“Beyond 10km” Optics Strawman (CFI) “The Need”

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Introduction

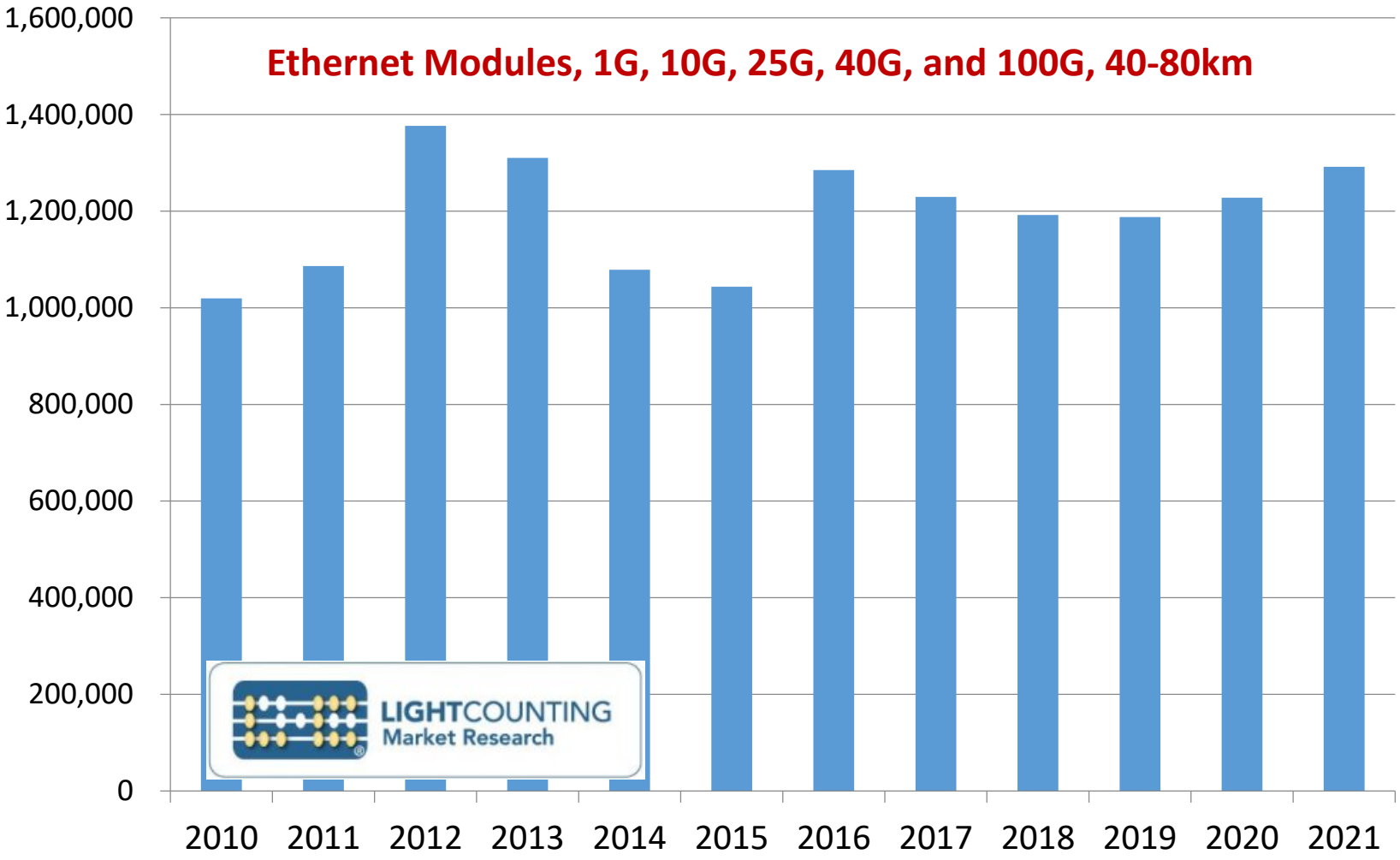
- This presentation will focus on “The Need” of a strawman / starting point for a CFI Proposal on “Beyond 10km Optics.”

Reminder – Objective for a CFI Consensuus Meeting

- To *measure the interest* in starting a study group to address *Beyond 10 km Optical PMDs*
- We don't need to
  - Fully explore the problem
  - Debate strengths and weaknesses of solutions
  - Choose any one solution
  - Create PAR or five criteria
  - Create a standard or specification
- Anyone in the room may speak / vote
- RESPECT… give it, get it

“The Need for Optical PMDs Beyond 10km”

Extended Reach Ethernet Modules



- Totals are for merchant supplier shipments. Captive supply could add another half-million units.
- SONET 40-80km shipments represent another half-million units in 2016. SONET is transitioning to Ethernet.
- For 100GbE, 40km, LightCounting projects a market that will roughly triple in value from 2017 to 2021.
- Data courtesy of Dale Murray, Light Counting

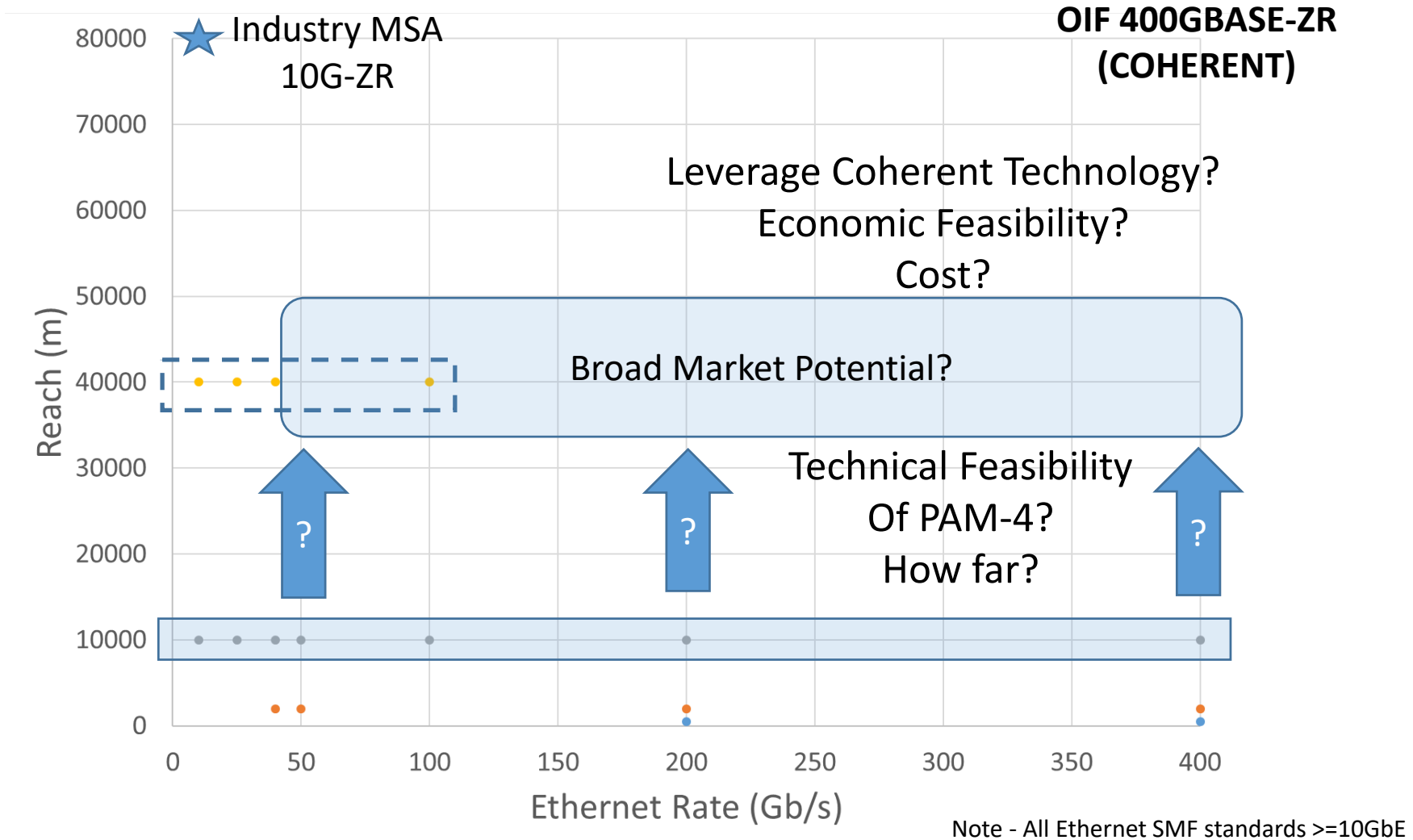
The Need for Optics Beyond 10km Reach

- Data presented to data has highlighted
  - 50GbE – campus / metro interconnect (wang_ecdc_01_0716) – offers 2x speed increase over 25GbE
  - Mobile Backhaul Networks 200GE & 400GE for metro transport aggregation layer network (zhao_ecdc_01_0716)
    - 4G / 5G
  - Inter-building Usage (>10km, 40km, 80km)
    - Example – MSK-IX (dambrosia_ecdc_01_0516)
    - Example - Metro Data Center Interconnect (booth_ecdc_01_0716)

State of IEEE 802.3 Ethernet P2P SMF Standards

		10GbE	25GbE	40GbE	50GbE	100GbE	200GbE	400GbE
500m	10G	-	-	-	-	-	-	-
	25G	-	-	-	-	-	-	-
	50G	-	-	-	-	-	4X50G	-
	100G	-	-	-	-	1X100G	-	4X100G
2km	10G	-	-	-	-	-	-	-
	25G	-	-	-	-	-	-	-
	40G	-	-	1X40G	-	-	-	-
	50G	-	-	-	1X50G	-	4X50G	8X50G
	100G	-	-	-	-	-		
10km	10G	1X10G	-	4X10G	-	-	-	-
	25G	-	1X25G	-	-	4X25G	-	-
	50G	-	-	-	1X50G	-	4X50G	8X50G
	100G	-	-	-	-	-	-	-
40km	10G	1X10G	-	4X10G	-	-	-	-
	25G	-	1X25G	-	-	4X25G	-	-
	50G	-	-	-	-	-	-	-
	100G	-	-	-	-	-	-	-
	Note	Standard in development						

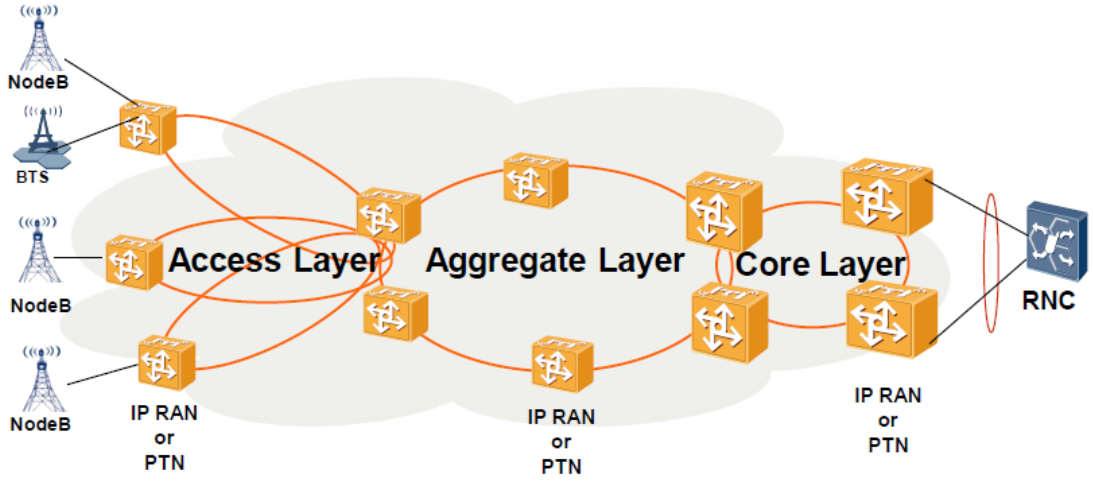
The Industry State of Ethernet P2P Links



Note - All Ethernet SMF standards >=10GbE (completed or in progress) shown.

Example - Mobile Backhaul Networks

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%

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Source: Xinyuan Wagng Huawei, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_09/wang_ecdc_01_0916.pdf

Carrier Input

Present status and forecast

• According to our survey, long distance module is a mandatory requirement for us

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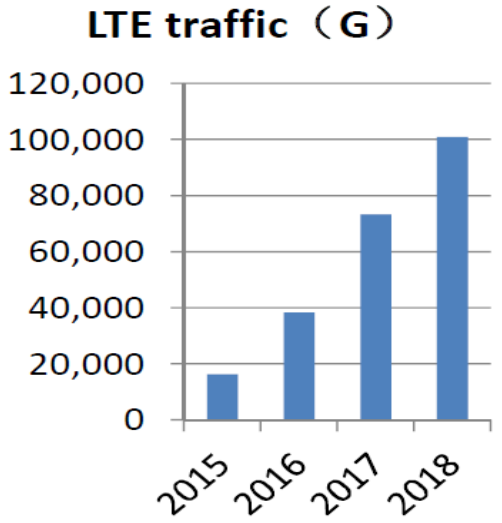
• According to the increase of LTE traffic, as LTE backhaul network, PTN will face 4~5 times traffic in 2017 or 2018.

• Then we will have to use 400GE interface in the same scenario and take the same percentage with 100GE and 10GE.

• In 2018~2019, we expected the requirement for 400GE ER modules will be more than 10K.



Source: Huang/ Cheng, China Mobile, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/huang_ecdc_01_0716.pdf

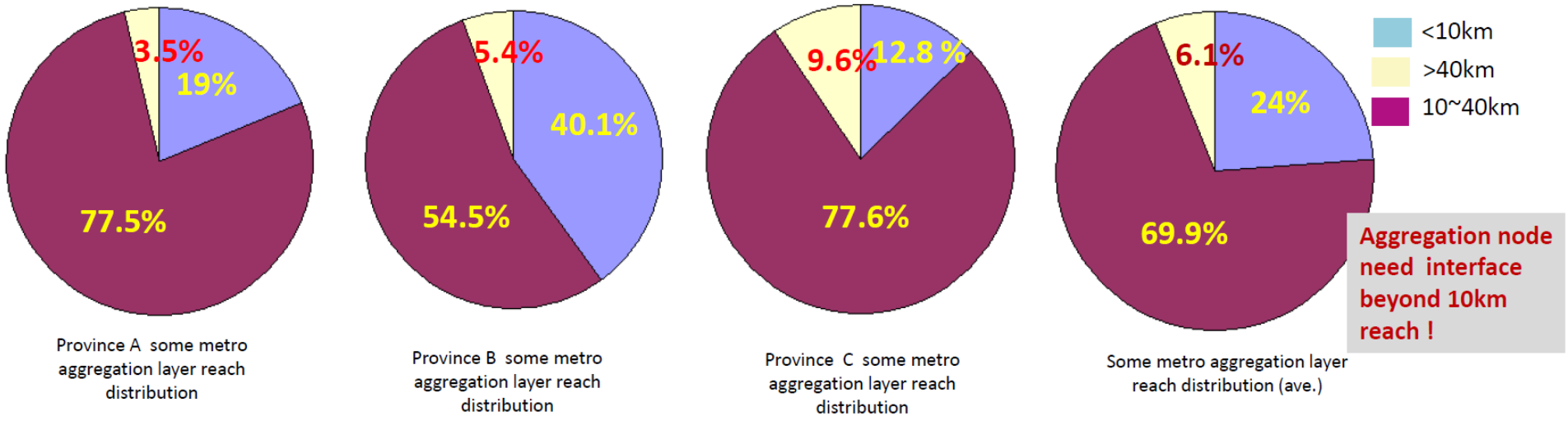
Carrier Input – Reach Targets

CAICT 中国信通院

Aggregation node distance from actual networks

As metro core usually use WDM/OTN to extend reach distance of Ethernet interface, therefore current aggregation layer transmission distance is crucial to the future higher bitrate interface, such as 200GE and 400GE,etc.

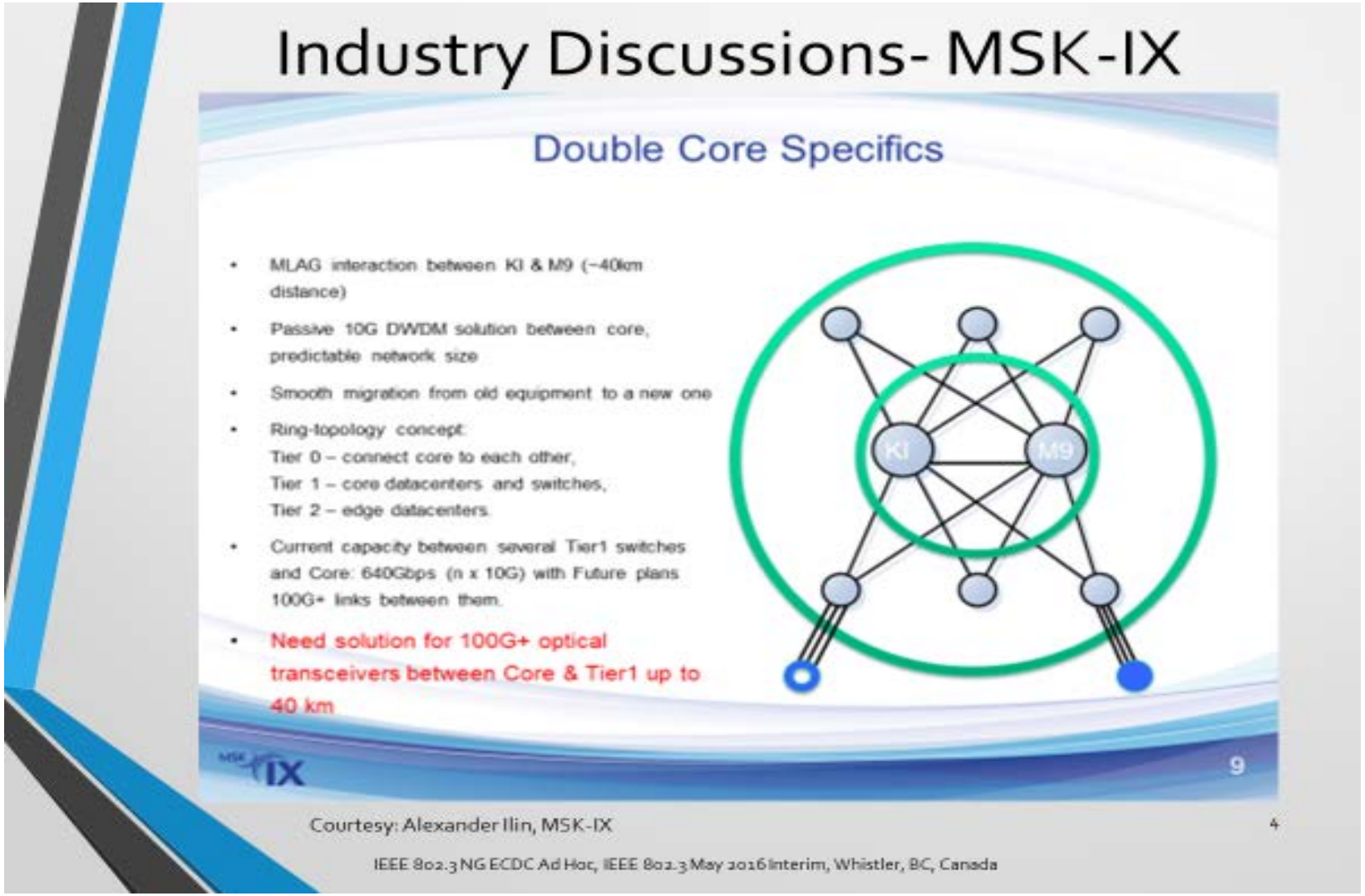
Furthermore, each metro network may has its own distribution characteristic of reach distance, and some metro aggregation layer node distance from actual networks in China are investigated, and these nodes would has the requirement to deploy link capability more than 10GE.



Source: Wenyu Zhao, CAICT<
http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/zhao_ecdc_01_0716.pdf

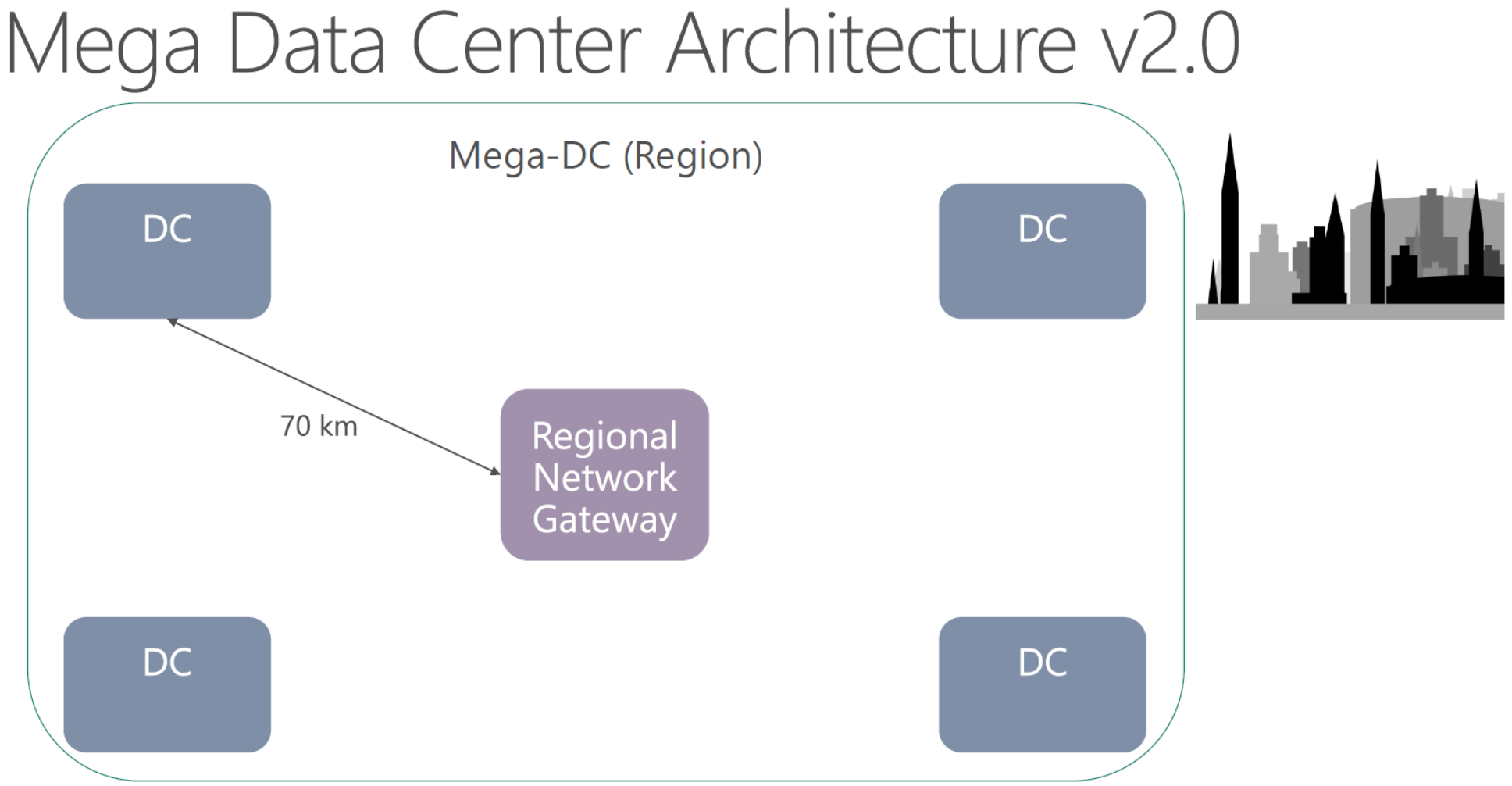
IEEE 802.3 NG-ECDC Ad Hoc, July, 2016 , San Diego

Example - Inter-Building Connections



Source: John D'Ambrosia, Futurewei, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_05/dambrosia_ecdc_01_0516.pdf

Example - Regional Data Center Architecture



Source: Brad Booth, Microsoft, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/booth_ecdc_01_0716.pdf

Backup –
Mobile Bandwidth Drivers

Re-visiting Cisco VNI*

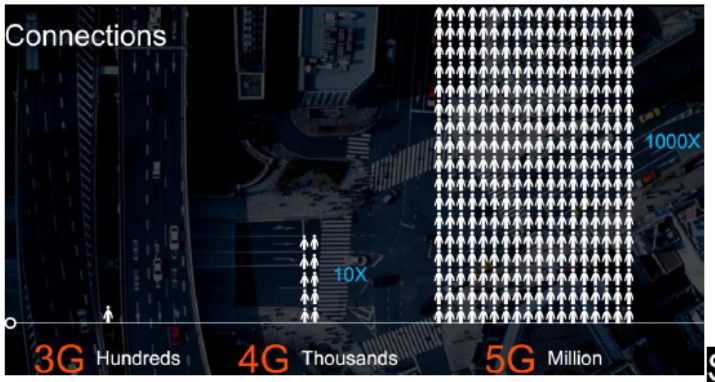
- Some interesting global forecasts
  - Mobile data traffic (2015 – 2020)
    - 8x growth – 53% CAGR
    - 30.6 Exabytes/ month (up from 3.7 Exabytes)
    - Avg mobile connection 3326 megabytes / month (up from 495 megabytes)
    - Video 75% of global mobile data traffic (up from 55%)
  - Smart Phones (2015 – 2020)
    - 5.6 billion (up from 3.0 billion)
    - Average 10.5GB / month (up from 2.0GB)

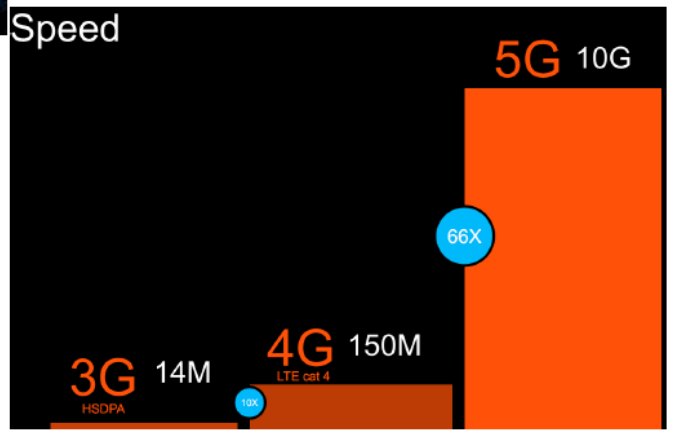
- Clearly something is up and Ethernet needs to be prepared.

*Source: http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html

Comparing Mobile Generations

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

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Source: Xinyuan Wang, Huawei, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_09/wang_ecdc_01_0916.pdf

5G Mobile Network Services

- Enhanced Mobile Broadband
  - HD Video
  - 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

Network Bandwidth Required of VR

- Bandwidth needed of 4K/8K video and VR depend on Quality requirement
  - Typical Video Bit Rate = (Resolution × Bits per Pixel × Frame per Second) ÷ Compression
  - Bandwidth Requirement = Typical Video Bit Rate × 1.5

VR Quality	Entry-Level VR	Advanced VR	Ultimate VR
Video Resolution	360-degree 4K 2D (3840*1920)	360-degree 12K 2D (11520*5760)	360-degree 24K 3D (23040*11520)
Resolution per Eye	960*960, FOV 90° Using low-price VR glasses	3840*3840, FOV 120° Using professional VR headset	7680*7680, FOV 120° Using professinal VR headset
Bits per Pixel	8	10	12
Compression Ratio*	120	150	200(2D), 350(3D)
Frames per Second	30	60	120
Typical Video Bit Rate	15Mbps	265Mbps	2.18Gbps
Bandwith Requirement**	25Mbps	398Mbps	3.28Gbps
*Assuming H.265 encoding. Numbers are based on experience. The compression ratio for 3D video is higher because the contents for two eyes are highly correlated.			
**Typical bandwidth requirement is 1.5x video bit rate, based on experience and test.			

- Multiple subscribers per site to statistics multiplex on Ethernet interface in Backhaul network

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Source: Xinyuan Wang, Huawei, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_11/wang_ecdc_01a_1116.pdf