Department of Management and Information Sciences

Key words Mobile Network, 5G/6G/Internet of Things (IoT), Software Defined Networking (SDN), Network Function Virtualization (NFV)

Doctor of Information Science / Assistant Professor

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Education

Osaka University Graduate School of Information Science and Technology, Department of Information Network (Master's Program and Doctoral Program)

Professional Background

Assistant Professor, Osaka University Osaka School of International Public Policy

Consultations, Lectures, and Collaborative Research Themes

Increased capacity in mobile networks, Mobile core networks in the 5G/6G era, Characteristics and applications of IoT communications

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Main research themes and their characteristics

「Effects of C/U Plane Separation and Bearer Aggregation in Mobile Core Network」

In response to the growing demand for cellular networks, it is essential to improve the capacity of mobile core networks. Especially, in terms of accommodating machine-to-machine/Internet-of-Things (M2M/IoT) terminals into cellular networks, the load on the control and the user planes of the mobile core network increases massively. To deal with this problem, it is possible to apply virtualization technologies, such as software-defined network and network function virtualization. However, few existing studies evaluate such solutions for mobile core networks numerically and in detail. In this study, we first evaluate mobile core network architectures with virtualization technologies and control/user (C/U) plane separation using the mathematical analysis. We also propose a novel bearer aggregation method to reduce the control plane load to accommodate massive M2M/IoT terminals. The result of numerical evaluation shows that the capacity of the mobile core network can be increased by up to 32.8% with node virtualization and C/U plane separation, and further by 201.4% by using bearer aggregation.

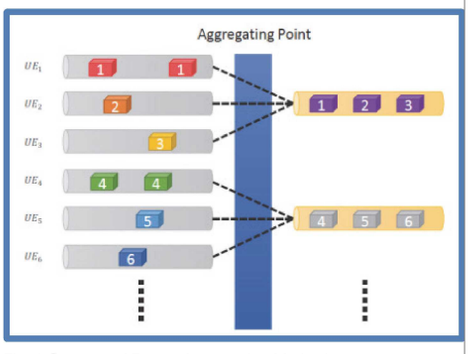

Fig. 1 Concept of Bearer Aggregation Method

「Immediate Release of Radio Resources in Mobile Networks Accommodating IoT Communications」

Mobile cellular networks are now serving all kinds of Internet of Things (IoT) communications. Since current contention-based random access and radio resource allocation are optimized for traditional human communications, massive IoT communications cannot be efficiently accommodated. For this reason, standardization activities for connecting IoT devices, such as Cellular-IoT (C-IoT), have emerged. However, there have been few studies devoted to the evaluation of the performance of the C-IoT communications with periodic data transmissions, despite their being the common characteristics of many IoT communications. Herein, we evaluate the capacity of mobile cellular networks in accommodating periodic C-IoT communications, focusing on differences in performance between LTE and Narrowband-IoT (NB-IoT) networks. To achieve this, we conduct end-to-end performance analyses of both control and data planes, including the random access procedure, radio resource allocation, and bearer establishment in EPC network. Moreover, we determined the effect of immediate release of radio resources considered in 3GPP. Numerical evaluation results show that NB-IoT can accommodate more IoT devices than LTE, although this results in significant latency in data transmission. Furthermore, we find that the number of IoT devices that can be accommodated increases up to 20.7 times with immediate release of radio resources.

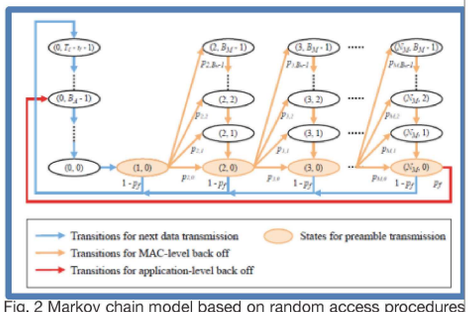

Fig. 2 Markov chain model based on random access procedures during radio resource allocation

Major academic publications

Shuya Abe, Go Hasegawa, Masayuki Murata, "Effects of C/U Plane Separation and Bearer Aggregation in Mobile Core Network", IEEE Transactions on Network and Service Management, vol. 15, no. 2, pp. 611-624, June, 2018.

Shuya Abe, Go Hasegawa, Masayuki Murata, "Performance Analysis of Mobile Cellular Networks Accommodating Cellular-IoT Communications with Immediate Release of Radio Resources", IEICE Transactions on Communications, vol. E105B(12), no. 12, pp. 1477-1486, Dec. 2022

Shuya Abe, Go Hasegawa, Masayuki Murata, "Performance Analysis of Periodic Cellular-IoT Communication with Immediate Release of Radio Resources," in Proceedings of 2020 IEEE International Workshop Technical Committee on Communications Quality and Reliability (CQR), Stevenson, WA, USA, pp. 1-6, June 2020