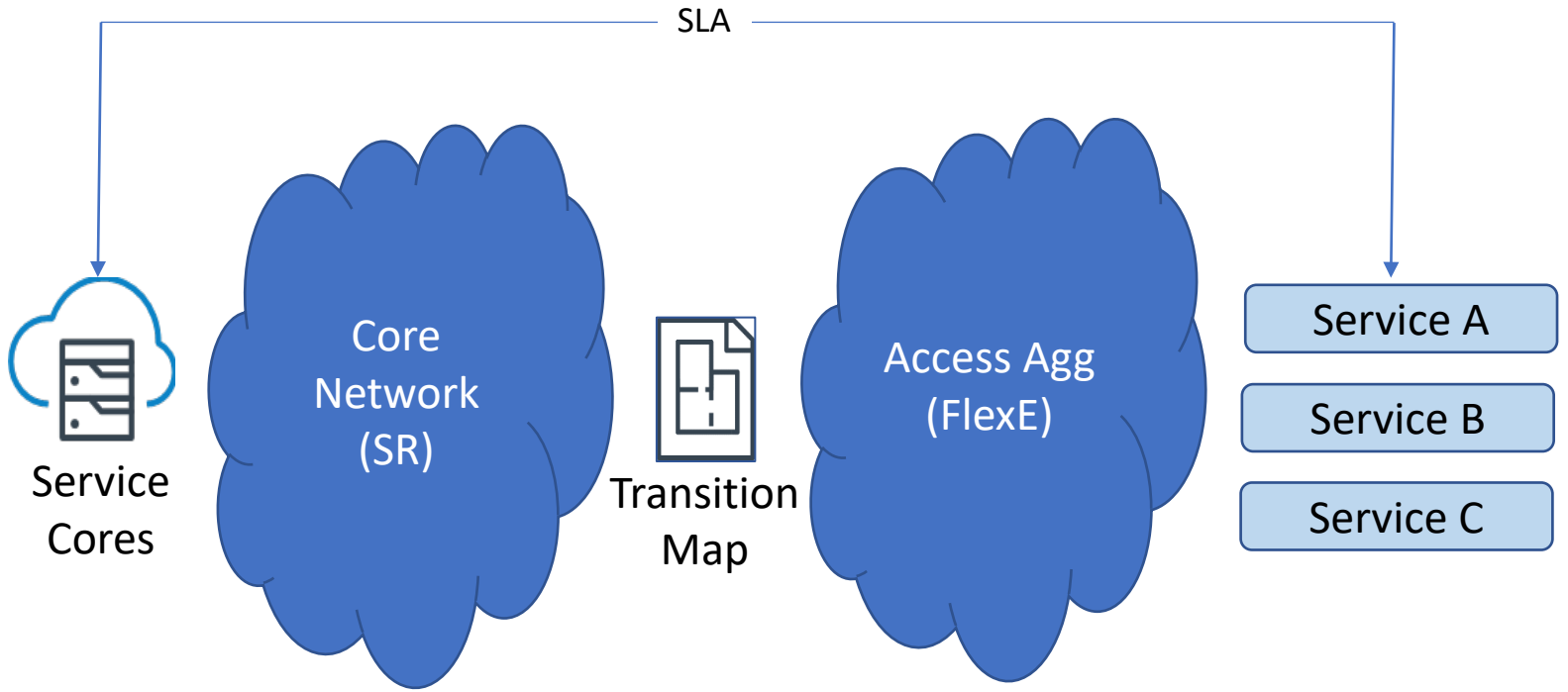
- From theory to practical implementation.
- Follow up on SCTE 2020 paper: "Framework For Convergence Of Services On The MSO Network Using The Principles of Network Slicing."
- Applicable to services and subservices.

Domains and Slices



Network slicing is an end-to-end combination of slices within separate domains.

This work is focused on the slices for the network domain.



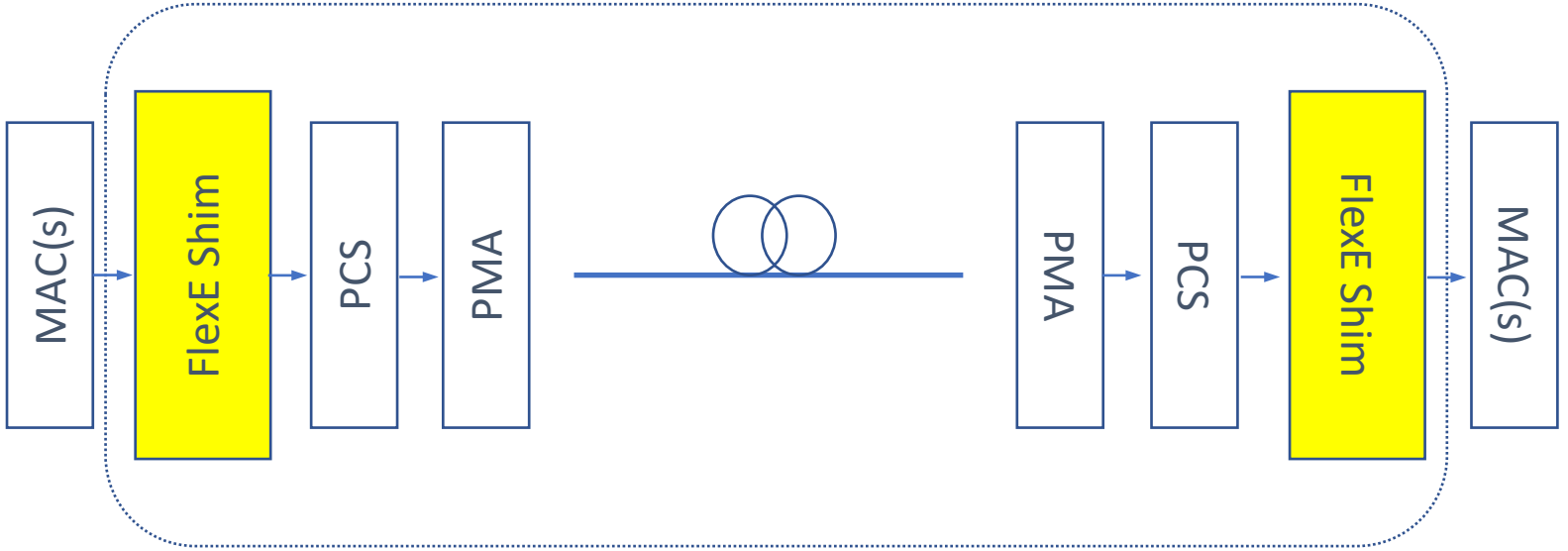
Life of SLA

Access Network: Aggregation (L2 tools) – hard slicing

Transition Map: mapping across boundaries.

Core Network: distribution and routing (L3) – soft slicing

Hard Slicing: Flexible Ethernet

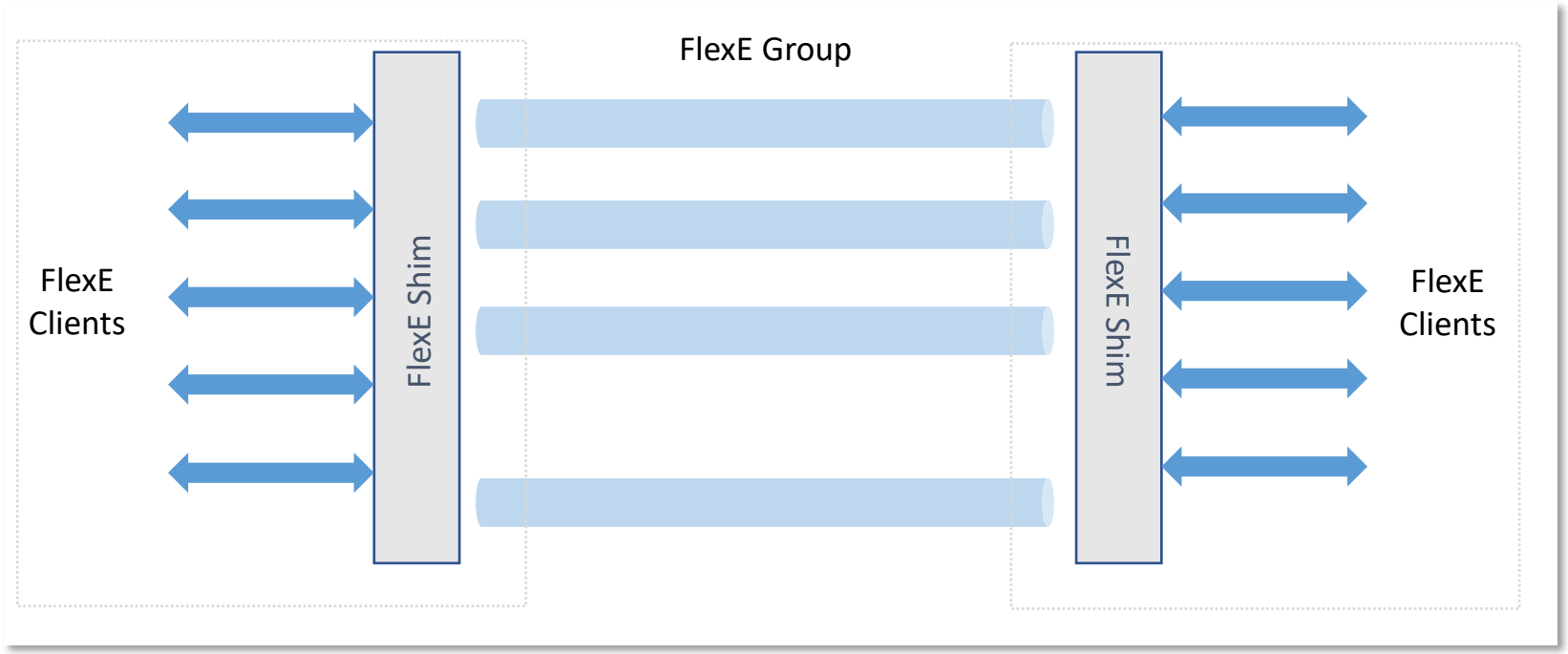


Specification: Shim layer (OIF-FLEXE-02.0-1) on IEEE 802.3

Relation mechanism for Ethernet signals of various rates.

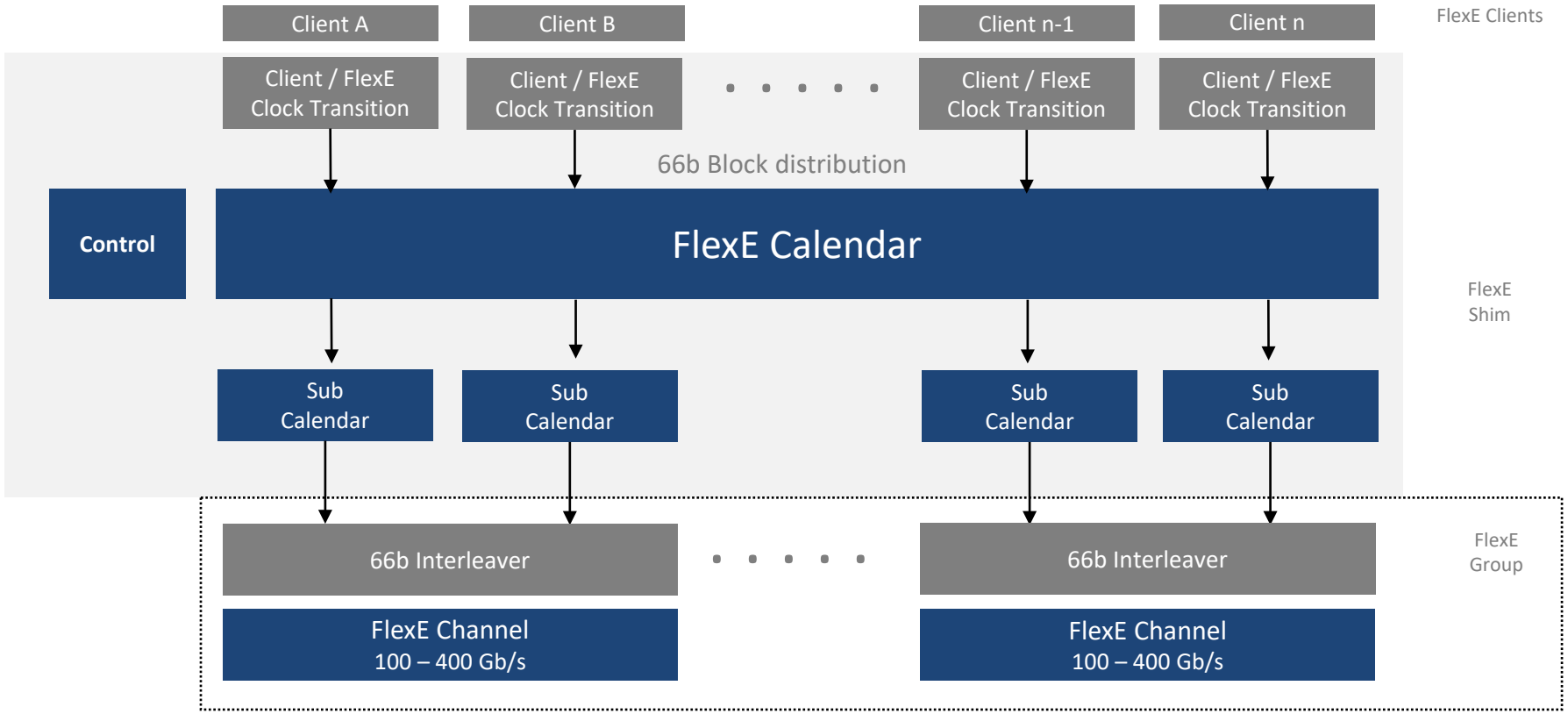
Shim layer disassociates client rates to transmission PHY and rate. Allows for multiple types associations between client and transmission signals.

FlexE Clients and Group



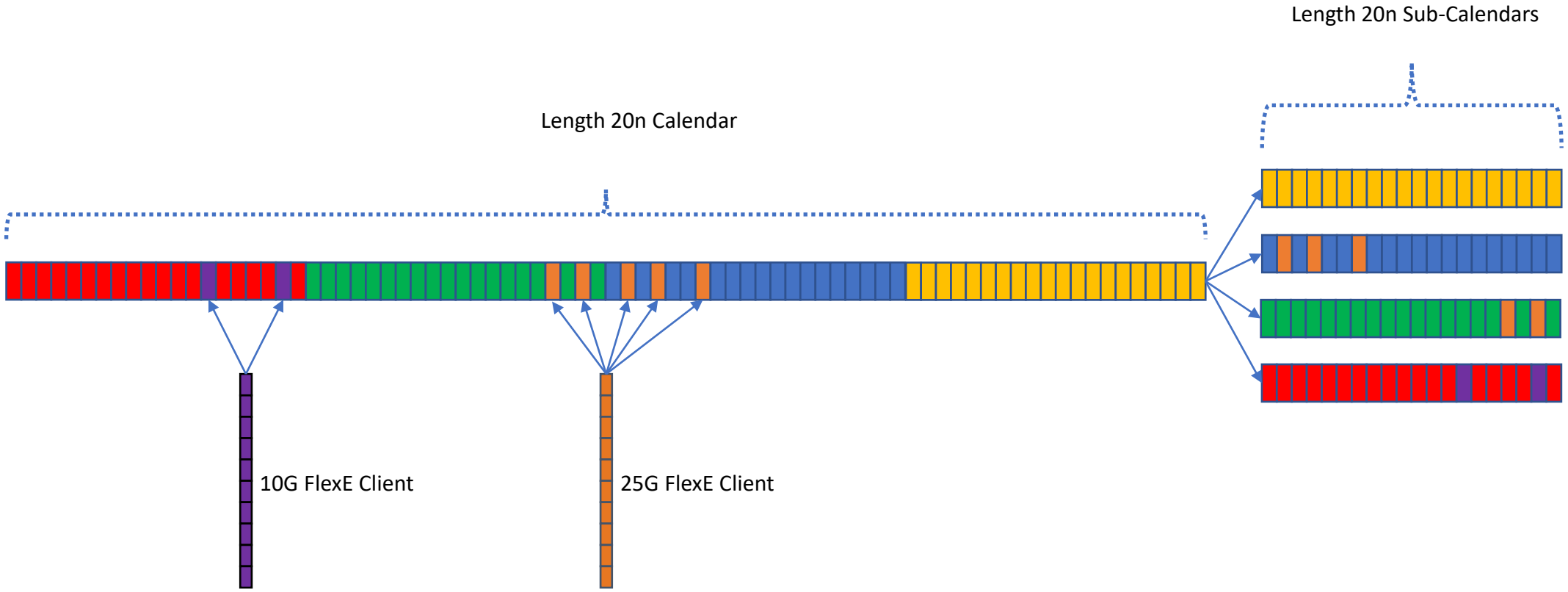
- Multiple clients, of varied rates map onto signal in a FlexE group.
- FlexE group can have multiple signals.
- No 1-1 correspondence of number of clients and signals in FlexE group
- No 1-1 correspondence of client rates and FlexE group rates

FlexE Shim Layer



FlexE shim layer is a TDM calendar that normalizes clocking and inserts and deletes data blocks according to policy. Clients at 10, 25 or 40 Gb/s, FlexE group at 100 – 400 Gbps.

Calendar and sub-calendar



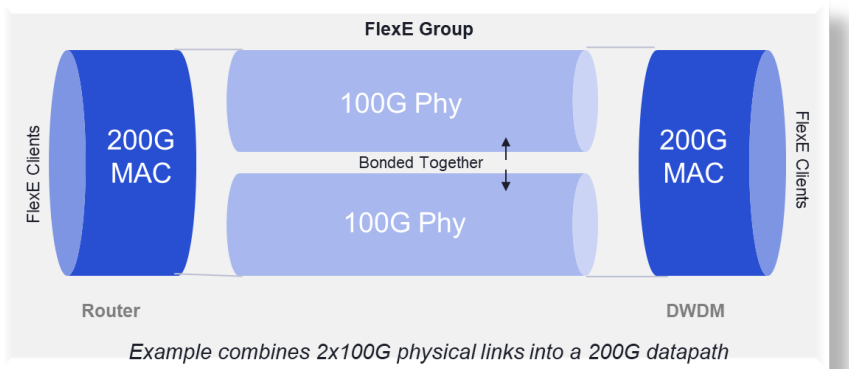
5G or 25G calendar slots.

No slots grouping calendar and sub calendar

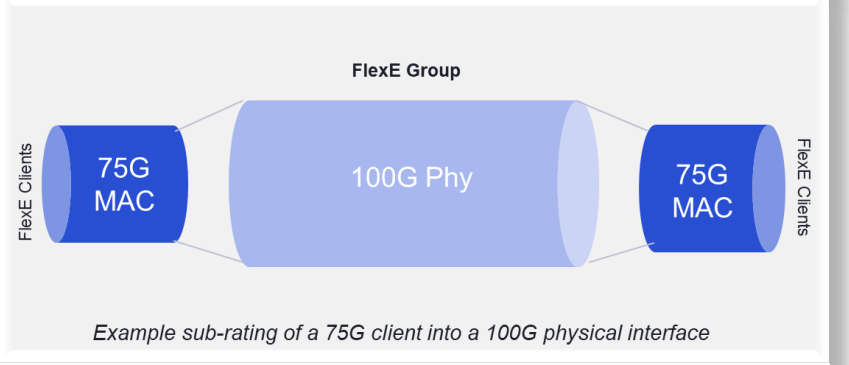
Client signals disbursed throughout calendar

Sub-calendars for sake of smooth transmission

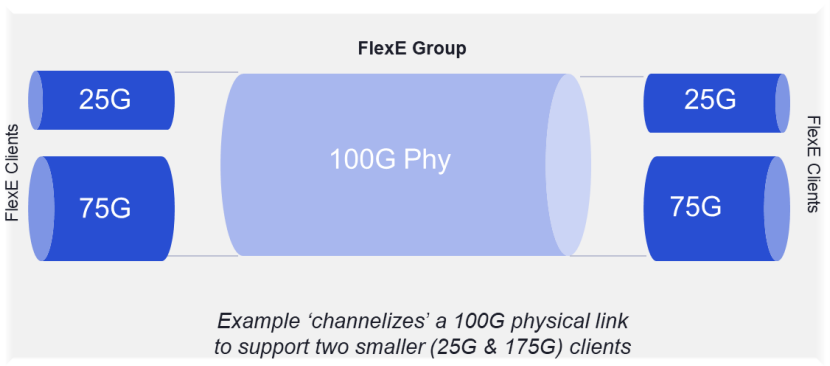
FlexE Functions



Example combines 2x100G physical links into a 200G datapath



Example sub-rating of a 75G client into a 100G physical interface



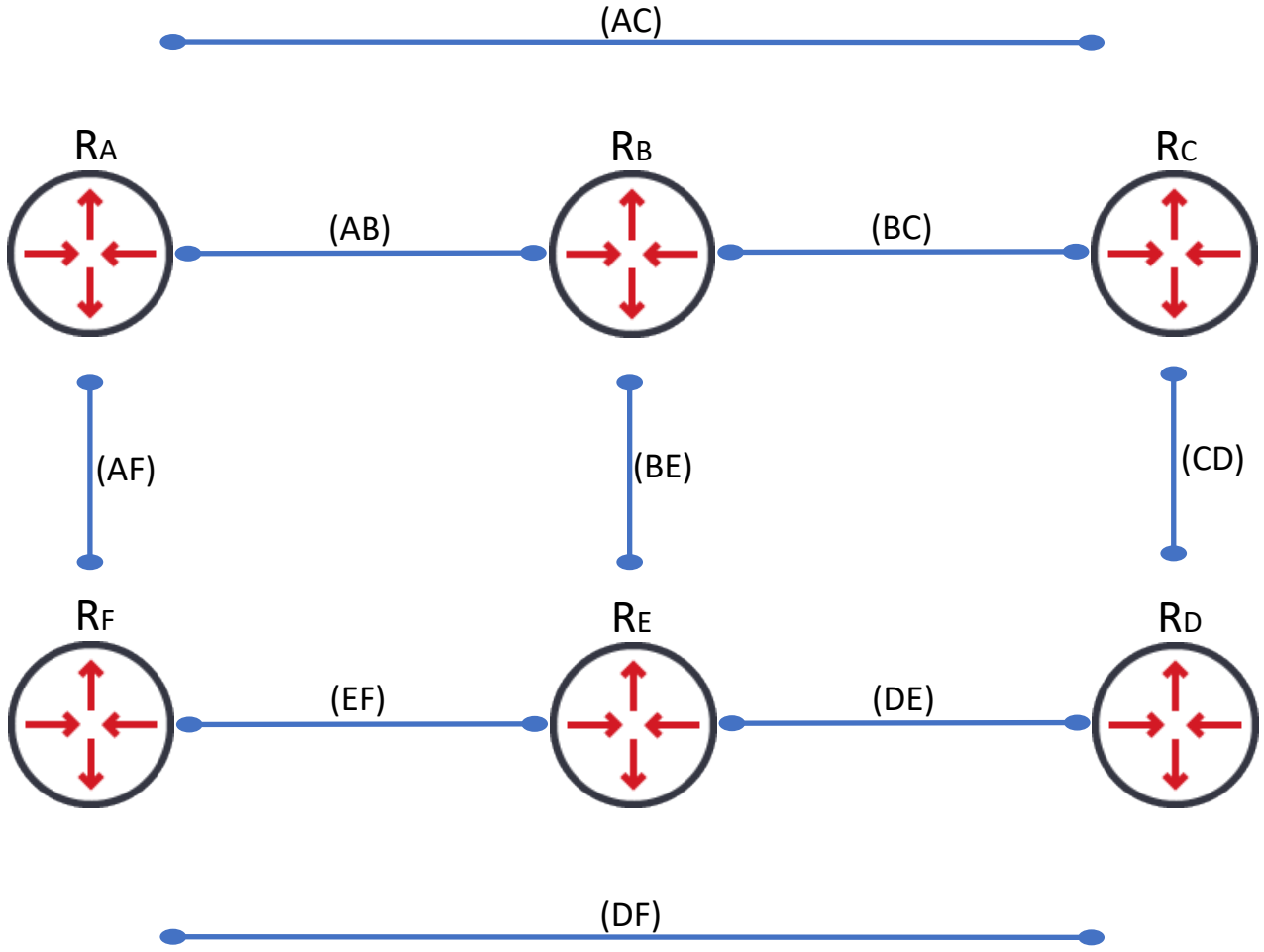
Example 'channelizes' a 100G physical link to support two smaller (25G & 175G) clients

Bonding combines multiple physical links into a single higher speed link

Sub-rating downsizes the physical rate to match the actual client rate

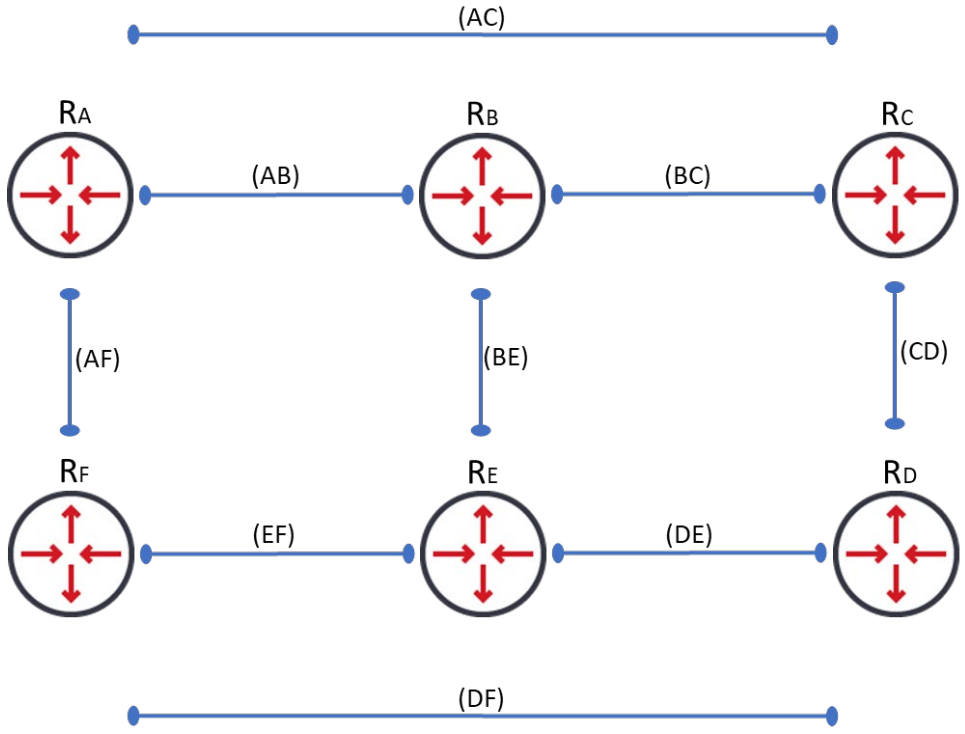
Channelization enables different data path rates to be mapped onto a common interface

Segment Rouging IDs (SID)

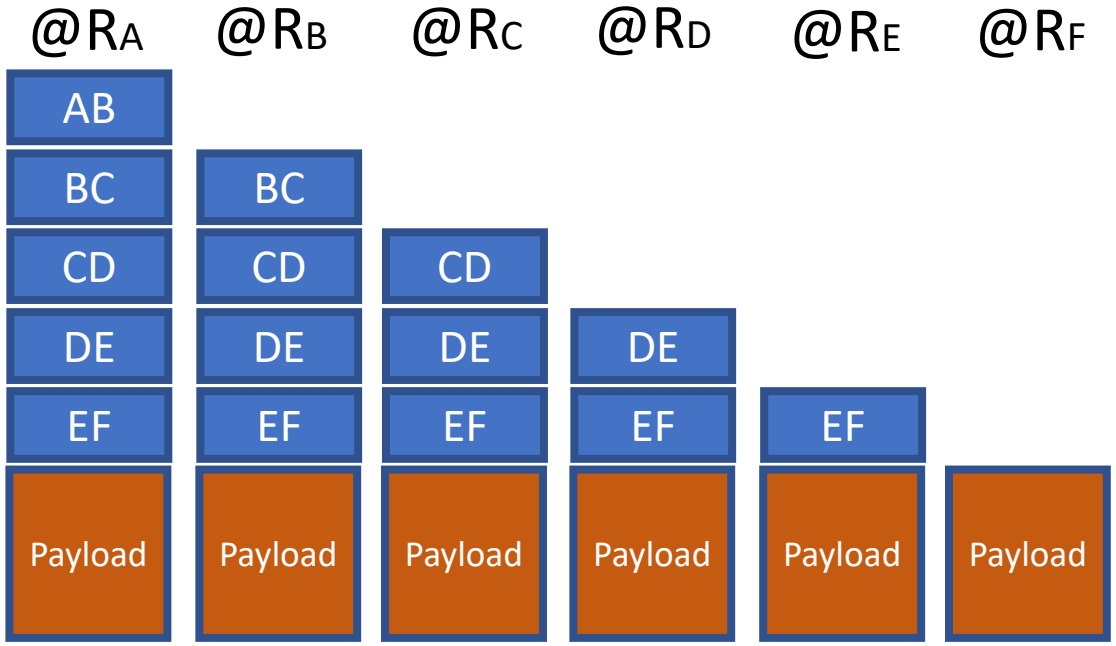


- SR breaks topology into segments. (SID)s
- Near neighbor segments
  - Lave local segment identifiers. E.g. (AB)
- Multiple hop segments
  - Global segment identifiers. E.g. (AC)

Local SID Transmission

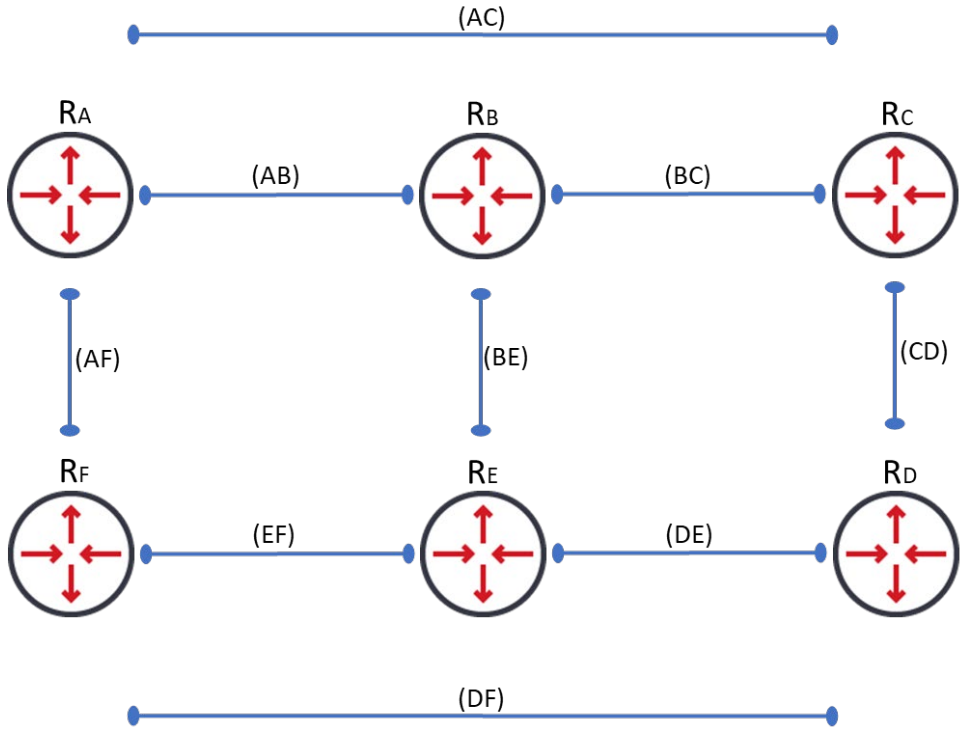


Local SID(s) Path A → F

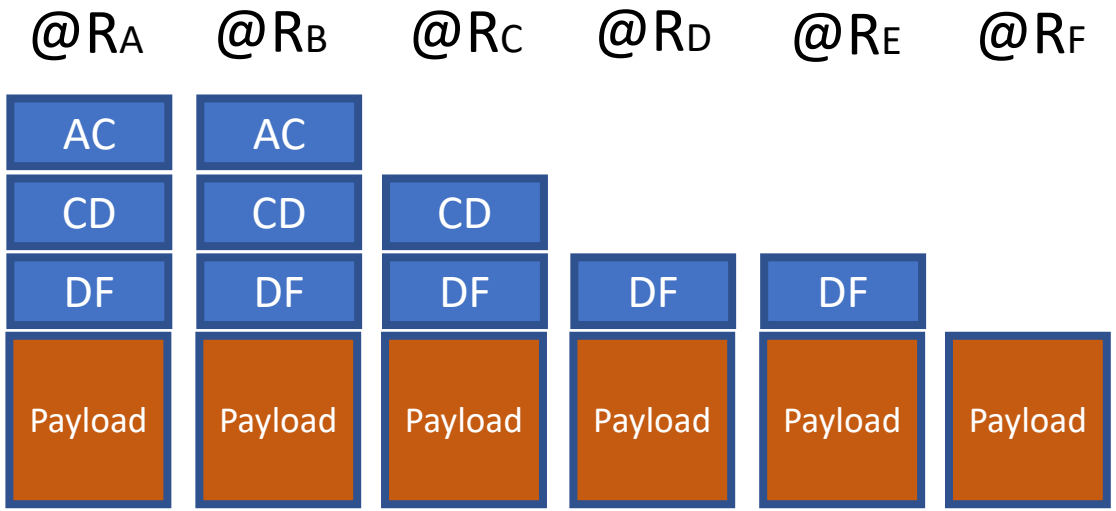


- Route of signaling embedded into packets, via label stack on MPLS or IPv6 headers.
- MPLS more common, takes advantage of other mechanisms of MPLS.
- At each stop the label is simplied, until destination is reached.

Global SID Transmission



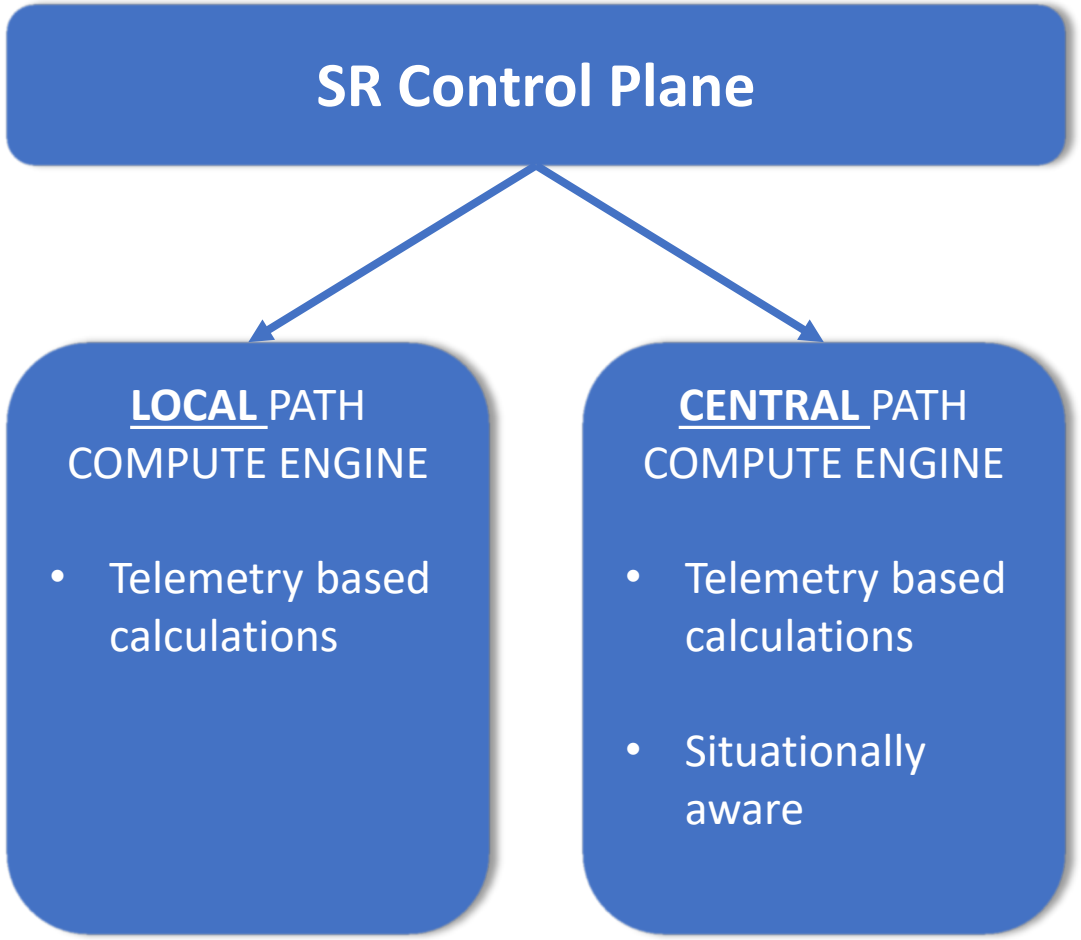
Global SID(s) Path A → F



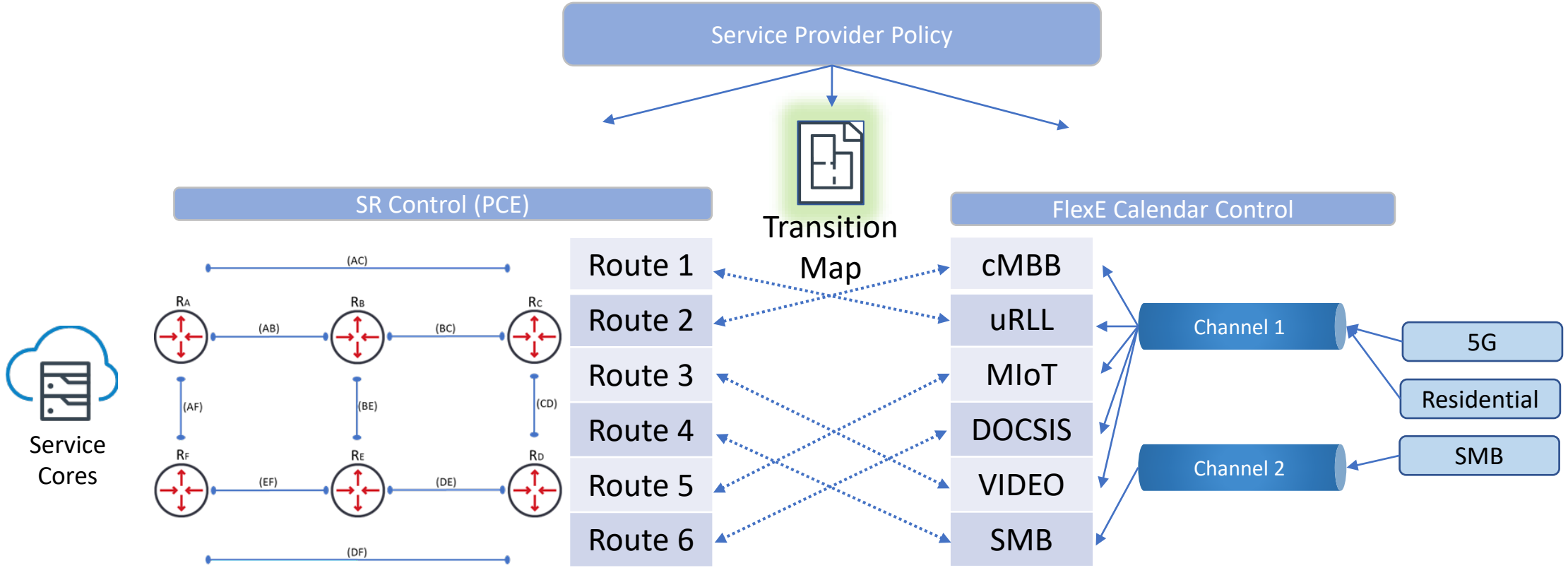
Eg. Mix of local and global SIDs

SR – Control Plane Options

- Route determination done two ways. Local PCE, Central PCE
- **Central PCE is best to maintain SLAs** with limitations beyond basic telemetries and need a global view.
  - Situational awareness is for guidance that that is deterministic but outside the realm of common networking parameters.

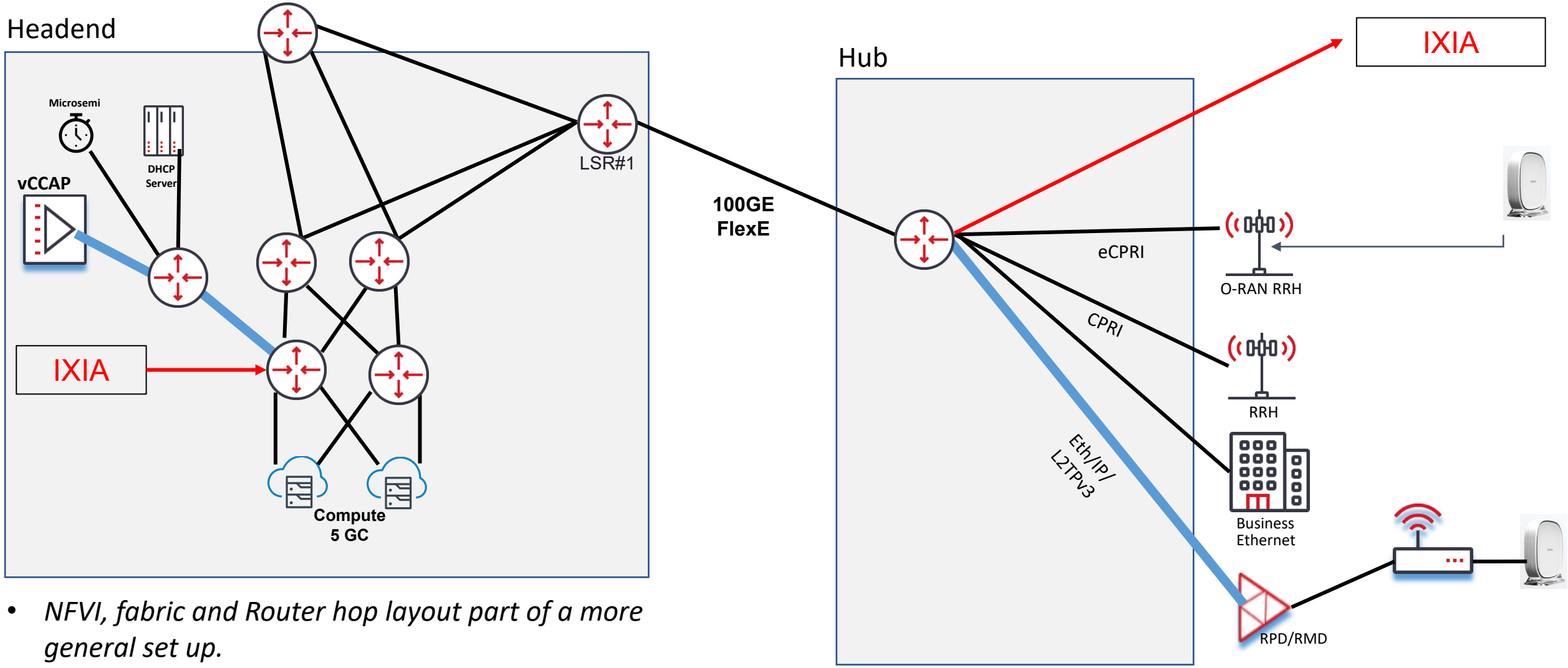


Domain transition via Transition Map



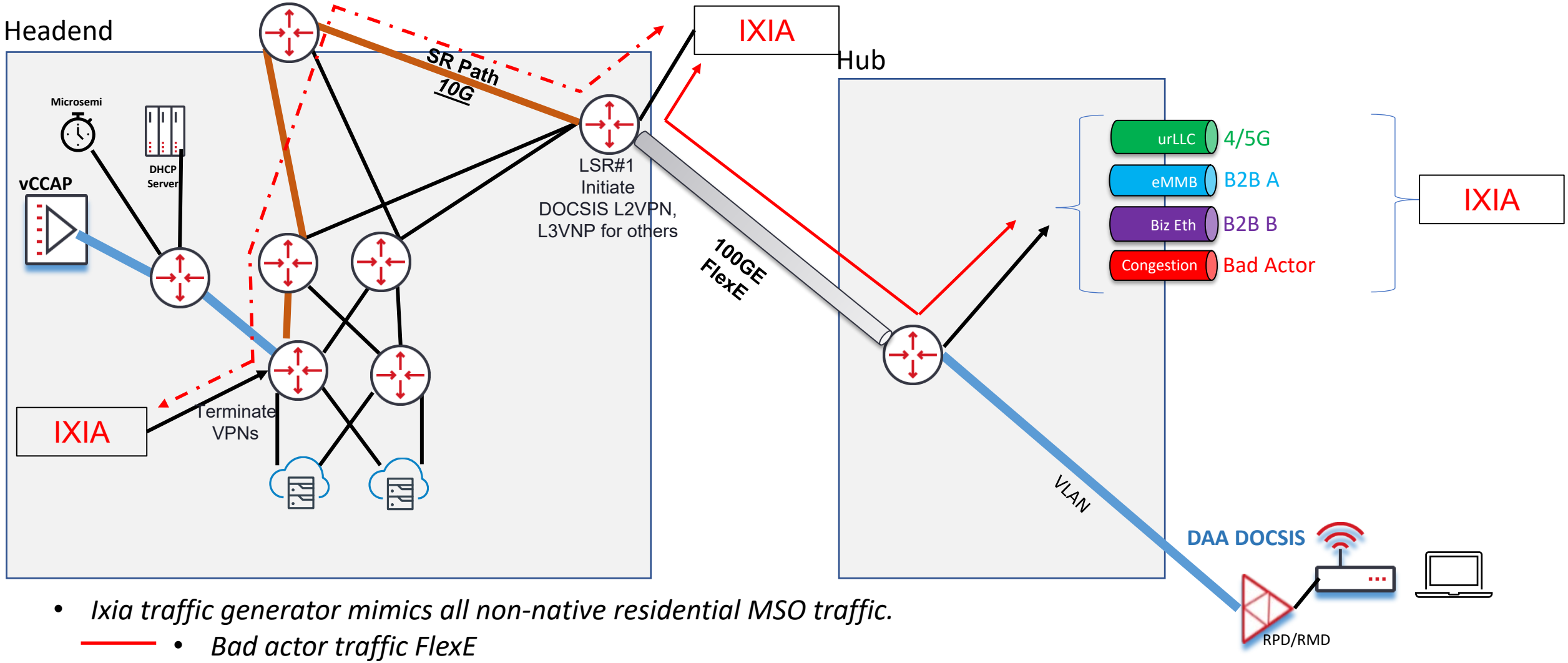
- Putting FlexE and SR together. FlexE in aggregation, SR in transport.
- L2 in Access / L3 in metro-core.
- A transition mapping is needed between FlexE and SR, (FlexE channels and SR flows).

Planned Laboratory Setup



- *NFVI, fabric and Router hop layout part of a more general set up.*

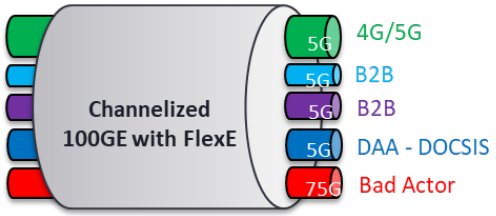
Actual Laboratory Setup



- *Ixia traffic generator mimics all non-native residential MSO traffic.*
  - *Bad actor traffic FlexE*
  - *Bad Actor traffic SR*

FlexE Settings

	FlexE Settings	
Service Type	FlexE Group (Gbps)	FlexE Channel (Gbps)
B2B - A	100	5
B2B - B		5
4G/5G		5
DAA - DOCSIS		5
Bad Actor – FlexE*		75



- * Bad actor = user attempting to exceed their SLA agreement
- FlexE Channel = assigned constant throughput rate.

FlexE Results with Bad Actor

Traffic Type	Tx (Mbps)	Rx (Mbps)
B2B - A	2G	2G
B2B - B	3G	3G
4G/5G	4G	4G
DAA - DOCSIS	25Mbps	25Mbps
Bad Actor	**90G**	**75G**

- FlexE segment with “bad actor” at 90G at ingress, but only 75G throughput as expected from FlexE channel settings.
- No effect on other channels.

SR CoS Settings

Service Type	DSCP	MPLS EXP	SR CIR	SR EIR (10G)
B2B - A	0 (Routine)	0	2G	8G
B2B - B	24 (Flash)	3	3G	7G
4G/5G	46 (Critical)	5	4G	0G (no burst)
DAA - DOCSIS	32 (Flash Override)	4	200Mbps	9.8G
Bad Actor – SR	1 (Priority)	1	200Mbps	9.8G

- IP QoS expressed in SR domain:
  - MPLS Experimental (3) Bits has uses 0-5 typical priority options, in rising order of priority. IP DSCP has 6 usable bits, first three set to match MPLS EXP.
- CIR is committed information rate, Guaranteed rate from SP to a given circuit.
- EIR provides burst capability. EIR = Link bandwidth - CIR
- At 10G interface for first SR hop.

SR CoS Results with Bad Actor

Traffic Type	Tx (Mbps)	Rx (Mbps)
B2B - A	2G	2G
B2B - B	6G	3G
4G/5G	4G	4G
DAA - DOCSIS	25Mbps	25Mbps
Bad Actor	10G	800Mbps

- Bad actor trying 10G throughout with only 200Mbps CIR. 800M with left over burst capacity.
- No other channels affected.
- Rx ~ 10G. DOCSIS small bandwidth in noise.

SCTE® CABLE-TEC EXPO® FAST FORWARD 2021

ATLANTA, GA
OCTOBER 11-14

SCTE
a subsidiary of CableLabs®

Thank You!

Fernando X. Villarruel — Chief Architect

Geoff Eaton — Sr. Solutions Architect

Marco Naveda — Sr. Director Architecture

2021 Fall Technical Forum
SCTE • NCTA • CABLELABS

ciena