Chapter V
Enabling Secure Wireless Real-Time Vehicle Monitoring and Control

Lek Heng Ngoh
Institute for Infocomm Research, A*STAR, Singapore

ABSTRACT

The use of in-car networked electronic controller units (ECUs) for monitoring and control of various vehicle subsystems has become a common practice among the automotive manufacturers. In this chapter, the author surveys one of the most popular in-car networking technologies, the Controller Area Network (CAN), as well as newer and emerging in-car network technologies called FlexRay and Media-Oriented System Transport (MOST). Currently, these networks are deployed for in-car applications such as engine diagnostics, and infotainment systems. In this chapter, however, the author extends the use of these embedded vehicular networks by proposing to remotely monitor and control the vehicles through them, in order to realize safety and driver assistance related applications. To accomplish this task, additional technologies such as real-time wireless communications and data security are required, and each of them is introduced and described in this chapter.

INTRODUCTION

In this chapter we present the increasingly important technological advances in a networked vehicle and the related technologies in achieving secure wireless real-time monitoring and control of these vehicles. As more electronics found their way into the vehicle, the ability to remotely gather and send information from and to the on-road vehicles opens up many application opportunities in the effort to make future vehicles safer (both the drivers and road users), more economical, more fun (e.g. multimedia entertainment) and last but not least, to simplify the often mammoth tasks of traffic management and road maintenance. However, for this vision to become a reality technology
development must take place on several fronts. This chapter attempts to present an overview and analysis of these key technical components.

The chapter is organized as follows. We begin by elaborating the controller area network (CAN) standard which is the most widely deployed in-vehicle network system. Our description includes an overview of the CAN technology (Section III), its deployment in a vehicle (Sections IV and V). The above is followed by a description of the various CAN-based car telematic applications (Section VI). A brief introduction is given in Section VII on other networking standards that are currently deployed in vehicles. In Sections VIII and IX, we elaborate two key components in achieving remote vehicle monitoring and control, namely the wireless communication component and data security component. In Section X, we present an overall architecture of the secure wireless real-time vehicle monitoring and control environment. Finally, in Sections XI and XII, we discuss some possible future trends in this field and conclude this chapter.

II. BACKGROUND

The Controller Area Network (CAN) (CiA, 2008; Audi CAN-bus, 1998) is a serial bus communications protocol developed by Bosch in around 1983. CAN is a standard suitable for efficient and reliable communication between sensors, actuators, controller, and other nodes in real-time applications. Since then, CAN has evolved to become the de facto low-cost standard in a large variety of networked embedded control systems. Many of the early deployments of CAN are found in automotive vehicles. To-date, however, CAN has been used in a variety of application domains such as transportation (e.g. trains), manufacturing (e.g. process automation), construction (e.g. structural monitoring), agriculture (e.g. agriculture equipment), healthcare (e.g. medical devices), entertainment (e.g. arcade game machine), and even in the control of scientific apparatus (e.g. proton accelerators). In this chapter, however, we will only focus on applications of CAN within the automotive vehicles (see Figure 1).

In 2007, it is estimated that sale of vehicular CAN nodes has reached more than 600 million each year (Johansson, K.H., Törngren M., & Nielsen L., 2005). Looking ahead, the number of CAN nodes deployed in automotive vehicles is expected to increase substantially as by 2008, all new vehicles sold in the US will be required to be CAN-compliant, in particular, all new vehicles are to equip with CAN-based diagnostic system. Moving forward, the number of automotive manufacturers adopting CAN for in-vehicle embedded data communications and control is expected to increase as more Japanese models have started to adopt CAN-based technologies which are relatively low-cost and a well-established standard.

Figure 1. CAN Replaces traditional mesh wiring in a vehicle

Without CAN Bus

With CAN Bus
Related Content

Characterization and Coarsening of Autonomous System Networks: Measuring and Simplifying the Internet
www.igi-global.com/chapter/characterization-and-coarsening-of-autonomous-system-networks/149418?camid=4v1a

An Exploration of the Critical Need for Formal Training in Leadership for Cybersecurity and Technology Management Professionals
www.igi-global.com/article/an-exploration-of-the-critical-need-for-formal-training-in-leadership-for-cybersecurity-and-technology-management-professionals/210628?camid=4v1a

Building IoT With Arduino
www.igi-global.com/chapter/building-iot-with-arduino/179789?camid=4v1a

Wireless Communications: Is the Future Playing Out as Predicted?
www.igi-global.com/chapter/wireless-communications-future-playing-out/49731?camid=4v1a