Examining The C-RAN Business Case For Mobile Operators

RAN & Backhaul Networks, Berlin
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Cloud RAN Defined

Stage 1
- Centralization
  - Distributed RAN
  - Baseband processing in data center or at “macrocell hub”
  - Remote radio at antenna on site
  - High-capacity connectivity (fronthaul)
  - Opex benefits

Implemented in Japan & Korea

Stage 2
- Virtualization
  - General purpose processors platform
  - Opex & capex benefits (leverage IT infrastructure economics)

Under development

Cloud RAN
- Virtual RAN
- Field tests & trials

Implemented in Japan & Korea
Under development
Field tests & trials
Cloud RAN: Baseband Virtualization

Aggregating baseband improves implementation of CoMP that enhances network performance.
Baseband Virtualization

- Migration to new technology
- Base station consolidation
- Applications at the edge

Decouple software from hardware
Evolution to Cloud RAN

- **Std. BTS**
- **Std. BTS with remote BBU**
- **BBU pooling**
- **BBU pooling & virtualization**

- **Implemented centralized topology (Phase 1)**
  - Rearranged architecture
  - BBU pooling
  - Centralized RAN

- **RAN virtualization R&D**
  - SK telecom
  - DoCoMo
  - KT
  - SoftBank
  - CHINA MOBILE
Benefits & Fundamental Challenge in C-RAN

How to reduce fronthaul requirements to maintain advantages of C-RAN while reducing cost of deployment?
Solution 1: Virtualization Architecture

Where to split?

Core Network

Backhaul

Layer 3
MAC
PHY
RF

Base Station

Higher line rate requirements

Core Network

Layer 3
MAC
PHY
RF

Core Network

Layer 3
MAC
PHY
RF

Core Network

Layer 3
MAC
PHY

RRH

CPRI

RF

Lower CoMP capacity gain
Solution 2: Deployment Topology

**Scenario 1**
Homogeneous network with intra-site CoMP
(Virtualized macrocell)

**Scenario 2**
Homogeneous network with inter-site CoMP
(a. Virtualized macrocell hub; b. baseband in data center)

**Scenario 3**
Heterogeneous network with low power RRHs within the macrocell coverage
(a. Virtualized macrocell hub; b. baseband in data center)
Case Study: Business Case for Asian Operator

- Macro cell deployment
  - 3 sectored cell sites

- Dark fiber is available to cell sites
  - PTP star topology from fiber center; 50 sites per center

- TDD LTE (Config 1); 20 MHz channel; 4:1 DL/UL traffic ratio
  - 104 Mbps peak capacity; 27 Mbps average capacity

- CoMP gain: 16% DL; 20% UL average cell area gain

- Pooled & virtualized base station resources in data center
8-Year Total Cost of Ownership

-26 % Opex
-28 % Capex

27% Reduction in TCO
Capex Analysis

Additional spend on fronthaul offset by reduction in site buildout and RAN equipment cost
Opex Analysis

Reduction in energy, site rental and O&M costs
Statistical & Sensitivity Analysis

› Monte Carlo Analysis
  – 2% std. deviation

› Cost reduction drivers
  – Site rental expense
  – Site buildout
  – Operation & maintenance
  – Power consumption
Cost of Capacity ($/Mbps)

- 36% Reduction in $/Mbps

Bar chart comparing Distributed Architecture and Cloud RAN.
HetNet Deployment Key Assumptions

- Three scenarios
  - Small cells with backhaul to a macro cell
    - Limited coordination of baseband resources
  - LP RRH with wireless fronthaul to a macro cell
    - Full coordination capabilities
  - LP RRH with fiber fronthaul to a macro cell
    - Full coordination capabilities
- Macrocell capex is the same whether or not it is virtualized
- 6 Remote cells per macrocell site (2 per sector)
- Cost of fiber to small cell/LP RRH site is $500/m
- Wireless fronthaul or backhaul is based on V-band (60 GHz): LOS is achieved in one hop
HetNet Deployment TCO

Key Takeaways

› 75 m breakeven distance for remote site between wireless and fiber – case assumption dependent but in general it holds that the breakeven point is a few tens of meters

› Advantage of CRAN w. fiber fronthaul is where remote sites are close to the macrocell and have high utilization

› Capacity gain alone is not a sufficient driver for implementing CRAN at the macrocell (scenario 3). There has to be another driver to prompt CRAN architecture at the macro cell (hint: mobile edge applications)
A Word About Xona Partners

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  – Infrastructure, OS, application ecosystem business verticals
  – Telco, Cloud Migration/Data Center, Data Sciences focus

› Services offering
  – New business incubation & growth strategies
  – Due diligence & lifecycle management

› Published C-RAN market report in collaboration with Mobile Experts (2nd edition, Jan 2015)