

# **Restoration Status for Damage Caused by the Great East Japan Earthquake and Future Responses**

**March 6, 2012**

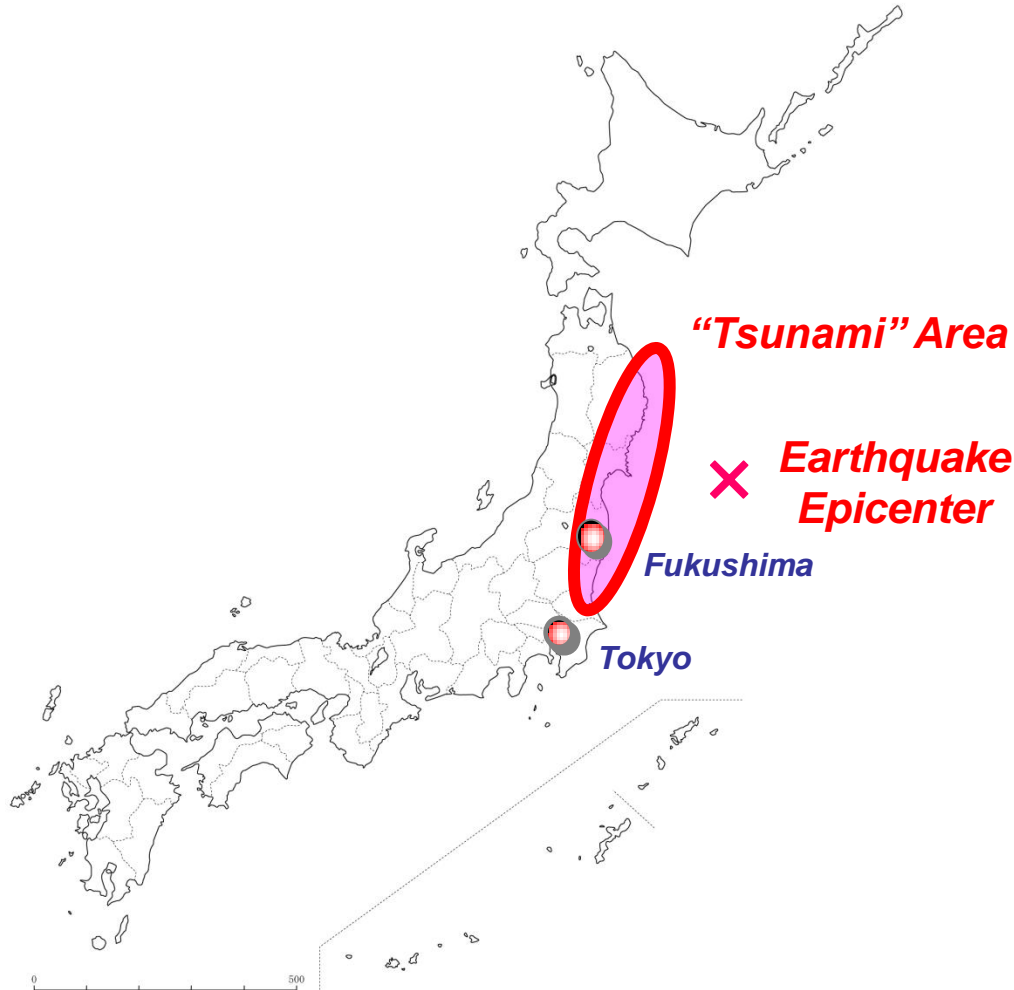
**Toshiya Masuzawa**

**Nippon Telegraph and Telephone Corporation**

- 1. Restoration Status**
2. Major Restoration Efforts
3. Main Activities for Securing Means of Communication, Efforts in Providing Life Support to the Affected People
4. Major Countermeasures against Future Disaster

# Outline of the Great East Japan Earthquake

- 2:46 p.m. on March 11, 2011
- Magnitude 9.0 with its epicenter off Oshika Peninsula, Miyagi Pref.
- Huge tsunami assaulting the coasts of the northeastern Pacific Ocean



# Huge Tsunami Assaulting the Coast Area



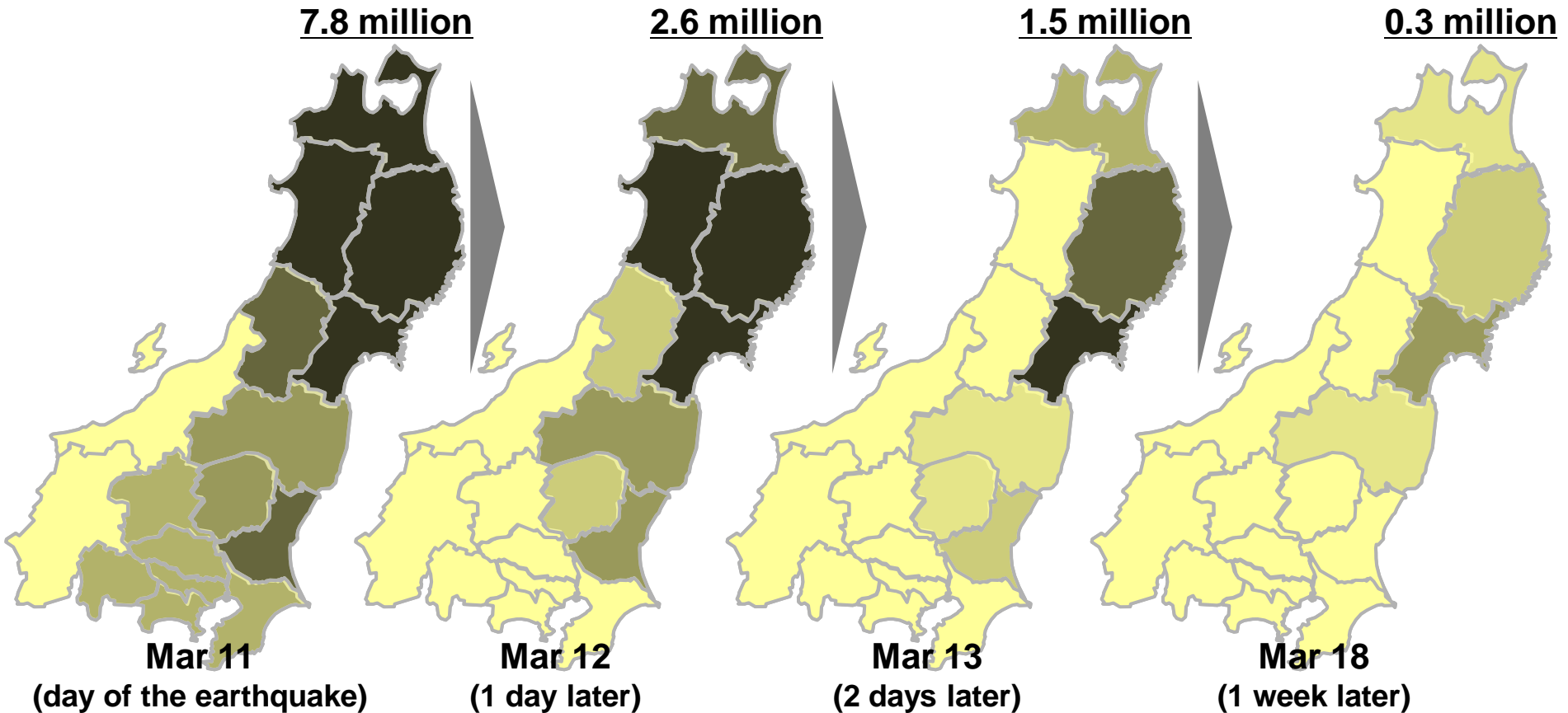
# Huge Tsunami Assaulting the Coast Area



# Widespread Power Outages

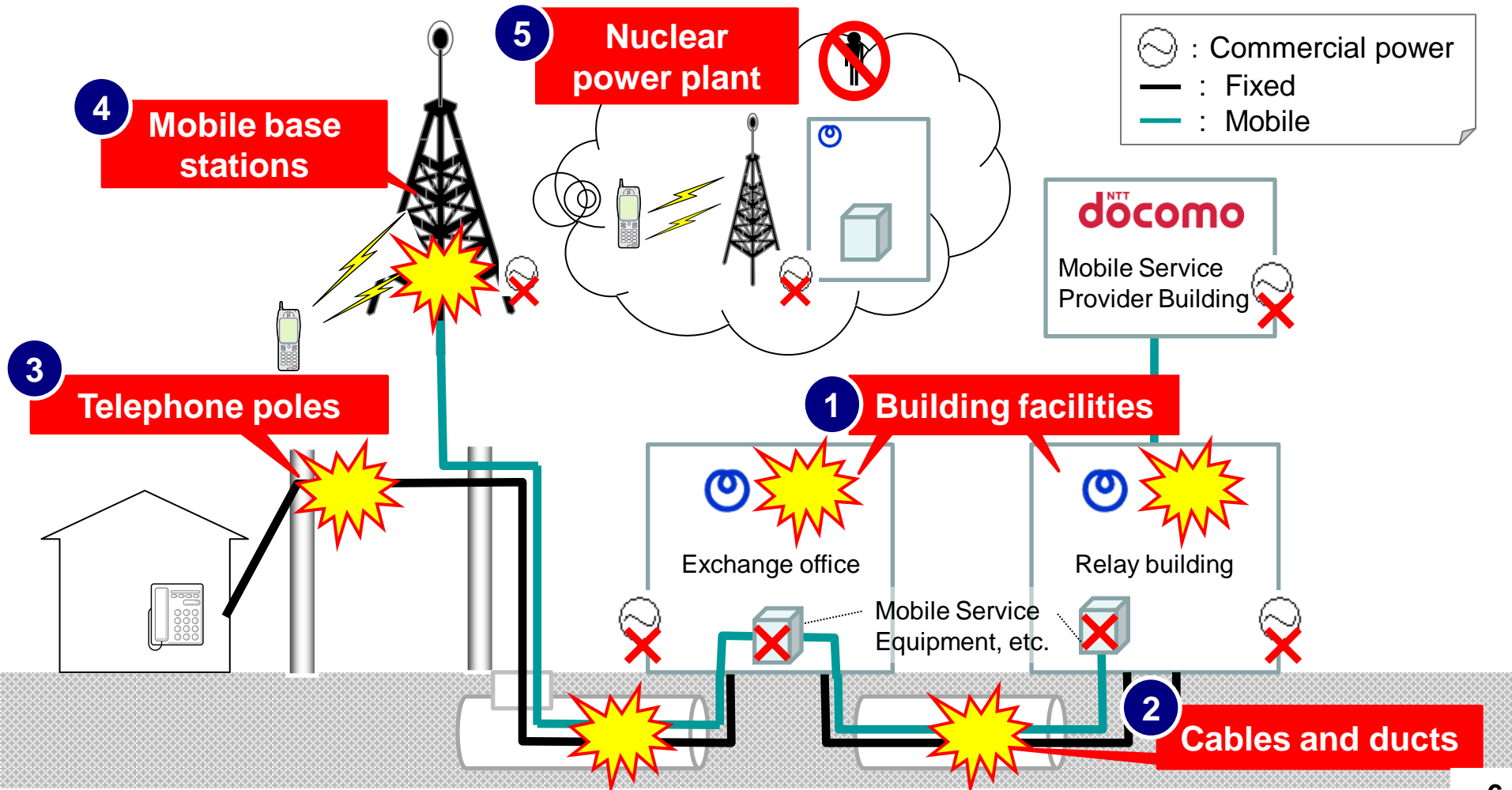
- Widespread, prolonged power outages in and around northeastern Japan
- The earthquake and tsunami affected generation plants, substations, and commercial power distribution facilities.

100% the number of households affected by power outage 0%



# Damage Condition of Communication Facilities

- Many exchange office buildings and facilities were affected by the large-scale earthquake and tsunami.
- Further damage was caused due to depletion of battery capacity associated with the prolonged disruption in commercial power supply.



# 1 Damage Condition of Building Facilities

## Photo of Shichigahama Building Before Tsunami



Tsunami carried the building 500m away from its original site.



## Satellite photo of Tokura Building



Tsunami carried the building to the sea.





## 2 Damage Condition of Cables and Ducts

Conduits broken as the Kesen Bridge collapsed (Iwate)

### 2 Cables and ducts (relay transmission lines)



# 3 4 Damage Condition of Telephone Poles and Mobile Base Stations

Telephone poles and mobile base stations destroyed by tsunami (Miyagi)

## 3 Telephone poles

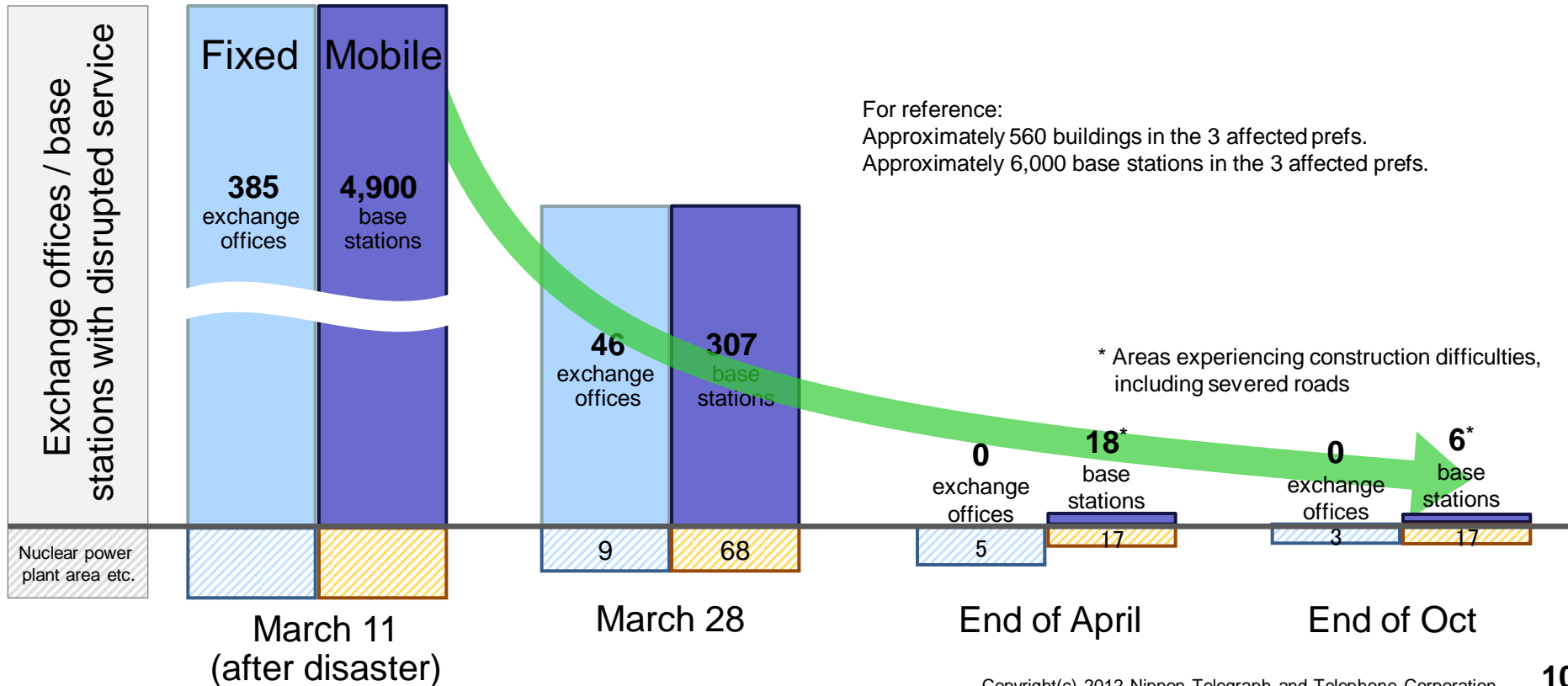


## 4 Mobile base stations



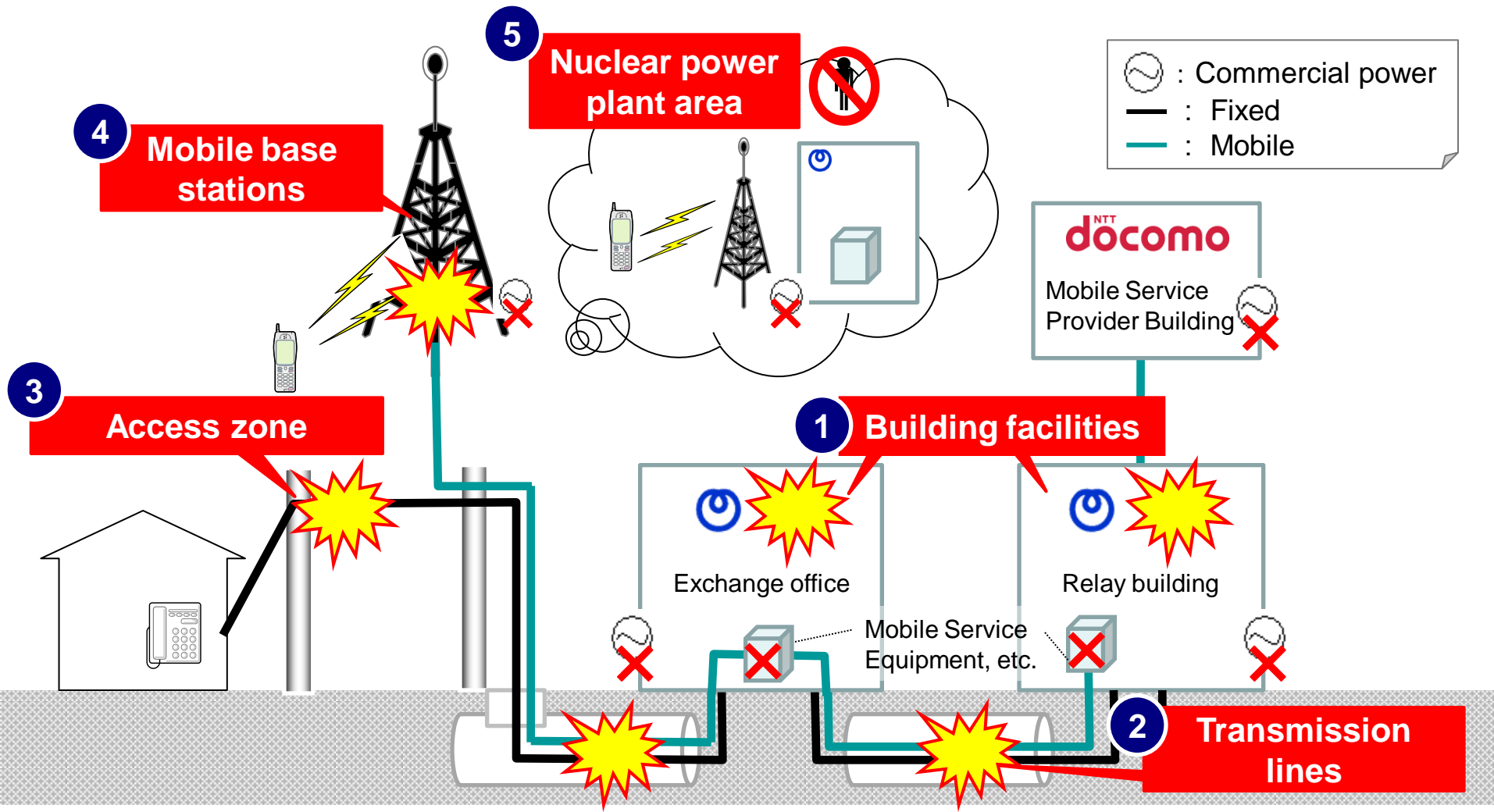
# Restoration Status

- Approx. 1.5 million circuits for fixed-line services and 4,900 mobile base station equipment were in service disruptions after the earthquake.
- More than 90 percent of the affected exchange offices and mobile base station equipment had been restored by the end of March.
- Restoration has been mostly completed by the end of April for exchange buildings and mobile base stations in areas, where customers reside.



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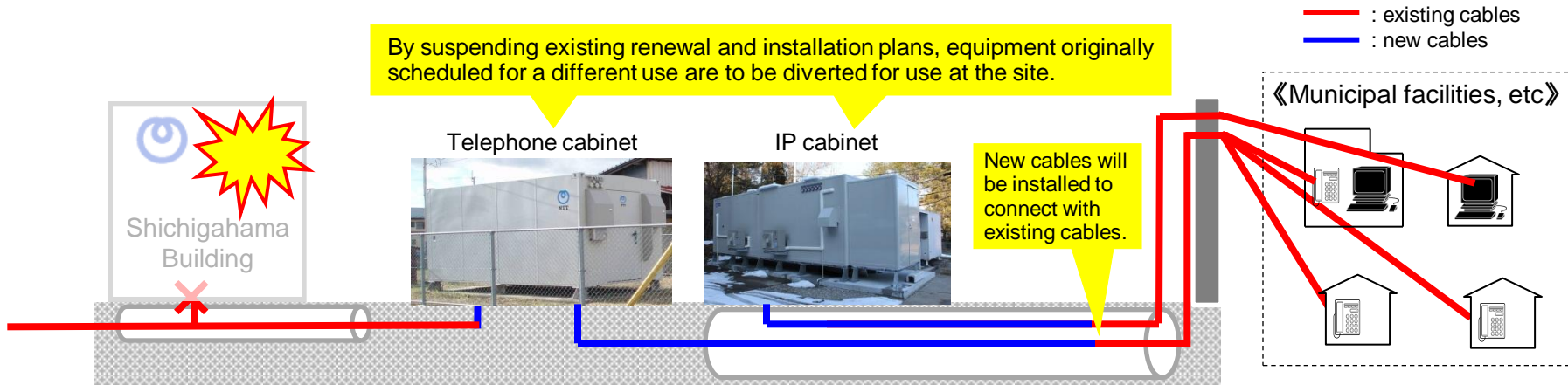
# Major Damaged Area/Field for Restoration



# 1 2 Restoration of Buildings and Transmission Lines

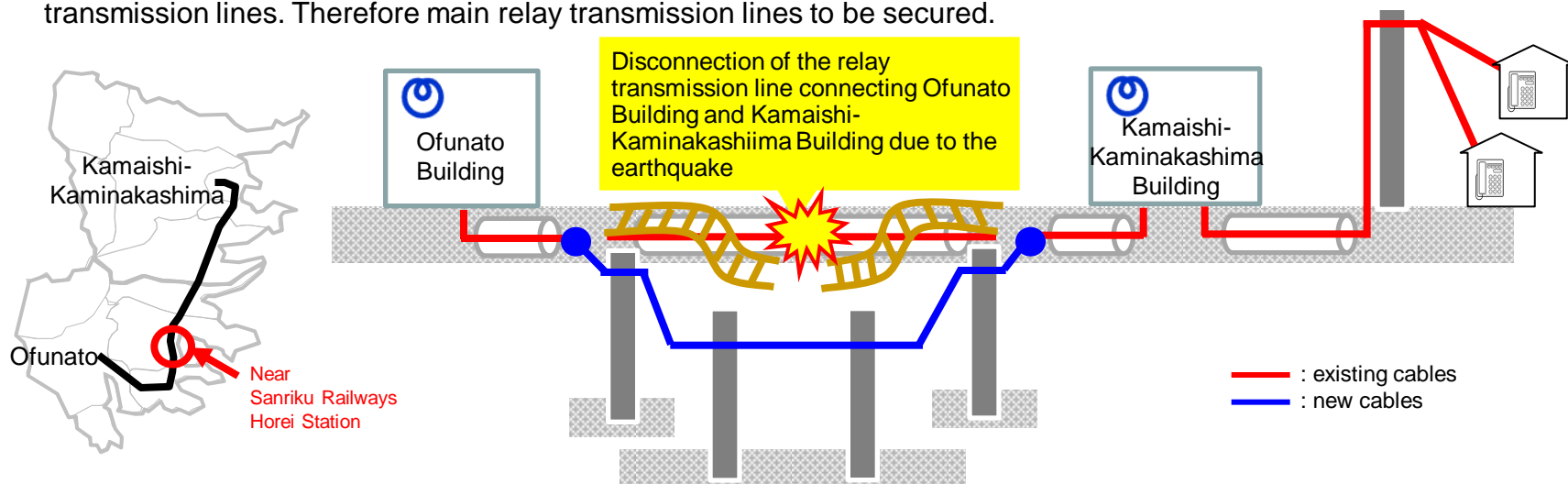
## 1 Restoration of exchange offices (Shichigahama building, Miyagi Pref.)

Since the whole Shichigahama Building had been lost to floods, Outdoor cabinets were installed at the building's original site.



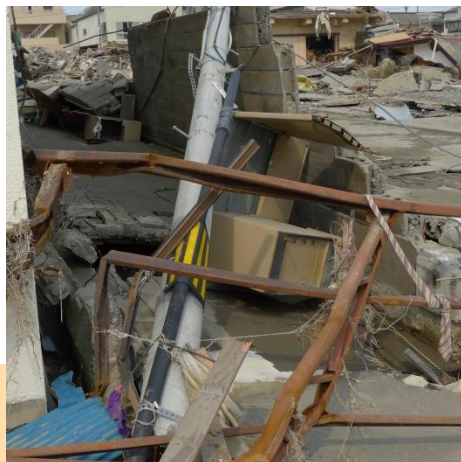
## 2 Restoration of transmission lines (from Ofunato Building to Kamaishi-Kaminakashima Building, Iwate Pref.)

Establish backup relay routes or switch routes to achieve connectivity at disrupted points or to bypass damaged relay transmission lines. Therefore main relay transmission lines to be secured.

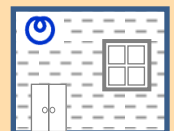


# 3 Restoration of Access Zone

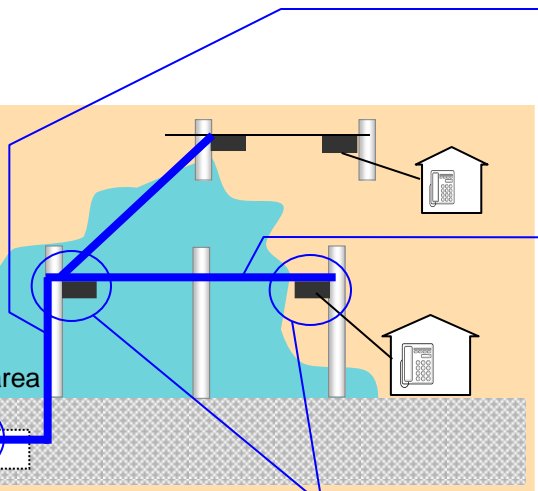
- Telephone poles and cables had extensive damages caused by tsunami.
- After the removal of debris, communication services were restored by installing telephone poles, laying out and connecting cables to residential areas.



Damaged telephone poles



Flooded area



[Step 3] Connections in manholes



[Step 4] Connections of aerial cables



[Step 1]

After the removal of debris, telephone poles were built and tow cables were laid



[Step 2]

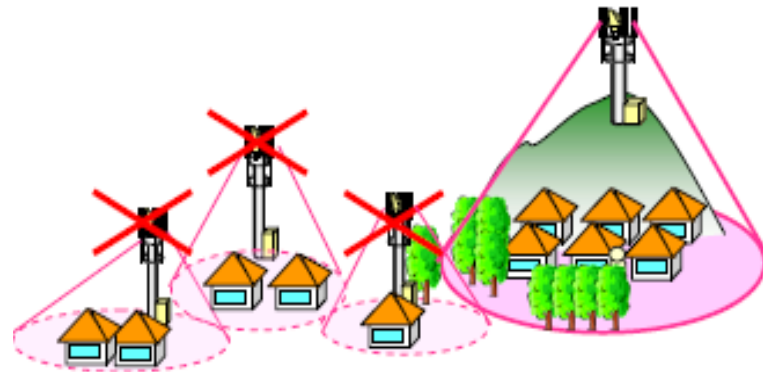
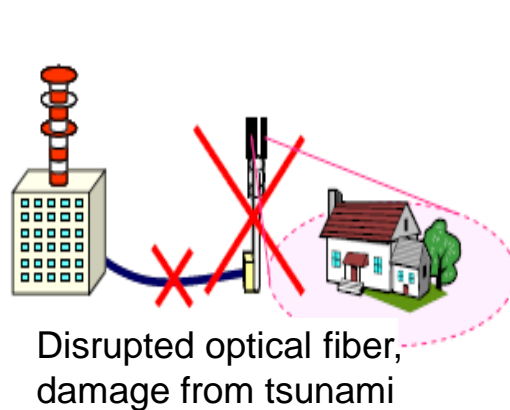
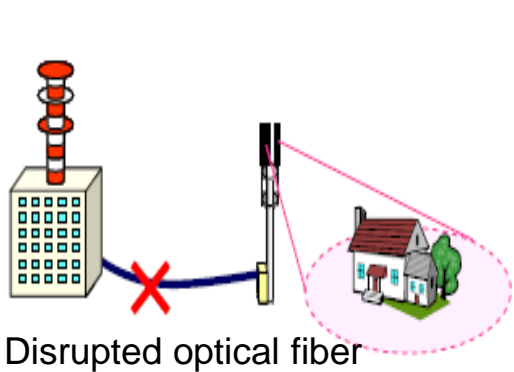
Installation of aerial cables



# 4 Restoration of Mobile Base Stations

Most mobile base stations have been restored by using microwave transmission, satellite circuits and applying large zone scheme\* in high-elevation base stations.

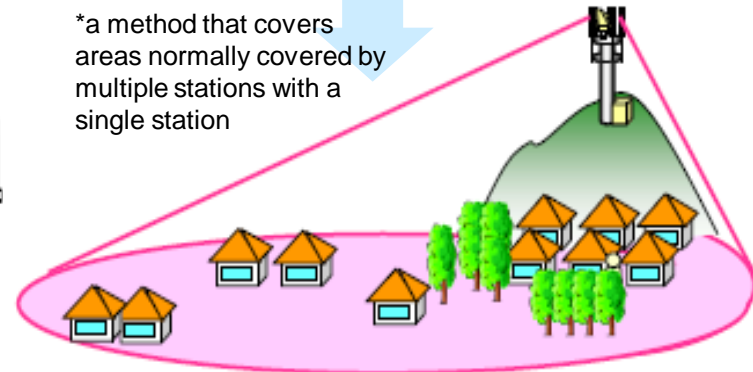
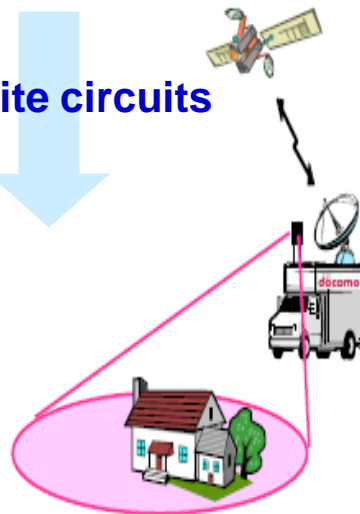
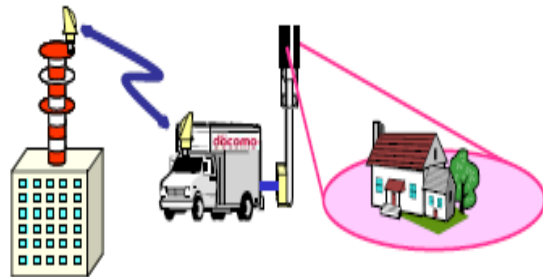
\* a method that covers areas normally covered by multiple stations with a single station



**Microwave transmission**

**Satellite circuits**

**Large zone scheme\***

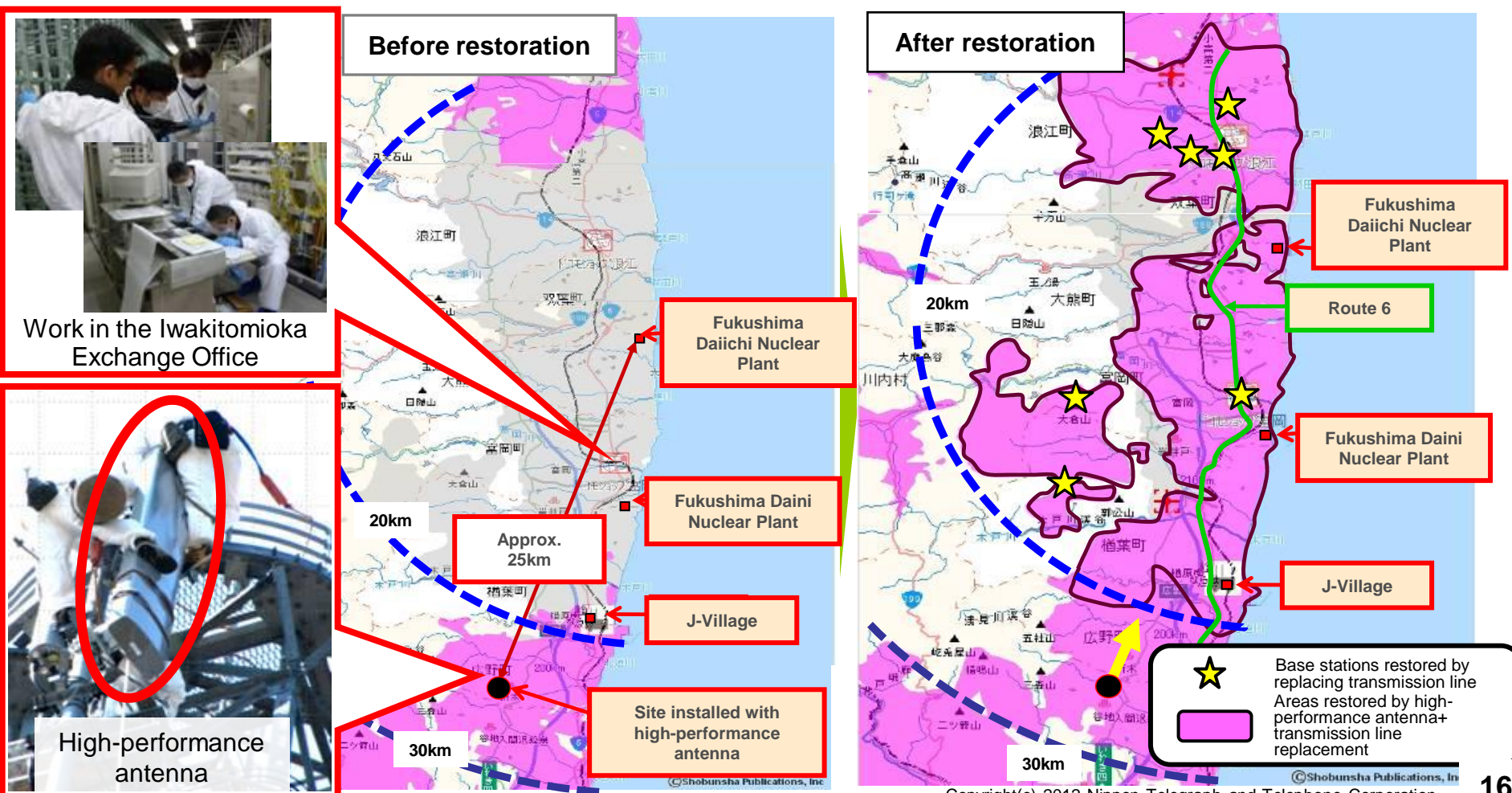


\*a method that covers areas normally covered by multiple stations with a single station



# 5 Restoration in the Nuclear Power Plant Area

- In order to restore non-functional exchange offices and some mobile base stations, restoration of Iwakitomioka Exchange Office, located approx. 10km from the plant, was completed with the cooperation of Tokyo Electric Power Company and Tohoku Electric Power Company.
- A high-performance antenna was installed in a base station, located approx. 25km away from Fukushima Nuclear Plant, to restore coverage in areas along Route 6.

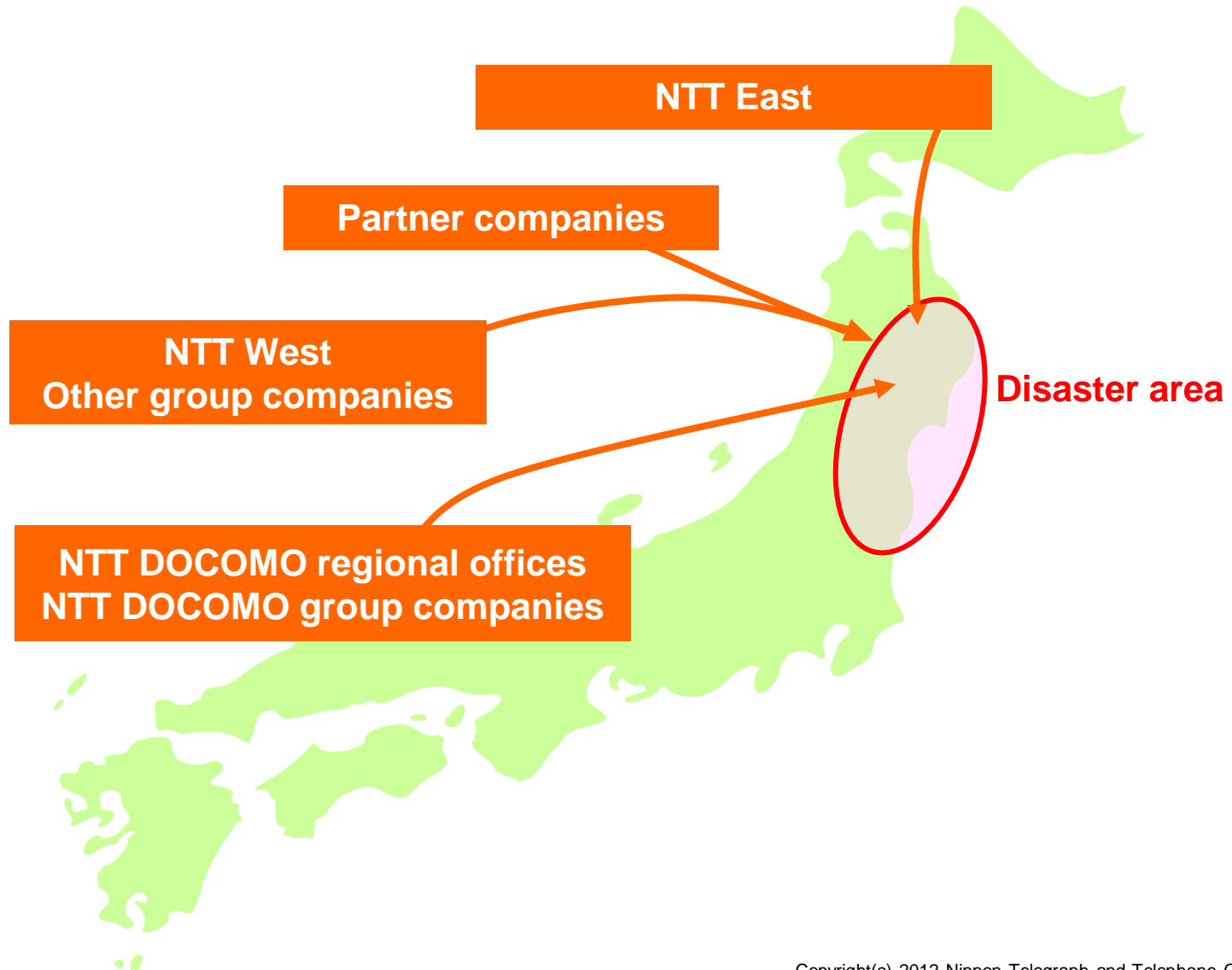


# Summary of Major Restoration Efforts

| Area/Field   | Method for restoration  |
|--|---|
| <b>1</b> Restoring exchange offices                  | <ul style="list-style-type: none"><li>– Install outdoor cabinets instead of severely damaged buildings.</li></ul>   |
| <b>2</b> Securing transmission lines                 | <ul style="list-style-type: none"><li>– Emergency restoration by connecting damaged sections and newly creating temporary aerial rerouting lines.</li></ul>   |
| <b>3</b> Restoring access zone                       | <ul style="list-style-type: none"><li>– Install immediately metal and optical fiber cables using materials stocked for planned constructions, etc.</li></ul>  |
| <b>4</b> Restoring mobile base stations              | <ul style="list-style-type: none"><li>– Install stopgap optical fiber, use microwave transmission and satellite circuits.</li><li>– Use large zone scheme, a method that covers areas normally covered by multiple stations with a single station.</li></ul>                            |
| <b>5</b> Restoration in the nuclear power plant area | <ul style="list-style-type: none"><li>– Restoration of the function at the Iwakitomioka Exchange Office, located approximately 10km from the plant.</li><li>– Coverage restoration by using high-performance antenna and deployment of satellite mobile base station vehicle.</li></ul> |

# Human Resources Mobilized for Restoration

Over 10,000 people from group companies and partner companies, were mobilized to make an all-out effort to restore communication services.



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# Main Activities for Securing Means of Communication **NTT**

Fixed-line and Mobile

Installation of special public phones using portable satellite equipment (approx. **3,900** phones)



Rental of free mobile phones (approx. **2,100** units)



Rental of free satellite mobile phones (approx. **900** units)

Portable satellite phone 01



Rental of tablet devices (approx. **670** units)



Internet

Deployment of free Internet booths (approx. **450** locations)



Installation of free battery recharging station (approx. **450** stations)



## Emergency Messages for Voice



approx. 3.5 millions

## Emergency Messages for Internet



approx. 0.3 millions

## Emergency Messages for Mobile



approx. 4.5 millions

## Saving messages from people in damaged area

NTT East staff members deliver messages, on behalf of affected people, to their families, and if the family members are away from home, NTT East registers their messages on the Disaster Emergency Message Dial on their behalf.

NTT East staff



- Contact on the phone
- Register messages on the Disaster Emergency Message Dial
- Provide information to mass media
- Provide information on Web site

message



NTT East staff



Safety confirmation



Evacuation shelters

|  |               |
|--|---------------|
| 伝言メモ   | 日時            |
| 発信元 (ご本人)  | 発信先 (お伝えしたい方) |
| お名前  | お名前           |
| 電話番号   | 電話番号          |
| 伝言内容   |               |
| 避難場所:  |               |
| <small>※この記載された情報は、安全確認のみ向けに使用いたします。 NTT東日本 岩手支店</small> |               |

# Support using ICT : Restoration Area Maps

- Indicating areas where service is available or disrupted, and the restoration schedule of disrupted areas.
- Displaying information such as locations where free mobile phone/satellite phone and battery recharging services are provided, etc.

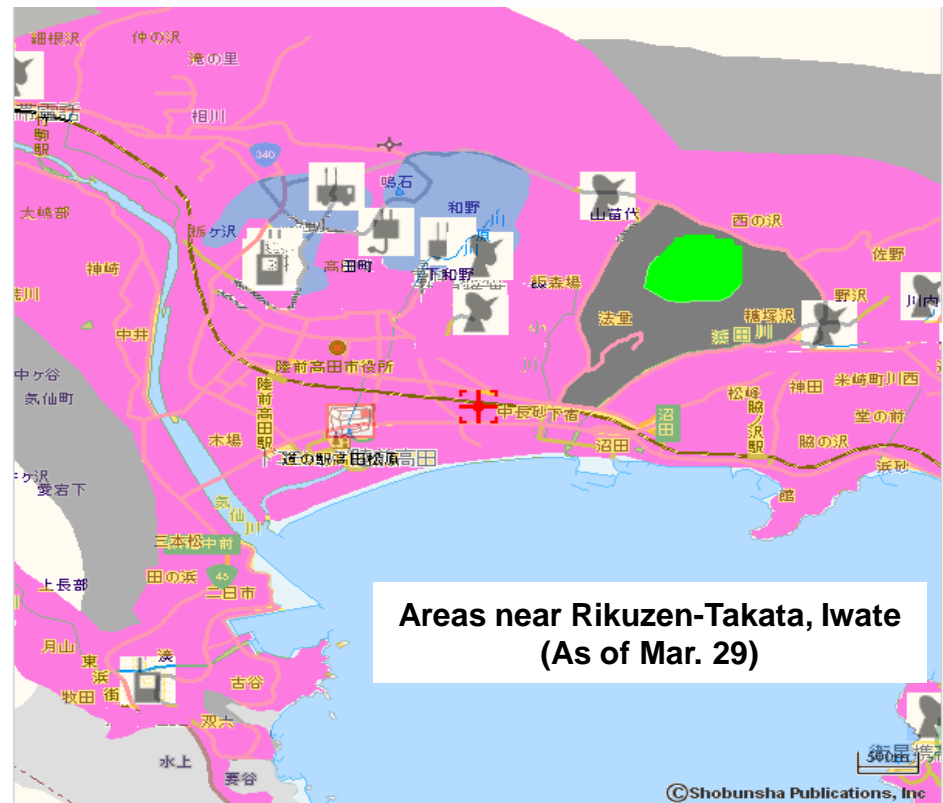
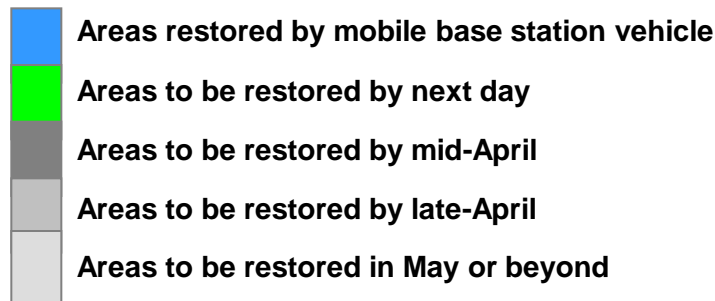
## Restoration Area Maps

Commenced on Mar. 20, 2011 after being urgently developed and updated on a daily basis.

**Possible to perform search by address, keywords**

**Flexible size levels through zoom in/out**

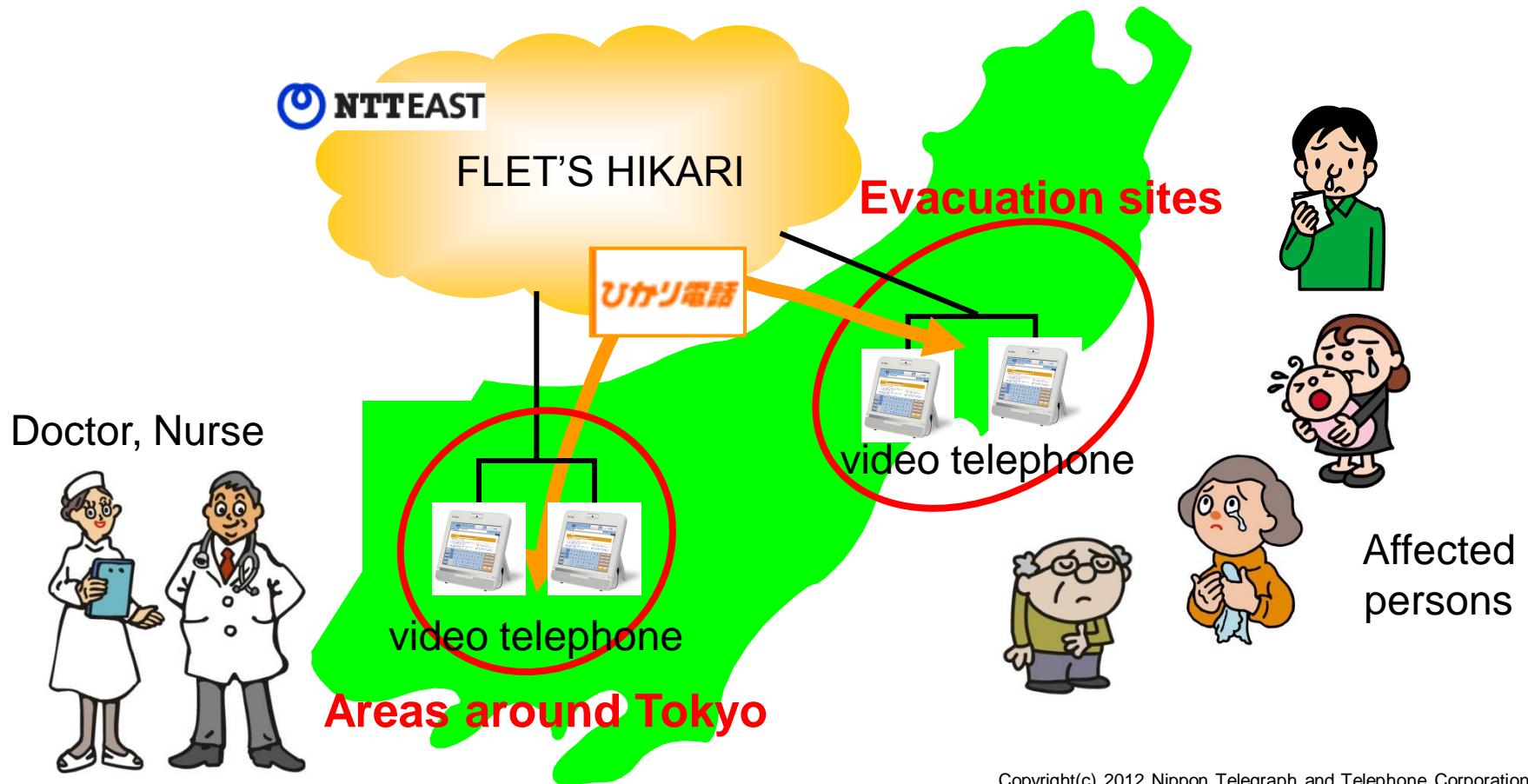
Restoration schedule



# Support using ICT : Medical Field

remote health consultations via free video telephones, etc. at evacuation sites

- NTT East implements remote health consultations via video telephones, etc., at evacuation sites.
- It is provided at Kurihara City in Miyagi Prefecture and Tono City in Iwate Prefecture to support the activities of the Continuous Care and Cure Network Project (C3NP), a volunteer organization.

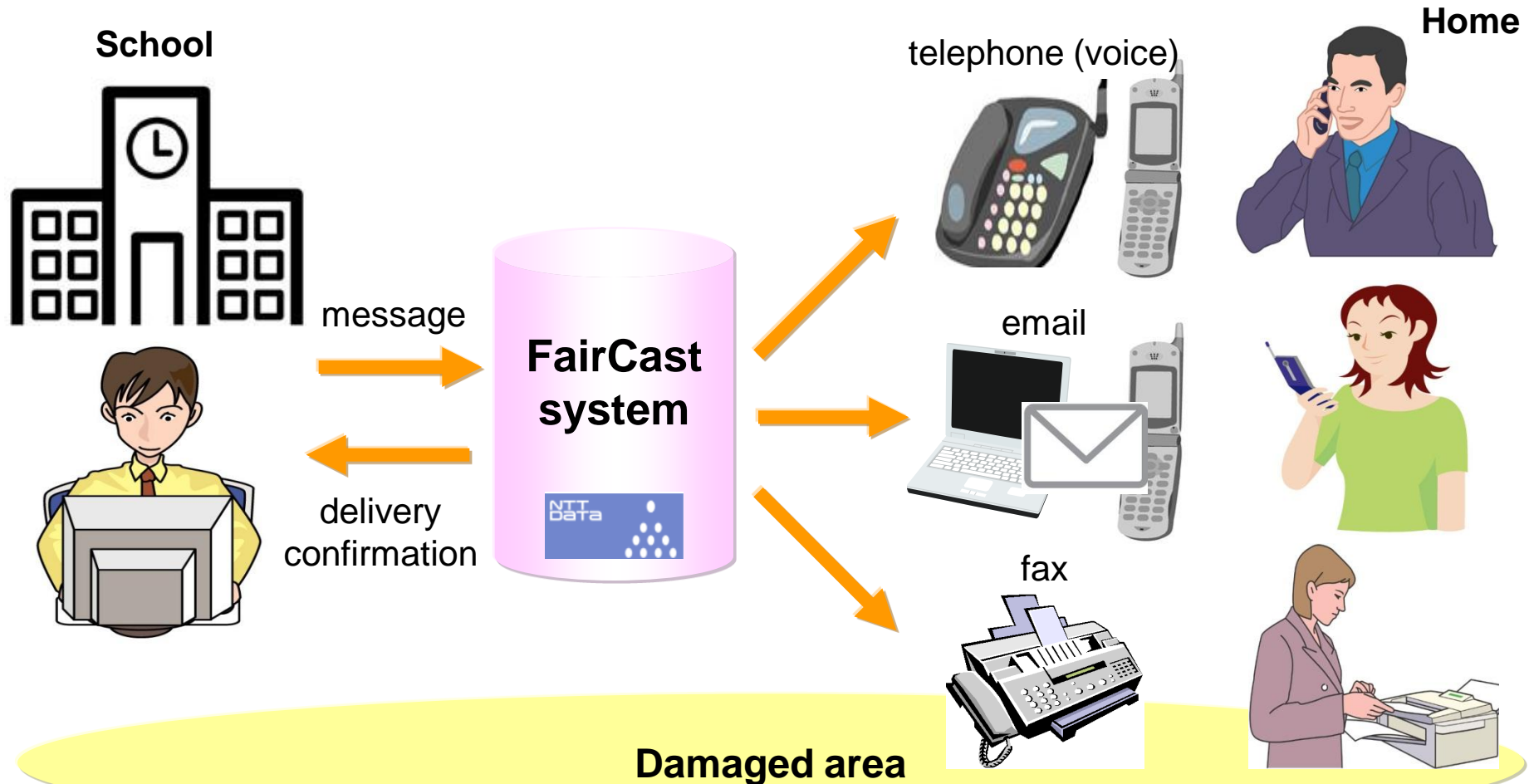




# Support using ICT : Medical Field

free provision of a comprehensive contact system for communication

- NTT DATA supplied a system for free provision of a comprehensive contact system for communication from schools to parents and guardians.
- It is deployed at elementary schools in Ishinomaki City, Miyagi Prefecture.

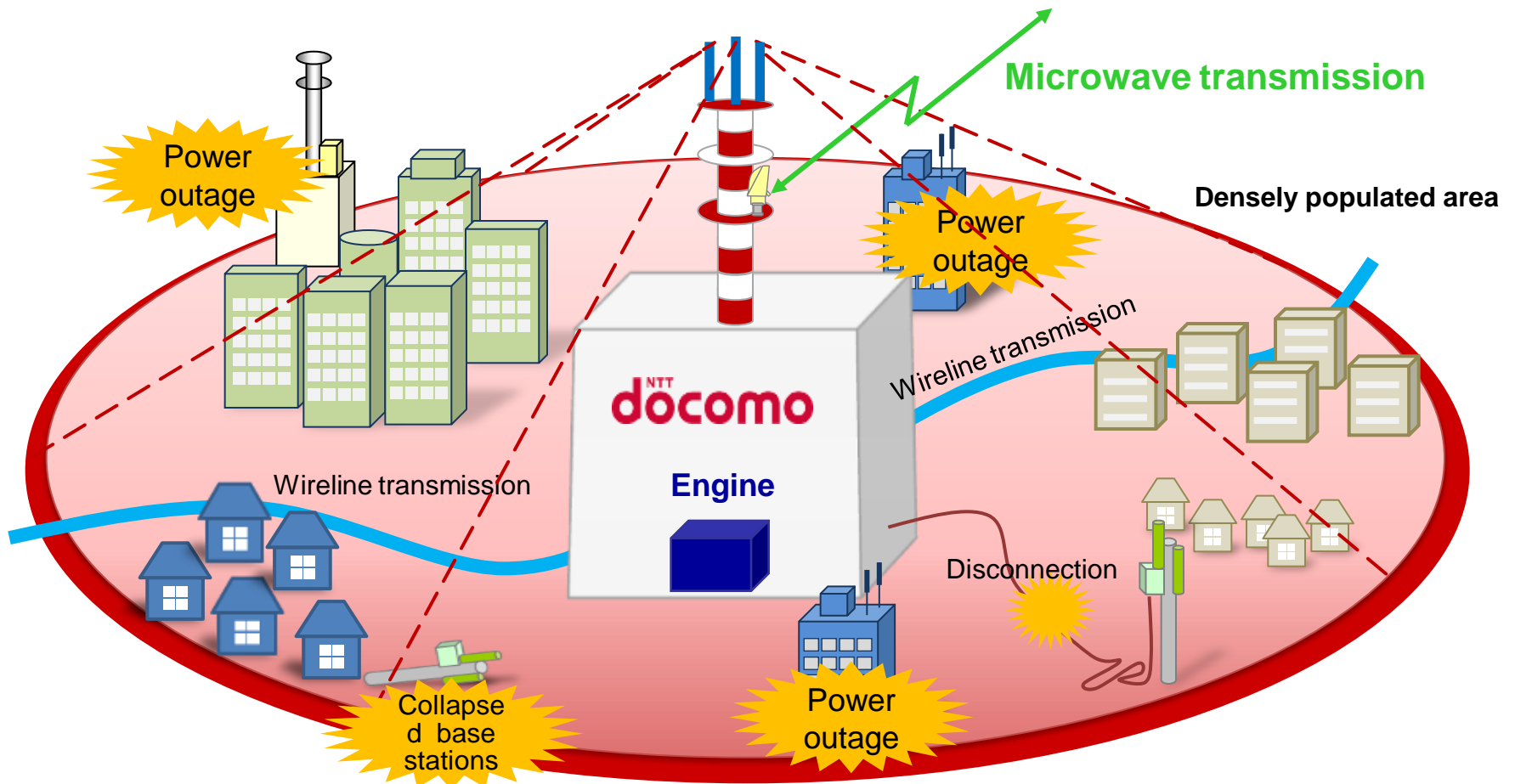


1. Restoration Status
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3. Main Activities for Securing Means of Communication, Efforts in Providing Life Support to the Affected People
4. **Major Countermeasures against Future Disaster**

- 1 Develop disaster-resistant networks and prompt recovery methods
- 2 Promptly reconnect local relief sites
- 3 Secure means of information sharing after disasters
- 4 Provide services and solutions during a disaster or recovery phase

# Deployment of Large Zone Base Stations

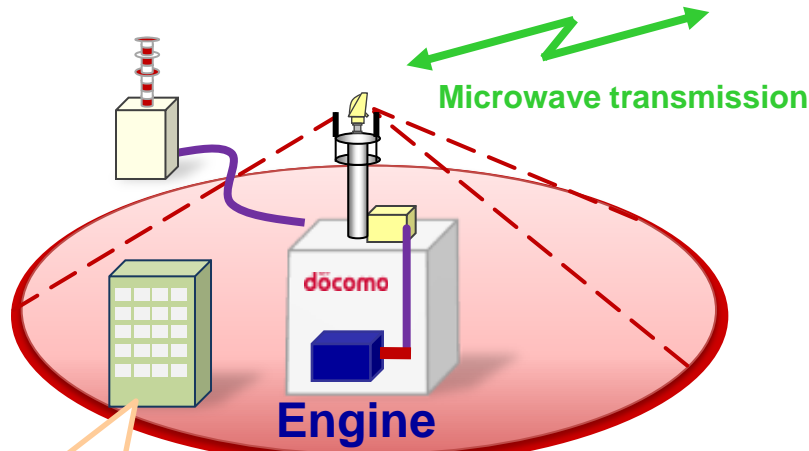
- Deploy large zone base stations, in addition to normal base stations, to secure communications over densely populated areas efficiently in emergency situations or power outage. (approx. 100 stations, covering approx. 35% of Japanese populations)
- Ensure high reliability by adopting uninterruptible power supply systems and duplicate routes.
- For larger cities, this scheme has been deployed in 6 areas in Tokyo, 4 areas in Osaka.



# Deployment of uninterruptible Power Supply Systems or 24-hour Power Supply from Battery in Base Stations

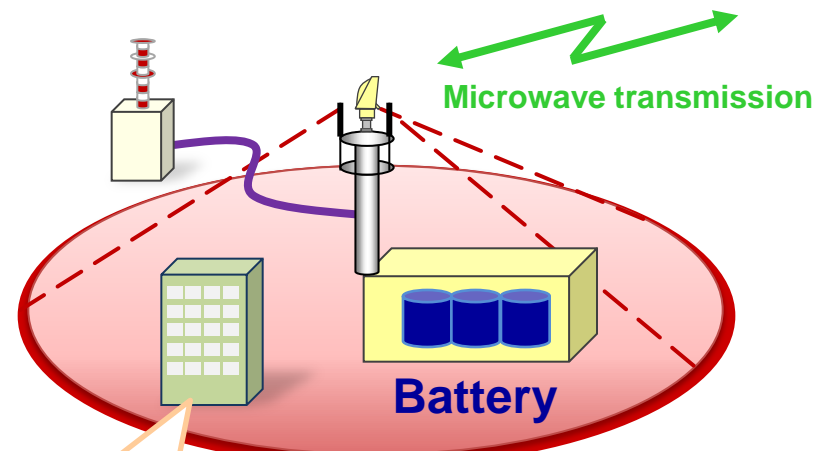
- Use uninterruptible power supply systems and/or extend battery life to 24 hours in base stations to secure communications for prefectural and/or municipal government offices.
- Uninterruptible power supply systems had been already installed in approx. 700 base stations.
- 24-hour battery supply systems had been already installed in approx. 1,000 base stations.

## Engine driven uninterruptible power supply (approx. 700 stations)



Prefectural/municipal government offices

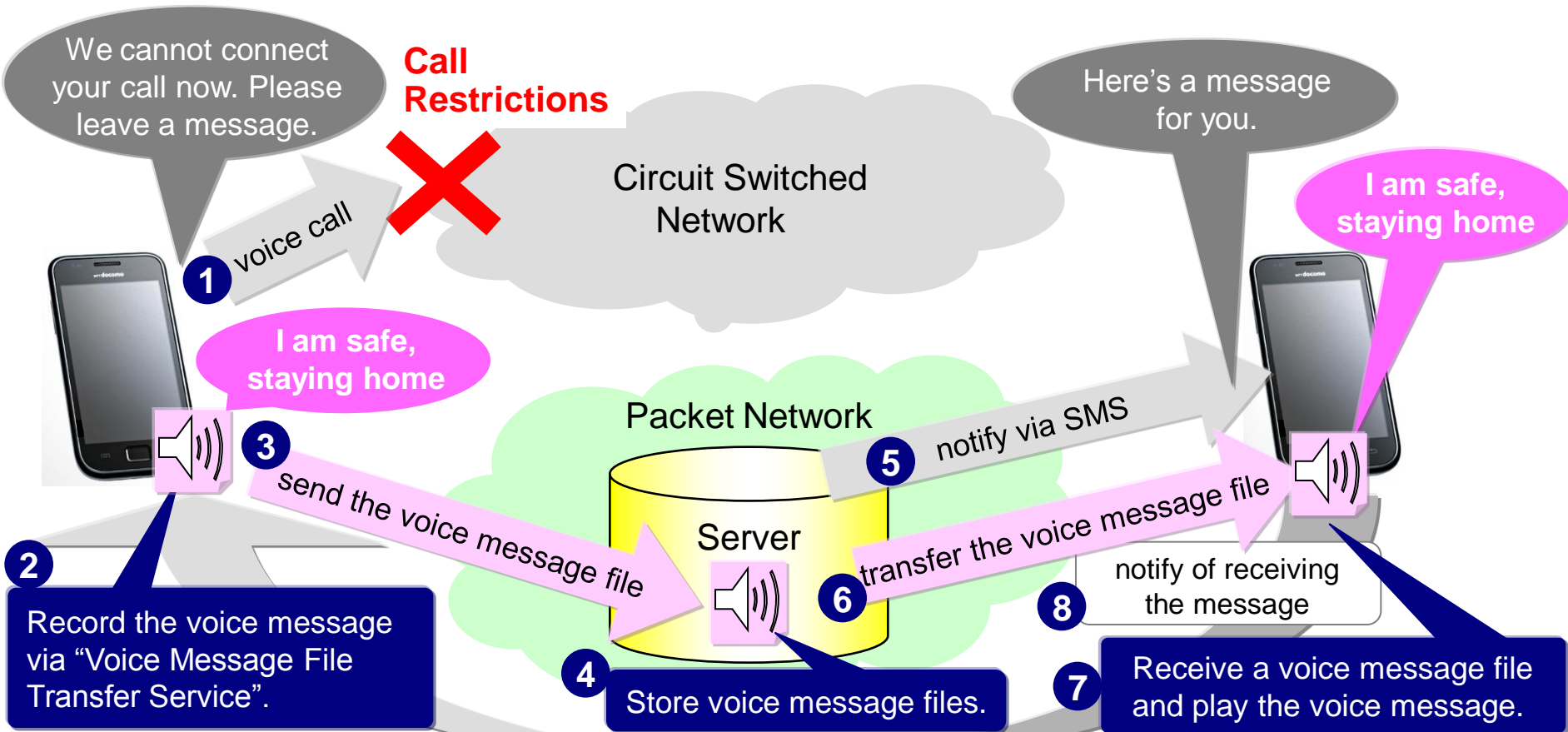
## 24-hour power supply from battery (approx. 1,000 stations)



Prefectural/municipal government offices

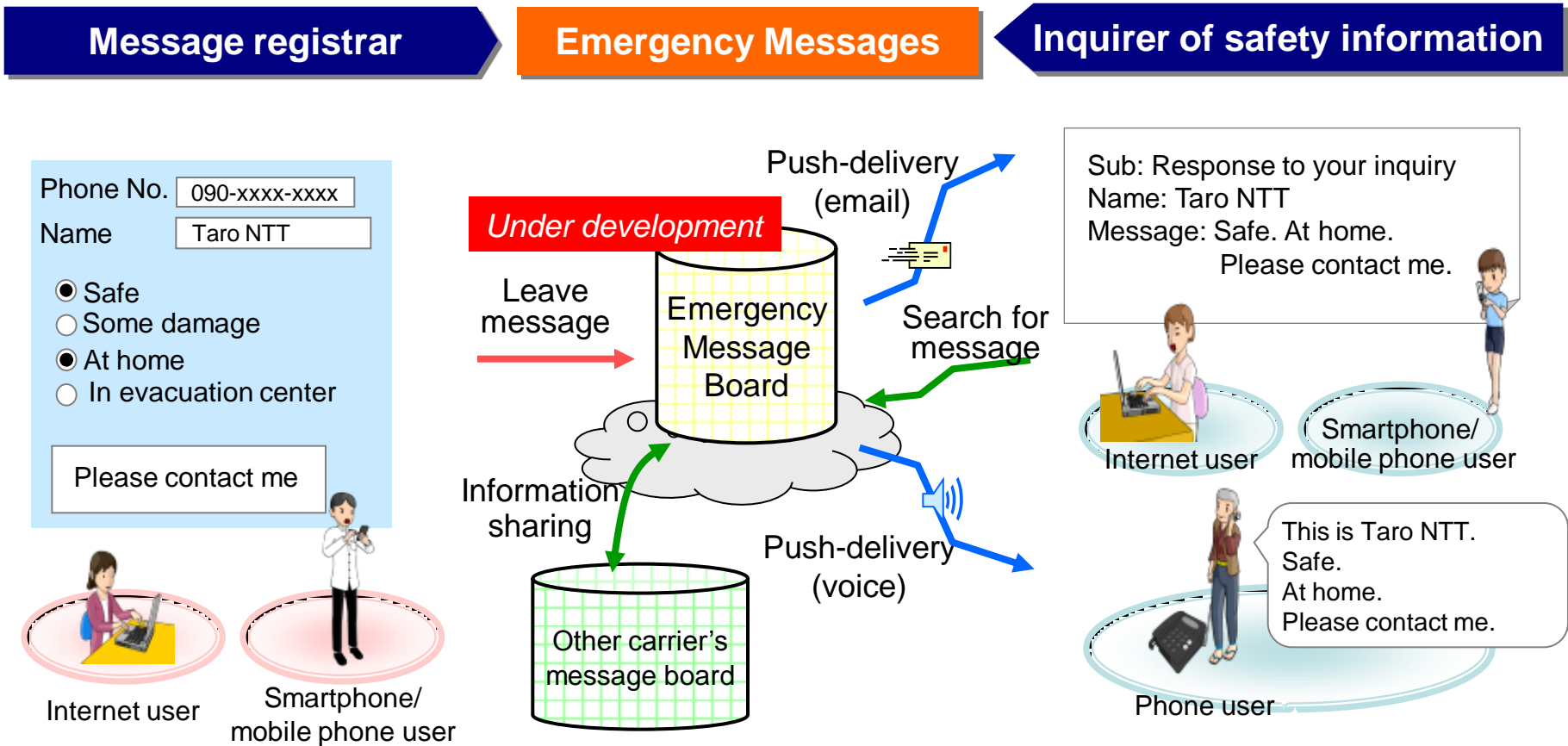
# Voice Message File Transfer Service

- In emergency situation, massive call origination congests the circuit-switched network, which making it difficult to get calls through.
- We have already developed the service which converts a voice message into a file and sends it to the called party over a packet network, which has been deployed since March 1<sup>st</sup>, 2012 .



# Emergency Message Service for Safety Confirmation NTT

- Improve user interface to enable anyone to leave messages easily. Email or voice message will be push-delivered to the inquirer of safety information.
- In addition, the information stored in the system could be searched by other carrier's users from the perspective of every user's convenience.



# Deployment of “Information Station” with Collaboration **NTT**

- The convenience store, Seven-Eleven Japan, will deploy “information station” at the store site in collaboration with NTT East.
  - Set up Wi-Fi network in the store, be available for free in the case of emergency.
  - Keep emergency phones (special public phones) at the store, be available for free in the case of emergency.

## Usual condition

## Emergency situation



Provide Wi-Fi network



Available  
for free

Register and check safety confirmation by Wi-Fi network



Smartphone  
Tablet, PC



- Register my safety information using smart phone application.
- Check family's safety away from you via voice message or email.

Install special public phone



Set up in  
front of the  
store

Secure means of communication after disasters



- Emergency communication device for whom are unable to go home.
- Persons without any device can make a phone call.
- Available in electricity outage.



- Promote installation and use of satellite communication (telephone, the Internet) to ensure prompt restoration of communication in regional disaster relief centers, such as evacuation centers.

## Reinforce current systems

- Increase number of satellite phones
- Increase number of transportable base stations that use satellite communication



## Enhance current systems

- Increase mobility  
(enhancing operational functions, reduce size)



## Introduce technical innovation

- Develop a new anti-disaster satellite system  
(supporting broadband access)
- Study future satellite systems

Both the public and private sectors need to work together in a study on the cost sharing of base stations for emergency communication, and a study on future satellite systems.

- We are moving ahead on research and development for disaster-resistant network.

## Secure prompt reconnection for local relief sites

- 1 New satellite communications system for disaster countermeasures

## Improving power capacity to withstand widespread and long-term power outages

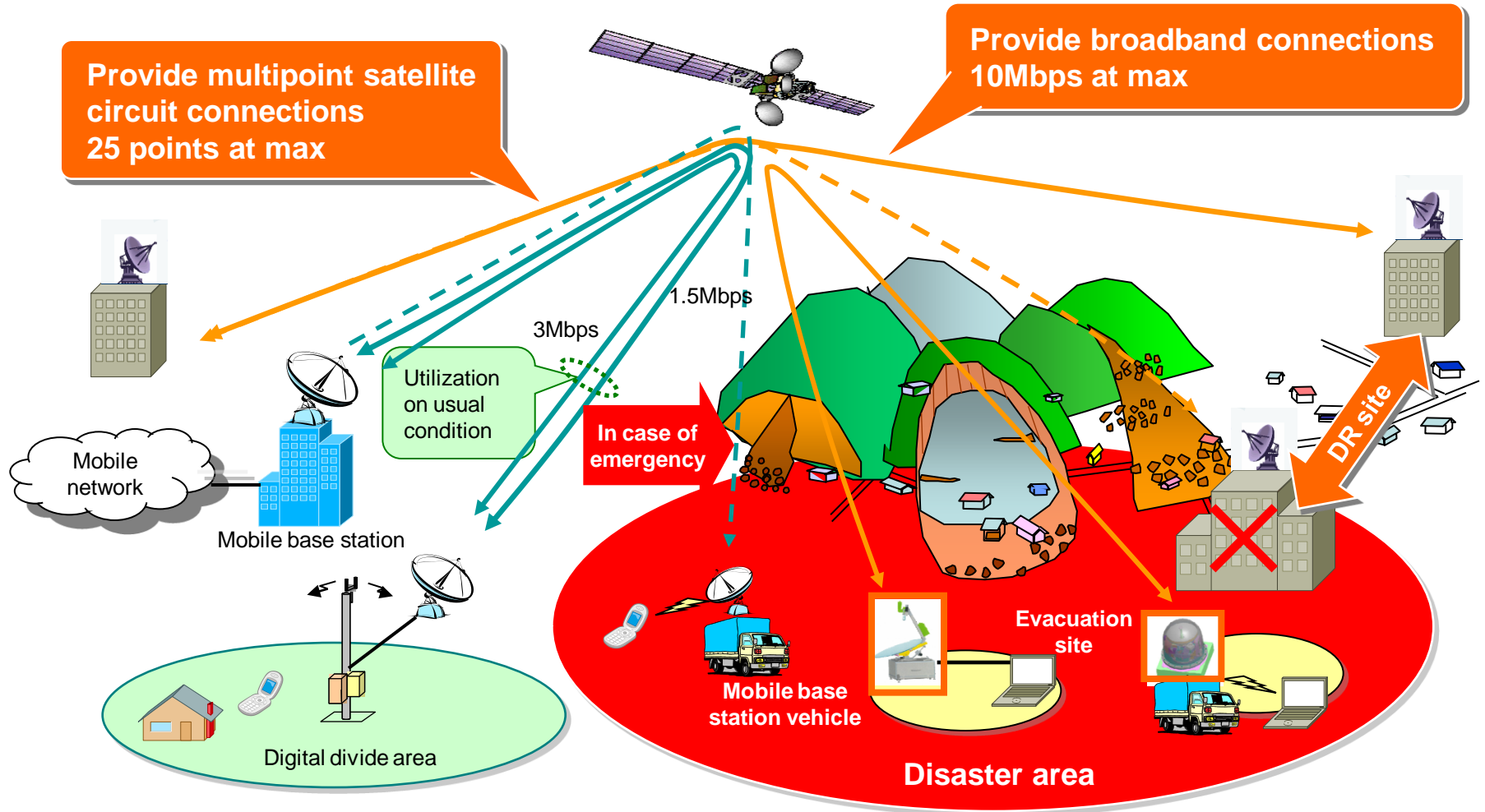
- 2 Energy management system coupled to power load
- 3 Optical fiber services available in case of power outage

## Implement congestion-tolerant network

- 4 Dynamic allocation of network resources
- 5 Prompt shift to disaster recovery site of cloud services

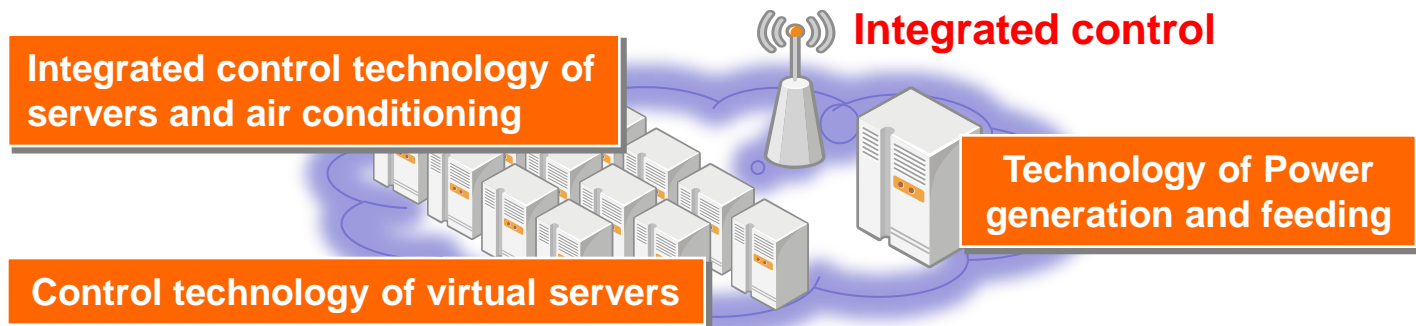
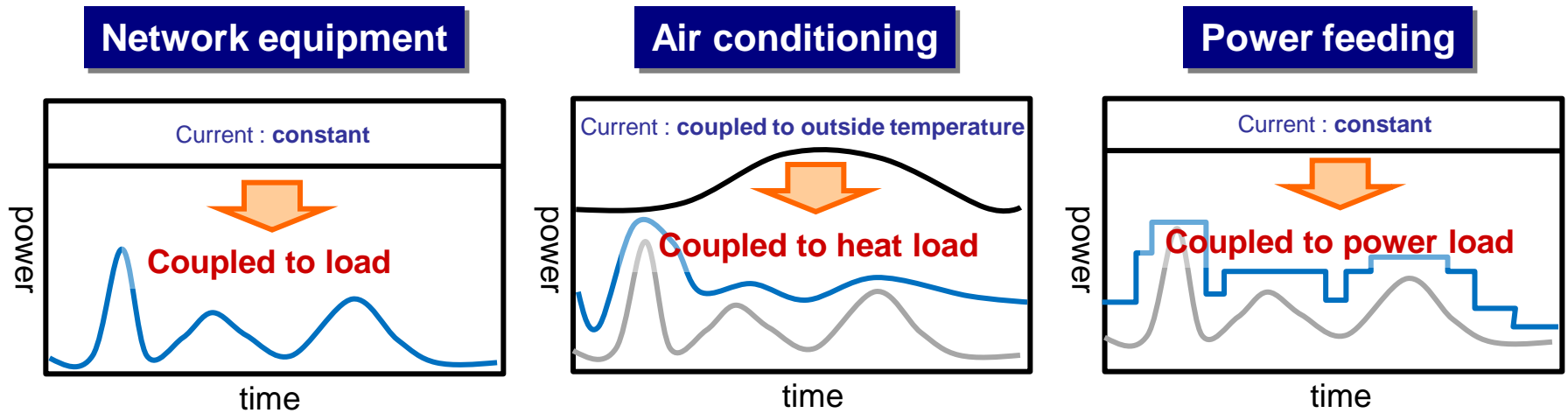
# 1 New Satellite Communications System

- New satellite communications system makes it possible to secure prompt reconnection for local relief sites.
- It is available on broadband and can provide multipoint communications, automatic acquisition radar, and easy operation.



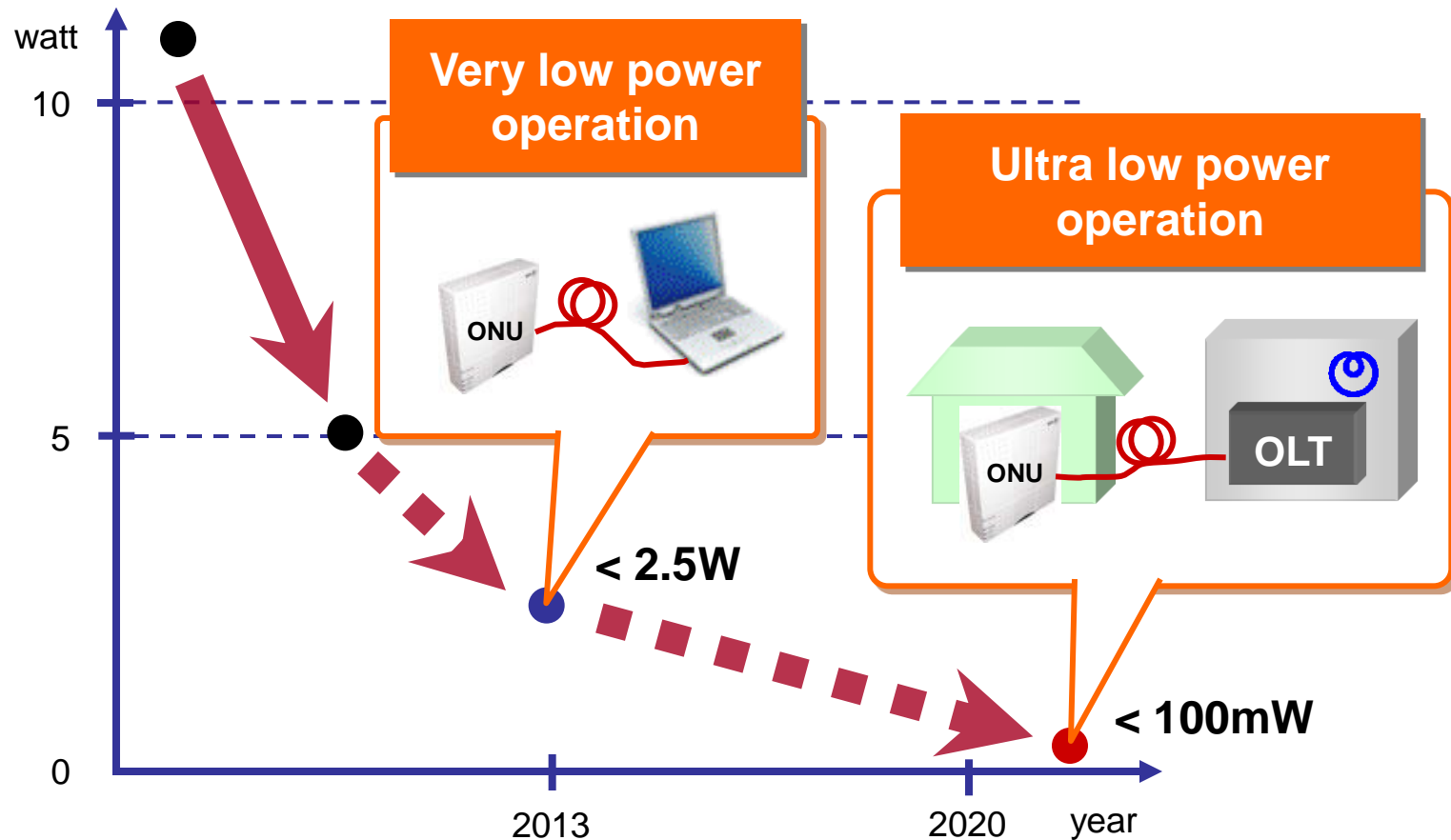
## 2 Energy Management System Coupled to Power Load NTT

- New energy management system can provide functions which can control power consumption of network equipment and cloud servers coupled to their load of CPU and traffic, etc.
- New EMS can also control power consumption of air conditioning and power feeding coupled to the load of a whole building and data center.



### 3 Optical Fiber Services Available in Power Outage

- Development of new ONU, which can operate in very low electric power, such as 2.5W fed by USB from the battery of PC, etc.
- In order to utilize optical fiber services even in case of power outage, we set a challenging goal which can operate in ultra low power such as 100mW.

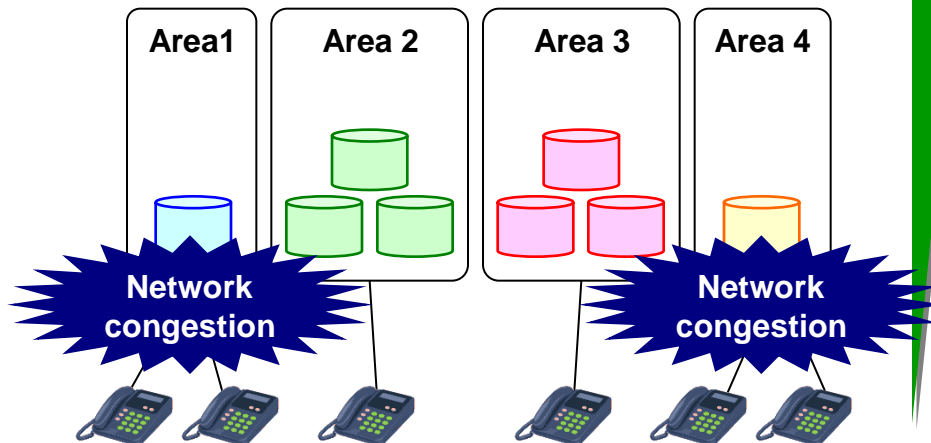


## 4 Dynamic Allocation of Network Resources

- Implementation of virtual network technology into call control servers can handle rapid increase of traffic in case of emergency, because its network resources are allocated dynamically.
- It can be applied for real-time and highly reliable services such as telephone.

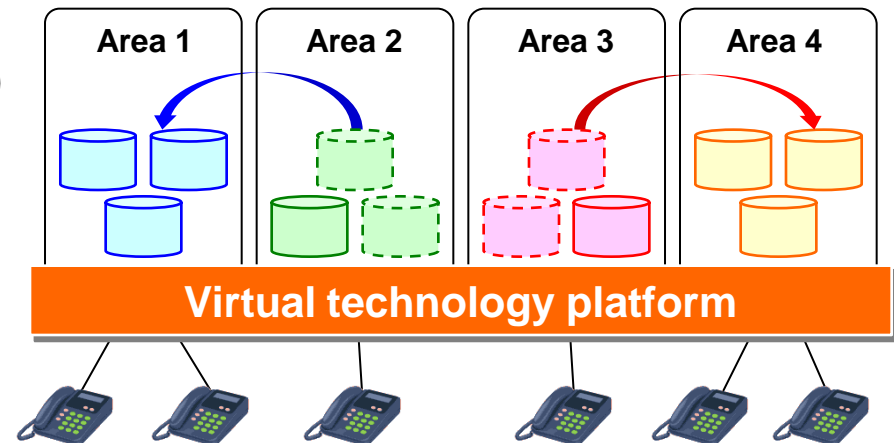
### Existing network

Existing network can NOT handle rapid increase of traffic in emergency, because its network resources are allocated statically.



### Virtual technology based network

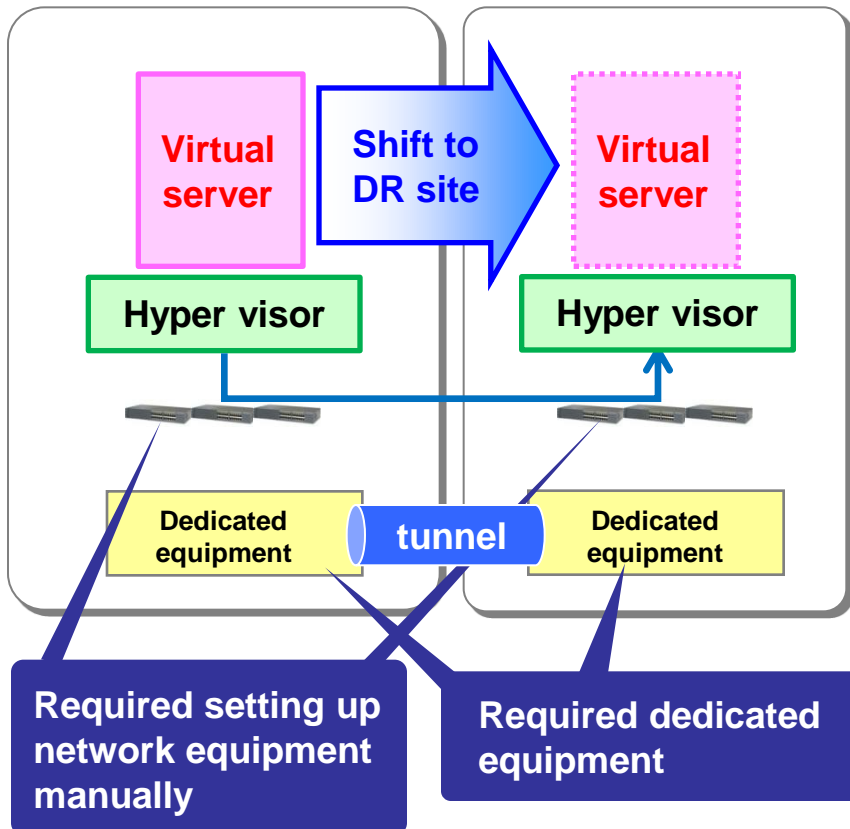
Virtual technology based network can handle rapid increase of traffic in emergency, because its network resources are allocated dynamically.



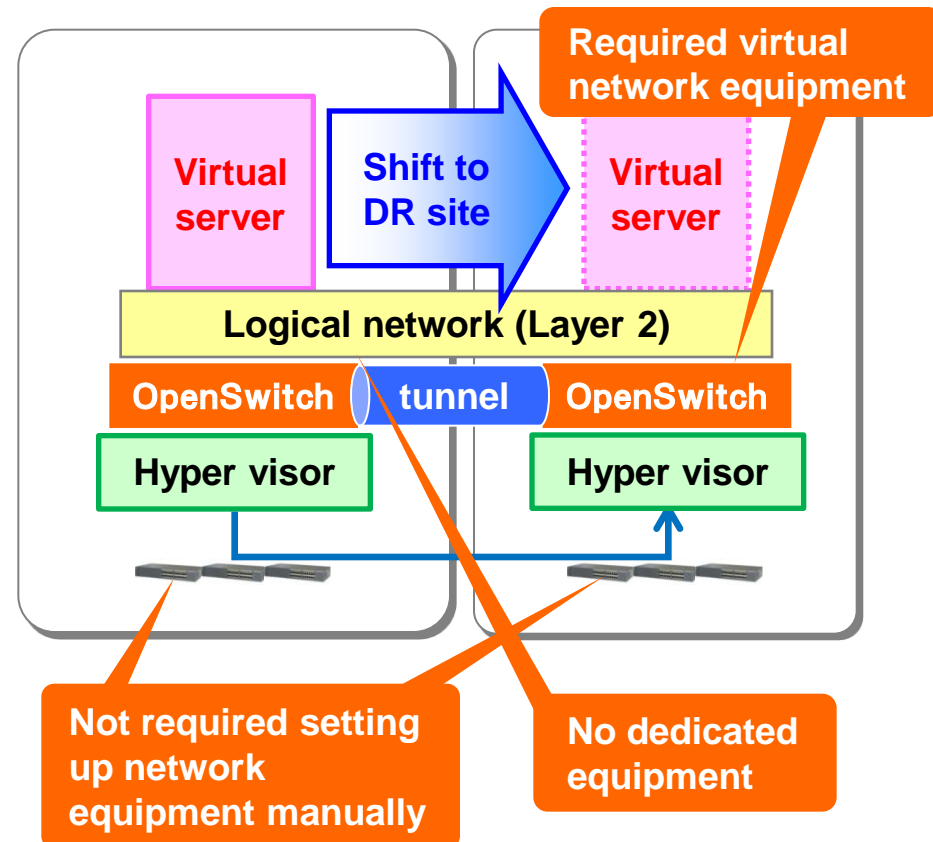
# 5 Prompt Shift to Disaster Recovery Site of Cloud Services NTT

- Implementation of virtual technology software into virtual servers and networks can provide a prompt shift to disaster recovery site among any cloud servers even if in case of emergency.

## Existing system



## Virtual technology based system



- 1** Develop disaster-resistant networks and prompt recovery methods:
  - Distribute key functions across regions and implement multiple routes in preparation against wide-area disasters
  - Improve power capacity to withstand widespread and long-term power outages
  
- 2** Promptly reconnect local relief sites:
  - Increase the use of satellite and wireless communications
  
- 3** Secure means of information sharing after disasters:
  - Communication needs directly following a disaster, such as confirmation of safety (countermeasures against congestion)
  - Strengthen means to meet the diversification of customer needs, which are shifting from using voice communications to using email and the Internet
  
- 4** Provide services and solutions useful during a disaster or recovery phase:
  - Support of municipalities, schools, remote medical care, etc.

Where solutions cannot be provided by the NTT Group alone, we will collaborate with the central and regional governments.



- We are deeply grateful to share our experience of how the 3/11 earthquake and the following tsunami affected telecommunications infrastructure, how we reacted, and what we are planning to do for the future.
- It could be possible that our lessons learned from the Great East Japan Earthquake might be extended to other disasters, such as floods, typhoons, or even wars and terror attacks, etc.
- We would sincerely appreciate it if this presentation could help any of the people here.

# Thank you

