C-RAN: The Road Towards Green Radio Access Network

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Agenda of Today

- Why C-RAN is Important to Mobile Operators?
  - Cost, performance and industry trends

- What’s the Next Big Thing after LTE?
  - Network implementation evolution

- How do We Drive C-RAN in the Future?
  - Joint requirement, R&D, and deployment
NGMN Paved the Way of LTE in the Past Years

NGMN played an important role in LTE
- Operators defines requirement jointly and drive the industry
- Market drives technology innovation
- Global standard, global market and global economic scale

What will the next big thing after LTE?

*Source: NGMN Alliance Highlights and Beyond, Dr. Peter, 2011*
Operator still has Challenges in Mobile Internet Era

A green evaluation path is needed for Radio Access Network deployment and operation, to achieve high capacity, high power efficiency, and low cost.

- **Power consuming surging as BS number increases**
  - [Graph showing the increase in number of BTS and power consumption over years]

- **CAPEX and OPEX associated with cell sites**
  - [Diagram showing components of CAPEX and OPEX]

- **Dynamic network load challenge**
  - [Graph showing load/EBR over time for Office Area and Residential Area]

- **BS cell site is the major source of power consumption of China Mobile**
  - [Pie chart showing power consumption sources: Cell Site (72%), AC (40%), Major Equipment (51%), Other Site Support Equipment (5%), Channel (6%), Management Office (7%), Transmission (15%)]

- **Fast increasing data traffic but slow revenue growth**
  - [Graph showing data traffic growth and revenue growth over time with mobile data explosion and voice-dominated traffic]

- **60% TCO**
  - [Breakdown of TCO components: O&M, Site Rent, Civil Work, Site Acquisition & Planning, Transmission, BTS, OPEX over 7 years]

- **40% TCO**
  - [Breakdown of TCO components: BTS, Site Acquisition & Planning, Civil Work, Site Rent, O&M, Electricity, OPEX over 7 years]
Network Implementation will be the Next Focus
C-RAN: Centralized, Collaborative, Cloud, and Clean System

Centralized Control and/or Processing
- Centralized processing resource pool that can support 10~1000 cells

Collaborative Radio
- Multi-cell Joint scheduling and processing

Real-Time Cloud
- Target to Open IT platform
- Consolidate the processing resource into a Cloud
- Flexible multi-standard operation and migration

Clean System Target
- Less power consuming
- Lower OPEX
- Fast system roll-out
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Centralized Deployment Helps Cost Structure

Lower CAPEX and OPEX
Save up to 15% CAPEX and 50% OPEX compared to distributed BTS 3G network*

Faster system roll out
Due to simpler remote radio site, system roll out can save up to 1/3 the time*

Lower energy consumption
Save up to 71% of power compared to traditional RAN system*

*Source: Base on China Mobile research on commercial networks
Collaborative Radio Further Improves Performance

**Interference has become the major limit**
E.g. in big cities of China, the distance between BTS is just 100~200m, and interference become a serious challenge

**Collaborative Radio is the Ultimate Solution**
Change the interference to useful signals
Make better use of TDD channel reciprocity

*Source: China Mobile simulation results on 3GPP assumptions*
IT Technology Helps Telecom Evolution

IT Technology Evolution
- Huge IDC, advanced server network technology
  - Cheap device, high BW, high reliability
- IT in Core Network: Soft switch based on GPP
  - 40 server = 10M line core network switch
- Open platform, VoIP etc
  - Replaced the proprietary systems

Traditional Switch Solution
- Proprietary hardware + embedded software
  - ASIC, 8086,
- Very expensive (used to be)
  - 2000 Yuan per line in 1990s
- High OPEX, and low flexibility
  - Dedicated equipment room, closed S/W env.

Today’s Soft-switch Solution
- Standard IT hardware + software switch
  - IA platform, standard OS
- Low cost
  - Far below 100 Yuan per line
- Simple OPEX, high flexibility
  - 10 times less room occupation with <30% energy consumption (*)
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NGMN Plays an important role in driving C-RAN in industry
P-CRAN project approved in March, 2011, with 12 operators approve
Active participants of 5 major operators and 7 major vendors

Delivered:
“Cost Analysis method”, one motivation of operator to drive C-RAN
“System Requirement”, the general requirement from operator perspective of C-RAN features

TODO:
“Solution Suggestions”, under working – views of potential solutions of future C-RAN system
“Standard Impact Analysis”, under going – impact to 3GPP, ORI and other standards
Joint R&D on C-RAN with TEM/IT Partners

- IT based wireless platform opens the door to more flexible system

2G/3G terminal

4G test terminal

2G/3G/4G RRU

CPRI

Today: Tri-mode BBU on IT Platform

- CMRI and Huawei, Intel, IBM, and ZTE have built two independent C-RAN PoC which realized LTE PHY processing in real time
- 2G/3G/4G RAT verified on IT platform Successful OTA demo in 2011 ITU Telecom World, Geneva
- Base of future LTE-A CoMP research & trial

Future: Large Scale, Real Time BBU Pool

- Build telecom grade reliable (99.999%) real-time Cloud with cheap building blocks with relatively low reliability (99.9%)
- Scalable, Reliable, and Cost Effective system
**C-RAN Trials in Commercial Networks**

- for dense urban city, business street and campus; well suit for HetNet deployment

C-RAN has shown advantages in places with fiber:

**Suitable for these deployment scenarios:**
- HetNet deployment in the following areas:
  - Urban city’s business street
  - University campus
- Suburb deployment

**Changsha C-RAN/2G Network**
- 10 sites, 247 GSM/EDGE carriers
- Dynamic resource allocation

**Changchun 2G Network**
- Dense city – college campus case
- 5 centralize device room, 98 RRHs
- 30,000 subscribers in 3 km²

**Guangzhou C-RAN 3G/4G Dual Mode**
- First dual-mode case
- Same BBU-RRU for 3G/4G network
- 12 sites, 36 LTE 20MHz carriers

**Zhuhai C-RAN/3G Network**
- First in China Mobile network
- 18 sites first, expend to 100 sites
Centralization Deployment
First step of C-RAN centralization trialed in 2G/3G in 7 city’s networks

Near Term:
Address the fiber resource and management challenge

Mid-Term:
Address the SDR and Collaborative Radio challenge

Long Term:
Address the real-time cloud challenge

We are here

Virtual BTS on real-time Cloud
Large scale BBU pool
Real-time virtualization
System OS, API standardization

Multi-mode and Collaborative Radio
Drive the industry to do research and prototype:
SDR on open platform, Collaborative Radio

Drive CoMP research and field trial, pre-commercial product

Commercial product development

C-RAN Research
Data traffic analysis
BBU pool research

Expend C-RAN to 2G/3G/4G networks

We are Driving C-RAN R&D as Planned
Industry Alliance to Drive C-RAN Eco-system
- Through NGMN P-CRAN Project and global industry collaboration

Call for Joint Exploration!

CMRI-IBM signed MoU on multi-mode SDR PoC
Signed C-RAN MoU with Ericsson and NSN
NGMN C-RAN Project drive by CMCC
Collaboration with KT and SKT

Cooperate-level strategy collaboration on C-RAN
Signed C-RAN MoU with Orange
Strategy collaboration with Alcatel-Lucent
Close collaboration with Huawei and ZTE