Toward Wireless Broadband
- Objectives and Challenges -

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NEC Group at a Glance

Established: July 17th, 1899

Sales: US$ 32.3 billion (@US$1.00=JPY95)
(FY2012 ending March 2013)

Employees: 109,100 worldwide (as of April, 2012)

Segment sales 2012

- Public Business: 22.2% (7.2 billion dollars)
- System Platform Business: 24.2% (7.9 billion dollars)
- Telecom Carrier Business: 23.1% (7.5 billion dollars)
- Enterprise Business: 8.2% (2.8 billion dollars)
- Others: 22.3% (7.3 billion dollars)

*U.S. dollar amounts are translated from yen, for convenience only, at the rate of ¥95 = U.S.$1.
(As of March 31, 2013)
Business Domains and Their Chief Products and Services

For Public
- Public Safety

For Enterprises
- Industry Solutions
- Office Solutions

For Telecom careers
- Long Term Evolution Network Systems
- Submarine Cable Systems
- Compact Microwave Communications Systems

For Smart energies
- Energy Management System
- Electric Vehicle (EV) Charging Infrastructure
- Energy Storage System

Solutions
- C&C Cloud Infrastructure
- SDN Solution
- Bigdata

Products
- Server
- Unified Communications and Collaboration Solution
- PC/Tablet
- Display
- Internet Service
- Mobile Terminals

For: Public, Telecom careers, Smart energies

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To provide products/systems/services which are necessary for transformation of carrier service as a business partner.

- **Transport**
  - Submarine Cable system
  - Land Terminal Equipment

- **Access**
  - Wireless Base station
  - Mobile (3G,LTE), Femtocell, WiMAX
  - Mobile backhaul (MBH)
  - FTTH, ADSL etc

- **Services & Management**
  - OSS/BSS
  - Carrier/ISP Data Centers
  - Service Platform
  - SDP

- **Core Network**
  - SIP Server
  - IMS
  - Core Network
  - PASOLINK
  - Router/Switch

- **Metro Network**
  - Router/Switch

- **Home**
  - Enterprise

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Changes in Environment for Carrier Network

**Service Evolution and Growth**

- More mobile broadband users
- Smart-phones, Tablets, PDAs
- More connected devices (e.g. M2M)
- Growths of social media, e-commerce, IP-TV

**Social Responsibility**

- Disaster resilience
- Public safety
- Green Environment (lower power consumption)
Solutions for Data Traffic Explosion

Different solutions depending on where the bottle neck is:

- At the Access Network
- At the Mobile Backhaul Network
- At the Mobile Core Network

<table>
<thead>
<tr>
<th>Access</th>
<th>Mobile Backhaul</th>
<th>Core</th>
</tr>
</thead>
</table>

Fixed Broadband Access Network

Wi-Fi Access

LTE
3G
2G

WiFi AP
How can we cope with exploding data traffic?

- LTE alone does not give us spectrum efficiency improvement to accommodate the traffic.
- Additional spectrum is obvious option but may not be available or too expensive to obtain.
- Several technology advancement will improve spectrum efficiency
  - MIMO, Adaptive Array Antenna, Beam Forming, High order modulation, advanced interference reduction, etc.

<table>
<thead>
<tr>
<th>Spectrum</th>
<th>~700MHz</th>
<th>~3.5GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIMO</td>
<td>2x2</td>
<td>4x4</td>
</tr>
<tr>
<td>Other tech. advance</td>
<td>8x8</td>
<td></td>
</tr>
<tr>
<td>Traffic Offload</td>
<td>WiFi</td>
<td>Femto</td>
</tr>
</tbody>
</table>

64QAM/128QAM, Coding, Scheduling, CoMP, Relay, ICIC/eICIC, etc.

Maximum: 7.5 x
How can we cope with exploding data traffic?

- One option is to increase frequency re-use factor by introducing small cells (micro-cell, pico-cell, femto-cell)
  - C-RAN
  - Standalone small eNB

Video transmission optimization
- By dynamically controlling video data transmission synchronized with playback status at the User device, undesired data bust can be reduced

Another approach is to improve “traffic offload”
- WiFi offload
- In-door offload

We need to be creative in applying appropriate combination of various methods to obtain required traffic throughput.
NEC’s Small Cell/Het-Net Vision

NEC has concentrated our R&D resources addressing various issues associated with Small Cell/HetNet scenario from the beginning.

NEC’s Small Cell Access Solution provides superior algorithms for the following:

- Multivendor Het-Net
- Interference mitigation
- Load balancing
- Mobility management
Evolution of the network and NEC’s portfolio
NEC Fully Committed to Backhaul Technology Development
Continuously Challenging Future High Capacity Backhaul Solutions !!!

<table>
<thead>
<tr>
<th>Year</th>
<th>Subscriber</th>
<th>Base Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>iPhone Music download, Game download</td>
<td>HSDPA</td>
</tr>
<tr>
<td>2009</td>
<td>iPad Video download, On-line game</td>
<td>HSPA+</td>
</tr>
<tr>
<td>2010</td>
<td>iPhone4S Streaming, Real-time game</td>
<td>LTE</td>
</tr>
<tr>
<td>2011</td>
<td>iPhoneX 3D streaming, 3D game</td>
<td>LTE Advanced</td>
</tr>
</tbody>
</table>

Microwave Capacity (per-link)

- 10Gbps
- 1Gbps
- 100Mbps
- 128QAM
- 256QAM
- 512QAM
- 1024QAM
- 2048QAM
- 4096QAM

Capacity Improvement

- +11%
- +25%
- +38%

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NEC solution toolkit for small cell backhaul

NEC offers focused portfolio of products to address the challenges of small cell backhaul:

- **iPASOLINK SX**
  - Compact all-outdoor 60GHz radio
  - 50MHz channels (FDD)
  - AMR from QPSK to 256QAM
  - Capacity up to 330Mbps (at 440m)
  - Link distance up to 980m (at 82Mbps)
  - Low cost, simple I&C procedures

- **iPASOLINK EX**
  - All-outdoor 70-80GHz radio
  - 50/250/500MHz channels (FDD)
  - AMR from QPSK to 256QAM, XPIC
  - Capacity up to 1600Mbps (at 1.6km)
  - Link distance up to 3km (at 400Mbps)
  - Capacity roadmap up to 12Gbps

- **NLOS Radio**
  - Range of licensed sub-6GHz radios
  - Supporting wide range of frequencies
  - Capable of ~500Mbps
  - Carrier aggregation to be confirmed
  - Product selection based on use case

- **iPASOLINK GX**
  - Compact all-outdoor L2/L3 router
  - Switching capacity 12Gbps
  - 6 GE ports, 4 of which PoE supply
  - Packet QoS, OAM & Sync
  - Low cost local aggregation and mesh

- **WDM PON Integration**
  - Colourless injection locked GigE SFP
  - Optical TRx in Small Cell / Backhaul
  - No need for colour management
  - One SFP for all end points
  - No network layer 1 configuration

- **Software Tools**
  - Common OAM&P framework
  - One NMS for the complete toolkit
  - Bulk configuration downloads
  - Multi-technology planning tools
  - Intelligent resource management

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Empowered by Innovation

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Vodafone 2013-09-11
All LTE are not created equal!

Implementation will influence performance of the LTE performance

Coverage
Performance
Resilience
  • Stability
  • Reliability
Manageability

NEC’s Advantage

End-to-end Support
  • End to end product portfolio and integration experience

Superb Engineering expertise
  • Antenna
  • Amplifier
  • Modem technology
  • Radio propagation/performance simulation

Established maturity
  • Result of rigorous testing by one of the leading Operator

Full Range of Backhaul Solutions