Contribution ID: **34** Type: **Oral Presentation**

Mitigation of inter-vehicle communication congestion by using visible light communication as an alternative path

Thursday, 27 August 2020 15:00 (20 minutes)

Currently, inter-vehicle communication technology that allow cars to communicate with each other directly is being developed. With this technology established, automobiles will become one of the major infrastructures of society as communication terminals with several sensing abilities and also communication entities that constitutes their own network. In other words, car is no longer just a tool for moving, it acts as a totally new sensor-incorporated communication node that can be scattered and voluntarily moved in various places. They can establish radio communication links with each other to form an automobile network, which is called VANET. Processing data acquired by automobiles at the cloud via VANET will greatly benefit society. For example, processing image data measured by a car to quickly check the state of each region at the time of a disaster, or processing measured traffic data to get a more detailed understanding of domestic traffic conditions.

To provide such a new mechanism using vehicles and the cloud, it is very important to maintain the quality of the communication link between the vehicle and the vehicle or between the vehicle and the cloud. However, as the number of vehicles equipped with inter-vehicle communication increases, the frequency band provided for inter-vehicle communication is expected to be exhausted. To solve this, we considered using not only wireless radio communication but also a visible light path by car headlights. Visible light communication does not cause radio wave interference and has high scalability, so in that respect it was considered the better transmission medium to solve this problem. However, communication quality is unavoidably affected by external noise such as sunlight, heavy fog, and rain. Various technologies have been studied to achieve high performance under these noises, and the technology of visible light communication is improving day by day. Therefore, it takes some time to realize.

In light of this situation, we propose a new method for improving the communication link of VANET that can be fully effective with the current visible light technology. This uses both a visible light path and a wireless path, usually communicates via the visible light path, and automatically switches the traffic flow to the wireless path when it detects a decrease in the communication quality of the visible light path. In addition, better traffic allocation is performed in consideration of the traffic volume required by in-vehicle applications and the current communication quality. In other words, by actively using the visible light path as much as possible, it is possible to avoid wasted bandwidth while maintaining throughput. By doing this, it prevents radio interference to other vehicles and improves the quality of the entire automobile network formed by vehicles in the area.

We implemented the proposed method and conducted simulations to evaluate its effectiveness. Specifically, we confirmed whether throughput can be maintained even when vehicle density is high and wireless communication quality is degraded by radio wave interference. In addition, we confirmed whether it is possible to prevent waste of frequency resources by effectively using the visible light path.

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Session Classification: Network, Security, Infrastructure & Operations Session

Track Classification: Network, Security, Infrastructure & Operations