The Japan Society of Civil Engineers and the Institute of Electrical Engineers of Japan

Integrated Research & Survey Team on Disaster Mitigation using Information and Communication Technology
(Third Survey Team)

Summary of Urgent Recommendations
- Disaster Mitigation (Disaster Prevention and Disaster Reduction) Using ICT -

July 13, 2011

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Introduction

To date, the Japan Society of Civil Engineers has dispatched two survey teams in association with the City Planning Institute of Japan and the Japanese Geotechnical Society. The first survey team was dispatched to determine an overall perspective of the content and characteristics of the damage in the present earthquake covering an extremely wide area and a wide variety of topics, which would be reflected in future survey activities. The second survey team was dispatched with the objective of supporting the establishment of recovery plans. They carried out an on-site survey and provided recommendations on the basic concepts for establishing recovery plans, recovering safety, recovering lifestyles, and recovering industry (industry = employment = income).

In this third survey, the objective was to have specialists carry out a survey and make specific recommendations regarding "constructing a two-stage 'comprehensive disaster mitigation method (disaster prevention + disaster reduction) that includes 'disaster reduction measures' that are a combination of various hard and soft aspects (reduction of damage without harming human life and to ease recovery), in addition to the 'disaster prevention measures' used to date," as proposed in the second survey. In particular, it was considered important to propose the form of a comprehensive disaster mitigation method based on the local needs from the aspect of undertaking recovery plans, indicating specific policies sufficiently based on the current scientific and technical environment. This will include information communication and information processing technology for measurement, warning, etc., analysis and simulation technology for tsunamis and structures, technology for collecting, processing, and providing spatial information, vehicle usage environment, Information and Communication Technology (ITS), personal information devices, etc., based on the current scientific and technical environment. For this purpose the Japan Society of Civil Engineers linked up with the Institute of Electrical Engineers of Japan to provide specialists, and carried out a site survey that would embrace the fields of many learned societies, such as civil engineering, civil engineering planning, traffic engineering, urban engineering, electrical engineering, information communication engineering, etc.

The survey was not just a survey of the state of the damaged areas, but also included interviews with those in central, prefectural, city, town, and village government engaged in responding to the disaster locally, those responsible in communication companies, and those in central government departments and organizations responding to the disaster. On site we received a strong impression of the battle against the disaster waged by the various organizations with all their might in order to protect human life. We salute the painstaking efforts of the many people who worked at the sites of the disaster. Also, each organization objectively looked back on the disaster response over three months from the occurrence of the disaster, and rationally started to analyze what went well and what did not go well, and what should be learned for the future. From this we received many specific recommendations on measures that should be immediately reflected in the restoration of the disaster areas, and points to prepare for earthquakes that are envisaged to occur in the future.

From the voices at the disaster sites, we heard many opinions on the necessity of reviewing once again "infrastructure" and examining "disaster mitigation (disaster prevention + disaster reduction)." It is necessary to carry out the reconstruction with a balance between efficiency in normal times and redundancy in times of a disaster, and between centralized processing and dispersed processing, for the various infrastructure to protect human life, such as detection of tsunamis, communicating evacuation information, evacuation centers, securing evacuation

routes, etc. It is necessary to re-consider the introduction of the ideas of risk management in preparation for disasters that may occur in the future, and whether it is possible to re-construct infrastructure in stages, for the whole land of Japan, based on scientific opinions.

Also, when an actual disaster occurs, "escape" is very important for protection of human life, so it is necessary to swiftly detect the magnitude of the disaster, swiftly communicate evacuation information to as many people as possible, and to facilitate information sharing among those involved in rescue and recovery activities, using ITC. However, the important information is mainly managed by public organizations, and the methods of handling and processing the information at these organizations determines the quality of the information. In the future, in terms of developing disaster mitigation information communication infrastructure, it is necessary to remember that the public circuits that are the main communication network for communicating information to the public have actually been developed and operated as systems for commercial use.

What has been learned from the experience in this disaster is that it is indispensible for not only public organizations but also private organizations, including communications companies, to work together in cooperation in times of a disaster. For example, it has become clear that multi-faceted and multi-layered mutual relationships are necessary among central government and local governments, private organizations and local governments, etc. In addition, the information sharing that is a precondition for these mutual relationships has been simplified by the development of the internet, so truly it can be said that the time has arrived to develop a new "disaster mitigation" methodology.

Based on the above, we have decided to publish for comment emergency recommendations regarding the methods of use of ITC, system design, development of new technologies, etc., after organizing the change in status of recovery from the disaster with time, and focusing on the variation in the content of the information demanded as these changes in status. It is my hope that these recommendations will be studied for incorporation into future recovery activities, as well as used at least as a springboard for discussion regarding introduction in areas where earthquakes are anticipated in the future, and also for introduction into areas throughout the world that are exposed to seismic hazards.

Hironao Kawashima
Leader of the Third Survey Team
Japan Society of Civil Engineers

CONTENTS

1. Matters Concerning New Thinking

(1) Re-construction of infrastructure with awareness of national security

- It is necessary to re-construct the infrastructure with awareness of national security in order to guarantee the safety of all the residents of Japan and ensure the lifeblood of the global economy, recognizing that Japan is located on fragile national land.

- It is necessary to introduce methods of risk management for the re-construction, including airports and ports that become bases for rescue operations, the main road network that form the routes for emergency transport and traffic, information and communication networks, the electrical power system, urban planning, etc., based on a balance between concentrated and independent dispersed systems to ensure both efficiency in normal times and redundancy in times of disaster.

- Also, it is important to ensure compatibility and interoperability of equipment and machinery to enable use and operation throughout the country.

(2) Introduction of "disaster mitigation measures" to further improve safety and security

- "Disaster resistance" includes the two stages of disaster prevention and disaster reduction. It combines the concept of disaster reduction which includes reduction of damage without harming human life to ease recovery with the conventional concept of preventing disasters in advance. It is necessary to carry out "crisis management" from the point of view of disaster resistance.

- In order to protect human life, "escape" is important. The know-how accumulated to date on disaster response should be combined with the latest information and communication technology to expedite detection of the scale of a disaster, determine the damage to evacuation routes, and guide evacuation, to lead the world in disaster mitigation measures.

- In particular, it is necessary to summarize the content and flow of information that changes at each turning point of time after occurrence of a disaster, and discuss what information should be shared when, to what extent, and until when, and to clearly define the procedures and processes for organically linking with the relevant organizations.

(3) Use of ITC to re-define the roles of private citizens and organizations, local government and central government

- It is necessary to create a network to enable private companies, NPOs, and government organizations to organically work together and carry out activities, and to have systems for distributing information. In particular, the official function of private organizations and NPOs in disasters should be skillfully utilized.

- It is important to utilize ITC to enable diverse organizations to link together and carry out activities easily, based on the concept of "self-help, mutual help, and public help" for safe evacuation of city residents and lifestyle support.

- Development, management, opening, and restoration of infrastructure is an important role, so organizations that can act independently should be enabled to link with each other more closely, and further speed up disaster measures.

(4) Organization of vehicle use and probe information use

- The use of vehicles during evacuation is determined according to the area. The use of vehicles during evacuation depends on the topography and the situation regarding the roads, so careful examination is necessary. However, the use of flat lands along the coasts, vehicles for evacuating the elderly and the handicapped, and new personal mobility devices should be investigated.

- The probe information of vehicles is important for confirming evacuation routes and supporting road-opening activities. Therefore a network should be develope so that government and private organizations can cooperate in collecting and providing this information not only during normal times, but also in emergencies.

- After studying the operation of complex combinations of road traffic information provision, such as broadcast type, communication between vehicles on a road, communication between vehicles, etc., measures such as modification of systems to achieve this communication should be examined.

(5) Verification test on model cases and early introduction

- For introduction of disaster mitigation measures, model cases should be set within the Tohoku region, the views of industry, government, and academia should be collected, and the measures introduced while verifying the advantages and disadvantages for disasters and normal times. In this case, it is necessary that the use of ICT should be the day-to-day work of the regions, and measures should be taken so that it will result in revitalization of people's lives.

2. Matters that Should be Undertaken Soon

(1) Preparation for rapid support activities by concluding disaster mutual support agreements

- Mutual functional support agreements between central, prefectural, city, town, and village governments, communication companies, construction companies, transport companies, and NPOs are provided. A framework should be constructed so that the necessary mutual relationships between relevant organizations can be reviewed in advance and the criteria to be implemented are clarified, to enable a wide-ranging cooperative system to be put into operation.

- In particular, the loss of the administrative function of a fundamental local government body would inflict a major blow to the residents' lifestyle support.

Therefore, mutual support agreements should be concluded in advance among fundamental local government bodies (preferably remote and alternatively central government organizations, etc.) could also be considered concerning the supply of support goods during disasters, work support, mutual supplementing various administrative data, etc.

(2) Creation of a network to ensure emergency communication under limited communication

- It is imperative to create a network for cooperation in information, such as information exchange, mutual use of CCTV images, etc., among disaster related organizations that have their own circuits, so as to improve the efficiency of disaster activities.

- In order to avoid congestion of public circuits, there should be links between safety confirmation systems, restrictions on conversation times, and packet communication of voice, etc.

- Ensuring priority for communication on public circuits for government organizations associated with evacuation, restoration, and rescue, in particular, those associated with local prefectural governors and government staff should be studied, and the architecture of the communication network should be investigated, including the terminals to enable it, base stations, relay stations, etc.

- Sharing information systems in normal times and in disasters, increasing the efficiency of work processes such as standardization of software used, etc., creation of specialist organizations to support these, and training systems should be investigated.

(3) Use of roadside stations, SA/PA, etc., as bases for evacuation and supply transport

- Roadside stations, the areas near ICs, etc., have functioned effectively as evacuation locations and bases for transport of emergency goods. However, chaos has occurred in information communication due to loss of information communication functions and power supply, etc. Therefore, there should be agreements made soon with communication companies regarding improvement of reliability such as duplication of information communication functions, and rapid recovery of mobile phones, etc. It is also important to utilize ports, airports, river disaster prevention bases, etc.

- Investigations should be carried out to ensure independent power supplies, such as natural energy, etc., as well as improvement in the disaster prevention function by small scale broadcast functions like mini-FM, etc., and they should be deployed in a planned manner during normal times with a view towards disasters so that their use in both normal times and disasters is achieved.

(4) Provision of road traffic information at crossroads, etc., to eliminate traffic bottlenecks

- Re-construct traffic signal systems to function even when there is loss of power supply and loss of wireless communication, in order to eliminate congestion and chaos at crossroads due to breakdown of traffic signals, and introduce evacuation guidance systems at crossroads using wireless or information boards, etc., using new traffic management systems that have already been developed.

- The relevant organizations should cooperate and proceed to deploy the necessary equipment so that telematics, probe information by ITS spots, and CCTV images can be used from the beginning, not only in normal times, but also based on the necessity during disasters.

- The roundabout, which is popular throughout the world, is a method of processing traffic that is not affected by loss of electrical power during a disaster, as it does not require traffic signals, so they should be introduced soon at crossroads with little traffic.

(5) Ensuring various power supplies for the main disaster mitigation bases and the use of electric vehicles

- Development of emergency power supply systems and diverse power supplies and storage systems in accordance with the locality, using micro-grid technology and electric vehicle (EV) mobile power supply function to ensure diverse power supply sources, in addition to battery facilities, at bases such as evacuation centers, public facilities, roadside stations, etc.

3. Matters Requiring Urgent Technical Development

(1) Improvement of tsunami detection systems

- If tsunami detection can be carried out on the ocean as far from the coast as possible, it will be possible to ensure that much extra time for evacuation. Therefore accurate wave meters with a communication function should be developed.

- The method of providing data to local governments for making decisions on evacuation warnings, etc., should be investigated and urgently implemented, such as duplication of marine communication networks and terrestrial communication networks to improve the dispatch of information to the Japan Meteorological Agency.

- It is necessary that the developed wave meter be deployed in a planned manner, in coordination with the relevant organizations responsible for coastal management.

(2) Advancement of a network for collection, processing, and sharing structural damage information

- In order to rapidly ensure emergency transport routes and enable emergency recovery activities, it is necessary to rapidly determine the damage to structures. After setting a priority on structures, sensors should be placed at critical locations where it is expected that damage would be large in a disaster, so that the damage can be detected, and it is possible to rapidly determine the damage.

- For introducing these systems, research and development is indispensible for technical development of sensors, etc., and to enable the maintenance cost to be greatly reduced by using them in normal times.

- For effective utilization in disaster response, the system should be combined with advanced technologies such as real time simulation, etc., and it is necessary to have technical development for information sharing, development of databases for sharing information among government organizations, and training of in-house engineers, etc.

(3) Investigation of logistics strategies for support supplies

- Chaos has occurred between information communication for essential supplies and coordination of support supplies. Private organizations (home delivery companies, etc.) and NPOs have high capabilities in these logistics operations, so a network for participation of private companies and NPOs using the most advanced information communication technologies should be investigated, and implemented as soon as possible.

- On the other hand, it is necessary to study the distribution of goods in the present disaster, determine the changes in needs for support goods with time from the occurrence of the disaster, and create a network for strategically delivering the necessary goods to the disaster areas.

- It was very difficult to determine routes on which large trucks carrying emergency supplies could travel. It is necessary to create a network using probe information, road foundation map information, VICS information, etc.

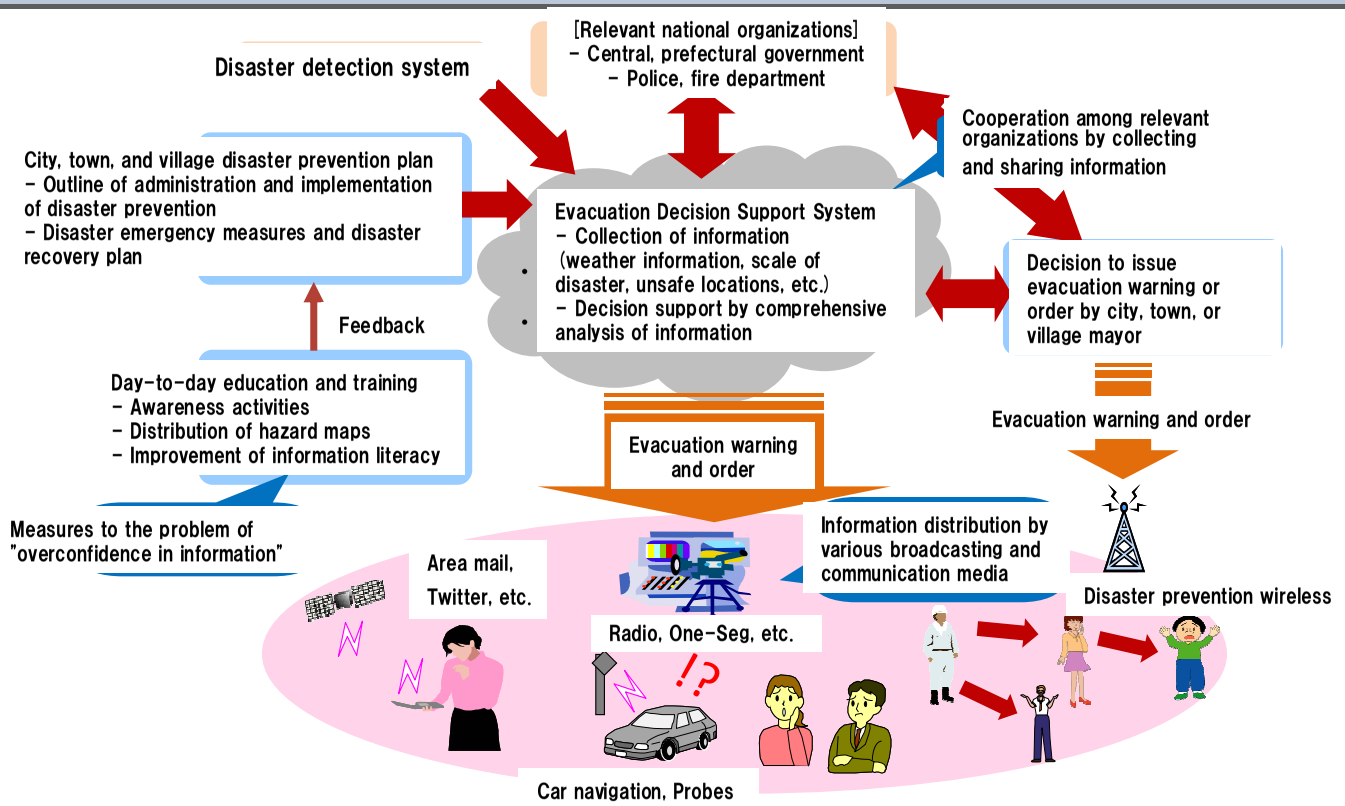
(4) Investigation of measures to the major congestion envisaged due to damage in major urban centers and ensuring emergency traffic routes

- Simulation technology to ensure emergency traffic in major cities should be developed as soon as possible. This includes determining the a network of start of congestion caused by the inflow of vehicles onto normal roads due to the closure of expressways, problems of closure of level crossings due to electrical power stoppages, and the occurrence of congestion in urban areas due to inability of making a left or right turn because of a large number of pedestrians at the intersections. In addition, measures for ensuring emergency traffic routes by simulation based on various scenarios should be investigated.

Disaster Mitigation Measure Package Using ICT (Examples)

(1)Proper Decisions and Rapid Evacuation

- Creation of a network for information collection and sharing by linking with the relevant organizations, so that local governments can issue proper evacuation warnings and instructions to the residents
- Creation of a network to enable information communication to the residents under various circumstances, based on the characteristics of diverse broadcasting and communication media
- In the present disaster there were many cases where "placing too much confidence in information" meant the difference between life and death, so education and training is necessary in normal times

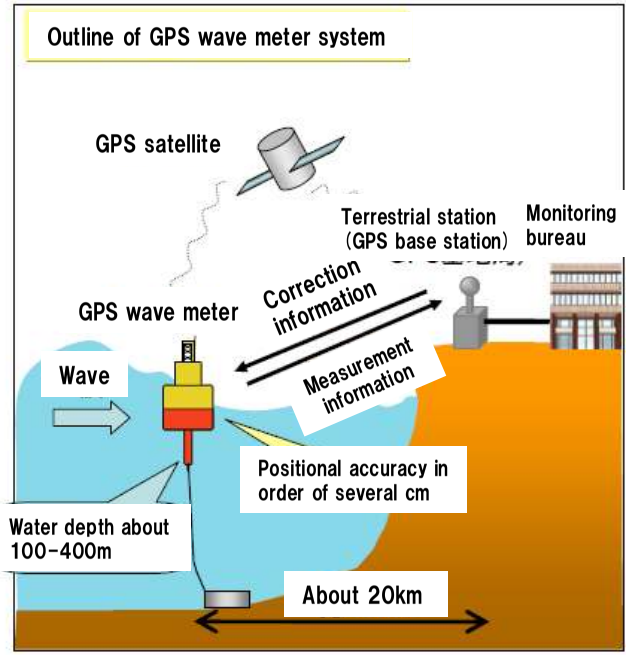


Collection and supply of information for evacuation

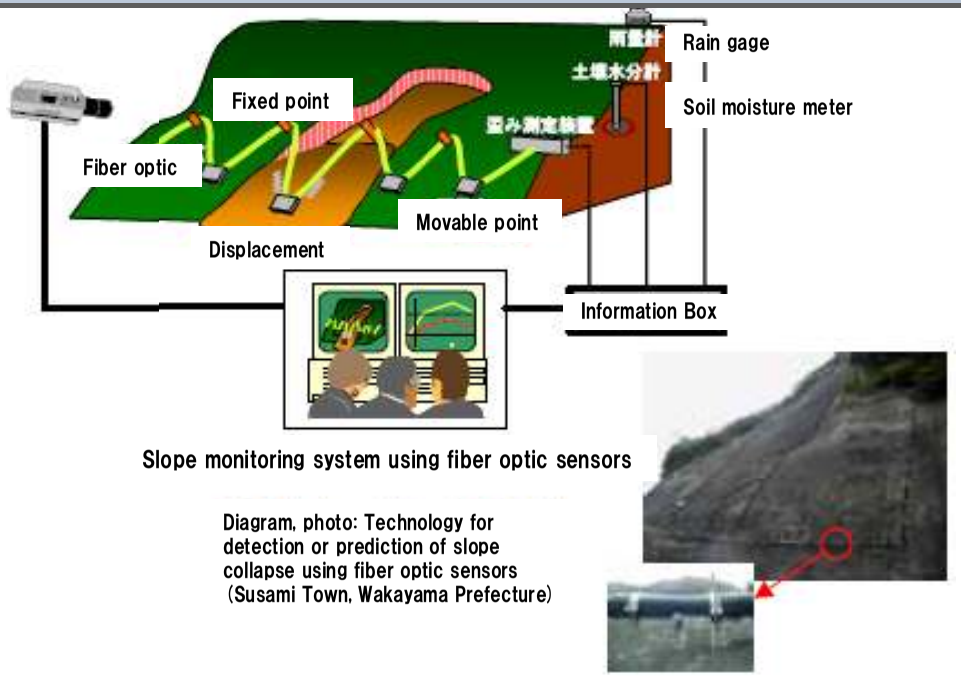
(２)Advanced Detection Systems

①Advanced tsunami detection systems
- Development of a detection system using GPS wave meters, etc., as a network based on links among relevant organizations
- Ensuring the necessary communication networks and sharing the data collected

②Advanced a network for collection, processing, and sharing structural damage information
- After setting priorities, detect damage to critical structures, in order to determine the damage to evacuation routes, etc
- Promotion of technical development and installation of sensors that can also be used for maintenance management



GPS Wave Meter
(Document from Port and Airport Research Institute)



Slope monitoring system using fiber optic sensors

Diagram, photo: Technology for detection or prediction of slope collapse using fiber optic sensors (Susami Town, Wakayama Prefecture)

Example of monitoring system using fiber optic sensors
(document from Ministry of Land, Infrastructure, Transport and Tourism)

(３)Road Transport Management for Recovery and Restoration

①Construction of signaling system with disaster mitigation design
- Ensuring power supplies to signaling systems using solar light or batteries at the main crossroads, and development of independent and dispersed signal network
- Introduction of roundabouts for crossroads with little traffic and investigation of a network for information provision

②Use of probe information
- Collection of probe information and provision of evacuation information during a disaster by new traffic management systems, telematics, and ITS spots
- Use of probe information to determine the routes that can be used by emergency vehicles

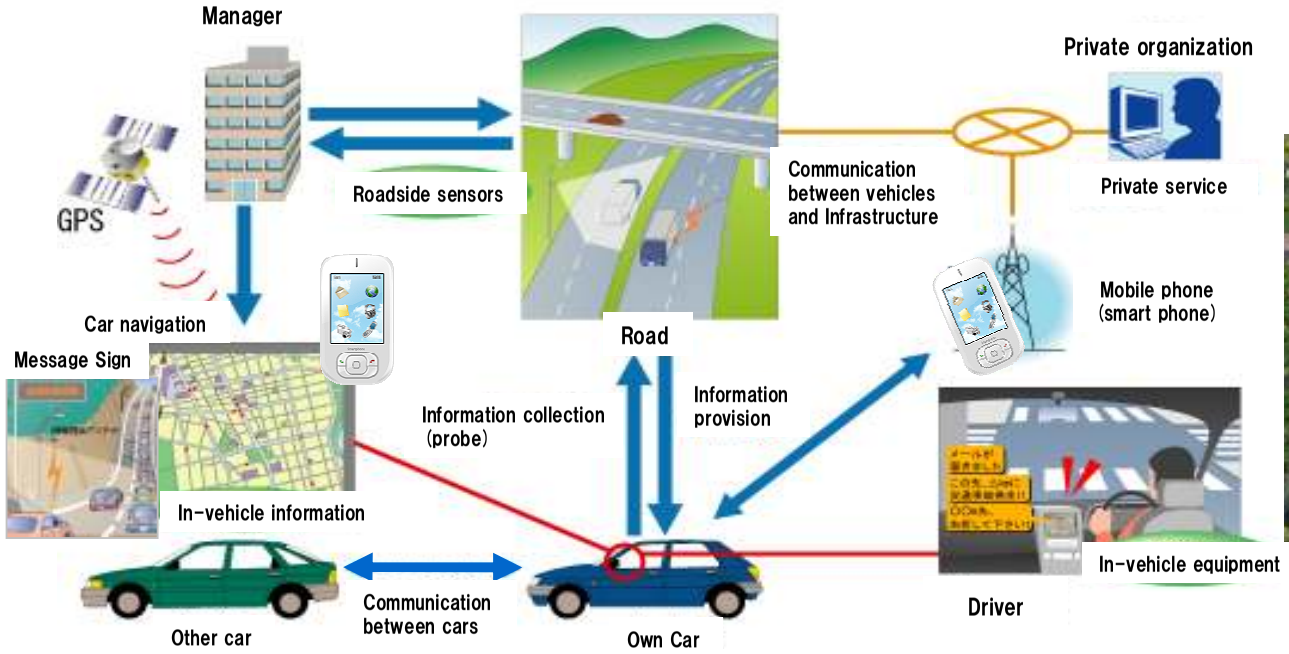


Image of real time traffic information collection and provision

Image of roundabout

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Reference Document Damage, Recovery Status

The Great East Japan Earthquake that occurred on March 11, 2011 inflicted great damage on the infrastructure of Japan, such as the information communication infrastructure, roads, etc.

As a result of the great efforts of those involved, emergency restoration was carried out as rapidly as possible, but base stations became inoperative after the disaster due to the effect of power stoppages, so phones could not be used over a wide area including Kanto, etc., and not only the area affected by the damage. Thanks to the accelerated opening activities, emergency vehicles were able to reach their destinations.

The following is an outline of the damage status in the infrastructure fields, such as information communication field, roads, etc., for reference with these recommendations.

(1) Information Communication Field

1) Damage status and congestion status on fixed and mobile communications

- A total of about 1.9 million fixed communication circuits were damaged. Restrictions were implemented on a maximum of 80-90%.

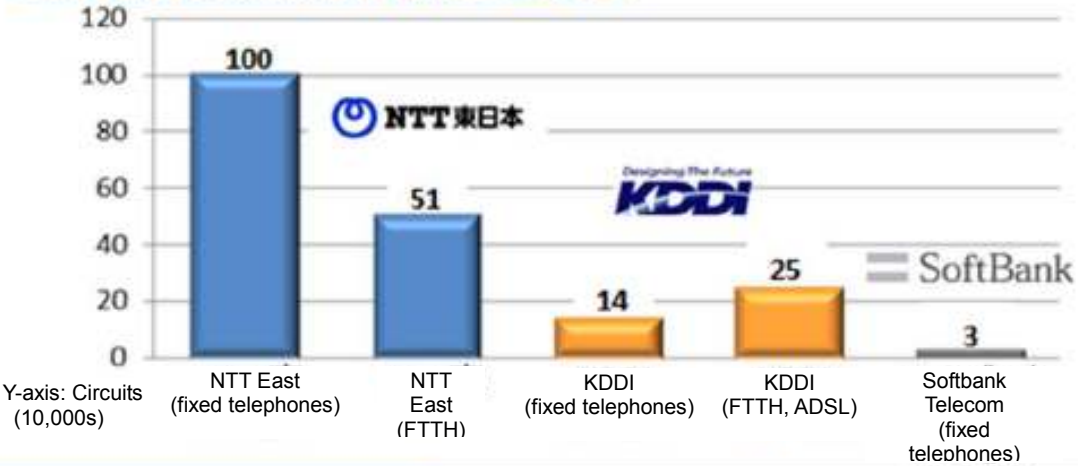
- In mobile communications operation of a total of about 15,000 base stations were stopped. Although for voice restrictions were implemented on a maximum of 70-95%, the restriction status for packet communication was 0-30%.

Fixed Communications

Damage Status

■At the peak, a total of about 1.9 million communication circuits were damaged.
■NTT had recovered by the end of April, apart from a part of the area

<Maximum number of damaged circuits (from survey by Ministry of Internal Affairs and Communications)>

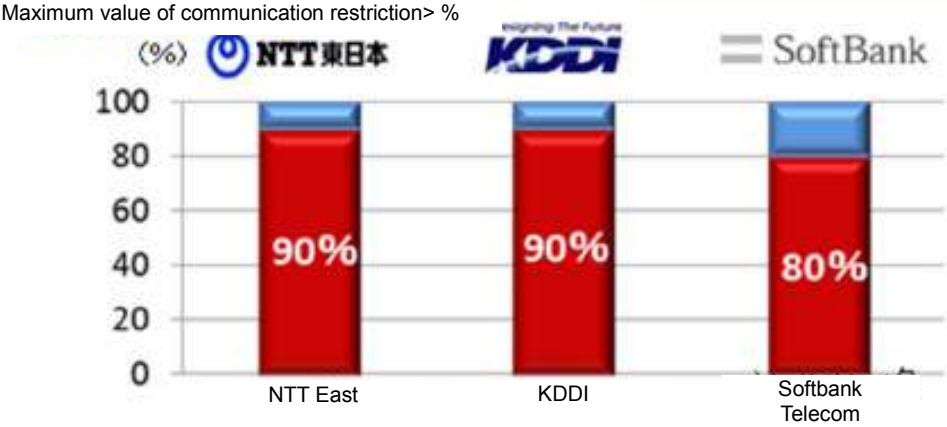


Congestion caused by communication concentration

(注)専門用語では「輻輳(congestion)」という。

■Each company implemented a maximum of 80-90% restriction on communication requests arising on fixed telephone,

<Maximum value of communication restriction> %



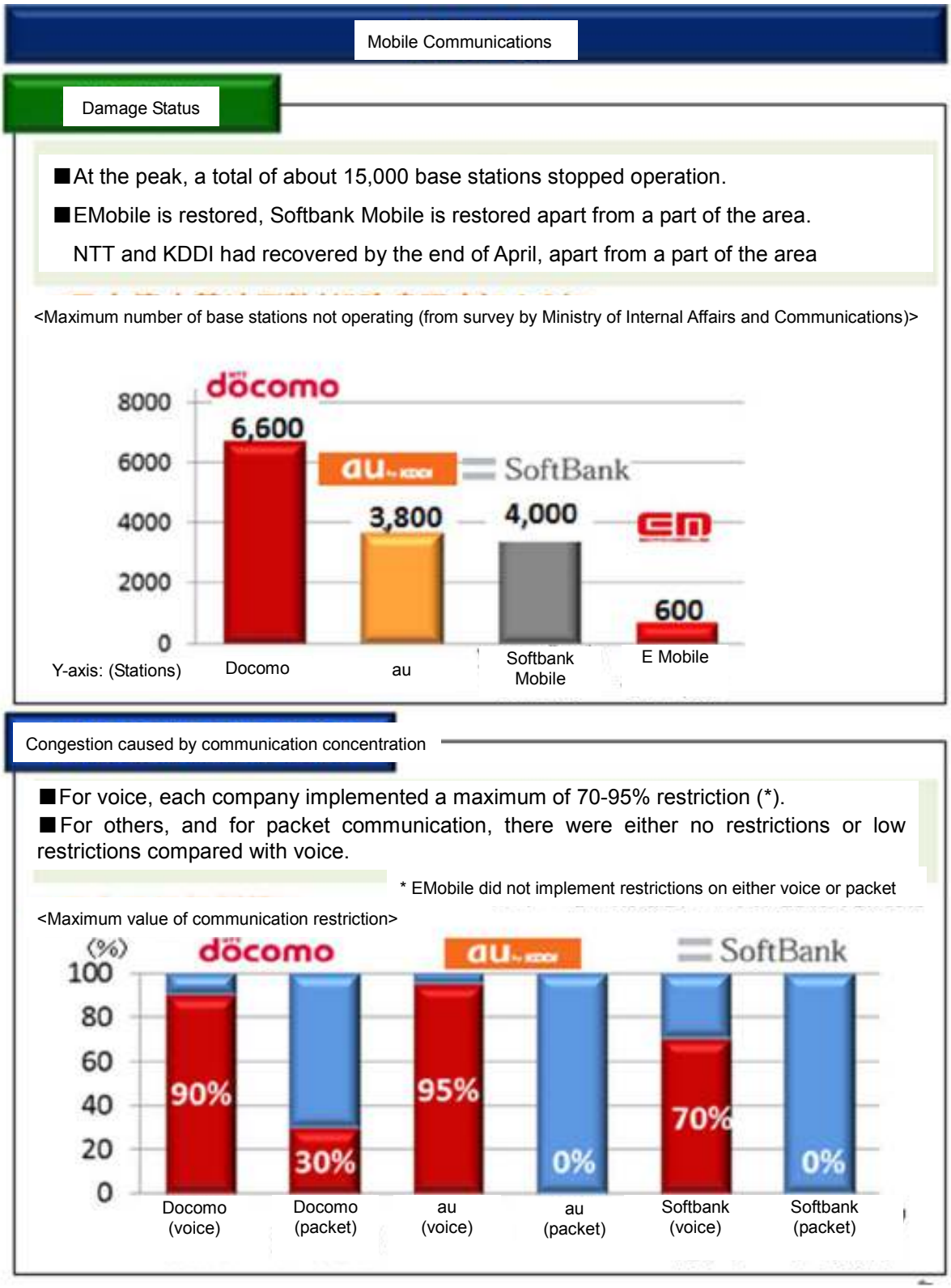
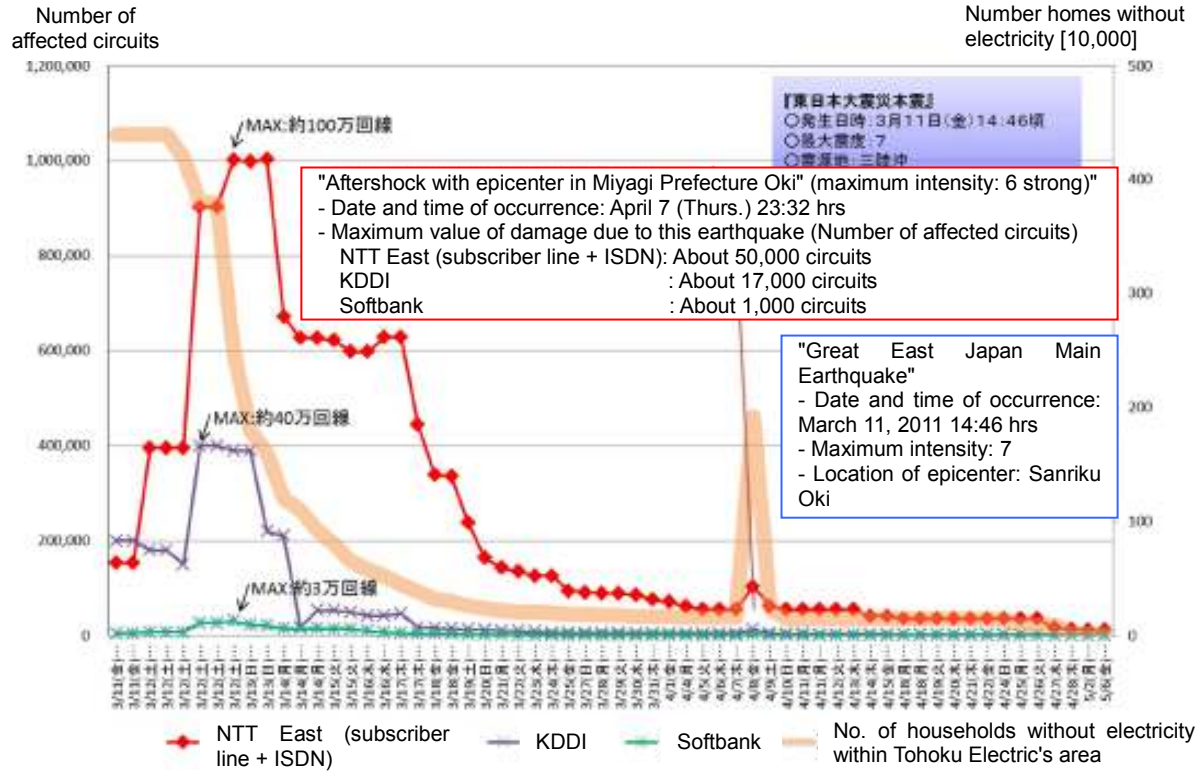
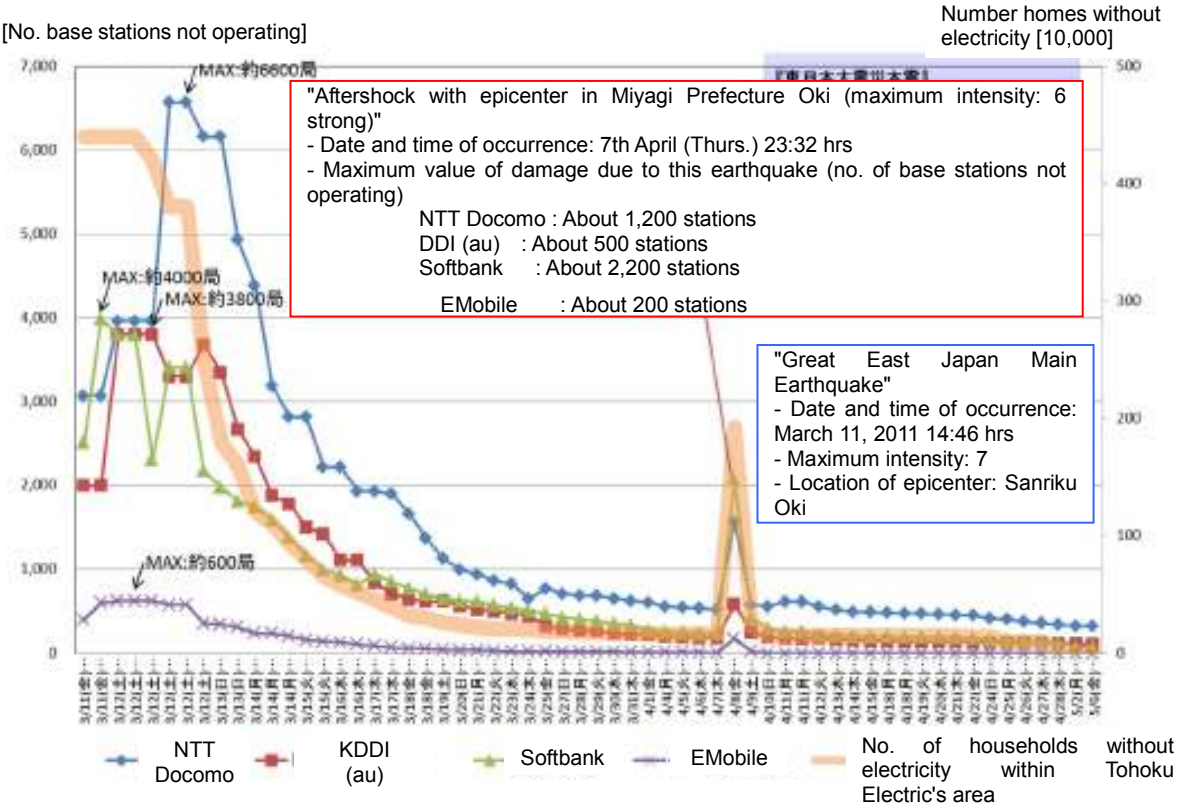


Figure Damage status and congestion status on fixed and mobile communications

Source) From "Damage Status and Restoration Status to Date in Information Communication Field Due to Great East Japan Earthquake" Ministry of Internal Affairs and Communications, June 6, 2011





Source) From "Damage Status and Restoration Status to Date in Information Communication Field Due to Great East Japan Earthquake" Ministry of Internal Affairs and Communications, June 6, 2011

(2) Status of Installation of Free Public Telephone, etc.

- In the east Japan area (17 prefectures east of Niigata Prefecture, Nagano Prefecture, Yamanashi Prefecture, and Kanagawa Prefecture), a total of about 120,000 public telephones were made free of charge.

- In the Kanto and Tohoku areas a maximum of 777 bases (2337 circuits) for specially installed public phones (satellite mobile phones) were installed.

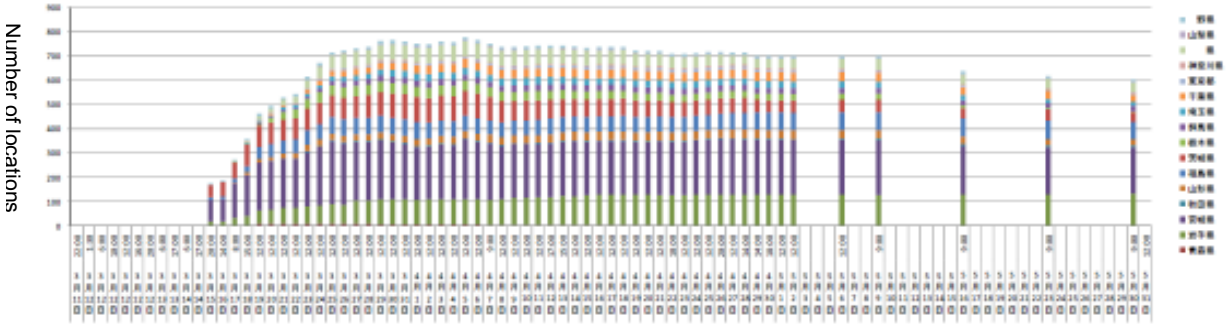


Figure Variation with time of number of locations where free of charge public telephones, etc., were installed (NTT East Japan)

Source) From "Status of Restoration of Lifelines from Great East Japan Earthquake (Time Series Edition)" Japan Society of Civil Engineers, Seismic Engineering Committee, June 3, 2011

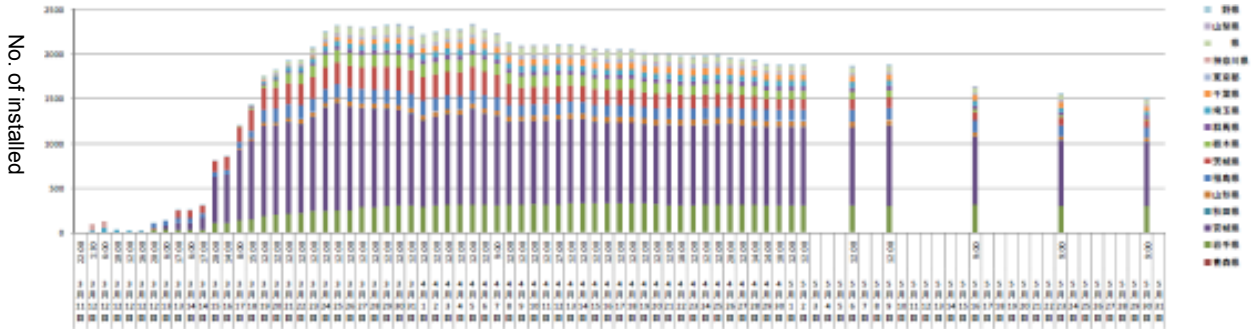


Figure Variation with time of number of free of charge public telephones, etc., installed (NTT East Japan)

Source) From "Status of Restoration of Lifelines from Great East Japan Earthquake (Time Series Edition)" Japan Society of Civil Engineers, Seismic Engineering Committee, June 3, 2011

(3) Status of Stoppage of Broadcast Stations (Television, Radio)

- There were stoppages of television at 120 locations and radio at 2 locations after the earthquake, including the area around Tokyo and Nagano Prefecture. Subsequently broadcasting resumed after the restoration of electrical power by the commercial electrical power companies.

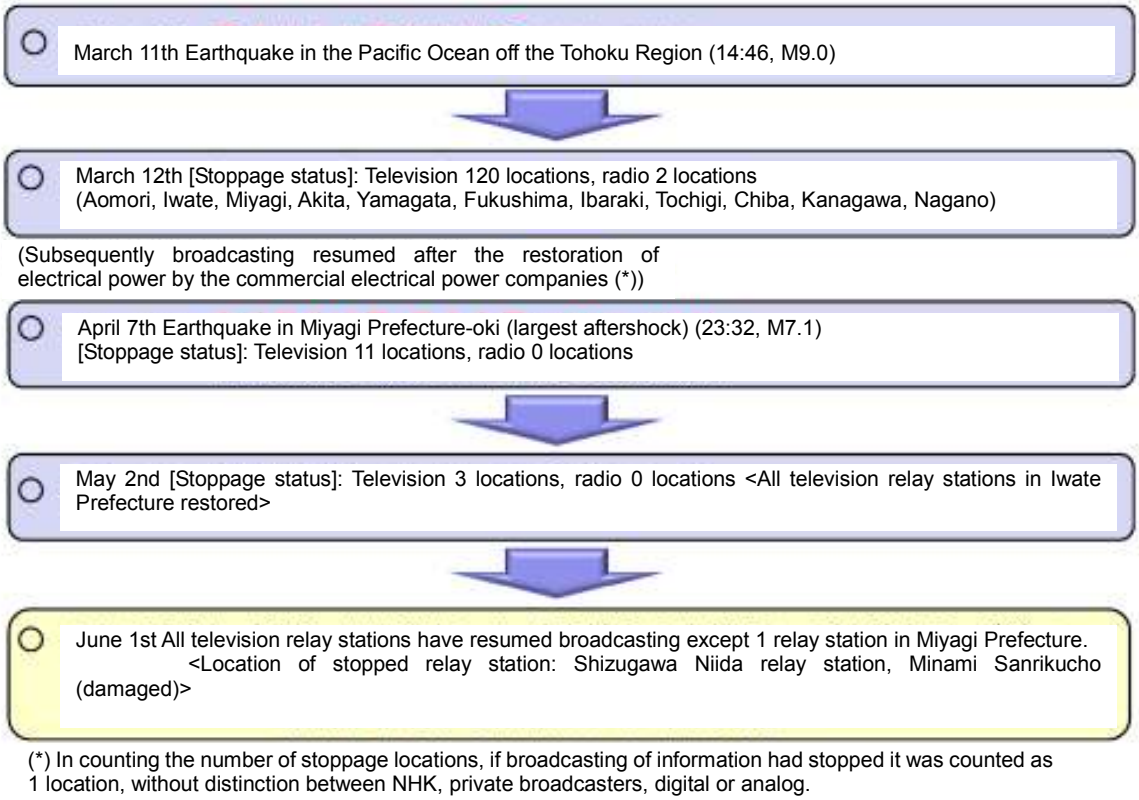


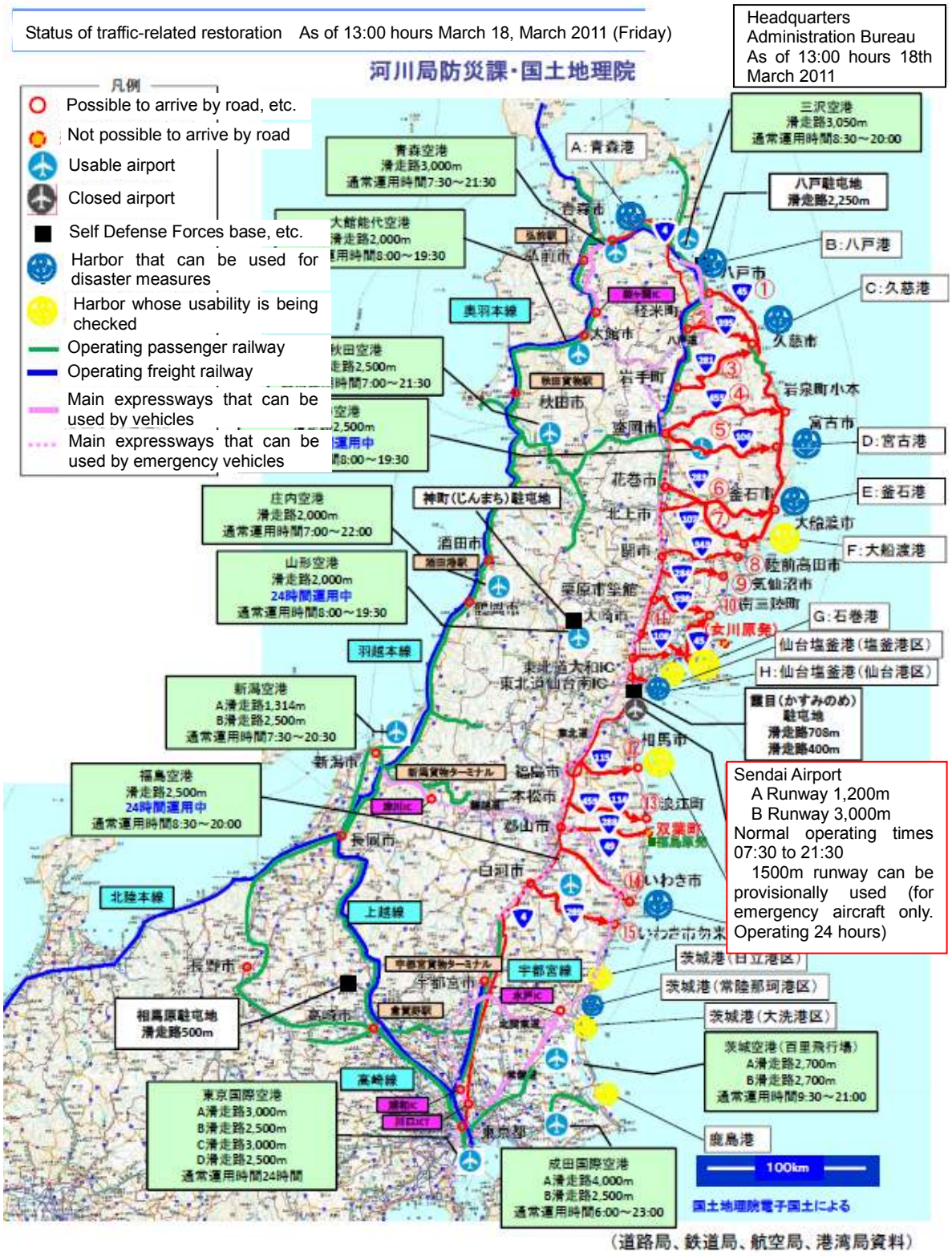
Figure Status of stoppage of broadcasting stations (television, radio)

Source) From "Damage Status and Restoration Status to Date in Information Communication Field Due to Great East Japan Earthquake" Ministry of Internal Affairs and Communications, June 6, 2011

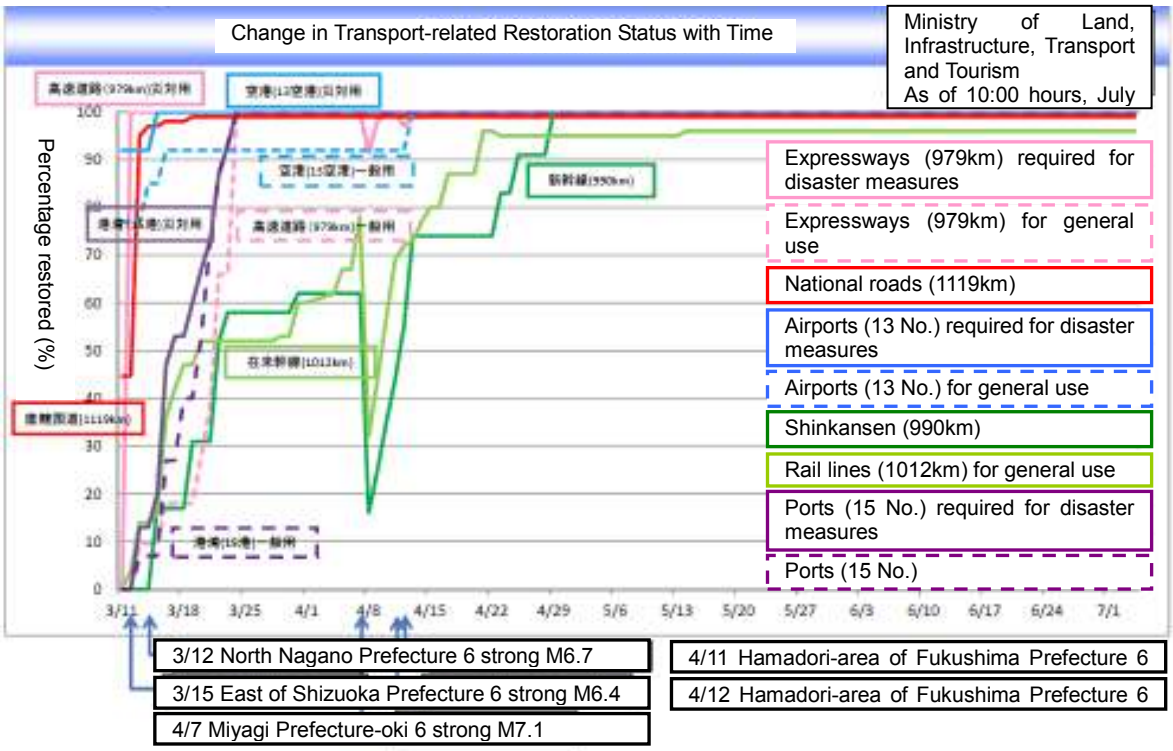
(2) Infrastructure Field

1) Roads

- Emergency transport routes for restoration and recovery of the damaged areas were arranged like the "teeth of a comb," and access to the Sanriku area was achieved in the lateral direction from northeast roads from the National Route No. 4. By March 18th all roads were re-opened.



(道路局、鉄道局、航空局、港湾局資料)



* Total length of rail lines updated on 4/23 (1012km). This was due to changing the rail lines not considered from the nuclear power plant exclusion zone to the warning zone and the emergency evacuation preparation zone.
* Total length of expressway updated on 4/23 (979km). This was due to changing the expressway not considered from the nuclear power plant exclusion zone to the warning zone.
* Total length of national roads updated on 4/23 (1119km). This was due to changing the expressway not considered from the nuclear power plant exclusion zone to the warning zone.
(Prepared by Disaster Prevention and Relief Division, Rivers Bureau & Geospatial Information Authority of Japan)

Figure Change in Transport-related Restoration Status with Time

Source) From Ministry of Land, Infrastructure, Transport and Tourism HP (http://www.mlit.go.jp/saigai/saigai_110311.html)

(2) Railways

- Immediately after the occurrence of the earthquake, operation of railways was suspended. Therefore in cities it was difficult for about 24,000 people to return home.

In the Tokyo area, people could not return home, trains were stopped, and empty taxis were not available

19:07 hours, March 11th

At Tokyo's stations, trains were stopped, and people who could not go home or to anywhere were swarming about.

On the evening of the 11th near JR Yurakucho Station, the streets were congested with people inquiring directions at the koban, taking photos of the maps in front of the station, and looking for directions.

A 59-year old male company employee from Totsuka-ku, Yokohama City, who works nearby was instructed by his company to "go home early if it is possible." "It is more than 40 kilometers to my home, so it is impossible to walk. In the worst case I will probably return to the company." He said that he has contacted his family by e-mail, and confirmed that he is safe.

In Ginza, a 31-year old woman from Ageo City, Saitama Prefecture said "I think I will walk to Ueno for now, but it is too far for me to go home by walking," looking in a quandary. A 35-year old male company employee in Nakano-ku stated "It does not look like the trains are going to move, also there is no information, so the only thing is to return home by walking" as he started walking.

A 26-year old male company employee watching the news on a television on the 1st floor of a high-rise building in Akihabara, Tokyo said, "My home is in Kawasaki City. The trains are stopped, I tried to go home by another means, but I can't get a taxi, and I don't know the bus routes. If there is no public transport then no one can move, so there is nothing I can do," with a resigned look on his face.

His workplace was the 26th floor of a building. "The shaking went on for a long time. I felt nausea like seasickness. I also experienced the Hanshin Great Earthquake, but this was a completely different type of shaking," he recalled.

A 21-year old female student on job hunting activities who was waiting to enter a family restaurant said that she was attending a company explanation meeting near Nihonbashi when the earthquake occurred. "The meeting was suspended. I walked to Akihabara thinking that trains might be running from here, but . . . ," as she showed her disappointment. Her home is in Nishitokyo City. "The worse is I can't go home because of the earthquake, and I was not able to get the job," she said with a tired look. She said that if the trains do not run, she intends to spend the night in the family restaurant.

The number that could not return home: More than 24,000 as of 20:00 hours March 11th.

Source) http://www.asahi.com/special/10005/TKY201103110519.html

首都圏では帰宅難民　電車ストップ、タクシー乗れず

2011年3月11日19時7分　　ソーシャルブックマーク　印刷

JR新宿駅前は混雑する人たちであふれた＝11日午後3時34分、東京都新宿区、朝日新聞社ヘリから、水野義則撮影

拡大

地震で交通機関が止まり、歩いて移動する人たち＝11日午後3時55分、東京・日比谷、榛山晃生撮影

拡大

止まった山手線から線路上に降りて混雑する乗客たち＝11日午後4時45分、東

拡大

首都圏の駅は、電車が止まって帰宅や移動ができなくなった人でごった返した。

JR有楽町駅付近では11日夕、交番で道を聞いたり、駅前にある地図を携帯で写真にとって帰る道を探したりする人が殺到した。

近くに勤める横浜市戸塚区の男性会社員(59)は会社から「早めに帰れる人は帰るように」と指示を受け、帰宅する途中という。「家まで40キロ以上あり、歩くのは無理。最悪の場合、会社に戻るしかないかな」。家族とはメールで連絡を取り、無事を確認したという。

銀座にいた埼玉県上尾市の女性(31)は「とりあえず上野までは歩こうと思うが、歩いて帰れる距離ではない」と途方に暮れた様子。中野区の男性会社員(35)は「電車は動きそうにないし、情報もないので歩いて帰るしかない」と歩き始めた。

東京・秋葉原。高層ビルの1階でテレビのニュースを見ていた会社員の男性(26)は「家は川崎市。電車が止まっており、他の手段で帰ろうとしたが、タクシーはつかまらないし、バスはルートがわからない。公共交通機関がないとみんな動けないし、仕方ないですね」とあきらめ顔。

職場はビルの26階。「長い横揺れで、乗り物酔いのように気持ちが悪くなった。阪神大震災も経験しているが、全然別の種類の揺れだった」と振り返った。

ファミリーレストランで入店待ちしていた就職活動中の女子学生(21)は、日本橋近くで会社説明会を受けていたら地震に遭った。「説明会は中止。秋葉原なら電車が動いているかもと歩いてきたのに…」とがっかり。自宅は東京都西東京市だ。「地震で帰れないし、就職は決まらないし最悪です」と疲れた表情。電車が動かなければファミリーレストランで一晩過ごすつもりだという。

帰宅困難者：3 月 11 日 20 時時点で **24,000 人以上**

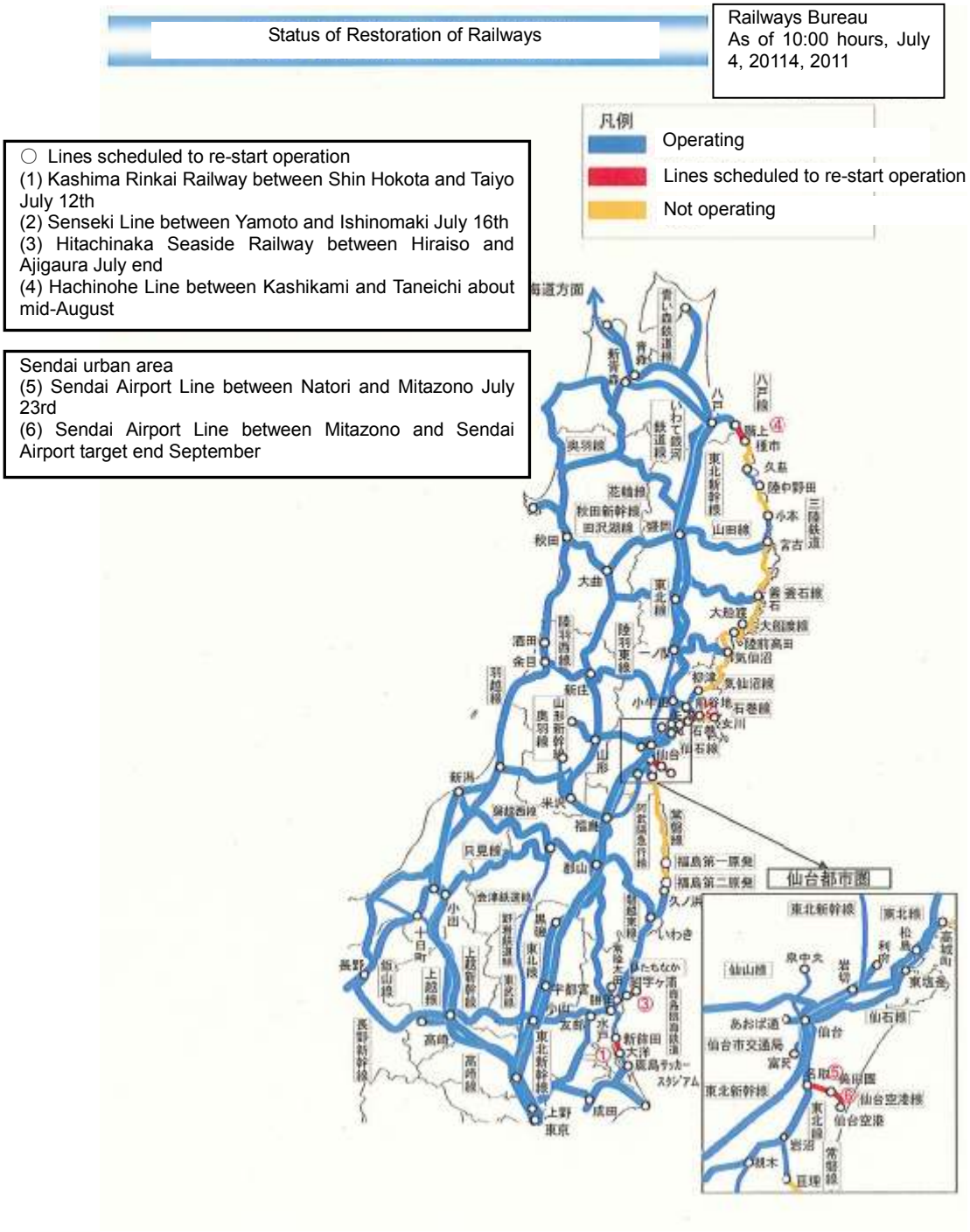


Figure Change in railway-related restoration status with Time

Source) From Ministry of Land, Infrastructure, Transport and Tourism HP (http://www.mlit.go.jp/saigai/saigai_110311.html)

(3) Status of Damage and Restoration of Electronic Communication Facilities

- Of the 163 power supply sources within the area of responsibility of the Tohoku Regional Bureau, there was damage due to power cuts at 152, and fiber optic cables were severed.

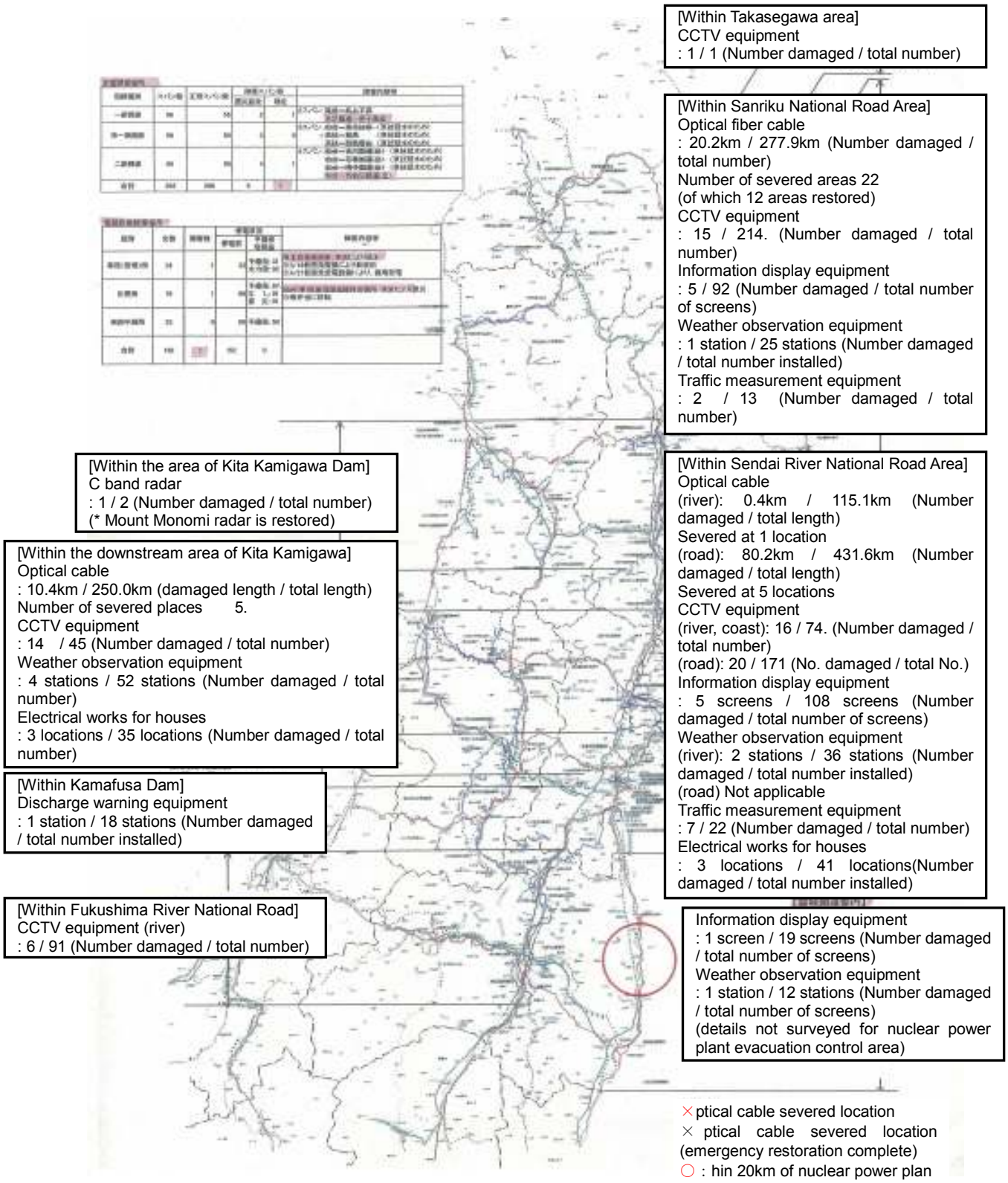


Figure Status of damage and restoration of electrical communication facilities (within the area of responsibility of the Tohoku Regional Bureau) From Tohoku Regional Bureau documents

(4) Electrical Power

- The total number of households with power cuts within the area of responsibility of Tohoku Electric Power Company was about 5 million, and the total number of households with power cuts within the area of responsibility of Tokyo Electric Power Company was about 4.05 million.

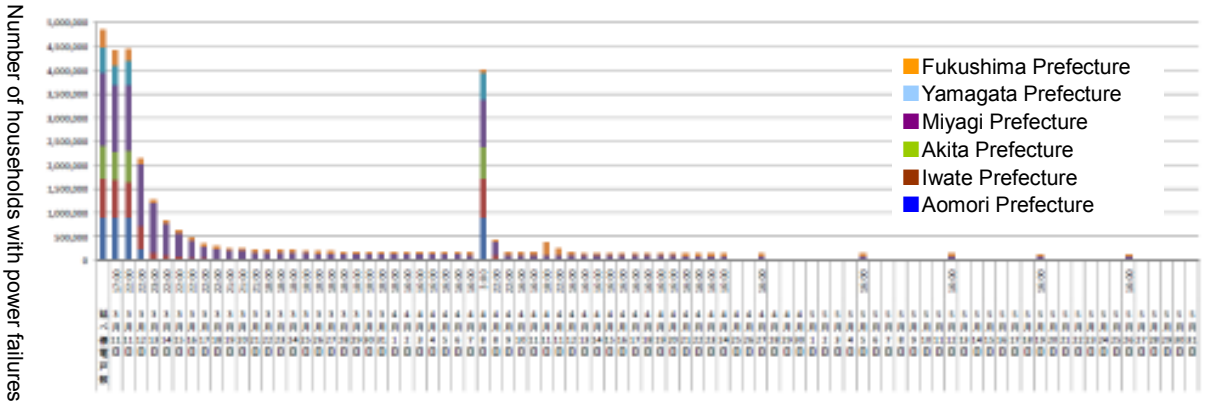


Figure Variation of status of power failures within Tohoku Electric area with time

Source) From "Status of Restoration of Lifelines from Great East Japan Earthquake (Time Series Edition)" Japan Society of Civil Engineers, Seismic Engineering Committee, June 3, 2011

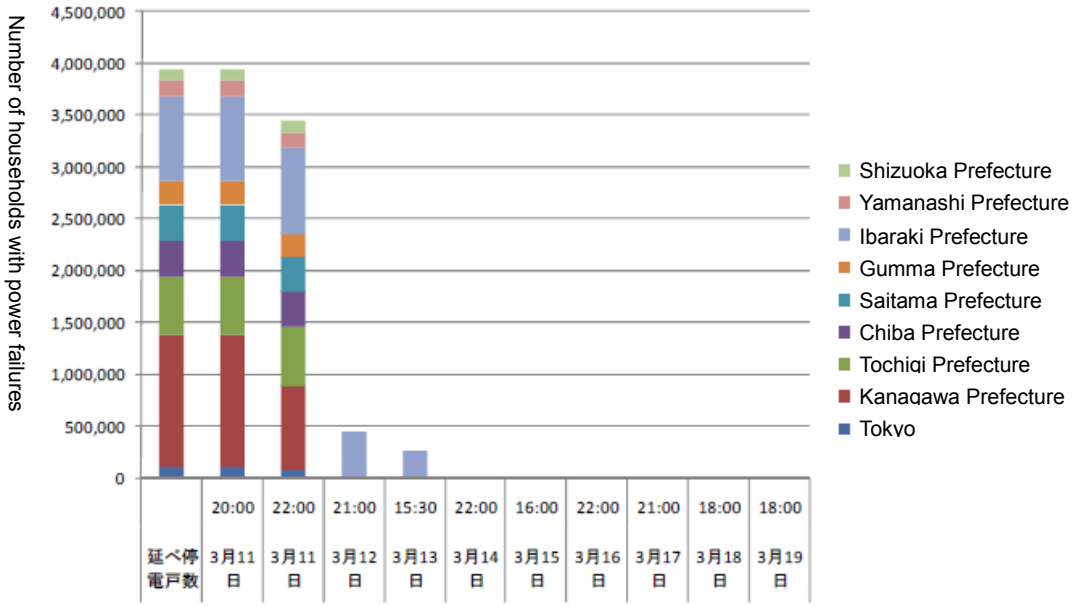


Figure Variation of status of power failures within Tokyo Electric area with time

Source) From "Status of Restoration of Lifelines from Great East Japan Earthquake (Time Series Edition)" Japan Society of Civil Engineers, Seismic Engineering Committee, June 3, 2011

(5) Water Supply and Sewage Works

- The total number of households without water was about 2.24 million, and at about 10 days after occurrence of the disaster about 50% of these were restored.

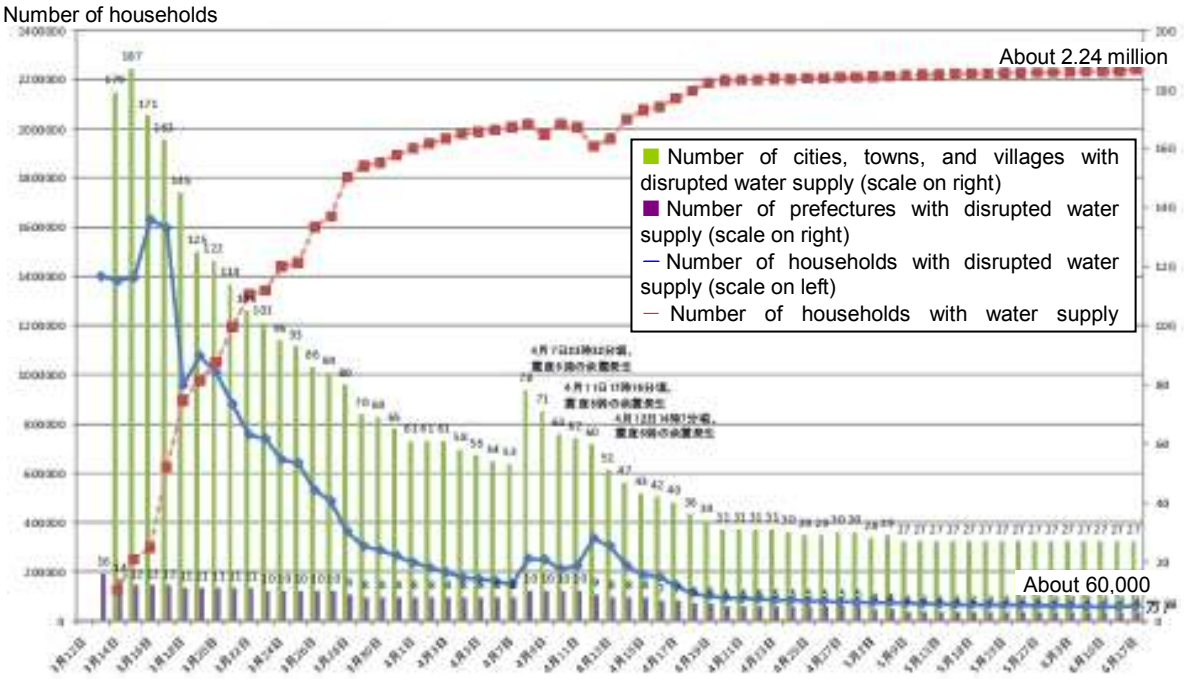


Figure Variation of status of restoration of water supply with time (as of June 17, 2011)

Source) From "Status of Damage to Water Supply in Great East Japan Earthquake" by Federation of Japan Water Industries, Inc. (http://www.suidanren.or.jp/action/dmg_rep.html)

(6) Utility Gas

- A total of 410,976 households for 16 gas companies in Japan Gas Association required restoration work, and this restoration work was completed on May 3rd.

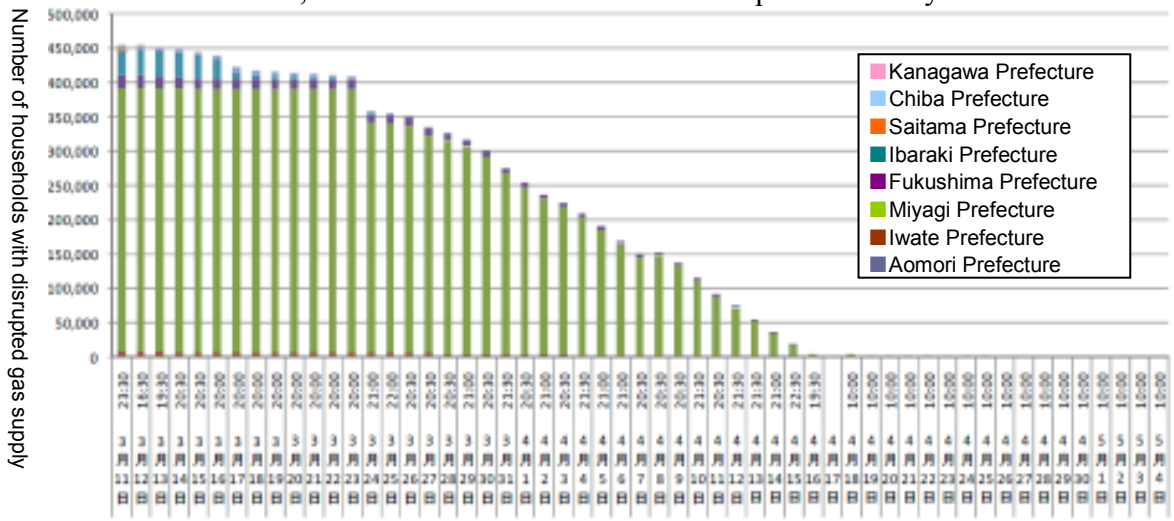


Figure Variation of status of restoration of utility gas with time

Source) From "Status of Restoration of Lifelines from Great East Japan Earthquake (Time Series Edition)" Japan Society of Civil Engineers, Seismic Engineering Committee, June 3, 2011

(3) Others (Deployment in Disaster)

- Number of persons deployed : Total 8.68 million

  - Deployment of the Self Defense Forces (SDF) in the disaster due to the Great East Japan Earthquake in the 3 months from March 11th to June 11th was a total of 8.687 million persons, 41,000 flights, and 4,100 ship movements

  - The maximum forces deployed in one day was about 107,000 persons (land SDF about 70,000, sea SDF about 15,000, air SDF about 21,600, and nuclear power plant related about 500 persons), aircraft about 540, and ships about 59.

  - Number of persons rescued 19,286, number of bodies recovered 9,487. Transport of supplies about 11,500 tons, transport of medical teams, etc., about 18,310 persons, transport of patients 175 persons. For life style support to victims: about 32,820 tons of water supply; food, about 4,477,440 million meals; fuel about 1,400 kiloliters. Others included bathing for about 854,980 persons, sanitation, etc., for about 23,370 persons.

    Source) From Self Defence Forces HP
    (http://www.asagumo-news.com/news/201106/110616/11061602.html)

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