The Experiences and Lessons from the Great East Japan Earthquake

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Overview of the Great East Japan Earthquake

Lessons from the Great East Japan Earthquake about telecommunication network infrastructure

Information delivery to the public in the Great East Japan Earthquake
Overview of the Great East Japan Earthquake

- The largest earthquake recorded in Japan
- 6 minute long tremor observed
- Destruction by Tsunami (the highest ever recorded in Japan)
- Tsunami caused fires
- Damage by liquefaction
- Subsequent Fukushima Daiichi nuclear power plant accident

Data of the earthquake

- Occurred on 11 March 2011, 14:46pm
- Moment Magnitude: 9.0
- Epicenter: N38.1, E142.9, Depth 24km
- Massive tsunami:
  - the maximum height of the water level: 9.3m
  - run up of tsunami wave height: 39.7m
  - total inundation area: 535km²
- Number of death or missing: about 20,000
- Number of completely collapsed houses: about 130,000
- Maximum number of evacuees: 450,000 (14th March, 2011)
- Direct economic losses: about 17 trillion Yen ($178 billion)

Based on Meteorological Agency materials
The Arrival of the Tsunami (Taro District, Miyako City)
Thanks for assistance from all around the world

Offers from 163 countries and regions, and 43 international organizations
Condolences expressed by more than 180 countries and regions, and more than 60 international organizations

As of October 17, 2011, survey by Ministry of Foreign Affairs Japan
Overview of the Great East Japan Earthquake

Lessons from the Great East Japan Earthquake about telecommunications network infrastructure

Information delivery to the public in the Great East Japan Earthquake
Voice traffic congestion (mobile network)

The traffic increased more than 10 times after the quake.

Estimated to be 60 times if the restriction was not applied.
Traffic Restrictions

Due to heavy congestions, carriers applied traffic restrictions.

Voice traffic was restricted by as much as 70-95%!

Packet traffic was restricted by 30% or no restriction.
Damage to Mobile Networks

Base stations collapsed or Backup batteries ran out

Cables cut off or Network duct destroyed

Backup generators ran out of fuel because of long power outages

Central office (housing building)

Transmission line relay station

RNC

Trunk exchange

Central office, customer building, etc. (relay building)

Base station

Communication cable

Area A

Area B
### Base station damages and blackouts

#### Number of off-the-air base stations

<table>
<thead>
<tr>
<th>Date</th>
<th>NTT docomo</th>
<th>KDDI(au)</th>
<th>Softbank</th>
<th>emobile</th>
<th>blackout in Tohoku region</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3/18</td>
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<tr>
<td>4/1</td>
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<tr>
<td>4/15</td>
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<tr>
<td>5/2</td>
<td></td>
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</table>

Peaked on March 14

#### Number of blackout houses [million]

- **NTT docomo**
- **KDDI(au)**
- **Softbank**
- **emobile**
- **blackout in Tohoku region**

The Quake Occurred

Aftershock (M7.4)
Over 80% of communications disconnection of fixed and mobile was caused by widespread and prolonged power outages.
<table>
<thead>
<tr>
<th><strong>Earthquake</strong></th>
<th>Preparation before the 3.11 disaster</th>
<th>3.11 problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Route diversity</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Tsunami</strong></th>
<th></th>
<th>Serious damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Flood prevention based on local government hazard maps</td>
<td></td>
<td>Unexpectedly high tsunami</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Congestion</strong></th>
<th>The services worked, but lack of awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Emergency message services (started after the Hanshin earthquake (1995))</td>
<td></td>
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</table>

<table>
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<tr>
<th><strong>Blackout</strong></th>
<th>Serious disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Emergency battery and generator</td>
<td>Unexpectedly long and wide-area blackouts</td>
</tr>
</tbody>
</table>
Countermeasures
(reported by Information Communications Council, February 17, 2012)

Ⅰ. Blackouts
- Generators/longer life batteries
- Disclosure of well-prepared facilities
- Base Station

Ⅱ. Disruptions of Lines/Networks
- Disruptions of lines/networks
- Building Disaster Center, etc.
- Disclosure of network congestion
- Vehicle/portable base station
- Deployment

Ⅲ. Tsunami/Flood
- Larger cell coverage
- Backup with geographically distributed facilities
- Authentication facility

Ⅳ. Traffic Congestion
- Call restriction
- Ordinary Mobile Phones
- Disclosure of network capacity

Ⅴ. Others
- PHS also available
- Thorough redundancy of network
- the latest hazard maps
- Authentication facility
- Switch

- Base Station Controller
- Operating Line
- Backup Line
- Micro Backup Line
- Building
- Operating Line
- Deployment
Example (Delivery) : ICT Disaster Management Unit

- ICT disaster management unit are radio communications equipment mainly transported to areas stricken by disasters for the emergency restoration of communications functions. Three types of ICT disaster management units are available; units of car type and attaché case type, both of which are referred to as MDRU (Movable and Deployable ICT Resource Unit), as well as units of container.

- The ICT disaster management unit incorporates functions to provide disaster management officials and disaster-affected residents of means of information communication, such as compact portable base stations and disaster-dedicate IP phone.

Characterized with high-quality infrastructure technology

- Possible to provide a minimum-required ICT environment (incorporating a compact portable base station, Wi-Fi network, and information processing server) immediately in case of disaster.

- Possible to transport easily because units of container type, car type, and attaché case type are miniaturized (and its contents are exchangeable according to needs).

- Possible to contribute to bridging the digital divide in villages not provided with electric power even in ordinary times by using solar panels.

Foreign case examples

- ITU, Ministry of Internal Affairs and Communications of Japan and Department of Science and Technology of Philippines signed a cooperation agreement for the joint project (in May 2014). Following this, the parties concerned have been working on the introduction of ICT disaster management units, including the start of a feasibility study using MDRU in the Philippines (in December 2014).
Overview of the Great East Japan Earthquake

Lessons from the Great East Japan Earthquake about network infrastructure

Information delivery to the public in the Great East Japan Earthquake
1. Usage of disaster prevention radio system (27 municipalities in coastal areas)
   Disaster prevention radio systems were used without any problem \(\cdots \cdots \cdot 10\)
   There were some problems in the usage of disaster radio systems \(\cdots \cdots \cdot 17\)

2. Reason for malfunction of DP radio systems (17 municipalities)

   - Destroyed by tsunami, etc.: 11
   - Ran out of battery power, etc.: 5
   - Ran out of fuel, etc.: 2

3. Alternative measures while DP radio system did not work (17 municipalities)

   - Volunteer fire corps, municipal information...
   - E-mail or FM radio etc.: 6
   - Paging after temporary repairs: 4
   - Paging from fire department: 1
   - No measures after the tsunami: 2
   - Realized malfunction later: 2
Survey on usage of disaster prevention radio system in the Great East Japan Earthquake

Lessons and solutions learned from municipalities affected by tsunami

<table>
<thead>
<tr>
<th>Suggestion</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengthen emergency back up batteries</td>
<td>24</td>
</tr>
<tr>
<td>Revision of information dissemination policy (contents, measures), education</td>
<td>17</td>
</tr>
<tr>
<td>Introduction of digital radio system</td>
<td>17</td>
</tr>
<tr>
<td>Diverse methods of information dissemination</td>
<td>15</td>
</tr>
<tr>
<td>Improvement of seismic design, relocation place less susceptible to tsunami</td>
<td>7</td>
</tr>
<tr>
<td>Establishment of a back up system</td>
<td>7</td>
</tr>
<tr>
<td>Revision of the emergency plan, drills</td>
<td>8</td>
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</tbody>
</table>
Measures to be considered based on Lessons learned from information dissemination to the public about disaster prevention radio system

【Strengthening information dissemination methods】
1. Emergency back up batteries for the radio system
   → Ensure that back up batteries last for at least 24 hours, by using generators, solar batteries, wind generators, high performance batteries, etc.

2. Introduction of a digital radio system, information dissemination in diverse methods
   → e-mail, FM radio, TV, introduction of a digital disaster radio system etc.

3. Anti-seismic design, relocation of equipment to places less susceptible to tsunami, etc., remote control for the radio system

【Revision of the emergency plan.】
4. More practical drills
5. Ensuring alternative measures to disseminate information, in case the disaster radio system is damaged
Thank you!

Ministry of Internal Affairs and Communications, JAPAN

(English)