

Update of Ethernet Bandwidth Forecast in 5G Application

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Background

- In “[wang_ecdc_01_0916](#)”, exploring Ethernet bandwidth forecast in 5G application from following aspect
 - Mobile Network Services, Virtual Reality (VR) application as example
 - KPI: Key performance indicator
 - Evolution of mobile backhaul network

- As Q&A in Fort Worth meeting, try to further clear some question:
 - User’s application to drive high bandwidth demand
 - CPRI Interconnection
 - Traffic forecast of Mobile backhaul network

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 professional 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
Bandwidth Requirement**	25Mbps	398Mbps	3.28Gbps

*Assuming H.265 encoding. Numbers are based on experience.

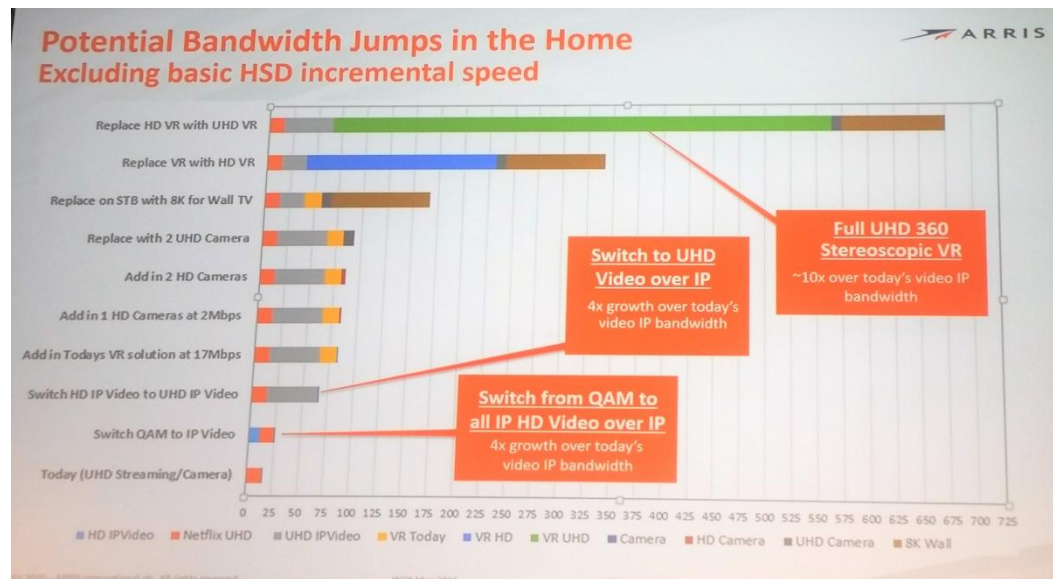
The compression ratio for 3D video is higher because the contents for two eyes are highly correlated.

**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

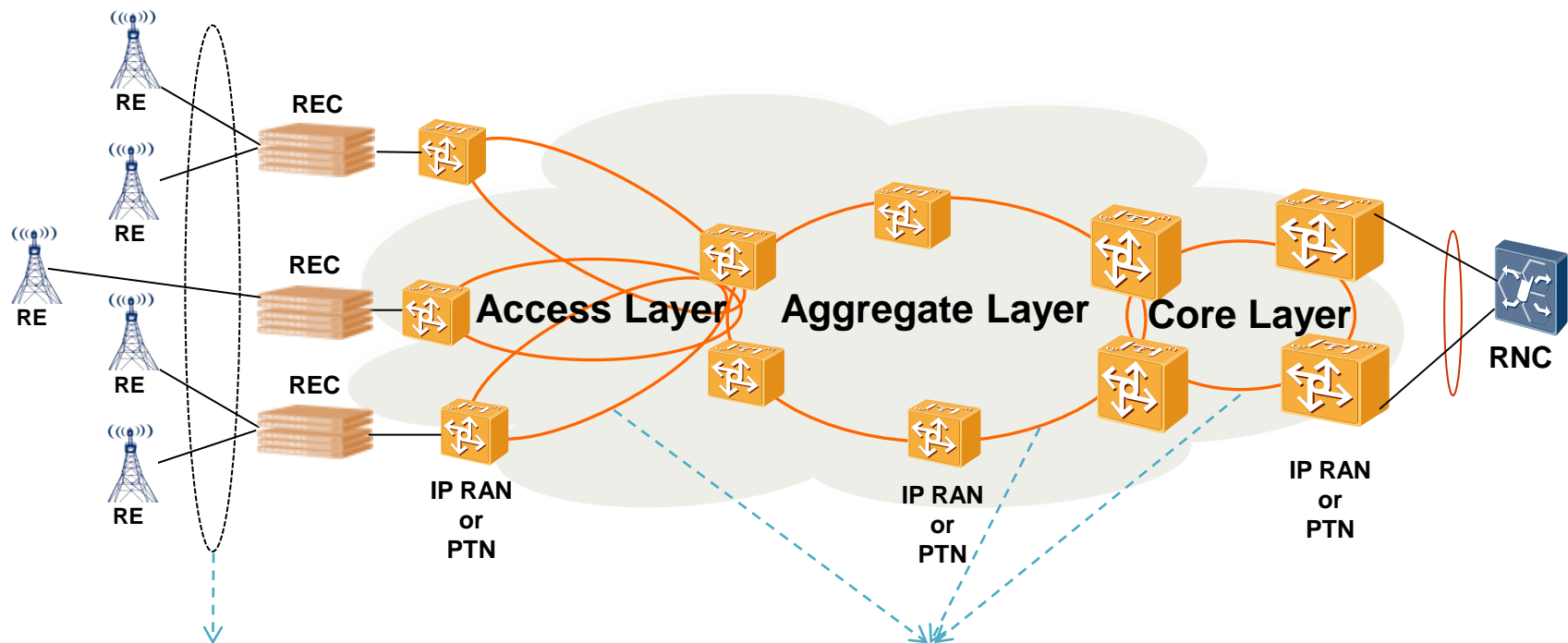
Network Bandwidth Required of VR

- ARRIS CTO Cheevers estimates that a VR game in 720p will require 50 Mbps, and a 4K VR game (do they exist yet?!) will need 500 Mbps. “So maybe VR is the one that drives the need for gigabit speeds, gigabit Wi-Fi and all that stuff,”.



<http://www.onlinereporter.com/2016/06/17/arris-gives-us-hint-bandwidth-requirements-vr/>

5G Bearer Network Based on IP/Etherent



CPRI interface:

Common Public Radio Interface

Backhaul Network:

IP/Ethernet interface and statistics multiplexing

Bandwidth of CPRI interface in 5G

- For CPRI interface with Digitalized radio signal connecting RE(Radio Equipment) to REC(Radio Equipment Control) in Centralized RAN
- IEEE Communications Magazine(February 2016) “[An Overview of the CPRI Specification and Its Application to C-RAN-Based LTE Scenarios](#)”
 - CPRI Technical Working Group already define upto 24330.24Mbps
 - Moreover, the upcoming 5G RANs, where 100 MHz channels with massive MIMO are envisioned, may require several tens or even hundreds of gigabits per second capacity in the fronthaul . As an example, an 8X8 MIMO Antenna covering four sectors produces 32 AxCs, which translate into around 32 Gb/s for 20 MHz bandwidth channels. In the case of 100 MHz LTE channels, this same scenario requires five times (i.e., 160 Gb/s) the previous CPRI bandwidth.
- Per critical latency requirement for CPRI with no more than ~100us, 10km reach is most popular. Extending to 40km reach is also interested by some carrier

New CPRI Specification: eCPRI

- “Industry leaders agree to develop new CPRI Specification for 5G”
- The target of the eCPRI Specification is to offer several advantages to the base station design:
 - The new split point enables ten-fold reduction of the required bandwidth
 - Required bandwidth can scale flexibly according to the user plane traffic
 - Use of main stream transport technologies like Ethernet will be enabled
 - The new interface is a real time traffic interface enabling use of sophisticated coordination algorithms guaranteeing best possible radio performance
 - The interface is future proof allowing new feature introductions by SW updates in the radio network
- Per forecasting huge bandwidth of CPRI, expecting eCPRI to further lower bandwidth requirement on link, 50/100/200/400GbE is still needed

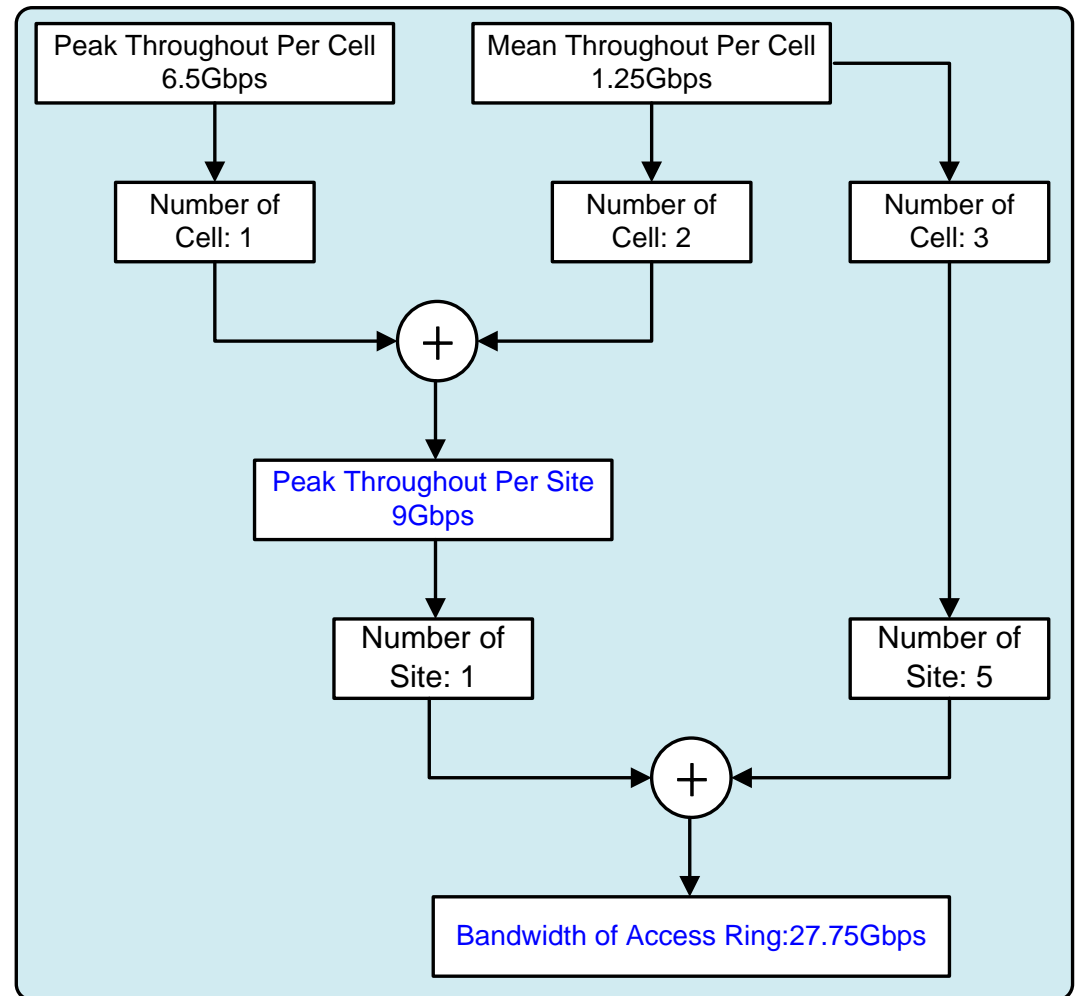
Bandwidth in Access Ring of 5G Mobile Backhaul Network

- 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

Summary

- This contribution give more information for future 5G requirement for mobile bearer network
- 50GE in access ring of mobile backhaul and deducing 100/200/400GE in aggregate/core ring
- 40km reach in IEEE 802.3 50/200/400GbE standard is needed for 5G telecom application

Thank You