Communicating via Connected Cars in the Event of a Natural Disaster

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1. Introduction

In October 2018, the Recommendation "Specification Information and Communication System using Vehicle during Disaster" was approved at a management session of the APT (Asia-Pacific Telecommunity) in Ulaanbaatar, Mongolia. This standard, which is referred to as V-HUB (Vehicle HUB), is mainly the work of the TTC Connected Car Expert Committee, and the studies leading towards its standardization were led by ASTAP (Asia-Pacific Telecommunity Standardization Program).

This article introduces the aims of V-HUB standardization, and describes the background, outline and use cases of this technology. Future standardization plans, including the collection of traffic accident information, are also discussed.

2. Background of the V-HUB study

In the Great East Japan Earthquake, which occurred in the Tohoku region on March 11, 2011, large areas of Japan's communication network were put out of action, hampering efforts to rescue victims and implement recovery activities. It is reckoned that this caused a reduction of 20–30% in the rate at which people were rescued during the 72-hour period following the disaster. To learn from this experience, countries, carriers and vendors have studied ways of rapidly setting up network functions in the aftermath of a disaster, and have conducted several verification trials.

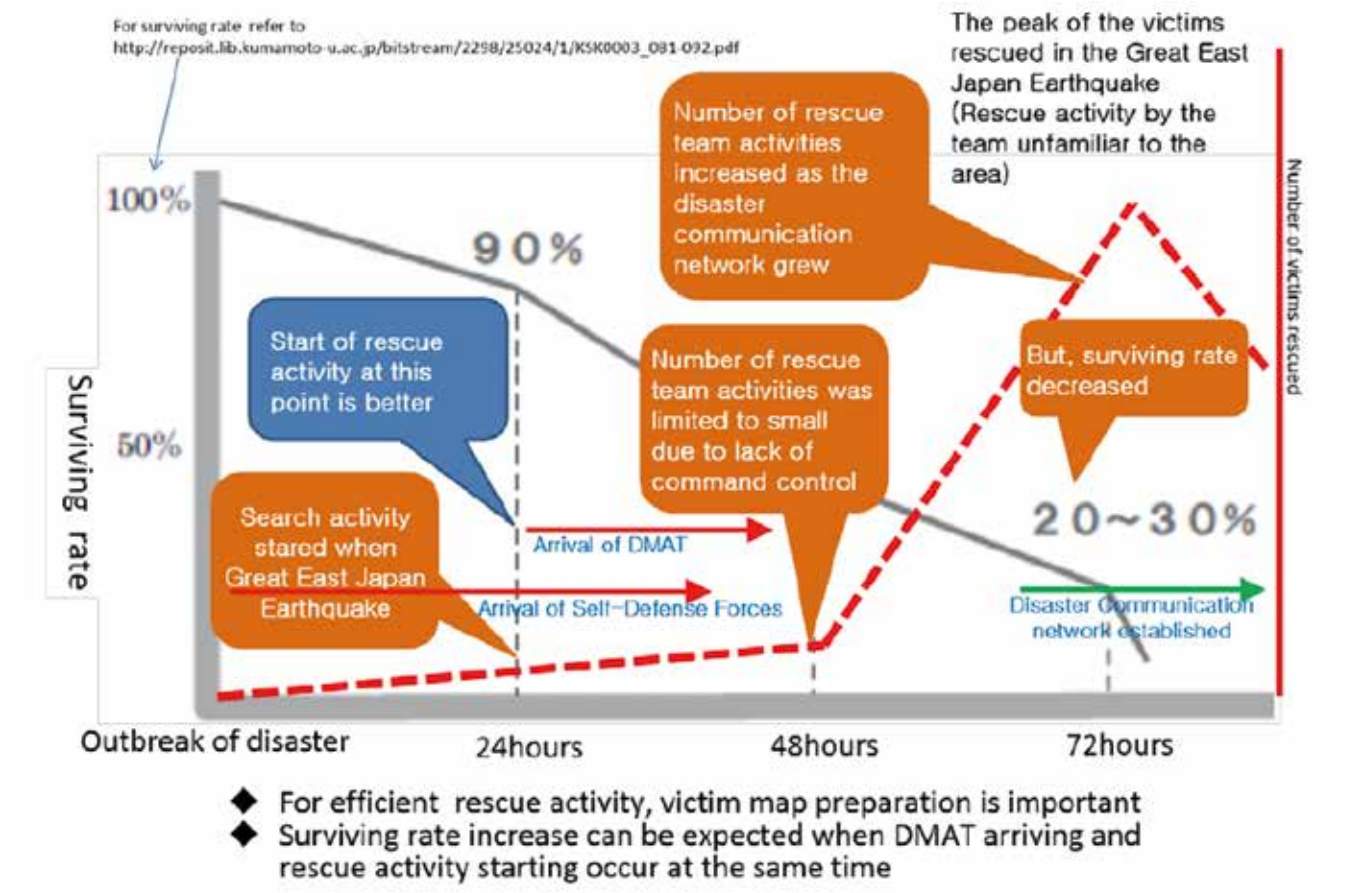
In the TTC Connected Car Expert Committee, organizations including Toyota InfoTechnology Center, the National Institute of Information and Communications Technology (NICT), Keio University and Oki Electric Industry conducted a survey of verification trials both in Japan and abroad on the use of vehicles to establish communication systems in the event of a disaster. In 2014, they presented their use case report (APT/ASTAP/REPT-21) to ASTAP and proposed the standardization of V-HUB specifications to the Expert Group on Disaster Risk Management and Relief System (EG-DRMRS).

After holding workshops and other discussion events involving other Asian countries over a period of five years, an agreement was reached between 15 Asian countries in 2018, resulting in an APT Recommendation on Standard Specification Information and Communication System using Vehicle during Disaster (APT/ASTAP/REC-02).

3. Overview of V-HUB

V-HUB provides a communication interface that allows the on-board communication equipment in road vehicles to be used to establish a temporary telecommunication network for geographical regions or organizations that have become unable to use ordinary networks due to large-scale natural disasters or the like. It is envisaged that this V-HUB technology could be used for purposes such sharing information about the location and condition of people in need of assistance so that search and rescue teams in the local area can coordinate their efforts more effectively, gathering information such as the condition of evacuees and the needs of evacuation shelters in regions where communications have been cut off, and sharing information about local or national government organizations that may be able to operate communication infrastructure. Instead of standardizing a new means of communication, V-HUB works by using existing communication technology. For example, it defines how ITS 700-MHz radio beacons, 5.8-GHz DSRC systems, Wi-Fi, and

Figure 1: Reduction of emergency rescue rate in the aftermath of a disaster

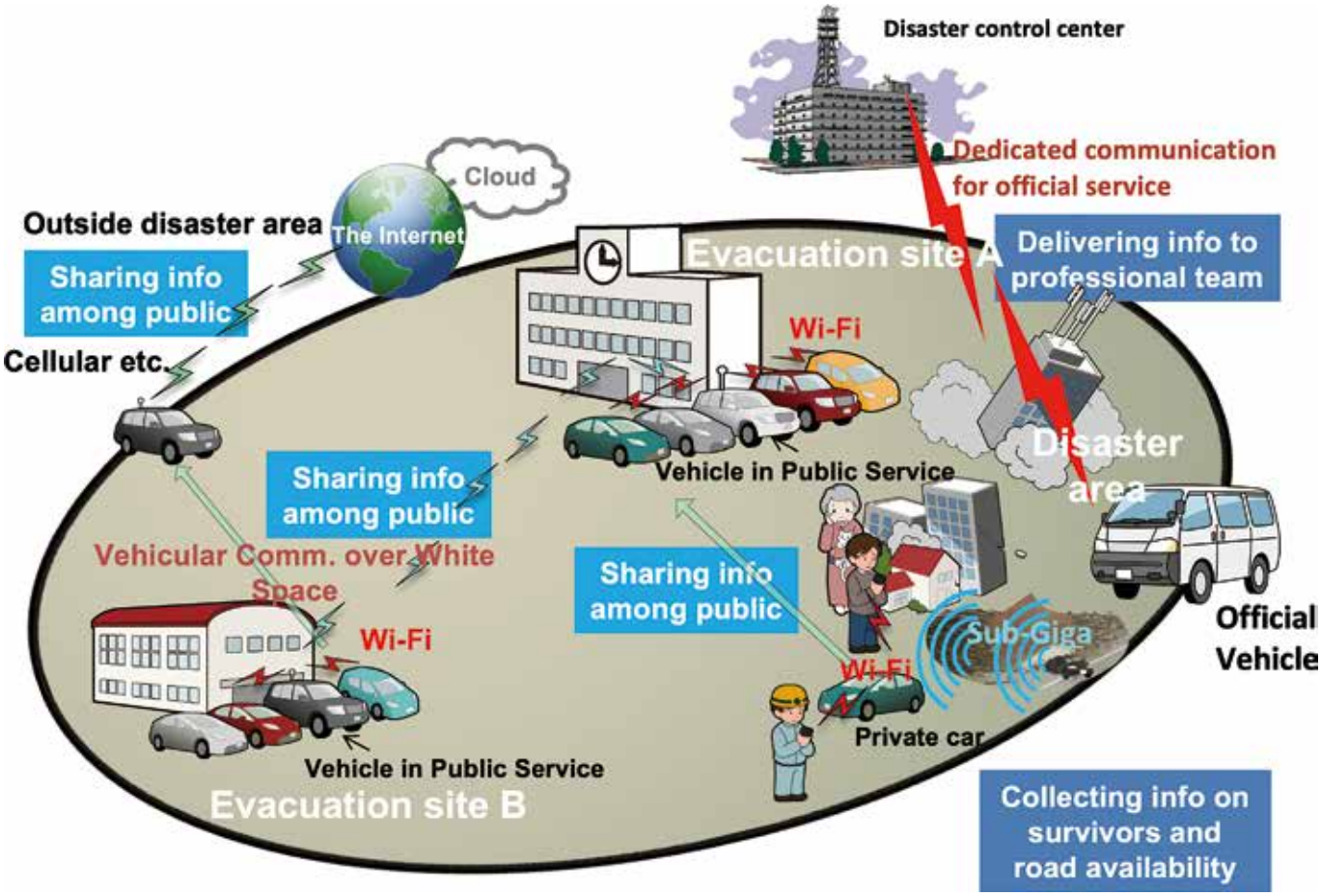


terrestrial digital communication (white space) technology can be used in the event of a disaster.

When V-HUB gathers information about disaster victims, it uses ITS V2P (vehicle-to-pedestrian) communication in the 700 MHz band, which will normally be used for reducing accidents involving pedestrians. V2P terminals carried by victims can if necessary transmit rescue request information (such as the victim's location and vital signs), which is picked up by the V-HUB of a nearby vehicle. The V-HUB uses a wireless interface such as Wi-Fi to share this information with other V-HUBs, and when this information has traveled far enough to reach the system of a rescue team in the local area, the victim's rescue request information is conveyed to the rescue team's system. Safety information and evacuation center information (required resources, required medical support information, etc.) from evacuees in areas where traditional means of communication are broken can also be shared between V-HUBs and transmitted to local and national government rescue centers. Information can be shared between V-HUBs in various ways, such as constructing a network by relaying radio signals (multi-hop connection), using DTN (delay/disruption tolerant networking) to transmit information between vehicles as they pass one another, and using white space in the terrestrial digital spectrum. These methods can be flexibly selected and even combined simultaneously to suit the current circumstances.

Since V-HUB only transfers information when it is possible to do so, it is inherently subject to delays to some extent. Thus, although it works well with non-real-time applications like text messaging, it cannot be used for real-time applications like phone calls. In addition, since there are currently limits on available radio bandwidth and transmission rate, it is more suited to the exchange of information via text messages than via video content. However, if high-bandwidth communication methods such as millimeter-wave communication become available in the future, then it may also be possible to transmit high-bandwidth data.

Figure 2: V-HUB use cases



4. Future work

To put V-HUB into practical use, it will be necessary to promote its use at disaster-affected sites, and to formulate guidelines for their use. We hope to achieve this by working together with government agencies and organizations.

Efforts should also be made to promote the use of V-HUB in ordinary situations. In 2015, the United Nations announced that it was setting Sustainable Development Goals (SDGs), including a 50% reduction in traffic fatalities, and in recent years the reduction of traffic accidents has become an important social issue across Asia. We intend to work towards establishing V-HUB as a social problem-solving method that is capable of solving these issues. To reduce traffic fatalities, it is essential to be able to identify where and how accidents have occurred. Most Asian countries do not yet implement adequate digital accident record creation and data analysis. For this reason, we proposed ASTAP for the standardization of traffic accident records and data analysis methods in Asia, and our proposal was approved. In the future, we plan to cooperate with traffic accident reduction initiatives across Asia, and to promote the use of V-HUB in ordinary situations.

5. Conclusion

The next ASTAP Meeting (ASTAP-31) will take place in Japan in June 2019. At the Industry Workshop that is due to be held at ASTAP-31, we will set up a panel display to explain the background and outline of the V-HUB APT Recommendation, and the development and verification status of communication equipment and applications that use it. We hope that many people will learn about the efforts being made to promote V-HUB, and we also hope to reduce the damaging effects of natural disasters in Asia as much as possible. Finally, we would like to express our gratitude to the many people involved in the V-HUB review and standardization process.

Reference
TTC Report, January 2019: Introduction to the Activities of the Connected Car Expert Committee — "APT Recommendation for V-HUB Systems: Standardization of communication systems using road vehicles in disaster situations across Asia" (in Japanese)