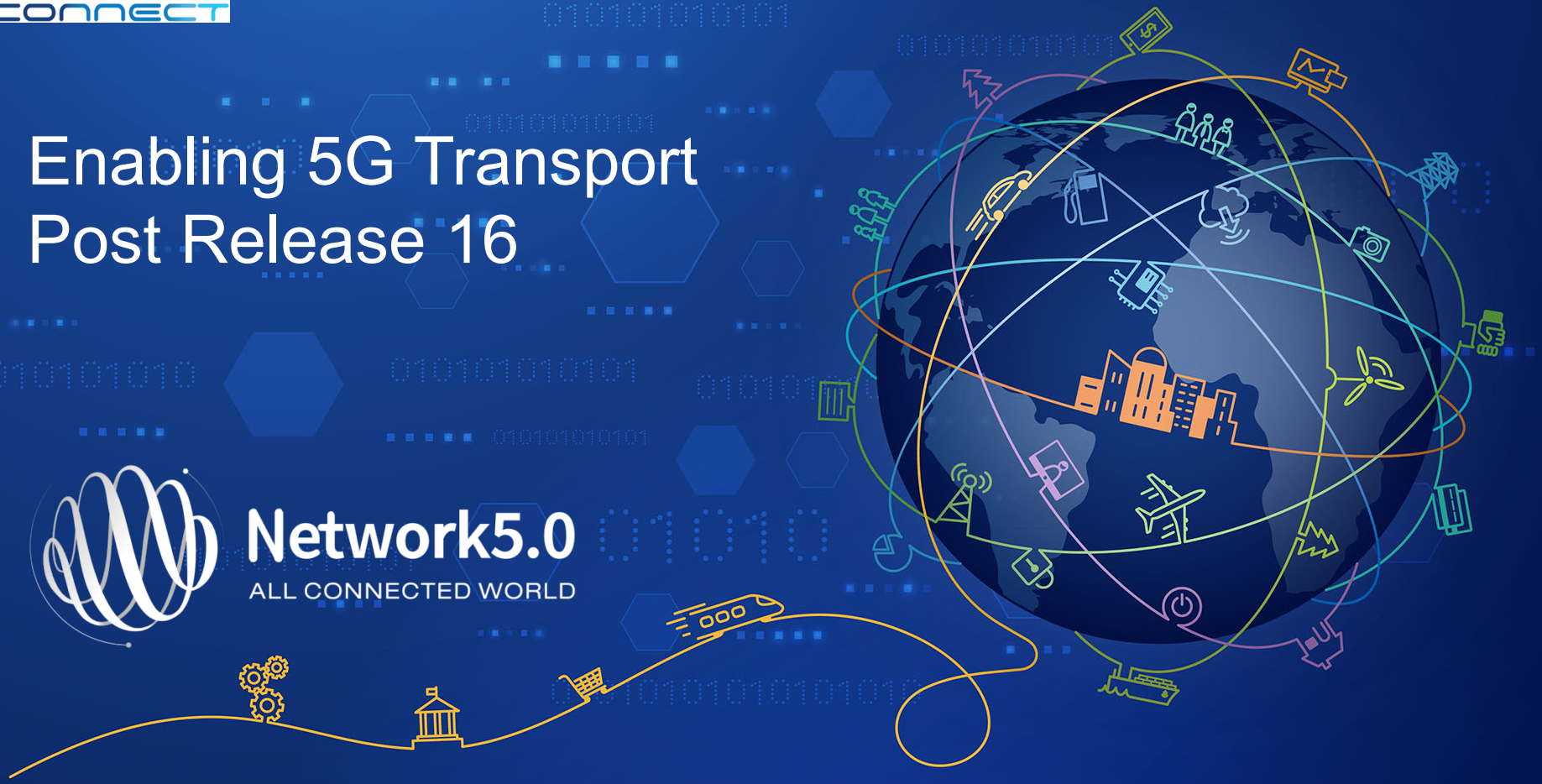
Enabling 5G Transport Post Release 16

Network5.0
ALL CONNECTED WORLD



New Challenges New Requirements

New Network Tech.

New Use Cases

New Business Models

Stricter Requirements

Change of Architecture

End to End Solutions

High Bandwidth

Low Latency

Network Slicing

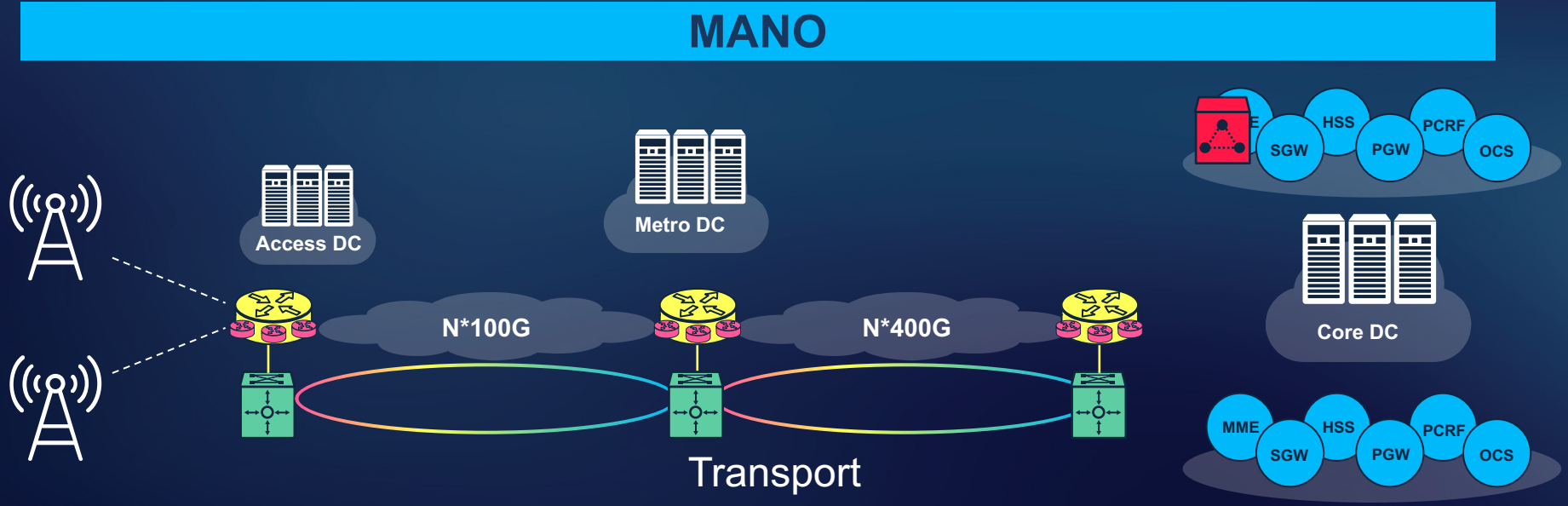
Agile

New Requirements

5G Mobile Architecture Evolution

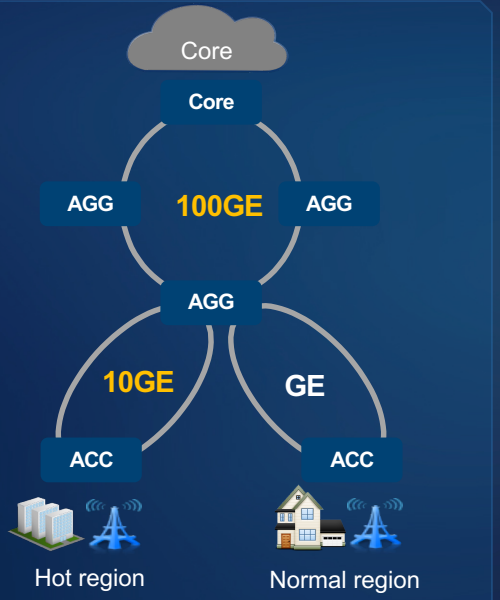
>>>“Tree” Structure
>>> Static nature
>>> Separated Management per segment

>>> Per service structure
>>> Modular core
>>> Dynamic nature
>>> Single orchestration managed



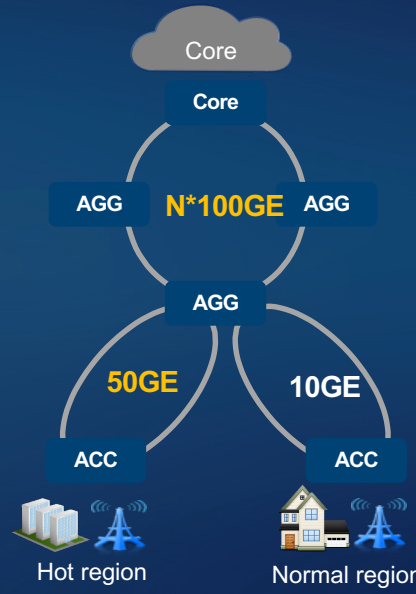
Mobile Transport Evolution Path

4.5G



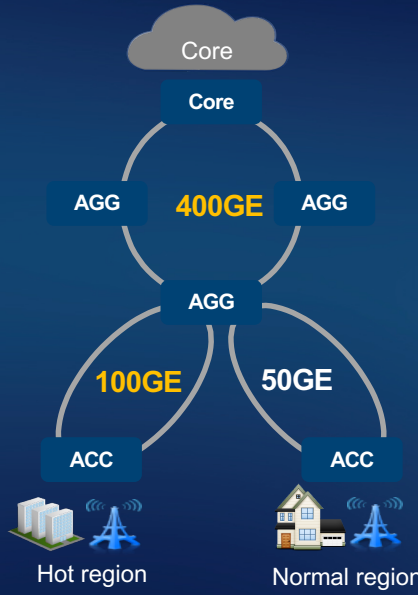
4.5G deployments, video became basic service, beginning of IoT

5G Release 15



5G eMBB use cases, enhance radio capacity, network transformation

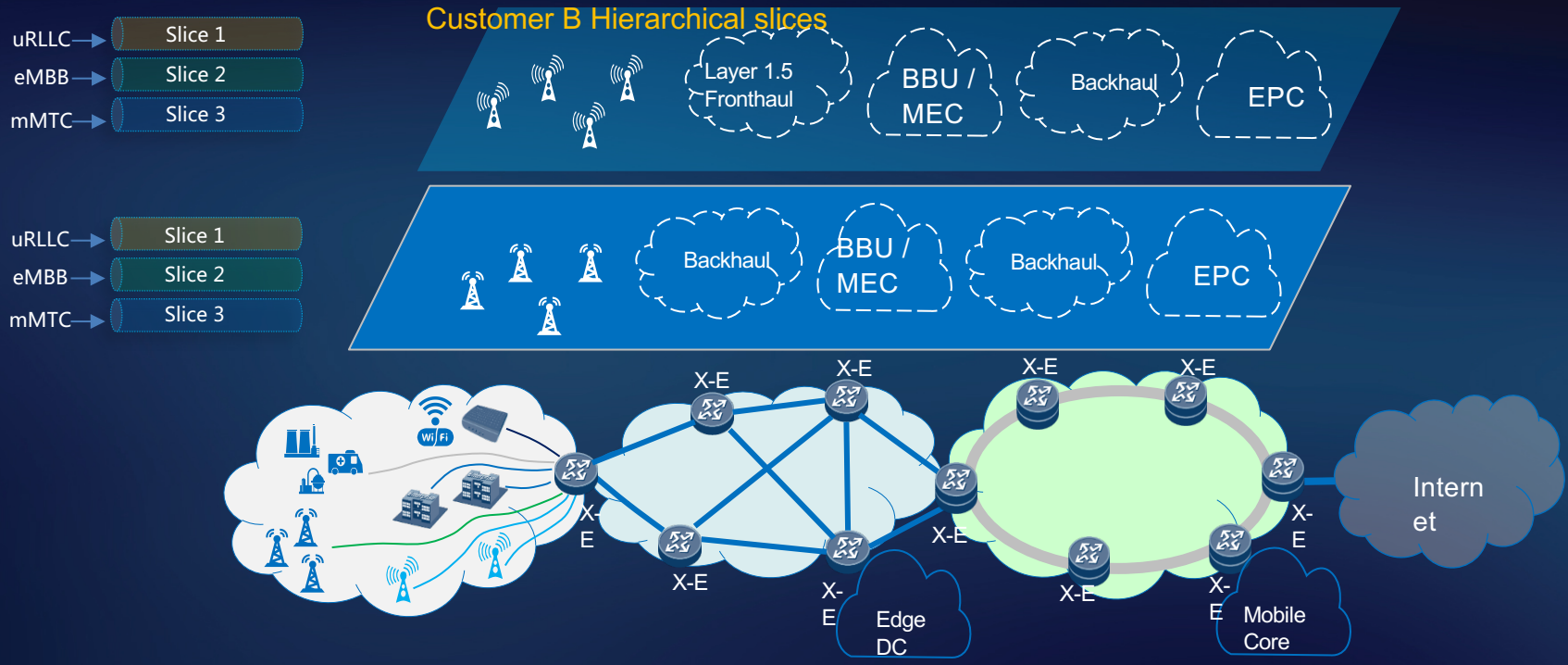
5G Release 16



5G URLLC MIoT use cases, Network slicing, new services

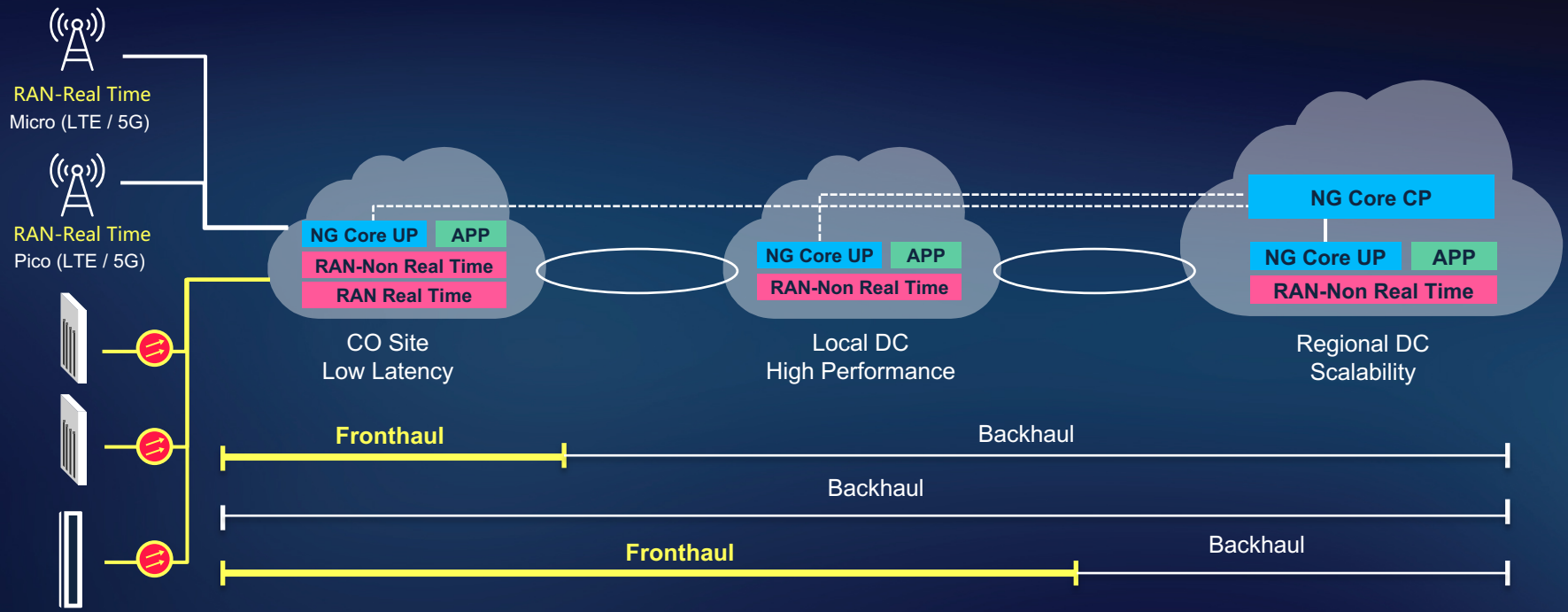
5G Transport Requirements and Technology Innovation

5G Network Slicing



- ❑ Fine Grin Network Slicing with Hard Isolation
- ❑ Support hierarchical slicing
- ❑ Support per slice behavior (routing logic, OAM policy etc.)

X-Haul (Fronthaul / Backhaul) Support



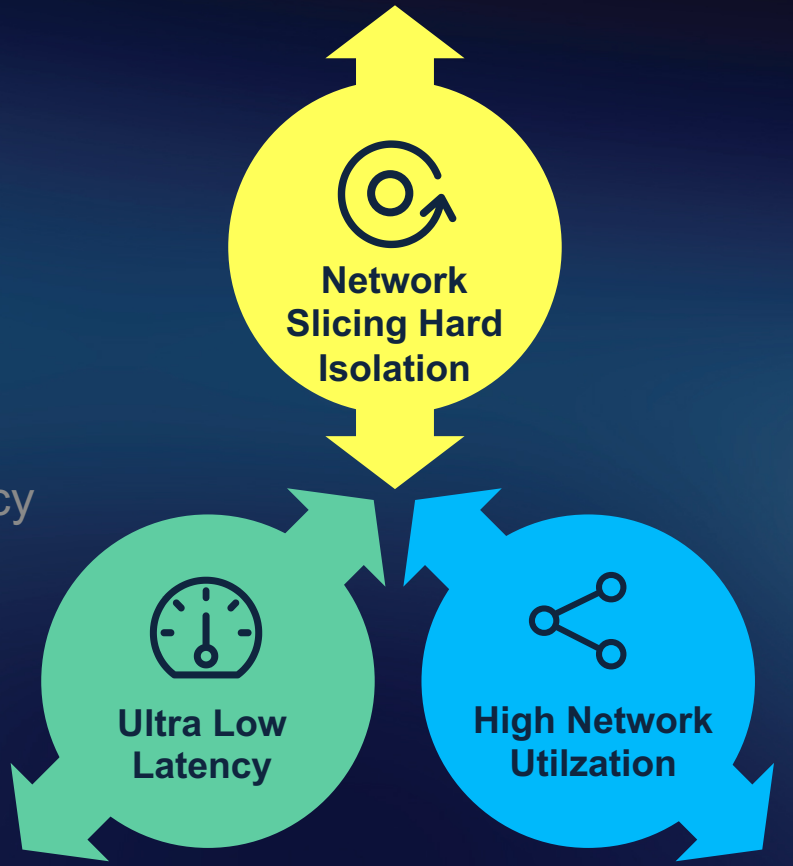
- Backhaul and Fronthaul coexistence
- Multi generation Backhaul and Fronthaul (3G/ 4G/ 5G)

5G Transport Requirements

Network Slicing
- Hard isolation
- Fine grin slice capacity
- Per slice behavior (optimized per service requirements)
- Dynamic and flexible

Low Latency
- Ultra Low Latency / Deterministic Low Latency
- Ultra Reliable Low Latency

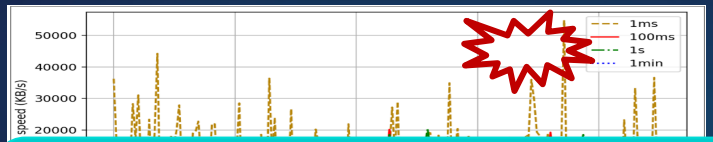
X-Haul
- Fronthaul / Backhaul unified technology



Why uRLLC Calls For New Technology Introduction?

Statistic Multiplexing Network needs buffer to mitigate the Micro burst even in light load network

Light load network still exists peak traffic(high load) in micro period



Downstream traffic is forwarded from high speed to low speed port exists micro burst

Current Networking technologies are optimized to deliver ***over provisioned bandwidth***, and challenged when need to deliver both **bandwidth and latency + jitter**

uRLLC Requirement

Low Latency E2E 1ms

Key problem:
Network congestion leads packet buffering delay(max 200ms)

Solution:
Light loaded , Remove buffer

Low packet loss

Key problem:
Network congestion packet buffer overflowing leads packet loss

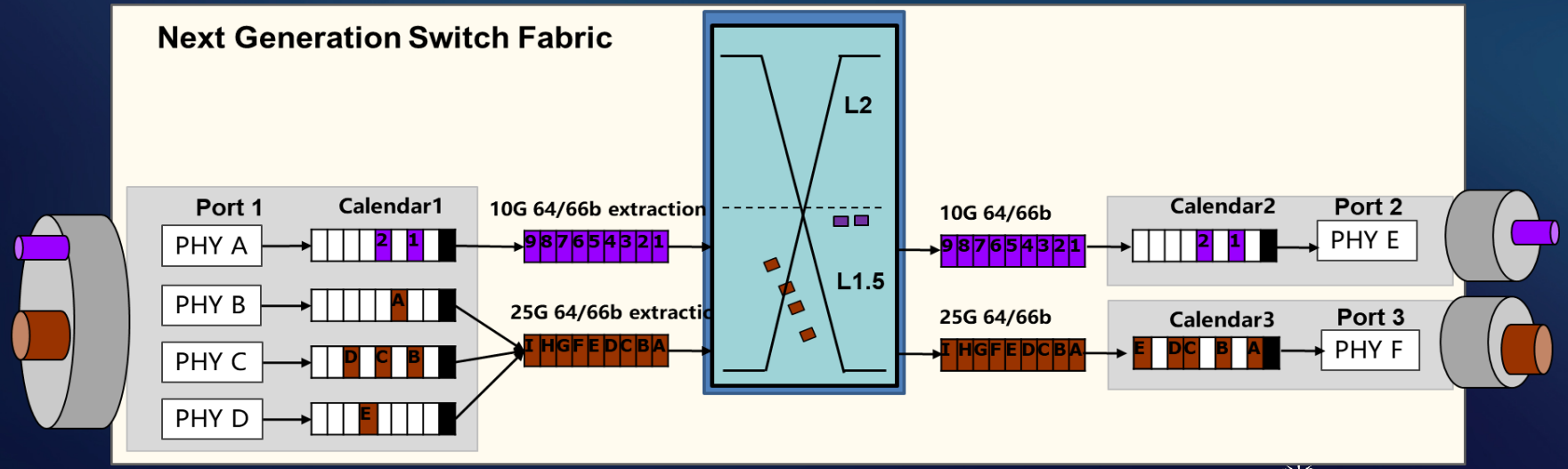
Solution:
Increase buffer

Conflicted, can't fulfill both

- Low Latency requirements (deterministic / ultra low / reliable ultra low) are challenging to existing statistical multiplexing technologies (Ethernet / IP/ …)
- **New technology is required to provide these capabilities together with high over provisioning bandwidth**

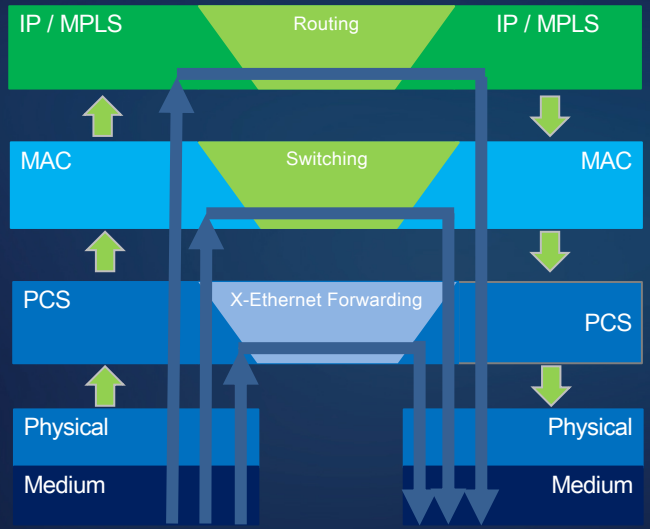
Introducing X-Ethernet

- X-Ethernet is next generation Ethernet technology
- Enhanced with L1.5 technology (PCS layer), X-Ethernet expends FlexEthernet from interface technology to network element technology
- L1.5 is another data plane option in addition to L2 / L3 utilizing the strong Ethernet / IP eco system

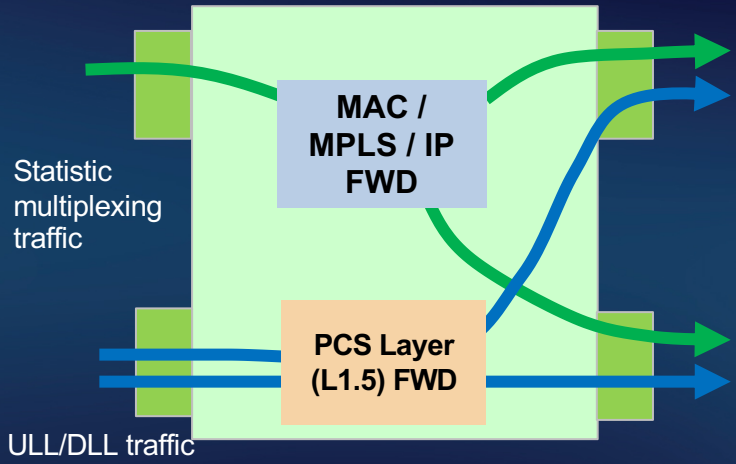


10

Per Slice Operational Flexibility – X-Ethernet Multiple Forwarding Planes



- L1.5 / L2 / L3 forwarding capability

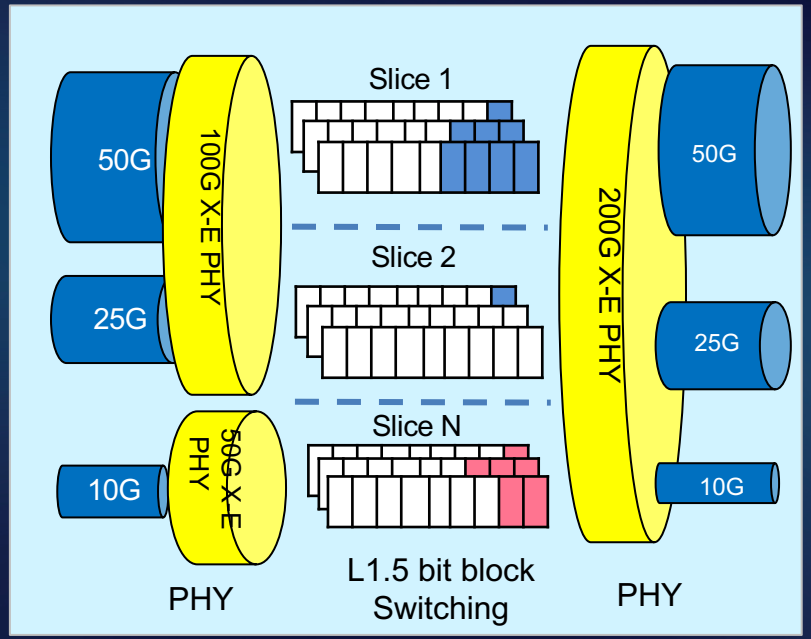


- Multiple forwarding modes in parallel in a single device
- Multiple traffic hard isolated in a single link

11

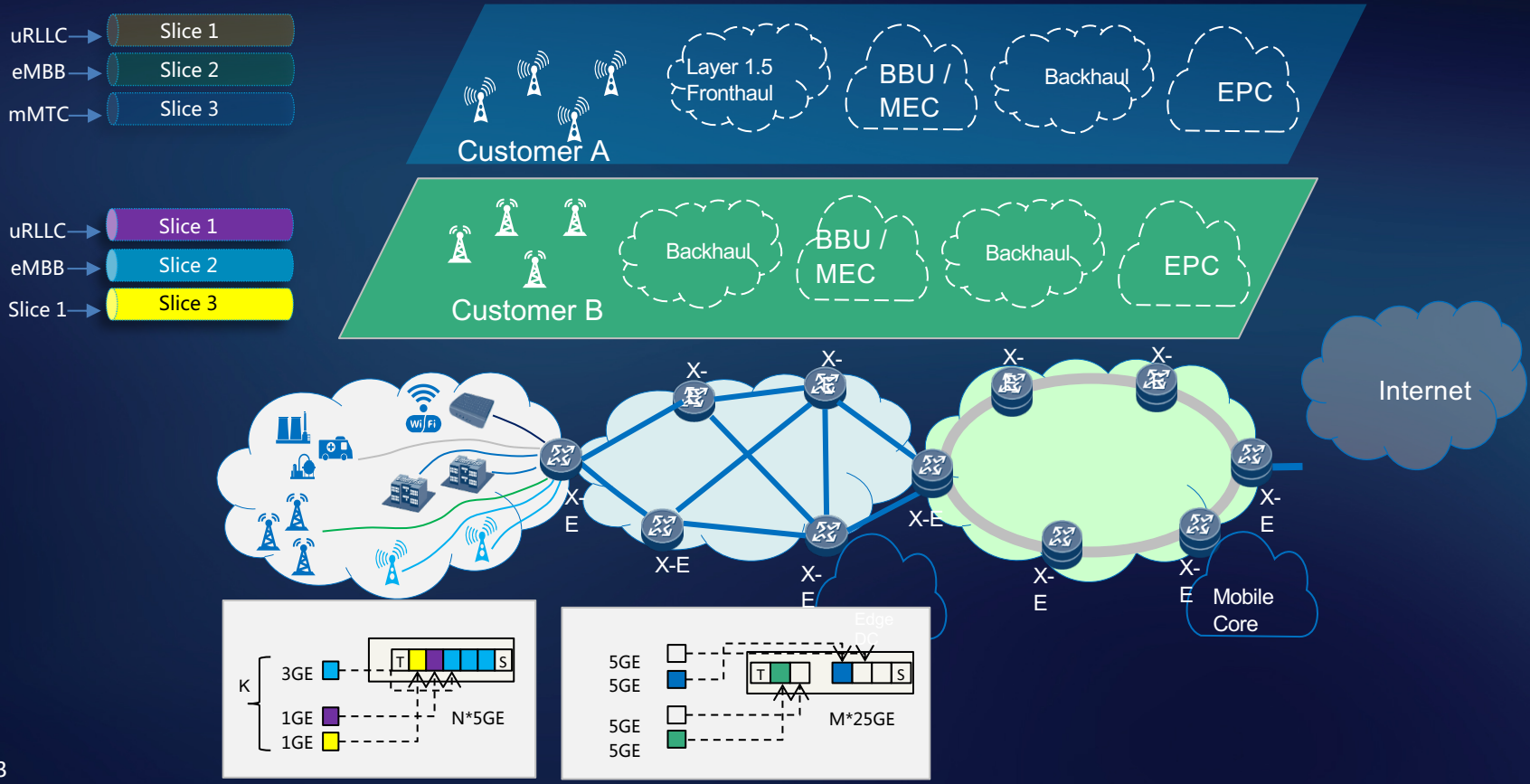
Bandwidth and Latency SLA Assurance - Network Slicing Hard Isolation

- X-Ethernet support multiple granularity slices with hard isolation (from 1G to 100G)
- Slices capacity is flexible and programmable, changing a slice capacity (i.e. assigning it more or less time slots) done dynamically in configuration
- The slices are separated by the number of slots assigned to them
- Each slice has separated channel in L1.5 switching (separated by the different time slots assigned to it), therefor there is no mutual effects of congestion among slices (i.e. no latency or jitter increase)



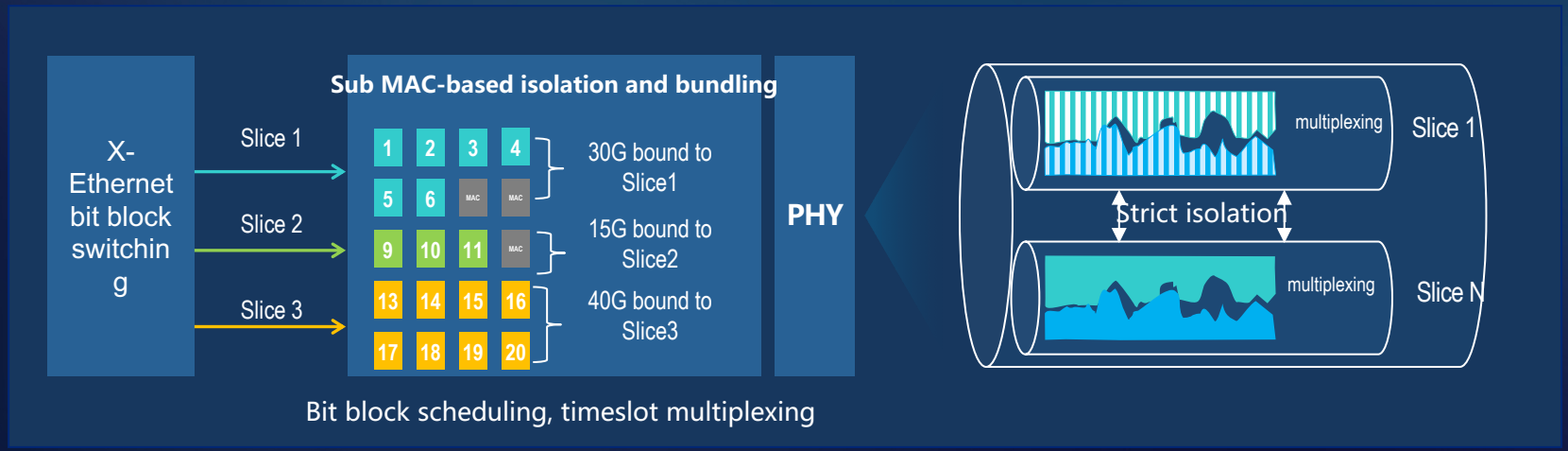
12

Hierarchical Network Slicing- Network Slicing Hard Isolation



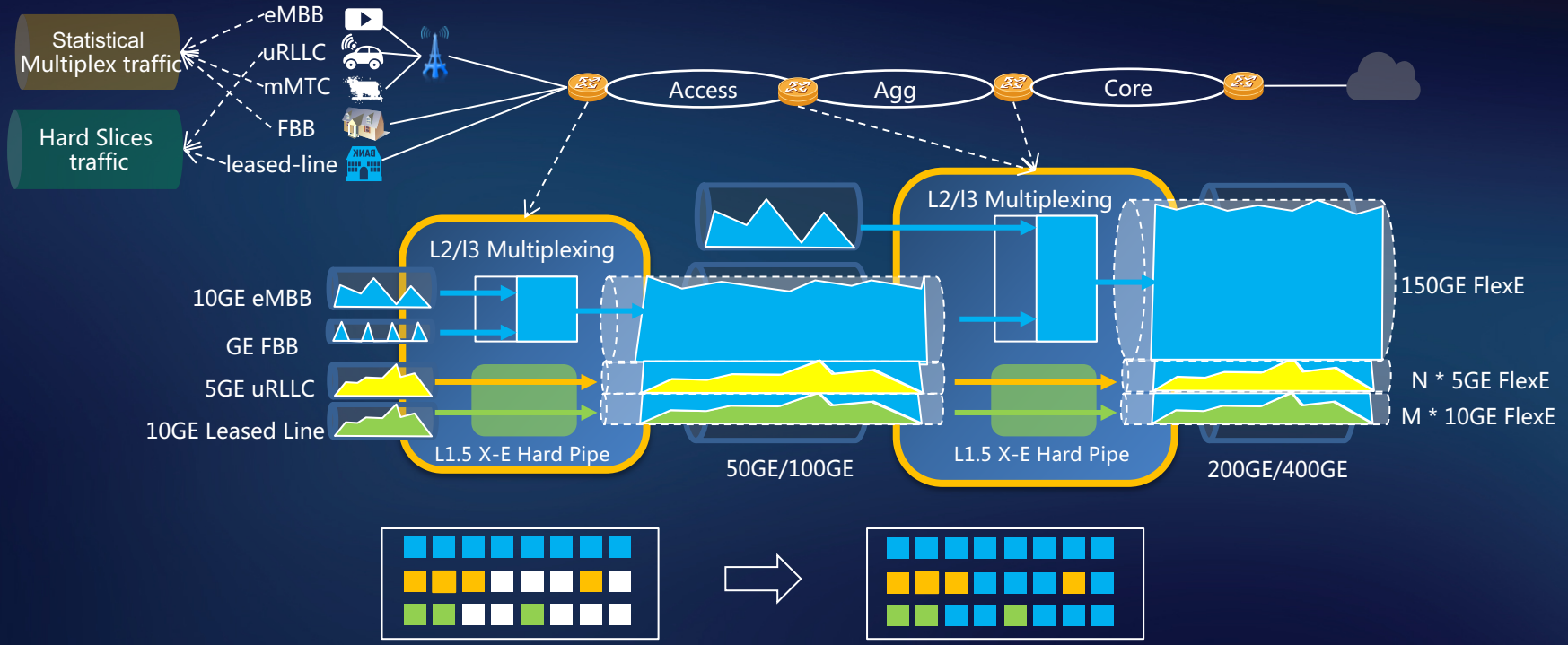
Secure by Design - Network Slicing Hard Isolation

- X-Ethernet offers advance “Secure by Design” capabilities:
  - X-Ethernet hard isolation prevent any cross slices effects as all the resources are fully separated
  - X-Ethernet bit block switching makes eves dropping and traffic mirroring much harder
  - X-Ethernet flows are configured via centralized controller and not by distributed control plane



14

High Network Utilization in Hard Slicing-Network Slicing Hybrid Multiplexing



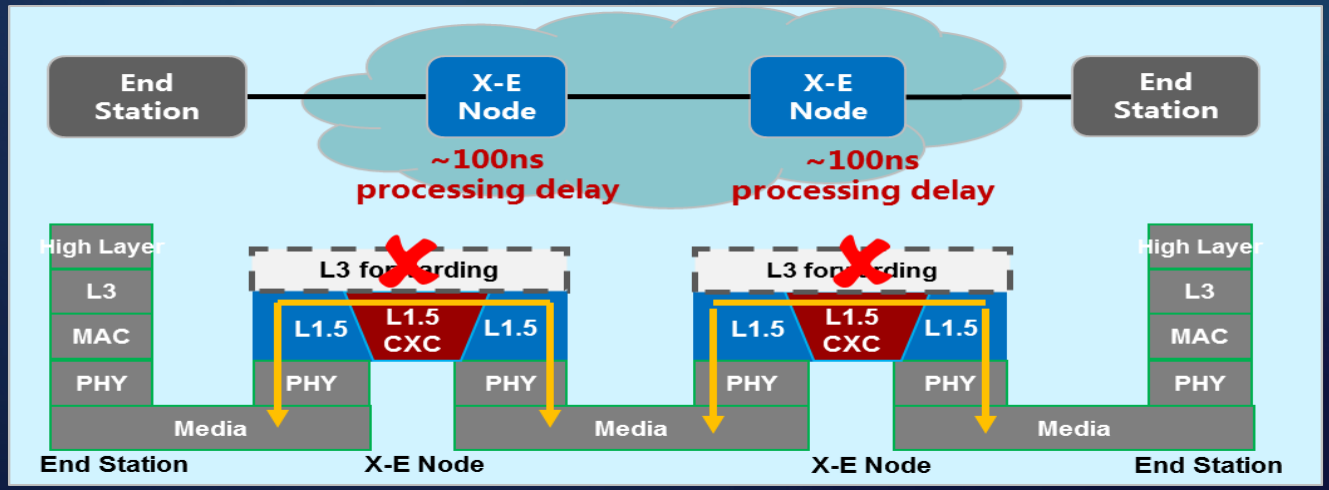
PCS layer encode idle blocks(white) in order to indicate that a specific time slot has no user data to transmit

X-Ethernet hybrid multiplexing:
Identify idle blocks in real time, replace idle blocks with background traffic data, and extract the background traffic at the destination

15
X-Ethernet

New Capabilities (Low Latency)
ULL / DLL E2E Service

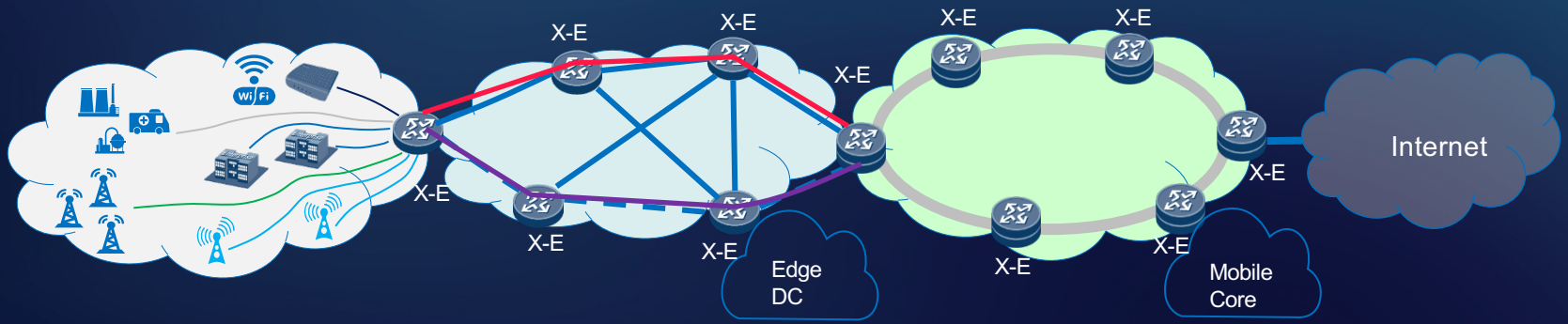
- X-Ethernet data plane provide ultra-low latency (~200ns per NE) / deterministic latency (near zero jitter) switching
- X-Ethernet support PCS layer switching based on Bit Block forwarding
  - No Packet buffering
  - No de/encapsulation
  - No table lookup
  - No queue scheduling



16

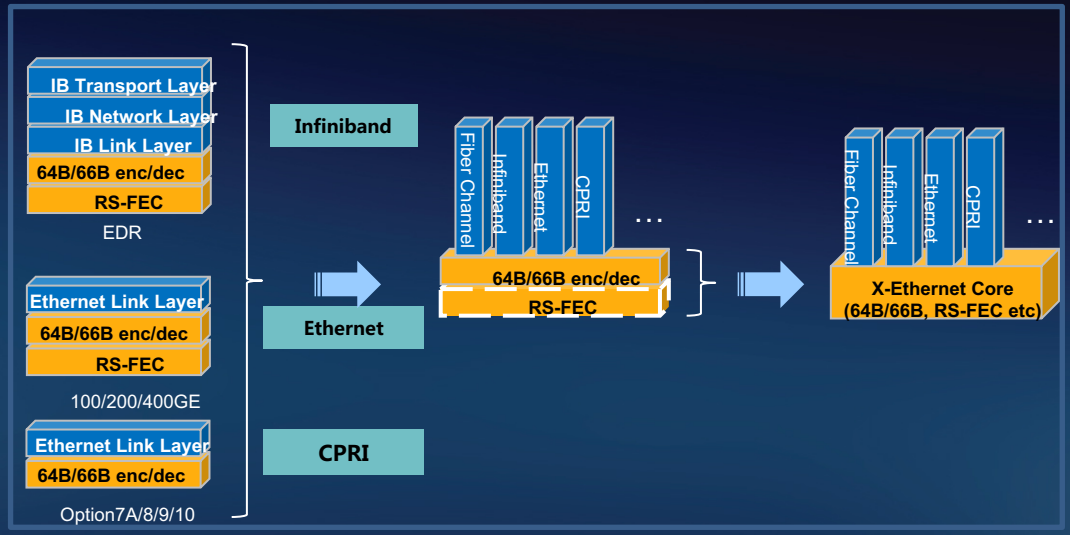
New Capabilities (Ultra Reliable Low Latency) ULL / DLL Protection

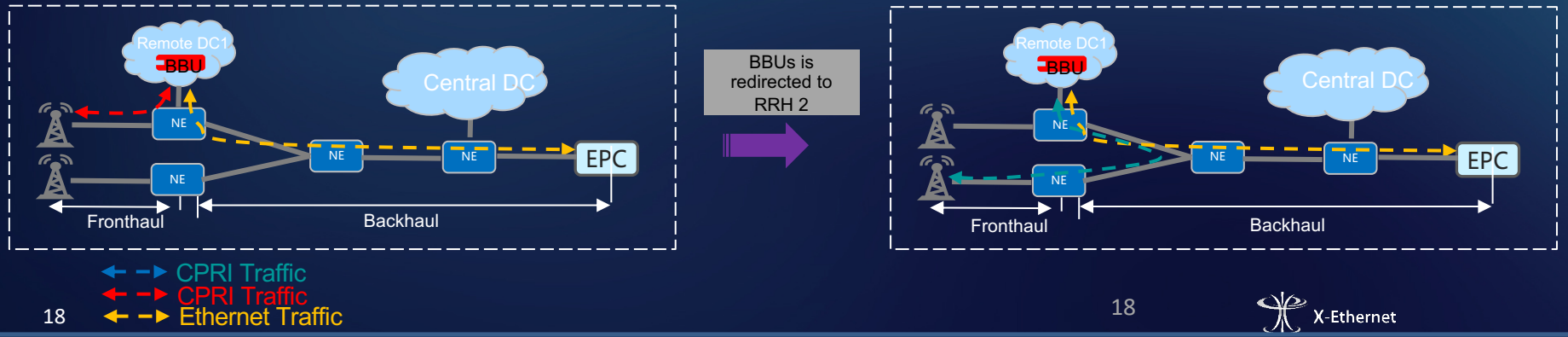
- X-Ethernet can support 1+1 and 1:1 redundancy mode and apply a separate policy per slice according to the service requirements
- In case of 1+1 the switching time is bounded by 5us switchover time
- Implementation examples:
  - V2X services may need guaranteed protection and use 1+1 protection
  - CloudVR may need ULL and can settle for 1:1 protection
  - Best effort traffic may not configure protection at all



Multi Technology Native Transport

- PHY technology of different interfaces is converging to use 66/64 Bit block format
- X-Ethernet can natively transport different Layer 2 technologies using the common PHY technology
- Enable new operation models that provide dynamic and flexible bounding between RRH and BBU





18
X-Ethernet

Standard Progress

- L1.5 switching idea
- Nested network slicing
- GSTR-TN5G project

2017.06 plenary

2017.10 interim meeting

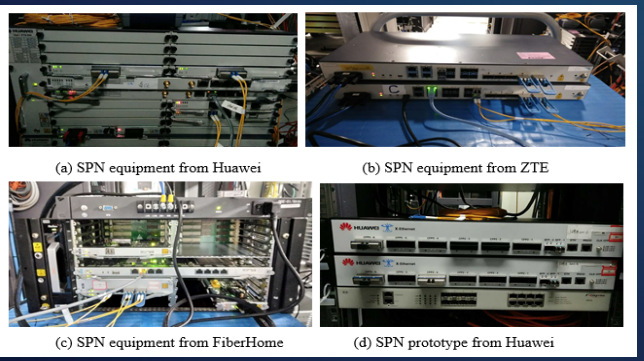
- SPN architecture
- GSTR-TN5G (bandwidth/latency/multiservice/network slicing/SDN/architecture/)

- GSTR-TN5G consent
- New work G.ctn5g to collect more specific requirement

2018.01 plenary

2018.10 plenary

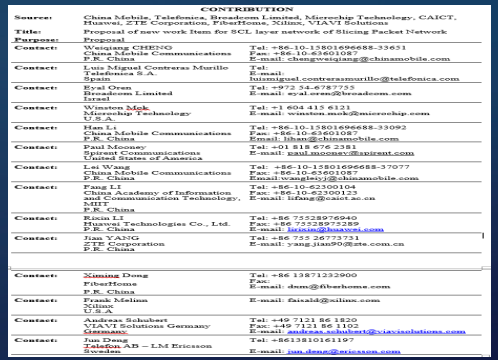
- New work item G.mtn initiated to standardize X-Ethernet technology



(a) SPN equipment from Huawei (b) SPN equipment from ZTE

(c) SPN equipment from FiberHome (d) SPN prototype from Huawei

X-Ethernet participated and passed China Mobile SPN interoperability testing



CONTRIBUTION

Source:	China Mobile, Telefonica, Broadcom Limited, Microchip Technology, CAICT, Huawei, ZTE Corporation, FiberHome, Xilinx, VIAVI Solutions
Title:	Proposal of new work Item for SCL layer network of Slicing Packet Network
Purpose:	Proposal

Contact:	Weiqiang CHEN	Tel: +86-10-13801696688-33651
	China Mobile Communications P.R. China	Fax: +86-10-63601087 E-mail: chengweiqiang@chinamobile.com
Contact:	Luis Miguel Contreras Murillo Telefónica S.A. Spain	Tel: E-mail: luismiguel.contrerasmurillo@telefonica.com
Contact:	Eyal Oren Broadcom Limited Israel	Tel: +972 54-6787755 E-mail: eyal.oren2@broadcom.com
Contact:	Winston Mok Microchip Technology U.S.A.	Tel: +1 604 415 6121 E-mail: winston.mok@microchip.com
Contact:	Han Li China Mobile Communications P.R. China	Tel: +86-10-13801696688-33092 Fax: +86-10-63601087 Email: lihan@chinamobile.com
Contact:	Paul Mooney Spirent Communications United States of America	Tel: +01 818 676 2381 E-mail: paul.mooney@spirent.com
Contact:	Lei Wang China Mobile Communications P.R. China	Tel: +86-10-15801696688-37077 Fax: +86-10-63601087 Email:wanglei@chinamobile.com
Contact:	Fang LI CAICT, Academy of Information and Communication Technology, MIIT P.R. China	Tel: +86-10-62300104 Fax: +86-10-62300123 E-mail: lifang@caict.ac.cn
Contact:	Ricin LI Huawei Technologies Co., Ltd. P.R. China	Tel: +86 75528976940 Fax: +86 7552897 5289 E-mail: lirixin@huawei.com
Contact:	Jin YANG ZTE Corporation P.R. China	Tel: +86 75 526773731 E-mail: yang.jin59@zte.com.cn
Contact:	Ximing Dong FiberHome P.R. China	Tel: +86 13871232900 Fax: E-mail: dxm@fiberhome.com
Contact:	Frank Melim Xilinx U.S.A.	E-mail: faizal@xilinx.com
Contact:	Andreas Schubert VIAVI Solutions Germany Germany	Tel: +49 7121 86 1820 Fax: +49 7121 86 1102 E-mail: andreas.schubert@viavisolutions.com
Contact:	Jun Dong Ericsson AB – LM Ericsson Sweden	Tel: +8613810161197 E-mail: jun.dong@ericsson.com

Multiple companies including Broadcom, Ericsson, Xilinx, Viavi officially endorsed X-Ethernet technology in ITU-T

Question:	11/15	Proposed new ITU-T Recommendation	Geneva, Switzerland, 8-19 October 2018
Reference and title:	ITU-T G.mtn "Interfaces for a metro transport network"		
Base text:	None	Timing:	2020-02
Editor(s):		Approval process:	AAP

Scope (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability):

This new Recommendation defines **two new non-recursive layer networks** (path and section) that will be used in the ~~Metro~~ **metro** ~~Core and aggregation~~ networks, ~~primarily~~ including the ~~to~~ transport of D-RAN and C-RAN traffic and **run over 50GBASE-R, 100GBASE-R, 200GBASE-R, 400GBASE-R Pluggable Ethernet Modules**.

The path layer provides flexible connections that carry client data and path OAM in 64B/66B blocks that are conformant to IEEE 802.3 clause 82 encoding rules and results in valid 802.3 64B/66B blocks, which allows using the lower layers of the Ethernet protocol stack. OAM functions include connection verifications, PM, path status and delay measurement, ~~supported include equivalent of ODUk PM functionality and APS~~ Protection overhead to support path layer SNCP will also be supported.

The section layer frame format will be defined in a way that maximizes reuse of FlexE implementation logic including support for bonding homogenous groups of 50GBASE-R, 100GBASE-R, 200GBASE-R, 400GBASE-R~~50G, 100G, 200G, 400G~~ PHYs. The section layer frame format will only use valid IEEE 802.3 clause 82 64B/66B blocks which will allow use of the lower layers of Ethernet stack in the same way as FlexE.

Path layer clients are mapped into the section 5 Gbit/s calendar slots in the same way as a FlexE client is mapped into the calendar slots of a FlexE group, with the modification that any n x~~x~~ 5 Gbit/sG client rate is supported (not limited to the FlexE client rates of 10 Gbit/sG, 40 Gbit/sG, n x ~~x~~25 Gbit/sG). **Use of additional mapping procedures for different client types may be specified if required.**

Overhead for section OAM will be designed to maximize reuse of FlexE implementation logic with the necessary extensions to support additional functions (e.g. OAM, APS) for the identified network applications.

ITU-T SG15 approves to start a new work item G.mtn (metro transport network) to standardize X-Ethernet

19

Summary

Next generation mobile technology (5G) has new requirements and challenges

In 5G, mobile backhaul and fronthaul (transport) Network will be integral part of the mobile network

New data plane technology is needed to provide network slicing hard isolation, high network utilization and ultra and deterministic low latency

X-Ethernet technology was develop to meet these requirements as well as to provide fine grin, flexible and programmable 5G transport solution

With 5G networks being deployed world wide, now is the time to start designing release 16 5G transport networks