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A Validation Tool for Cooperative Intelligent Transport Systems

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Abstract

This paper aims to present a set of tools that could be used in order to check the conformance of an Intelligent Transport System. These tools will consider each ITS component, i.e. C-ITS-R Road Side Units (RSU), C-ITS-V On-Board Unit (OBU), C-ITS-C (Central Server) with their specific features as location precision for an OBU and adequate forwarding of security events for an RSU.

We first tackle in this study the conformance testing aspect for each component (in fact a C-ITS component has to respect all the basic specifications) before checking the interoperability of all components (in order to ensure a correct functioning when they work together). Basic specifications have been mainly described by standardization institutes as ETSI or IEEE. But some additional specifications could be considered for particular purposes (for example, car manufacturers do not all agree on the pertinent moment to inform drivers on next hazardous events).

This framework has been experimented with various RSUs and OBUs from different providers and many troubles have been detected. Most of the bugs are due to a wrong interpretation of specifications. But, in some other cases, troubles reveal that specifications have been proposed with incorrect behaviors. The main conclusion is that such frameworks have to be improved and deployed widely in order to facilitate the deployment of large scale Intelligent Transport Systems.

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Keywords: C-ITS, Validation, Formal Testing, Networking, TTCN-3, Evaluation.

1. Introduction

Since the last decade, vehicular networks attract many academia and industry laboratories. The development of such networks has permitted the development of C-ITS (Cooperative-Intelligent Transport Systems). Such networks take advantage of V2X communications composed of Vehicle-to-Vehicle communications (V2V) and Vehicle-to-Infrastructure communications (V2I). Road operators have to manage the infrastructure part which is composed of various RSUs connected to traffic management centers through a C-ITS-C.

The European Telecommunications Standards Institute (ETSI) [1] has defined basic specifications for communication to be respected by RSUs and OBUs. All involved communication layers have been described from lower layers (ITS-G5) to upper layers (Network layer with geo-networking; Transport layer with Basic Transport Layer (BTP) and higher layer (under the application layer) called Facilities layer.

Similar specifications have been defined in the USA and the US department of transportation is very active for rapid deployment of connected vehicles over the USA. A very close collaboration has been undertaken to merge european standards with US standards. From all recent experimentations, we conclude that C-ITS deployment is still

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