ITU-T Workshop on Bridging the Standardization Gap and Interactive Training Session

(Nadi, Fiji, 4 – 6 July 2011)

LTE and Network Evolution

JO, Sungho
Deputy Senior Manager, SKTelecom
I. SKT’s Network Strategy and LTE
   ○ Data Traffic Explosion
   ○ SKT’s Network Evolution
   ○ SKT’s Network Strategy
   ○ SKT’s LTE Deployment

II. Technology Evolution and LTE
   ○ Technology Evolution
   ○ LTE Requirements
   ○ LTE Network Architecture
   ○ LTE Advanced Technology

III. Technical Challenges in LTE Deployment
   ○ Seamless Operation
   ○ Heterogeneous N/W & Network Automation (SON)

IV. SKT’s RAN Evolution: SCAN (Smart Cloud Access Network)
   ○ Cloud Architecture
   ○ Smart Network Technologies
In recent years, SKT’s analysis shows small increase in voice traffic, but explosive increase in data traffic due to popularization of smart devices.

- **Voice Traffic Saturation**
  - CAGR for voice traffic increases by 5%
  - Increasing rate diminishes after ’09

- **Data Traffic Explosion**
  - CAGR for data traffic increases by 106%
  - Data traffic explosion after ’09 (About 9 times increase from ’09 to ’10)

Data Traffic Explosion is "World-wide Trend"
SKT’s mobile network has evolved by rapid adoption of new technologies, and LTE-based evolution is on-going to offer top-class services continuously in the era of data explosion.
SKT’s network portfolio efficiently copes with the data traffic explosion by hierarchical multi-solution considering the traffic characteristics.

SKT’s strategy for Mobile Broadband

- Data Demand in Hot Zone (Campus, Home, Office, etc.)
- Cell Coverage Reduction for Higher Data Rate

New Deployment Concept for Mobile Broadband

Optimal Network Portfolio

- Metropolitan area (Seoul) Hot zones in major cities
  - 2.3GHz (BW 27MHz)

- Nationwide coverage
  - 2.1GHz (BW 30MHz)
  - 62% of total subscribers

- Nationwide coverage
  - 800MHz (BW 15MHz)
  - 38% of total subscribers

- Nationwide Coverage
  - IS-95A/B: Nationwide
    - 1X/DO: 92% Population
  - 800MHz (BW 15MHz)
  - 38% of total subscribers

- Metropolitan Coverage
  - IS-95A/B, CDMA 1X/EVDO
  - 800MHz (BW 15MHz)
  - 38% of total subscribers

- Hot Spot
  - High-speed Data Demand

- Hot Zone
  - Optimal Network Portfolio

- Metro (Seoul)
  - Hot zones in major cities
  - 2.3GHz (BW 27MHz)

- Nationwide Coverage
  - Metropolitan Coverage
  - Hot Zone
  - Hot Spot

- Voice Service
  - Basic IP Service
  - Multimedia IP Service
LTE will be used for dealing with high data traffic in metropolitan area over nationwide WCDMA/HSPA (’11/’12), then extended to nationwide coverage (’13).

**SKT’s LTE Deployment**

In July of 2011, SKT will provide the First LTE Service in Korea.

**SKT’s LTE Plan**

2011: **First LTE service in Korea (’11, July)**
- with data card type terminal (Handset type terminal will be available in 2nd half of ’11)

2012: Coverage extension to major cities

2013: Nationwide coverage

**SKT’s LTE Deployment**

First LTE service in Seoul (’11)

LTE coverage extension to Major Cities (’12)
CDMA-based mobile technology is evolving to OFDMA-based technology for high data rate service. LTE will provide 3~15 times peak data rate as compared to HSPA.

---

**CDMA (Voice-oriented)**: Connectivity, Circuit, Soft Handover

**OFDMA (Data-oriented)**: Wider Bandwidth, Packet, Less Interference
Technology Evolution and LTE

- **Peak data rate**
  - 100 Mbps DL/ 50 Mbps UL within 20 MHz bandwidth
    *(DL : 5bps/Hz, UL : 2.5bps/Hz, 2x2 MIMO default)*

- **Capacity**
  - Up to 200 active users in a cell (5 MHz)

- **Latency**
  - Less than 100 ms on control-plane (Idle to Active)
  - Less than 5ms on user plan (Unload condition, one-way transmit time bw UE ~ RAN Edge node)

- **Mobility**
  - Optimized for 0 ~ 15 km/h, 15 ~ 120 km/h supported with high performance
  - Supported up to 350 km/h or even up to 500 km/h

- **Handover**
  - Hard Handover

- **Spectrum**
  - Flexibility: 1.4, 3, 5, 10, 15, 20 MHz

- **User Equipment**
  - Support up to 20 MHz

- **Duplex**
  - FDD, TDD
LTE Network Architecture

**Technology Evolution and LTE**

- **EPC**: Evolved Packet Core
- **MME**: Mobility Management Entity
- **P-GW**: Packet Data Network Gateway
- **S-GW**: Serving Gateway

**SAE**
System Architecture Evolution

**Long-Term Evolution**
**LTE**

EPC: Evolved Packet Core
MME: Mobility Management Entity
P-GW: Packet Data Network Gateway
S-GW: Serving Gateway
LTE will evolve to LTE-A (Advanced) to enhance the capacity, QoS, and N/W flexibility. SKT will provide LTE-A service in 2013-14.
Seamless operation is one of the most important issues for LTE deployment in multi-N/W environment.

### N/W Selection
Selecting serving N/W based on customer profiles, operator policy and terminal types.

### N/W Redirection
Redirecting requested calls into other N/W (e.g., CS Fallback).

### Seamless Handover
Supporting continuity and mobility of voice/data calls.

### Seamless Voice Service
CS Fallback based on 3GPP-R9 standard/ IMS-based mVoIP.

---

**Diagram:**
- **LTE**
  - Hot Zone/Nationwide
  - Data H/O
  - m-VoIP & Hi-speed Data

- **WCDMA**
  - Nationwide
  - Voice & Low-speed Data
  - m-VoIP or Voice H/O

---

**Multi-Mode Multi-Band Terminal**
Heterogeneous network maximizes the spatial reuse gain, and deals with non-uniform traffic.

**Conventional (Voice-oriented)**
- Macro Cell
- Repeater
- Pico Cell
- Weak Spots (High Interference)

**HetNet (Data-oriented)**
- Pico
- WiFi
- Relay
- Biz. Cell
- Femto
- Hot Zone

**Network Automation (SON)**
Network operation and management can be automated by SON technologies.

**Self-Configuration**
Plug and Play
Automated setup and configuration

**Self-Optimization**
Auto Tune
Real-time network optimization

**Self-Healing**
Auto Repair
Fast, autonomous failure mitigation
SKT’s RAN(Radio Access Network) architecture is evolving to “SCAN” in order to reduce the network cost and enhance the capacity.

“Cloud” Access Network
- Cloud-based digital processing
  - Centralized cloud DU
  - BS virtualization by real-time cloud processing
  - Resource sharing (pooling)
  - Efficient maintenance

“Smart” Access Network
- BS cooperation in cloud architecture
  - Interference management and Cooperative Tx/Rx
  - Load balancing & Traffic optimization

Smart Cloud Access Network

Network Cost Reduction
Flexible Network Architecture

Capacity Improvement
Eco-Friendly Technology
IV. SKT’s RAN Evolution : SCAN

✓ Evolution to Cloud Architecture

Centralized Digital Processing in Cloud DU
- First step: Separate DU/RU & Centralized DU
- Second step: BS virtualization by real-time cloud processing

✓ Flexible Network Architecture
- Efficient resource management via virtualization
- Flexible network configuration using open platform
IV. SKT’s RAN Evolution: SCAN

- Evolution to Smart Network: Cloud-based BS cooperation, SDR, Self-optimization

- Cloud-based BS Cooperation: Network Capacity Enhancement
  - Cooperative Radio Resource Management
  - Multi-cell Transmission based on Multi-antenna Scheme
  - Load Balancing and traffic optimization

- SDR (Software Defined Radio) to support multi-technology
Thank You