Signal Processing for Virtualization Technology Environments

Project Leader
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1. Objective

This project is aimed at:

Development of the Future Internet is progressing and research on its effective application is attracting attention. We have studied a distributed information processing system using the new generation network test bed JGN. The purpose of this research is to develop a completely new distributed signal processing system which can utilize the Future Internet capabilities effectively. This system would make the system highly efficient by using network virtualization in addition to parallelization of processing.

2. Project Outline

To that end, the project will consist of the following phases:

(a) The creation of a signal processing algorithm suitable for a virtualized network
(b) The development of an information distribution method on the virtualized network
(c) A demonstration experiment over the test bed network JGN (Built and operated by NICT)

3. Expected Performance

In this project, the successful candidate would be expected to:

(a) Working independently, develop the signal processing system.
(b) Assist the senior members with the development of the application system of the new generation network.

4. Required Skills and Knowledge

The successful candidate for this project will have the following knowledge and skills:

(a) Algebra/Linear algebra
(b) Information theory
(c) Programming (C language, etc.)
(d) IP network

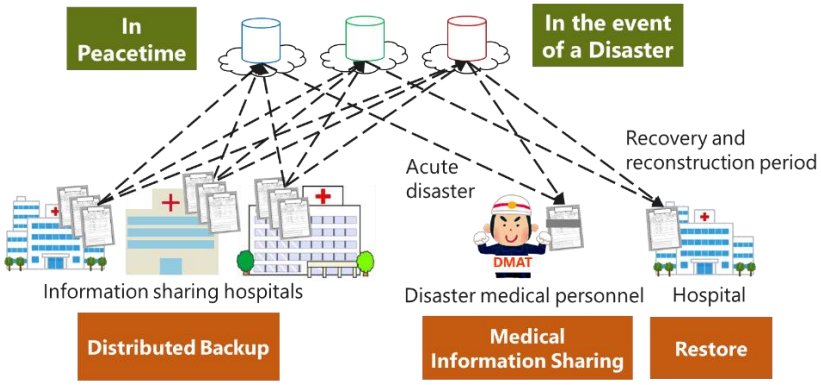
5. Examples of current research projects

(a) Wide-area distributed backup of electronic medical record

In order to protect medical information from large-scale disasters, it is effective to back up data distributed over a wide area. Encryption is commonly used to keep data secret, but it can always be decrypted if enough calculation time is spent, and it is not sufficient when dealing with highly secure personal information such as medical information. In the Shamir's (k, n) threshold secret sharing scheme, the information to be kept secret is distributed into n pieces of data called shares, and when k or more of these are collected, the original information can be completely restored, but when $k-1$ or less shares are collected, the original information cannot be known. Unlike encryption, security is guaranteed information-theoretically. Since the (k, n) threshold secret sharing scheme restores all the backed up data together, it is suitable for restoring electronic medical record data after the electronic medical record system is restored after a disaster, but is not suitable for sharing medical information.

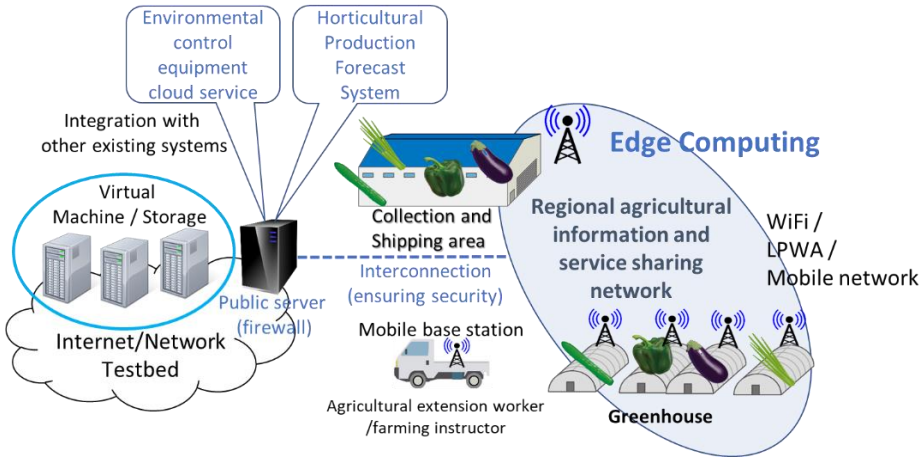
It is desirable to use the wide-area distributed backup of electronic medical record data not only for

restoration at a single hospital, but also for sharing medical information for regional medical cooperation in peacetime, disaster medical assistance teams (DMATs) in the event of a disaster, and medical treatment at medical relief stations. To achieve this, it is necessary to search the electronic medical record data of a patient from information that identifies the individual (such as name, date of birth, address, and My Number), and to make it possible to view only the data necessary for on-site medical treatment. First, in order to search for electronic medical record data of a specific individual across multiple medical institutions from the backed-up electronic medical record data, secret calculation is required. Next, in order to make it possible to view only the information that is particularly required for medical treatment during the acute phase of a disaster, such as the most recent medication history, from the searched data, it is made possible to partially restore the distributed information). In this method, electronic medical record data recorded in the standardized storage SS-MIX2 format is divided into meaningful units of information and then distributed to the shares to be stored. When the data is divided, the data length of each divided piece of data is used as "joining information" to enable partial recovery.



(b) IoP (Internet of Plants) Project

In Kochi Prefecture's competitive advantage in greenhouse agriculture, the industry-government-academia collaboration project “the Advanced Next-Generation Greenhouse Horticulture by IoP (Internet of Plants)” and its expansion framework “Evolution to Society 5.0 Agriculture Driven by IoP (Internet of Plants)” are also demonstrating the technology, and are working to expand to other fields. By sharing information and services in the region, it aims not only to reduce labor, increase the added value of agricultural products, and increase yields and income, but also to encourage new farmers. The “Regional Information and Service Sharing Network” uses a “partially searchable and restorable secret division method”, so it is possible to safely and flexibly store and share data with a mixture of security levels from different fields. For this reason, it is expected that the burden on users will be reduced by sharing it in many fields such as medicine, agriculture, fisheries, distribution, and disaster prevention.



References

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[2] Masahiro FUKUMOTO, Hajime KUBOTA and Shigeo TSUJII, “Simplification of stochastic fastest NLMS algorithm,” IEEE International Symposium on Circuits and Systems (ISCAS’99), Vol.3, pp.158-161, ISBN:0-7803-5471-0.

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