Research Activities in Emergency Communications Group

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In this report, we introduce two major research themes in the Emergency Communications Group. They are:
(1) Research and development of the emergency communications system which supports communication and information exchange for victims of the huge natural disasters.
(2) Research and development of the information system for crisis management on the internet.

The emergency communications system has been developing for more than 5 years and it is important to consider how to deploy the system.

The research and development on information system for crisis management has just started since 1999. At this moment, we have started some experiments from last April.

Both of these two themes are related both internet technology and crisis management. Our group think that these themes are very important for the internet research field and our daily life.

Keywords
Internet, Information and Network, Emergency Communications, Crisis Management, Multimedia

1 Introduction

The Internet has now become a primary part of our societal infrastructure. A variety of services are available on the Internet and a large number of people are using Internet services. The Internet is now an essential part of the most popular and important communication services. On the other hand, since the Internet is still in an evolutionary stage, there are many challenges and problems that must be addressed and resolved. For example, bandwidth expansions in backbone networks and a greater range of services are often pointed out as challenges to be addressed immediately. However, the realization of faster and more diversified services is not the only goal we should strive to attain on the Internet in the near future.

It is natural to think that the Internet - viewed as a part of the infrastructure and as an important, familiar, easy-to-use communication tool - should also be used in emergencies, and should not be limited to day-to-day applications. For example, in case of serious disasters, it would be useful for the Internet to work as a secure, convenient communication tool. On the other hand, as the Internet grows as part of the overall societal infrastructure, it will be more frequently hit by large-scale, malicious, unauthorized access, as well as by "cyber terrorism," which could come to threaten even the very existence of the Internet. Therefore, research on methods for preventing such attacks is of the utmost importance.

Such areas of research will be increasingly important in the near future. The Hanshin-Awaji Earthquake offers a good example of the importance of Internet-based information exchanges for victims. Recent drastic increas-

es in computer viruses and homepage tampering has alerted the public to the reality of constant, numerous cyber-attacks on the Internet.

Our Emergency Communications Group at the Information and Communications Group, has been working on two major research themes, focusing on two fields - the "Internet" and "Crisis Management." We refer to the research themes as "Crisis Management Using the Internet"(or management by the Internet) and "Crisis Management for the Internet" (management of Internet crises). This paper describes the current status of this research.

2 Internet and Crisis Management

2.1 Crisis management utilizing the Internet

The term "crisis management" often appears on TV and in newspapers. Originally a term used in military fields, this term currently is used to describe the process of dealing with unpredictable accidents that may occur in daily life.

There are a number of concepts relating to crisis management; however, many textbooks agree that crisis management can be categorized as including the four phases listed below. Discussions and studies of crisis management are usually conducted with reference to these phases.

*Preparedness
*Responsiveness
*Recovery
*Mitigation

The basic concept of crisis management utilizing the Internet is to deal with unpredictable accidents, utilizing various techniques learned through 30 years of Internet history.

Emergency Communications Group[1] has been developing crisis-management technology utilizing Internet technology to prepare for large-scale natural disasters (in particular). The IAA system (which will be discussed later in this paper), represents a portion of the results of this research.

2.2 Crisis management for the Internet

Crisis management for the Internet(or protection of the Internet), as opposed to crisis management by the Internet, has become a important topic in the past couple of years.

In a short time, we have come to rely on the Internet more than ever. In fact, it is an essential element of many businesses. If the Internet, which has become an important part of the infrastructure within a few years, should fail for some reason, the whole world would be profoundly affected. If the failure were due to a problem in equipment and hardware, it could be corrected by standard measures - such as upgrading the hardware for higher performance and capability, or through elaborate maintenance. This approach would be similar to that taken in many other fields of application. However, if computers and communications hardware were to be attacked by software originating from an unidentified site within the Internet, this would represent a new type of threat, one that has not yet been faced. Thus, a new approach is necessary for handling issues relating to the above four phases of crisis management.

Several Japanese government homepages suffered tampering in February of last year. Although no official reports on that tampering were released, the techniques employed were not unknown, according to an internal governmental investigation. Also, a number of domestic homepages experienced intensive tampering in February of this year. Those systems, attacked by unauthorized access, faced serious situations, as their preparedness, responsiveness, recovery, and mitigation procedures were not satisfactory. Even in the United States, Yahoo, E-Trade and other prominent enterprises suffered distributed denial of service(DDoS) attacks from many sites on the Internet in the spring of last year and faced temporary service failures. As a result, many individuals suffered serious damage.

Because those cases were widely covered by the media, the public has come to learn that the Internet can carry such threats. In fact,

even more serious damage may be caused. In the fields of primary infrastructures such as power, communications, and transportation, discussions and plans based on various possible crises (ranging from small glitches to political terrorism and wars), have been prepared. The Internet has come to require preventive measures of this level, or even higher levels, of reliability. What is particularly important is that the attacks on the Internet use common TCP/IP technology, regardless the scale of attack. Namely, there does not exist a large methodological difference between a kid who uses an easily obtained intrusion program to draw graffiti on a friend's home page and a national agent waging a sabotage campaign against another nation through the Internet. This is an important point that must not be missed in considerations of crisis management for the Internet.

3 Current Status of Crisis Management Utilizing the Internet

3.1 Necessity of communications system supporting victims

Following the Hanshin-Awaji Earthquake, TV, radio, and newspapers intensively delivered a great deal of information on behalf of victims. However, reportedly, they failed to provide sufficient victim-support information, such as where and how friends and loved ones were, and what sort of relief goods were needed at shelters in stricken areas. Although the telephone infrastructure avoided serious damage, the subscriber lines were destroyed. In addition, there was frequent congestion, due to a rush of calls from outside. It seemed that cellular phones worked with fewer problems than traditional phones, but this is because the number of cellular phone subscribers was small at the time. In fact, in the case of the earthquake that hit the western part of Totori Prefecture (with its epicenter in west Totori) on October 6 of last year, there were many reports that calls via cellular phone to the area hit by the quake had difficulty connecting for several hours immediately following the earthquake.

It was just the beginning of the Internet era in Japan when the Hanshin-Awaji area was hit by the big earthquake. Nonetheless, when phone lines recovered and access to the Internet became possible again, information exchange through the Internet quickly resumed. Such information exchange was effective in encouraging the exchange of information in and between areas both within and outside the earthquake zones. However, since the communication systems for such information exchanges were prepared in haste right after the quake, they lacked the necessary capacity for large-scale exchange of data with similar systems.

3.2 Research and development of the IAA system and its installation

The WIDE project[2] has continued intensive research since its first efforts to get the Internet off the ground in Japan in the late 1980s. It started another round of research work immediately after the Hanshin-Awaji Earthquake, aiming to use the rich resources of the Internet to support communication systems for victims hit by large-scale disasters. The IAA system[3][4] is a communication-based support system, the development of which was initiated by the Lifeline Working Group (a part of the WIDE project) in 1995. The system helps victims communicate with other victims and people outside the stricken area. The author was transferred from Tokyo Institute of Technology to current position in July, 1999, and was, involved in the development of this system from its early stages; top priority was assigned to this theme for the Emergency Communications Group (then referred to as the Emergency Communications section of the Communication Systems Division). The term IAA is an acronym for "I am alive!"

The design and implementation of the IAA system is being eagerly improved and expanded even now. Recently, a framework has been finally established under which we can imme-

diately start operation of the IAA system and help victims, if and when a massive disaster takes place.

The Lifeline Working Group has conducted open experiments using the IAA system on January 17 (the date of the Hanshin-Awaji Earthquake) and on September 1 (Disaster Prevention Day, which was established in 1960, for the date of the Great Kanto Earthquake in 1923) of each year. At the times of the recent Mt. Usu and Miyake Island eruptions, what was then known as the Emergency Communications Lab and the WIDE project jointly offered a victims' information registration and retrieval service using the IAA system, to help facilitate communication for the people in the stricken areas. The IAA system had, as of the end of October 2000, recorded more than 3000 hits.

Fig.1 briefly illustrates the current structure of the IAA system. The IAA system consists of a user interface unit (top half of the figure) and a distributed database unit (bottom half).

The user interface unit allows victims to register their information to the Internet; people both inside and outside the stricken area may then use a database search to check on friends and loved ones. Registrations and information searches can be done using web browsers, of course; however, various user interfaces besides web browsers are available in the IAA system, as PCs are not always available in stricken areas, and not all people are familiar with keyboard typing.

For example, if a victim fills in a prepared FAX sheet distributed in the stricken area and sends it to the IAA server via fax, the IAA server automatically recognizes the contents and stores the information (our FAX Service); victims may then register and search information using the buttons on a push-button phone, guided by a voice-assistance system (our Telephone Service). The FAX Service is also available through "bulk processing:" a number of victims fill out FAX sheets, and a representative then takes the sheets to a site outside the earthquake area, to send them all at once.

The registration and retrieval information collected through the user interface unit is transferred to the distributed database located on multiple Internet sites. Each distributed database server has a database program and a data synchronization mechanism for data synchronization with the other distributed servers. Since victim information is thereby maintained at several sites on the Internet, the registration and retrieval service will survive, even if a couple of the databases fail.

In the IAA system, all functions other than the FAX auto-recognition function work under the PC UNIX platform (FreeBSD and BSD/OS). Under present discussions, its source code will be open and free. Although only the FAX auto-recognition function was initially designed for Windows NT, it has been since transplanted to PC UNIX.

4 Current Status of Crisis Management for the Internet

4.1 Upgrade of the Crisis Management Research Facility for Information Systems

As already mentioned, the Internet itself has come to be exposed to serious threats.

Analyzing Japan's current status from the viewpoint of the four phases of crisis management, we have to say that this country has deep cause for concern. In recent years, an increasing number of organizations restrict access by setting up firewalls between intranets and extranets (to block intrusion) and make it a must to periodically execute antivirus check programs. Such actions are commendable, but they represent no more than preparations. In fact, there is almost no organization that has clear emergency measures or a recovery scenario for cases of cyber attacks. Nor are there truly any organizations that are making efforts in security-education and encouragement, with "occurrence", "responsiveness" and "recovery" phases all clearly included in its policy.

In order to improve the above conditions, groups of researchers keenly recognizing the

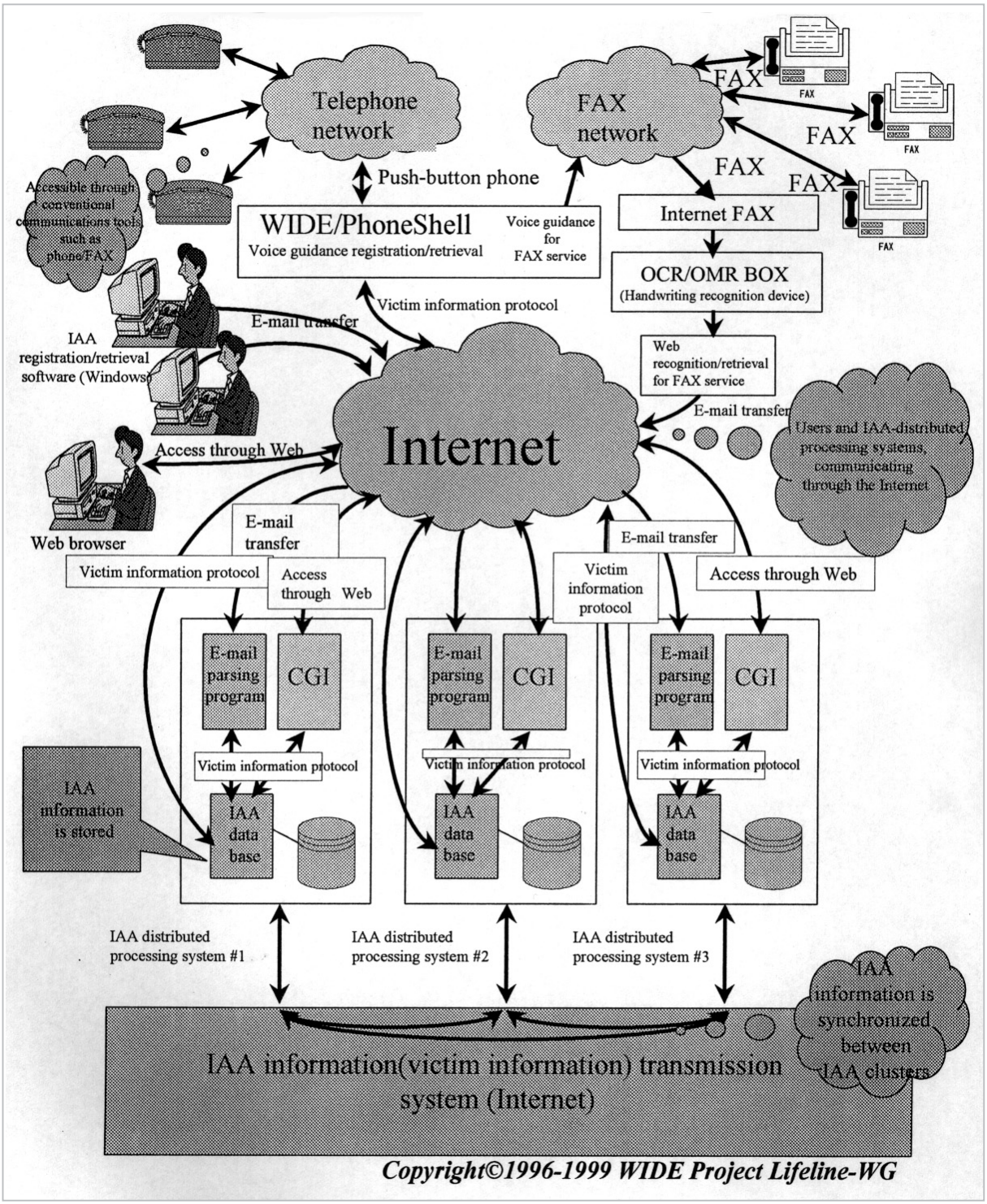

Fig.1 *Outline of IAA system*

importance of crisis management of information systems should collect and analyze the latest information on a daily basis, quickly select the best solution (from the many diverse choices), and make efforts to promote security encouragement and basic research in normal times. As Emergency Communications Group has people who can contribute to such activities, it applied for the public utilities reserve budget last year to upgrade the Crisis Management Research Facility for Information Systems. When CRL secured grants for that proj-

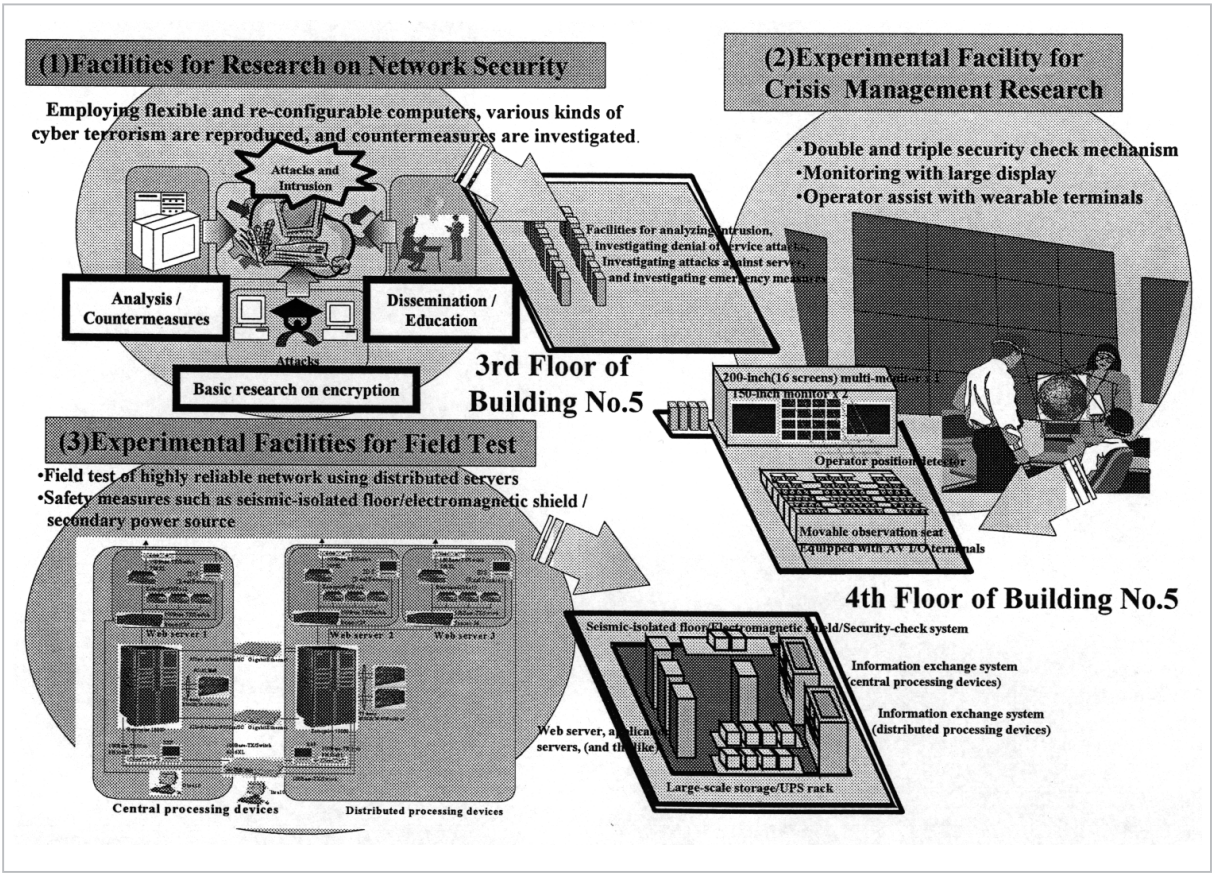

Fig.2 *Crisis Management Research Facility for Information system*

ect, its budget size was much smaller than the original request, however, and the facility was completed last year. Fig.2 illustrates the outline of the facility.

4.2 Future of the facility

If the facility becomes fully operational in the future, it will become possible (within a closed network) to reproduce cyber attacks threatening the Internet (such as those based on intrusion). Then we will be able to conduct effective research on resultant damages and necessary countermeasures. It will a the same time be possible to check the Internet for unpredicted emergencies. We can discuss effective countermeasures in the event any anomaly is detected.

The facility has just started operations, and all details are not fully set forth in this paper. However, I would like to emphasize that the facility's goal is to be a crisis management research facility for information systems of a world-class scale and performance. The course of improvement and results of this facility will be introduced on the home page of CRL and relevant transactions.

5 Conclusions

There are a number of systems similar to the IAA system. We will expedite the establishment of interoperability with similar systems developed by the other organizations. In addition, we will seek parallel approaches to providing a high-speed, high-capacity system that can deal with access of more than one million users per hour and a light, compact system that can be installed in notebook PCs. We will also introduce new types of user interfaces, improve access methods via cellular phones, and address the privacy problem of victim data handled in distributed databases. Further improvements will be needed to make the system easy to operate for world users.

Efforts to make the IAA system an international standard will be of great importance. We have taken action in IETF and in the ITU-T since last summer to register the system as a global standard.

The Crisis Management Research Facility for Information and Network started full operations at the beginning of this year. The Emergency Communications Group is making an all-out effort to grow this facility, to allow it to become an institute that will play an important role in Internet crisis management in Japan.

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Computer Networks, Crisis Management