Chapter 1
Introduction of Vehicular Network Architectures

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ABSTRACT

A vehicular network organizes and connects vehicles with each other, and with mobile and fixed-locations resources. This chapter discusses the architectures in the vehicular network environment. The authors introduce the overview of in-vehicle and out-vehicle network architectures. An automobile in an in-vehicle network adopts four vehicle bus protocols, CAN (Controller Area Network), LIN (Local Interconnect Network), MOST (Media Oriented Systems Transport) and FlexRay. However, these protocols cannot intercommunicate with each other. Therefore, the OSEK operating system is designed as standard software architecture for the various ECUs (Electronic Control Units). In the out-vehicle network, the OBU (On Board Unit) in the automobile can communicate with the infrastructure via the Internet. The authors discuss next-generation vehicular network architecture, the modern in-vehicle networks, on-board computers and the Internet, mobile telecommunications and telematics applications in the ground vehicles, and finally, we introduce future desired features. This chapter discusses the architectures in vehicular network environment. The first section introduces the overview of in-vehicle and out-vehicle network architectures. The next section describes in-vehicle network architecture for disaster communication network by combining various automotive bus protocols. The third section describes the out-vehicle network architecture for disaster communication network by combining various wireless LANs. The last section discusses next-generation vehicular network architecture, the modern in-vehicle networks, on-board computers and the Internet, mobile telecommunications and telematics applications in the ground vehicles, and introduces future desired features.

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INTRODUCTION

A vehicular network organizes and connects vehicles with each other, and with mobile and fixed-locations resources (Wu et al., 2005). Many telematics architectures, including navigation services architecture, traffic information architecture, location-based services architecture, entertainment services architecture, emergency and safety services architecture have been provided. In these architectures, traffic information and navigation services are generally provided by central TSPs (Telematics Service Providers). Emergency and safety services are supplied by an on-board platform, which is likely to be installed by the individual car manufacturers.

In contrast to these conventionally adopted architectures, telematics architectures are rarely applied in public local hotspots such as public parking lots, hotels, restaurants, airports and shopping centers. In local hot-spot architecture, a vehicle is considered as an alternative mobile computing platform (logically equivalent to a PDA, laptop or a cellular phone) with short-range localized WLAN (Wireless LAN) devices such as Bluetooth and Wi-Fi. This local (hot-spot) architecture allows the car driver to interact with many local services. Telematics architectures will be useful for telematics services only for vehicles providing traditional services such as traffic information, navigation services provided by the central TSP, and local services provided by distributed third-party service providers that can supply the appropriate contextual data. For instance, consider a driver wishing to drive a car to a convention center. The driver initially finds routes to the center using a navigator, then selects a route free from traffic jam based on traffic information from a TSP. The car automatically discovers the resources of the convention center, obtains directions to the designated parking lot, and makes associated payments using the WLAN communication, as it enters the premises. The driver can obtain various local services provided by the convention center even before stepping out of the car.

Current telematics systems depend on mobile infrastructures to deliver telematics services to service users. Therefore, deploying a telematics service between mobile networks it is a very expensive task. System developers need to have strong knowledge about the underlying mobile network. Additionally, a telematics terminal cannot be applied for the telematics service from another telematics service provider, since telematics service developers devise their own protocols between telematics terminals and a service provider.

Figure 1 shows an overview of in-vehicle network architecture and out-vehicle network architecture. An automobile in an in-vehicle network adopts four vehicle bus protocols, CAN (Controller Area Network), LIN (Local Interconnect Network), MOST (Media Oriented Systems Transport) and FlexRay. However, these protocols cannot intercommunicate with each other. Therefore, the OSEK operating system was designed as standard software architecture for the various ECUs (Electronic Control Units). In the out-vehicle network, the OBU (On Board Unit) in the automobile can communicate with the infrastructure via the Internet. The remote home service and remote vehicular service providers provide particular services to an automotive user. The in-vehicle and out-vehicle network architectures are discussed in detail in the next two sections.

IN-VEHICLE NETWORK ARCHITECTURE

This section introduces an in-vehicle network architecture for disaster communication network that combine different automotive bus protocols, namely Controller Area Network (CAN), Local Interconnect Network (LIN) and the recently developed FlexRay protocol standard. Moreover, the OSEK/VDX operating system, a joint project