（ 続紙 1 ）

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論文題目	Importance-Aware Information Networking toward Smart Cities （スマートシティに向けた重要度を考慮した情報ネットワーキング）		

（論文内容の要旨）

The concept of smart cities has been evolving. While the evolving concept of smart cities does not have a fully shared and globally accepted definition, it is possible to describe the most common characteristics of smart cities as implementing the latest technologies to obtain benefits in a wide range of domains. Technological fields such as device networks, sensing, and information analysis enable smart cities to provide various services. As smart city relates to different fields of services, it brings challenges for smart cities, one of which is information networking. As the information networking towards smart cities should satisfy requirements from heterogeneous services, the metrics on which the information networking based should be able to describe requirements from various services. However, conventional metrics for information networking are insufficient for smart cities because they are quantized in the network layer, and thus they do not always describe requirements for various services. Therefore, information networking that quantifies the important attributes of requirements of various services in the service layer, which is called “importance-aware information networking” in this thesis, is essential for smart cities. This thesis studies three specific problems on information networking for smart cities based on data importance, each of which focuses on a typical application scenario. This thesis consists of six chapters.

Chapter 1 introduces the background of importance-aware information networking towards smart cities.

Chapter 2 introduces the technologies related to this work.

Chapter 3 proposes a system for device sharing based on importance extracted from online social relationships between a device owner and user. For smart city services, users provide sensing ability, computation capacity, or network connectivity of their personal devices to smart city services by sharing their devices with other users. When device owners share the limited resources on their devices, they generally want to reduce their costs when they share their devices with someone who is less socially close to them. The proposed system in this work automatically determines how much resources the user can use by acquiring and evaluating online social relationships between a device owner and user as a metric of the importance of transmitted data among devices. This work presents a prototype implementation and a large-scale simulation using a dataset of a real social network. The results show that the proposed system limits resource usage for guest users who are not as close to the device owners. The overhead of the authentication process in the system does not interfere with the resource sharing with guest users close to the device owners.

Chapter 4 proposes an Internet of Things (IoT) device control system that uses the importance of data to reduce the amount of transmitted data for input of a machine learning model while maintaining prediction accuracy. Predicting real-time spatial information from data collected by mobile IoT devices is one of the most common structures of smart city services. Mobile IoT devices for real-time spatial information prediction generate an extremely high volume of data, making it impossible to collect all of it through mobile networks. Simply reducing the volume of transmitted data does not ensure the prediction accuracy of real-time spatial information. This work presents an IoT device control system that reduces the amount of transmitted data used as input for real-time prediction while maintaining prediction accuracy. In this work, the proposed system is evaluated with a real-world vehicle mobility dataset in two practical scenarios using the random forest model, an extensively used machine

learning model. The results show that the proposed system reduces the amount of transmitted input data for real-time prediction while achieving the same level of prediction accuracy as benchmark methods.

Chapter 5 proposes a framework that periodically updates a machine learning model used to reconstruct the partially collected data by evaluating the importance of the data in terms of both inference and re-training and prioritizing collecting important data. Sparse mobile crowdsensing is a crowdsensing paradigm that reduces the sensing cost while ensuring data quality by collecting data sparsely and reconstructing desired data using inference algorithms, including machine learning algorithms. However, real-time inference of spatial information with sparse mobile crowdsensing has not sufficiently considered the change of the nature of data over time. As a result, the accuracy of the reconstructed data can deteriorate over time. This work presents a framework that periodically updates a machine learning model used for reconstructing data by evaluating the importance of the data in terms of both inference and re-training and prioritizing collecting important data. The evaluation results show that the proposed system with periodical model updates performed better in accuracy than the benchmarks over time.

Finally, Chapter 6 concludes this thesis and discusses the future works to extend this work.