FOR IMMEDIATE RELEASE

# Data Replication for Disaster-resilient Information Platforms

*Ensuring access to critical information even during widespread disaster-related network disruption while suppressing system costs*

The Research Institute of Electrical Communication of Tohoku University ("RIEC"), Hitachi, Ltd. (TSE:6501, "Hitachi"), and Hitachi Solutions East Japan, Ltd. ("Hitachi Solutions East Japan") today announced the development of a data replication method to protect data and enable the continuation of information services in disaster affected areas even when there is wide area network disruption preventing access to remotely located back-ups. A simulation was conducted on a configuration of 24 servers at various municipal locations at the city or prefectural level. When the data was replicated between locations unlikely to be simultaneously affected, the simulation confirmed that 94% of the data could be protected when 50% of the servers were damaged. By changing the number of data replicas to be made according to the risk of data loss,[*1] the same amount of data can be protected with half the amount of replicas compared to conventional methods. This technology will enable disaster-resilient information platforms at a practical cost.

Social infrastructures handling information have become increasingly important with the rapid development of advanced information societies. In recent years, disaster recovery services[*2] are available to provide service continuation even in the event of a wide-area disasters, such as those that back-up data to remote locations via the Internet. In the case of the Great East Japan Earthquake, however, the wide area network connecting to the remote backups was disrupted while some regional network environments survived. As a result, the problem arose that backup data could not be accessed and critical information required immediately after the disaster, such as resident registries and medical records, was not available.

In September 2012, RIEC, Hitachi and Hitachi Solutions East Japan initiated collaborative research to resolve this issue. The team first developed a "risk-aware data replication"[*3] technique to protect the data which involves preparing replicate data in servers distributed throughout hospitals and municipal offices in neighboring regions, and pairing the original server with backup servers that have minimal risk of being simultaneously damaged. It became difficult however to justify the increased

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cost of additional storage for data protection when the number of replicas was increased to raise survival rate, as the number of replicas was set to be the same in all servers. Another issue was that the computation time required to determine the optimal pairs, exponentially increases with the number of replicas.

To resolve this issue, that is, raise the survival rate of data in the event of a disaster while minimizing the additional cost of increasing replicas, the team developed a new technique, "cost/risk-aware data replication." This method achieves a balance between the cost of additional storage and data protection by reducing the number of replicas in servers which have a lower risk of data loss and increasing the number of replicas in servers with a higher risk. Further, a method was developed to solve the optimization problem of determining the optimal backup server each time the data is replicated.

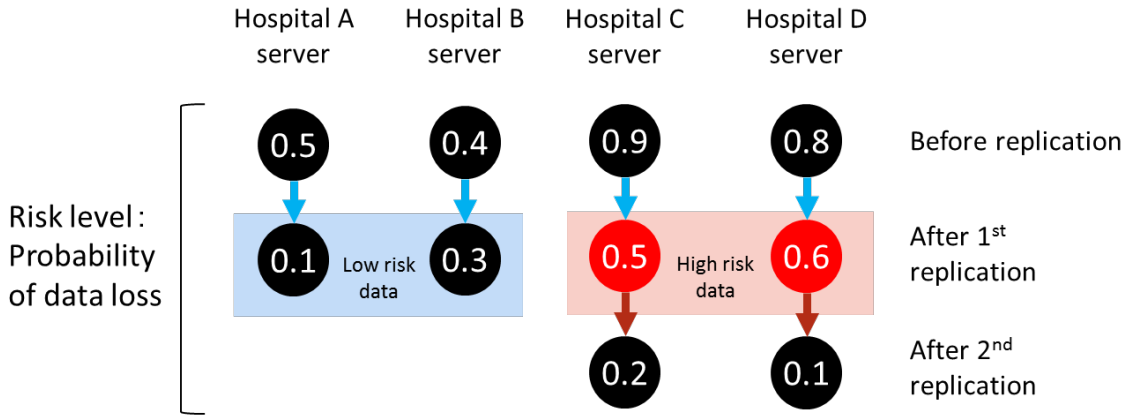


Fig 1. Concept of cost/risk-aware data replication (Example: 4 servers with an average of 1.5 replicates)

The cost/risk-aware data replication technique illustrated in Figure 1 with 4 servers and an average of 1.5 replicates, selects appropriate servers which reduce the risk of data loss compared to the original server, for first replication. After first replication, it determines the data loss risk level of that server, and if the risk is still high, selects another server for second replication. As the average number of replications is fixed at 1.5 times, servers C and D which have a higher risk of data loss at 50%, are selected as the servers that require second replication.

To validate the technique, a simulation was conducted on a configuration of 24 medical facilities located within 25 sq. km of the city of Sendai, Japan, with 1 server each, using a realistic disaster model.[*4] As can be seen from the result shown in Figure 2, the cost/risk-aware data replication technique protected 94% of the data

when 50% of the servers were damaged even with a cap of 1.5 replications, compared to when the cost and risk are not taken into consideration. In this case, the additional cost for replication is reduced by half. Further, the computation time required to select the optimal server for data replication was reduced to 0.6 seconds in the cost/risk-aware data replication technique from 2,500 seconds in the risk-aware technique due to the new optimization solution developed for a condition of 100 servers and a cap of 2.0 replications.

The next step in this research will be to conduct verification tests using servers loaded with the cost/risk data replication technique placed in multiple locations throughout the three campuses of Tohoku University to create a large scale test environment. In the experiment, the data on the servers will be accessed by the electronic prescription notebook system developed with the Miyagi Prefecture Pharmaceutical Association. This technology is being developed to contribute to the promotion of IT in the Tohoku region through collaboration with the “Tohoku IT Re-innovation Consortium,” established after the Great East Japan Earthquake to contribute to the restoration and development of the region.

This technology development was conducted under the commissioned research project, “Research and Development on Highly-functional and Highly-available Information Storage Technology” (Project leader: Prof. MURAOKA Hiroaki, RIEC) funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan. A part of this work will be presented at a meeting of the IEICE Technical Committee on Magnetic Recording & Information Storage, to be held from 9-10 June 2016 at Tohoku University, Sendai, Japan.

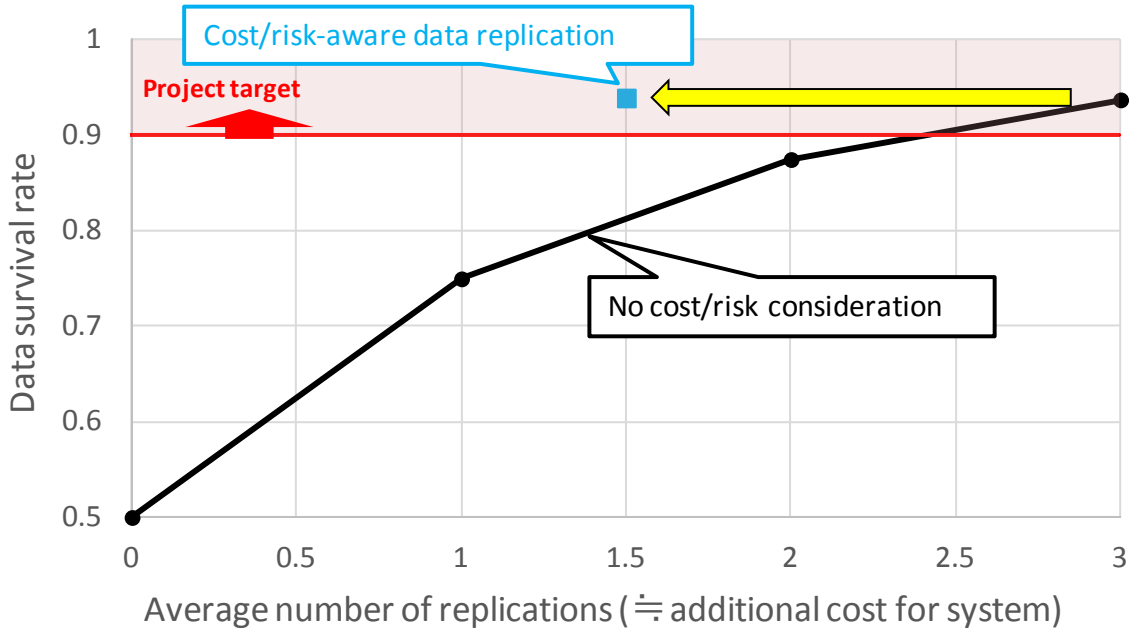


Fig 2. Impact on data survival ratio by cost/risk-aware data replication (24 servers).

*1 Risk of data loss is defined as the risk that the server providing the data as a service during normal circumstances, and the server storing the replicated data for service during disaster periods, are both damaged at the same time.

*2 A service which support the recovery and reconstruction of data systems if damaged by disaster by backing up the data in remote areas.

*3 Hitachi News Release on April 24 2014 (in Japanese): “Development of disaster resilient storage system technology to realize service continuation without data loss during widespread disaster” http://www.hitachi.co.jp/New/cnews/month/2014/04/0424a.html

*4 To ensure that conditions were as realistic as possible, the disaster model adopted was that available from J-SHIS, the earthquake hazard information service of the National Research Institute for Earth Science and Disaster Resilience in Japan, which takes into consideration the impact of all earthquakes may occur and affect Miyagi Prefecture and surrounding regions within the next 30 years.

**About RIEC, Tohoku University**

The Research Institute of Electrical Communication (RIEC) was established in 1935 as a research institute of Tohoku Imperial University, predecessor to the present-day Tohoku University, which is the third earliest national university in Japan after those in Tokyo and Kyoto. RIEC has made a series of pioneering achievements in laying the foundations of modern information and communications technology, including antennas, magnetic recording, semiconductor devices and optical communication, and has continued to play a world-leading role. It has approximately 100 staff. For more information on RIEC, please visit the website at http://www.riec.tohoku.ac.jp/en/.

**About Hitachi, Ltd.**

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges. The company's consolidated revenues for fiscal 2015 (ended March 31, 2016) totaled 10,034.3 billion yen ($88.8 billion). The Hitachi Group is a global leader in the Social Innovation Business, and it has approximately 335,000 employees worldwide. Through collaborative creation, Hitachi is providing solutions to customers in a broad range of sectors, including Power / Energy, Industry / Distribution / Water, Urban Development, and Finance / Government & Public / Healthcare. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

**About Hitachi Solutions East Japan, Ltd.**

Hitachi Solutions East Japan, Ltd., headquartered in Sendai, Japan, is a comprehensive system integrator which provides advanced solutions supporting "PLAN (strategy system and planning system) / DO (execution system) / SEE (visualization system and analysis system)" to companies across many industries. Hitachi Solutions East Japan catches the needs of customers and delivers products and services of superior value to customers. "Delivering Value to Customers and Customer's Customers" is the company's creed. For more information on Hitachi Solutions East Japan, please visit the company's website at http://www.hitachi-solutions-east.co.jp/.

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