.jp and .jprs:
Preparing for the Disaster

March 11, 2019

ICANN Kobe TechDay

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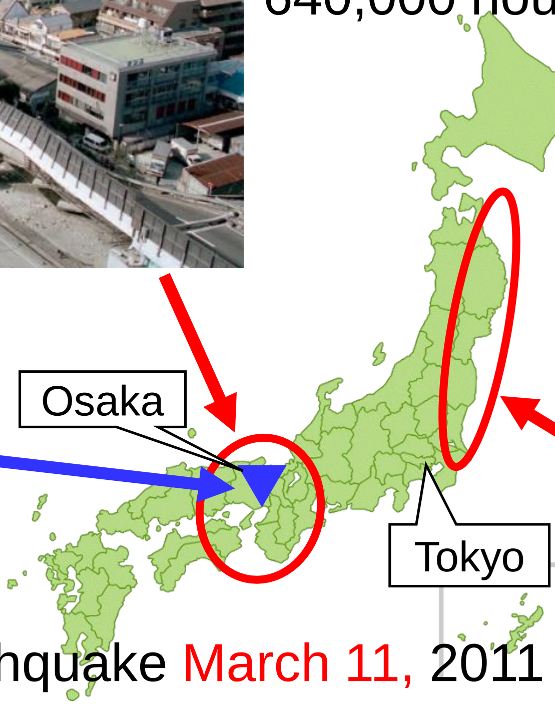
Natural Disasters in Japan

Great Hanshin-Awaji (including Kobe) Earthquake, January 17, 1995
magnitude scale 7.3
6,500 dead, 44,000 wounded,
640,000 houses broken



ICANN64 Kobe

Great East Japan Earthquake March 11, 2011
magnitude scale 9.0
15,900 dead, 6,200 wounded,
2,289,000 houses broken
Tsunami ran up land to 30-40 meters high

What happened

- Jan 17, 1995
  - Buildings and highways collapsed
  - Roads, Railways and Lifelines severed
- Network Situation
  - Launching days of the everyday-life Internet
  - Kobe government and Universities were using WWW
  - Main information sources for users were TV and radio
  - Servers and circuits recovered by academic network operators help

- March 11, 2011
  - Buildings and highways collapsed
  - Roads, Railroads, Lifelines severed
  - Land liquefaction affected buildings
  - Nuclear power plants disaster
- Network Situation
  - Smartphones and SNS, Safety confirmation services widely used
  - Some lives were saved via information from SNS

The effectiveness of the Internet has been recognized

To continuously provide one of the core Internet function, DNS, is critical mission for JPRS

Preparing for Disasters, and What we’ve done

<Preparing for Disasters>

- Distribute the DNS server location
  - DNS servers to multiple geographic locations
  - Assume the loss of connections of domestic, and conduct experiment of local node of DNS authoritative servers within local regions
- Construct the DR site
  - Registry Systems and Office Systems are placed in both Tokyo and Osaka
- Conduct training for emergency situation
  - Establish emergency headquarters, Walking training toward Tokyo Office
  - Emergency response for DNS shutdown

<What we’ve done>

- Help for domain name registrant
  - Dispense with the renewal fee of the domains having registrant address of the affected area

Distribution of DNS Servers

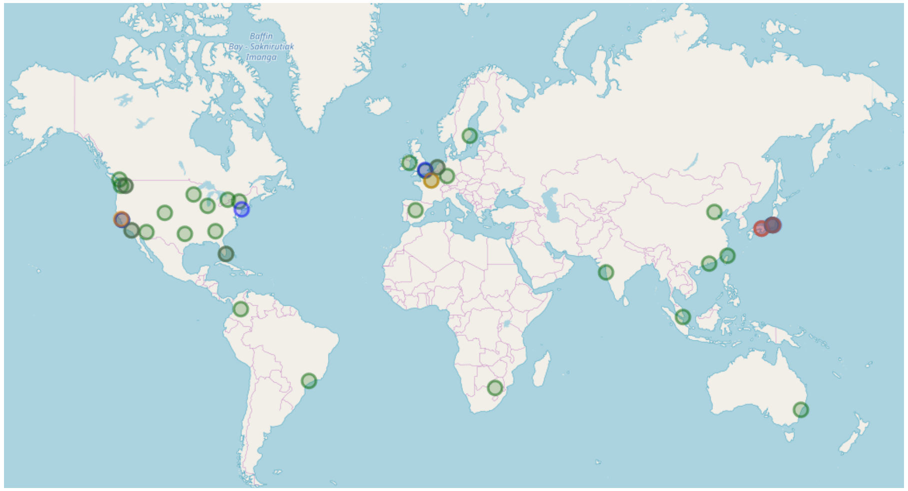
.jp DNS Servers

.jp DNS	Location
A.DNS.JP	2 JP (Anycast)
B.DNS.JP	JP (Unicast)
C.DNS.JP	Worldwide (Anycast)
D.DNS.JP	2 JP, 2 US, UK (Anycast)
E.DNS.JP	JP, US, FR (Anycast)
F.DNS.JP	JP (Unicast)
G.DNS.JP	JP (Unicast)
H.DNS.JP	Worldwide (Anycast)

.jprs DNS Servers

.jprs DNS	Location
TLD1.NIC.JPRS	JP (Unicast)
TLD2.NIC.JPRS	JP (Unicast)
TLD3.NIC.JPRS	Worldwide (Anycast)
TLD4.NIC.JPRS	JP (Anycast)
TLD5.NIC.JPRS	Worldwide (Anycast)

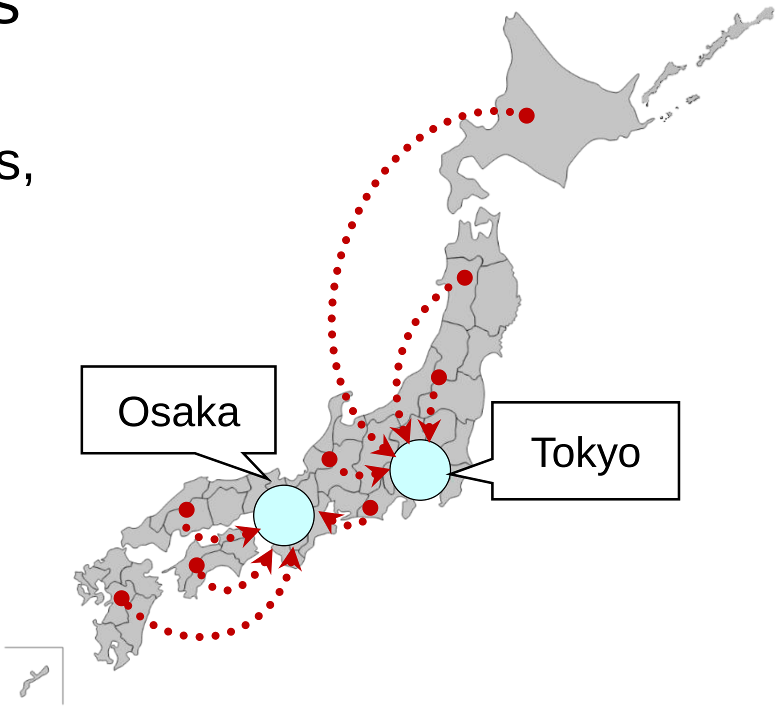
.jp and .jprs DNS Server Locations



Demonstration Experiments for Continuous Internet Services

- Concentrated Internet Resources
  - in Tokyo and Osaka
  - IXs, transit connections, datacenters, hosting services, etc.

- Natural disasters may cut the link to Tokyo / Osaka
  - Local networks will be isolated within its region



Distribute the local DNS server nodes to domestic regional ISPs and conducted joint research using R&D Platform, .jprs (2015 to 2017)

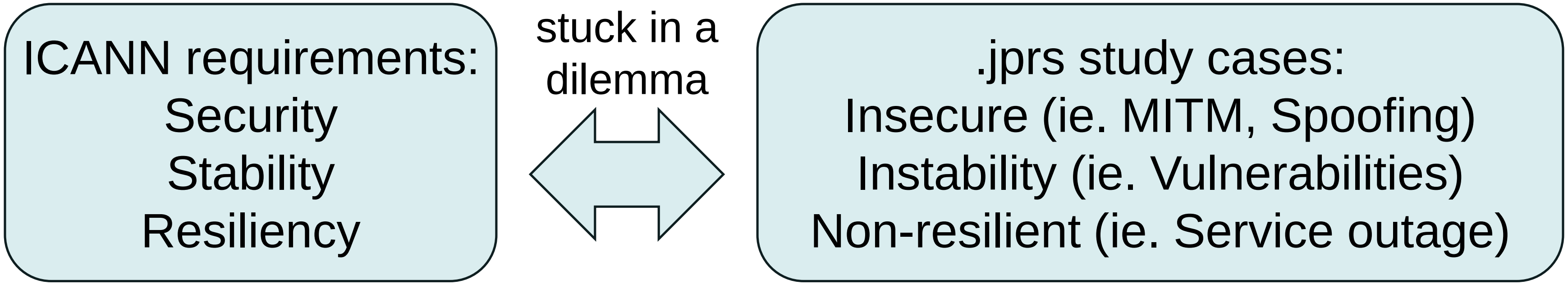
“.jprs” R&D Platform

.jprs is;

- gTLD operated by JPRS
- the experimental environments, where we can learn lessons from incidents, errors, failures

▷ .jprs will lead us to success of .jp
and further to the local and global community

... but ICANN SLA does not allow us to do so



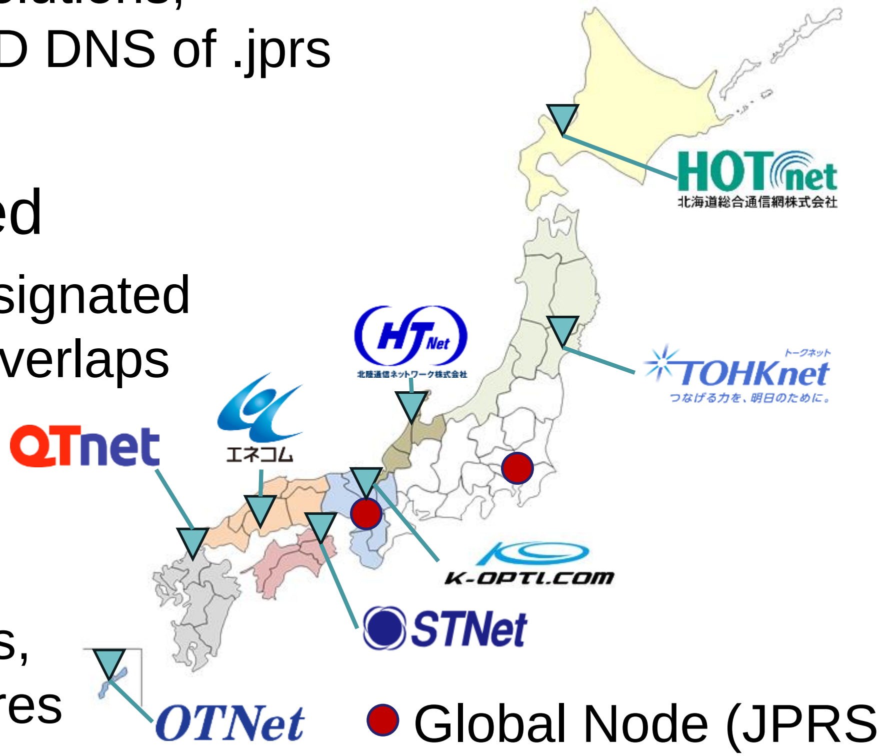
ICANN requirements:
Security
Stability
Resiliency

stuck in a dilemma

.jprs study cases:
Insecure (ie. MITM, Spoofing)
Instability (ie. Vulnerabilities)
Non-resilient (ie. Service outage)

Joint Research with local ISPs

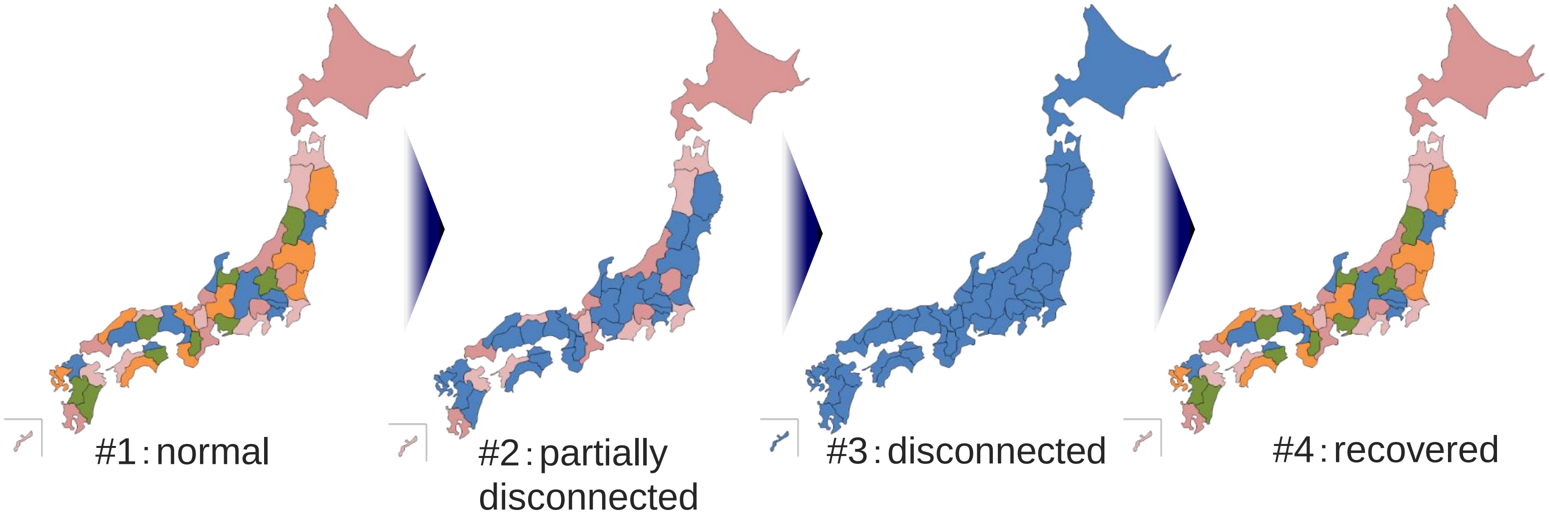
- Goal: to keep continuous access to the Internet resources in each area
  - Provide continuous DNS resolutions, by local nodes of anycast TLD DNS of .jprs
- 8 domestic ISPs participated
  - Each service area covers designated geographical areas without overlaps
  - Collectively cover the whole Japan
  - ISPs are subsidiary of regional electricity companies, thus have robust infrastructures

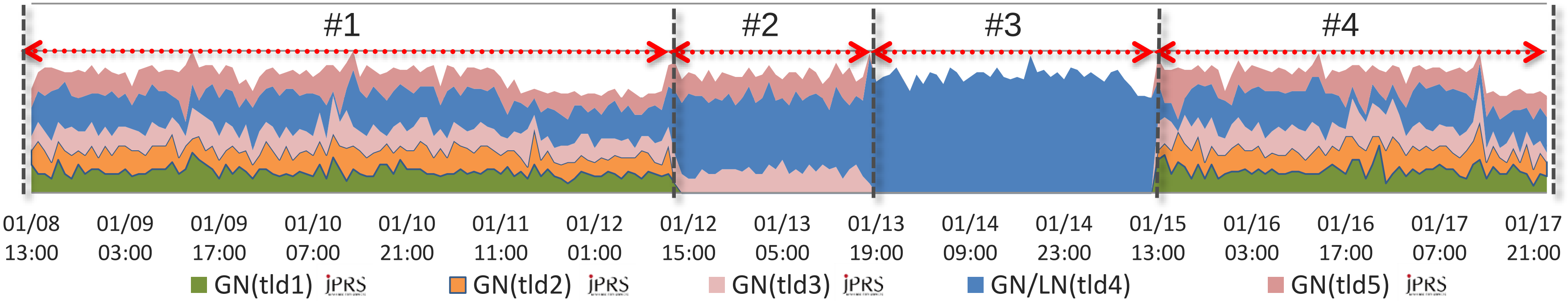


● Global Node (JPRS)
▽ Local Node (ISP)

Sample of Results

- Simulating the loss of Tokyo/Osaka connectivity, and see the effectiveness of TLD local nodes



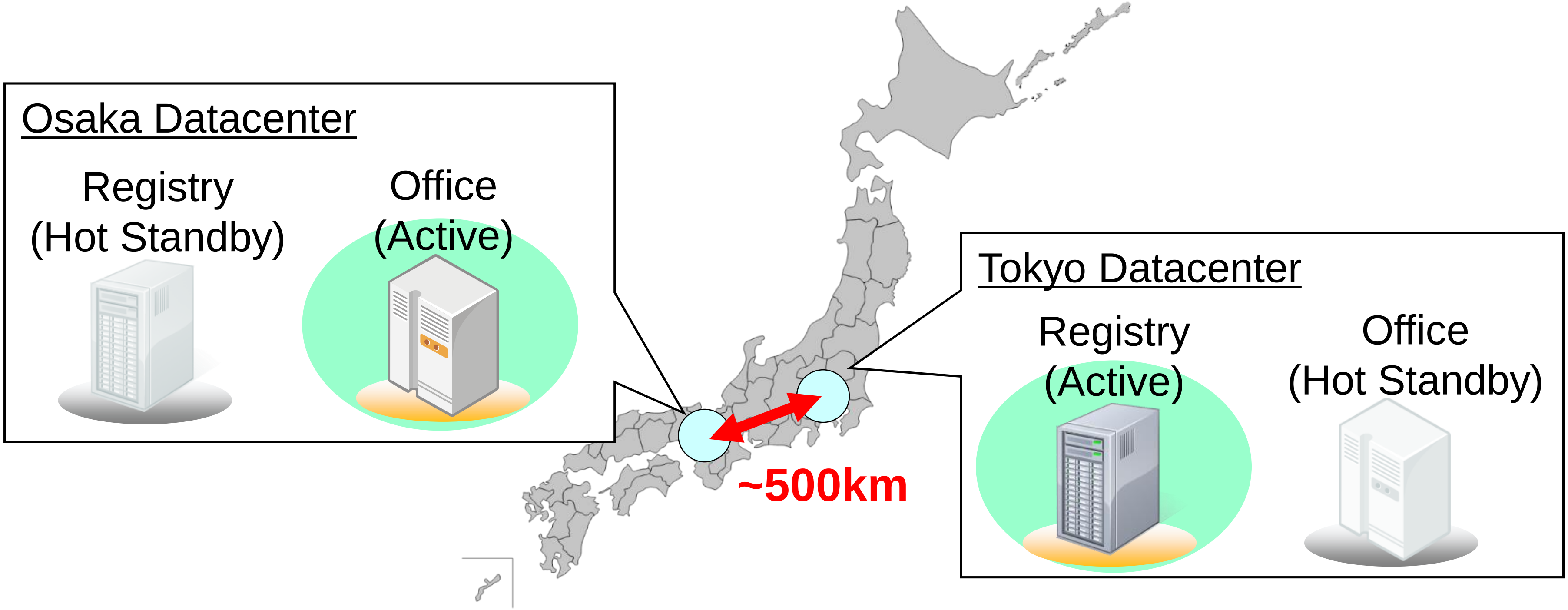


Number of queries toward each TLD servers

See here for details: https://tldlabs.jprs/en/acts/s001/

Construction of DR Site

- Registry Systems and Office Systems are placed in both Tokyo and Osaka
  - Registry Systems are active on Tokyo side, and Office Systems are active on Osaka site
  - To avoid the simultaneous failure of both systems at once



Osaka Datacenter

Registry (Hot Standby)

Office (Active)

Tokyo Datacenter

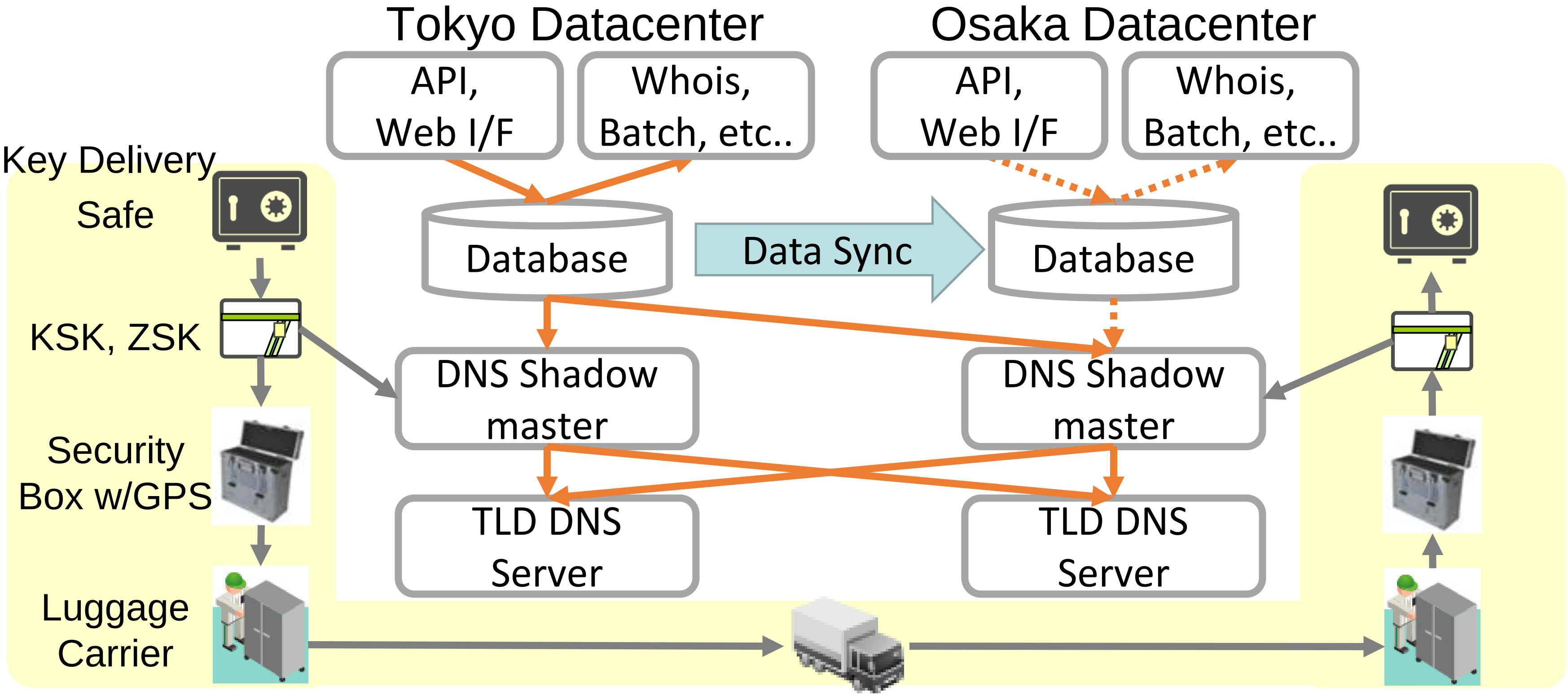
Registry (Active)

Office (Hot Standby)

~500km

Architecture of DR Registry System

- DR site architecture
  - Simple architecture; Same hardware and same functions
  - Real time data synchronization by database feature
  - DNSSEC KSK and ZSKs delivered by secure transportation service
  - Site failover partially automated, and triggered by hand operation



Trainings in JPRS

- Prepare to take immediate actions in events
- Several times per year, each for different purpose
  - Building structure of emergency headquarter
    - To define temporary decision makers, launch a team to manage the subcontractors, team to ensure the security of facilities and human
  - Walking to JPRS office
    - Assume gathering at the office, and walking to the office
    - Check the route, potentially dangerous places, public facilities along
  - Failover to DR site
    - Stop data synchronization and start DR system
    - Test the process just before providing the real services
  - Cyber attack response training
    - Assume all DNS services have stopped by cyber attack
    - Launch the emergency operation environment, and make response to the attack

Pictures of Training

Launching Emergency Headquarter

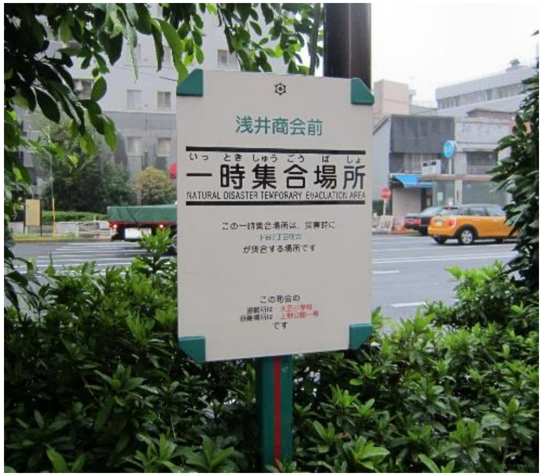
Assume power outage

Decision-making with board members

Walking Training

Check dangerous places

Check public facilities
(ie. temporary meeting place)


浅井商会前
いっ とき しゅう ごう ば しょ
一時集合場所
NATURAL DISASTER TEMPORARY EVACUATION AREA
この一時集合場所は、災害時に
が集合する場所です
この町会の
です

Pictures of Training

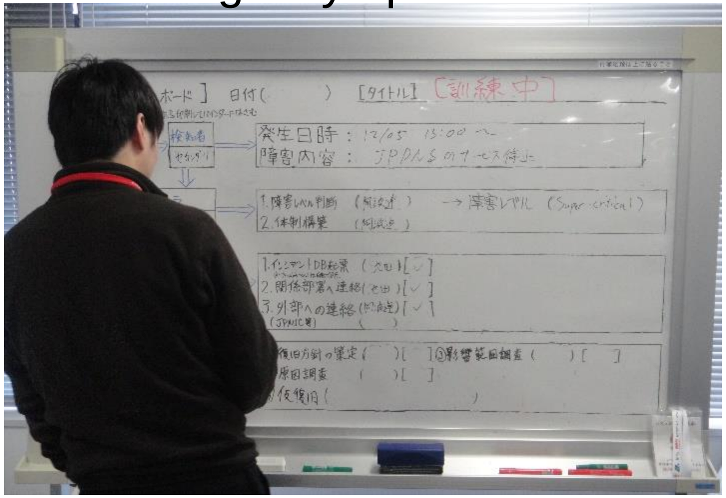
DR Site Failover

Rush to datacenter by walking

DR site failover operation at DC

Cyber Attack Response

Filling information to emergency operation board



ボード］　日付（　　　）　［タイトル］〔訓練中〕

検知者
セカンダリ

発生日時：12/05　13:00 ～
障害内容：JPDNSのサービス停止

1.障害レベル判断（　　）→ 障害レベル（Super-critical）
2.体制構築（　　）

1.インシデントDB起票（　　）[✓]
2.関係部署へ連絡（　　）[✓]
3.外部への連絡（　　）[✓]
（JPNIC等）（　　）

復旧方針の策定（　　）[　]　③影響範囲調査（　　）[　]
原因調査（　　）[　]
仮復旧（　　）

Making contact to outsource providers

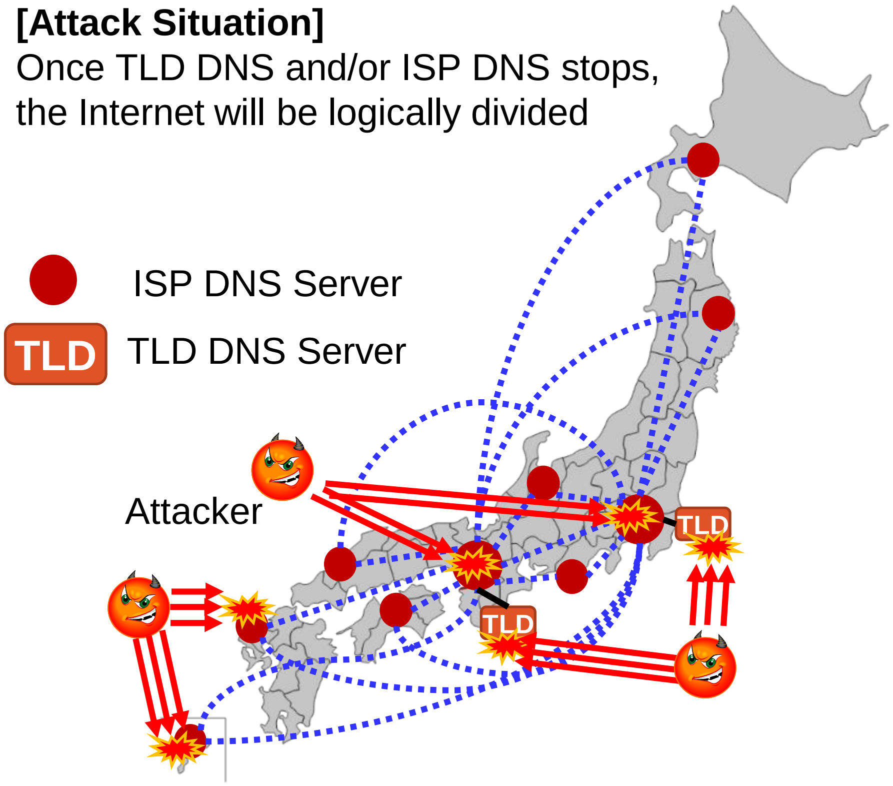
What JPRS has done

- Dispense with the renewal fee of the domain names
  - In March 11 2011, disaster affected area was very wide
  - JPRS worried that registrants in the area may not make the renewal
  - JPRS made the renewal fees free to affected registrants for one year. Many thanks to the registrars which helped us
  - Japanese telecom careers are also starting to make the remedies of fees in disasters

- Issues in identifying the target domain names and registrants
  - Identification of the targets cannot be automated
  - Operations of checks and adjustments were done mannualy
  - Inadequacy of WHOIS information
    - Changes of city names were not reflected to WHOIS
    - Multiple ways to describe the same address
    - Addresses not written in Japanese, etc…

Future Works

- (Cont) Continue trainings and DR site system improvement
- (New) Prepare for Cyber Attacks toward 2020 Tokyo Olympics and Paralympics
  - Demonstration Experiments with local ISPs using .jprs
  - BIND 9 fetch limit, serve-stale, RFC8198 (nsec3 aggressive use), etc.
  - Plan to make feedbacks to the communities and DNS software developers

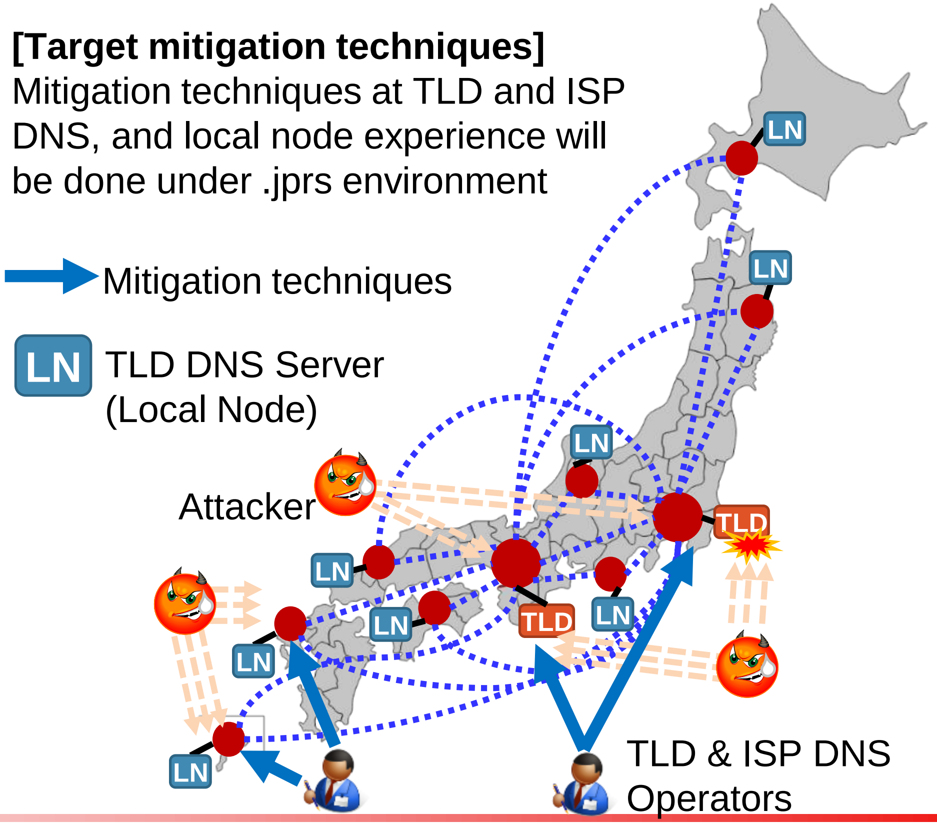


[Attack Situation]

Once TLD DNS and/or ISP DNS stops, the Internet will be logically divided

● ISP DNS Server

TLD TLD DNS Server



[Target mitigation techniques]

Mitigation techniques at TLD and ISP DNS, and local node experience will be done under .jprs environment

→ Mitigation techniques

LN TLD DNS Server (Local Node)

Q&A ?