

Recommendation

ITU-T H.552 (04/2024)

SERIES H: Audiovisual and multimedia systems

Vehicular gateways and intelligent transportation systems (ITS) – Architecture for vehicular gateways

Implementation of vehicle multimedia systems

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Audiovisual and multimedia systems

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Recommendation ITU-T H.552

Implementation of vehicle multimedia systems

Summary

Recommendation ITU-T H.552 specifies essential requirements for the implementation of vehicle multimedia systems (VMSs), addressing four of their main aspects:

- connectivity, providing essential standard references and specific performance requirements for the vehicular environment;
- human machine interface, dealing with voice assistant (VA) and auditory interaction requirements;
- media format and control, providing standard references for different types of media for VMSs;
- smartphone infotainment assistant, with requirements related to the interface architecture between smartphones and VMSs, as well as performance requirements to provide a fair level of user experience.

Two appendices provide VMS implementation guidance:

- radio frequency performance criteria for wireless local area network (WLAN) and user performance testing scenarios for WLAN and wireless personal area network connectivity;
- implementation of a diagnostic interface for tuning the VA functionalities.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
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Keywords

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Recommendation ITU-T H.552

Implementation of vehicle multimedia systems

1 Scope

This Recommendation specifies requirements relevant to the implementation of vehicle multimedia system (VMS) functionalities in vehicles, with a focus on connectivity, human machine interface and especially voice assistant (VA) and auditory interaction, media format and control, and smartphone convergence.

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-T F.749.3] Recommendation ITU-T F.749.3 (2020), *Use cases and requirements for vehicular multimedia networks*.

[BT-CoreSpec_5.4] Bluetooth (2023), *Bluetooth core specification*, version 5.4. Available [viewed 2023-11-27] at: <https://www.bluetooth.com/specifications/core54-html/>

[IEEE 802.11ax] IEEE 802.11ax-2021, *IEEE Standard for information technology – Telecommunications and information exchange between systems local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN medium access control (MAC) and physical layer (PHY) specifications – Amendment 1: Enhancements for high-efficiency WLAN*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 vehicle multimedia system (VMS) [ITU-T F.749.3]: The VMS consists of vehicle multimedia system inputs (VM I/P), vehicle multimedia unit (VMU) and vehicle multimedia system outputs (VM O/P).

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 smartphone: A mobile telephone, having the capabilities to connect to cellular networks, for providing functionalities or applications, at least call and text messaging, and optionally navigation, video call, playing media.

NOTE – A smartphone can be connected to a vehicle multimedia system (VMS) with short-range communications, for performing its functions or applications under the control of the VMS.

3.2.2 typer: A software agent that manages alerts, notifications or responses for the user of the voice assistant, and which provides text input for the speech synthesis engine (text-to-speech).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

2D	two Dimensional
aacPlus	enhanced advanced audio coding
ALS	Application Layer Service
AMR-WB	Adaptive Multi-Rate Wideband
API	Application Programming Interface
ASR	Automatic Speech Recognition
BER	Bit Error Ratio
CAN	Controller Area Network
CANFD	Controller Area Network with Flexible Data rate
DASH	Dynamic Adaptive Streaming over Hypertext transfer protocol
DC	Discovery Connection
DEVM	Differential Error Vector Magnitude
DI	Diagnostic Interface
DMIPS	Dhrystone Million Instructions Executed Per Second
DV	Device Virtualization
DVB	Digital Video Broadcasting
EDR	Enhanced Data Rate
HF	Hands Free
I/O	Input/Output
I/P	Input
IP	Internet Protocol
MBMS	Multimedia Broadcast or Multicast Service
MPEG	Moving Picture Experts Group
MT	Masking Threshold
NLG	Natural Language Generation
NLU	Natural Language Understanding
NM	Network Management
NR	Noise Reduction
OEM	Original Equipment Manufacturer
O/P	Output
PHY	Physical Layer
PoI	Point of Interest
ppm	parts per million
QoS	Quality of Service
RF	Radio Frequency

rms	root mean square
RNN	Recurrent Neural Network
SOME/IP	Scalable service-Oriented Middleware over Internet Protocol
SSML	Speech Synthesis Mark-up Language
STP	Shielded Twisted Pair
SW	Software
TTS	Text To Speech
UDS	Unified Diagnostic Service
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair
VA	Voice Assistant
VM	Vehicle Multimedia
VMS	Vehicle Multimedia System
VMU	Vehicle Multimedia Unit
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network

5 Conventions

The phrase "is required" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

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

The phrase "is permitted to" is used to indicate a course of action permissible within the limits of this Recommendation.

The phrase "can optionally" indicates an optional requirement that 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 or service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

In the body of this Recommendation and its annexes, the words *shall*, *shall not*, *should*, and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or auxiliary verbs in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 Technical requirements for the implementation of vehicle multimedia systems

6.1 Connectivity

6.1.1 WLAN

6.1.1.1 WLAN protocols

It is required that the VMS support a wireless local area network (WLAN), for connecting the VMS to WLAN access points or smartphones.

To ensure fair compatibility with a wide range of WLAN devices, it is recommended that the VMS support [IEEE 802.11ax]. To ensure fair integration conditions for different models of vehicles, VMS may use [b-IEEE 802.11ac] or [b-IEEE 802.11n].

6.1.1.2 WLAN RF performance

It is recommended that the VMS apply the radio frequency (RF) performance criteria listed in Table 1, which is based on [IEEE 802.11ax] and the vehicle-operating environment.

When supporting [b-IEEE 802.11ac] or [b-IEEE 802.11n], the VMS may apply the RF performance requirements in Tables I.1 and I.2.

Table 1 – WLAN RF performance – [IEEE 802.11ax]

Item	Data rate	Channel spacing (MHz)	Lower limit	Upper limit	Unit
Transmit power	MCS11	80	6	20	dBm
		160			
Transmitter constellation error	MCS11	80	N/A	−35	dB
		160			
Transmit centre frequency leakage	MCS11	80	N/A	−20	dB
		160			
Transmit centre frequency tolerance	MCS11	80	−20	20	Parts per million (ppm)
		160			
Receiver minimum input sensitivity	MCS11	80	N/A	−52	dBm
		160	N/A	−49	
Receiver maximum input level	MCS11	80	−20	N/A	dBm
		160			

6.1.1.3 WLAN user performance

It is recommended that VMSs meet the user performance criteria listed in Table 2. The corresponding detailed test conditions are listed in Table I.3.

Table 2 – WLAN user performance

Performance item	Description	Value
Connection success rate	Minimum WLAN connection establishment success rate	90%
Connection stability	Minimum time without WLAN disconnection	4 h
Transmission rate	Minimum WLAN downlink transmission rate	20 Mbit/s

6.1.2 WPAN

6.1.2.1 WPAN protocol

It is recommended that the VMSs support a wireless personal area network (WPAN) communication protocol based on [BT-CoreSpec_5.4].

6.1.2.2 WPAN RF performance

It is recommended that the WPAN RF performance criteria listed in Table 3 be applied, based on [BT-CoreSpec_5.4].

Table 3 – WPAN RF performance criteria

Category	Item	Condition	Packet type	Lower limit	Upper limit	Unit
RF transmitting performance	Output power	Normal connection	DH5	0	10	dBm
	Power density	Normal connection	DH5	N/A	20	dBm
	power control	Normal connection	DH5	2	8	dB
	TX output spectrum-frequency range	Normal connection	DH5	2.4	2.4835	GHz
	TX output spectrum –20 dB channel spacing	Normal connection	DH5	N/A	1	MHz
	Modulation characteristics	$\Delta f_{1,avg}$	DH5	140	175	kHz
		$\Delta f_{2,max}$	DH5	115	N/A	kHz
		$\Delta f_{2,max}$ passage	DH5	99.9	N/A	%
		Min $\Delta f_{2,avg}/\Delta f_{1,avg}$	DH5	0.8	N/A	N/A
	Carrier frequency drift	Drift	DH1	–25	25	kHz
		Drift rate/50 μ s		–20	20	kHz
		Max rate		N/A	20	kHz
		Drift	DH3	–40	40	kHz
		Drift rate/50 μ s		–20	20	kHz
		Max rate		N/A	20	kHz
		Drift	DH5	–40	40	kHz
		Drift rate/50 μ s		–20	20	kHz
		Max rate		N/A	20	kHz
	Enhanced data rate (EDR) relative transmit power	Normal connection	2-DH5	–4	1	dB
		Normal connection	3-DH5	–4	1	dB
	EDR carrier frequency stability and modulation accuracy	Carrier frequency stability, ω_i	2-DH5	–75	75	kHz
		Carrier frequency stability, $\omega_i + \omega_0$	2-DH5	–75	75	kHz
		Carrier frequency stability, ω_0	2-DH5	–10	10	kHz
		Carrier frequency stability, ω_i	3-DH5	–75	75	kHz
		Carrier frequency stability, $\omega_i + \omega_0$	3-DH5	–75	75	kHz
		Carrier frequency stability, ω_0	3-DH5	–10	10	kHz
		Root mean square (rms) differential error vector magnitude (DEVm)	2-DH5	N/A	20	%
		Peak DEVm	2-DH5	N/A	35	%
		99% max (%)	2-DH5	N/A	30	%
		Rms DEVm	3-DH5	N/A	13	%
		Peak DEVm	3-DH5	N/A	25	%
		99% max (%)	3-DH5	N/A	20	%
	EDR in-band spurious emission	For $ M - N = 1$	2-DH5	N/A	PTXref –26 dB	N/A
			3-DH5	N/A		N/A
		For $ M - N = 2$	2-DH5	N/A	–20	dBm

Table 3 – WPAN RF performance criteria

Category	Item	Condition	Packet type	Lower limit	Upper limit	Unit
RF receiving performance			3-DH5	N/A	−20	dBm
		For $ M - N > 3$	2-DH5	N/A	−40	dBm
			3-DH5	N/A	−40	dBm
	Sensitivity single slot packets	Bit error ratio (BER) upper (%): $<0.1\%$	DH1	N/A	−80	dBm
	Sensitivity multi slot packets	DH3 BER upper (%): $<0.1\%$	DH3	N/A	−80	dBm
		DH5 BER upper (%): $<0.1\%$	DH5	N/A	−80	dBm
	Blocking performance	BER (%): $<0.1\%$, CH58	DH1	N/A	−67	dBm
	Maximum input level	BER (%): 0.1%	DH5	−10	N/A	dBm
	EDR sensitivity	BER: $\leq 7 \times 10^{-5}$ after 1 600 000 bits or BER: $\leq 1 \times 10^{-4}$ after 16 000 000 bits	2-DH5	N/A	−75	dBm
			3-DH5	N/A	−75	dBm
	EDR BER floor performance	BER: $\leq 7 \times 10^{-6}$ after 8 000 000 bits or BER: $\leq 1 \times 10^{-5}$ after 160 000 000 bits	2-DH5	N/A	−60	dBm
			3-DH5	N/A	−60	dBm
	EDR maximum input level	BER: $\leq 0.10\%$	2-DH5	−10	N/A	dBm
			3-DH5	−10	N/A	dBm

6.1.2.3 WPAN user performance

It is recommended that VMSs meet the WPAN user performance specified in Table 4. Detailed test conditions are listed in Table I.4.

Table 4 – WPAN user performance

Performance item	Description	Value (%)
Pairing and connection success rate	Minimum pairing and connection success rate	90
Sound quality	Presence of echo or noise	0

6.1.3 Broadcast communication

For bi- and unidirectional broadcast communication, different protocols are available over terrestrial, satellite and IP-over-mobile communication networks. It is recommended that VMSs support the digital video broadcasting (DVB) specifications of [b-EN 302 755], [b-EN 302 307], [b-ETSI TS 103 285] and [ITU-T F.749.3] as described in clauses 7.2.3 and 7.2.4.

For media types, content navigation methods and interactivity methods for multimedia broadcasting services, it is recommended that VMSs support the DVB specification [b-ETSI TS 101 154], the hybrid broadcast broadband television (HbbTV) specification [b-ETSI TS 102 796] and clause 8.4.1.1 of [ITU-T F.749.3].