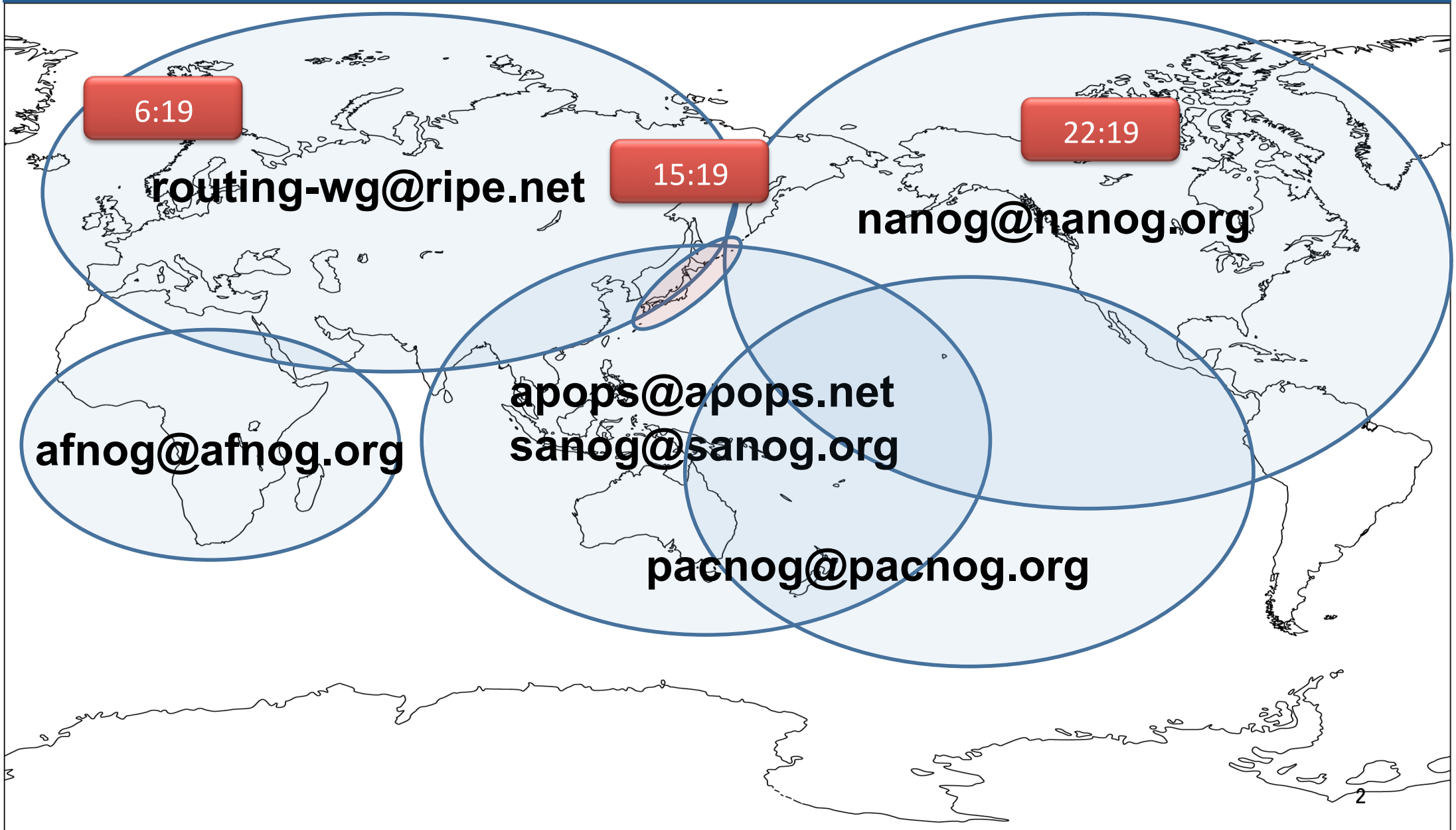
First of all

- Thank you very much for every heartwarming message and support from all over the world.

2011/3/11 15:19(JST), 33min's later



2011/3/11 15:19(JST)

6:19

routing-wg@ripe.net

15:19

22:19

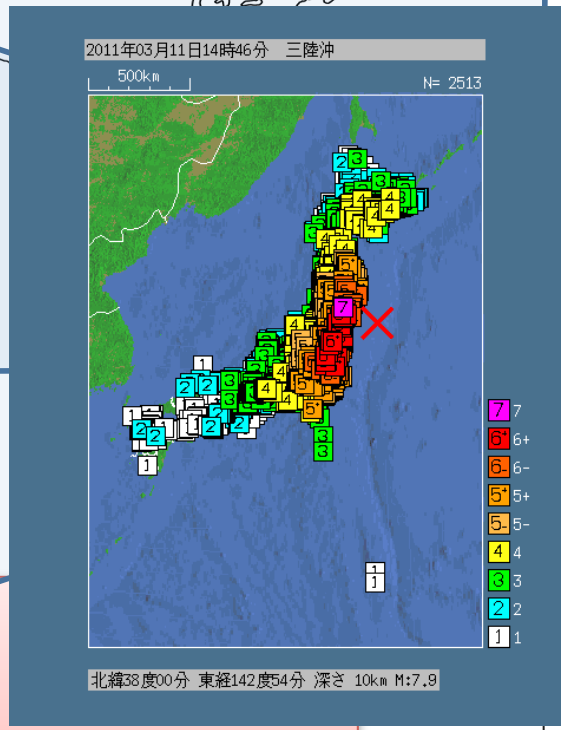
nanog@nanog.org

afnog@afnog.org

apops@apops.net

sanog@sanog.org

pacnog@pacnog.org



Just one sentence:

Japan had so big terrible earthquake

9 min’s later

15:28

On Fri, 11 Mar 2011 15:28:37 +0900 (JST)
Yasuhiro Orange Morishita / 森下泰宏 <yasuhiro@jprs.co.jp> wrote:

超速報ですが、JP DNSサーバーは現時点で無事の模様。

-- 森下泰宏/Orange

9 min’s later

15:28

JP DNS is working ☺

On Fri, 11 Mar 2011 15:28:37 +0900 (JST)
Yasuhiro Orange Morishita / 森下泰宏 <yasuhiro@jprs.co.jp> wrote:

超速報ですが、JP DNSサーバーは現時点で無事の模様。

-- 森下泰宏/Orange

apops@apops.net : We verified all JP DNS servers are still fine.

A record for about 40 min's after the quake

- 14:46 M9.0 Great East Japan Earthquake

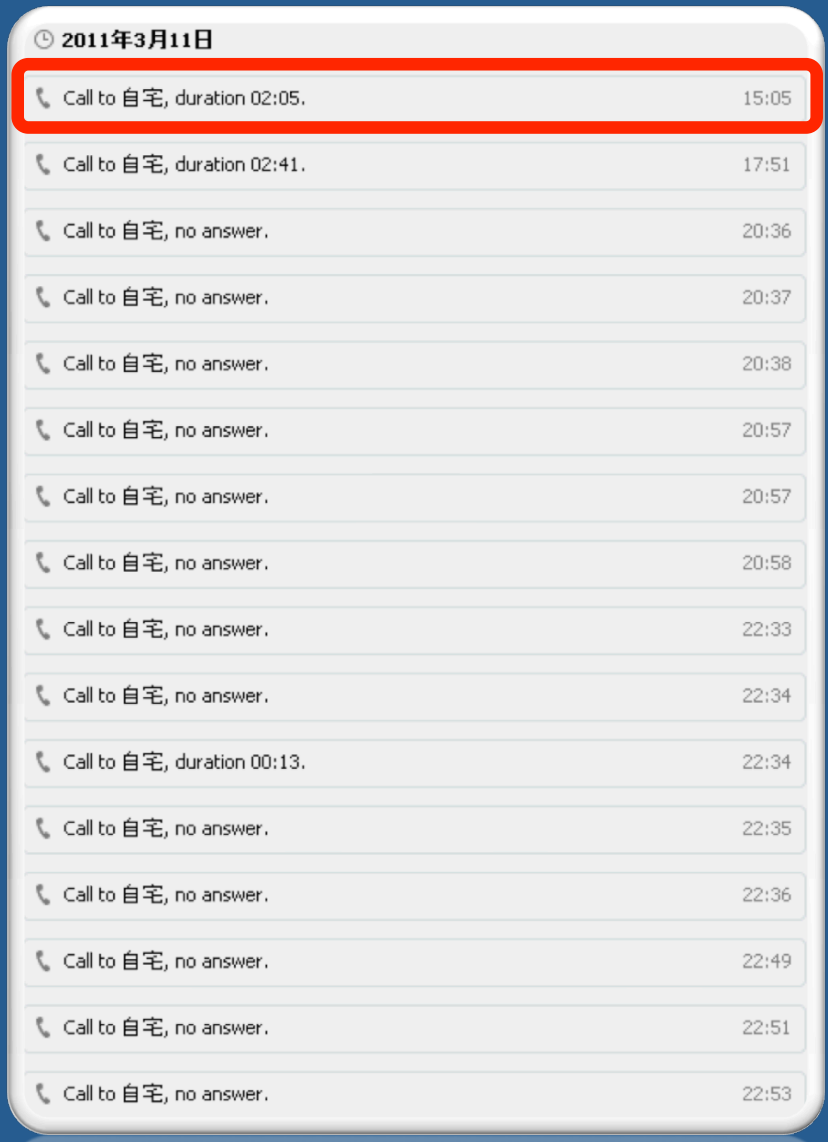
- 15:15 M7.7 big aftershock

- 15:19 Subject: so big earthquake in JP
  - To : apops@apops.net, nanog@nanog.org, routing-wg@ripe.net, afnog@afnog.org, sanog@sanog.org, pacnog@pacnog.org

- 15:28"JP DNS is working"by Mr. Morishita@JPRS

A record for about 40 min's after the quake

- 14:46 M9.0 Great East Japan Earthquake
- 14:5X Called my home but not available
- 14:59 Sent e-mail to my wife mobile phone
- 15:05 Could reach my home by skype_out[2:05]
- 15:09 Sent an empty e-mail nttv6.jp -> ntt.com
  - checking whether a mail of ntt.com could be received via internet ; OK
- 15:15 M7.7 big aftershock
- 15:16 Sent to parents "I am OK"
- 15:19 Subject: so big earthquake in JP
  - To : apops@apops.net, nanog@nanog.org, routing-wg@ripe.net, afnog@afnog.org, sanog@sanog.org, pacnog@pacnog.org
- 15:27"We are OK"from a parent by e-mail
- 15:28"JP DNS is working"by Mr. Morishita@JPRS



Outline

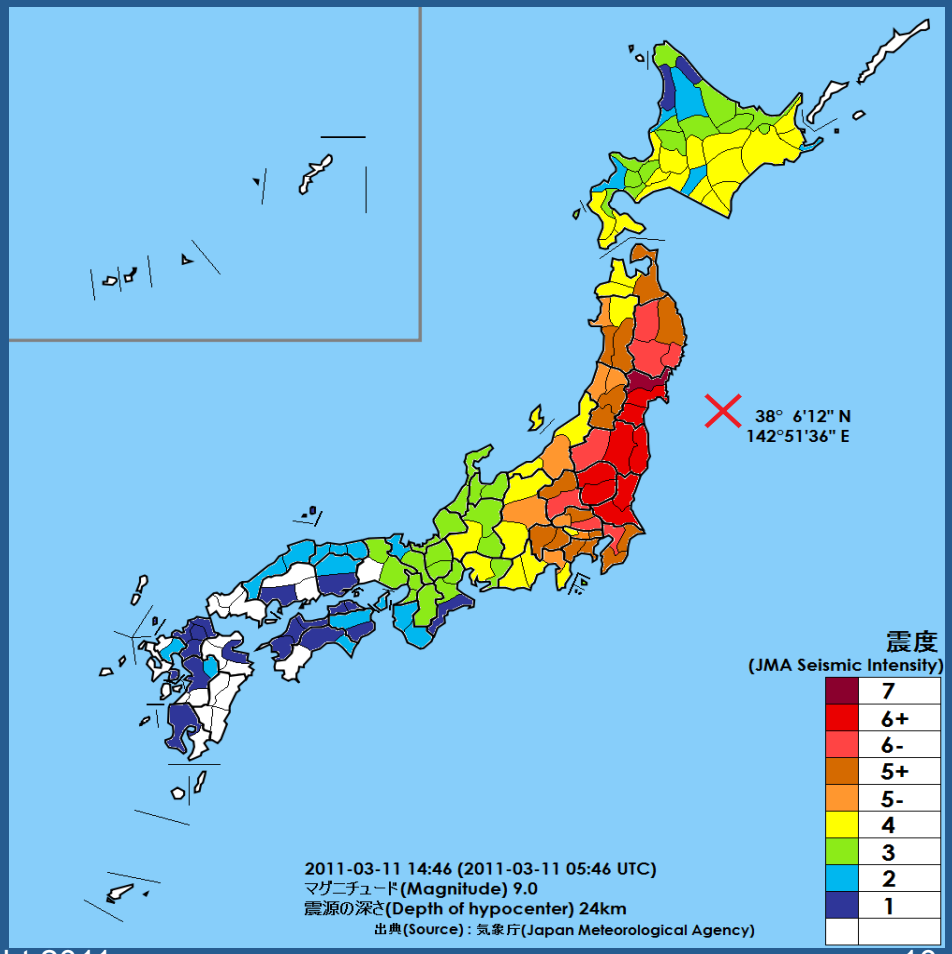
- Overview of the Great East Japan Earthquake
  - Earthquake, tsunami, Nuclear power plant
- Its impact on inter-networking
  - Internet Exchange
  - Datacenters
  - Domestic backbones
  - Submarine cables
  - Access lines

OVERVIEW OF THE DISASTER

It happened

- At 14:46, March 11, 2011 (JST) [05:46 UTC]
- M9.0 earthquake

- 20 min. or later
- Tsunami
  - 15m or higher



http://upload.wikimedia.org/wikipedia/commons/5/5a/Shindomap_2011-03-11_Tohoku_earthquake.png

Tsunami

- It was much more dangerous than we had expected.
  - http://www.youtube.com/watch?v=Ann27T6JTek
  - http://www.youtube.com/watch?v=jxng4VE8ptw

Tsunami

Damage situation (on Aug 22)

- Personal damages
  - Killed 15,721
  - Missing 4,615
  - Refugees 102,501
- Property damages
  - Totally collapsed 113,936 (doors)
  - Half collapsed 150,806
  - Partially collapsed 533,079

http://www.npa.go.jp/archive/keibi/biki/higaijokyo_e.pdf

92.5% of killed were **drowned**.
(from newspaper on Apr. 19)

Tsunami

- Its impact was not only on in Japan…
- Four Seasons Resort Hualālai (Hawai, US)
  - …, reopens April 30, 2011. The reopening follows a six-week closure caused by the recent earthquake-generated tsunami in Japan.[a]
- Santa Cruz (CA, US)
  - “Tsunami: Santa Cruz harbor dock destroyed, man swept out to sea near Klamath River”

Telecommunication in Tokyo

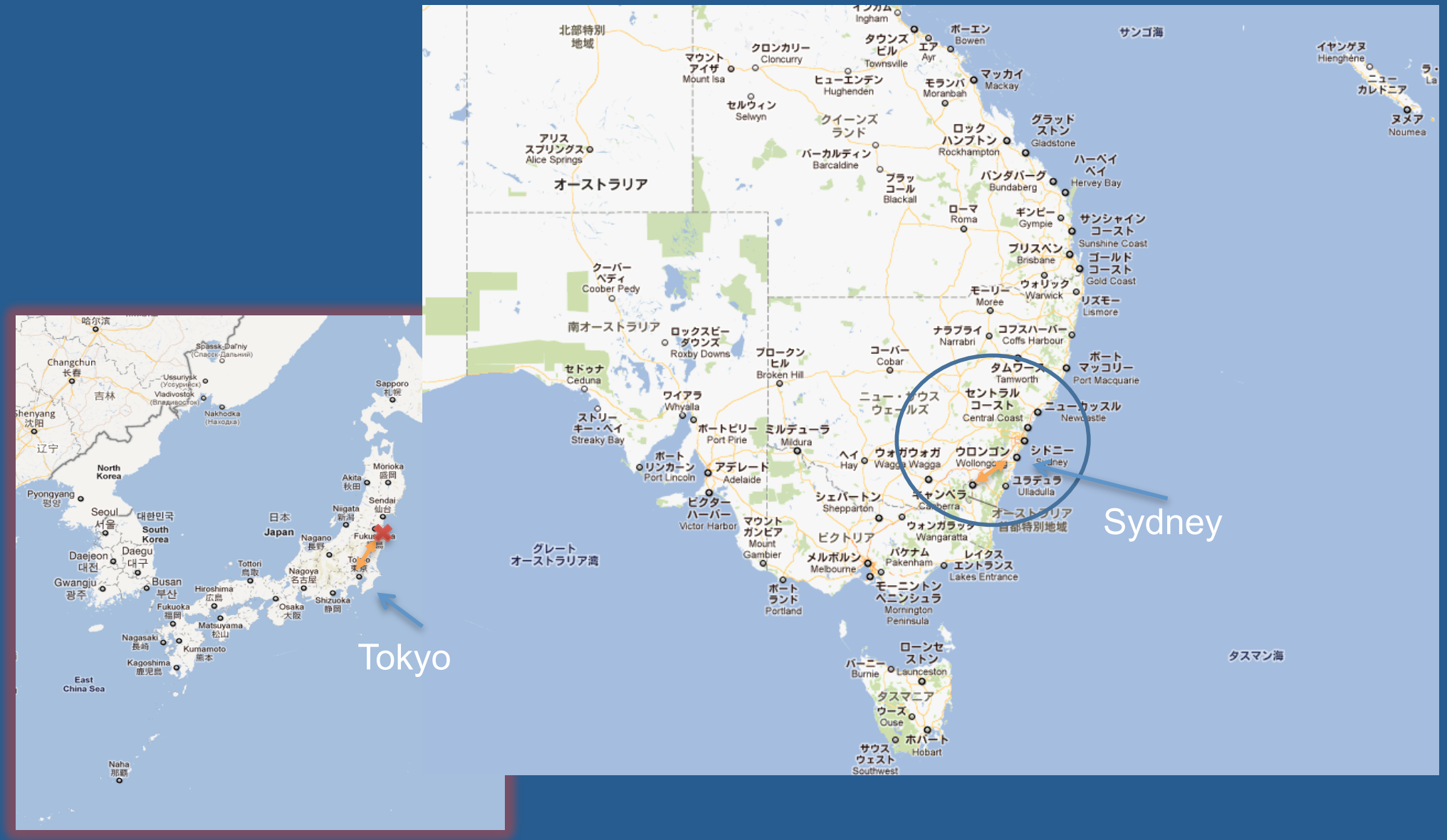
- After 14:46 on March 11
  - Mobile phones (voice) were useless.
    - Outgoing calls were restricted.
    - SMS/MMS did not work properly for a hour or two.
  - On the other hand,
    mobile data communication worked well.
    PCs in office (connected to the Internet) as well.
  - People relied heavily on the Internet
    - SNS: Twitter, Facebook, mixi
    - Streaming: Youtube, Ustream, Nicovideo
  - Therefore, people thought “Internet is the only media survived.”

Nuclear Power Plants

- Tokyo Electric Power Company (TEPCO)
  - Fukushima Power Plant #1

Australia and Japan

Google map



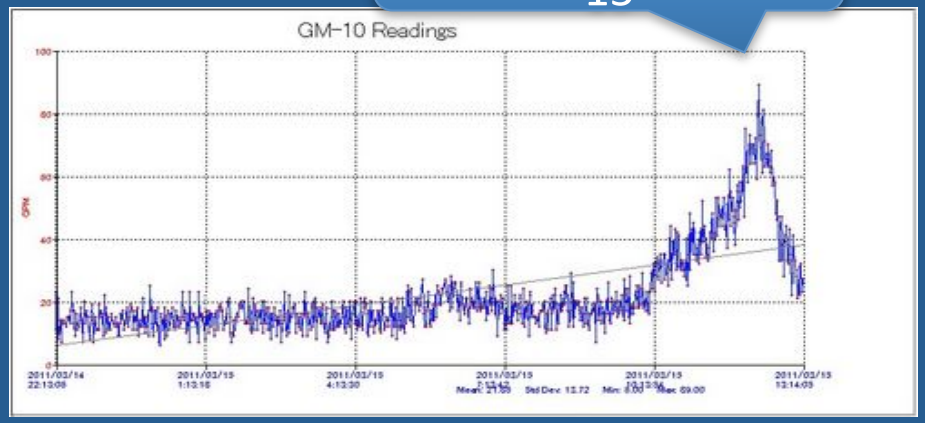
Nuclear Power Plants

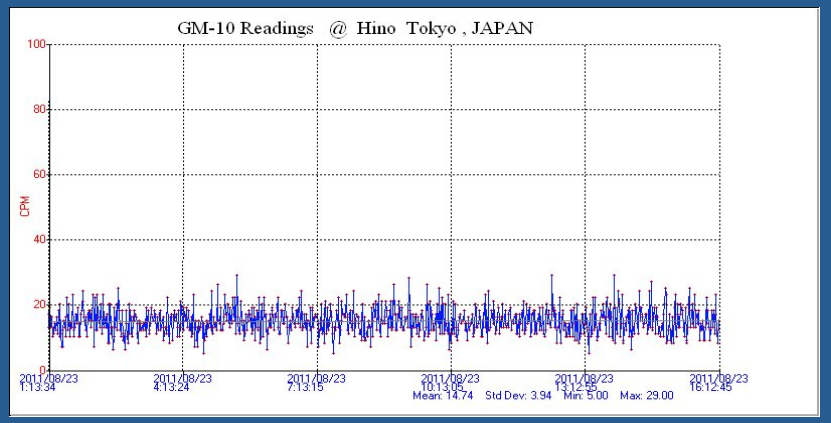
- Tokyo Electric Power Company (TEPCO)
  - Fukushima Power Plant #1
  - 14:46　Quake occurred, automatically suspended the plants. Immediately started cooling it with emergency power generators.
  - 15:30　Tsunami reached, and washed out the emergency generators and facilities.

Impact of nuclear power failure

- Radiation
  - Radioactive substances have been leaked during the early stage of stopping reactors.

around noon, Mar. 15





http://park30.wakwak.com/~weather/geiger_index.html
http://kaimakulink.seesaa.net/upload/detail/image/2011-03-15_132105.jpg.html

Impact of nuclear power failure

- Shortage of power
  - TEPCO's service area:
    - Tokyo and surrounding prefectures, where a lot of residences and factories exist.

  - Before quake: 60,000 MW
  - immediately after quake: 30,000 MW
  - Currently 50,000 MW

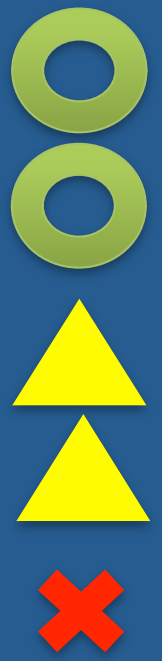
Impact of nuclear power failure

- In March: planned outage (blackout)
  - Blackout area was rotated one by one
  - Huge impact on our economies
    - Factories, hospitals, schools, shops, and traffic signals... almost everything heavily depends on electricity.

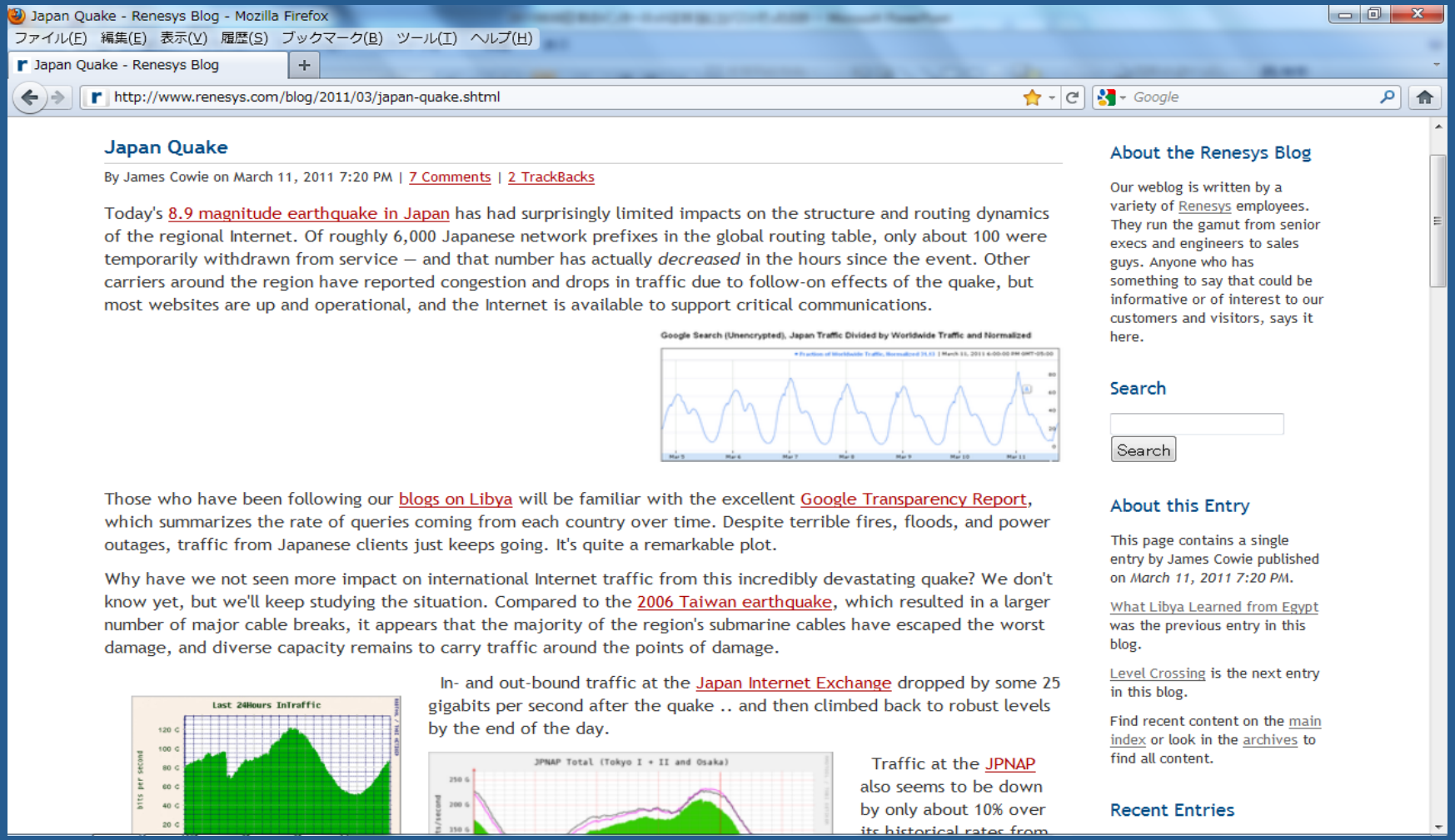
INTERNETWORKING

Summary on Impact of the Earthquake

- Services/Servers
- IX/IDC
- Domestic Backbone
- Submarine Cables
- Access Line

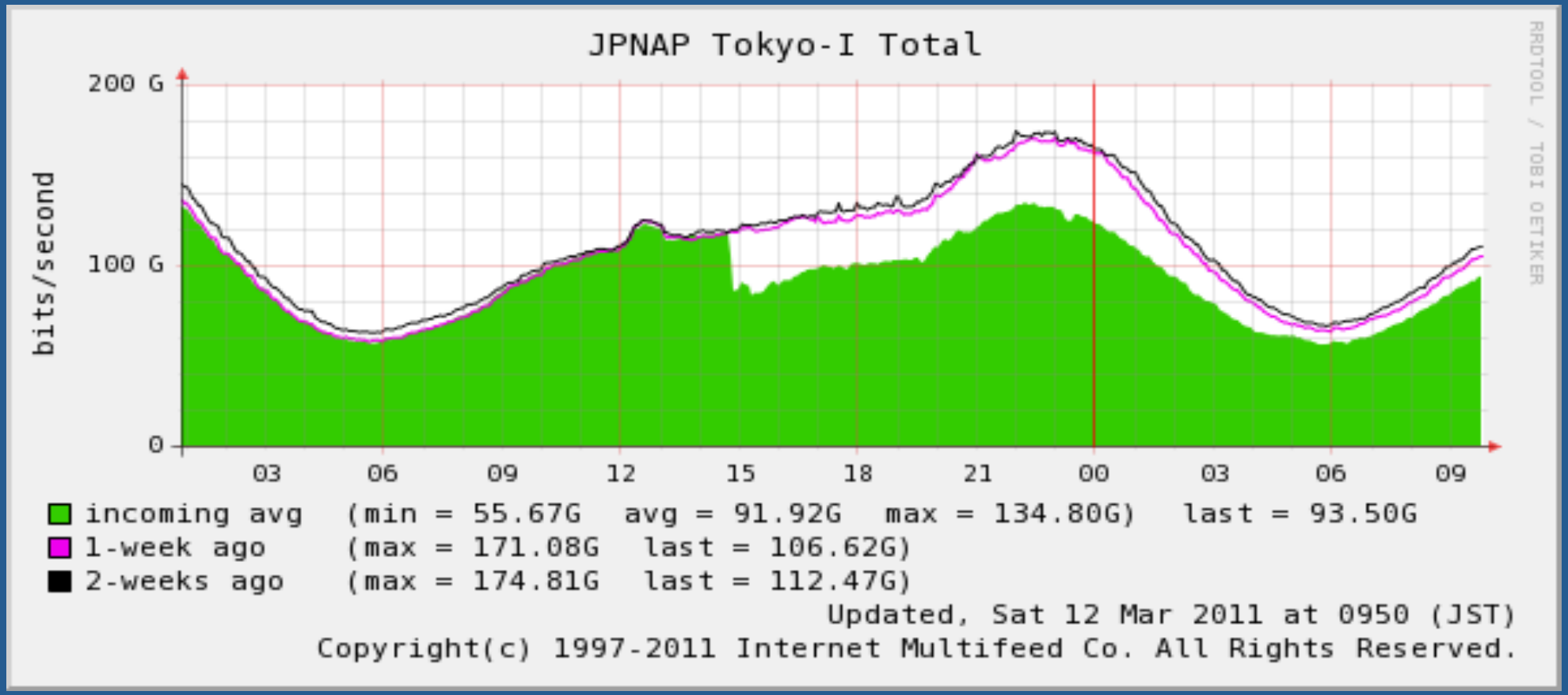


Renesys Report

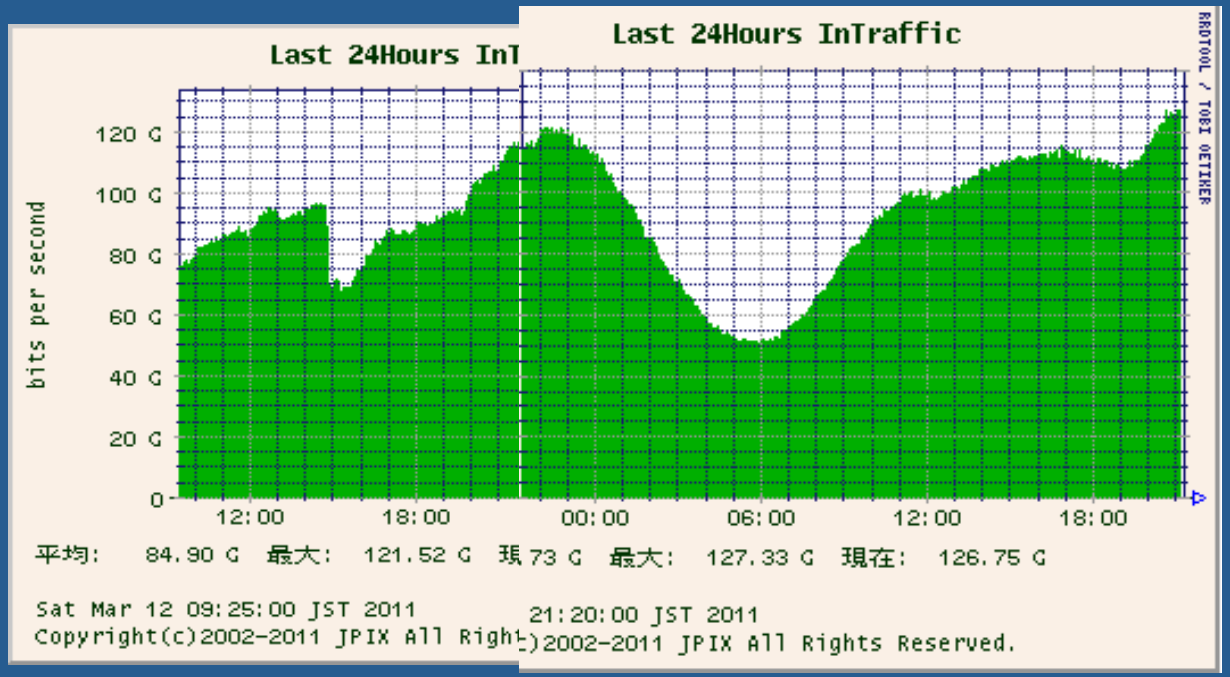


http://www.renesys.com/blog/2011/03/japan-quake.shtml

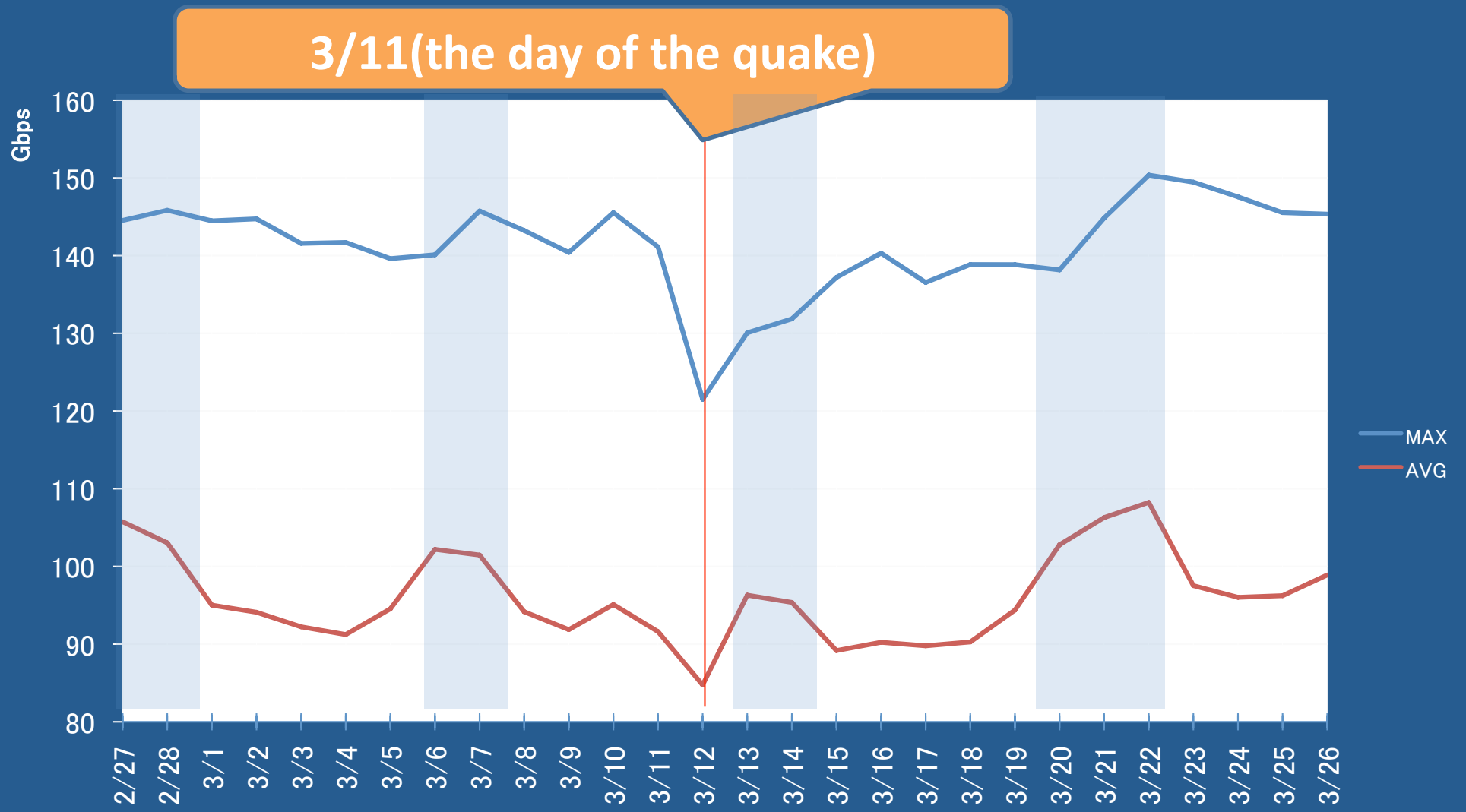
Traffic at JPNAP



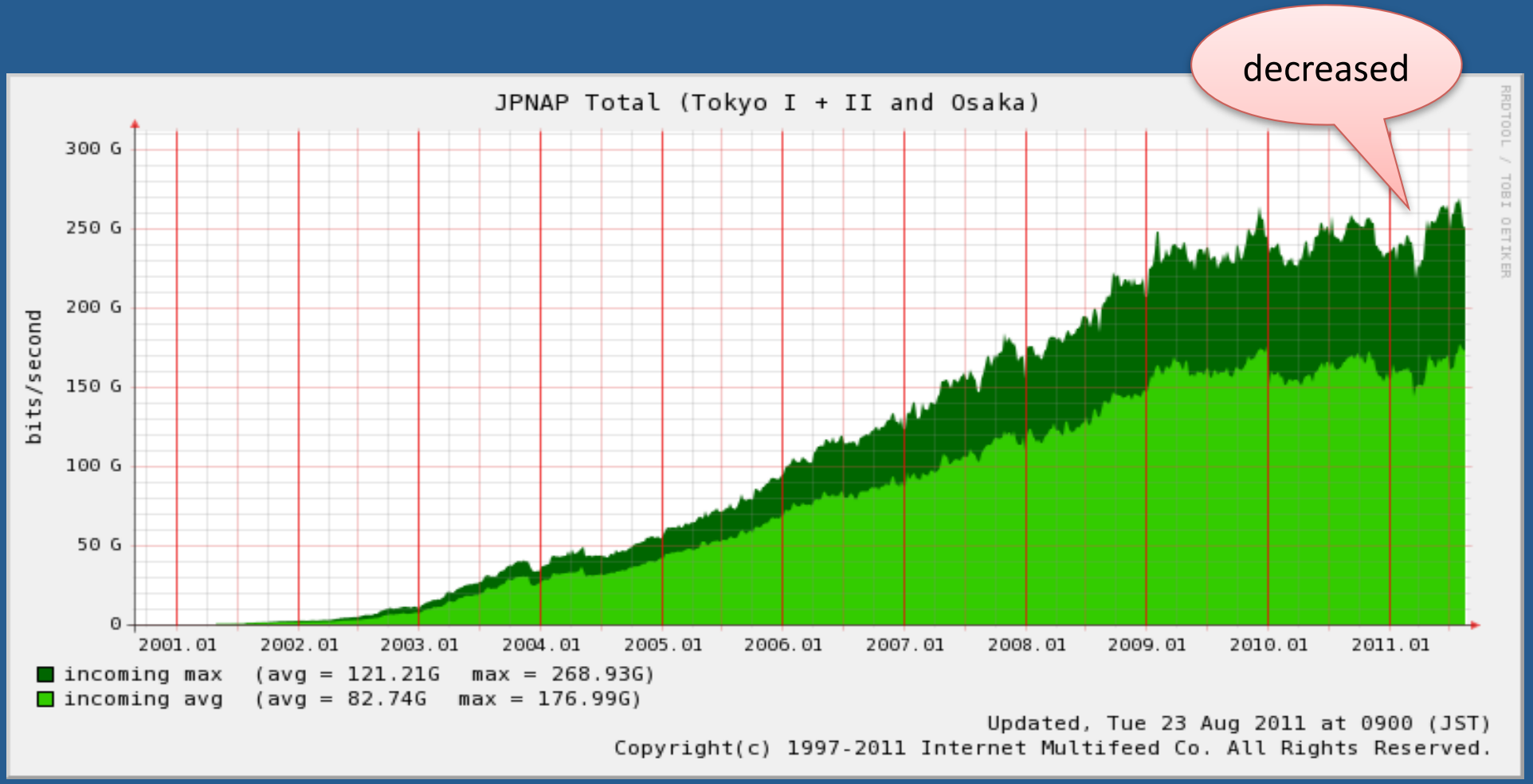
Traffic Status at JPIX(36 hours)



Traffic Stats(JPIX)(1 month)

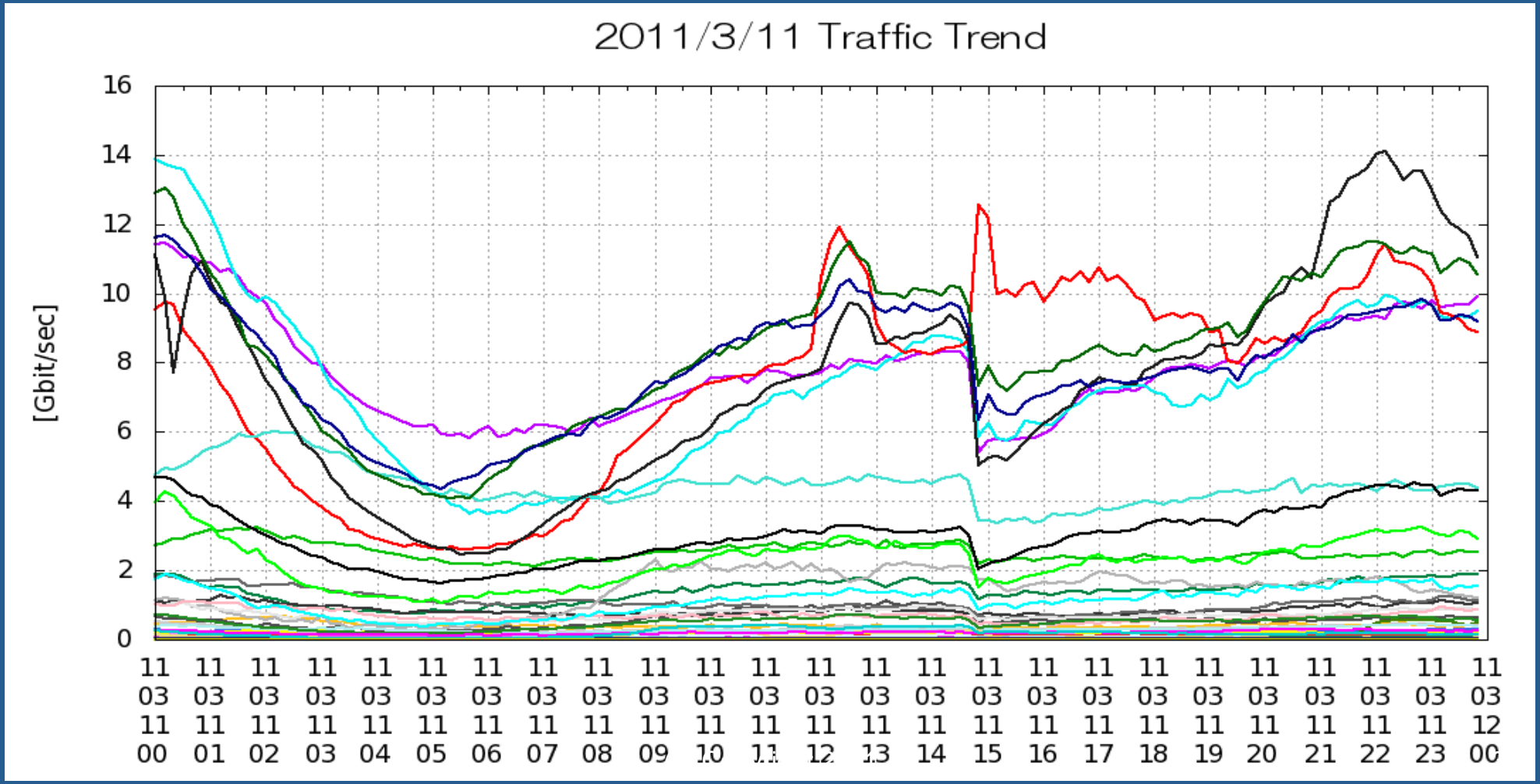


Recovered after one month
-- JPNAP --



Traffic from each AS

All the traffic went down except from one AS…



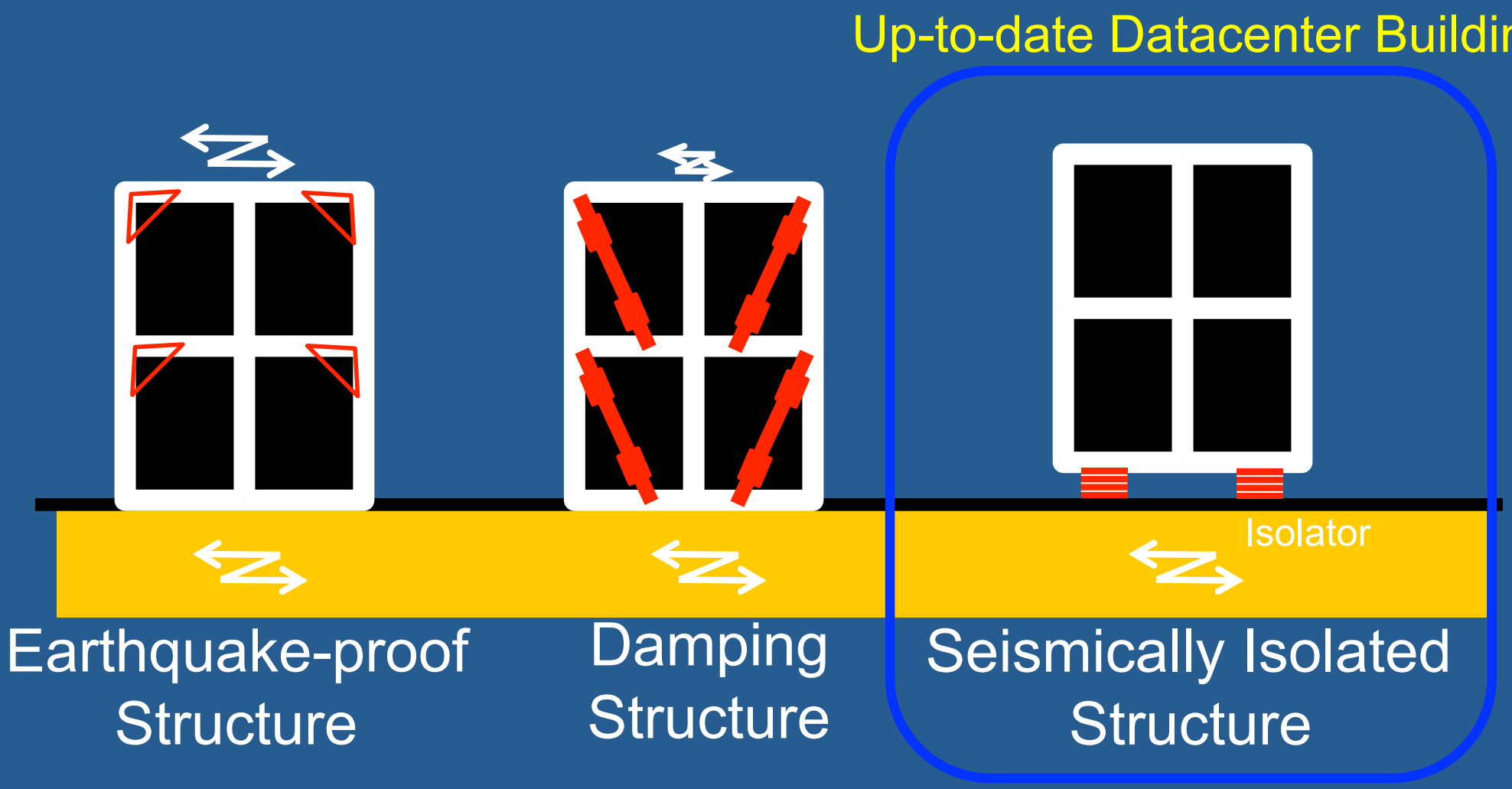
Earthquake Damages on IX/Datacenters

- Comparatively negligible
  - JPIX/JPNAP switches worked well, but customer traffic vanished.
- Some minor issues
  - Looseness of patch cables
  - Degradation of optical fibers

Why no big damages?

- Seismically isolated buildings
- Carefully mounted equipment
- UPS, Generators with securing fuel
- Circuit diversity
- Securing human resources

Earthquake resistant structure



Huge Problems after the Earthquake

- Planned outage (in March)
  - Fortunately no outage now…
- ISP and IDC had to prepare for it
  - Checking:
    - UPSs
    - Generators
  - Securing;
    - Electricity
    - Fuel
    - Human Resource

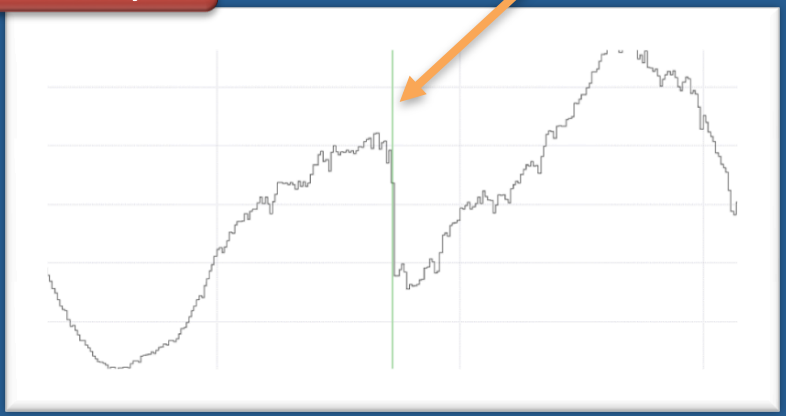
Mid/Long-Term Measures

- IX
  - Avoiding a single point of failure
  - Geographically dispersing into Nagoya and Osaka
    - Tokyo - Nagoya: 260Km
    - Tokyo - Osaka: 400km
- Datacenter
  - Strengthen against Disasters
  - Diversifying into other Regions

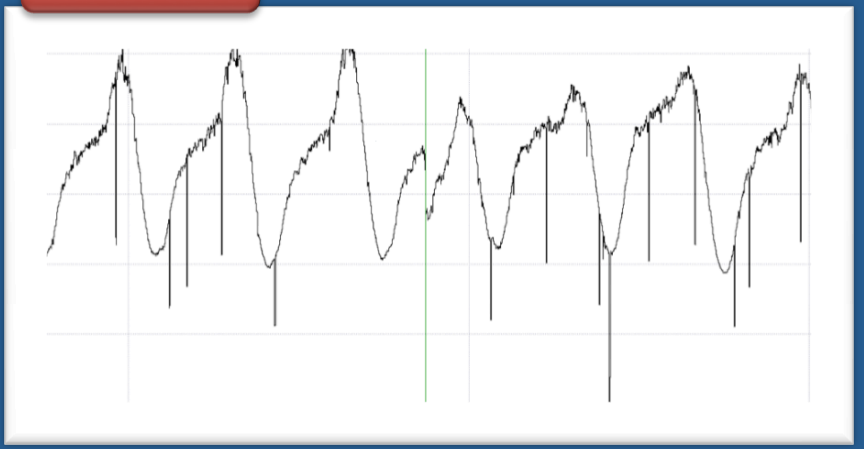
Traffic – 1 day, 1 week, 1month

1day

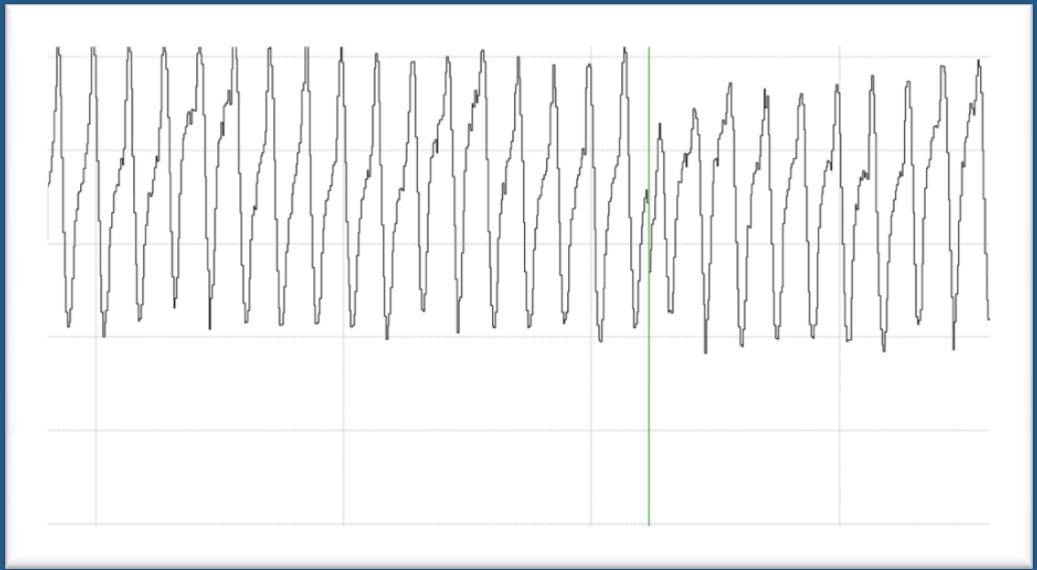
14:46 11th Mar. 2011



1week

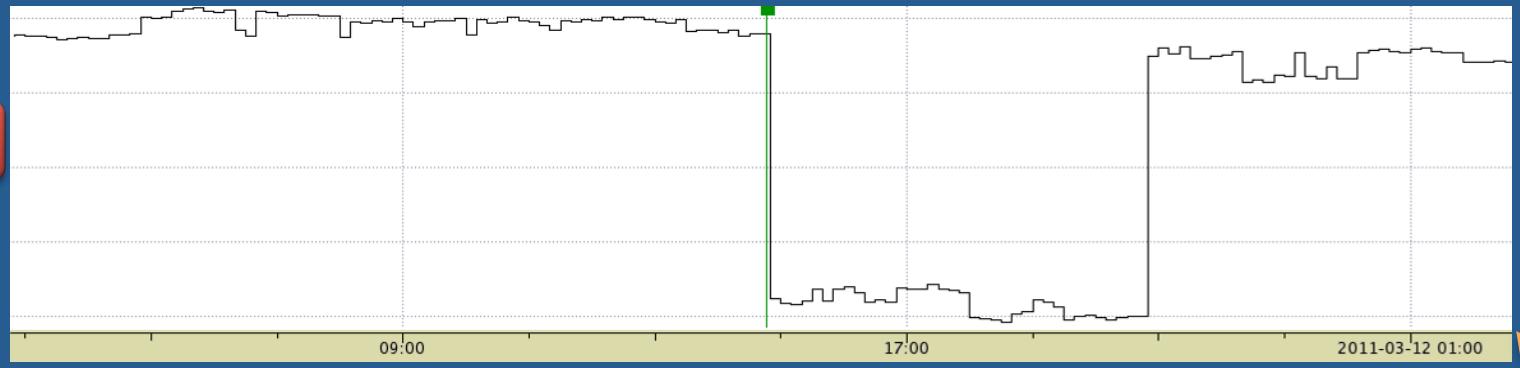


1month

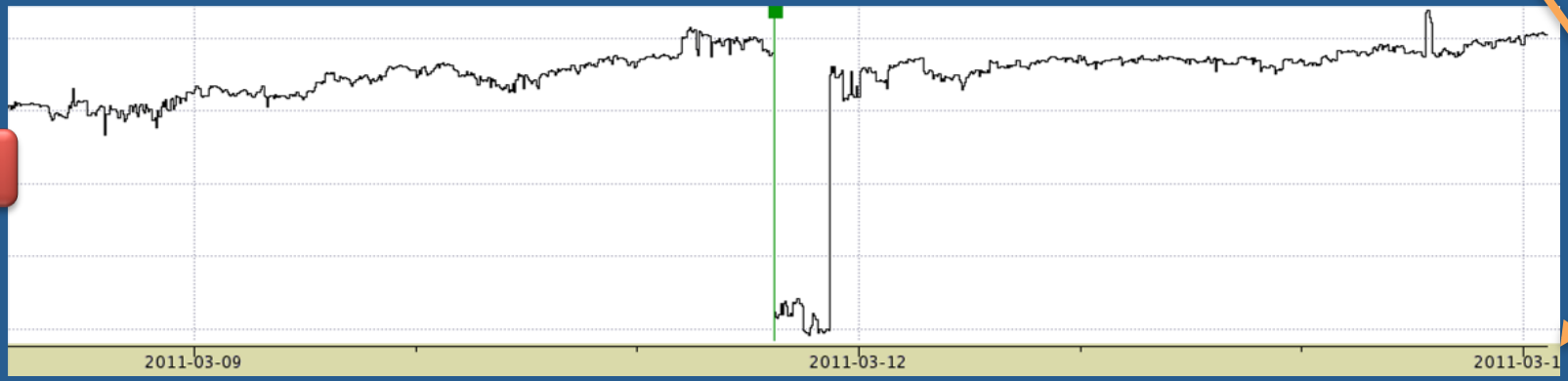


BGP Routes – 1 day, 1 week, 1 month

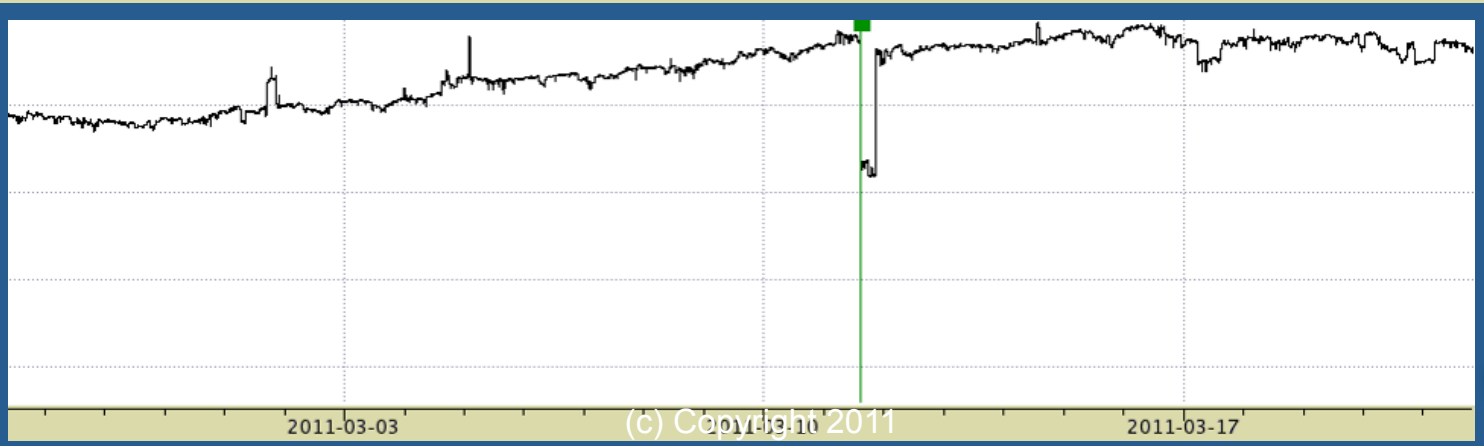
1day



1week



1month



not zero

2011/3/11 Traffic

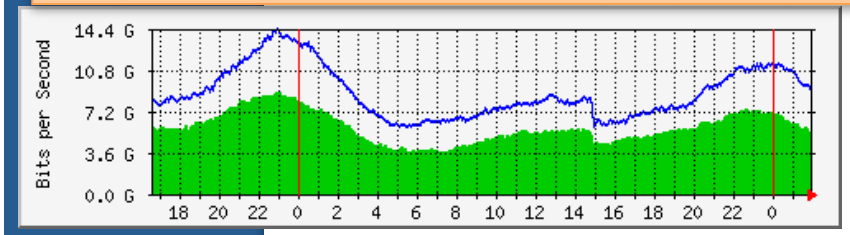
Possible traffic rerouted and the internet in whole Japan kept functioning

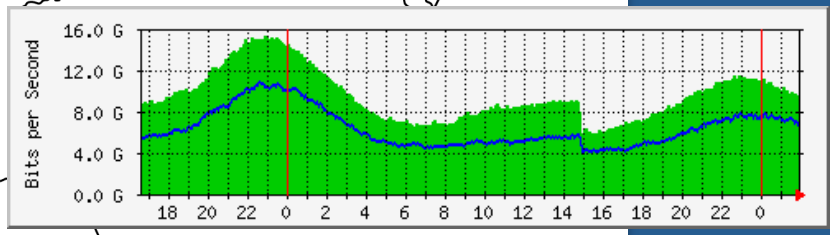
West

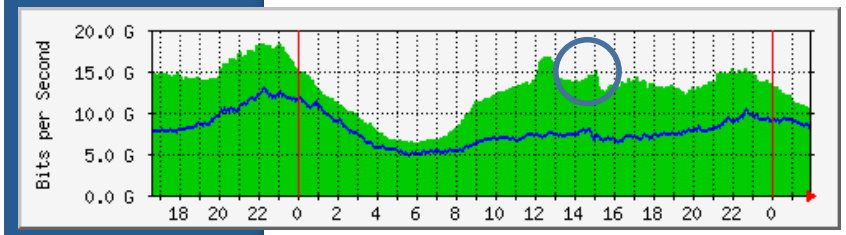
East

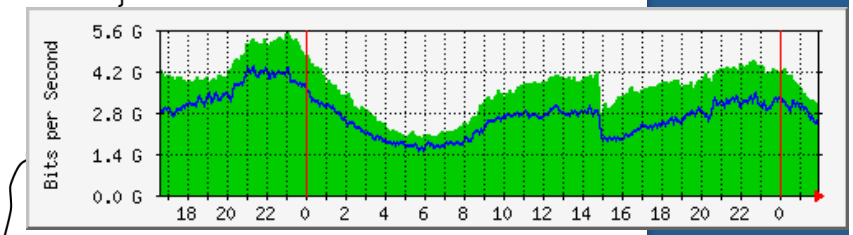
Also observed traffic down in west area (especially the ISP who deploy hot-potato routing)

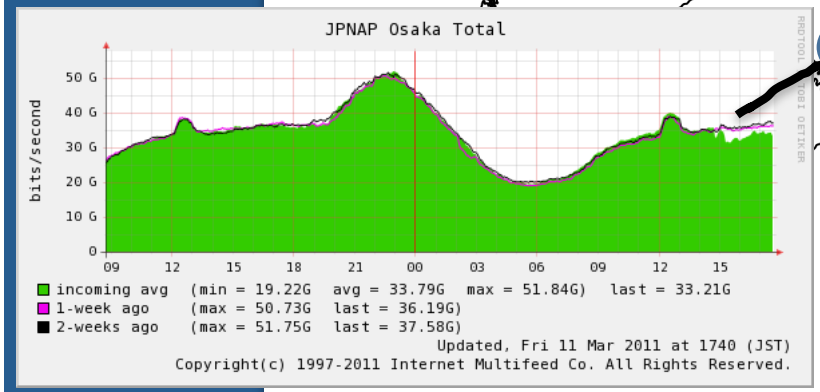
30% down





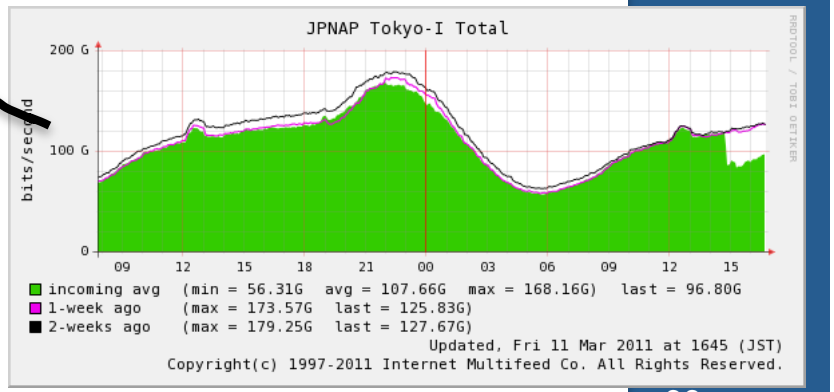






IX

IX



2011/3/11 Traffic

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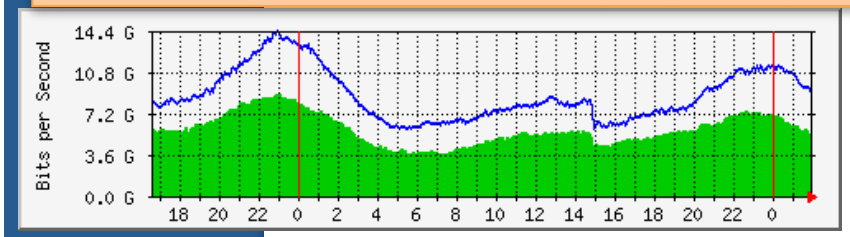
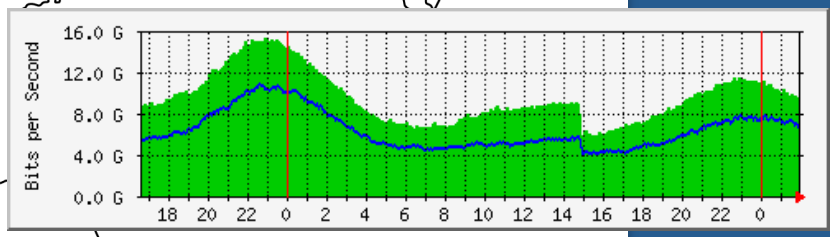
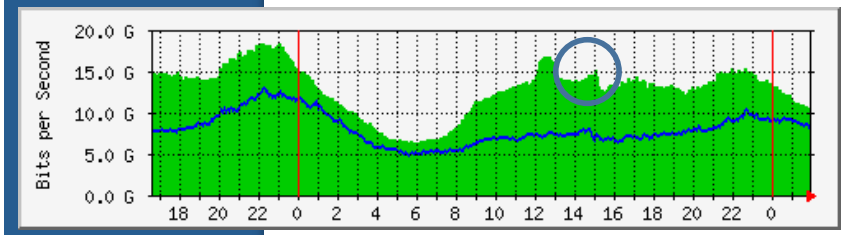
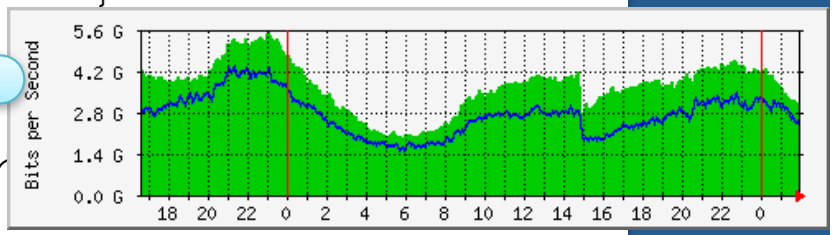
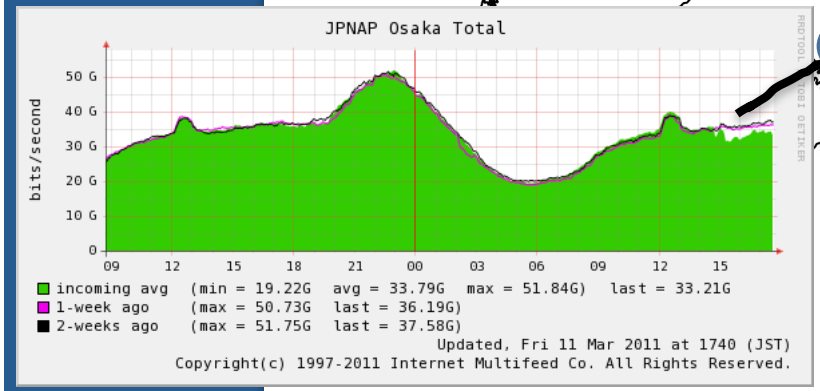
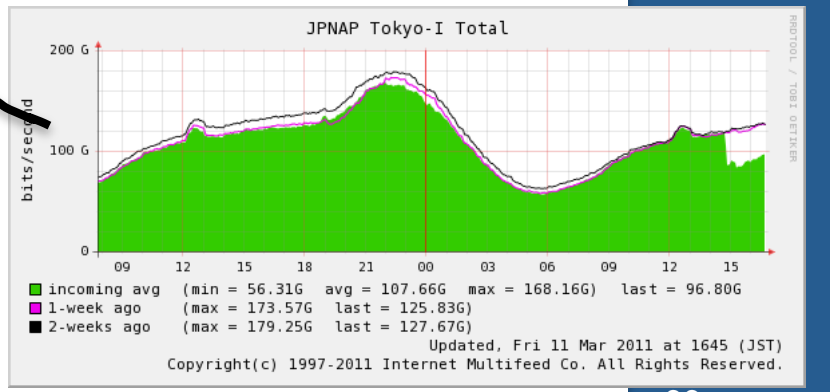


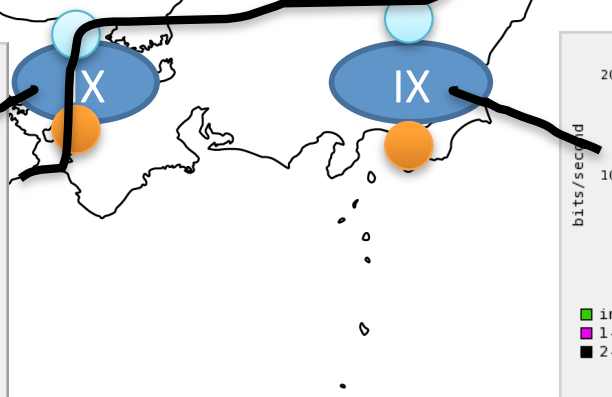




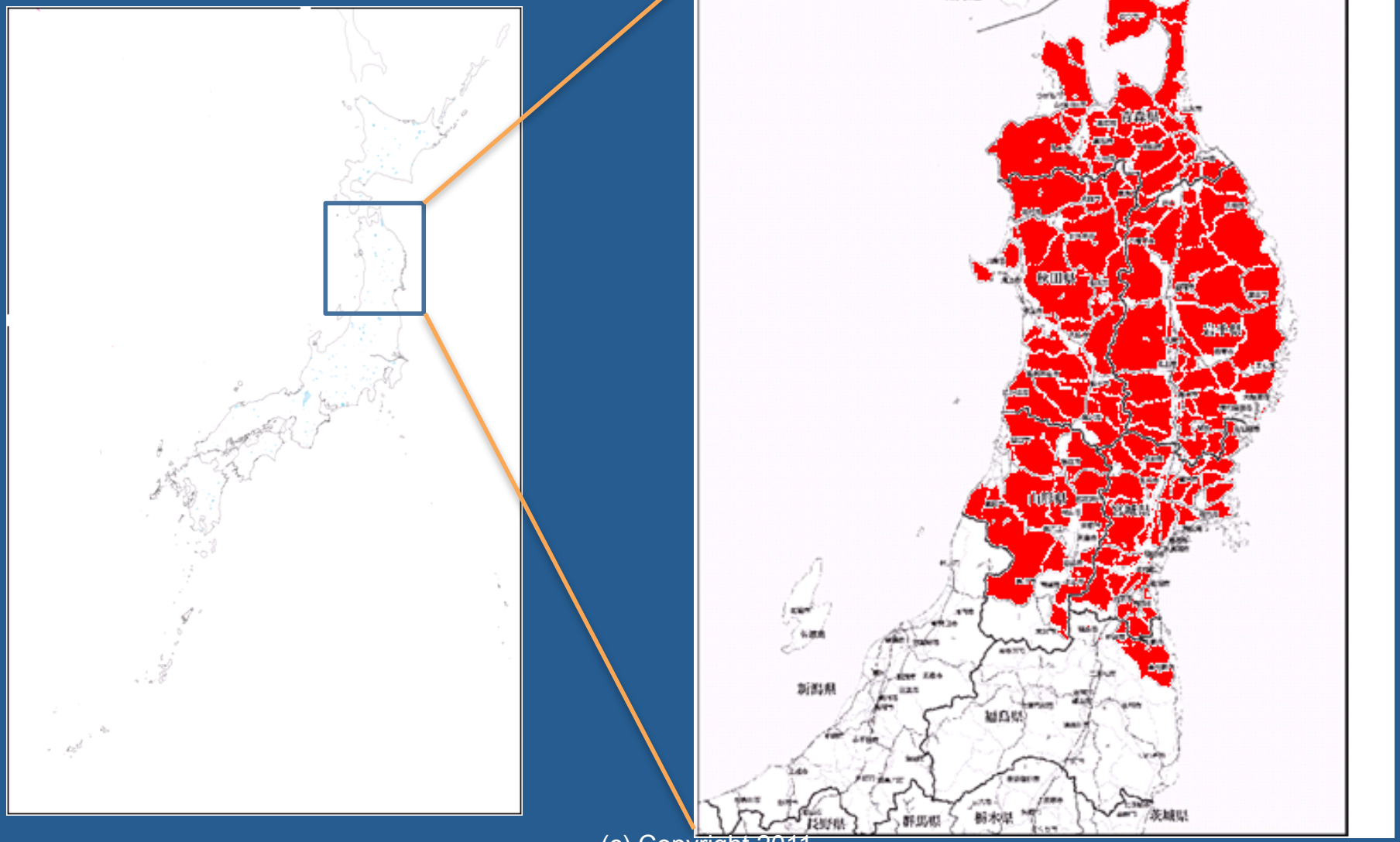








Influence of a blackout 2011/3/11 22:00(JST)



Cutoff of a domestic relay cable (NTTCom)

Among 3 routes, 2 routes were hit at the same time

11th Mar
At the time of suffering

Sapporo

Middle Route

Japan sea Route

Sendai

Nuclear power plant Restriction Area

Tokyo

Pacific sea Route

Fiber cut 11th Mar

bypass fiber was installed in a telephone pole 14th Mar.

Temporary restoration

Sapporo

Route Addition

Temporary Recovered

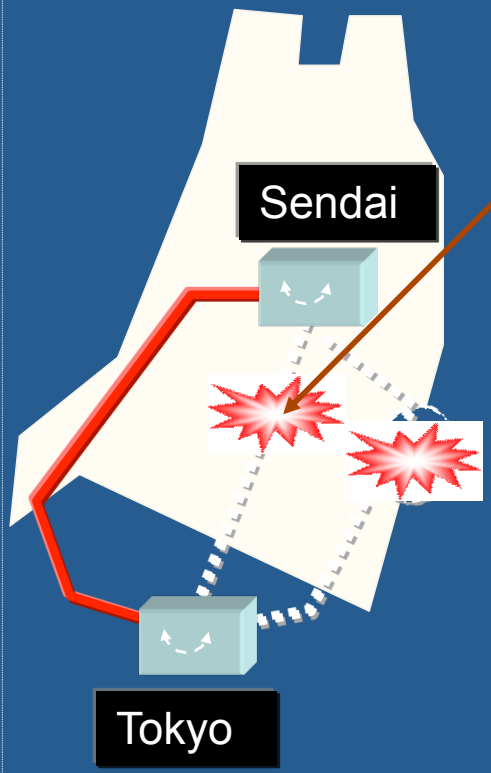
Sendai

Nuclear power plant Restriction Area

Tokyo

Restoration of relay cable (NTTCom)

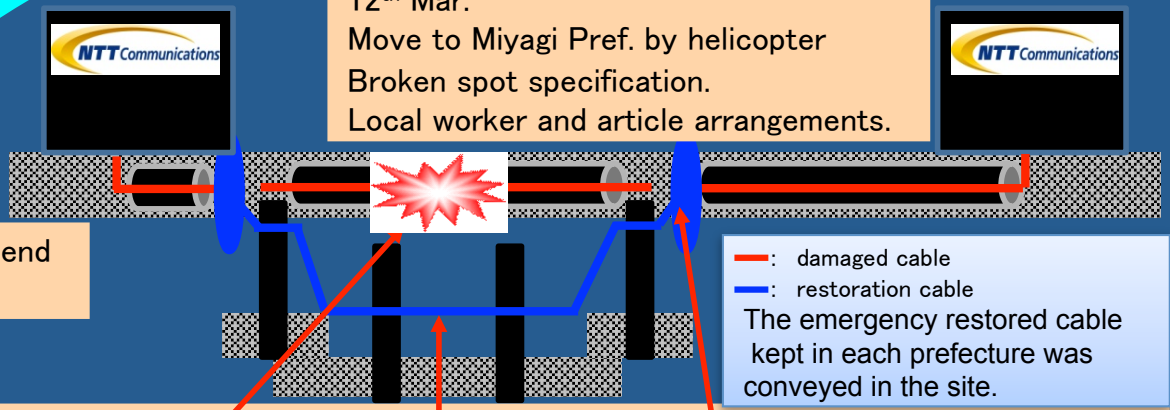
- Restoration of cutoff points, building a bypass route, changing a route etc,
- Emergency restoration has been completed 2 days later



【 Flow until restoration 】

11th Mar. Quake happend
Changed the route

12th Mar.
Move to Miyagi Pref. by helicopter
Broken spot specification.
Local worker and article arrangements.



—: damaged cable
—: restoration cable
The emergency restored cable kept in each prefecture was conveyed in the site.

13th Mar Resoration

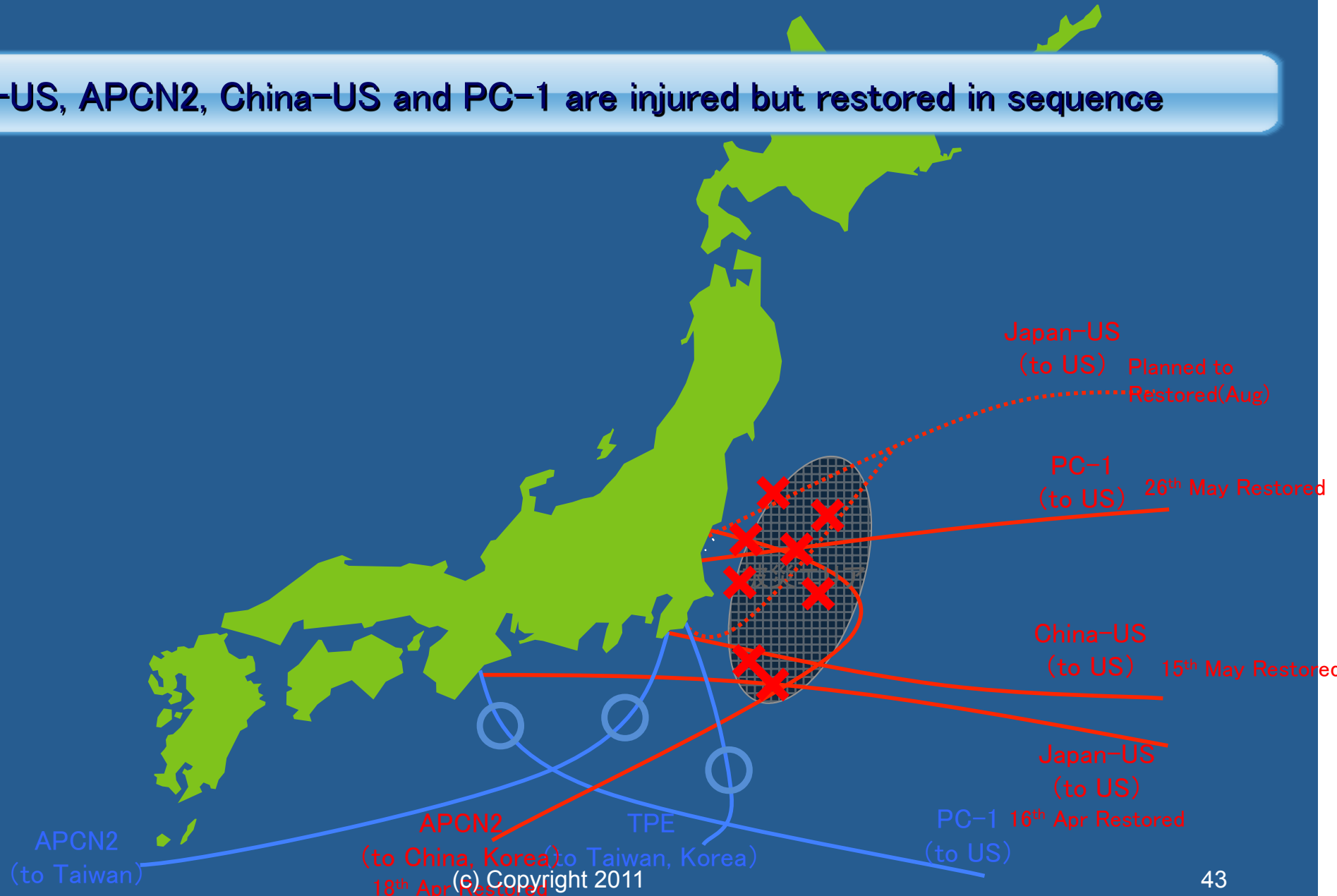
Specification in a cable cutoff spot

Bypass fiber was installed in a telephone pole

A pipe was made next to the manhole and a cable is constructed to a telephone pole.

Submarine cable outage (NTTCom)

Japan-US, APCN2, China-US and PC-1 are injured but restored in sequence



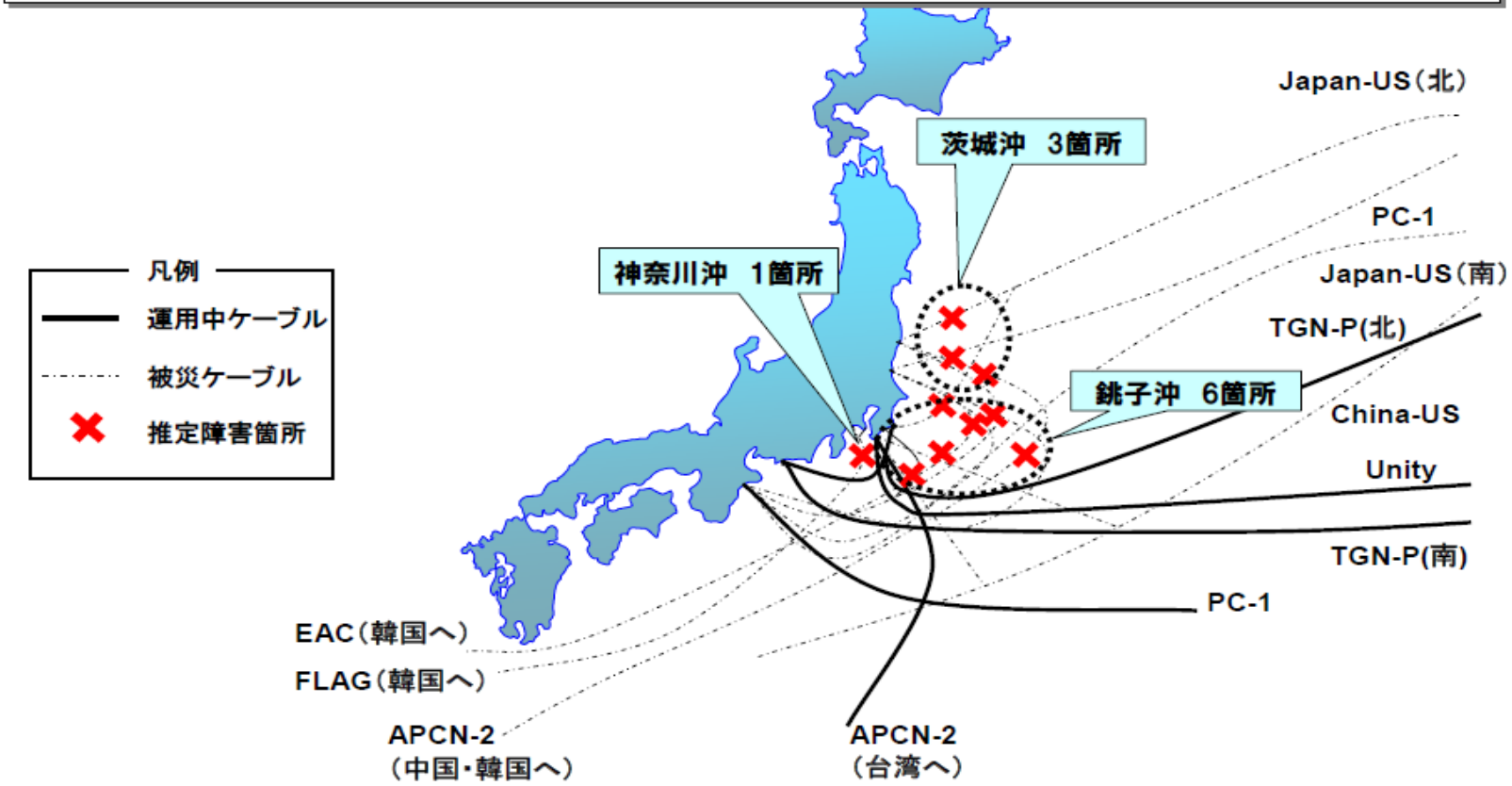
Submarine cable outage (KDDI)

Designing The Future KDDI

サービス影響状況について(4)

3. 国際通信サービス

・海底ケーブルの故障により、国際専用線・国際IP－VPN・国際電話付加サービスにサービス影響が発生したが、3月15日15時9分に復旧。

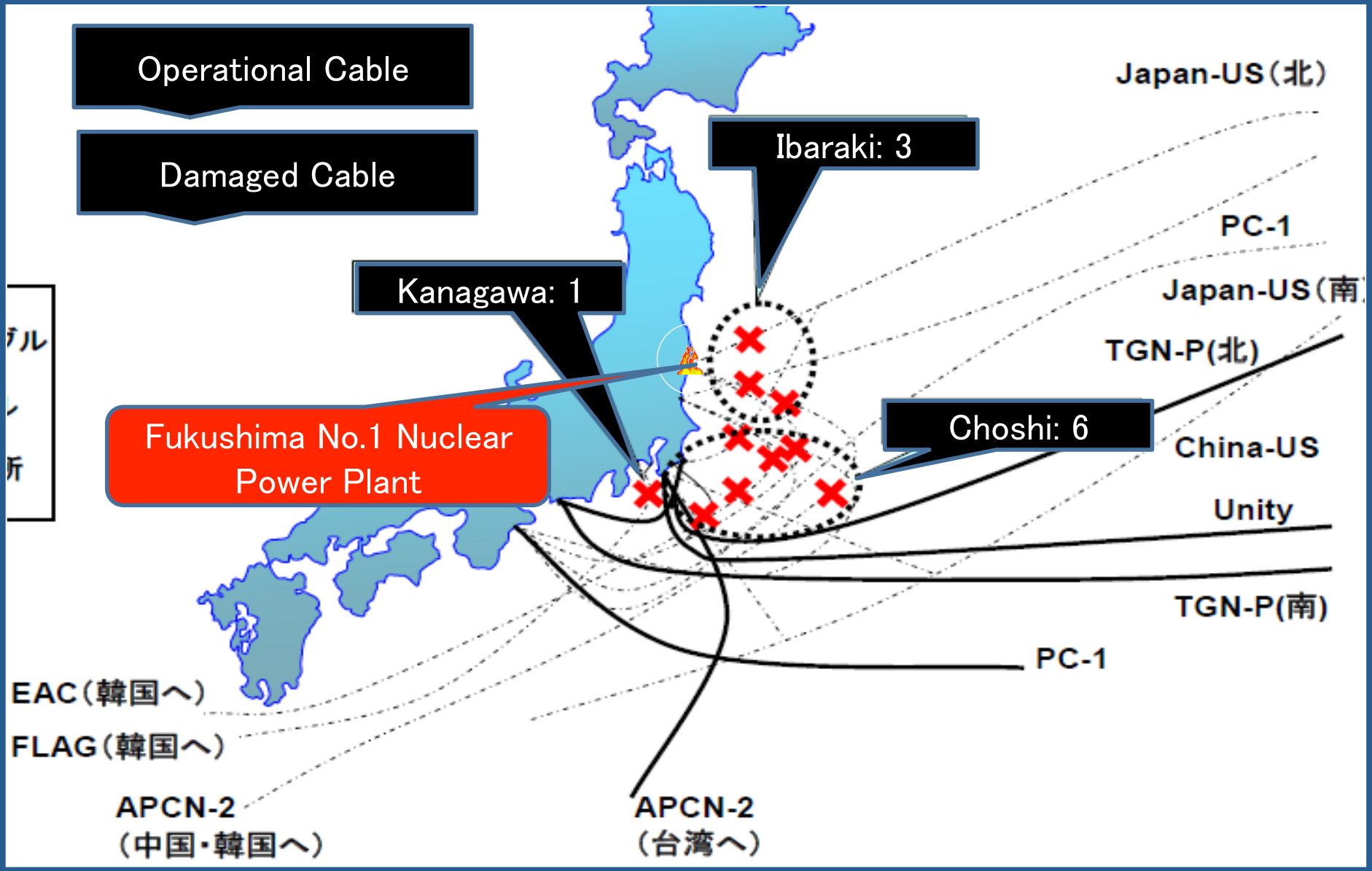


7

http://www.kddi.com/corporate/news_release/2011/0408/pdf/besshi2.pdf

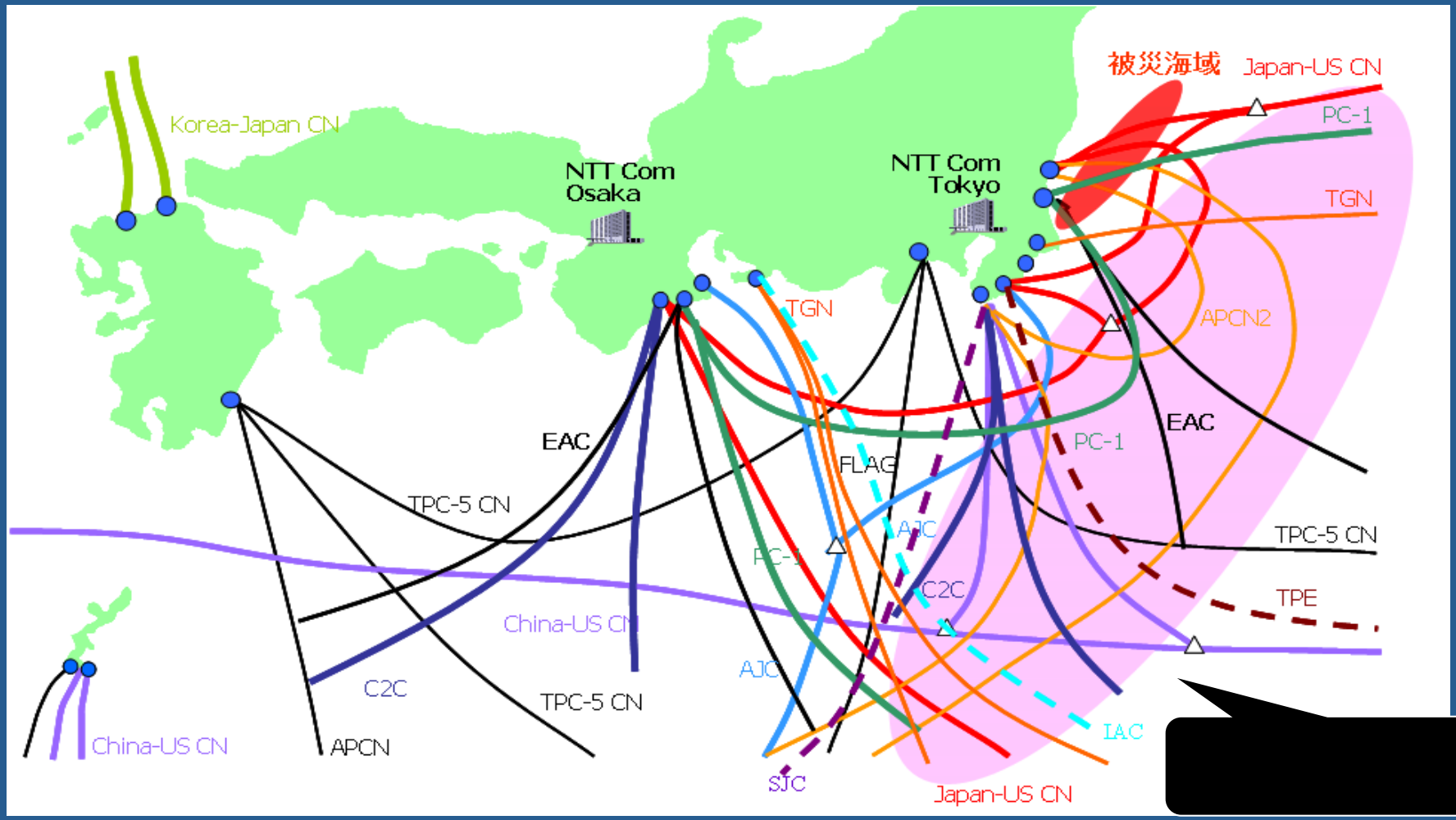
(in Japanese) from Ishida-san @ JPIX

Submarine cable outage (KDDI)



Damage and recovery of submarine cables

Approximately 60% of submarine cables between Japan and US were damaged.



Why our global IP network survived?

(1) Recovery speed

To deal with the shortage of bandwidth immediately after the quake
•Recovered 100G for US and 7.5G for Europe on March 13, only in 2 days.
•Additional 60G for US was recovered by March 16, in 6 business days.
Now we can offer reliable communication.

Direction	Before quake Feb. 23	After the quake	Mar. 23
US	460	180	340
Europe	67.5	30	37.5

(Gbps)

(2) Why so quickly?

- Fully redundant IP network by using various submarine cables
- Bandwidth is designed to be tolerant to big disaster
- Good relationship with carriers in abroad and submarine cable companies

Damages on Access Lines/Domestic Backbone(NTT-East)

過去の被災との比較《物量》

項　目		東日本大震災	新潟中越地震	阪神・淡路大震災
発災時期		平成23年3月	平成16年10月	平成7年1月
ピーク時のトラヒック		約9倍	約50倍	約50倍
り障回線数		約150万	約0.5万	約28.5万
サービス回復に要した期間		約50日（原発エリア、避難エリア除く）	約4日	約2週間
設備被害	中継伝送路	約90ルート（原発エリア除く）	6ルート	－
	通信建物	全壊18、浸水23ビル	－	－
	電柱	約65,000本（沿岸部）	約3,400本	約3,600本
	管路	約3,000km	約11km	約220km
	マンホール	約2,800個	約180個	約2,650個
	架空ケーブル	約6,300km（沿岸部）	約100km	約330km
	地下ケーブル	約1,700km	約100km	約25km

出典：http://www.riec.tohoku.ac.jp/sympo201106/

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese)

Damages on Access Lines/Domestic Backbone

Date		11th Mar. 2011	23rd Oct 2004	17th Jan 1995
Area		East Japan	Niigata	Hanshin-Awaji (West Area)
Magnitude		M9.0	M6.8	M7.3
Damages	Access Lines	150,000,000	5,000	285,000
	Time to Recover	50days	4days	14days
	Domestic Backbone	90lines	5lines	0lines
	Teleco Buildings	Demolished: 18, Flooded: 23	0	0
	Cables	8,000km	200km	355km

NTT teleco building

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

Inside also

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf

(in Japanese) from Akiyama-san @ NTT East

Removal of mud etc.

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

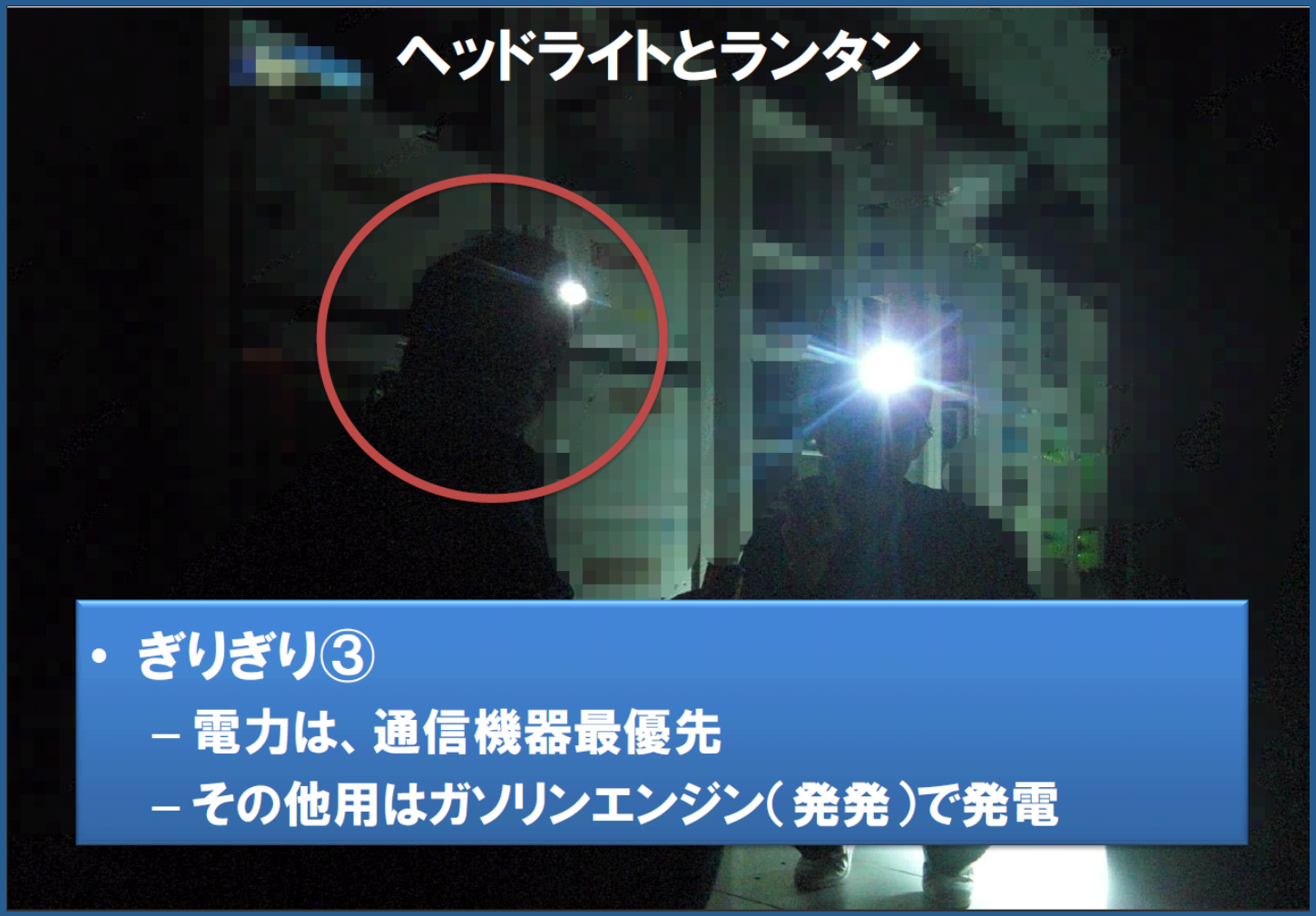
Repair in a building, install the electric power equipment

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

Reinforcement in an outer wall

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

At night



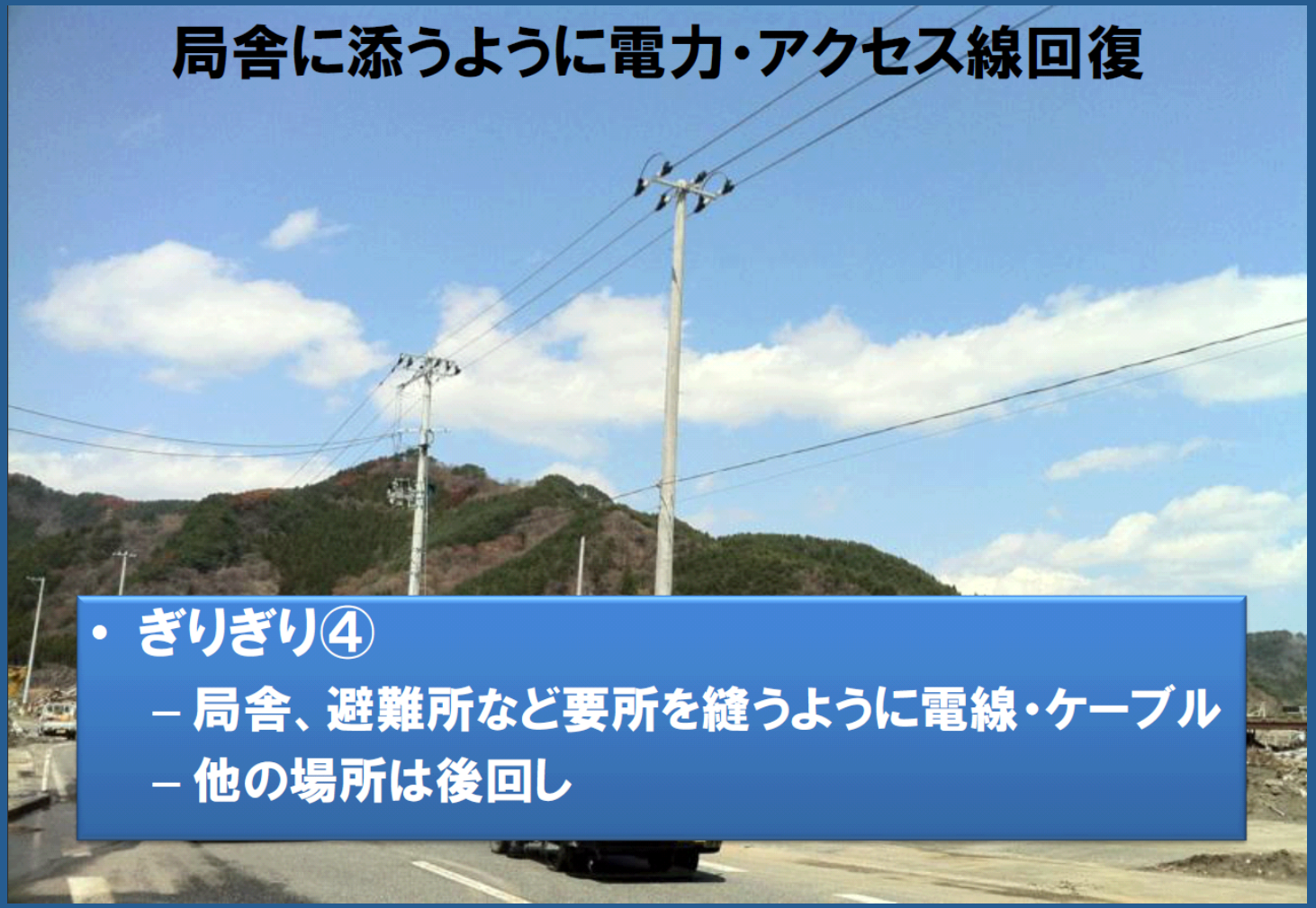
http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

Tepco(Tokyo Electronic power Co.)

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf

(in Japanese) from Akiyama-san @ NTT East

Repairing of power, access line



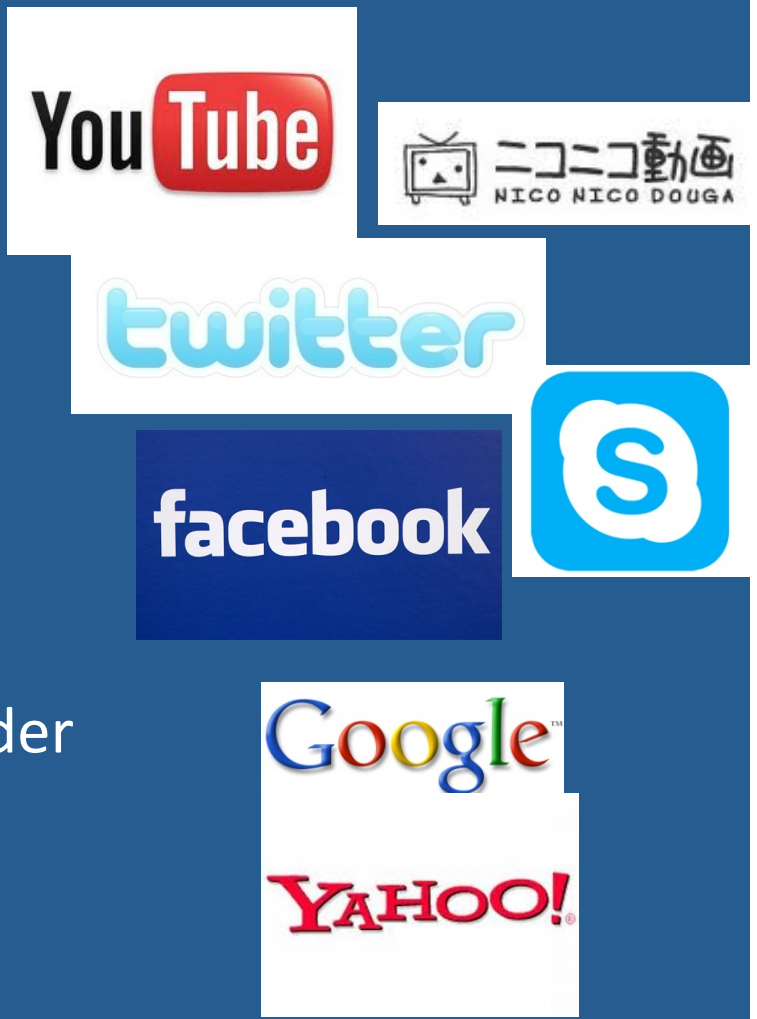
http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

opposite side…

http://www.janog.gr.jp/meeting/janog28/doc/janog28-robust-akiyama-after.pdf
(in Japanese) from Akiyama-san @ NTT East

Issues, next-step

- More layer-1 level redundant design
- Desperation to Osaka
  - Backbone level redundancy
  - Contents level redundancy from tokyo
- Desperation of DNS/MAIL/RADIUS etc
- Traffic Control at savior disaster
  - Preparing between ISP and Content Provider
  - guidline
- Desperation of Operation
- Internet disaster simulation day



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- [cause of death] http://www.47news.jp/CN/201104/CN2011041901000540.html (in Japanese)
- [Radiation] http://park30.wakwak.com/~weather/geiger_index.html
- [Snapshot of radiation] http://kaimakulink.seesaa.net/upload/detail/image/2011-03-15_132105.jpg.html

Current life in Tokyo

- Our lives gradually returned to normal.
  - Visitors from abroad vanished.
- Saving energy in summer
  - Enterprises and factories are trying hard to save energy.
    - Air-conditioner: temperature = 28C
    - shifting their holidays into week days.
      - For example, Wednesday and Thursday are their weekends.
  - Successfully we passed the peak time

For the bright future

- Japan is trying very hard to recover from damages.
- It will take a long time to be fully recovered.

- Your supports are helping us so much.

Thank you very match