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Next Generation Networks – Service aspects:
Interoperability of services and networks in NGN

Framework of networked vehicle services and applications using NGN

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Recommendation ITU-T Y.2281

Framework of networked vehicle services and applications using NGN

Summary

This Recommendation describes the framework of networked vehicle services and applications in the context of next generation network (NGN). This Recommendation identifies the relationship between NGN and a networked vehicle as well as requirements taking into consideration the necessity of supporting networked vehicle services and applications using NGN. In addition, a framework architecture of NGN capable networked vehicle and intelligent transport systems (ITS) infrastructure is described to support the communication features of an NGN harmonized with the networked vehicle.

Keywords

NGN, ITS, Networked Vehicle, Vehicle communication

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Introduction

Vehicle is one of the important components utilising network capabilities in terms of vehicle to infrastructure (V2I), vehicle to vehicle (V2V) and vehicle to home (V2H) communications. In that context, networked vehicle can cooperate with next generation networks (NGNs) to support more advanced services and applications such as road safety applications, road traffic related applications, multimedia services and location-based implementation of these services.

1 Scope

This Recommendation describes a framework of networked vehicle services and applications assuming operation in an area where telecommunication services are provided by NGN. This Recommendation identifies features and requirements for the provision of networked vehicle services and applications using NGN. This Recommendation also provides a framework architecture to support these features and requirements.

2 References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-R M.1453-2]

ITU-R Recommendation M.1453(2005), *Dedicated short range communication (DRSC) at 5.8GHz*

[ITU-R M.1457-9]

ITU-R Recommendation M.1547-9 (2010), *Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)*

[ITU-T Y.2012]

ITU-T Recommendation Y.2012 (2010), *Functional requirements and architecture of the NGN*

[ITU-T Y.2201]

ITU-T Recommendation Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*

[ITU-T Y.2291]

ITU-T Recommendation Y.2291 (2011), *Architecture overview of Next Generation Home networks*

[ITU-T Y.2701]

ITU-T Recommendation Y.2701 (2007), *Security requirements for NGN release 1*

[ITU-T Y.2702]	ITU-T Recommendation Y.2702 (2008), <i>Authentication and authorization requirements for NGN release 1</i>
[ETSI EN 302 665 v1.0.0]	ETSI EN 302 665 (2010), <i>Intelligent Transport System Communication Architecture</i>

3 Definitions

3.1 Terms defined elsewhere:

This Recommendation uses the following terms defined elsewhere:

3.1.1 functional entity [ITU-T Y.2012] : An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.2 intelligent transport systems (ITS) [b-ITU-R handbook]: ITS can be defined as systems utilizing the combination of computers, communications, positioning and automation technologies to improve the safety, management and efficiency of terrestrial transport systems.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 infrastructure: The basic facilities and systems comprised of network nodes (i.e. switches and/or routers) and means to connect them (i.e. wired (cable or fibre) or wireless) for the purpose of communication between two end-points.

3.2.2 networked vehicle: A vehicle capable of providing communication between entities within the vehicle as well as between entities within the vehicle and ITS infrastructure or other communication networks such as NGN using various access technologies.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ABS	Automatic Break System
AM	Amplitude Modulation
ANI	Application to Network Interface
API	Application Programming Interface
CALM	Communication Access to Land Mobile
DMB	Digital Multimedia Broadcasting
DRM	Digital Rights Management
DSRC	Dedicated Short-Range Communications
DVB-T	Digital Video Broadcasting - Terrestrial
DVD	Digital Versatile Disc
ECM	Engine Control Module
ECU	Electronic Control Unit
FM	Frequency Modulation
FMC	Fixed Mobile Convergence

GNSS	Global Navigation Satellite System
GPS	Global Positioning System
H2V	Home to Vehicle
ICT	Information and Communication Technologies
IMT	International Mobile Telecommunications
ISDN	Integrated Services Digital Network
ITS	Intelligent Transport Systems
IVN	In-Vehicle Network
MAC	Media Access Control
MM	Multifunction Mobile
MP3	Moving Picture 3 (digital audio format)
NAPT	Network Address Port Translation
NAT	Network Address Translation
NGN	Next Generation Network
NNI	Network to Network Interface
OBD	On Board Diagnostics
OBU	On Board Unit
OEM	Original Equipment Manufacturer
PDA	Personal Digital Assistant
PSTN	Public Switched Telephone Network
QoE	Quality of Experience
QoS	Quality of Service
RFID	Radio Frequency Identification
RTK	Real-Time Kinematic
SMS	Short Message Service
SNI	Server to Network Interface
SNMP	Simple Network Management Protocol
SP	Service Platform
SPI	Service Programming Interface
SRC	Seamless Radio Connectivity
TCM	Transmission Control Module
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UNI	User to Network Interface
USB	Universal Serial Bus
UWB	Ultra-Wideband

V2G	Vehicle to Grid
V2H	Vehicle to Home
V2I	Vehicle to Infrastructure
V2I2V	Vehicle to Infrastructure to Vehicle
V2V	Vehicle to Vehicle
VGP	Vehicle Gateway Platform
VoD	Video on Demand
VPN	Virtual Private Network
WLAN	Wireless Local Area Network

5 Conventions

In this Recommendation, the “I” in the keywords “V2I” and “V2I2V” stands for ITS infrastructure.

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation can still be claimed even if this requirement is present.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 High level view of networked vehicle

Intelligent transport systems (ITS) provide capabilities, using information and communication technologies (ICT), to support safe and efficient use of transport infrastructure and transport means (e.g. car, train, plane or ship) for transportation of goods and humans.

A vehicle (i.e. bus, car, lorry (truck,) or van) which is one of the most dominant means of transportation is either moving or stationary.

A moving vehicle requires various capabilities including the support of networked vehicle services and applications such as road safety, traffic status, automatic toll road billing and emergency information. The support of such networked vehicle services and applications normally requires the use of communication capabilities supported by telecommunication infrastructures such as NGN, dedicated short-range communication (DSRC) [ITU-R M.1453-2] or IMT-2000 [ITU-R M.1457-9]. Considering the importance of such communications to/from a networked vehicle, QoS/QoE, security and mobility, together with other factors, should be supported by the above mentioned networking infrastructures.

A stationary vehicle requires, from time-to-time, static operation such as maintenance and/or upgrade of devices. While in a stationary mode, networked vehicle communication generally needs support from residential home networks (e.g. that of the vehicle owner) and/or other networks (e.g. that of a repair workshop).

Thus, key features of NGN such as fixed mobile convergence (FMC) support providing QoS and security play an important role. Figure 6-1 shows a high level conceptual view of relationship between a networked vehicle and external networks using NGN capabilities. In this figure, a networked vehicle is composed of personal devices and on-board equipments, etc. Roadside station and central station (e.g. traffic information centre) are examples of elements within ITS infrastructure.

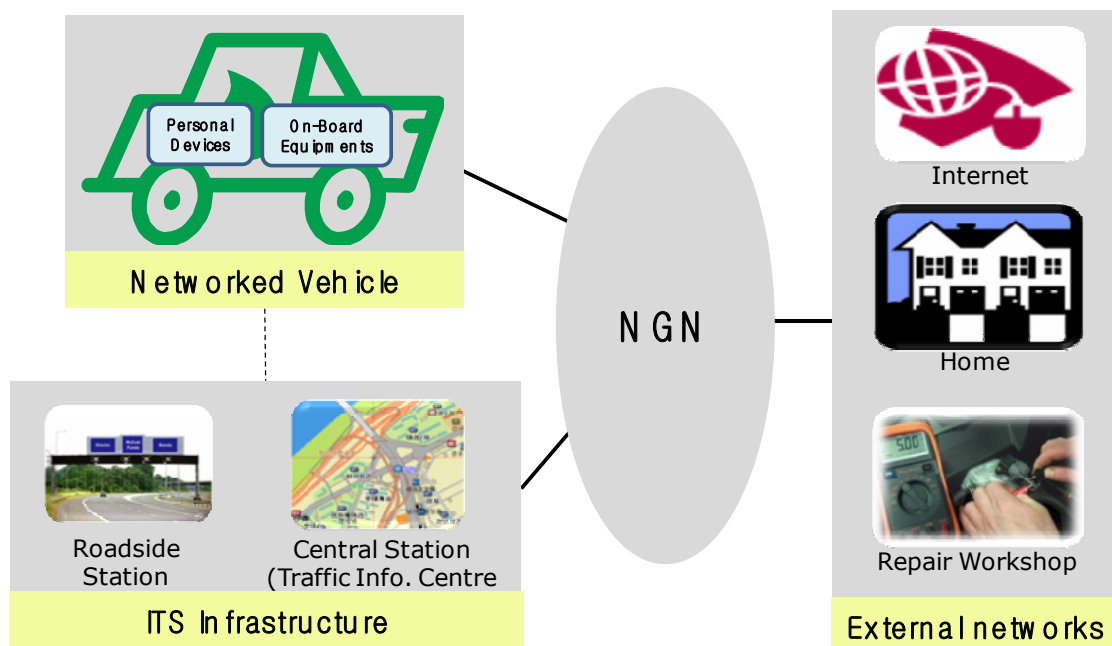


Figure 6-1: High level view of networked vehicle using NGN capabilities

7 Services and communication features of networked vehicle

7.1 Networked vehicle services and applications

From the service and application aspects related to networked vehicle, the following perspective can be considered:

- 1) **Vehicle maintenance oriented services/applications (SA-1):** The primary objective of these services/applications is the management of the vehicle itself. Possible vehicle management oriented services/applications include:
 - Remote vehicle diagnosis: This service/application supports the remote monitoring of the vehicle status based on the status of relevant vehicle devices and management of internally controlled and monitored diagnostics. Security and privacy protection of remotely monitored vehicle information is recommended to be ensured.
 - Vehicle data/software provisioning and update
- 2) **Road safety services/applications (SA-2):** The primary objective of these services/applications is the improvement of road safety. However, it is recognized that in improving road safety these services/applications may offer secondary benefits which are