Some View on Next Generation Radio Interface

Clark Chen
Senior Researcher
China Mobile Research Institute
Challenges for future 5G networks

Agility, openness, scalability, efficiency

• So many issues for current “hard” mobile networks
  ✔ Time-to-market
  ✔ Service innovation
  ✔ Energy efficiency
  ✔ TCO
  ✔ Interoperability
  ✔ ...

Trillions Connections
How to coordinate our four networks to satisfy user needs? From 2008 to 2012

- 0.9 Million BTS
- 0.5 Million BTS
- 4.41 Million AP
- 0.61 Million BTS by 2014.10
- 80 Million users by 2014.12

The answer: Green and Soft
C-RAN: the revolutionary evolution towards 5G, proposed by CMCC in 2009

"Soft BS" in C-RAN virtualization/cloudization

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
Fronthaul is a major challenge for C-RAN deployment.

Challenge by fronthaul b/w BBU and RRU

- Data rate b/w BBU and RRU using CPRI is as high as 9.83Gbps for 8-antenna TD-LTE, requiring 4 fibers for each carrier with 6G SFP.

<table>
<thead>
<tr>
<th>Configuration</th>
<th># of carriers</th>
<th>CPRI data rate per carrier</th>
<th>Total CPRI data rate before compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical configuration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSM</td>
<td>3 RRU, S6/6/6</td>
<td>36</td>
<td>40Mbps</td>
</tr>
<tr>
<td>TD-S</td>
<td>3 RRU, S3/3/3</td>
<td>9</td>
<td>300Mbps</td>
</tr>
<tr>
<td>Current TD-LTE</td>
<td>3 RRU, S1/1/1</td>
<td>3</td>
<td>10Gbps</td>
</tr>
<tr>
<td>Medium term TD-LTE</td>
<td>S2/2/2</td>
<td>6</td>
<td>10Gbps</td>
</tr>
</tbody>
</table>

In addition, CPRI has critical requirements on synchronization and latency.

Efficient fronthaul solution is required to enable C-RAN large-scale deployment.
Time to rethink FH for the sake of 5G evolution

1. **CPRI for 5G? Probably NOT**
   - Too high data bandwidth
   - Scalability issue to support 5G evolution
   - Lower efficiency due to TDM mode

2. **Rethink FH**
   - Traffic dependent to enjoy and enable statistical multiplexing for FH transport networks
   - Decoupling cell processing and UE processing
   - Decoupling UL and DL
   - Support key 5G technologies, e.g. LSAS, CoMP etc.

3. **Initial work in SDOs**
   - NGMN conducted initial function split solutions for LTE
   - Newly founded project in CCSA to study the requirements, scenarios and the key technologies
   - Discussion in ITU-T and IEEE TSN recently

• **More radically, could we relax the critical CPRI requirements** (e.g. 0.002ppm sync. requirement)?
Expected benefits

- Reduced FH bandwidth and therefore the cost
- Disaster-tolerant backup thanks to flexible mapping b/w BBU pool and RRU
- Better support for live migration
- Better support for 5G technologies due to the flexible routing capability
Some initial work in this front

- **Initial study on BBU-RRU function split for LTE**
  - Design principle:
    - Traffic-dependent BW adaptation
    - Statistical multiplexing
    - Multiple mapping relationship b/w BBU and RRU
    - Independent of antenna number

- **Initial verification of the feasibility of CPRI over Ethernet**
  - Simple point to point connection
  - CPRI I/Q sampling -> Ethernet packet of 512 Bytes
  - 1588v2 for RRU phase sync.

- **WP on Next-generation Radio Interface (NGRI) ongoing, to be published by March**
- **NGRI forum planned for Q1 2015 (contact: huangjinri@chinamobile.com)**
Initial study on BBU-RRU function split

Converter: to reduce bandwidth b/w BBU and RRU
- CPRI termination
- Pre-processing
- Switching interface
- BW proportional to traffic load
- Reduce maximum data rate to 1/5, e.g. 9.8Gbps to 2.1Gbps
- Make it possible for packetized CPRI and CPRI over ethernet

Still, other issues are under discussion
• NGRI requires joint re-design from both wireless and transport perspectives

• From wireless perspective:
  – BBU and RRU function split is required
  – A big impact on existing product form
  – Maintenance and future update are also concerns

• From transport perspective
  – Latency, jitter and synchronization issues on Ethernet
Thank you!