

Broad Marketing Potential of 50/200/400GbE Beyond 10Km in Mobile Backhaul Application

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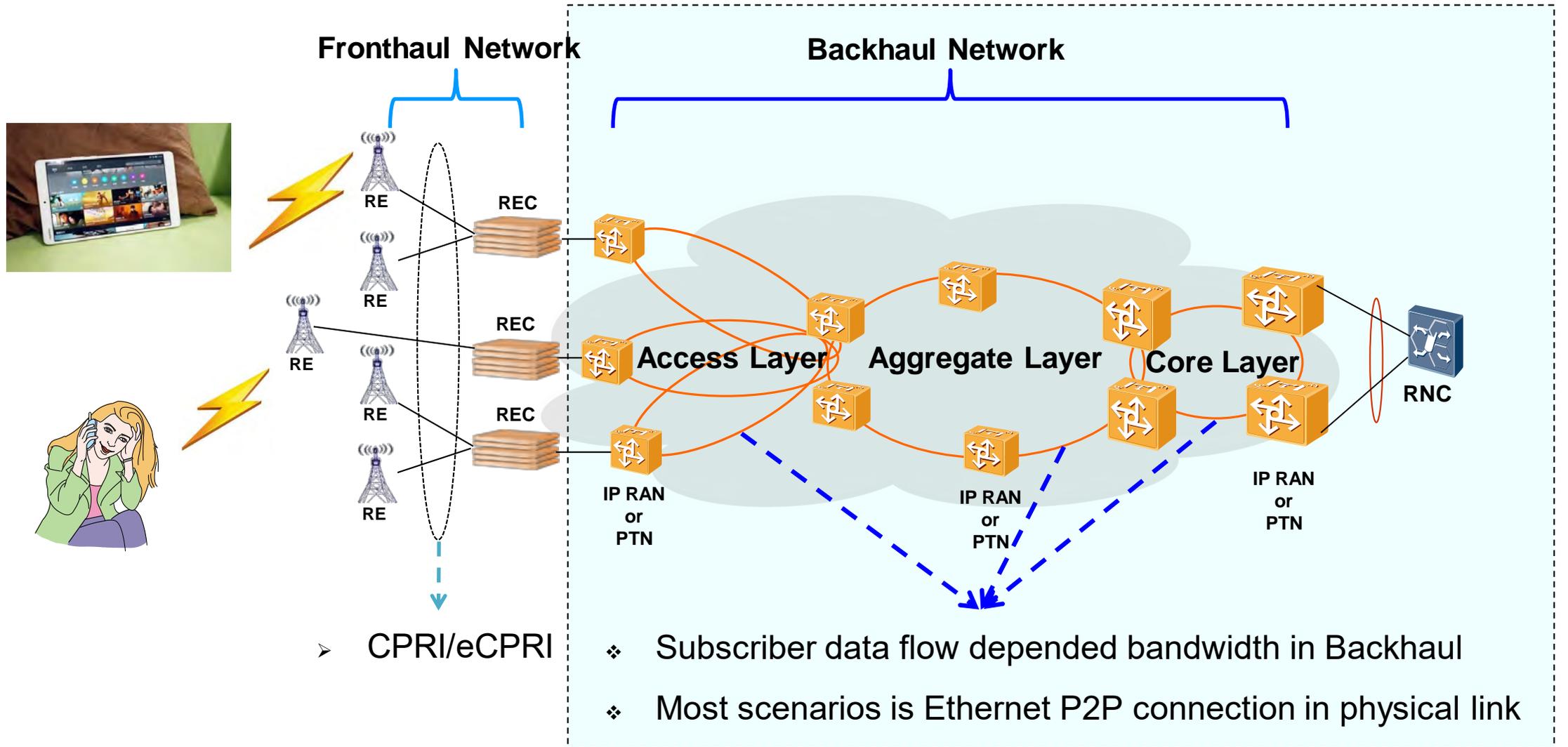


Motivation

- As in “[CFI Consensus-Beyond 10km Optical PHYs](#)” at Berlin meeting, mobile application is interested user case for Beyond 10km study group,
 - **3 Million units (GbE to 100GbE) for 40km and beyond shipped annually**
 - Not a data center application!
 - Bandwidth growth throughout EcoSystem
 - **“Geographically challenged” applications exist throughout Ecosystem**
 - Internet Exchanges
 - Financial Industry
 - Mobile Backhaul
 - **China – Mobile Networks**
 - Traffic in China alone exceeds other regions of the world
 - Consumer video driving application
 - **Emerging applications to drive future traffic over mobile networks**

- In this contribution, to build consensus on broad market potential of 50/200/400GE with Beyond 10km objective, we present the bandwidth forecast and requirement for mobile backhaul network to Ethernet standard.

Background of Mobile Transport Network



➤ CPRI/eCPRI

- ❖ Subscriber data flow depended bandwidth in Backhaul
- ❖ Most scenarios is Ethernet P2P connection in physical link

- IEEE 802.3 50/200/400GE Beyond 10km reach can be deployed in mobile backhaul network.

Bandwidth Required of 4G LTE Application

- UE, (User Equipment, for example cell phone) connect to cell of each site/tower by air interface
- The throughput of each wireless cell is depended on number of UEs and different between busy and quiet time
- Access ring bandwidth of 4G LTE backhaul is popular at 10GE/NX10GE
 - 150Mbps at 20MHz Carrier
 - Varying due to tide of subscriber traffic and throughput of user Busy/Quiet time
 - Not simple accumulated on all of throughput from cells or subscribers

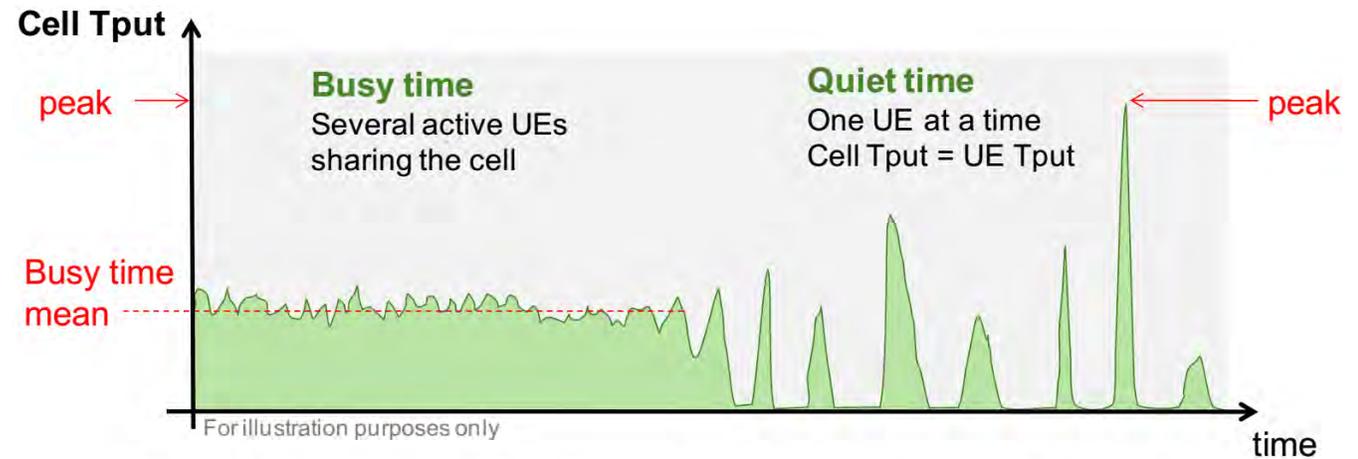
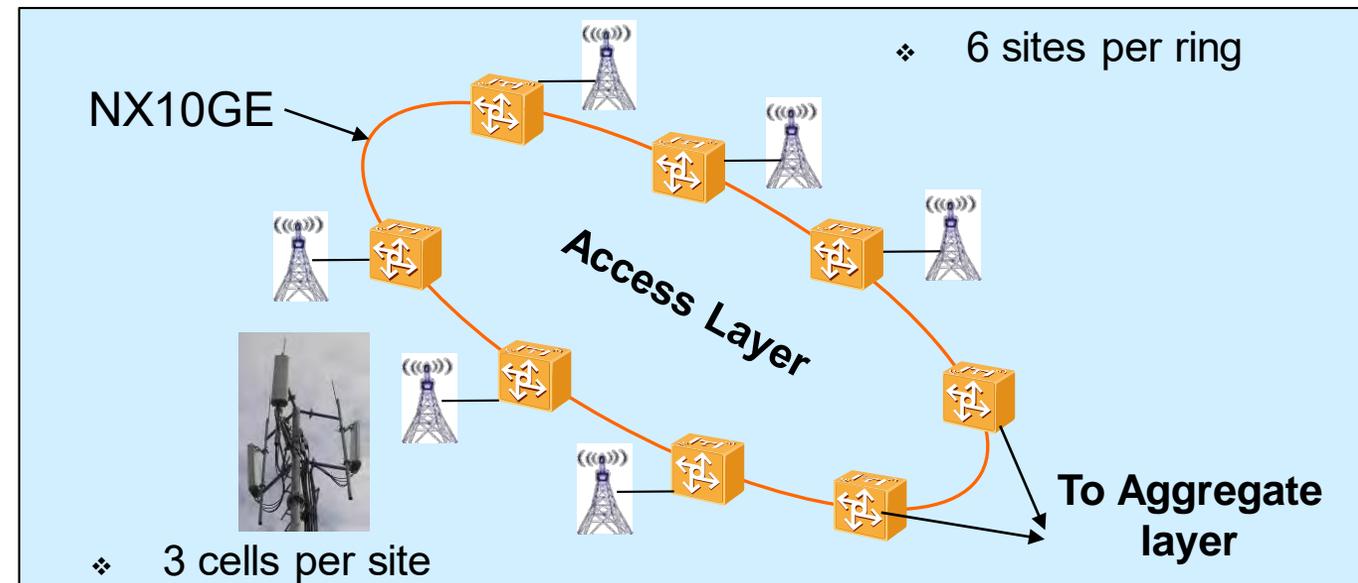
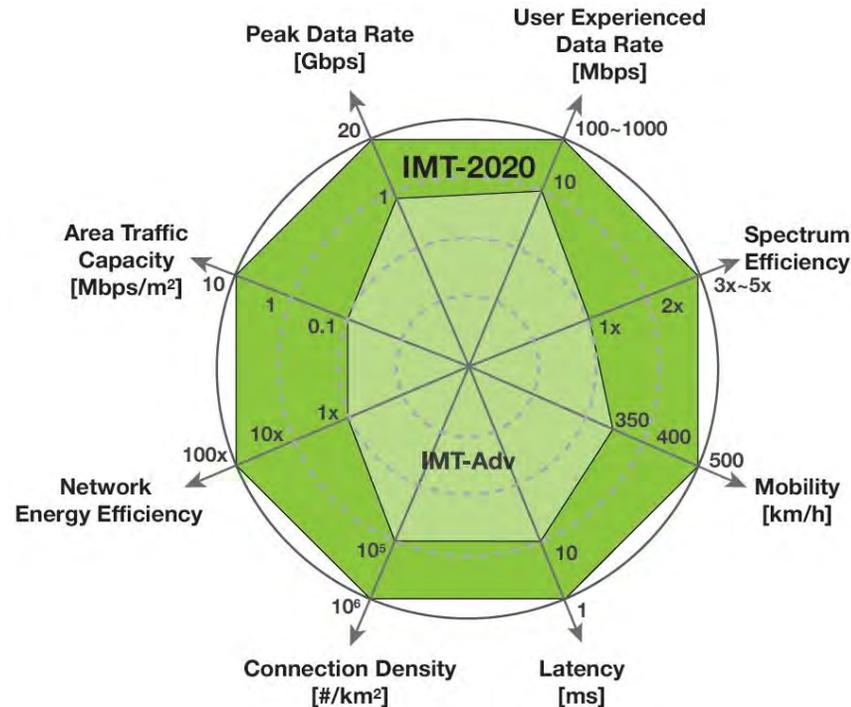


Figure 4 Illustration of Cell Throughput during Busy and Quiet Times



Bandwidth Forecast of 4G+/5G Application

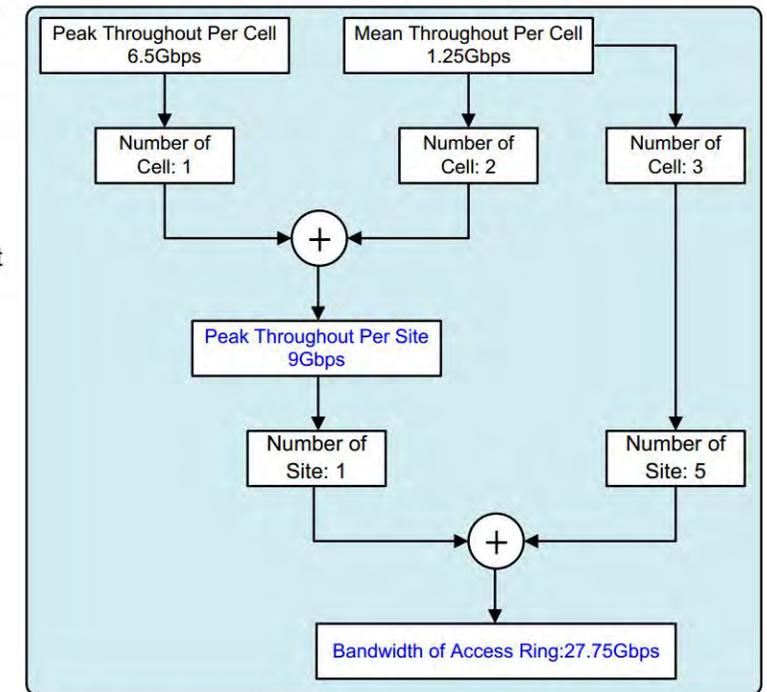
- 5G should have the following performance advantages with peak data rate at 20Gbps, up to 1Gbps user experienced data rate



- In “[wang_ecdc_01a_1116](#)”, the following information support a 50GE at access ring with same physical link when 4G upgrade to 4G+/5G 1st stage.

Bandwidth in Access Ring of 5G Mobile Backhaul Network

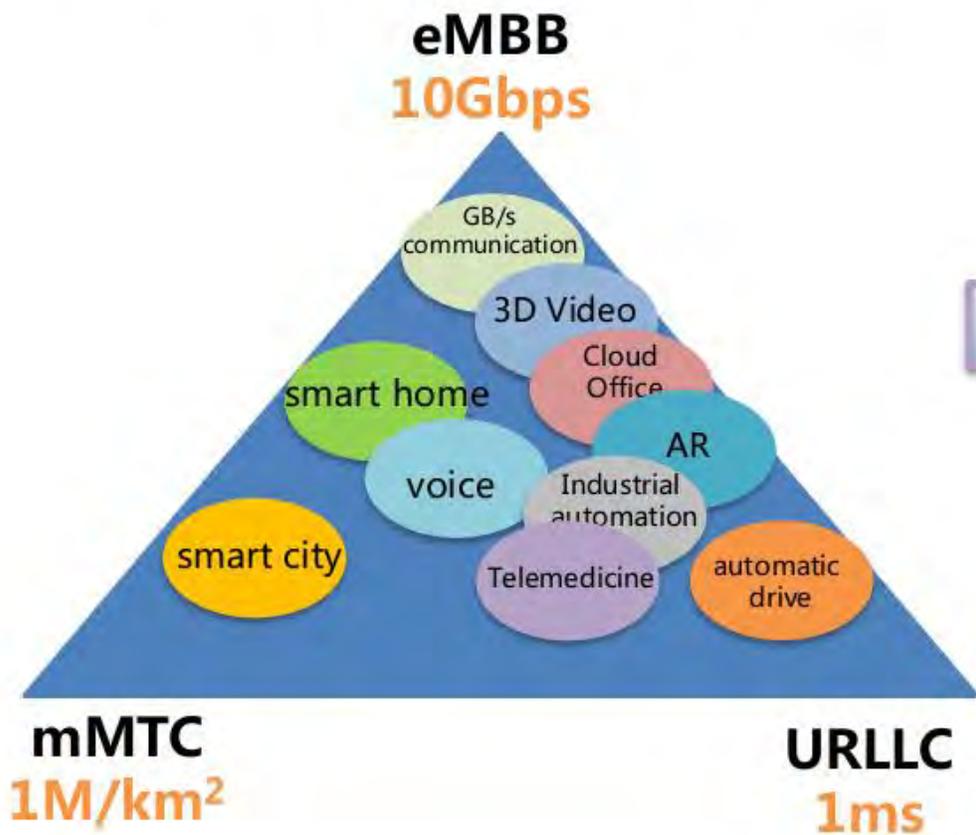
- For Ring topology in Backhaul network:
 - Multiple sites will share one physical/logic link
 - Per statistics multiplexing mechanism, bandwidth forecast depend on air interface, subscribers behavior
- Typical example for access ring bandwidth:
 - 6 sites per Ring
 - 3 LTE/5G Cells per Site
 - LTE: 5X20MHz carrier
 - 5G :100MHz carrier



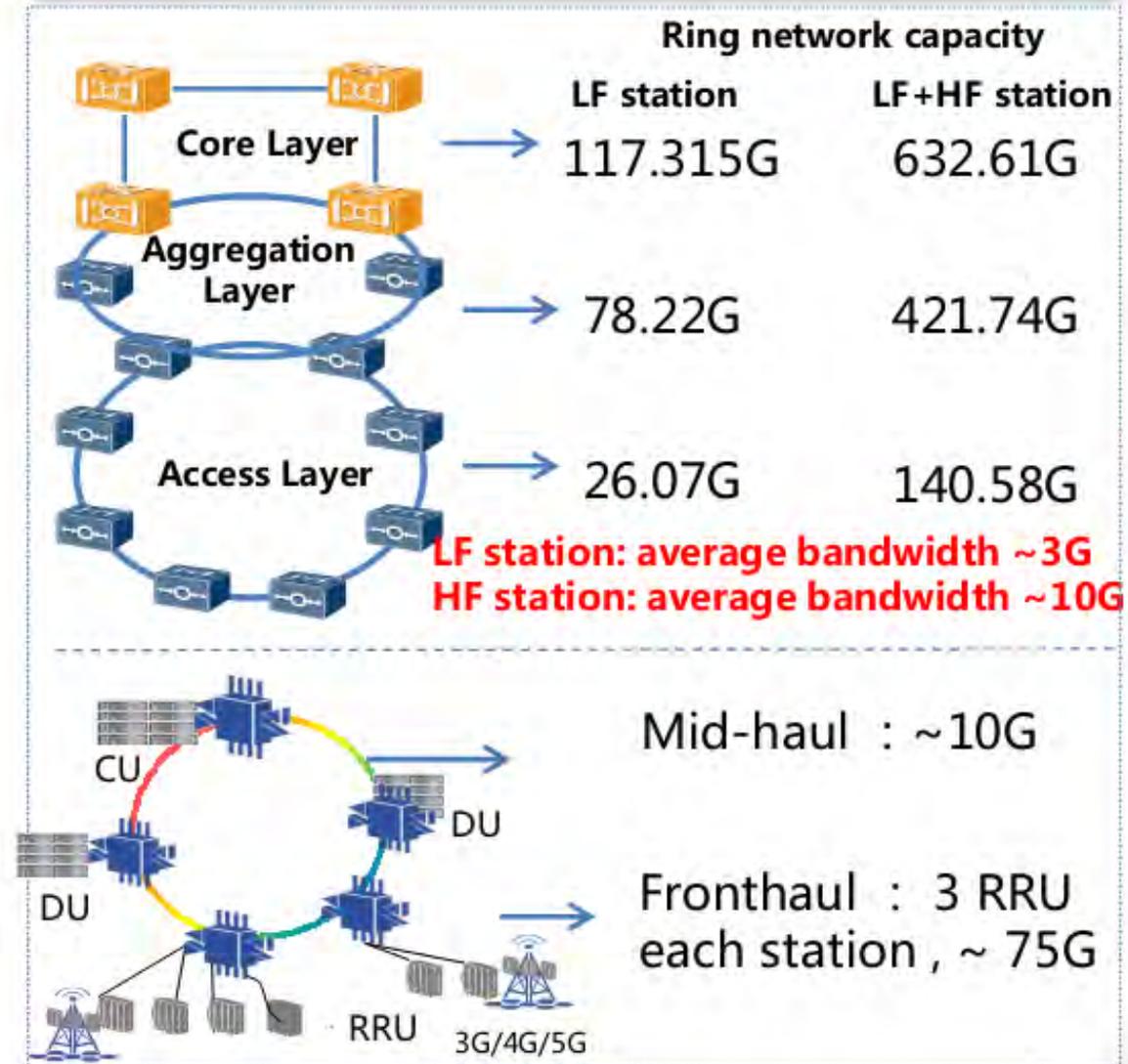
- In carrier network, 50GE is required in this case as service guarantee requirement

Overview and Forecast for 5G Backhaul Network from China Mobile

Families of usage scenarios for 5G



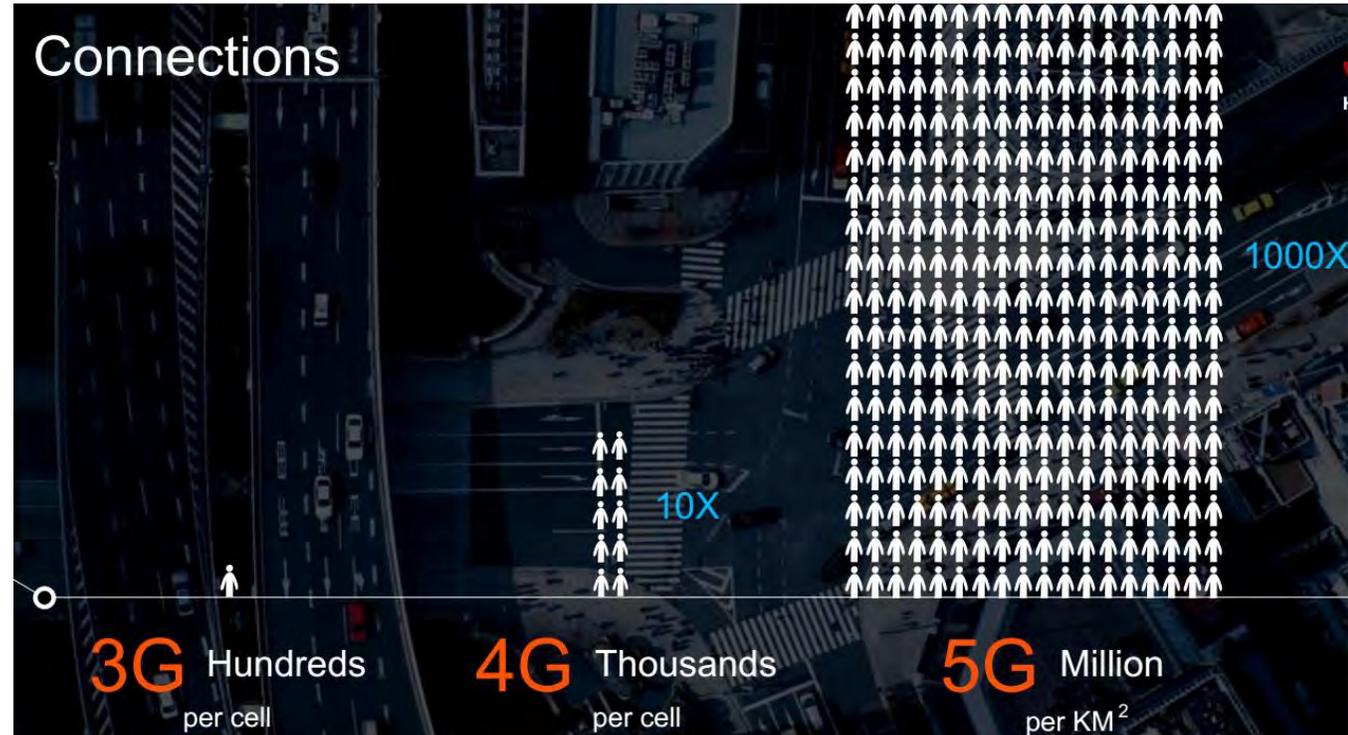
5G bandwidth estimation



Further Using 5G in Fixed Wireless Access (FWA) to Home

- ❑ Fixed Wireless Access, or FWA, is an established means of providing internet access to homes using wireless mobile network technology rather than fixed lines
- ❑ 5G in FWA is another potential access service as low cost and easy deployed

- ❑ In 4G era, thousands connections (subscribers) per cell are already deployed
- ❑ High volume connection than 4G in 5G 1st era with 50GE good enough at access ring

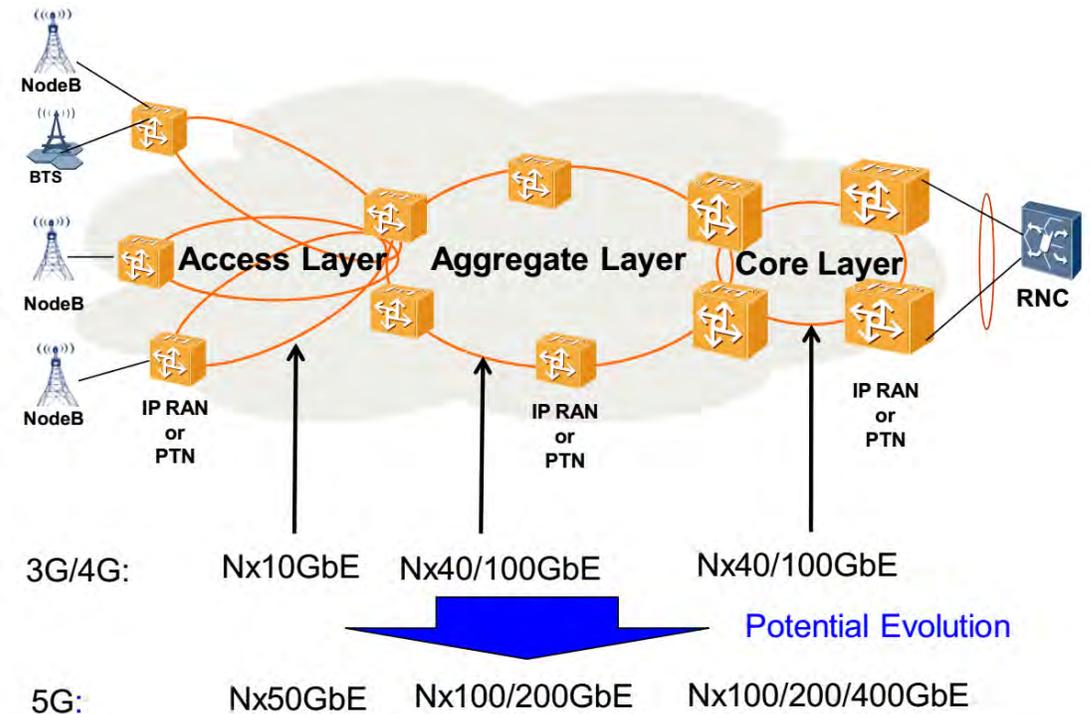


Why gaps in backhaul bandwidth comparing to number of subscribers?

- Low CAPEX for IP/Ethernet based IP/Ethernet network, WHY?
 - Yes, depend on low cost in hardware of whole network.
- “Statistical multiplexing” , aka “share resource” , is the key principle as oversubscribe from Access to Aggregate to Core layer with sharing the optical link, module, network equipment to achieve low cost

- Low CAPEX achieved from a system perspective to benefit industry from evolution of Pay-As-You-Grow.

- (4~8) :1 oversubscribe in Aggregate layer to connect Access layer with NX100/200GE,
- Core layer to connect Aggregate layer with NX100/200/400GE.



Beyond 10km Ethernet Optical PHY in Mobile Application

- Passive fiber link is popular in most mobile backhaul application with the following benefit:
 - Capability of plug-and-play, allowing to buy parts at the “store around the corner”, then install modules, connect fibers and it just works.
 - Compatible and smooth upgrade to previous deployed 10/40/100GE link as in “[huang_ecdc_01_0716](#)”

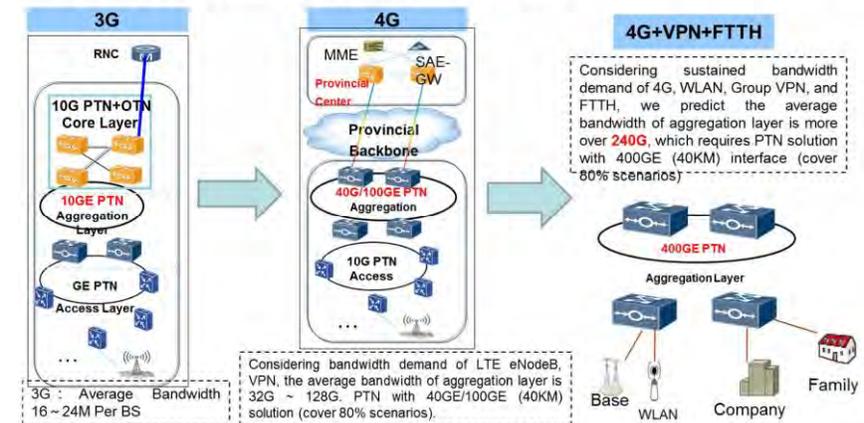
- Open question of using WDM to replace existing installed fiber infrastructure deployed by Ethernet P2P link?
 - Assume optical amplifier needed, allocating OA outside of optical module will require some slot of space, impact total available capacity of backhaul equipment
 - Manage WDM system in Ethernet will lead another new area to increase OPEX to end user

Link Scenario in Mobile Broadband Backhaul Network

Based on Ethernet technology, we choose PTN to build the mobile backhaul networks of China Mobile

Because backhaul network is in metro area, where is usually lack of OTN, most of link between PTN nodes are direct fiber connection

With the large scale deployment of TD-LTE, PTN is evolving from 10GE to 40GE/100GE, and we believe 400GE will be necessary in the near future



Summary

- With emergence 5G mobile backhaul networks require 50/200/400Gbps Ethernet links with up to 40 km reach
- Mobile backhaul network volume address broad market potential of B10K project
 - In addition to mobile backhaul, other business area such as Enterprise or Cloud access will also benefit from B10K PHYs
- Objective for Beyond 10km PHY can be met with following:
 - Provide physical layer specifications which support 50 Gb/s operation over at least 40km of SMF
 - Provide physical layer specifications which support 200 Gb/s operation over at least 40km of SMF
 - Provide physical layer specifications which support 400 Gb/s operation over at least 40km of SMF

