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Approach to Strengthening Power Company Networks in Japan

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Tohoku Electric Power Company (Tohoku EPCO):

- Geographically northern regions in Japan.
- Number 5 in total amount of power generated in Japan.
- Providing for the largest area in Japan. (Figure 1)

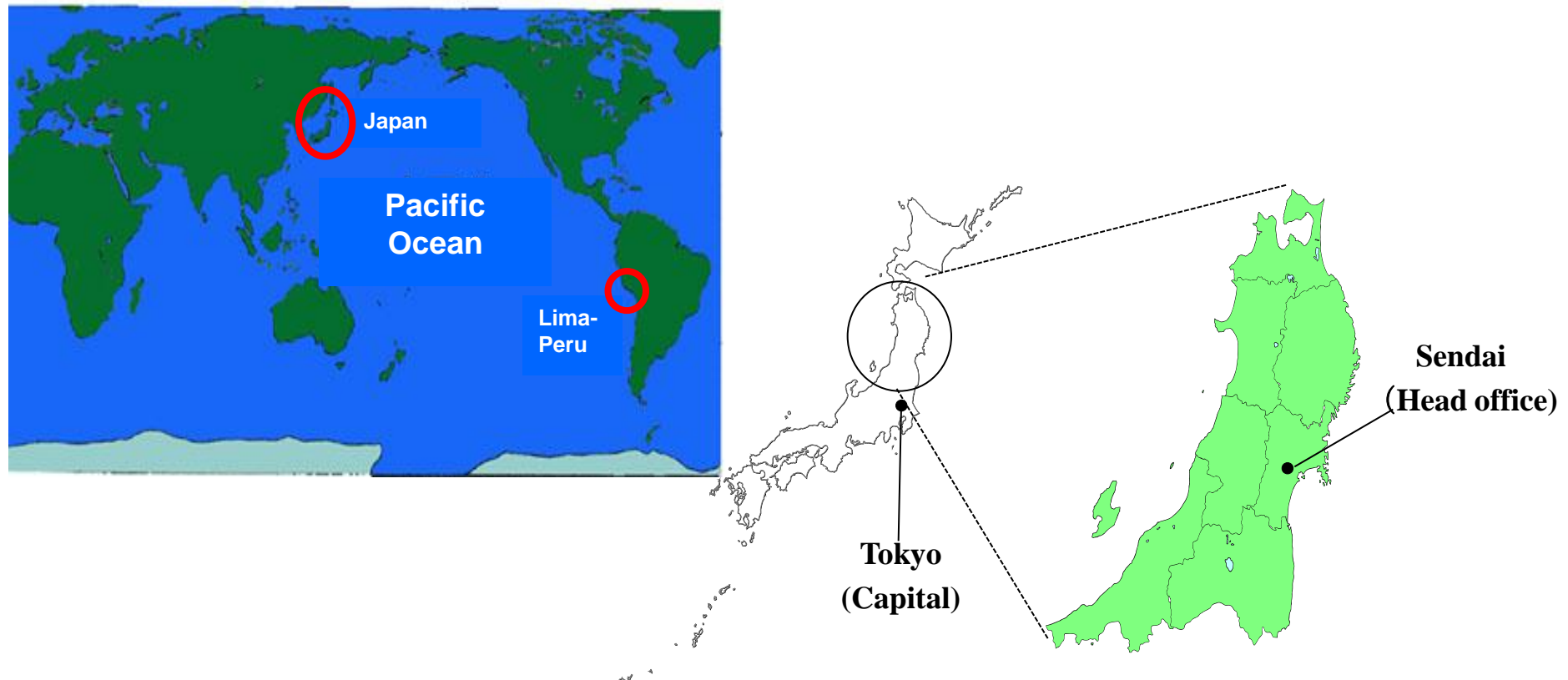
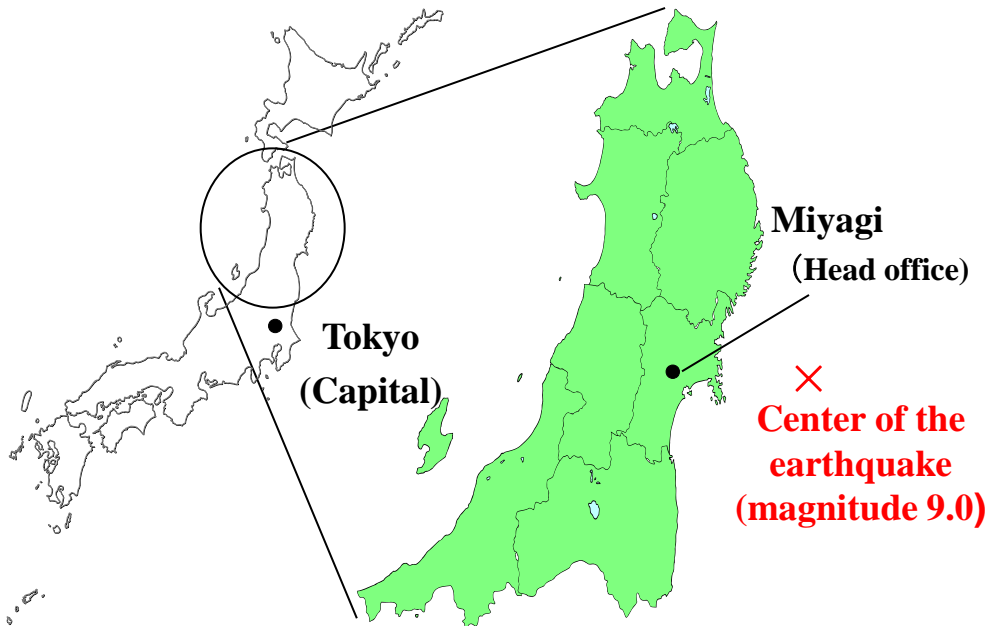


Figure 1 Tohoku Electric Power Company operation area

At the time of the Great East Japan Earthquake

- On March 11, 2011 at 2:46 PM (Japan time) offshore Miyagi prefecture at 130 km.
- An earthquake of magnitude 9.0.



-Within our service area **4,860,000** households experienced power outages.

Figure 2 Tohoku Electric Power Company operation area (earthquake)

At the time of the Great East Japan Earthquake

- The anti-disaster measures functioned effectively in core networks and communication network management system.
- The damage was minimized.
- The system was recovered within a short period of time.

Core networks

Constructed of using microwave communication or IP networks.



-Own the following telecommunications network for electric power systems to keep the grid stabilized.

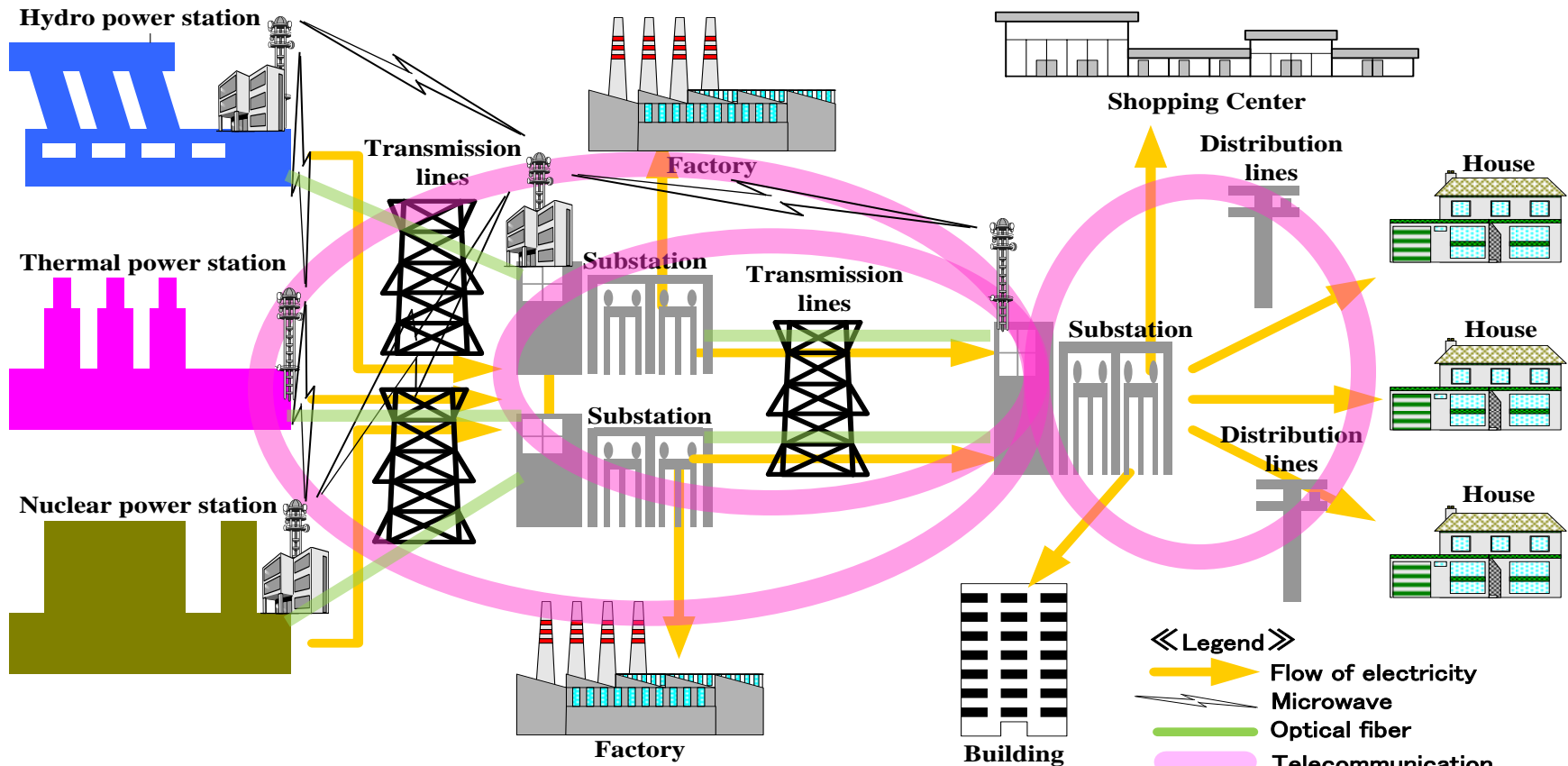
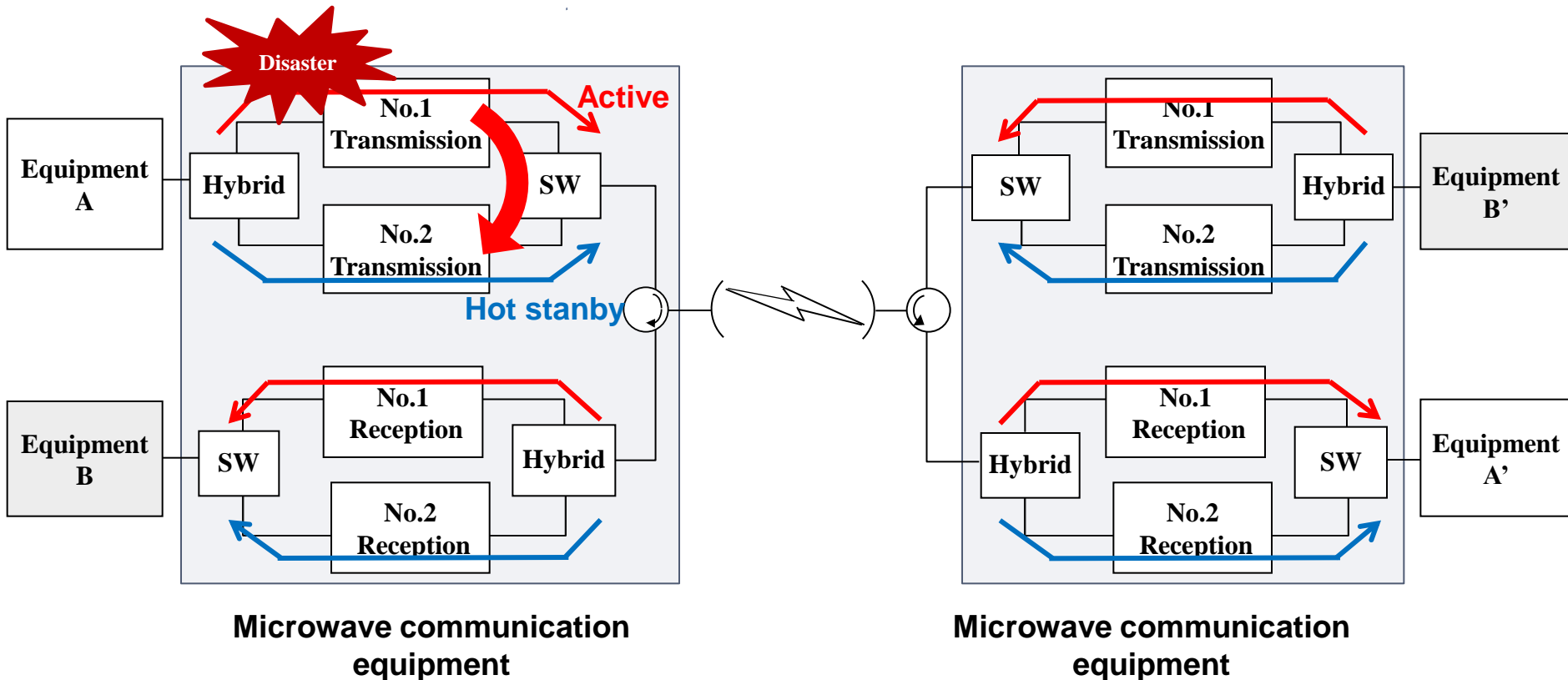


Figure 3 Telecommunication Network of Tohoku Electric Power Company

Features of Microwave Network

1. Strong in disaster

2. Higher reliability for two parallel structures

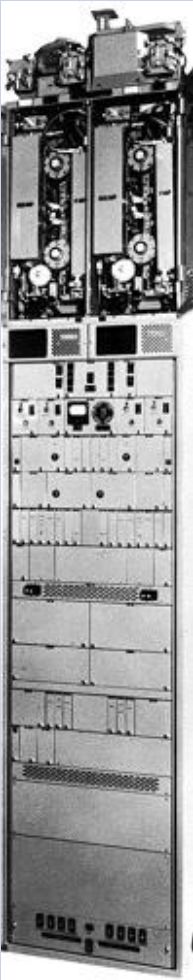


Anti-earthquake Measures of Microwave Communication Equipment

Extent of Damage and Anti-Measures taken for the Microwave Network after the earthquake offshore Miyagi Prefecture in 1978 .

Equipment	Extent of Damage	Anti-Earthquake Measures
Microwave communication equipment	Packages fall Racks get bent	Lock all packages to rack Strengthening the junction points of racks
Antenna	Damage to waveguide	Application of flexible waveguides
Telecommunication equipment room	Damage to waveguide Damage to cables when moving the racks	Reinforcement of building penetration, usage of cushioning Reinforcement of the installation method Rigid structure that does not resonant during earthquakes

Example of anti-earthquake measures 1



in1978

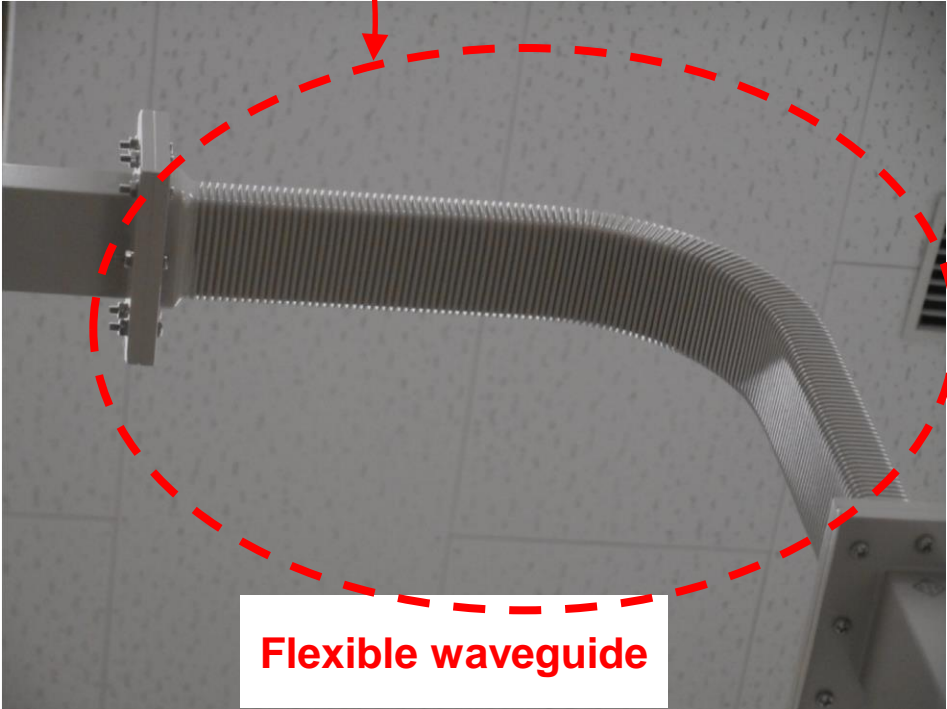
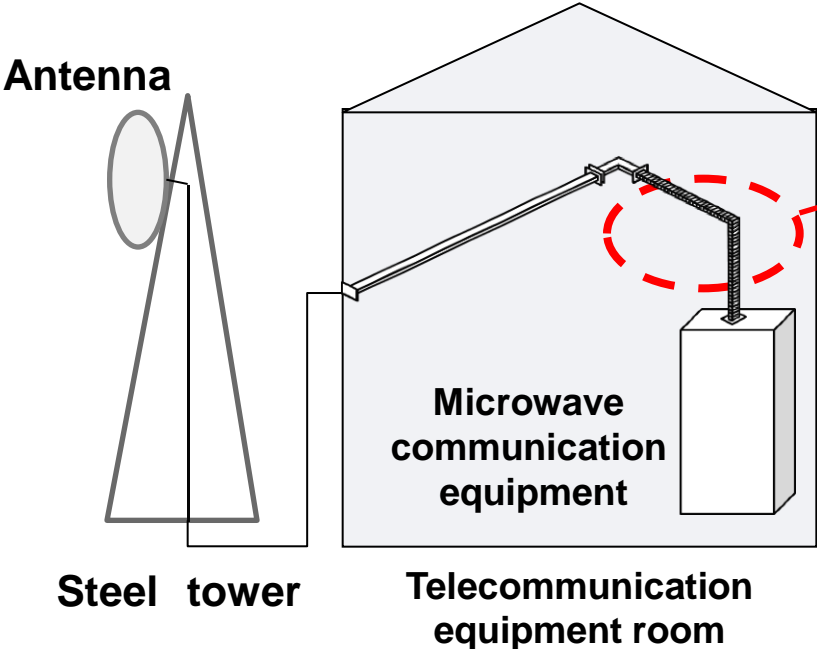


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Example of anti-earthquake measures 2



Flexible waveguide

IP network

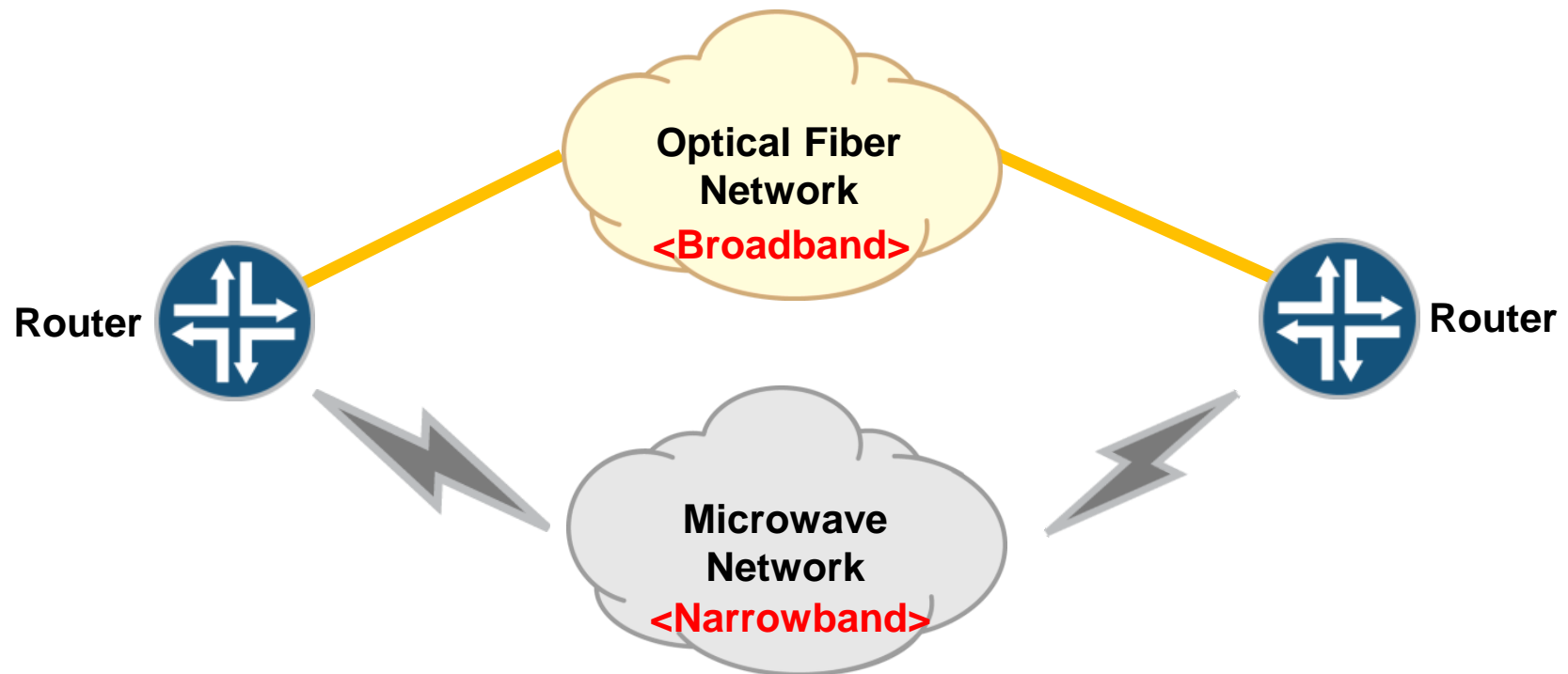
IP network consists of ...

1. Optical Fiber Network

Broadband, but less reliability than Microwave Network

2. Microwave Network

Narrowband, but more reliability than Optical Fiber Network



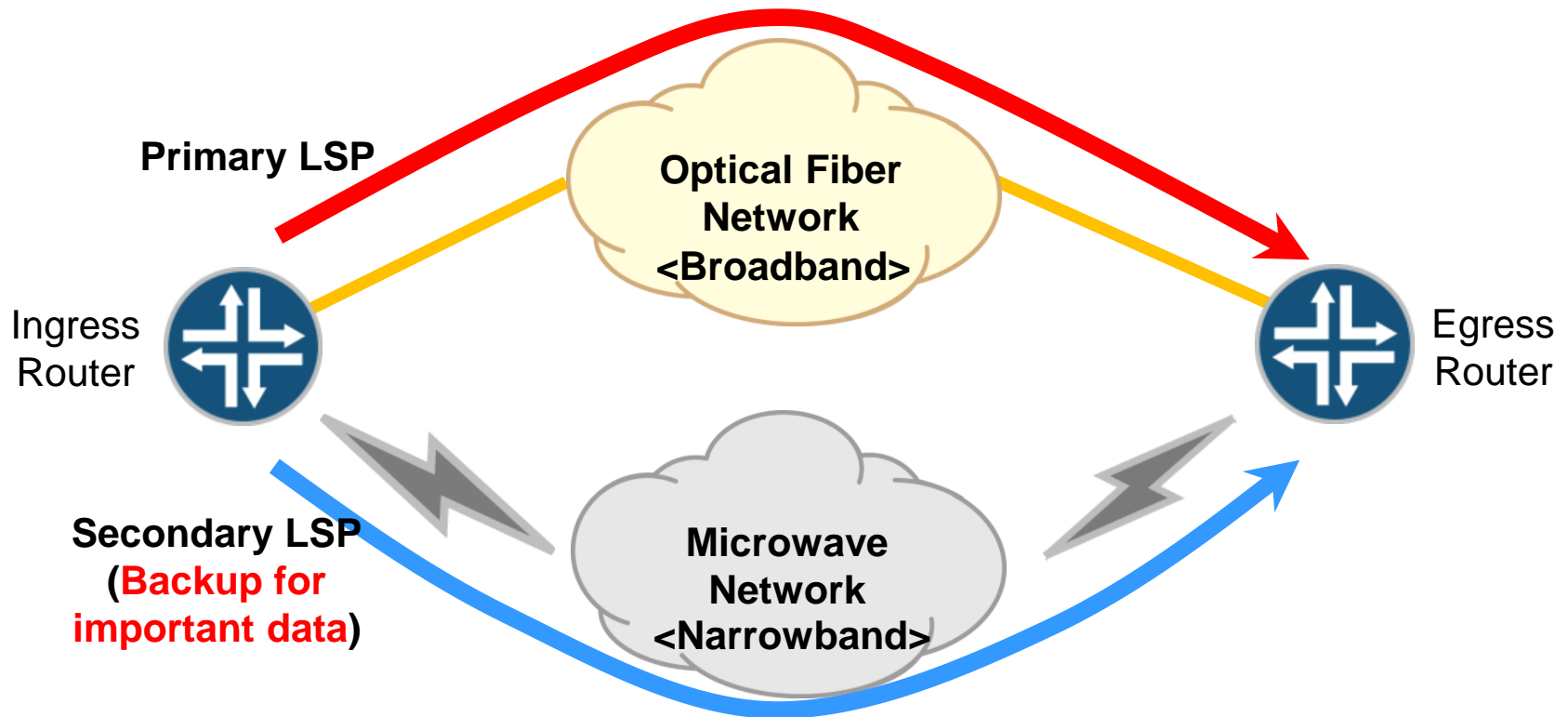
Specifying a route using LSP of MPLS

MPLS uses LSP as a path for sending packet.

- LSP can specify route at Ingress Router

LSP can also configure with service(data).

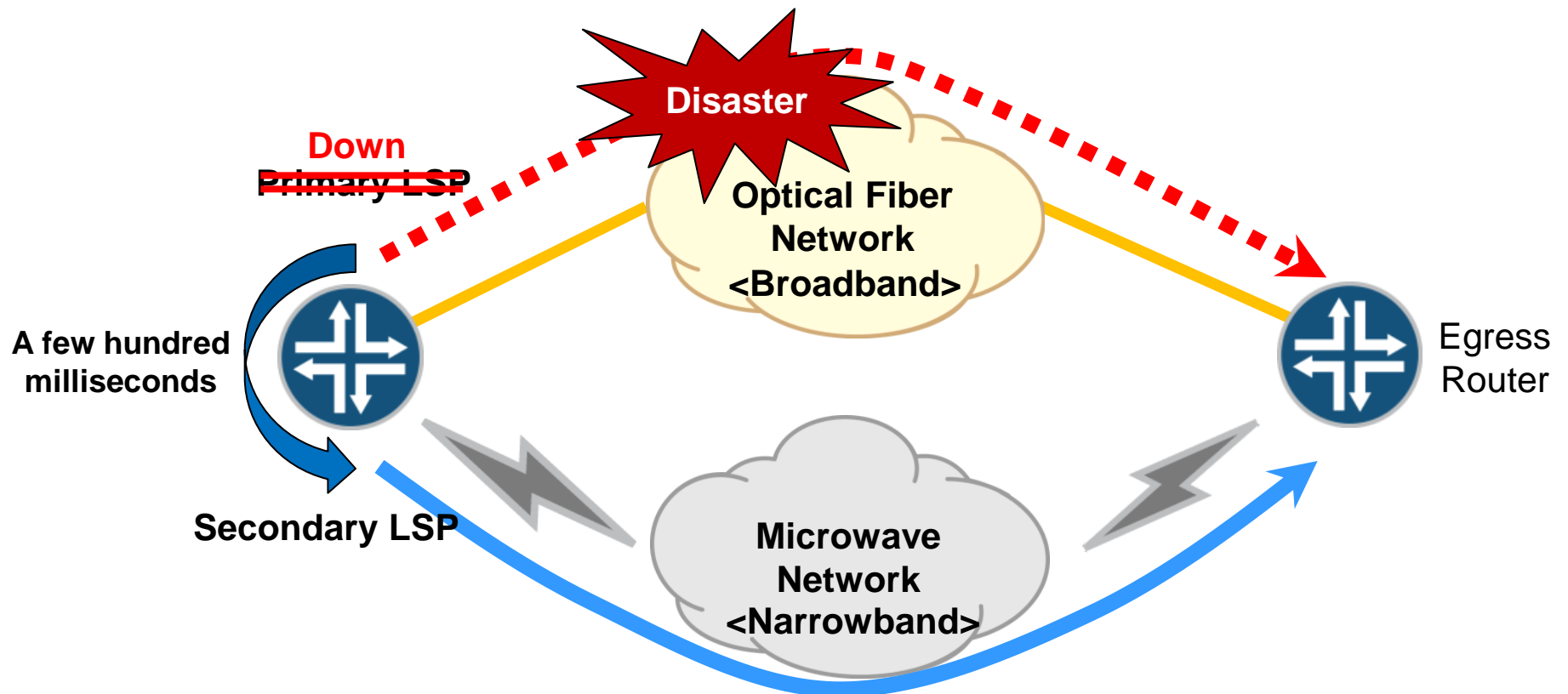
- In the case of damage, only important data can be sent to the Secondary LSP(that is through the Microwave Network).



Swift switch after system failure

Fast Convergence

-MPLS LSP can switch automatically from Primary LSP to Secondary LSP within a few hundred milliseconds after system failure.



Communication network management system

After the Great East Japan Earthquake, the following points and conditions have been added as of March 2014 as part of the anti-disaster measures.

Function	Before update	After update
(1) Processing capacity	200 status changes / second	500 status changes / second
(2) Human machine Interface	Only for the log display	For the log display Detailed search function Data output function
(3) Business Continuity Plan	Keep redundancy	Keep redundancy Substitute the cold standby HDD* to the server, then download backup data from the NAS* at 50km away the head office
(4) Training	None	New addition

*HDD: Hard disk drive

*NAS: Network attached storage

Tohoku EPCO, NEC and Juniper Networks will continue to improve conditions through constant developments to communication technology.

Including reinforcements necessary for anti-disaster measures and swift restoration procedures.

Thank you for listening !

Next:

Answers to the Special Report Questions

Q2-11. In the paper, it is clear that both the MPLS and the microwave network have redundant paths. Are the optical transport networks also protected in the same way? If so, are they protected by using different optical cables? Please detail it more.

A2-11. Optical fiber are comprised of a root and a spare route exists.

(Optical fiber composite overhead Ground Wire and distribution line)

Q2-12. What are the services that are protected by the secondary LSP?

**A2-12. Mostly, Information of the transformer substation.
(switch , voltage , current and more...)**

Q2-13. Has Tohoku EPCO considered using telecommunication links provided by traditional telecommunication carriers as redundancy? If not, why? Were these carriers subject to new regulation as well after the Great East Japan Earthquake?

A2-13. Japanese Power company has to own their network for electric power systems with exclusive facilities by Japanese law, we don't use telecom company's network for the purpose.

In addition, a new standard about electricity preservation communication is not established based on an earthquake disaster, we planned the speedup of the network in the office.

Q2-14. ALL: What has been your experience using packet transport networks for critical data, such as teleprotection? Have the results been acceptable? Would you consider to migrate your services to an all-IP network?

A2-14. Apply IP technology to important network such as power control is still under discussion and not applied yet.

Thank you for your time !