

Converged backhaul and fronthaul considerations

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IEEE 1914.1 TF



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**IEEE 1914.1 TF
NGFI
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Practical approach to converged FH/BH network architecture and functional partitioning

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Outline

- Architecture proposal for converged fronthaul and backhaul network for 4.5/5G RAN.
- Proposal for NGFI interfaces based on different functional splits.

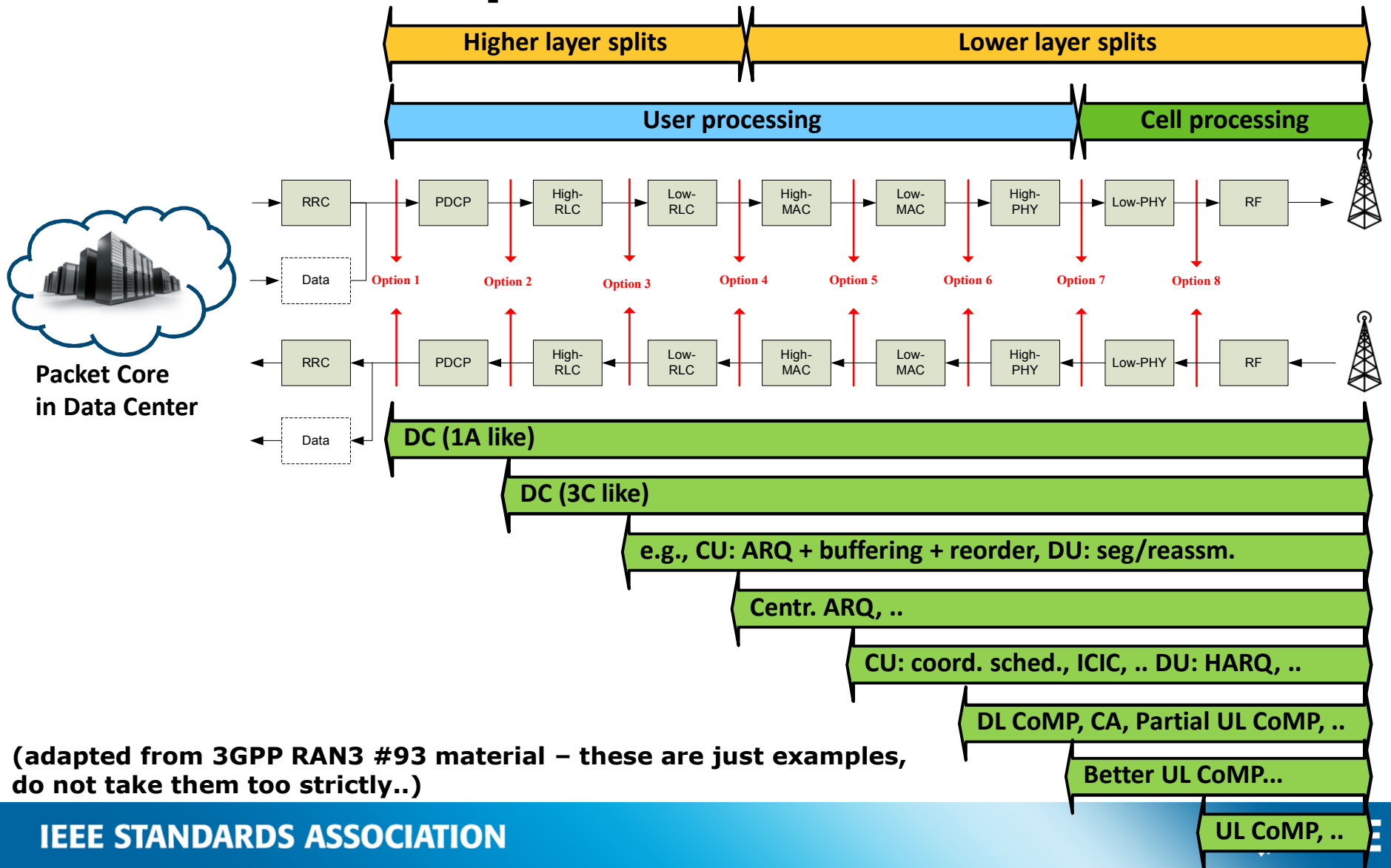
Objective (same from Aug meeting)

- Evolutionary path from 3/4G to 5G RAN.
- Identify the essential features from 4.5/5G RAN transport circuit & equipment realization point of view:
 - Flexibility vs Bandwidth/time-synchronization/complexity/cost.
- Propose an architecture and functional splits to 4.5/5G RAN that:
 - Allow E2E packet & Ethernet solutions.
 - Allow converged fronthaul and backhaul network deployments.
 - Scale up to 5G numbers keeping align with optics evolution.
 - Aim at transport level interoperability.

Proposal

- Functional splits should aim for simplicity:
 - Identify the most common and important functions that are easy to design "5G ready".
- **Adopt** the three interfaces proposed in this contribution as a baseline:
 - NGFI1 – "lower layer splits"; high volume of nodes, lower bandwidth per device but tight synchronization demands.
 - NGFI2 – "lower layer splits"; aggregation, converged front- and backhaul, high aggregated traffic volumes and tight synchronization demands.
 - NGFI3 – "higher layer splits"; with full service provider functions. High aggregated bandwidth per node.

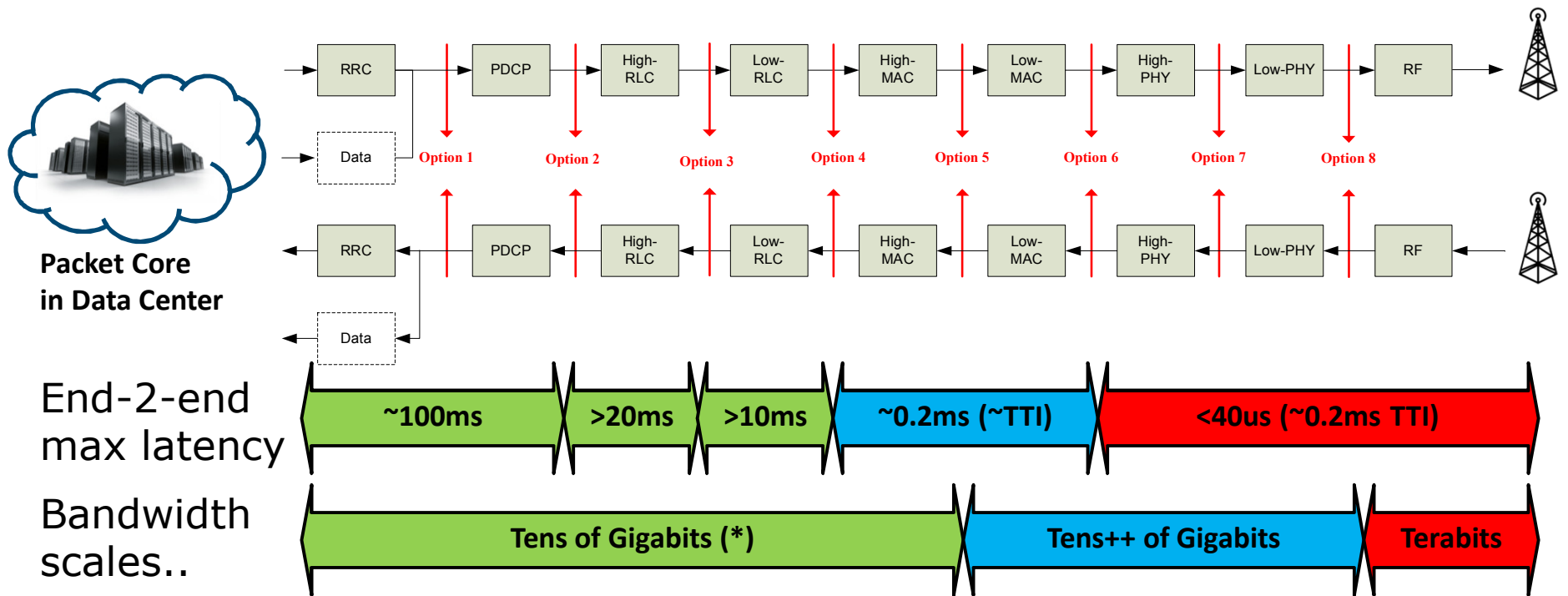
Functional splits and radio features..



(adapted from 3GPP RAN3 #93 material – these are just examples, do not take them too strictly..)

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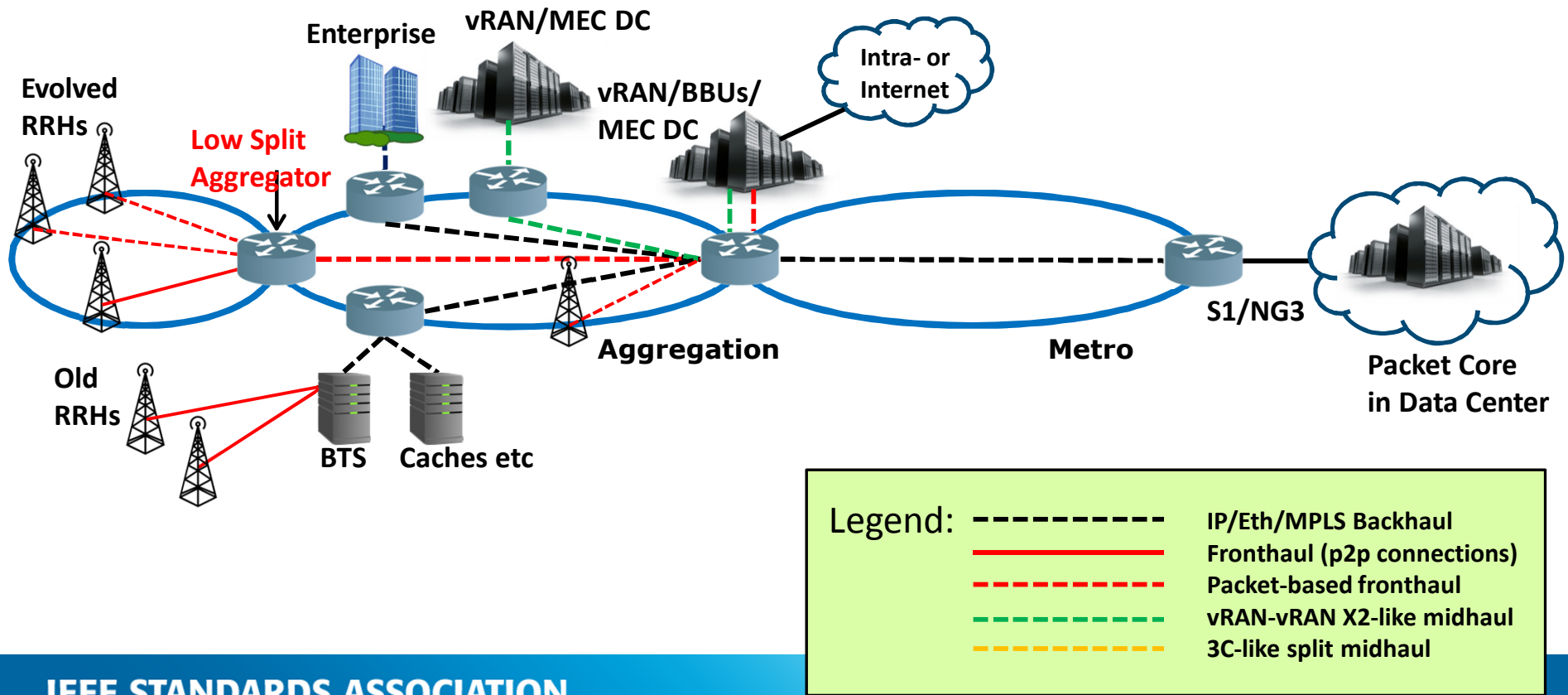
Functional splits and impact to transport



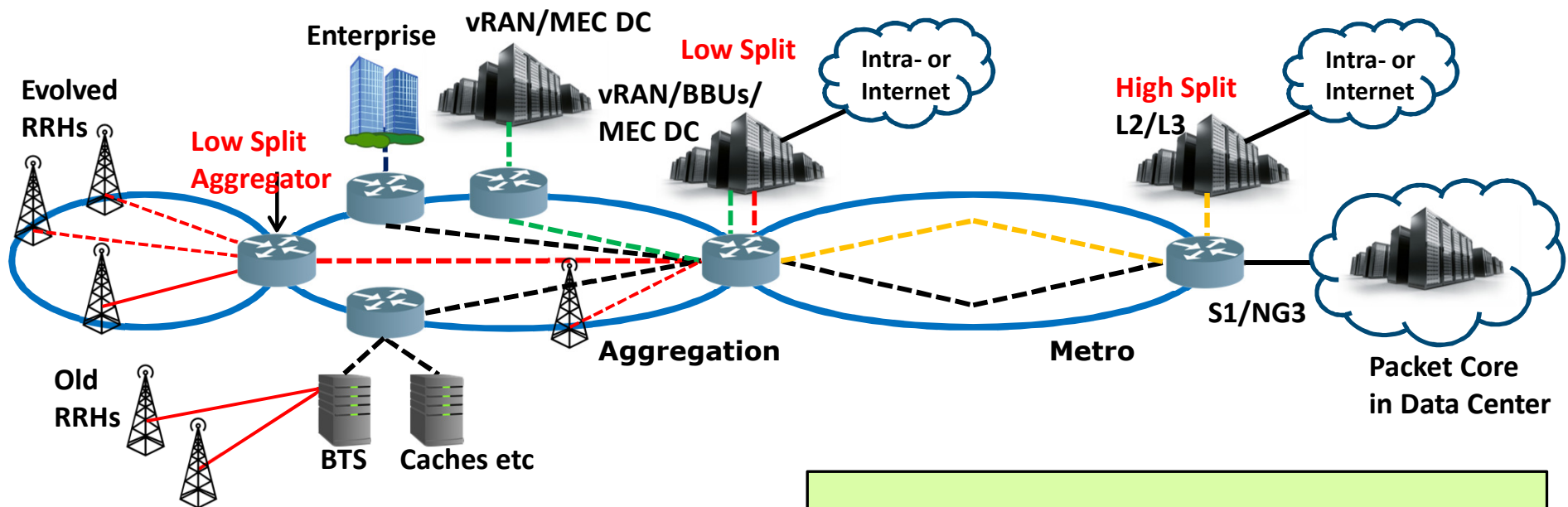
(*) Assumption: 5G radio with 1GHz air spectrum and M-MIMO, 0.2ms TTI..

(adapted from 3GPP RAN3 #93 material)

Mapping to a high level architecture

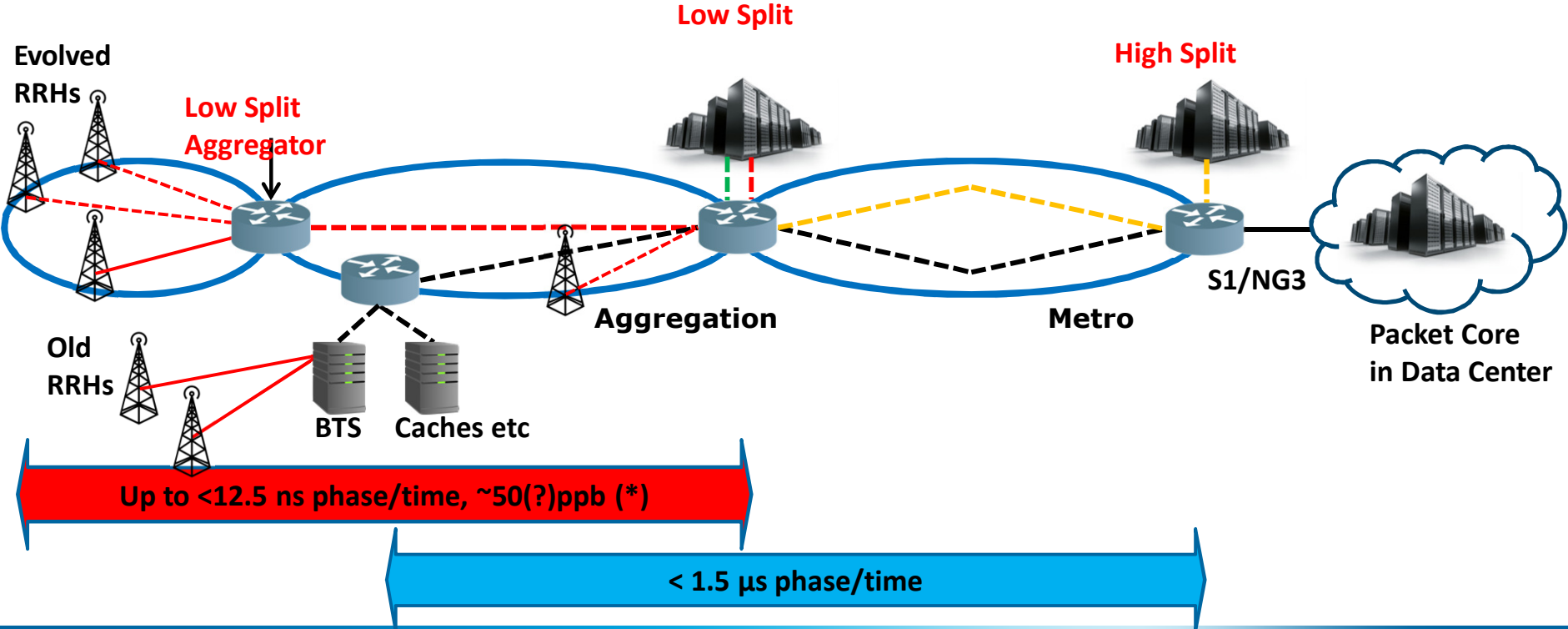


Mapping to a high level architecture



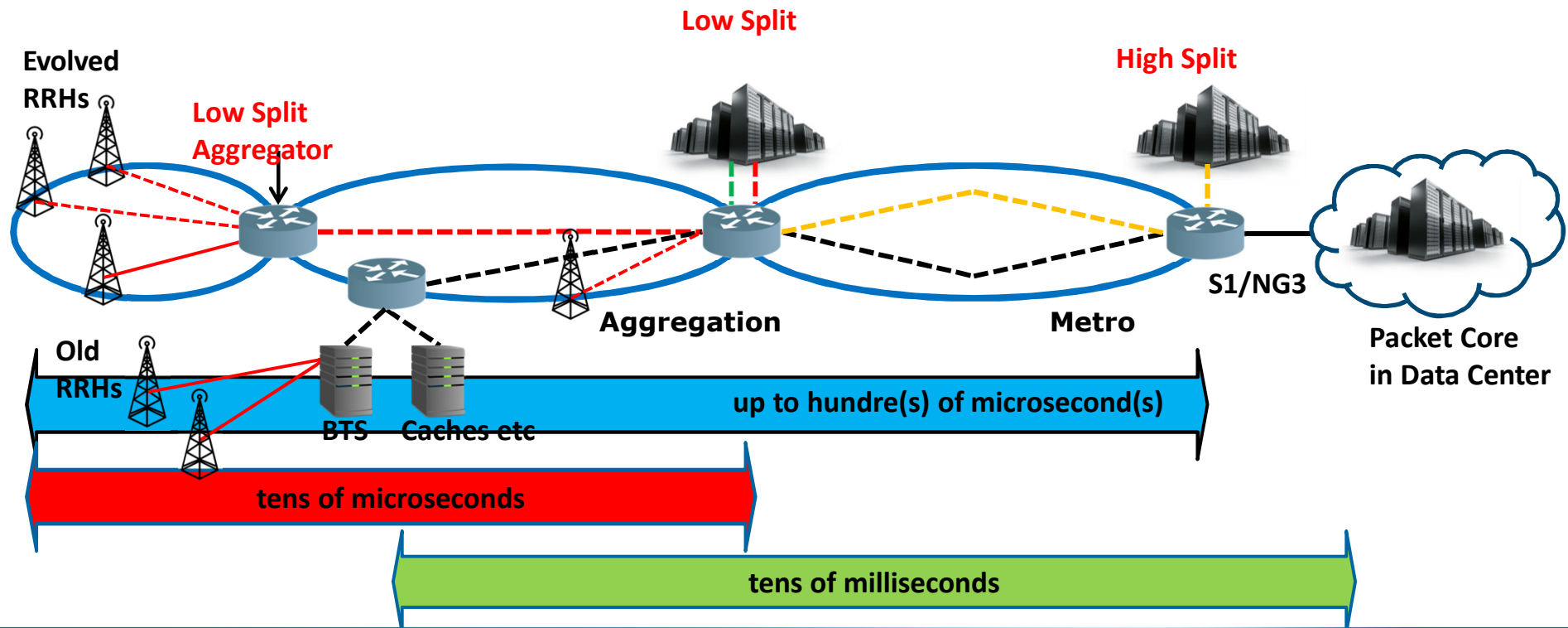
Legend:	
-----	IP/Eth/MPLS Backhaul
—————	Fronthaul (p2p connections)
- - - - -	Packet-based fronthaul
- - - - -	vRAN-vRAN X2-like midhaul
- - - - -	3C-like split midhaul

Time-synchronization accuracy requirements

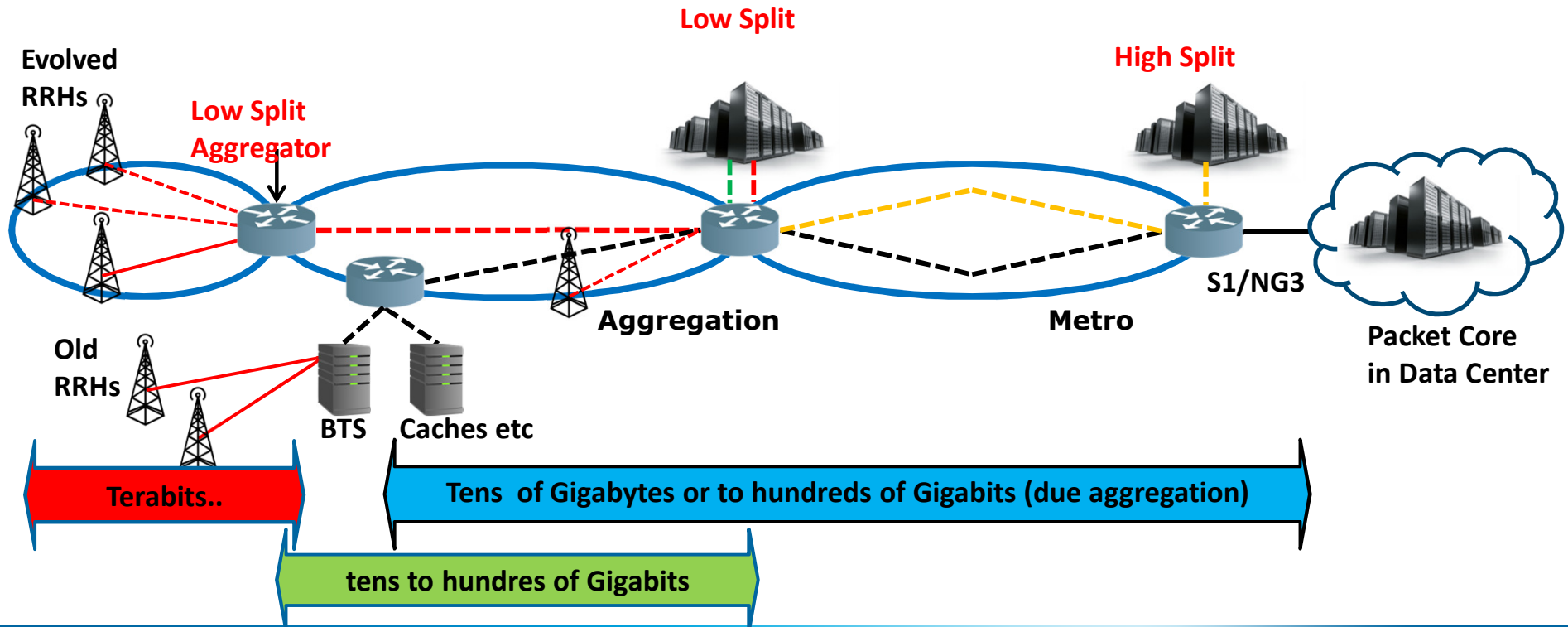


(*) Simplified view; sync requirement depend on used radio features and location of common masters, etc.

Latency requirements



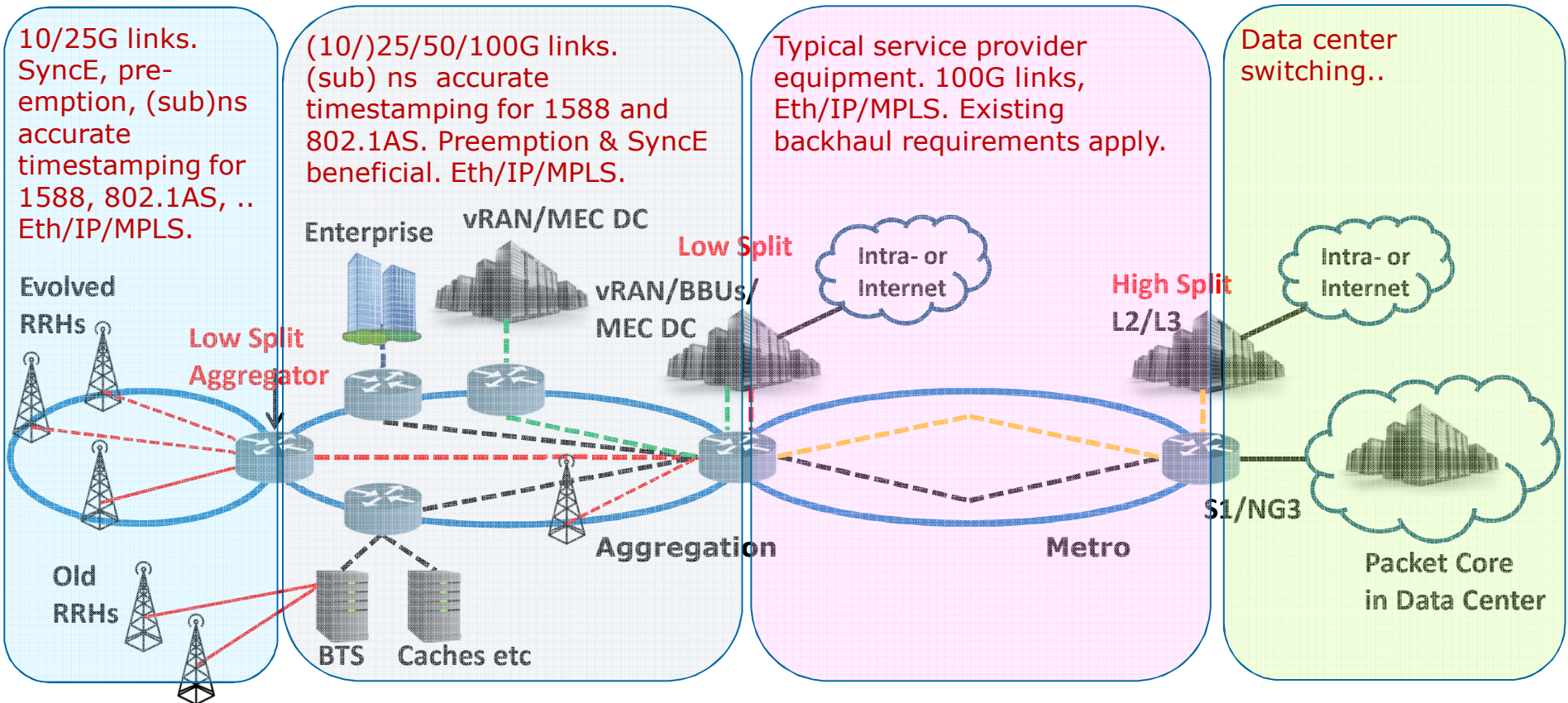
Bandwidth requirements



Network domains per node requirements

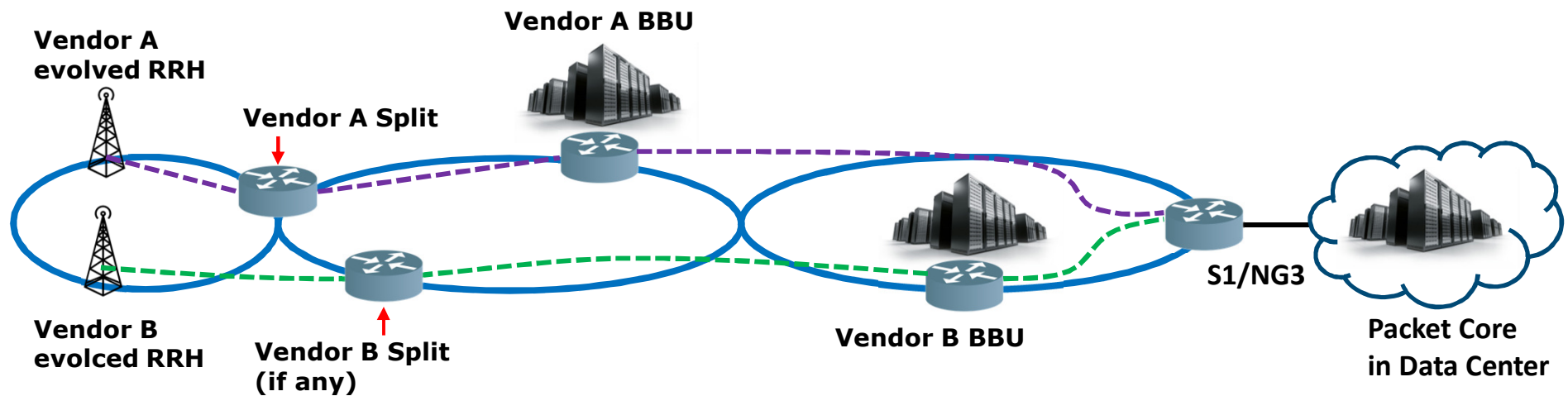
Lot of nodes

Aggregation nodes



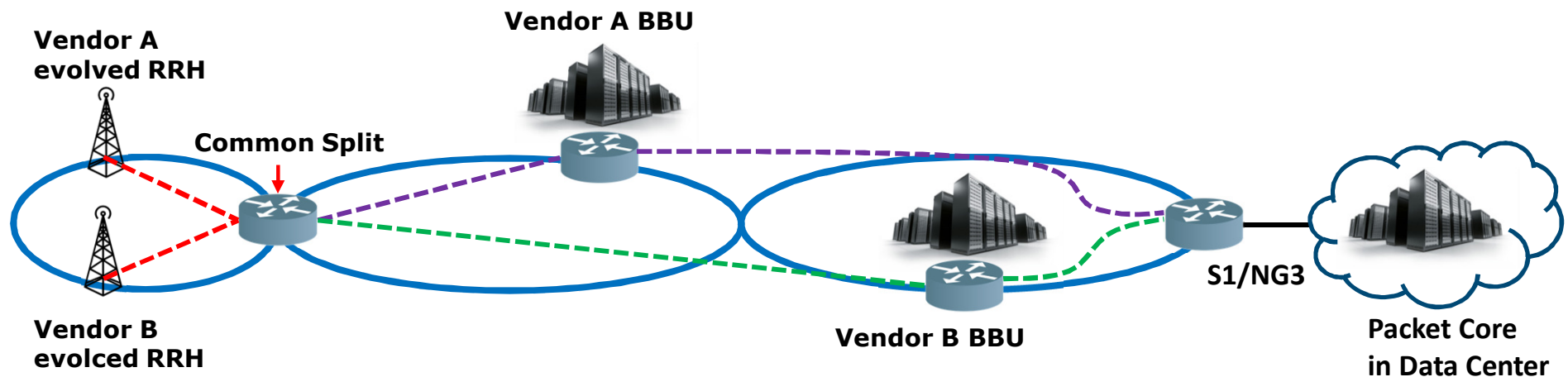
About interoperability targets 1/3

- What are the assumptions of interoperability?
- Purely at the transport level?



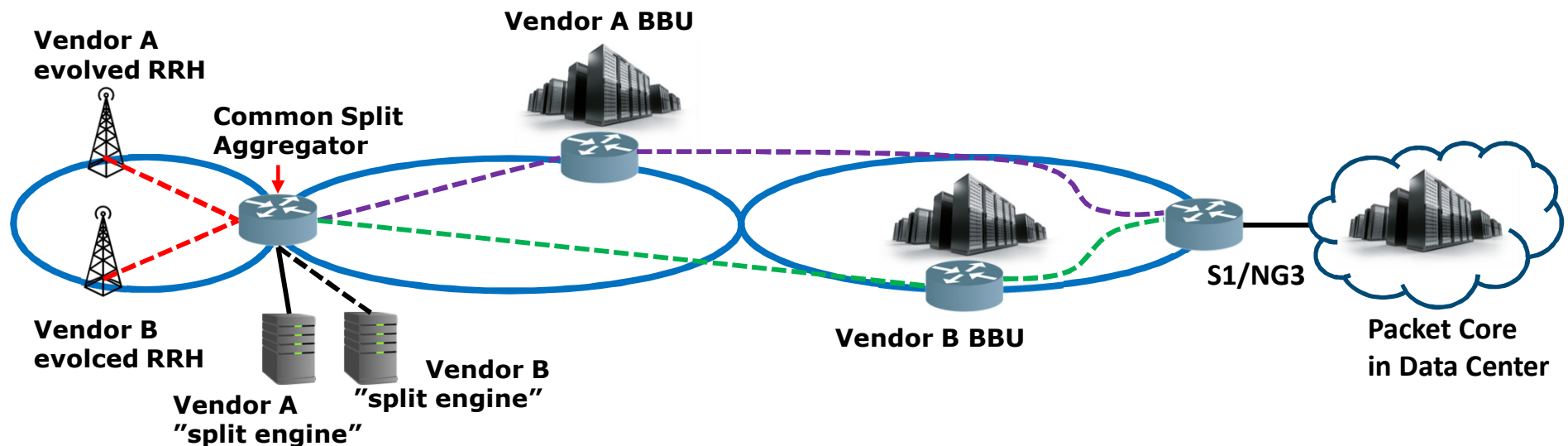
About interoperability targets 2/3

- Or promoting some common split(s) that would ensure interoperability beyond transport level?
 - Can be very(!) hard to get any agreement on..
 - A fixed split is "dangerous" regarding future proofness..

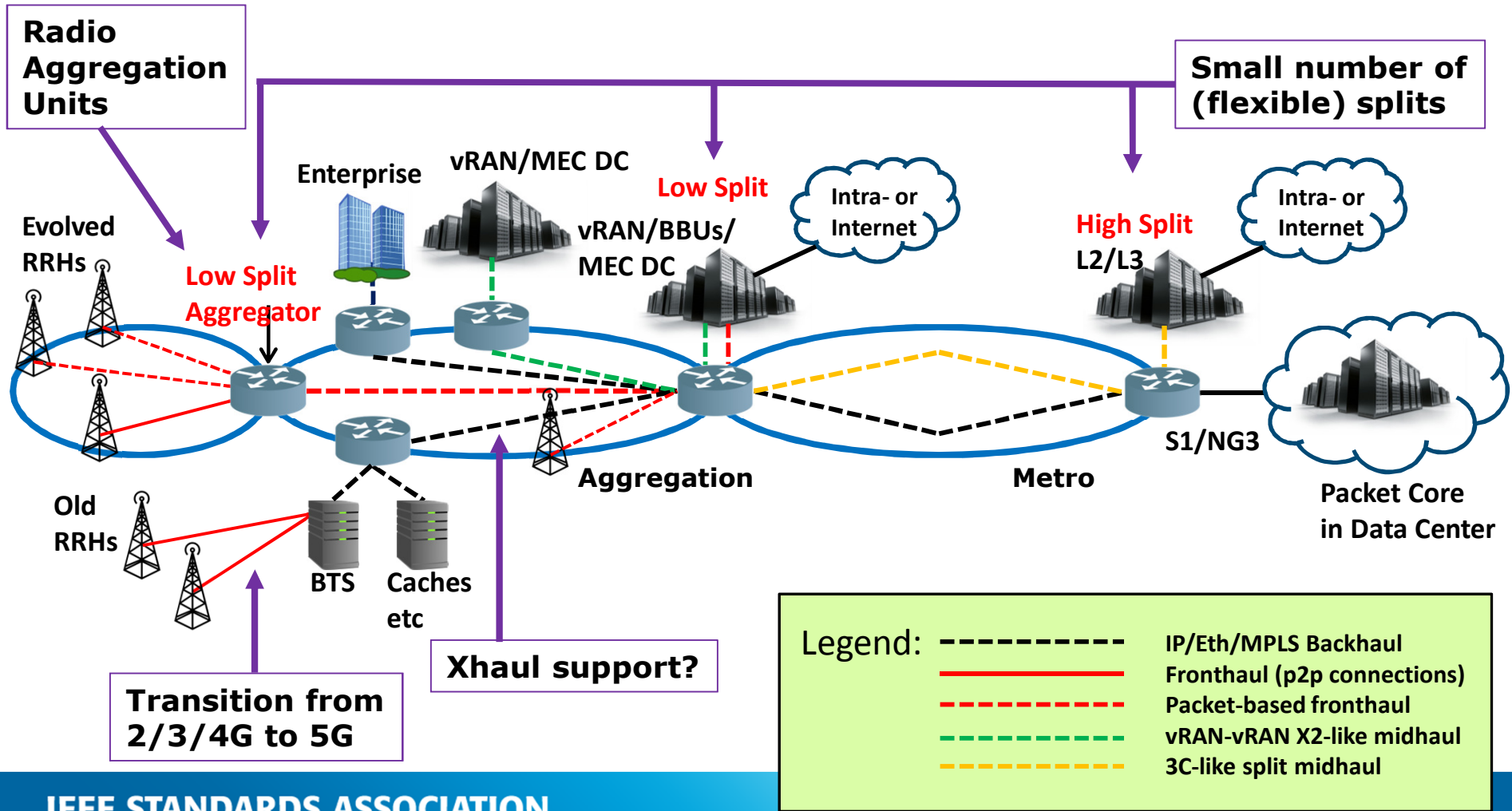


About interoperability targets 3/3

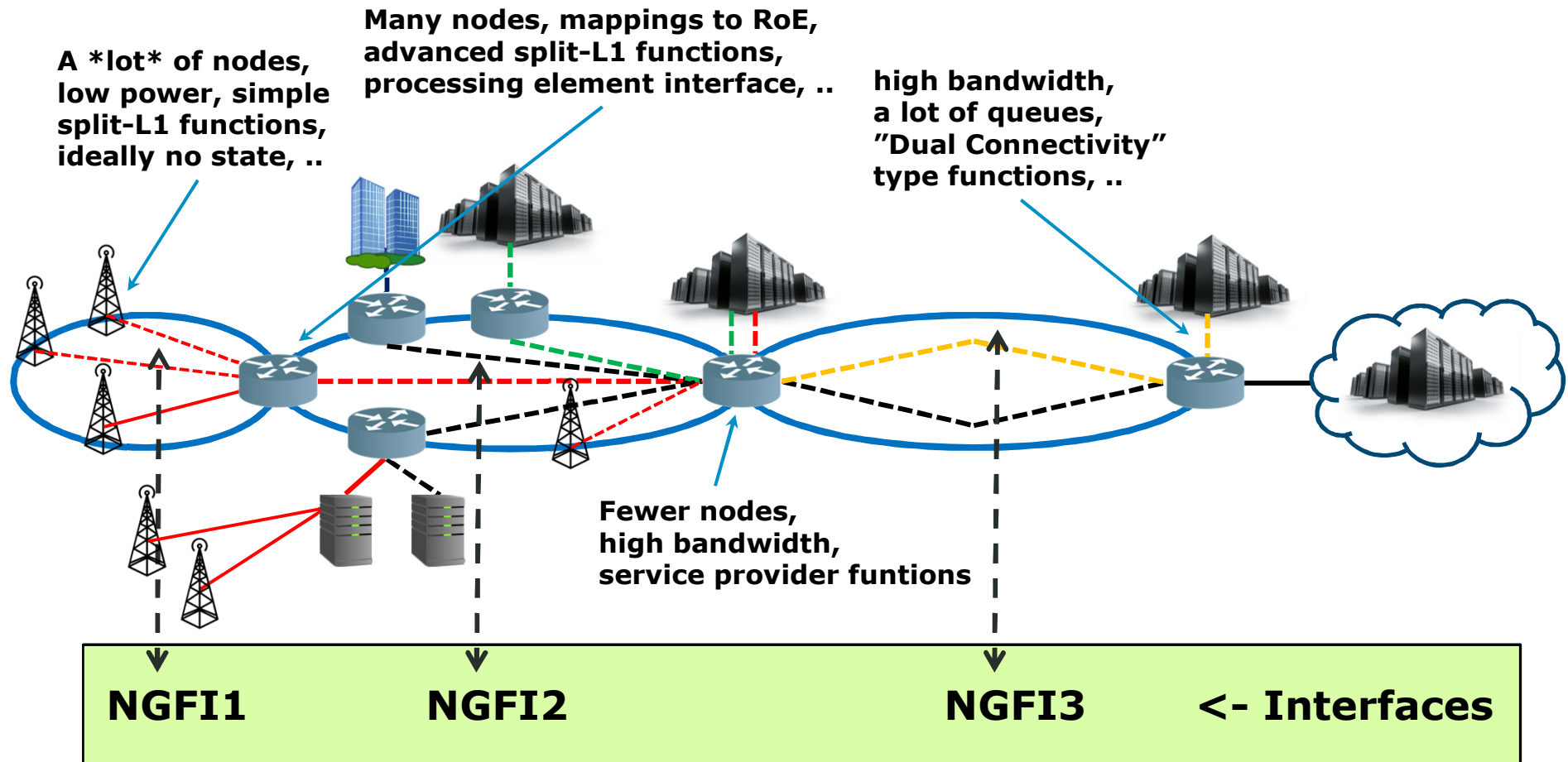
- Accept the fact that splits are moving and evolving entities.
- Think a split as a “side card” in a networking device or an “additional hop” in the network..
- Interoperability still remains at the transport level.



Proposal – high level architecture



Proposal – transport interfaces



Interface Summary

- NGFI1
 - A lot of nodes with ~10-25G links.
 - Tight network sync requirements up to 12.5ns time alignments.. but rather homogeneous traffic profiles.
 - End-2-end latency tens of microseconds.
 - Network aggregated bandwidth up to Terabytes.
 - Mainly Ethernet & MPLS over fiber.
- NGFI2
 - Many nodes up to 100G links; up to close terabit scale.
 - Tight network sync requirements up to 12.5ns time alignments.. Heregeneous traffic profiles (converged network enabling features needed from nodes).
 - End-2-end latency tens of microseconds.
 - Network aggregated bandwidth in tens to hundres of Gigabytes.
 - Ethernet/IP/MPLS over fiber.
- NGFI3
 - Fewer nodes; terabit scale; 100G links.
 - Network sync requirements in backhaul class. Heregeneous traffic profiles.
 - End-2-end latency measured in scales of millisecond.
 - Network aggregated bandwidth in hundres of Gigabytes.
 - Ethernet/IP/MPLS over fiber; service providers features required.

Motion #___

- Agree as a baseline the high level architecture and NGFI interfaces described in slides 18 and 19 of tf1_1610_korhonen_converged_1.pdf.
- Mover: Jouni Korhonen
- Seconder:
- Yes: ___ No: ___ Abstain: ___ (technical motion needs $\geq 2/3$)