Ethernet Bandwidth Forecast in 5G Application

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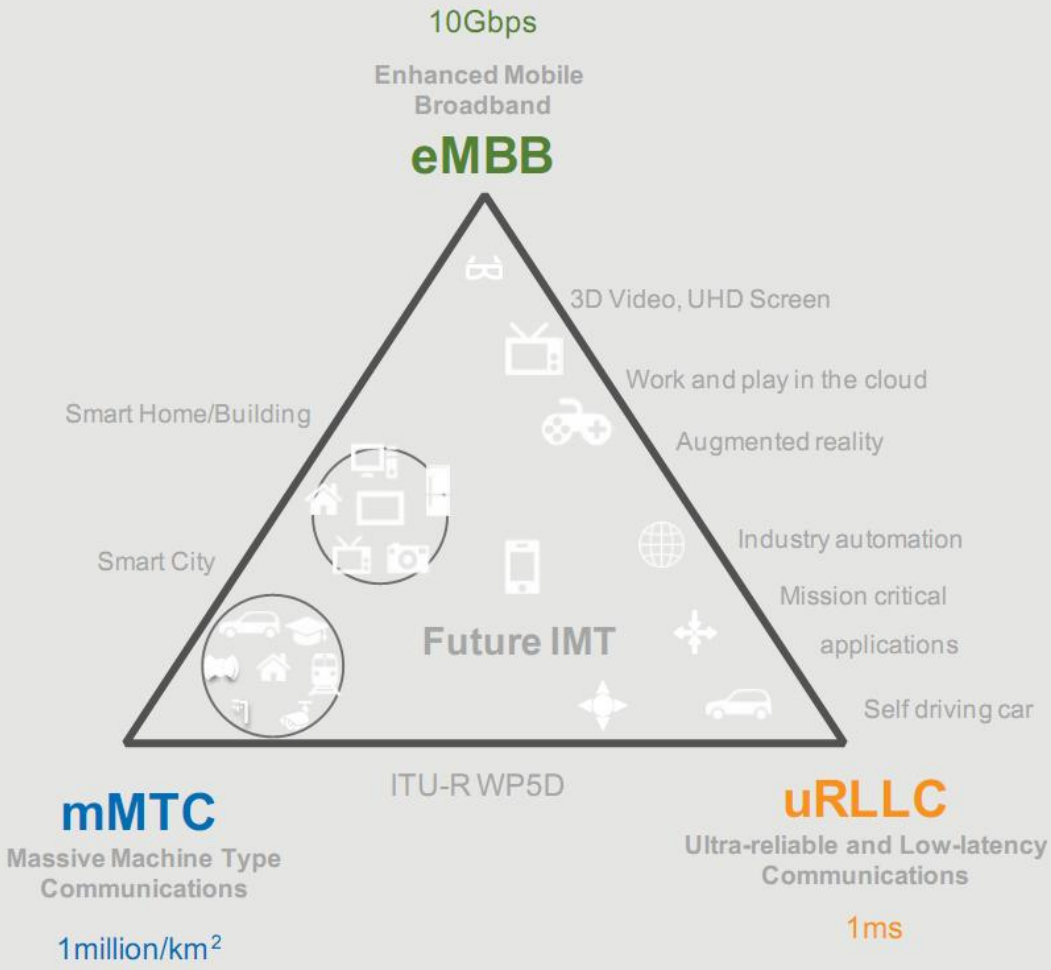
5G Mobile Network Services

- Enhanced Mobile Broadband (eMBB), such as:
  - High Definition (HD) videos with cloud storage
  - Virtual Reality (VR)
  - Augmented Reality (AR)
- Ultra-Reliable and Low-latency Communications (uRLLC), such as:
  - Assisted and Automated driving
  - Remote management
- Massive Machine Type Communications (mMTC), such as:
  - Smart city
  - Smart agriculture

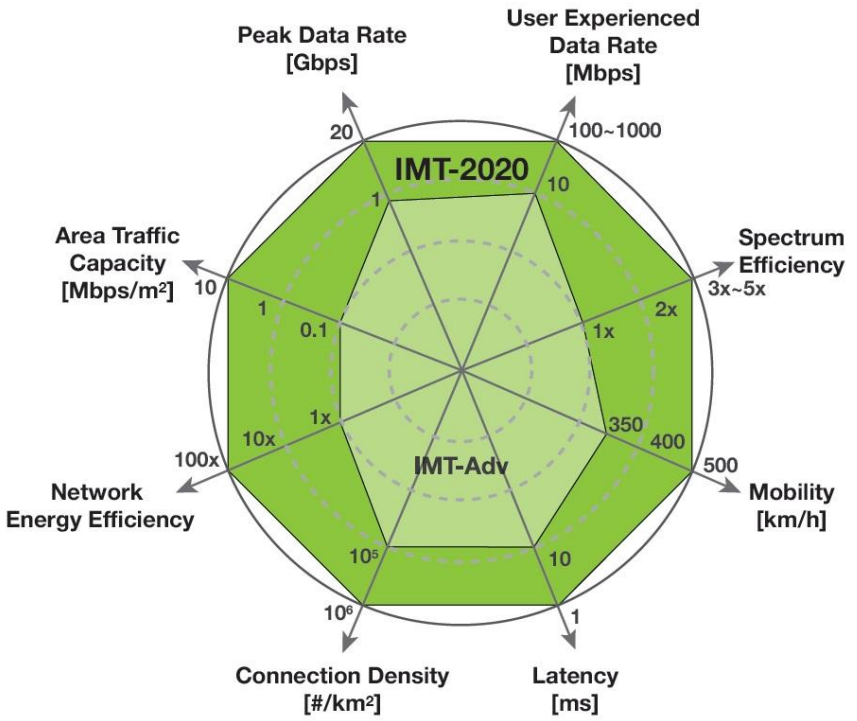
http://www.huawei.com/minisite/5g/img/5G_Nework_Architecture_A_High_Level_View_en.pdf

5G Mobile Network Services(Cont'd)

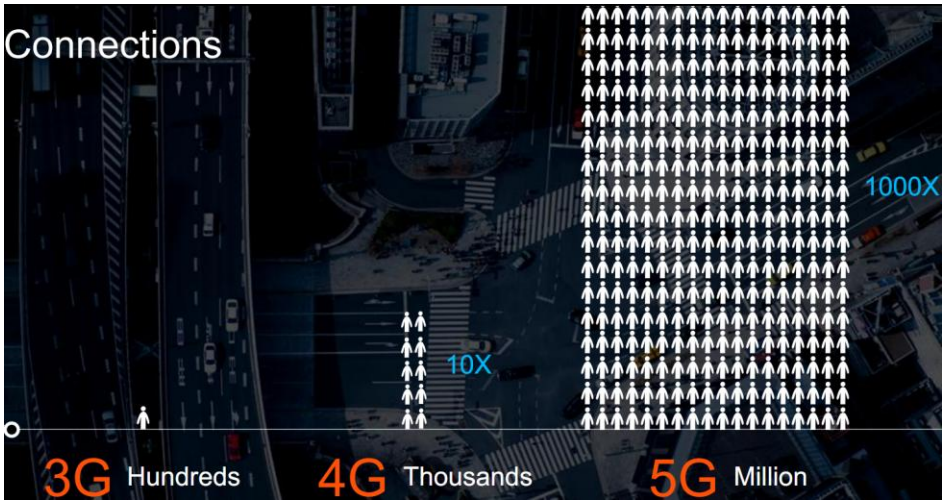


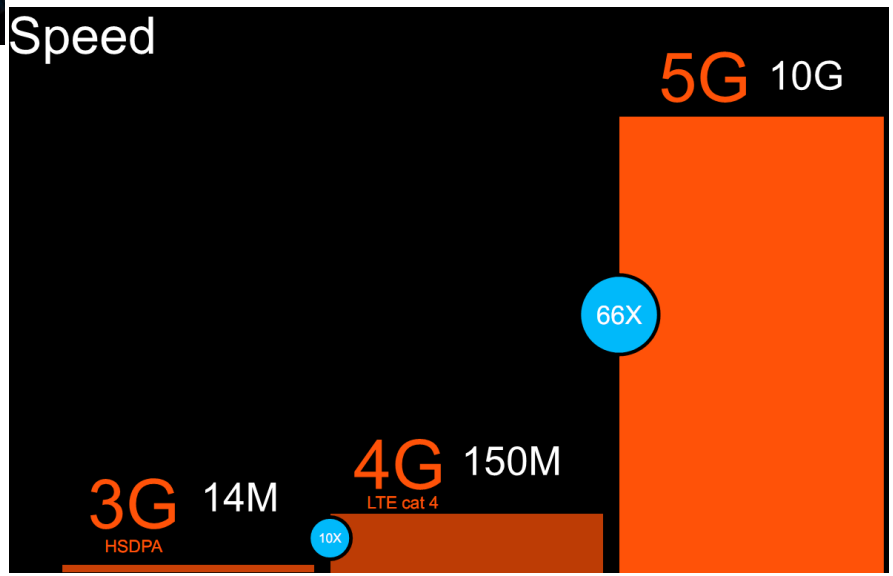
Challenges of 5G Application

- To meet the preceding requirements, 5G should have the following performance advantages over existing 4G mobile communication technologies:
  - 100 billion connections
  - 1 ms latency
  - 10 Gbps throughput



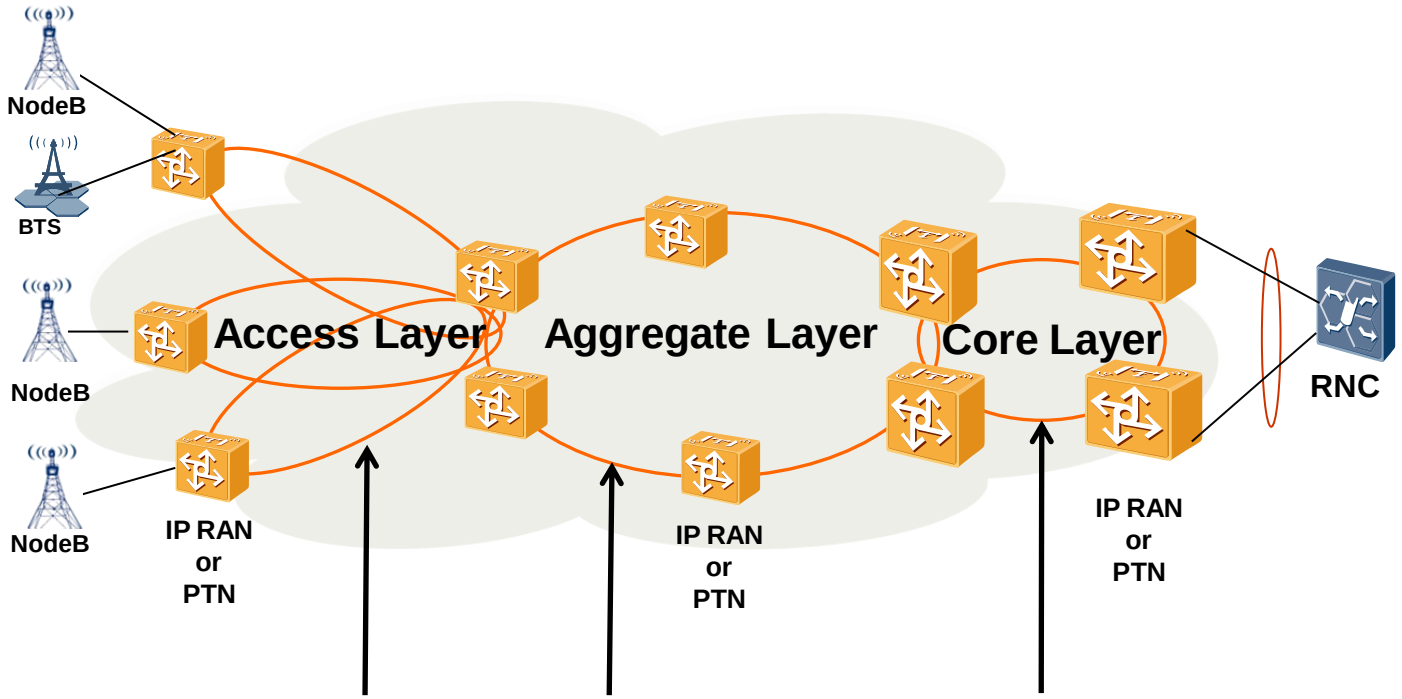
5G KPI Comparing to 3G/4G





http://www.huawei.com/minisite/5g/img/5G_Road%20to%20a%20Super-Connected%20World(Ken%20Hu%20MWC15%20Keynote)_final.pdf

Bandwidth in 5G Mobile Backhaul Network



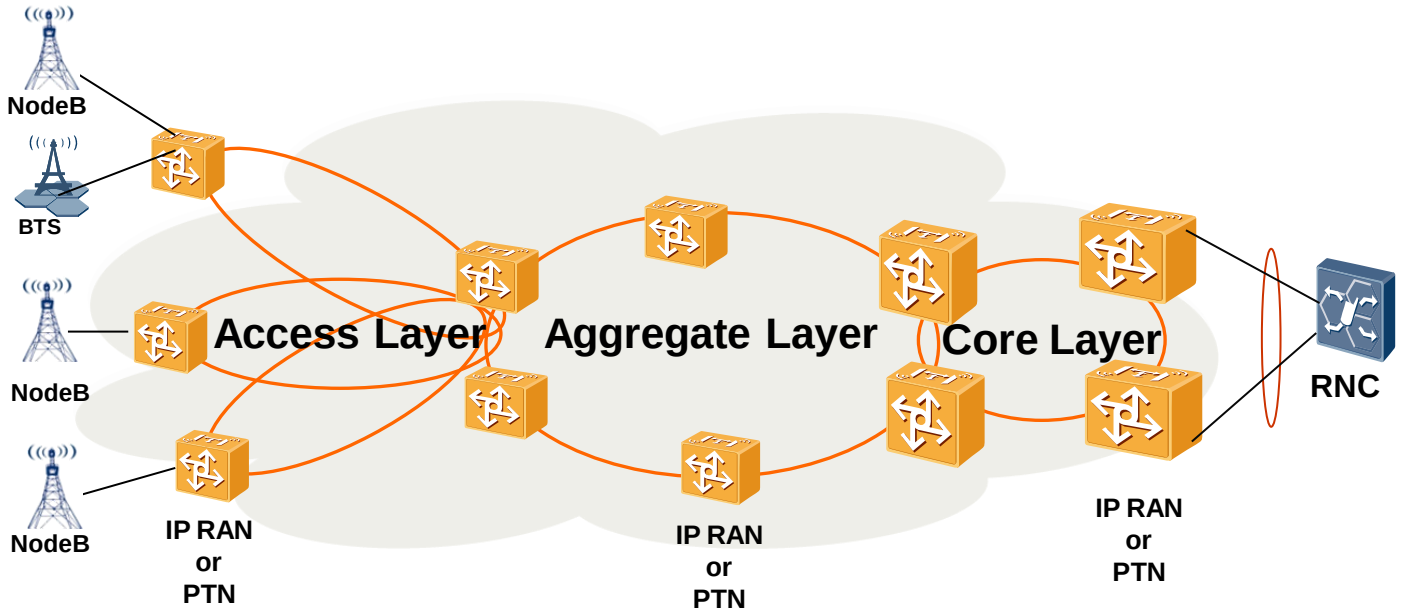
3G/4G: Nx10GbE Nx40/100GbE Nx40/100GbE

Potential Evolution

5G: Nx50GbE Nx100/200GbE Nx100/200/400GbE

Based on 1G average user date rate and
>50% compound annual traffic growth rate

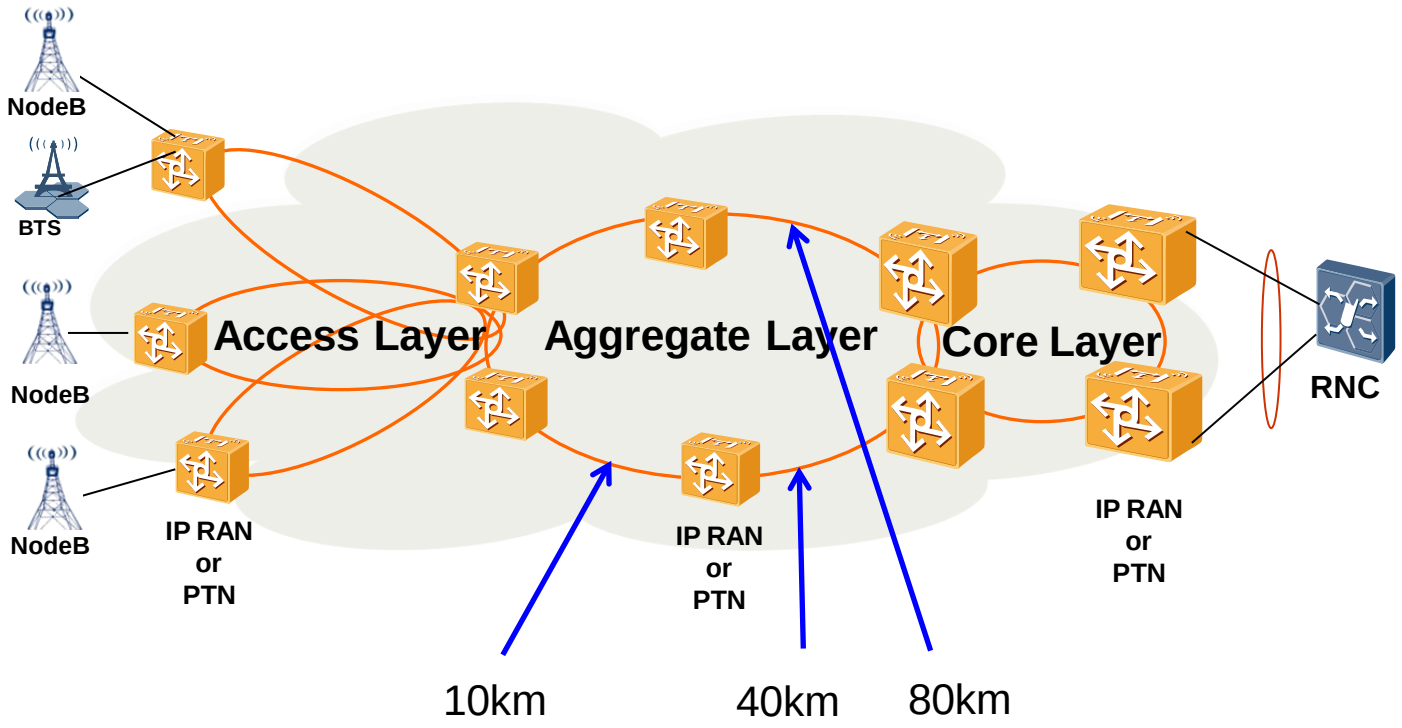
40km Reach in Mobile Backhaul Network



- In huang_ecdc_01_0716 and observation from shipment in Carrier network, 40km volume is increasing

Statistics for 10GE & 100GE Modules used in PTN, as of June, 2016				
Transmission Distance	**<2km**	**10km**	**40km**	**80km**
10GE distribution	0.28%	44.46%	44.05%	11.20%
100GE distribution (more than 15K modules)	0	56.43%	34.59%	8.97%

Multi Reach to Construct Mobile Backhaul Network



- Take aggregate layer as example:
  - To deployed 50/200GbE, all of 10/40/80km optical PMDs is required to enable ring topology
  - 40km reach standard is contributed to expand optical module eco-system based on 10km solution

Copy from "Report: IEEE 802 EC 5G/IMT-2020 SC"

Action A – IEEE 802 Access Network

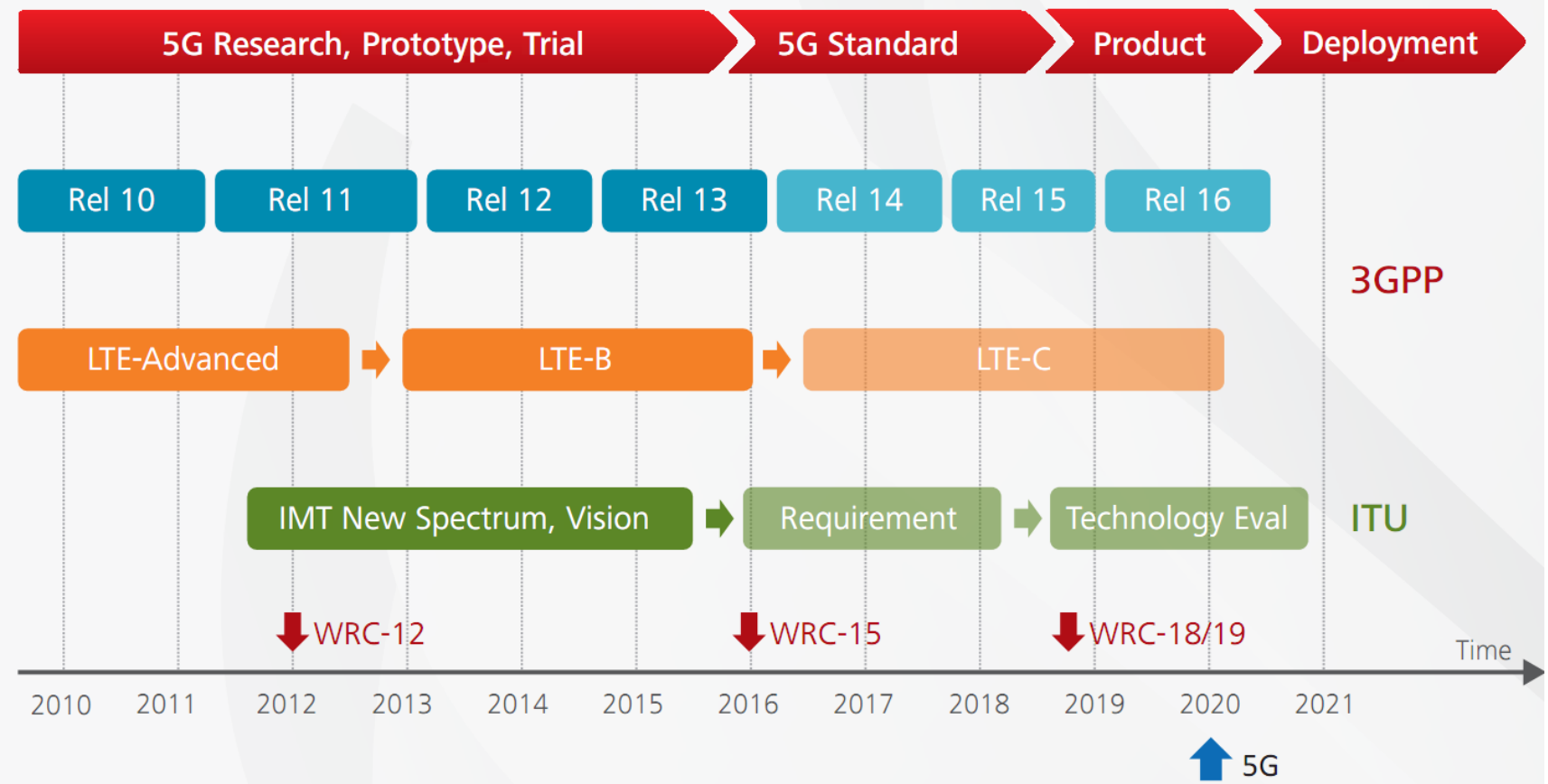
Objective
Adoption of IEEE 802 Access Network specification in multiple disparate operator networks.

Description
Specify an IEEE 802 Access Network, incorporating IEEE 802 MAC/PHYs and supporting standards, with a unified interface to end-to-end networks. Promote standardization of the integration of the IEEE 802 Access Network into end-to-end networks.

Strength	Weakness	Opportunity	Threat
1. Builds on traditional 802 presentation of interface to support many networks	1. Could require compromises in the support of any specific network	1. Can be applied in both 3GPP networks and in alternative networks	1. Coordination efforts required– may not be accepted
2. Enhances interoperation with identified end-to-end networks	2. Requires liaison activity to coordinate interface requirements.	2. Offers an advantage for end-to-end networks to use 802	2. Specifications may come too late or under-perform
3. Could be leveraged to promote spectrum for non-IMT systems; e.g. WAS	3. May require development of uses cases and requirements	3. Increases value of the entire range of 802 MAC/PHYs; could support spectrum expansion	3. Non-802 technologies may be used at the specified interface

Cost	Benefit
IEEE 802 needs to develop Access Network spec; 802 MAC/PHYs may need to develop new amendments; external ecosystems need to be developed	Makes IEEE 802 the central player in heterogeneous access and in access networks for 5G of all forms; IEEE has no responsibility to specify end-to-end

5G Roadmap and Timeline



- To match 5G filed trial and early deployment, 40km Ethernet standard is suggested to be started in 802.3 right now

Summary

- 5G bandwidth forecast provide broad market potential for 50/200/400GbE standard
- In case of 5G deployment and time line, 40km reach in IEEE 802.3 50/200/400GbE standard is needed in near future

Thank You