Precision variable anonymization method supporting transprecision computing

Keiya Harada*, Henri-Pierre Charles**, Hiroaki Nishi*

*Graduate School of Science and Technology, Keio University 3-14-1 Hiyoshi Kouhoku Yokohama Kanagawa 223-8522 Japan

**Université Grenoble Alpes CEA, List, F-38000 Grenoble France

harada@west.sd.keio.ac.jp, Henri-Pierre.Charles@cea.fr, west@sd.keio.ac.jp

***Abstract*— Recently, the number of Internet of Things (IoT) sensors has been increasing rapidly; hence, various data are gathered. As a secondary use of the data, they are useful in providing new services, such as the demand response service in the Smart Grid. However, data services cause several problems in preserving privacy and during computation. This study focuses on these two significant problems. First, the invasion of privacy while using the data to provide such new services is problematic. A lot of private information is available in the data. For example, power consumption data may reveal the lifestyle of the residents, and the technique of obtaining information is known as nonintrusive load monitoring. Second, the penetration of IoT devices and sensors increases the computational and communicating energy consumption for processing the data and for providing various services using the data. In this paper, a new method is proposed to solve these two problems. This method is based on the fact that the anonymization process reduces the amount of information itself, as well as the quantity of computational resources required. This leads to a trade-off between anonymization level and computational cost. For example, raw data have a maximum amount of information and maximum computational cost. In contrast, fully generalized data (all zero data) have minimum amount of information and minimum computational cost. Compared to the conventional method, the proposed method demonstrated lower precision and a higher error rate. Therefore, the proposed method aims to control the trade-off and enables the provision of anonymized data with less information, the required anonymity level, and low computational cost compared to the conventional method. The proposed method is practiced using power consumption data gathered from the Urban Design Center Misiono (UDCMi) and the demand response service is evaluated as an experiment using the data. In this evaluation, a simple model of energy consumption was used in the calculation, which uses the required bit width of the arithmetic logic unit (ALU) for providing the service. The computational efficiency of the proposed method was increased by 60% when k=2 and by 65% when k=3,4,5,6 compared to the conventional method. The method can also maintain an acceptable range of service error. The transprecision platform can restrict energy consumption by reducing the bit width of the data. Therefore, the proposed anonymization method can also reduce energy consumption by achieving lower usage of the ALU based on the transprecision architecture.**

***Keyword*— anonymization, k-anonymity, transprecision computing, approximate computing, power consumption data**

(Pt8) Keiya Harada received his BS degree from Keio University, Japan, in 2018. He is now a master student in Keio University and a member of Nishi Laboratory, Keio University. He is currently interested in data privacy.

Henri-Pierre Charles is research director at CEA-LIST since September 2010. He was previously assistant professor in Versailles University during 17 years, authorized to supervise PhD students (HDR) since 2008. During this period he participated in many European and national projects, mainly in the high performance computing domain. He has supervised many PhD theses on code optimizations and High performance computing. Since his arrival in CEA he applied his knowledge on multi-processor system on chip (MPSoC) and embedded systems.

Hiroaki Nishi received his PhD from Keio University, Japan, in 1999. He is a professor at Keio University since 2014. He is the president of the Omotenashi ICT Consortium and the chairperson of Misono Town Management. He also chairs the IEEE P21451-1-6 Standard Working Group. The main theme of his research is building total network systems including the development of smart