

The Future of Mobile Internet Japan: Lessons from the 3.11 Disaster

December 8, 2011

Chairman of KDDI Corporation
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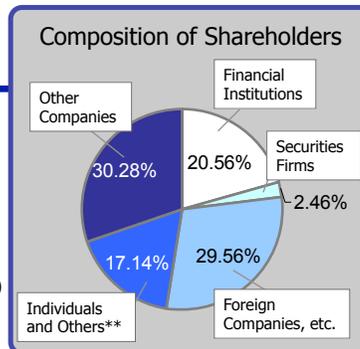
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1. Introduction to KDDI
2. Damage Caused by the Disaster
and the Impacts on Telecommunications
3. Human Behavior and Traffic Trends
4. Lessons from the Disaster

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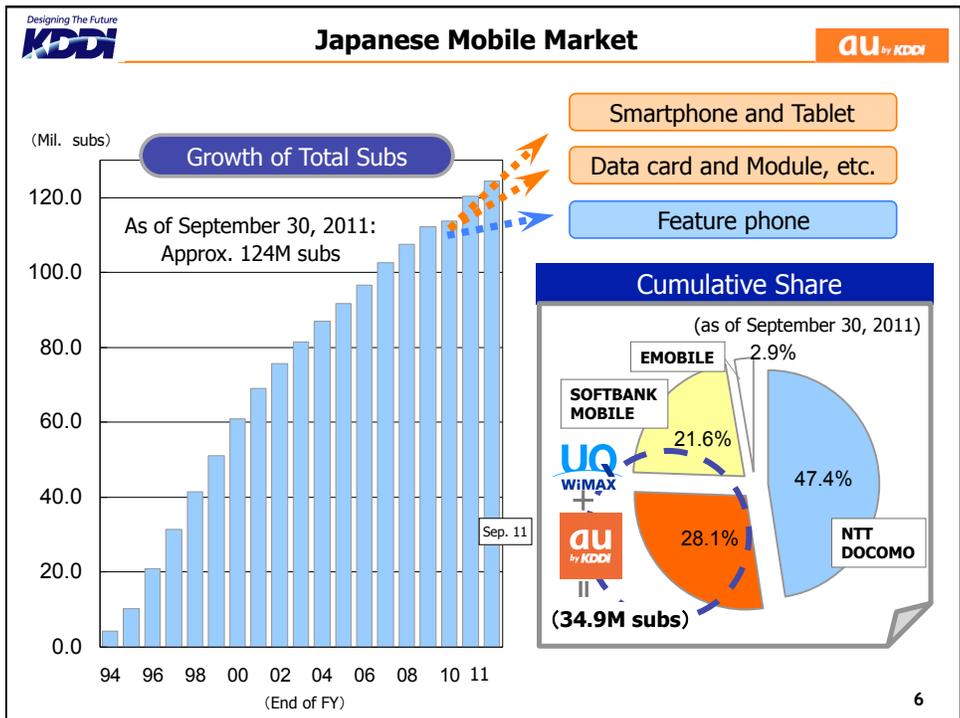
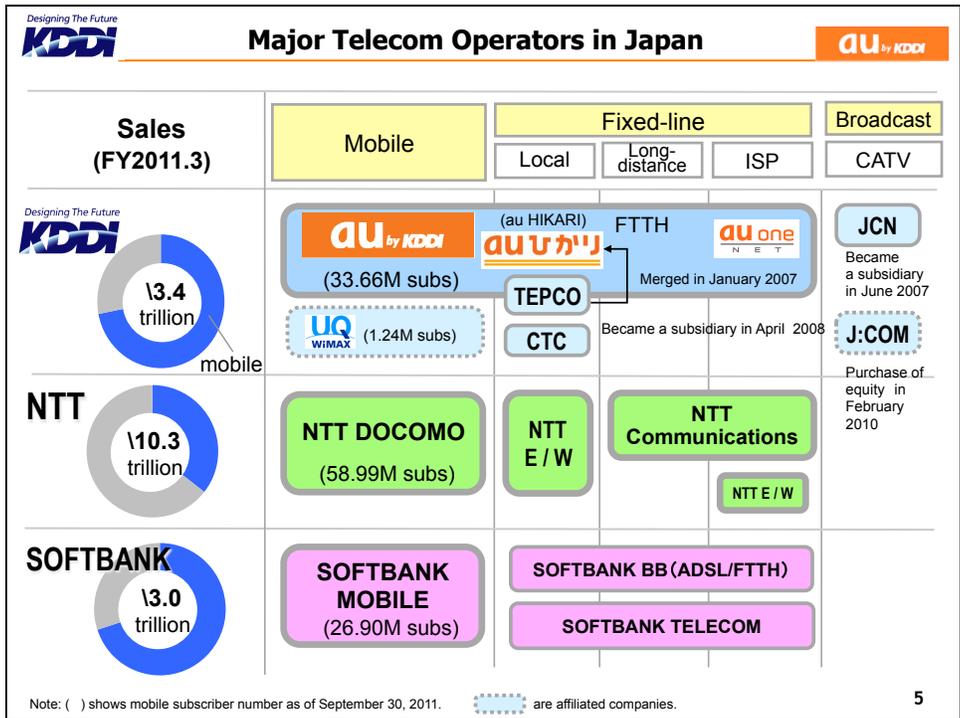
1. Introduction to KDDI

- **Date of Establishment** : June 1, 1984
 - KDDI was established upon a three-company merger (DDI, KDD, IDO) in October 2000.
 - **Capital** : 141,851 million
 - **Number of Employees** : 19,290 (consolidated basis)
 - **Ticker** : TSE 9433
 - **Market Capitalization** : 2,404 billion yen(@536k yen)
 - **Major shareholders** :
- | | |
|--------------------------|----------|
| Kyocera Corporation | : 12.76% |
| Toyota Motor Corporation | : 11.09% |



** Of which, own shares 13.3%

Note 1: As of November 30, 2011.
 Note 2: Ratio of controlling share.
 Note 3: The controlling stake % reflects only the acquired portion from TEPCO out of the total treasury stock reacquired on November 29 based on the shareholders' list as of September 30 2011.



2. Damage Caused by the Disaster and the Impacts on Telecommunications

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Comparing Two Major Earthquakes (1)

The Great Hanshin-Awaji Earthquake

- Date: Jan. 17, 1995
- Size : Magnitude 7.3
- Number of fatalities: 6,434
(About 80% were crushed)
- Number of missing: 3
- Total amount of damages: 10 trillion yen (*)

(*) Source: Papers by the Cabinet Office

Collapsing
houses and buildings

The Great East Japan Earthquake

- Date: Mar. 11, 2011
- Size: Magnitude 9.0
- Number of fatalities : 15,829 (**)
(More than 90% drowned)
- Number of missing: 3,686 (**)
- Total amount of damages: 16 to 25 trillion yen (*)

(*) Source: Papers by the Cabinet Office
(** *) as of Nov.1, 2011

Tsunami

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The Great Hanshin-Awaji Earthquake (1995)

- Most victims were crushed to death by collapsing houses and buildings with poor earthquake resistance.
- It took more than six months to restore the expressways and the Shinkansen bullet trains.

The Great East Japan Earthquake (2011)

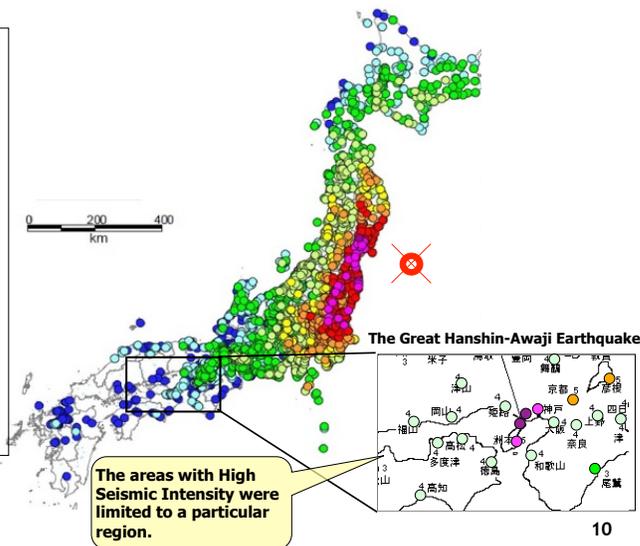
- Most houses and buildings were quake-resistant in the Tohoku area, since it had been predicted that a major earthquake would occur nearby in the near future. In fact, far fewer houses and buildings collapsed than in the Great Hanshin-Awaji Earthquake.
- The expressways and the Shinkansen bullet trains were almost fully restored within approximately two months.
- Serious damage was caused by the tsunami.
- Widespread blackouts and severe fuel shortages caused additional problems for locals.

Source: <http://www.bousai.go.jp/jishin/chubou/higashinohon/1/sub2.pdf>

The 9.0-magnitude earthquake occurred at 2:46, March 11, 2011.

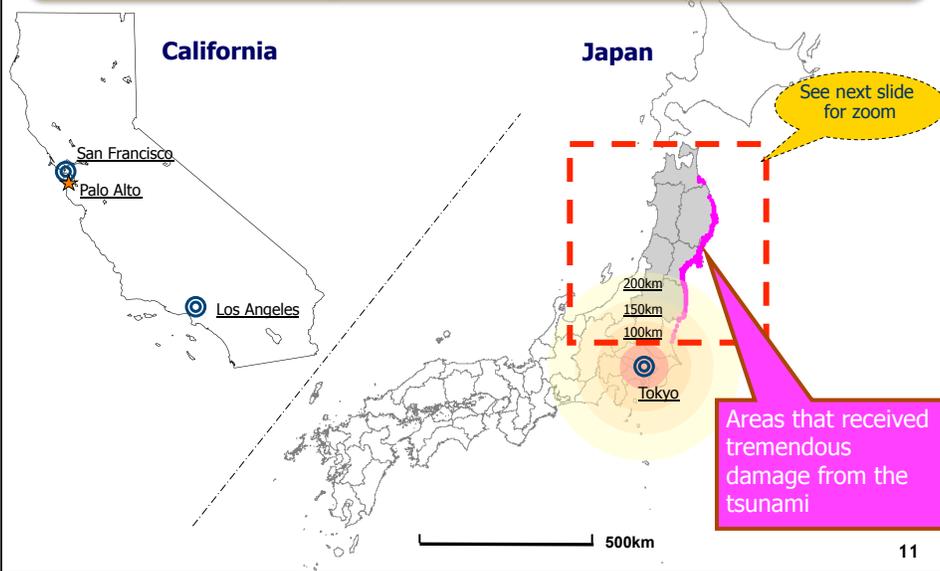
- Seismic Center

- Japanese Seismic Intensity Scale
 - Intensity 7 (Purple)
 - Intensity 6 upper (Pink)
 - Intensity 6 lower (Red)
 - Intensity 5 upper (Orange)
 - Intensity 5 lower (Yellow)
 - Intensity 4 (Light Green)
 - Intensity 3 (Green)
 - Intensity 2 (Light Blue)
 - Intensity 1 (Dark Blue)

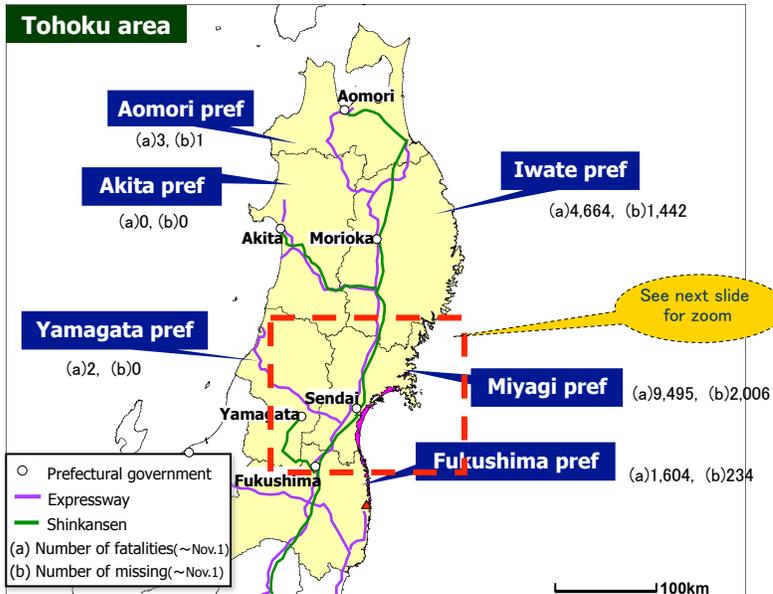


Tsunami Hit the Tohoku Region (1)

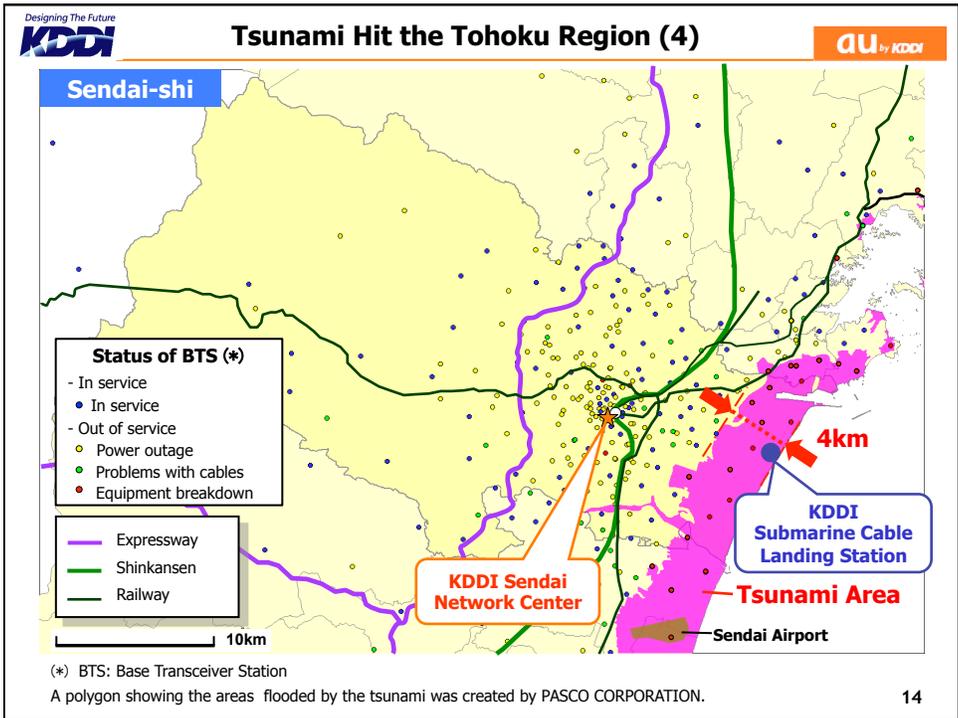
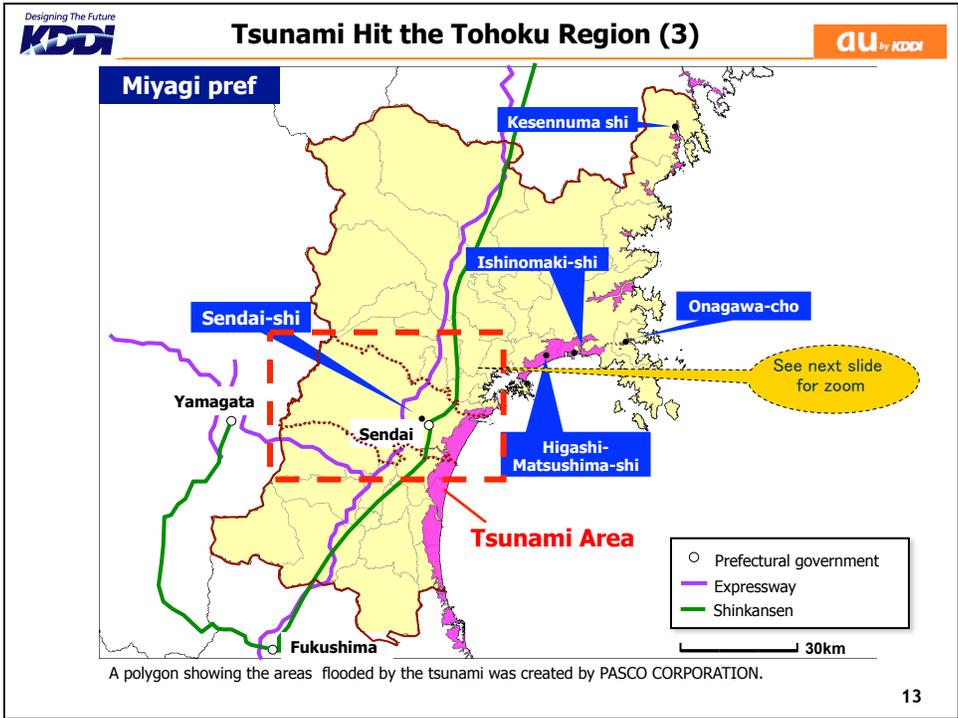
Approximately half an hour after the first earthquake, the tsunami began to hit the east coast of the Tohoku region.



Tsunami Hit the Tohoku Region (2)



A polygon showing the areas flooded by the tsunami was created by PASCO CORPORATION.
<http://www.kantei.go.jp/saigai/pdf/201111011700jisin.pdf>

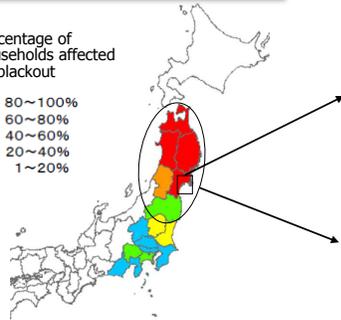
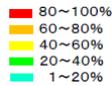


Massive Blackout

Immediately after the quake, a massive blackout occurred across a wide area, significantly disrupting telecommunications. It also hindered the gathering of information on the disaster.

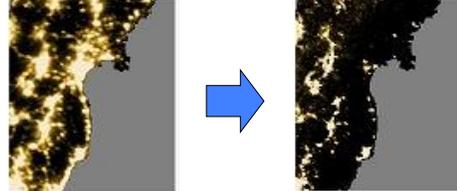
(1) Area of Blackout (3/11 20:00)

Percentage of households affected by blackout

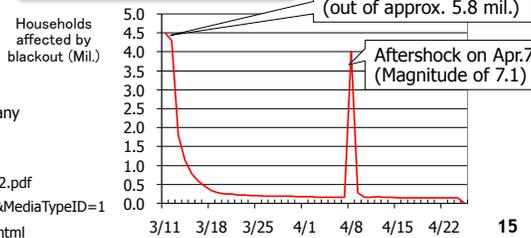


(2) Data taken from DMSP satellites (*)

Average Nighttime Lights Nighttime Lights on Mar.12, 2011



(3) Restoration of power (**)



(*) DMSP: Defense Meteorological Satellite Program
(**) In the areas served by Tohoku Electric Power Company

[Source]
(1) <http://www.bousai.go.jp/jishin/chubou/higashinihon/1/sub2.pdf>
(2) <http://www.nnvl.noaa.gov/MediaDetail.php?MediaID=697&MediaTypeID=1>
(3) http://www.tohoku-epco.co.jp/information/1182212_821.html

Severe Fuel Shortage

- Severe shortage of gasoline in the damaged areas.
- Long lines of people with tanks at gas stations.
- Long lines of cars trying to refuel at gas stations. Shortage of gasoline made it difficult to transport relief supplies.
- The situations had recovered in a few months.



[Source] CHUNICHI Web
http://www.chunichi.co.jp/ee/feature/photo/earthquake110311/i_025.html

[Source] asahi.com (March 15, 2011)
<http://www.asahi.com/special/10005/TKY201103150394.html>

- The shock of the quake directly caused damage, mainly to optical fiber cables.
 - Fiber cables for trunk transmission lines.
 - Fiber cables for access lines connecting customers.
- No direct damage from the shock on NC buildings, equipment housed within, or BTS, thanks to the earthquake-proof structures and deployment.

- Optical fiber cable cuts due to cracks on expressways
- Trunk transmission line: Tohoku Expressway



- Optical fiber cable cuts due to cracks on expressways
- Trunk transmission line: Joban Expressway



[Source] NEXCO East

- The unexpected scale of tsunami damaged the Sendai-higashi submarine cable landing station.



- A room inside the Sendai-higashi submarine cable landing station



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- Destructive damage to the Kamaishi Ryogoku BTS from the tsunami



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- Destructive damage to the Yamada Orikasa BTS from the tsunami



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- Destructive damage to the Naruse Ohama BTS from the tsunami



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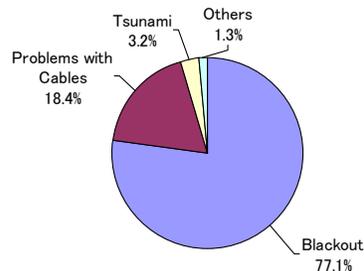
- Serious damage to the Kamaishi au shop



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- The blackout was the main reason why the Base Transceiver Stations (BTS) were taken out of service in terms of number.
- After the quake, the emergency batteries for the BTSs worked properly. However, the period of the blackout was so long that the batteries ceased supplying power due to the electric discharge before the blackout was restored.

Reasons	The number of BTSs taken out of service as of Mar.12 (*)	
Blackout	1,491	77.1%
Problems with Cables	355	18.4%
Tsunami	61	3.2%
Others	26	1.3%
Total	1,933	100%



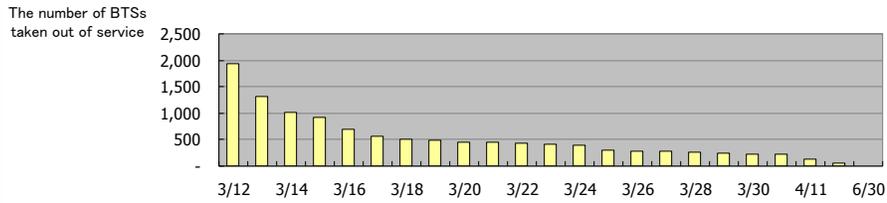
(*) In six prefectures in Tohoku.

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The mobile service coverage had almost fully recovered by the end of June, with the exception of the restricted area around the Fukushima I Nuclear Power Plant, utilizing satellite radio and land radio entrance line equipment.

	As of March 12 (maximum impact)	As of June 30
The number of BTSs taken out of service (*)	1,933 (Amongst 3,004 stations)	0

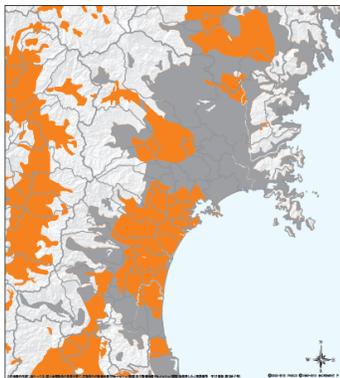
(*) In six prefectures in Tohoku.



Recovery of au base stations in six prefectures in Tohoku

	As of March 12 (maximum impact)	As of April 22
The number of BTSs taken out of service (*)	1,933	124

(*) In six prefectures in Tohoku.



March 12



April 22

- After the Earthquake



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- Clearance of Rubble



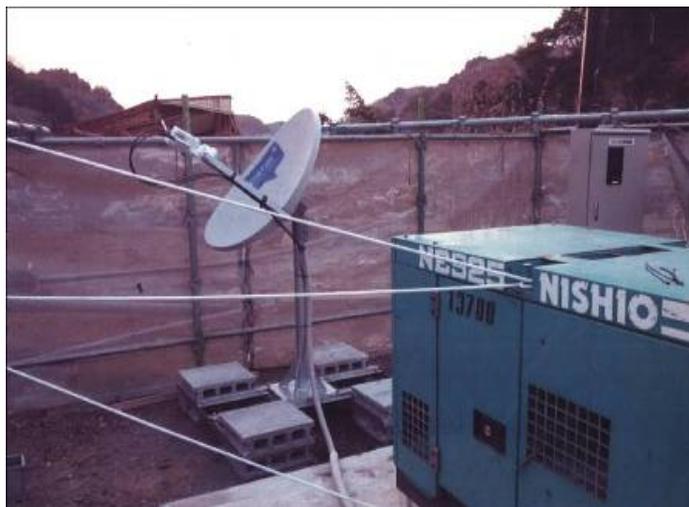
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- Radio Equipment / Power Supply



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- Satellite Service → Service Restoration



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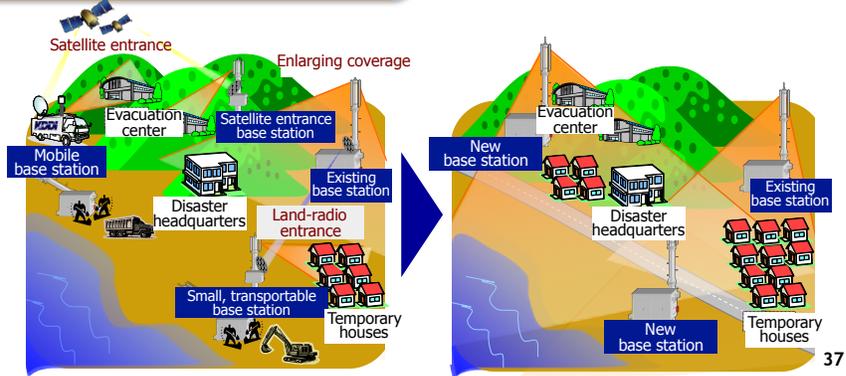
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Temporary Measures

- Enlarging the coverage area utilizing existing base stations
- Setting up base stations with satellite radio entrance line equipment
- Installation of mobile base stations equipped with satellite radio entrance
- Installation of small, transportable base stations equipped with satellite radio entrance
- Installation of small, transportable base stations equipped with land radio entrance

Final Measures

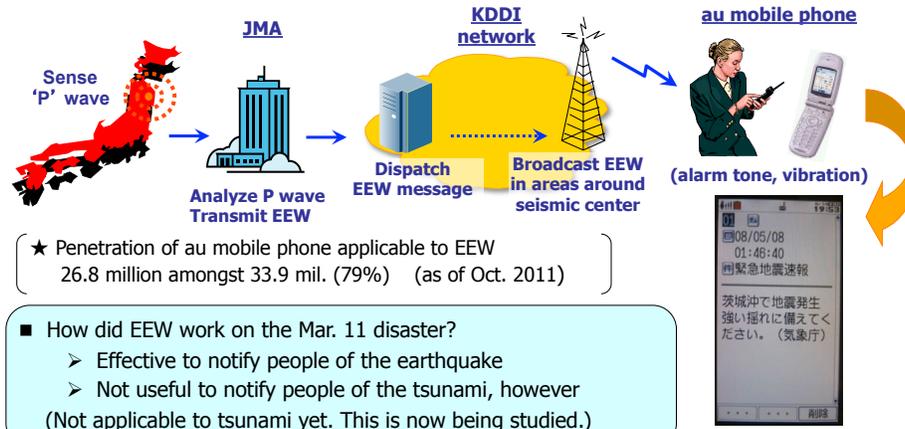
Recovery of the coverage areas with new base stations



3. Human Behavior and Traffic Trends

■ What is the earthquake early warning system? (Started from Mar. 2008)

- Broadcasting the Earthquake Early Warning (EEW) originated with the Japan Meteorological Agency (JMA) to au mobile phones in areas around the seismic center, free from congestion.
- An alert with a dedicated alarm tone, vibration, and display on a mobile phone screen.
- Only when a maximum Seismic Intensity Scale 5 lower or more is estimated, the EEW is broadcasted to areas where a Scale 4 or more is foreseen.



- The most commonly used media for people to receive information on the coming tsunami were community wireless systems followed by the radio (based on consolidated results from five surveys, as shown below).
- Many victims could have been saved if the tsunami warning could have been given in advance. (The tsunami came approximately 30 minutes after the earthquake.)

	Media	Rate
1st	Community wireless system	About 50%
2nd	Radio	20~35%
3rd	Loudspeaker by local government, police, fire fighting etc.	15~20%
4th	Family, coworker, neighbor, and acquaintances	10~15%
5th	TV, including one segment	8~9%



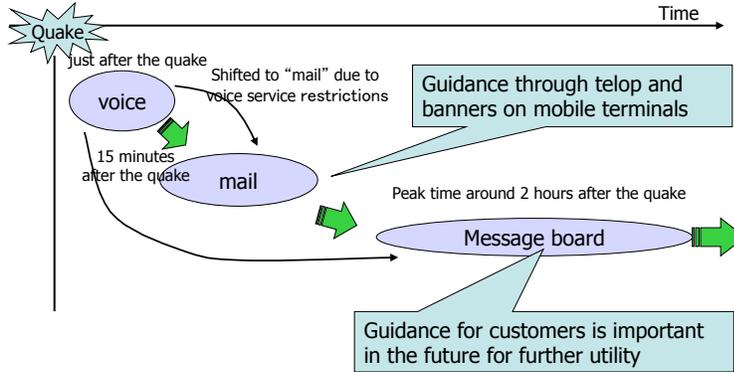
The method of providing information on tsunami is a future issue.
What can ICT do?

[Source]

- Comprehensive research into the roles of media in the Great East Japan Earthquake (the National Association of Commercial Broadcasters in Japan etc.)
- Questionnaire on the coast of Miyagi Prefecture about the Great East Japan Earthquake (Survey Research Center etc.)
- Prompt report on questionnaire about the tsunami following the Great East Japan Earthquake (Crisis & Environment Management Policy Institute etc.)
- Overview of Great East Japan Earthquake Survey - Reactions to Earthquake and Tsunami from 88,000 People Nationwide - (Weathernews)
- Survey on people's informational behaviors following the Great East Japan Earthquake (Information Support pro bono Platform (iSPP)) 40

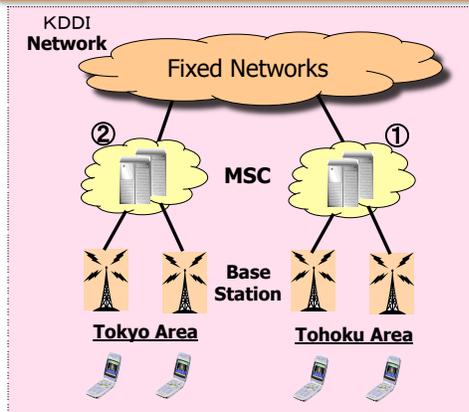
Transition to Use of Mobile Services

- After the earthquake occurred, people first rush to make voice calls, which is direct, real time communication, to confirm the safety of their friends and families.
- Next, they shifted to send e-mail 15 minutes after the quake, because they could not make a voice call due to traffic restrictions.
- After that, the number of registrations on disaster message boards increased by utilizing banner notices, etc. (The peak was around two hours after the earthquake.)



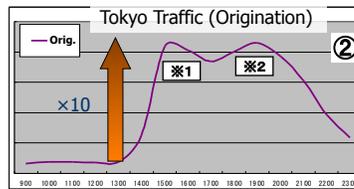
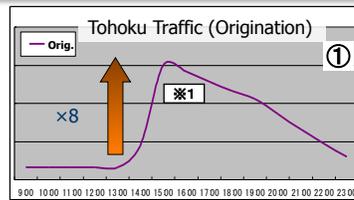
KDDI's Voice Traffic

- Burst traffic occurred just after the disaster, as people made "voice calls" to confirm the safety of their friends and family.
- With voice traffic restrictions, originating voice traffic was 8 to 10 times higher than usual. If traffic restriction ratio was 80%, it is assumed that the actual call generation was 40 to 50 times higher than usual.



MSC : Mobile Switching Center

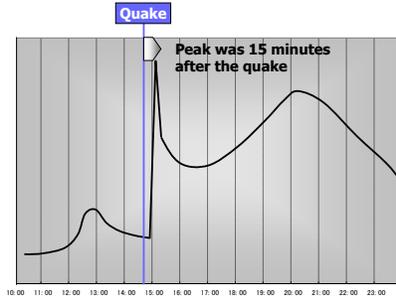
※1 : A traffic burst occurred just after the disaster. (It was 8 times higher than usual in Tohoku, 10 times in Tokyo.)
 ※2 : Another traffic burst occurred, when all public transport stopped.



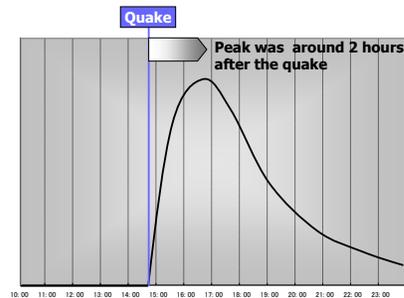
- E-mail traffic sharply increased, to around five times higher than usual after the quake.
- The number of accesses to the disaster message board peaked approximately 2 hours after the quake.

(Originated in Japan)

Mails in Japan

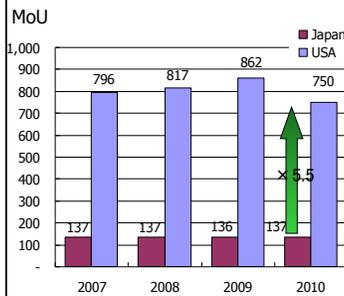


Disaster Message Board



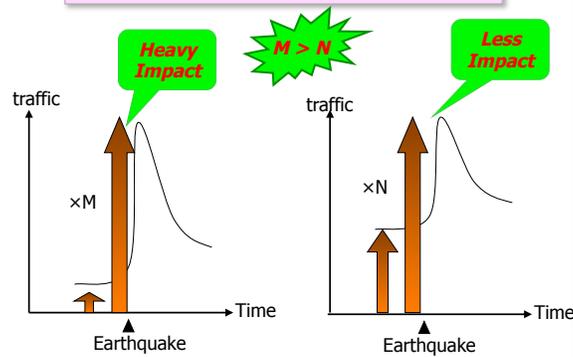
- The MoU in the USA is higher than that in Japan. (MoU: Monthly "Minutes Of Use")
- When a large earthquake occurs, the rate of increase in voice traffic immediately after the earthquake would be higher in Japan than in the USA.
- On this assumption, voice traffic congestion could be more severe in Japan than in the USA in a disaster. --> The traffic restriction ratio could be higher in Japan.

Comparison of MoU



[Source] Pyramid Research

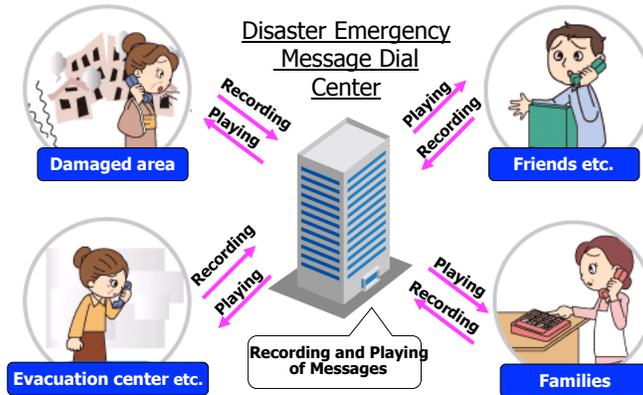
Sharp increase in voice traffic in a disaster



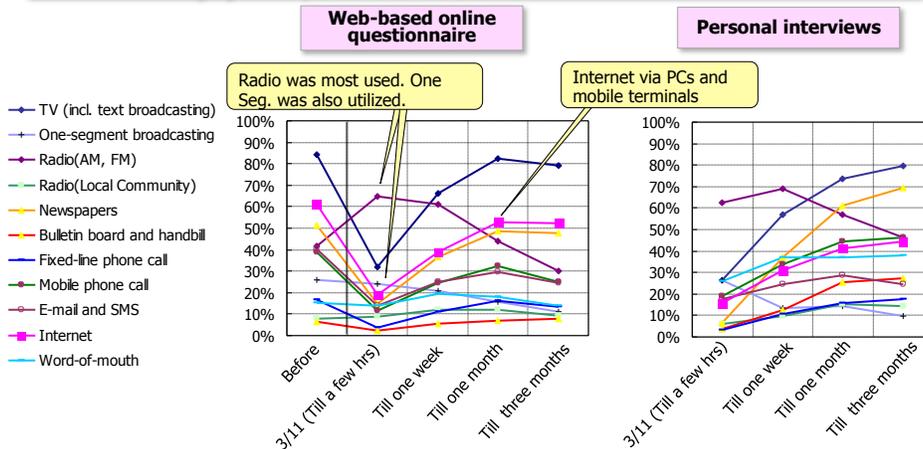
(a) In Japan

(b) In the USA

- “Disaster Emergency Message Dial” had not been fully used, even though the service itself was well prepared. The main reasons were:
 - Announcement of the service in advance was not sufficient.
 - Access to the system of this service via telephone networks was difficult due to voice traffic restrictions.



According to the survey results, the information sources which affected people found to be useful were changing in the period after the disaster.



The survey was carried out by iSPP in July in Iwate, Miyagi and Fukushima prefectures. It was a combination of a web-based online questionnaire, which received 2,815 responses, and personal interviews with 186 interviewees.

[Source] – Survey on people’s informational behaviors following the Great East Japan Earthquake (Information Support pro bono Platform (iSPP))
– The role of ICT during the disaster – A story of how Internet and other information and communication services could or could not help relief operations at the Great East Japan Earthquake (Izumi Aizu)

- In the period immediately after the disaster, radios were mostly used. The availability of TV, the Internet, and mobile services was not sufficient. One Seg was also used.
 - Radio and One Seg were used more than usual.
(Most radios were battery-operated.)
 - TV, the Internet, and mobile phones could not be fully used due to blackouts, damage to telecommunications infrastructure, and traffic restrictions etc.
 - In some cases, mobile services were available immediately after the disaster. After electronic power for a mobile phone or BTS ran out, service eventually became unavailable in a few hours or a few days after the disaster.

- As the Internet access was restored, extensive information about the disaster could be obtained over the Internet.

[Source]

Survey on people's informational behaviors following the Great East Japan Earthquake (Information Support pro bono Platform (ISPP))

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- Difficulty for content server operators to provide disaster information:
 - The items/formats of information on refugees as collected from evacuation centers and local government differed significantly. It took considerable time to provide a cross-sectional search service.
 - Since most of the information given by the local government is in the form of PDF files, it took time to process it. Secondary processing required manual entry, which took time to do.
- Problems with Social Media Services: Concerns about spoofing
- Gap in IT literacy: Possible disadvantage for people with low IT literacy
- Overconcentration of access traffic to a certain website: Need for mirror sites



An evacuation center

[Source] Union Forest Inc.

<http://www.union-forest.co.jp/home/news/110427i.html>

[Source] Extract from materials prepared by "the Working Group on the Usage of the Internet" conducted under "the Study Group on Maintaining Communications Capabilities during Major Natural Disasters and other Emergency Situations" set up by the Ministry of Internal Affairs and Communications.

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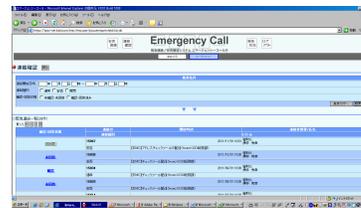
- KDDI had confirmed the safety of employees utilizing its web-based system on the following dates;
 - Employees: March 12 (1day after the quake)
 - Employees + Temporary employees: March 13 (2 days after the quake)
 - Employees' families: March 18 (7days after the quake)

EMC (Emergency Call)

Start Page



Confirmation Page
(Checking a colleague' s safety)



4. Lessons from the Disaster

- **Damages incurred by the disaster**
 - Quake-proof houses/buildings + Shinkansen bullet-trains with superior safety systems
 -> Number of victims due to collapse or derailment minimized
 - “Earthquake Early Warning System” <-> No “Tsunami Early Warning System”
 - Blackout & scarce fuel supply -> impact on communications infrastructure
 -> for people wanting information on the disaster
- **Improving telecommunications infrastructure**
 - Quick recovery
 - Robust at times of disaster
 - Blackout -> emergency batteries lasting 24 hrs
 -> expanding the zone of the BTS
 - Tsunami -> introduction of “Tsunami Early Warning System”
- **Utilizing telecom services/networks more efficiently**
 - “Voice call” -> the most important service immediately after the disaster
 - However, the capability of the existing voice network < entire traffic demand
 - “Voice mail” is useful.
 - Controlling traffic in packet networks (in the future)

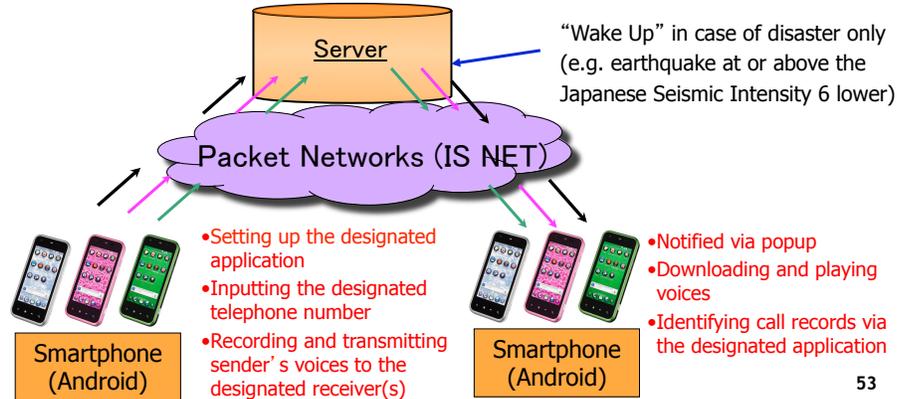
- **Devices / Media**
 - Radios / Broadcasting over mobile terminals -> useful (even in blackouts)
 - Internet / SNS -> useful for various purposes
 -> problems to be solved
 (e.g. collecting / processing information efficiently)
 - For people with low IT literacy -> Measures necessary
- **Information exchange / Mutual assistance in local communities -> effective**



What happens in the United States
 when a disaster occurs?

Emergency Voice Message Delivery Service

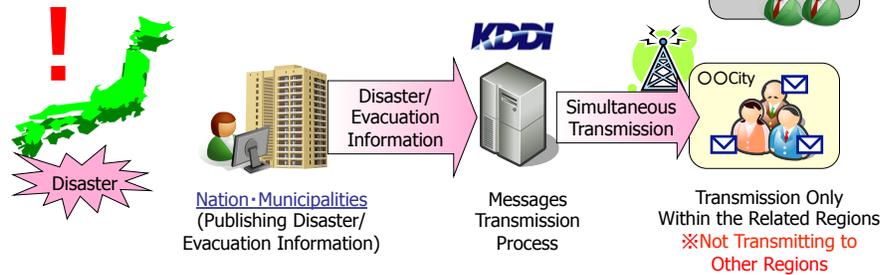
- When a disaster happens, it's almost impossible to assure 100% access to mobile voice communications.
- ⇒ We will propose an "Emergency Voice Message Delivery Service" via packet networks, instead of direct voice communication via circuit networks, for confirming the safety of friends and family.
 - Greater use of packets, Internet (PC) and fixed-line communications should be recommended.
 - We are already conducting activities to raise awareness of the use of "Disaster Message Board Service" via packet networks from mobile handsets.



Emergency Rapid Mail

[Emergency Rapid Mail “Disaster/Evacuation Information”]

- Simultaneous Transmission, like broadcasting
- Maximum 500 letters
- Transmission only within affected regions



- We would start the above scheme later on and after Spring 2012.
- We are now examining the inclusion of the “Tsunami” information published by the Japan Meteorological Agency to be simultaneously transmitted on this scheme.

- To save human life
- To maintain the minimum telecommunication service available by utilizing all measures (e.g. cognitive radio, Wi-Fi, traffic control)
 - In a normal situation => In case of a disaster
- To contribute to restoration and reconstruction
 - Mobile Internet
 - Joint activities among industry, academia and government
- To alleviate the disadvantages to people with low ICT literacy, in order to get enough support (e.g. foods and commodity)
- Cooperation between communications and broadcasting



We need to consider how to use ICT to resolve the above issues.

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- Business models are changing with each day, and there are many opportunities.
- It is important to work on something new.
 - You can understand that the social infrastructure is critical.
- Not only the (high) profitability of the business, but also contributing to society are important missions.

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Thank you