論文 / 著書情報
Article / Book Information

題目(和文)	協調認知を実現するためのSDNに基づくV2Xプラットフォームに関する研究
Title(English)	SDN-Based V2X Platform for Cooperative Perception
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	電気電子 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 (学術) Doctor of
学生氏名： Student's Name	Zongdian LI	指導教員（主）： Academic Supervisor(main)	Kei SAKAGUCHI
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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

Cooperative perception is envisioned as a significant vehicle-to-everything (V2X) application for road safety and automated driving. A comprehensive overview of this application is provided in Chapter 2 of this thesis. To enable cooperative perception which has stringent requirements in communication data rate, latency, and reliability, this thesis integrates software defined networking (SDN) into vehicular networks to utilize the promising but intractable millimeter wave (mmWave) communications.

First and foremost, this thesis presents a fully centralized architecture of SDN-based dynamic mmWave V2X networks in Chapter 3. This architecture introduces three dedicated control functions for mmWave, including context management, access management, and routing management. They are responsible for collecting dynamic mobility information from vehicles, facilitating the association with mmWave access points on roadside units (RSUs), and scheduling multi-hop transmission for sharing raw sensor data, respectively. The prototyping and proof-of-concept experiments are all revealed in the thesis, including a field trial of a common risk scenario (right turn under occluded vision) for vehicles. It demonstrates that the designed and implemented network can support cooperative perception and ensure road safety.

Despite of the advantages of centralization for control, the research of this thesis targets a practical, scalable, and versatile software defined vehicular network (SDVN) platform. Therefore, this thesis presents an enhanced architecture called Het-SDVN in Chapter 4, which introduces hierarchy (local/global C/D-planes) and heterogeneous V2X technologies (at low/high frequencies). The chapter firstly illustrates the design and implementation of a local SDVN framework that empowers RSUs with the capability of network and sensor management for cooperative perception. Then, an integration test of Het-SDVN with real-world infrastructures and equipment is showcased. The Het-SDVN mechanisms which support different types of cooperative perception (detected object-based and raw point clouds-based) and cooperative perception across multiple local SDVNs are verified. The chapter also analyzes the experimental results in detail.

Ultimately, to convince that the proposed Het-SDVN platform has generality and extensibility for other V2X applications, this thesis introduces the delivery of a mobility-aware high-definition (HD) map distribution service for automated vehicles based on the Het-SDVN in Chapter 5. The service request and vehicle mobility information are collected through global C-planes. At the cloud or multi-access edge computing (MEC) servers, map processing takes the mobility information into account. After partition, the HD map is cached to an RSU in proximity to the request vehicle and then distributed through local D-planes when the vehicle approaches. In this chapter, the design, implementation, and proof-of-concept work are presented. It shows that the Het-SDVN organizes expected network resources for map delivery. Most importantly, the test vehicle performs smooth automated driving with the receive HD map.

The main contributions of this thesis are summarized as follows:
(1) A novel SDN-based vehicular network architecture that enables mmWave for cooperative perception.
(2) A hierarchical SDVN capable of managing heterogeneous V2X resources for diverse service requests.
(3) A promising HD map distribution service fostered by the proposed network platform.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).