#CloudRAN

How to Achieve Full-Blown Cloud RAN

An IHS Infonetics Webinar Co-produced with Fujitsu and SOLiD

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This Webinar Will Begin Shortly

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Today's Speakers

#CloudRAN

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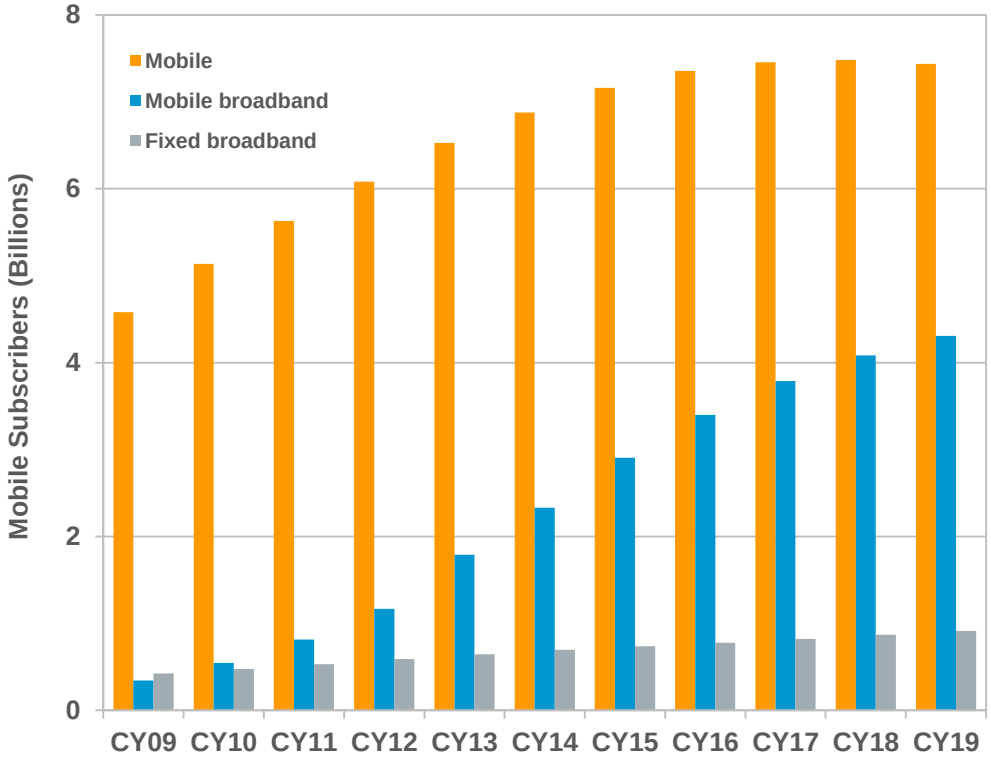
IHS

#CloudRAN

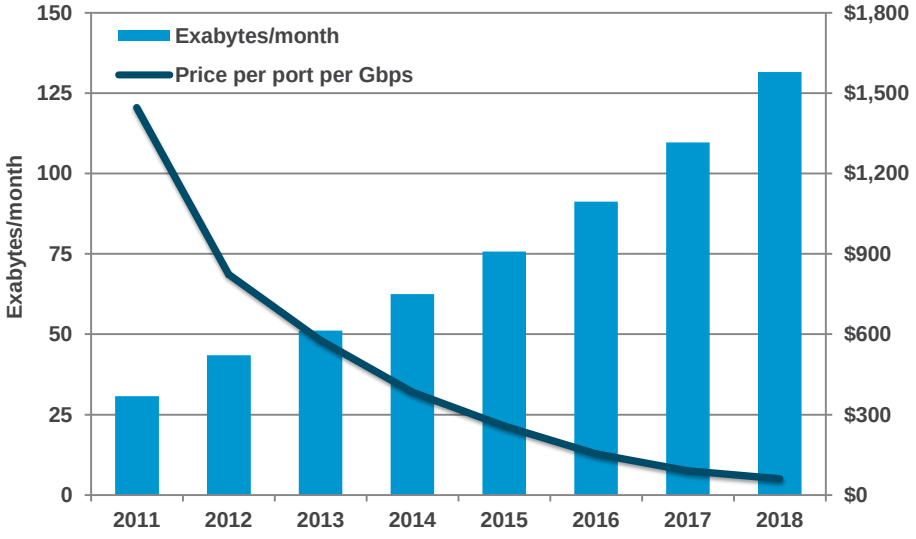
1. **Market Trends**
2. Challenges on the Path to Cloud RAN
3. New Options and Solutions
4. Cloud RAN Deployment Options
5. Sponsor Approaches
6. Conclusions
7. Audience Q&A

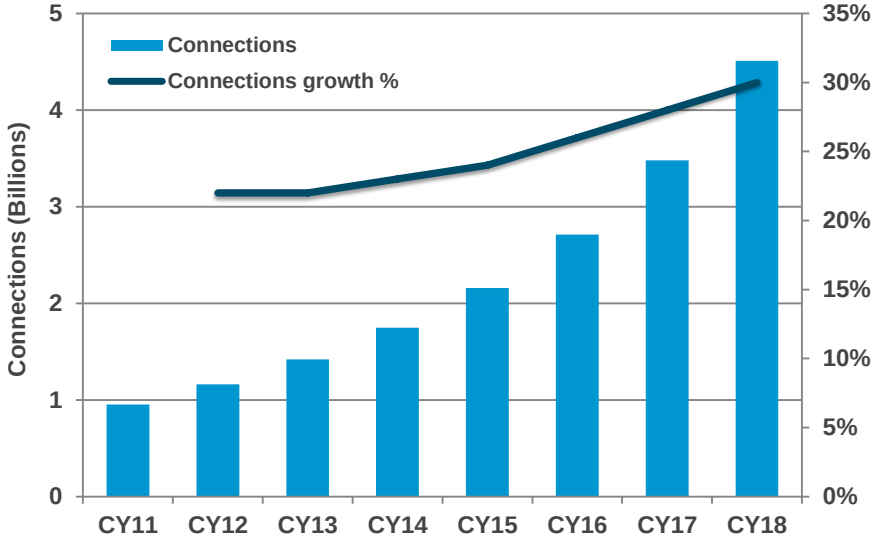
>4 Billion Mobile Broadband Subscribers by 2019

- True 4G (LTE-Advanced) commercially launched in South Korea in 2013, now ramping globally
  - 5GPP launched Dec. 2013, commercial service planned for 2020
- Mobile penetration likely to exceed worldwide population (>7.2 billion today) by 2016
- Adding further fuel to the demand for mobile and fixed broadband services is the fast-rising M2M (machine-to-machine) segment



Traffic Keeps Growing, Outstripping Constantly Dropping Transport Cost; M2M Opens New Chapter





- The cost of the telecom equipment used to transport is dropping 38% a year, and traffic is climbing 21% annually -- and all of this driven by video traffic, which is both a challenge and an opportunity
- M2M brings new impact on traffic: 4.5B connections in 2018 on top of more than 7B mobile subscriptions!

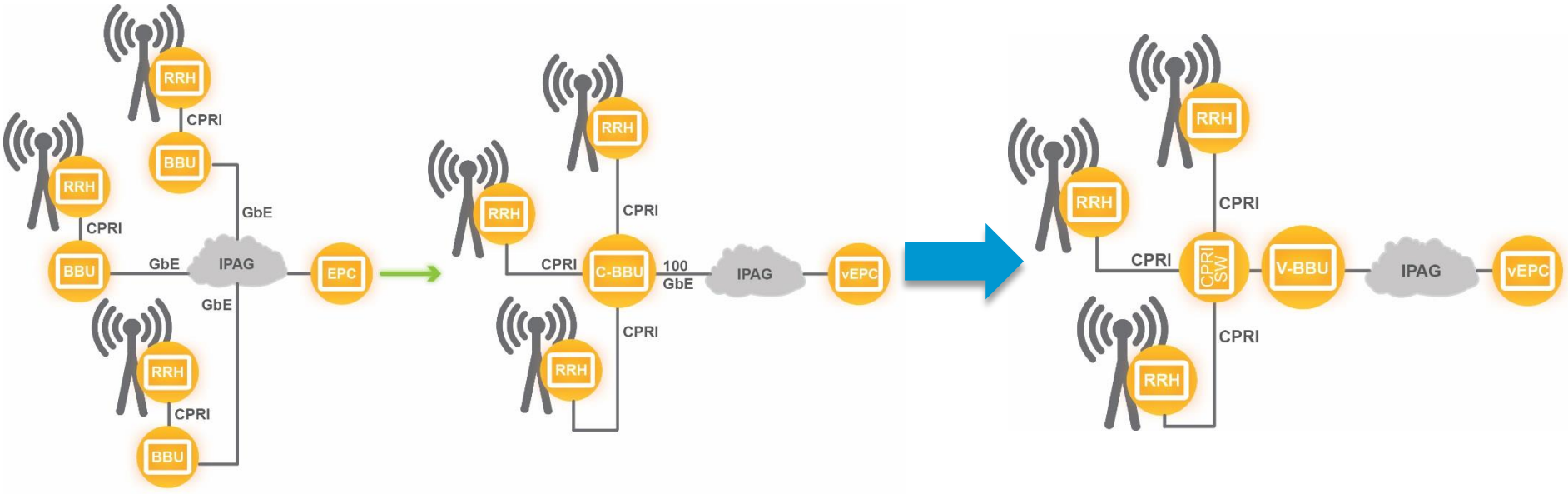
Therefore, RAN Needs to Be Re-architected

Moving to centralized and cloud RAN, which is not ready for prime time!

Current RAN

Centralized RAN

Cloud RAN



Source: IHS Infonetics C-RAN Architecture Equipment Market Share, Size, and Forecasts, June 2015

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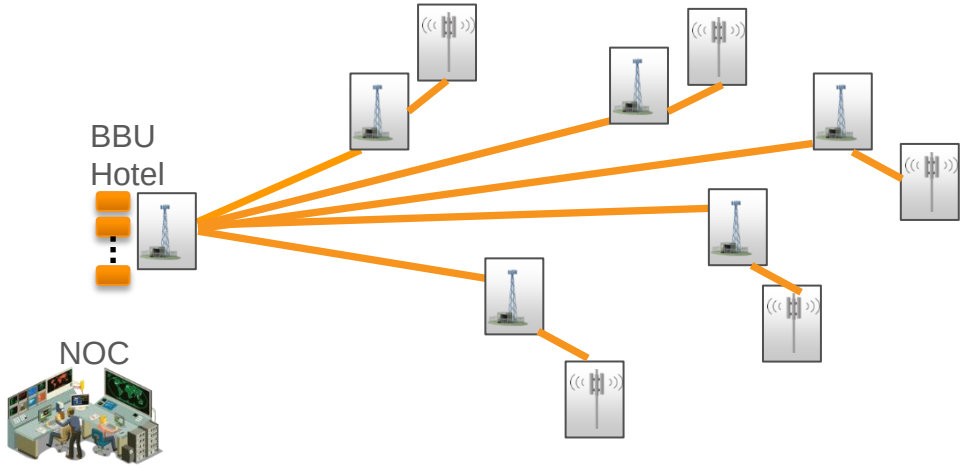
RAN Needs to Evolve; Question Is How?

- **It is clear that bandwidth demands are going up**
  - This is a good thing as long as operators can monetize this demand
  - Ideally revenues per user go up -- for example, by introducing new services -- but this is not simple
- **At the same time, costs need to go down**
  - Increasing competition -- and in some cases, regulation -- can put pressure on prices
  - One possibility is to share infrastructure (and thus cost) between operators
- **Technologies are evolving – RAN is a competitive advantage!**
  - For example: next gen LTE and/or 5G, small cells, HetNet, SDN/virtualization, MIMO, fiber/μwave
  - Goal: leverage new technologies such that performance improves, cost reduces, and that are future proof
- **Key questions**
  1. What is right direction? Many point to C-RAN, but there are different versions and needs differ as well
  2. How do we go from A to Z? Creating a step-by-step migration path that reduces risk and cost

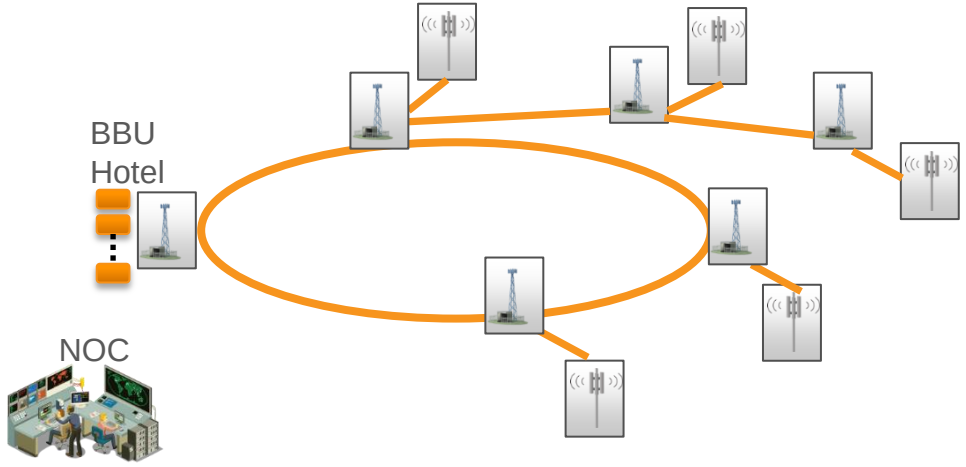
Mobile Network Operator Challenges Migrating to C-RAN



C-RAN hub & spoke network

- Verify latency budget between BBU and RRH
- Need remote visibility back to NOC
- Need diverse topology support and scaling flexibility
- Need to scale for small cell deployment

More MNO Challenges



C-RAN hybrid network: ring with linear segments

- Maintain resilient, high availability network
- How do they deal with low quality fiber
- C-RAN deployment when DF not available

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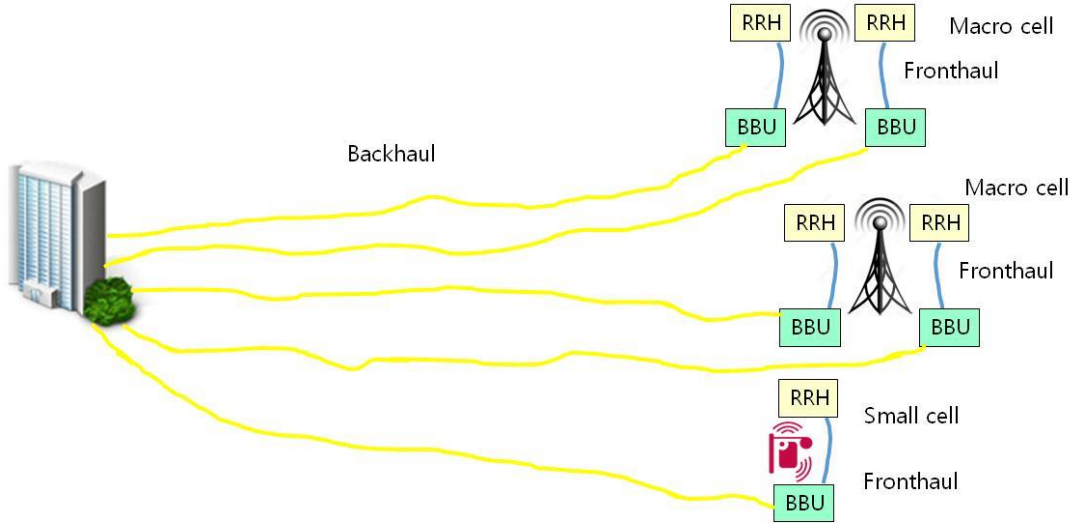
Benefits of Centralized RAN

- **First level of cost reduction through the introduction of WDM**
  - This reduces the need for dark fiber; note that the cost savings depend on # of λ channels
- **Second level of cost reduction through centralization**
  - Centralizing the BBUs reduces the cell site build and rental costs as well as power dissipation
- **Third level of cost reduction through virtualization of the BBU pool (the Cloud)**
  - Virtualization allows for the use of generic and thus lower cost hardware
- **On top of the savings, C-RAN brings performance improvements**
  - For example, Coordinated MultiPoint (CoMP) requires a centralized front-haul solution
  - In addition, C-RAN brings smaller latency and reduces the network complexity in case of a HetNet
- **WDM-based C-RAN provides a solid ground for future network expansion / upgrade**
- **But benefits depend on the local situation, including the availability of dark fiber**

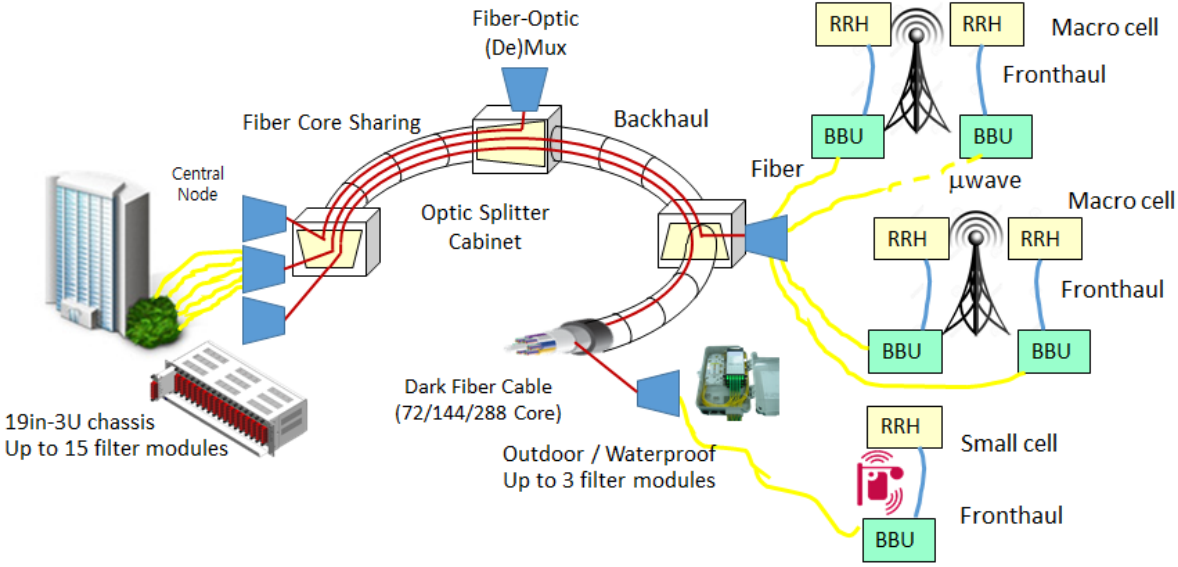
Key Considerations for Next-Gen RAN



- **Baseline is a RAN consisting of point-to-point fiber that carries backhaul (in the form of GbE)**
- **First step is the introduction of WDM in order to save on fiber**
  - Note that μwave and fiber are complementary (μwave is close to the tower, whereas fiber reaches the CO)
  - Important to use a WDM system that has a large # of λ-channels and that is front-haul ready

Both Passive & Active WDM Can Do the Job…

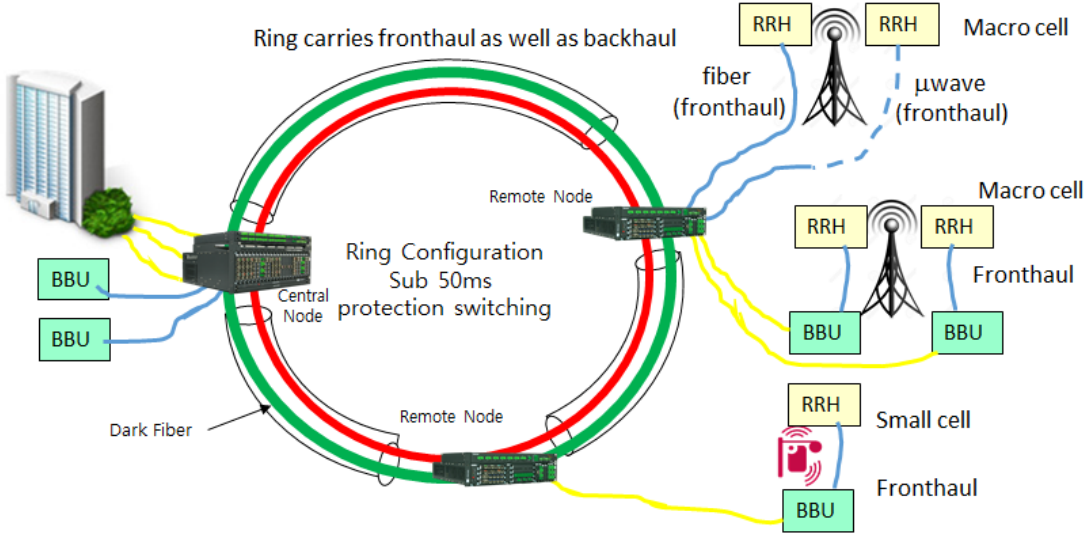
Example shows passive solution



- **Passive WDM solutions consist of passive (de)muxes plus colored SFP transceivers**
  - Passive solution offers lowest cost and does not require powering of the muxes
- **Active WDM solutions use active transponders (like a regular WDM system)**
  - Active offers CPRI compression, is managed, and facilitates SLAs through defined power levels
- **Both active and passive solution come in protected as well as unprotected versions**

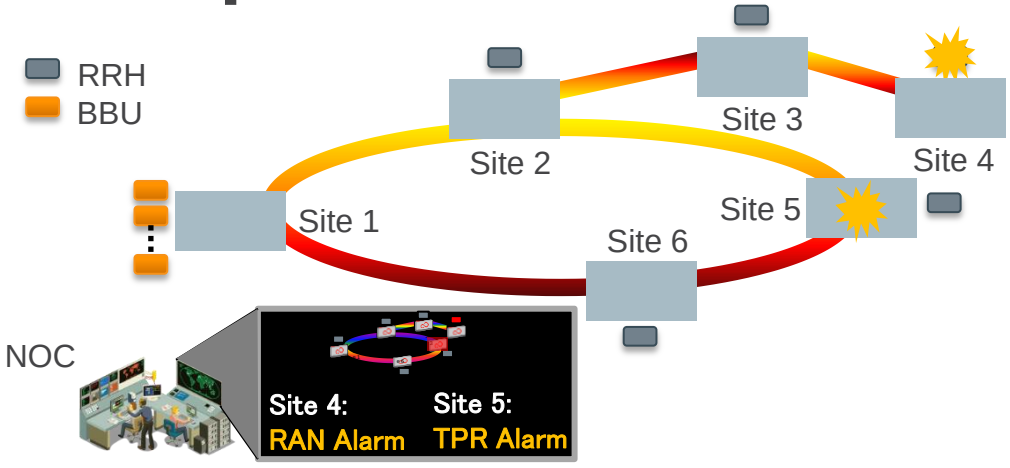
Front-Haul Capable WDM Allows for Centralization

Example shows active solution



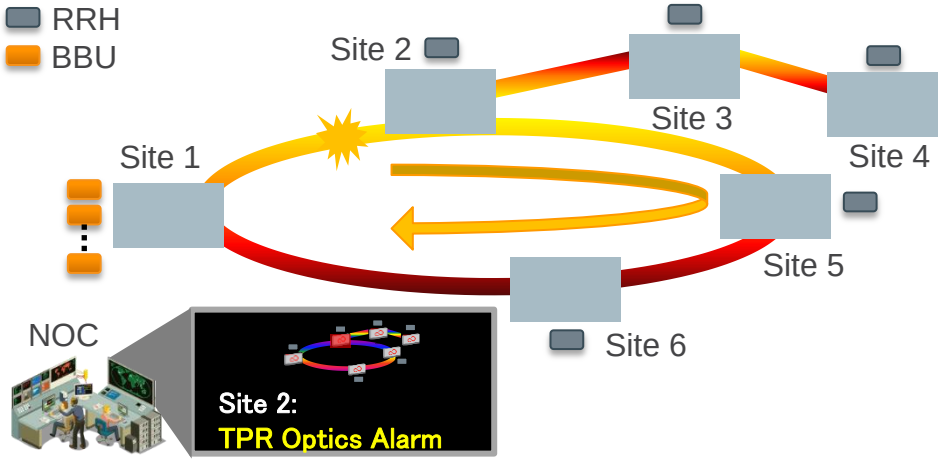
- Fronthaul capable WDM allows BBUs to be centralized into a “BBU pool”
- The centralization saves on electricity costs as well as site build-out and rental cost
- If the WDM system can carry both front- and backhaul, then the centralization can be step by step
- This reduces the investment by only centralizing a BBU during maintenance or upgrades

Smart CPRI Transport Reduces Installation & Maintenance Expenses



- RAN aware transport solution distinguishes between Transport and RAN impact:
  - Eliminates expense when failure is not immediately located (NTF Truck rolls)
- Integrated Latency Measurement per segment for ease of installation
- Integrated BERT turn-up and remote loopback eliminates remote site Tech/Truck roll coordination
- Integrated optional FEC overcomes poor quality fiber impairments

Self Healing Resilient Network

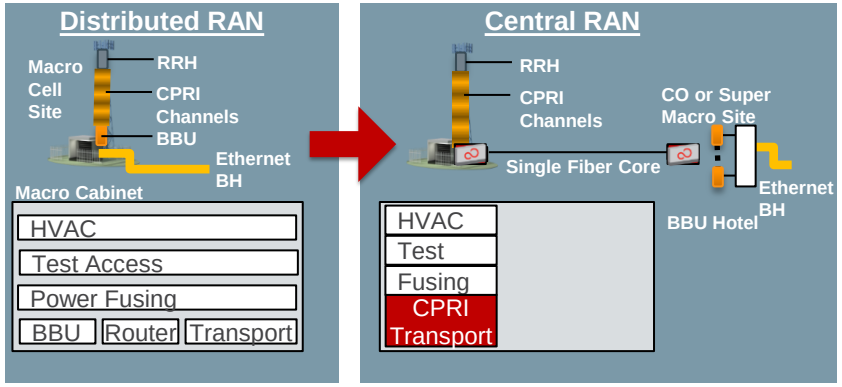


- Provide Five-Nines availability via network resiliency
- Maintain in-service calls upon a protection switch

- Self healing network for ring or diverse linear paths
  - Sub-50 ms protection switch
  - Switch on transport (LOS) or BER (CV/BIP-16) impact
- Differential delay compensation maintains in-service calls upon protection switch

C-RAN Benefits

- **Evolve to a C-RAN transport architecture**
- **Improves capacity, performance, and efficiency**



- **Improves RAN performance up to 30%**
  - Low latency b/w BBUs enables X2 port optimization
  - Easier to scale
  - Positions BBU for NFV and RAN for SDN to achieve SON
- **Reduces CapEx by up to 30%**
  - Reduced site acquisition
  - Lower construction cost
- **Reduces OpEx by up to 50%**
  - Lower operation and maintenance
  - Up to 71% lower power consumption
  - Lower rent

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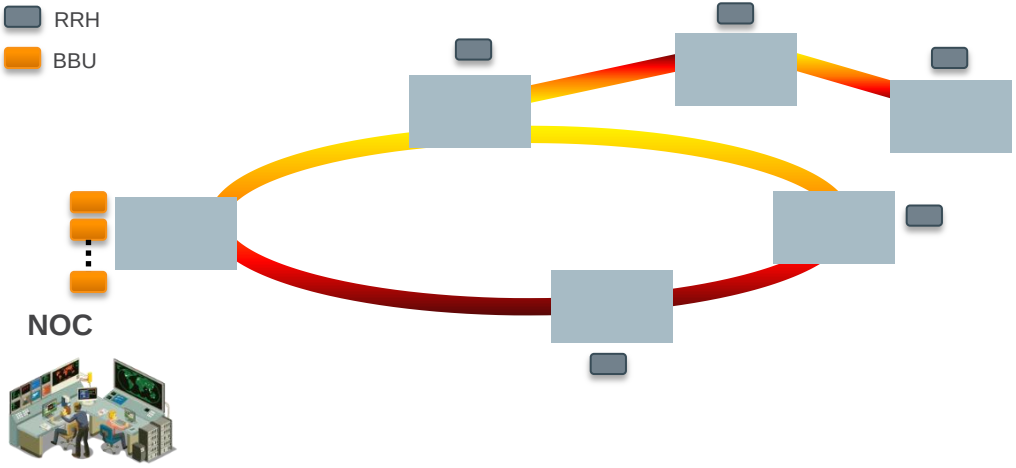
Hybrid Topology Deployment Applications

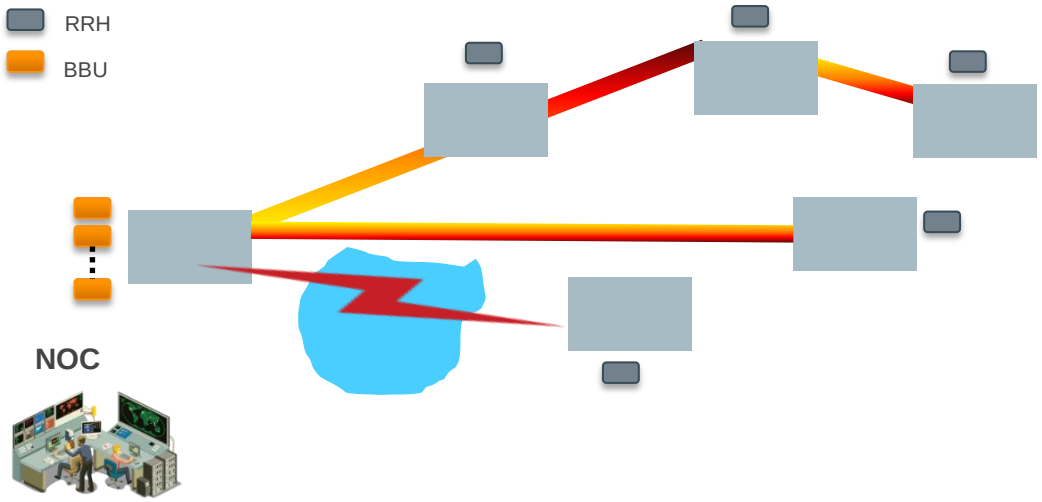
Ring & Linear



- Ring and linear smart WDM network
  - Ring minimizes fiber span count at BBU hotel while providing a resilient option
- Mix of optical technology
  - DWDM 50Ghz spaced optics for high density applications yields 80 CPRI channels over fiber pair
  - Low cost CWDM optics for lower density small cell applications

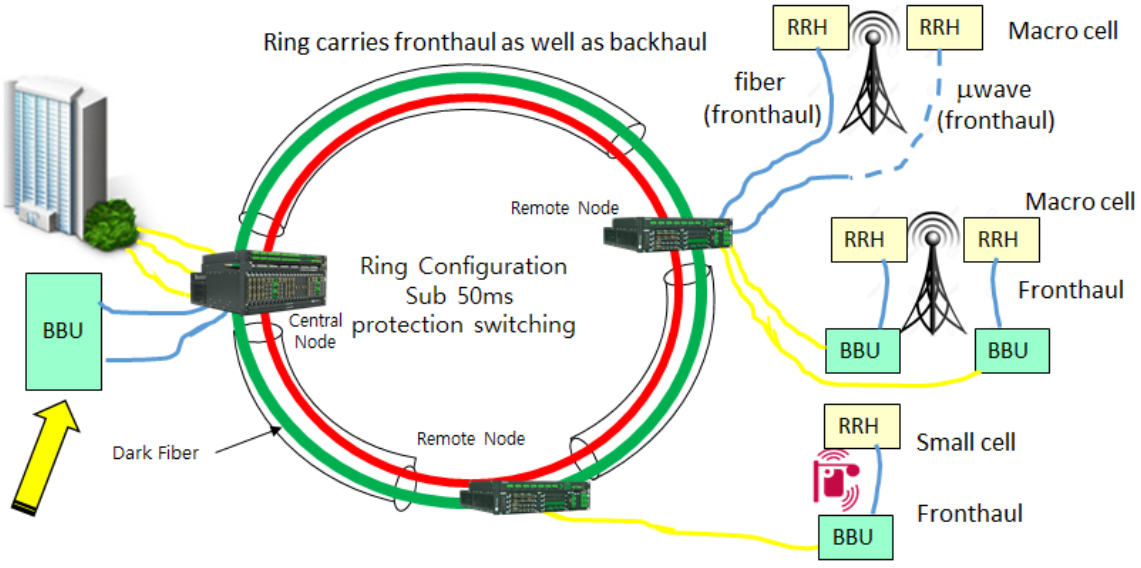
Hybrid Topology Deployment Applications

Hub/Spoke, Wireless and Linear



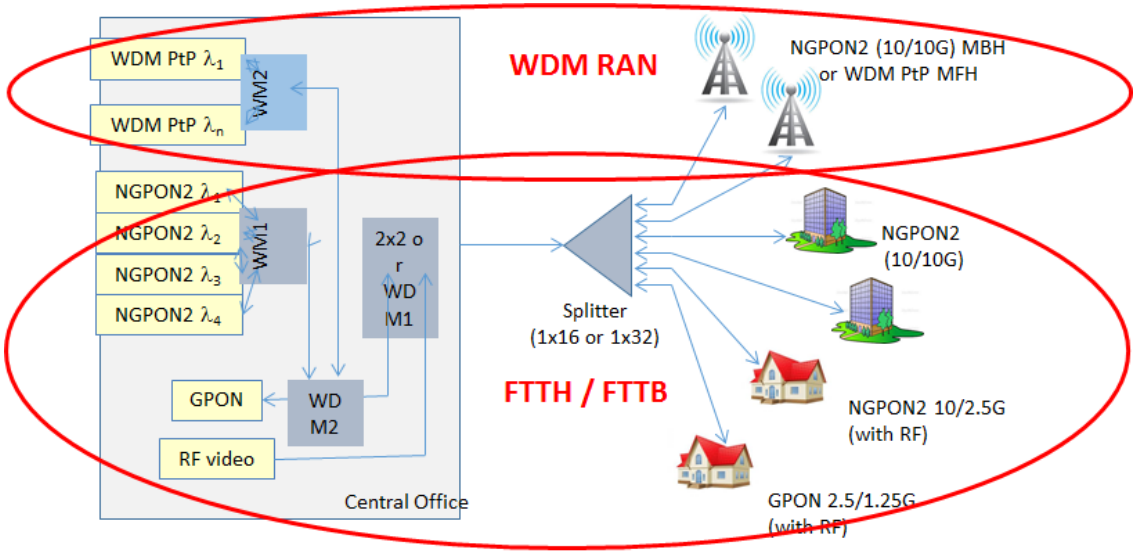
- Hub/spoke and linear topology
- Wireless CPRI transport when dark fiber is not available

C-RAN Enables Third Level of Cost Reduction



- **Once centralized, BBUs can be combined into more efficient versions**
- **In addition, the BBUs can be virtualized (the "Cloud") using generic hardware**
  - This allows further cost reduction and network simplification

WDM RAN Key for Mobile/Fixed Convergence



- Ideal is to leverage a single network for residential, business, and mobile
- Mobile/fixed convergence can be achieved using PtP with WDM that can carry GbE and CPRI
- Convergence can also be achieved using NGPON2 since it includes PtP WDM
- Low-cost access-optimized tunable lasers are the ideal source (colorless)

Cost Savings in SOLiD C-RAN Use Cases

- **SOLiD is from Korea, which saw the first country-wide rollouts of C-RAN**
  - In these use cases, significant savings were reported in CAPEX as well as OPEX
  - There is a lot of interest in these experiences, but the results do not always map directly to other situations
- **For this reason, SOLiD is now starting a benchmarking effort**
  - Effort consists of developing a financial model that allows C-RAN cost savings to be calculated
  - Results of that model will be gauged against early use cases (i.e., results build over years)
  - Plan is to make the benchmarking results available to interested carriers, e.g., white papers
- **First results are encouraging**
  - Shows that passive solution has larger cost-reduction potential than the active solution
  - CAPEX reduction depends strongly on the number of available wavelengths (e.g., 108 vs. 36 vs.18 vs. PtP)
  - The introduction of front-haul capable WDM is, to first order, a CAPEX story
  - Centralization, on the other hand, mainly translates to OPEX savings

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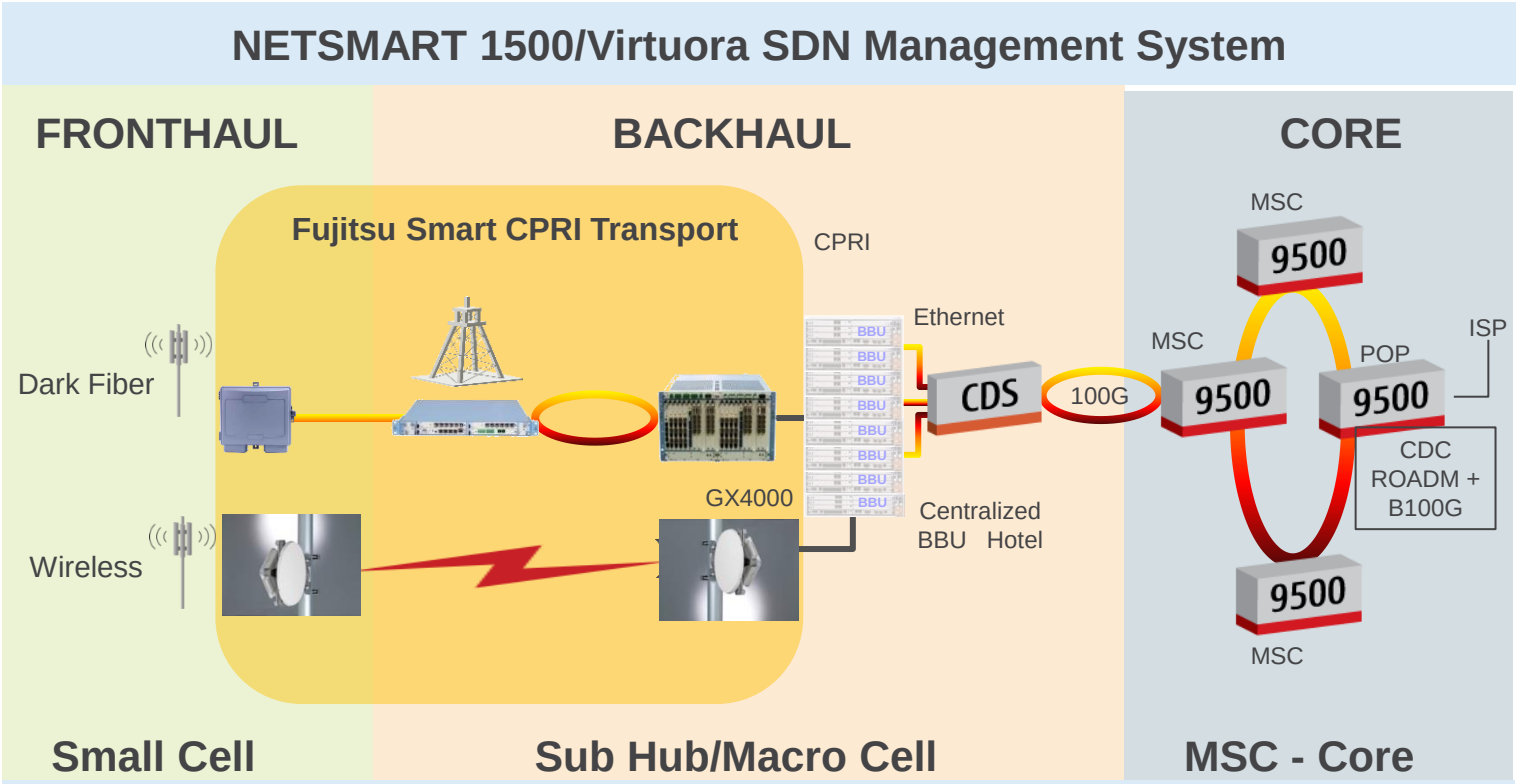
SOLiD Mobile Optical Access Solutions

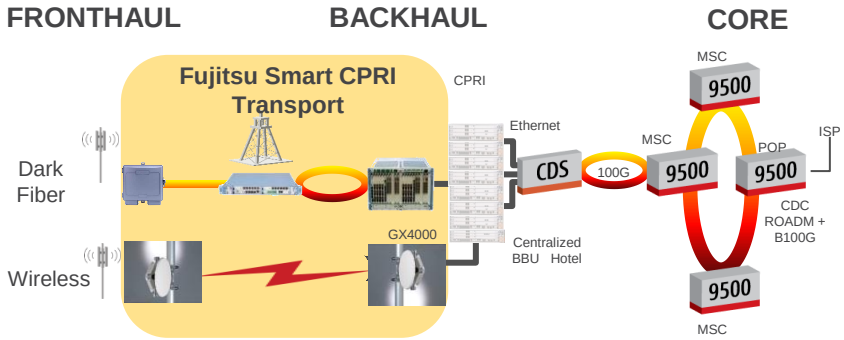
- **SOLiD is headquartered in Korea and is leading in DAS as well as mobile optical access solutions**
- **Active: CRM6400**
  - High system capacity: 52 CPRI channels with single fiber strand ring (or 104 λ channels)
  - Network survivability: under 50ms ring protection for fiber failure
  - Powerful OAM&P management: performance, failure, alarm, etc.
  - Access platform covers Ethernet (small cell), TDM (BTS backhaul), GPON, as well as fronthaul
- **Passive: CWDM-PLUS and CWDM-MAX**
  - CWDM-MAX is the only passive CWDM solution that offer 108 λ channels (54 CPRI channels)
  - Seamless upgrading from conventional 18 λ channel CWDM, via 36 λ channel CWDM-PLUS
  - Can carry both GbE as well as CPRI, can be offered in a protected and unprotected fashion
- **Tunable: Infinity Access**
  - Advanced optical RAN system based on low-cost tunable lasers with automatic tuning and locking
  - Simplifies deployment logistics and reduces the inventory cost
  - System capacity growing from 16 to 32 λ channels and from 1G to 10G

Fujitsu C-RAN + Dynamic Core *Evolution*
Smart Mobile Transport Solution

- Fronthaul to Core complete transport solution
  - Resiliency
  - Wireline
  - Wireless
- Management visibility from fronthaul to core
- A to Z service provisioning



Fujitsu Smart CPRI Transport Solution



- Smart CPRI Transport lowers OpEx
  - Proactively resolve impairments before they become service impacting
  - RAN aware transport solution distinguishes between Transport and RAN impact
  - Integrated performance monitoring and measurement applications
  - Self Healing high availability service delivery
- Wireless impulse radio CPRI transport provides alternative when DF is not available
- Virtuora SDN controller provides a seamless transport network solution

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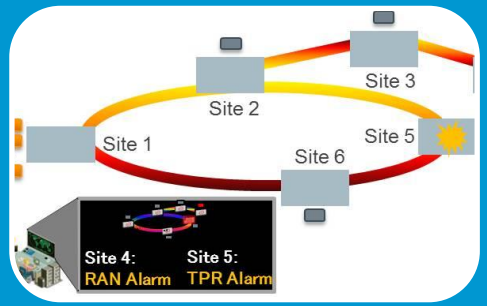
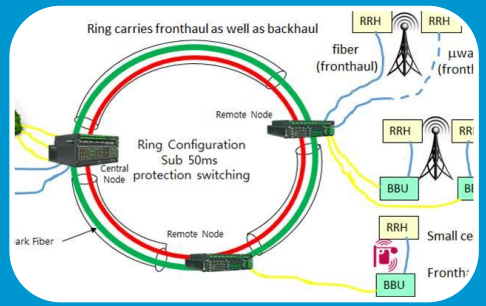
C-RAN Already Improves Performance and Efficiencies, and Cuts Cost



But fronthaul is key to ensure low latency between BBUs and RRHs

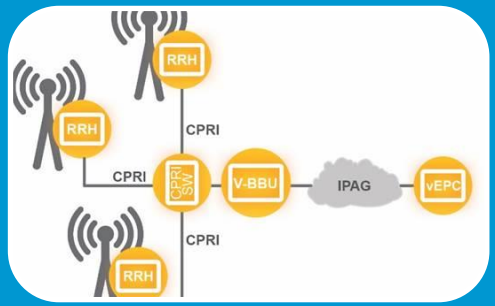
Both fiber and microwave do a perfect job

Smart CPRI transport is a key component of C-RAN



When fiber is available, protected WDM ring or passive WDM star are well suited

Saves on fiber, allows for protection, is future proof, enables cost sharing



Moving forward, BBUs will be combined in larger efficient equipment, and eventually be virtualized, paving the way to ***full blown cloud RAN***

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Audience Q&A

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