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Large-Scale Cooperative Dissemination of Governmental Information in Emergency —— An Experiment and Future Strategies

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SUMMARY On the 11th of March, 2011, a massive earthquake hit the northeast region of Japan. The government of Japan needed to publish information regarding the earthquake and its influences. However, their capacity of Web services overflowed. They called the industry and academia for help for providing stable information service to the people. Industry and academia formed a team to answer the call and named themselves the "EQ project". This paper describes how the EQ Project was organized and operated, and gives analyses of the statistics. An academic organization took the lead in the EQ Project. Ten organizations which consisted of commercial IT industry and academics specialized in Internet technology, were participating in the EQ Project and they structured the three clusters based on their relationships and technological approach. In WIDE Cluster, one of three clusters in the structure of EQ, the peak number of file accesses per day was over 90 thousand, the mobile browsers was 3.4% and foreign languages (translated contents) were referred 35%. We have also discussed the future information distribution strategies in emergency situation based on the experiences of the EQ Project, and proposed nine suggestions to the MEXT as a future strategy.
key words: *governmental information in emergency*

1. Introduction

On the 11th of March, 2011, a massive earthquake hit Tohoku Region, the northeastern part of Japan. This earthquake not only caused huge damages and impacts upon the Tohoku (northeast) Region, but also raised discussions on how large-scale distributions of official governmental information should be achieved.

The MEXT (Ministry of Education, Culture, Sports, Science and Technology) has been publishing official information from the Japanese government regarding the earthquake and its aftermath on their Web pages. However, soon after this catastrophic event, they began to receive as much as approximately 16 times than the normal access, which overloaded the capacity. As a result, they were no longer able to provide stable information services.

This was due to the severe damage by the earthquake to Fukushima Daiicihi Power Plant of Tepco (Tokyo Electric Power Co.). Thereby, causing a rush to the Web server by those who were interested in obtaining the official information from the Japanese government in regards to radiation leaks and blackouts.

The MEXT then requested industrial and academic organizations, with expertise in Internet technology for assistance in providing a stable environment for publishing official governmental information in relation with the nuclear accident. The engineers in the requested organizations immediately formed a cooperative team for emergency information dissemination solely through online communication and named themselves the "EQ project".

In the EQ project, policies were organized based on the engineers' rough consensus in a bottom-up manner. They never met in a face-to-face fashion for approximately 150 days since the 15th of March, during which the MEXT uploaded and disseminated 7,289 files in 50 categories.

This article describes how the EQ project was organized, how it has worked in detail, making suggestions for the government, academia and industry so they may be better prepared for another event of this magnitude.

The rest of this article is organized as follows: Sect. 2 describes how the EQ project was structured and operated based on the actual timeline, and clarifies the philosophy of its operations. Section 3 shows technological overview of the WIDE Cluster, one of three clusters in the structure of the EQ. In Sect. 4, we will show the statistics of the access logs, and analyze the characteristics of the data. We will discuss the merits and demerits of our experience in Sect. 5 based on analyses, and suggesting the future direction. In Sect. 6, we will conclude this paper.

2. EQ Project Overview

"EQ" is the name of the project for managing the Web services to publish the radiation monitoring data and related information originally published on the MEXT Web page, per request from the MEXT.

Its purpose is to maintain stable Web service in a massive access situation by using distributed system technology while keeping the consistency of the data. This could not be achieved by the MEXT by itself, and they needed other supporting entities to be formed immediately after the earthquake.

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2.1 Distributed Information System

To answer the MEXT's call for support, KEIO University took the lead to form the team to private sectors including cloud computing companies, end-user portal service companies and academia specialized in Internet technology, and coordinated the agreement of basic policy and established the work flow by email basis.

Through the preparation process, the following principles were agreed among EQ parties implicitly.

- Provide multiple access points to distribute the technological and social risks.
- Minimize the overhead of the MEXT to work this EQ.
- Utilize the existing resources in each party as much as possible in order to build the system and set up the work flow in the shortest time.
- Design an autonomous operation system so that each party can work independently in a loosely-connected manner.

One of the outcomes of these principles was to provide 3 independent access points (URLs) from each group of supporting parties for the end users, while EQ recognized the technological possibility and benefits to provide a single access point.

Main reasons for this choice of the multiple-access-point strategy were to minimize the risks of DNS problems by having a single name, and to keep the social and technological diversity by allowing independent technological approach by each party. Technological diversity also helps for improving robustness of the service as it can avoid all services to be shutdown by a single kind of attack.

2.2 Architecture

10 supporting parties were naturally grouped into 3 clusters based on the daily business relationships and technological harmonization. Each cluster provided an access-point with the robust information service with its own technology (Appendix). This way, EQ constructed the information service that was distributed in two different levels: distributed access points and distribution within each cluster.

Figure 1 shows how the EQ system was structured. Each party took a responsibility for one the following three major tasks of EQ system; (1) *Master Data Distributer*, (2) *Actual Content Distributer* and (3) *Dispatcher*,

(1) Master Data Distributer

A *Master Data Distributer* is responsible for receiving new files from the MEXT, adding proper meta information, sorting and classifying those files, and then publishing them to *Actual Content Distributers* in all clusters in timely manner.

(2) Actual Content Distributer

An *Actual Content Distributer* is responsible for providing web service for substribers to obtain the requested files.

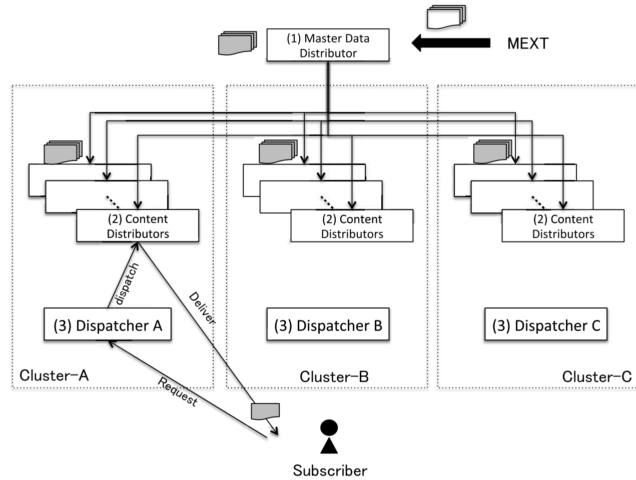

Fig. 1 Structure of the EQ project.

(3) Dispatcher

An *dispatcher* is a coordinator of the cluster, responsible for providing stable access point to the subscribers and dispatching the subscribers' requests to the appropriate *Actual Content Distributer*.

2.3 The Clusters

2.3.1 Overview of the Clusters

The following 3 clusters were formed; 1) a cluster formed by cloud venders, organized by SAKURA Internet [1] (SAKURA Cluster hereinafter), 2) a cluster operated by Yahoo! Japan [2] (Yahoo Cluster hereinafter) and 3) a cluster of CDN venders and academia organized by the WIDE Project [3] (WIDE Cluster hereinafter). These clusters prepared the following access points respectively:

1. `http://eq.sakura.ne.jp`
2. `http://eq.yahoo.co.jp`
3. `http://eq.wide.ad.jp`

Those URLs were announced on the MEXT Web page and other media widely, and users could choose one of them by their own preferences.

2.3.2 SAKURA Cluster

SAKURA cluster was organized by SAKURA Internet Inc., working with other cloud venders such as Microsoft, IBM and Amazon. *Actual Content Distributers* in this cluster were the Web services provided by those venders, and the file synchronization were achieved by the mirroring with CVS. A single access point of this cluster was provided by SAKURA Internet, and access to the real files were dispatched using JavaScript to distribute the access load randomly to their servers in back-end. The content on this cluster was designed lightly, to be used mainly by mobile users.

2.3.3 Yahoo Cluster

Yahoo Cluster was operated by Yahoo! Japan only. The content was integrated into their own portal service that had been providing robust service to end users by its nature. In this cluster, content were provided in visually improved manner using the data from the MEXT. After the 24th of March, 2011, Yahoo Cluster switched to a mirroring service for the MEXT, working as a cache server of the whole the Mext Web page with the alternative URL (`http://www.mext.go.jp.cache.yimg.jp/`) to contribute to the MEXT Web site stability as a whole.

2.3.4 WIDE Cluster

WIDE Cluster was organized by WIDE project, working with CDN venders such as Accelia, Broadband Tower and K-Opticom as Actual Content Distributers. Those distributers operated the mirrors of the Web pages maintained by the Dispatcher.

The Dispatcher provides the master Web tree by CVS and Wget to synchronize the files among *Actual Content Distributers*. The access to the Distributers were load-balanced by DNS Round-Robin in the beginning, then switched to the Dura Site-aDNS which is a commercial service but was offered free-of-use to the EQ project for a certain period of time to cope with the high access rates, then migrated to use the load balancer after the access number was moderated. Durasite-aDNS is a commercial load balancing service released by Acceria, Inc., Durasite-aDNS is a DNS authoritative server with weighted load balancing, server health checking and optimized DNS answering based on DNS query source address.

In this cluster, the content was designed for three different types of subscribers; i) those who only need the latest information quickly, ii) those who need more detailed information including the past data, and iii) foreigners accessing from both inside and outside Japan.

For i), the light-weight web page was setup as a top page. For ii), well organized pages were prepared for easy access to the files of specific kinds in the specific date. For iii), foreign language version provided by the *Master Data Distributor* was distributed on this cluster.

The detailed technology and operation are discussed in Sect. 3.

2.4 Master Data Distributer

The *Master Data Distributer* provided a point of feed for the data from the MEXT, and prepared and maintained the master data for all clusters. EQ used a simplest way for the MEXT to feed the data which is by adding one email address (eq@wide.ad.jp) to their ordinary Web maintenance communication between the MEXT and its own Web service vendor. This was not an ideal method from the technological point of view but best from the point of overhead for the MEXT.

eq@wide.ad.jp included all the parties related to EQ project so that each cluster could process the files independently when necessary. For SAKURA Cluster and WIDE Cluster, WIDE project played the role of the Master Data Distributer by providing master files to distribute. Dispatchers could get them by CVS and Wget. Preparation processes required the following process;

- Verification (to assure consistency between the names of the files and their contents, and to eliminate duplications)
- Naming and placement of the files (to rename the files according to the convention agreed among the EQ parties, because the files were named inconsistently by the MEXT)
- Version control (to disable the access to the obsolete files)
- Multi-lingual translation (to translate the file contents into English and other demanded languages; this was terminated on the 22nd of March, when the MEXT started to provide English versions of the files by themselves)

Volunteer students of the universities provided translations into English, Portuguese, Indonesian, Thai, Chinese, Korean, Bengali and Vietnamese for WIDE Cluster which helped foreign people living in Japan.

More and more processes in the EQ were gradually automated and the daily work load to maintain this service were decreased. On the other hand, the work process at the Master Data Distributer became more complicated by the increased variety of the information. As the time went by, wider range of information were fed by the MEXT that was not only originated by the MEXT but also included all the radiation related information published by other entities such as other ministries and government sectors. EQ architecture was no longer sustainable in that situation.

2.5 End of EQ Project

While EQ were supporting this emergency situation, the MEXT was preparing the new scheme for providing radiation related information in a more sustainable way. On the 8th of August, 2012, this new scheme became ready to start the service (`http://radioactivity.mext.go.jp`) and EQ finished its role.

3. Technical Detail of WIDE Cluster

WIDE Project has been implementing and operating *WIDE Cloud* [4], a distributed private cloud computing environment based on IaaS (Infrastructure as a Service). The authors, as members of the WIDE Project, were in charge of WIDE Cluster as the *Dispatcher*. We also worked as the *Actual Content Distributers* and a *Master Data Distributer*. All of our activities were performed on WIDE Cloud. In this section, we describe the design concept and implementation of WIDE Cloud, and operation of WIDE Cluster on the WIDE Cloud.

3.1 Requirements

In order to ensure the redundancy and scalability for the Web service, historically basic load balancing technologies were established, then CDN like Akamai [5] was prosperity to decrease from bandwidth point of view. Currently, cloud computing environment [6] is a popular service to establish scalable Web sites. As a result, Web service providers don't have to manage hardware resources and locations, because computing resources are virtualized to conceal its physical existence.

However, physical location of catastrophe and its influence don't always correspond in the emergency situation. For example, rolling blackouts happened in Kanto region despite the face that the damaged nuclear power plants were located in northeast region of Japan. Therefore, the operator or the system for cloud the computing had to know where virtualized resources were, and if they or the system detected failure due to the disaster, they had to replace corresponding resources to the other safety region.

3.2 Design Concept of WIDE Cloud

We focused on IaaS cloud computing architecture to ensure sustainable server operations. Most IaaS cloud computing environments have a *Cloud Controller* such as Eucalyptus [7], OpenNebula [8] or OpenStack [9] to manage its resources, and they have similar architectures [9]. However, they don't suppose IaaS resources to be widely distributed. Most of hypervisors and storages are located at a same data center. On the other hand, we assumed that IaaS provider collocates its resources at multiple data centers to realize a resilient system against catastrophes. The important properties for continuous VM-based services are VM network transparency, storage transparency and load balancing without explicit human operations. Thus, we proposed Distributed Cloud Architecture as Fig. 2.

Cloud region is a location of the hardware computing resouces, basically same meaning of collocation data center. Every cloud region has a *Local Network* which is offered by a corresponding data center network. Hypervisors connect to *Local Network* to ensure connectivity to the other entities such as *Cloud Controller*, and they establish *Cloud Overlay Network* using overlay network technologies to create a wide-area layer-2 network over the Internet. *Cloud Gateway* advertises *Cloud Overlay Network* routes to the backbone or global Internet, and provides some advanced functions such as Network Address Translation, Server Load Balancing or Mobile Network Anchor. A subscriber always accesses this identifier that is globally reachable IP Address. Cloud GW translates the destination IP Address to assign working servers. *Cloud Storage* and *Cloud Gateway* also connect to *Cloud Overlay Network* nodes in the same segment. Thus, *Cloud Overlay Network* and *Cloud Gateway* ensures network transparency for VM Live Migration even if VM is migrated to any other data center.

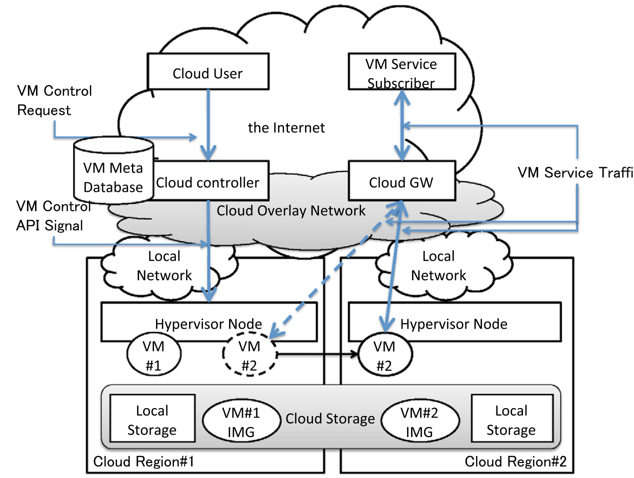

Fig. 2 Distributed cloud architecture.

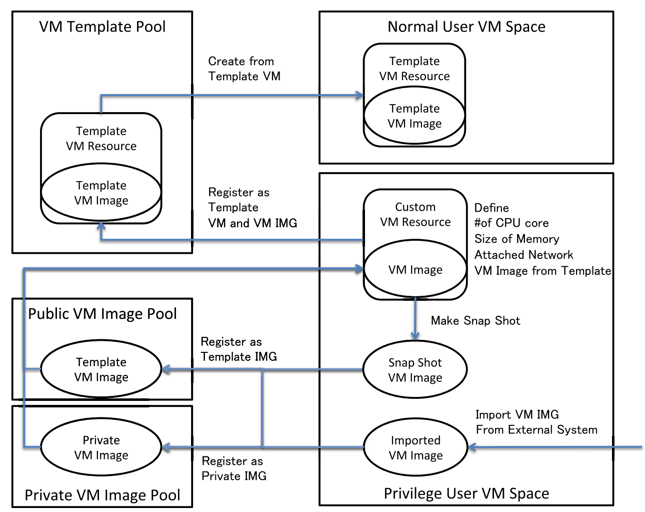

Fig. 3 VM creation and management procedure.

Figure 3 shows VM creation and management procedure in WIDE Cloud. We separated VM disk images and other VM resources to provide template-based operations. In the template-based operations, users define VM resources properties such as number of vCPUs, memory size, etc, and install an Operating System to an empty disk. On the other hand, we defined following three functions to create same VMs easily. Users can upload or take a snapshot of a hard disk image, and register it as a template image in the public or private VM image pool. Users can create VMs by combining a VM image and VM resources that is defined by users. Users can register pair of VM image and resources as a VM template so that users can create a VM just by choosing a template on the list and clicking on it to run. Then users can create VMs so that users choose a template from the list and just click to run it. This mechanism makes VM copy operation and its automation easily.

3.3 Implementation of WIDE Cloud

We have implemented WIDE Cloud as a proof of concept for the proposed Distributed Cloud architecture. WIDE Cloud is operated by 7 institutes that are participating in WIDE Project. In WIDE Cloud, we used some open source technologies for IaaS virtualization (KVM [10]), VM and Hypervisor control API [11] and virtual network storages (NFS). We are using VLAN and Layer-2 over IP encapsulation for *Cloud Overlay Network*. We implemented WIDE Cloud Controller (WCC) as *Cloud Controller* to manage all of VMs and hypervisors, and stateless Network Address translation as *Cloud Gateway* to ensure global VM reachability and network transparency for Live Migration.

3.4 Operation of WIDE Cluster on WIDE Cloud

Figure 4 shows a system overview for EQ-Web as an application of WIDE Cloud. A user's request is led to an SLB (Server Load Balancer) that is located in WIDE Cloud by DNS round-robin technique. SLB works as *Cloud Gateway*, its IP address is a service identifier and worker nodes (VMs) are located behind an SLB. SLBs are installed in multiple places to avoid outage, redundancy is ensured by routing advertisement using IP Anycast. When governmental officers publish original materials, Web managers would modify Web pages on Master node. Content synchronization is realized by 5-minute polling from each worker node. The worker node OS image was registered as a template, and operators would configure CPU usage threshold. If WCC detects CPU usage over threshold, WCC automatically creates a new worker node from the template VM image. Then, WCC acquires the worker's IP address that is assigned by DHCP from own managed database and registers it in an SLB. Furthermore, the template worker VM image was configured with Syslog and content synchronization software. Thus, when WCC detects a load over the threshold, WCC has to call single VM creation only. There is no human interaction.

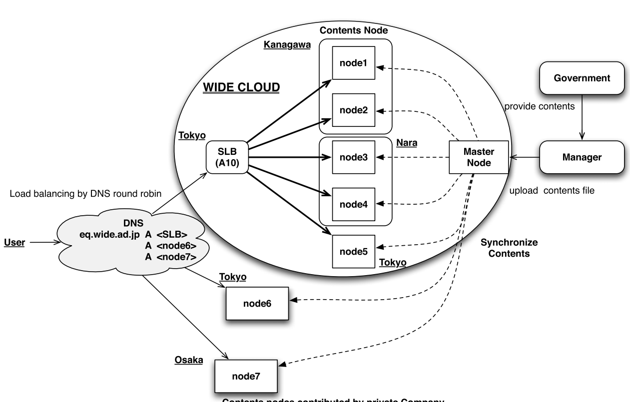

Fig. 4 Overview of WIDE cluster.

4. Analyses of Web Accesses on WIDE Cluster

The WIDE Project was in charge of *Actual Content Distributers* in WIDE cluster, part of access logs were available to the authors. In this section, we show the analyses of the access logs.

Figure 5 shows the number of file accesses to Web servers on the WIDE Cluster `http://eq.wide.ad.jp` and the countries of access source addresses obtained on Dokodoko JP service [12].

The peak number of file accesses per day was over 90 thousand at the next day after we started (the number of page views was over 50 thousand). Afterwords, access rate had been less and less. We do not have a clear evidence, but we figured that the reason was as follows. Many third party services that used information that the MEXT had provided, focusing on the situations and influences of radiation regarding Fukushima Daiichi nuclear power plant had appeared, publishing on Twitter, Facebook and so on. They gathered data regarding radiation from many sources (including the MEXT information distributed on EQ), generated graphs and provided their own opinions, which increasingly drew public attentions. There were two important days with respect to rapid increases in the number of accesses in Fig. 5: on the 21st of April, the government announced prohibition of entry within 20 km of Fukushima Daiichi nuclear power plant, and on 12th of May, newspapers published that the reactor no.1 has indeed been through melt-down.

Figure 6 shows the ratio of mobile devices based on the user agents of Web browsers. DoCoMo, KDDI and SoftBank express feature phones released by Japanese major mobile carriers. (A feature phone is a mobile phone which at the time of manufacture was not considered to be a smartphone, but nevertheless had additional functions over and above standard mobile services [13]). Blackberry, Symbian, WindowsPhone, iOS and Android express smart phones regardless mobile carriers. We referred naming conventions for the user agents of mobile phones. The total number of

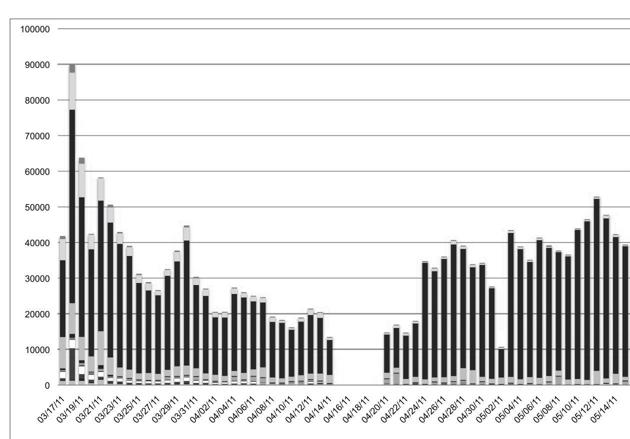

Fig. 5 Number of file access per day. No data available from 14th to 20th of April due to disk overflows.

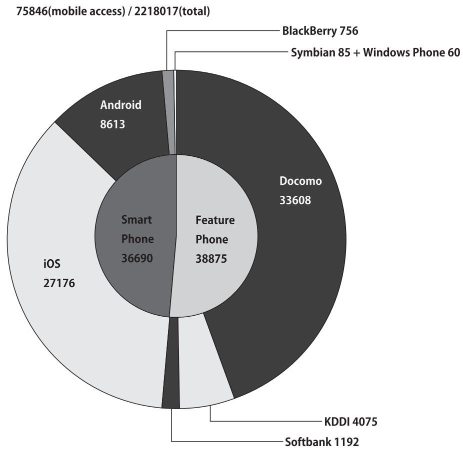

Fig. 6 Distribution of the HTTP user agent of the accessed files.

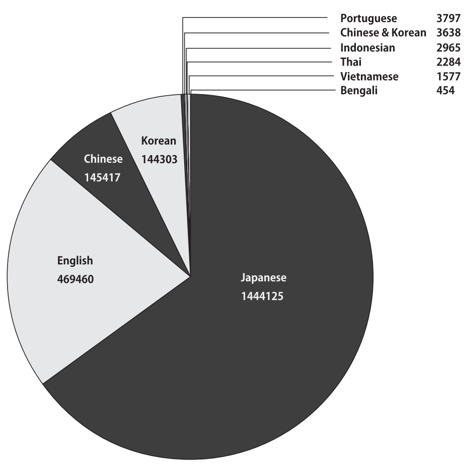

Fig. 7 Distribution of the languages of the accessed files.

file accesses were 2,218,017, and 75,846 (3.4%) accesses were from mobile phones. Furthermore, smart phones accounted for over 50% of mobile devices' accesses. We couldn't confirm individual feature phone's function, but most of them probably couldn't display pdf format.

In EQ project, published contents were translated to various languages by volunteer students. Figure 7 shows the ratio of the number of file accesses based on the referred languages. Over 65% accesses were to Japanese files, followed by English (21.1%) and Chinese and Korean (6.5%) each. From figure 5, it is apparent that most of source addresses were found in Japan, thus we can infer that many people who lived in Japan but used foreign languages referred to translated contents on EQ.

5. Discussion

EQ project had some problems regarding its operation and trust. These problems were marginally solved and managed based on manpower and personal trust.

In this section, we clarify problems of information distribution services in emergency situation, and propose strategies for the next time.

5.1 Main Problems of EQ Project

In EQ Project, all participants were fundamentally not expected to behave maliciously. For example, we did not assume that someone published falsified data to the subscribers. That was a precondition. That means that there were no data verification systems in EQ project.

Preparation of multi-lingual information was similar. Foreign students in Japanese universities and students in Asian countries helped to translate the information from Japanese to their own languages. We depended solely on them, and nobody could verify or strictly audit the correctness of their work.

In the data publication, the MEXT was providing periodical data (such as radiation monitoring) that sensors generated, but they were often handwritten. There were not only no naming convention based on time, locations or versions, but also no meta data embedded in the files. Therefore, the *Master Data Distributer* had to add proper information in the file names, and they created a table to sort and classify data.

5.2 Need for Proper Data Format

According to the access logs described in Sect. 4, huge disaster and its secondary accidents were noticeable phenomena, and there were various types of subscribers and their devices. Therefore, we have to assume many more types of situations such as handicapped, mobile and international subscribers.

The third parties who are familiar with radiation and its influences created visualized information based on our publications. They used SaaS (Software as a Service) environments to publish and ensure the scalability over huge number of accesses. In the SaaS environment, there are some APIs not only to access the databases, but also to process the data set. It was strongly requested to publish the data in machine-readable format instead of PDF format that The MEXT distributed to encourage this kind of usage of the data for public benefit by any parties. On the other hand, a technique to verify that their original data is not falsified needs to be established.

5.3 Need for Periodical Practice

Access logs showed that the amount of the access is also difficult to predict in disaster cases. It depends on visibility based on the topics printed on the newspapers and international needs. Thus, a scalable and stable information distribution environment is necessary, but it is commonly expensive and not needed in normal situations. The other problem is that the government did not have an alternative plan to ensure that kind of environment. Thus, if the government office decides to bring some third party equipment in requisition, they do not create the proper environment by themselves. Therefore, the government should plan to periodically practice to ensure such environment, and adjust newest solutions at diverse times.

5.4 Need for Geographically Distributed System

At one of the regions of WIDE Cloud, rolling blackouts actually occurred, and NOC (Network Operation Center) space became entirely unavailable. To ensure properly working application services on the Internet, many technologies have to be working completely. In emergency situation, we have to consider and discuss the matter from every physical aspect. Distributed system is one of the answers to avoid failure due to disasters. WIDE Cluster was operated on WIDE Cloud which is a distributed IaaS environment, and VMs were distributed to 5 locations. It made WIDE Cluster to be robust against rolling blackout. We wouldn't stop our services even if the other parts of our cloud region suffered other disaster.

5.5 Suggested Future Strategies

We have proposed the itemized list of 9 things to consider as follows to preparing for future emergency situations, which we presented to the MEXT, based on our experiment, analyses and discussions.

1. Grand Design to disseminate information:
   There are various types of subscribers, for emergency use (mainly mobile devices) and for investigation use (mainly PCs) from access logs. Thus, we should design a service plan and model depending on their assumed needs. A single entity, however, such as the MEXT cannot serve all kinds of subscribers. But if first-source data were published in machine-readable format, other parties could help for variation of presentation of the data to meet various types of needs in distributed manner, much more timely, with less cost.
   The grand design for data creation and distribution incorporating those entities and usages in the architecture is much more important than trying to serve all the needs by government only.
2. Consideration for Mobile users:
   Accesses from mobile devices were not rare for emergency uses, which means that a simple Web site, distributing information with small data size, is necessary for this specific target. In addition, users have individual needs and interests, and they do not want all of information from the government. Thus, customizing based on their needs could make distribution system and network avoid congestions.
3. Multi-Language Support:
   According to analyses of the access logs, foreign languages were in high demand in time of emergency, especially for those foreign-language-speaking people living in or visiting our country. Governmental publishing should prepare polyglot documents on a regular basis. Otherwise, we would be in confusion in emergency situations.
4. Load Balancing in emergency situations:
   Various server-load-balancing services are available commercially. However, they are too costly to maintain full redundant services, and difficult to ensure geographical distribution in server load balancing or unifying these services. Thus, we should not only organize cooperation among the government, academic society and commercial society, but take annual training against emergency situations.
5. File ID and Version Management
   Naming convention is very important to identify the information resources. Additional data tagging is also necessary to process data such as version, checksum, source, data, time, etc.
6. Data Archiving for Processing
   Proper data archiving for data processing is very important thing to the autonomous third party service development.
7. Compilation of a Database for Flexible Search
   The radioactive monitoring information published in this scheme was not only useful for emergency situation but it could become a important resource for the future research in several areas such as environment, health, nuclear technology and policy. However, the daily-generated monitoring data was just published as an "announcement" but were not automatically stored in the database for the future use.
   It is time and cost consuming to convert from "announcement" to data. It is strongly recommend designing the sensor generating data to store in database without manpower involved. The database to store the sensor data should be carefully designed by incorporating feedbacks from researchers in various academic areas and API to access data for wider usage is also important.
8. Visualization
   Visualization is important for general users to understand the situations easily. SaaS environment such as Google Maps or BING are useful to create visualized data. The government is better to play a role to provide the source information to those information service providers.
9. Communication with Users
   Most of users needed to understand current situation with bird's-eye. Contact point is necessary to understand user's demands.
   Many technical partners could help to provide various kinds of presentation of the data but cannot help without the first source data from the government. It is one of the important role of the government to maintain the way to get feedbacks from the target audience of the information, in order to prioritize the work properly in limited time and resource.

6. Conclusions

The EQ scheme was established immediately after the call from the government in a condition of extremely limited resource and time. The project members also being victims, made the situation even more difficult. The priority of the design was promptness and the long-term sustainability was not well considered at the beginning. That led to the high operational cost but the project members managed to work out with their quick decision making, flexibility and strong commitment.

Although the scheme was not optimal and the information published through this scheme was not fully satisfactory, the project surely contributed to the society by providing a stable information service for the people for 150 days. More importantly, the experience through this project gave valuable lessons to many stakeholders.

In this project, academia played an important role in bringing together a cooperation between government and industry. A variety of university resources (i.e. human, computing, network resources) came together to facilitate public wellness without any extra decision making

Therefore, it is strongly recommended for academic organizations to take the lead in addressing issues in times of emergency until the circumstance can be stabilized for more resources to be implemented.

This experiment has uncovered the necessity of the ministries and government offices to improve the quality and capacity of access to information. It also suggested that a better designed system for the information distribution infrastructure in emergency situations with proper estimations of the massiveness of the Internet usages to be crucial.

Even in emergency situations, the same methods in everyday life were used in gathering information by the people. Nothing new could be introduced at such timing. Thereby making the ordinary information service to be the only functional service in times of crisis.

EQ with three clusters reported in this paper were also a collection of resources and functions which have been operated in dailylife.

This suggests to us that the system of daily operation in ordinary times should be reconsidered to incorporate the requirement in the emergency situations. Creating a new system solely designed for the emergencies cannot be readily accepted by users nor become functional in a limited time.

From a technological point of view, there are many issues to discuss in the application of data distribution, data verification and data references.

We expect these issues will be discussed and solved step by step by all stakeholders, and our experiments placed under consideration.

Acknowledgements

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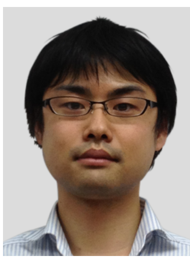
Appendix: EQ Parties

- WIDE Cluster - `http://eq.wide.ad.jp`
  - WIDE Project
  - Accelia, Inc.
  - BroadBand Tower, Inc.
  - K-Opticom, Inc,
- SAKURA Cluster - `http://eq.sakura.ne.jp`
  - SAKURA Internet, Inc.
  - Microsoft Japan Co., Ltd.
  - Amazon Data Services Japan
  - IBM Japan
  - NTT SMARTCONNECT CORPORATION
- Yahoo Cluster - `http://eq.yahoo.ne.jp`
  - Yahoo Japan Corporation
- Translation Student Volunteers
  - KEIO University (English, Portuguese, Vetnamese)
  - The University of Tokyo (Korean)
  - SOI Asia [14], [15] Partner - Universiti Sains Malaysia (Chinese)

– SOI Asia partner - Prince of Songhkla University, Thailand (Thai)
– SOI Asia partner - Bangladesh University of Engineering and Technology (Bengal)
– SOI Asia partner - Brawijaya University, Indonesia (Indonesian)



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