論文 / 著書情報
Article / Book Information

題目(和文)	Mobile Edge Computingを用いた低遅延ネットワークモデルに関する研究
Title(English)	A Study on Low-latency Network Model in Mobile Edge Computing
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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Information and Communications Engineering 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of （Engineering）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The concept of distributed cloud service called "Mobile Edge Computing" (MEC) is being introduced in the 5G networks for low-latency network. However, MEC can reduce only the communication latency. The computing latency in MEC must also be considered to satisfy the required total latency of services. Therefore, this dissertation aims to study the impact of both latencies in MEC architecture with regard to latency-sensitive services. Moreover, the reference architecture of MEC has been announced. The implementations of MEC desires a study in many aspects before being developed into the real business world. It should be investigated by simulation and evaluated with the real environment. This dissertation also discusses theoretical model and the implementation design of the low-latency network system.

The dissertation includes six chapters. The summary of each chapter is followings.

Chapter 1: Introduction
This chapter introduces the background of the network architecture. First, the fifth generation of cellular networks or 5G is described in aspect of vision, requirement, impact, and key technologies. It promotes a novel application named Tactile Internet which is a latency-sensitive application. The ultra-low latency requirement depends upon Edge computing technology called MEC for support of computational service at the base station. The chapter addresses the problem that MEC still faces to issues of latency and implementation. MEC must consider latency including communication and computation to operate the system. As a result, before deploying MEC, this dissertation evaluates the issues with simulation and experiment in real networks. This chapter also shows the research strategy that must be completed through ideal assumption, practical assumption and prototype implementation.

Chapter 2: Related work and MEC architecture
This chapter summaries the existing related work of this dissertation in various points of view. Firstly, the theoretical studies are examined for MEC state-of-art and fundamental knowledge. The simulation studies of MEC and related technologies are explored in a scope

of latency issue. Then, the implementation studies are reviewed to address the reference architecture, concept and idea of MEC design. This chapter shows the gap of MEC research which this dissertation can fulfill.

Chapter 3: Ideal model of low-latency network

Chapter 3 proposes a fundamental model of MEC. It identifies the ideal assumptions which focus on only communication and computation latency. The communication is calculated by hop count while the computation applies Process Sharing (PS). The optimization model is proposed with allowance latency constrains. The system called Strict system inflexibly follows all constrains while the system called Permissive system ignores some of them. Three policies—random, lowest latency, minimum unfinished workload—are considered to select a destination edge node in case of multiple candidate satisfying the constrains. The simulation implementation is also described. The simulation evaluation, then, is done by showing performance of each policy and system in term of blocking probability, error, and modified blocking probability (combining blocking and error). The results show that determining the lowest latency policy with permissive system provided the best performance under the latency allowance condition though there were some decision errors because of ignoring some constrains.

Chapter 4: Practical model of low-latency network by applying MEC architecture

MEC introduces a controller and manager unit called "orchestrator" into its referenced architecture. This chapter adopts this component to the model to make the model more practical. Other system definitions follow the ideal model in Chapter 3. The practical model more describes its functions and interaction to other components. This chapter also includes how to extend the simulation in Chapter 3 to simulate an orchestrator. The simulation evaluation concentrates on the impact of the orchestrator, sometimes called a controller in this chapter, especially its operation latency and interaction latency. It shows that when the simulation includes the orchestrator updated interval in the system, the permissive system still has the low blocking probability while the strict system is affected to get high blocking probability.

Chapter 5: MEC model prototype: Design and evaluation

Chapter 5 takes the analysis from Chapters 3 and 4 to propose the implementation design of MEC. It literately follows the components and relationship from ETSI MEC framework. The functions of each component are based on the simulation results specially the orchestrator. This chapter, then, presents the design of the MEC system. The prototype of MEC is developed in the real network. The experiment sets up the real scenario of MEC system and evaluates the prototype. It compares the results with the simulation. It explores that the accuracy of latency estimation is one of important factors. MEC development should consider this issue when implementing in the real system.

Chapter 6: Conclusion and future works

The conclusion of Chapters 3, 4 and 5 is put at the last part, Chapter 6. It sums up the contribution of each previous chapter and expresses eventually what the whole dissertation has done and found. Finally, the suggestion for further study of MEC is leaved and opened for future.