NTT DOCOMO RAN Migration Strategy

26 April, 2010
Takehiro Nakamura
Radio Access Development Department

NTT DOCOMO, INC.
**NTT DOCOMO**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established</td>
<td>1991</td>
</tr>
<tr>
<td>Employees</td>
<td>22,000</td>
</tr>
<tr>
<td>Stock listings</td>
<td>Tokyo, London, NYSE</td>
</tr>
<tr>
<td>Operating revenues (FY2008)</td>
<td>4,448 billion JPY (22.3 billion Euro)</td>
</tr>
<tr>
<td>Operating income (FY2008)</td>
<td>831 billion JPY (6.20 billion Euro)</td>
</tr>
<tr>
<td>Net income (FY2008)</td>
<td>472 billion JPY (3.52 billion Euro)</td>
</tr>
<tr>
<td>Market Share</td>
<td>50.8%</td>
</tr>
<tr>
<td>Subscriptions</td>
<td>54,601,000</td>
</tr>
<tr>
<td>Churn Rate (FY2008)</td>
<td>0.50%</td>
</tr>
<tr>
<td>ARPU (FY2008) (average revenue per user)</td>
<td>5,710 JPY (42.6 Euro)</td>
</tr>
</tbody>
</table>

*As of March 2009*

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**Japan’s Cellular Phone Market**

**Market share by subscribers**

*As of Dec. 2009*

- **DOCOMO**: 55.4 millions (50.1%)
- **KDDI**: 31.39 million (28.4%)
- **Softbank**: 21.66 million (19.8%)
- **NTT**: 2.12 million (1.9%)
- **Ee移动**: 1.14 million (1.1%)
- **mova (PDC)**: (end of 2009/12)
- **FOMA**:

**Historical subscriber growth**

*Extracted from TCA information [here](http://www.tca.or.jp)*

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Mobile Broadband Outlook for the Americas, Rio de Janeiro, 26 April 2010
Mobile cellular system migrates every 10-years.

Some improvements are conducted within a generation.

- **1G**: Analogue system
  - Low speed data communications
  - Voice
  - System migration
  - Improvement: 28.8kbps
  - Improvement: Packet transmission (9.6kbps)
  - Improvement: High capacity analogue system (suppressing radio bandwidth)

- **2G**: Digital system
  - High speed data communication
  - System migration
  - Improvement: 384kbps
  - Improvement: 14Mbps

- **3G**: IMT-2000
  - Global standard
  - System migration
  - Improvement: 14Mbps

- **4G**: Ultra high speed data communications
  - System migration

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**Improvement and migration of mobile cellular system**
In addition to providing means for communication, information access and life assistance, mobile phones will also assume the role of assisting customers’ individual behavior. DOCOMO will take on the challenge of advancing each of these roles.
• With a magnitude of functions, the concept of cellular phones is being changed to more than just a communication tool.
Growth of Packet Traffic in 3G

Most of packets carries HTML in PDC and i-motion, GIF and JPEG in FOMA. Ratio of i-motion is further increasing in the latest years.

Mobile Broadband Outlook for the Americas, Rio de Janeiro, 26 April 2010
**Network evolution**

- **HSUPA (HSPA):**Introduced in June 2009
- **LTE:**Planned for introduction in CY 2010 as one of the first adopters in the world

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**Continual evolution of 3G network**

- **W-CDMA**
  - DL: 384K
  - UL: 384K

- **HSDPA**
  - DL: 3.6/7.2M
  - UL: 384K

- **HSPA**
  - DL: 7.2/14M
  - UL: 5.7M

- **LTE**
  - DL: 300M
  - UL: 75M

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*1 abbreviation of Long Term Evolution.
*2 DL: Downlink  UL: Uplink
*3 Transmission rates described in the chart are max transmission rates defined in the standard specifications.
Handset/network collaboration by introduction of LTE

- Provide advanced services by optimizing the allocation of functions between handsets and networks, in particular to leverage the high-speed, low-latency, large-capacity properties of the LTE network.

Introducing LTE

Processing, memory, etc. to be split optimally between network and handsets
## Overall LTE Time Plan of DOCOMO

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tbody>
<tr>
<td><strong>3GPP Standardization</strong></td>
<td>SI</td>
<td>WI phase</td>
<td>▲ ▲ Core spec</td>
<td>▲ ▲ Test spec</td>
<td></td>
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<tr>
<td><strong>System Development</strong></td>
<td>▲ RFP</td>
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<tr>
<td><strong>Experimental System</strong></td>
<td>Development</td>
<td>Indoor/Field Experiments &amp; Demo</td>
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<tr>
<td><strong>Commercial System</strong></td>
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*Mobile Broadband Outlook for the Americas, Rio de Janeiro, 26 April 2010*
Field experiments have been executed in 3 cities in Japan to confirm LTE practical performance in variety of environments.

**Sapporo, Hokkaido**
- Started in October, 2008
- A single site, 2 sectors
- Urban environment
- 10 MHz bandwidth

**Kofu, Yamanashi**
- Started in August, 2008
- 2 sites, 6 sectors/site
- Suburban environment
- Up to 20MHz bandwidth

**Yokosuka, Kanagawa**
- Started in February, 2008
- 2 sites, 2 sectors/site
- Rural environment
- Up to 20MHz bandwidth
NTT DOCOMO field experiments

1. Sector 1
   - 4 Tx/2Rx
   - 2 sectors

2. Sector 2

BS#1
(DOCOMO R&D Centre)

BS1

BS2

- Sector 2
- Sector 1

NTT DOCOMO R&D center

Measurement course

Power delay profile

Residual block error rate

Throughput

Current Min Max

Rate[Mbps]

238.02 0.00 255.72

Rio, 26 April 20
### Overall LTE time plan of DOCOMO

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<tr>
<td>Commercial Deployment</td>
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<tr>
<td>Field trial</td>
<td></td>
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- DOCOMO will launch LTE as one of the leading operators in the world
  - To ensure the interoperability, we will keep watching the global status
  - DOCOMO’s plan is in line with that of other leading operators
- 1.5GHz band was assigned to DOCOMO for LTE
- Introduce LTE first using 2.1GHz band, and then expand to 1.5GHz band

<table>
<thead>
<tr>
<th>FY</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>201X</th>
<th>201X</th>
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<tbody>
<tr>
<td>1.5GHz band</td>
<td></td>
<td></td>
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<tr>
<td>1.5GHz band LTE</td>
<td>15MHz BW available for LTE nationwide</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2.1GHz band</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>2.1GHz band LTE</td>
<td>LTE with at least 5MHz BW</td>
<td>LTE with 10MHz or wider BW if available</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Others (800MHz band, 1.7GHz band, etc)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3G</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Number of Base stations</td>
<td></td>
<td></td>
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<tr>
<td>20,700 BSs (2GHz BSs+1.5GHz BSs)</td>
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</tr>
<tr>
<td>5,700 BSs (1.5GHz BSs)</td>
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Figures derived from the application based on the deployment plan.
**LTE system deployment scenarios**

- At the LTE launch,
  - LTE area will be overlaid over the legacy 3G area
  - LTE UEs will have legacy 3G functionality
  - Focus on PS services
    - CS services will be provided by the legacy 3G systems with CS fallback
  - Reuse of existing BS site for low cost deployment
- After LTE UEs and enhanced services become widely available
  - CS services will be provided by LTE on the PS domain
  - DOCOMO is also planning to smooth path to LTE-Advanced with simple NW for all services

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**Area Deployment Example**

**Simple NW for all services**

- CS&PS Services over Packet NW

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**Mobile Broadband**

- 2001-2010: Americas
- After 2020s
Field Trial

- DOCOMO is conducting Field Trial near by Tokyo.
- Following items are verified and confirmed in the trail.
  - Systematic confirmation using total LTE network nodes (multiples vendors)
  - Confirmation of connectivity and mobility functions
  - Confirmation of handover between 3G and LTE
  - Parameter optimization to maximize LTE performance
LTE trials and deployment

- **LTE Trials**
  - NTT DOCOMO conducted LTE indoor and field trials from July 2007 and February 2008, respectively.
  - Field trials are conducted in 3 cities in Japan to confirm practical LTE performance under variety of environment
  - The trial results shows satisfying high performance of LTE in terms of delay, throughput and stability

- **NTT DOCOMO’s views on LTE deployment**
  - NTT DOCOMO will launch LTE in 2010 as one of the leading companies of LTE in the world
  - LTE area will be overlaid with 3G area and LTE/3G dual mode terminal will be introduced in order to deploy seamless service area from the beginning of LTE launch
  - 2 GHz spectrum band will be used for LTE launch considering utilization of existing NW facilities and global roaming
  - LTE spectrum can be increased in the future according to wide spread of LTE terminals and new spectrum band allocation