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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS  
Infrastructure of audiovisual services – Communication  
procedures

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**HSTP-CITS-Reqs**  
**Global ITS communication requirements**  
**(Version 1)**

ITU-T

## Summary

This technical paper is a compilation of requirements on communications requirements of high-priority ITS applications in different countries and regions. This document is based on replies to a questionnaire issued by CITS (Collaboration on ITS Communication Standards), as of 4 July 2014.

## Keywords

Intelligent transportation systems (ITS), communications, CITS, requirements

## Change Log

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# Technical Paper ITU-T HSTP-CITS-Reqs

## ITU-T Technical Paper Global ITS communication requirements (Version 1)

### Summary

This Technical paper is a compilation of requirements on communications requirements of high-priority ITS applications in different countries and regions. This document is based on replies to a questionnaire issued by CITS (Collaboration on ITS Communication Standards), as of 4 July 2014.

### 1 Introduction

This is a compilation of requirements based on replies to a questionnaire (see [Appendix I](#)) issued by the CITS (Collaboration on ITS Communication Standards) on communications requirements of high-priority ITS applications in different countries and regions. The information from that questionnaire has been reorganized to highlight the communications requirements themselves. Each clause indicates the type of communications, the applications and regions that have indicated a need for them, and the requirements themselves. Specific values for requirements, when they have been stated, have been selected from the questionnaire response summary.

### 2 References

- [YDB 064-2011] CCSA YDB 064-2011, *Vehicle Telematic Service Requirement and General Framework*.
- [JT/T 794-2011] Ministry of Transportation of China JT/T 794-2011, *GNSS system for operating vehicles – Technical specification for vehicle terminals*.
- [JT/T 796-2011] Ministry of Transportation of China JT/T 796-2011, *GNSS for operating vehicles – Technical specification for platform*.
- [ISO CALM] ISO 21217:2014, *Intelligent transport systems - Communications access for land mobiles (CALM)*, various parts.
- [ISO CAN] ISO 11898, *Road vehicles - Controller area network (CAN)*, various parts (1-6).
- [IEEE 802.11p] IEEE 1609.0-2013, *IEEE Standard for Wireless Access in Vehicular Environments (WAVE) – Architecture*.  
<<http://dx.doi.org/10.1109/IEEESTD.2014.6755433>>
- [GB 17859-1999] SAC GB 17859-1999, *Classified criteria for security protection of computer information system*.
- [GB 20135-2006-T] SAC GB 20135-2006-T, *Intelligent transport systems - Electronic toll collection - System architecture*.
- [GB/T 20851.1-2007] SAC GB/T 20851.1-2007, *Electronic toll collection - Dedicated short range communication - Part 1: Physical layer*
- [GB/T 20851.2-2007] SAC GB/T 20851.2-2007, *Electronic toll collection - Dedicated short range communication - Part 2: Data link layer*
- [GB/T 20851.3-2007] SAC GB/T 20851.3-2007, *Electronic toll collection - Dedicated short range communication - Part 3: Application layer*

- [GB/T 20851.4-2007] SAC GB/T 20851.4-2007, *Electronic toll collection - Dedicated short range communication - Part 4: Equipment application*
- [YDB 102-2012] CCSA YDB 102-2012, *General architecture of intelligent transportation system based on telecommunication networks.*
- [ITS-F/IVC] ITS Info-communications Forum Japan, *Experimental Guideline for Vehicle Communications System using 700 MHz-Band.*
- [Mainöfer, 2004] Christian Maihöfer, A survey of geocast routing protocols, IEEE Communications Surveys & Tutorials, vol. 6, no. 2, Second Quarter 2004, pp. 32-42.

### 3 Definitions

**3.1 geocast** [Mainöfer, 2004]: The delivery of a message to nodes within a geographical region.

**3.2 "I am alive" message:** Message transmitted after emergency situations, e.g., natural disasters, including personal information, geographical position and other information to support search and rescue.

**3.3 infotainment:** Blend of information and entertainment. Broadcast material which is intended both to entertain and to inform.

### 4 Abbreviations

C/R	Challenge-response [authentication]
C2CCC	Car to Car Communication Consortium
CALM	Communications access for land mobiles
CAN	Controller area network
CCTV	Closed-circuit television
CCSA	China Communications Standards Association
CITS	Collaboration on ITS Communication Standards
CRC	Cyclic redundancy check
DEA	Data encryption algorithm
DSRC	Dedicated short-range communications
ETC	Electronic toll collection
FEAL	Fast data encipherment algorithm
GNSS	Global navigation satellite system
I2V	Infrastructure-to-vehicle [communication]
IPER	IP Packet Error Ratio
IPLR	IP Packet Loss Ratio
IPTD	IP Packet Transfer Delay
ITS	Intelligent transportation system
IVC	Inter-vehicle communication [ <a href="http://dx.doi.org/10.1109/SURV.2009.090202">http://dx.doi.org/10.1109/SURV.2009.090202</a> ]
LAN	Local area network

MAC	Media access control [layer, address]
OBE	On-board equipment
PKC	Public key certificate
QoS	Quality of service
RSA	Rivest, Shamir and Adleman [encryption algorithm]
SAC	Standardization Administration of the People's Republic of China
SIM	Subscriber identity module
USDOT	United States Department of Transportation
V2V	Vehicle-to-vehicle [communication]
VPN	Virtual private network
WAVE	Wireless Access in Vehicular Environments

## **5 Vehicle/ITS station-to-infrastructure short-range communications**

### **5.1 Related applications**

- Air traffic management, ship management
  - Arab region
- CCTV surveillance
  - Arab region
- Electronic toll collection (ETC)
  - China
- Emission control
  - Arab region

Fleet management, hazardous material tracking, vehicle monitoring (See also clauses 6 and 7)

- Arab region, China, Europe, Japan
- Improving emergency response
  - Arab region

Loading zone management, border crossing management

- Arab region, China, Europe, Japan
- Road hazard warning (e.g., road workers, accident)
  - Arab region, Europe
- Smart pedestrian crossings (e.g. automatic warning of pedestrians for drivers, prolonging crossing times for elderly users, and changing pedestrian prioritization)
  - Arab region, Europe
- Speed warnings/regulation enforcement/signage reinforcement
  - Arab region, Europe
- Traffic signal violation detection and enforcement
  - Arab region, Europe

- Traveller information, urban multi-modal information
  - Arab region

## **5.2 Requirements**

### **5.2.1 Addressing**

- Applications such as speed warning and emission control require point-to-multipoint addressing.

### **5.2.2 Bandwidth/throughput**

- Medium to high bandwidth is needed for the majority of these applications.
- Multiple channel support is required for applications such as vehicle monitoring.

### **5.2.3 Connection type (persistent or not)**

- Applications such as speed warnings and emission control require both types of connection.

### **5.2.4 Coverage**

For further study.

### **5.2.5 Data integrity**

- Applications such as speed warning and signage reinforcement require highly robust signals, as indicated in the Arab region's requirements for signage reinforcement:
  - "Data to be transmitted such that when in radio range (say 250m) any approaching vehicle will receive the signal reinforcement even in the event of 80% message loss (note that transmitters can be placed above cars such as to maximize coverage and optimize communication path integrity)"
- See also Reliability, below.

### **5.2.6 Directionality**

For further study.

### **5.2.7 Latency**

- Applications such as speed warning and road hazard warning require very low latency or 100 ms or less.
- Applications such as fleet management and loading zone management require maximum latency of 500 ms.
- Most of these applications require both real-time and stored transmission.

### **5.2.8 Pre-emption priority of applications**

- Safety and law enforcement applications require pre-emption priority.

### **5.2.9 Quality of service**

- High level of QoS is needed for applications such as air traffic management, speed warning, and road hazard warning.

### **5.2.10 Range**

- Range for these applications varies from tens of meters to one kilometre.



### **5.2.11 Reliability**

- Services such as ETC require high reliability defined in terms of requirements such as:
  - IPTD (IP Packet Transfer Delay)
  - IPLR (IP Packet Loss Ratio)
  - IPER (IP Packet Error Ratio)
- Sleep mode, transmission restoration, and multilink support are required for applications such as fleet management, hazardous material tracking, loading zone management, and border crossing management.

### **5.2.12 Reserved bandwidth needed**

- 5.9 GHz spectrum might be used for some public safety applications.

### **5.2.13 Security and privacy**

- High security is needed for applications such as air traffic management, ETC, speed warning, road hazard warning, and emission control.
- Features needed include security against data interception and manipulation:
  - Authentication: To make acceptance authentication for received data, to prove the validity of the identity and data source, the certification methods includes: MAC verification, PKC certification and C/R authentication
  - Privacy control: To avoid illegal monitoring of sensitive information by means of information encryption, encryption methods includes: DEA, FEAL, RSA, etc.
  - Data integrity control: CRC check; MAC verification

### **5.2.14 Topology**

- Services such as fleet management, loading zone management, and border crossing management require broadcast capability to inform ITS stations of their availability. They also require unicast capability to enable I2V data transmission.

## **5.3 Related standardization**

- General Architecture of Intelligent Transportation System Based on Telecommunication Networks (YDB 102-2012), CCSA TC10 WG2
- Intelligent transport system - Electronic toll collection - System architecture (GB 20135-2006-T)
- Electronic toll collection - Dedicated short range communication - Part 1: Physical layer (GB/T 20851.1-2007)
- Electronic toll collection - Dedicated short range communication - Part 2: Data link layer (GB/T 20851.2-2007)
- Electronic toll collection - Dedicated short range communication - Part 3: Application layer (GB/T 20851.3-2007)
- Electronic toll collection - Dedicated short range communication - Part 4: Equipment application (GB/T 20851.4-2007)
- Existing ISO, IEEE and ETSI standards for vehicle-to-vehicle and vehicle-to-infrastructure communication
- IETF specifications for Internet communications

- 3GPP and other mobile standards for communication
- ETSI ITS and ISO CALM
- GNSS system for operating vehicles – Technical specification for vehicle terminals (JT/T 794-2011)
- GNSS for operating vehicles – Technical specification for platform (JT/T 796-2011)
- Classified criteria for security (GB 17859-1999)

#### **5.4 Standards gaps**

For further study.

### **6 Vehicle/ITS station-to-infrastructure wide-area communications**

#### **6.1 Related applications**

- Cooperative navigation (probe traffic data, etc.)
  - Europe
- Disaster information
  - Japan
- Evacuation route information
  - Japan
- Fleet management, hazardous material tracking, vehicle monitoring (See also clauses 0 and 7)
  - Arab region, China, Europe, Japan
- Floating car (probe) data
  - Europe
- "I am alive" message
  - Japan
- Loading zone management, border crossing management (See also clause 0)
  - Arab region, China, Europe, Japan
- Location-based services/infotainment/insurance/financial services (See also clause 7.2.2)
  - Arab region, Europe, Japan
- Management of electric vehicles and electric vehicle charging spots
  - Japan
- Navigation, including call-centre assisted navigation
  - Europe, China, Japan
- Person finder
  - Japan
- Refugee information
  - Japan
- Vehicle diagnostic information
  - China

- Weather information
  - Arab region

## **6.2 Requirements**

### **6.2.1 Addressing**

For further study.

### **6.2.2 Bandwidth/throughput**

- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information do not require high bandwidth.
- Infotainment, navigation, and vehicle monitoring applications require moderate to high bandwidth. Some require multiple channels (audio, video, etc.)

### **6.2.3 Connection type (persistent or not)**

For further study.

### **6.2.4 Coverage**

For further study.

### **6.2.5 Data integrity**

- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information require robust communication.

### **6.2.6 Directionality**

For further study.

### **6.2.7 Latency**

- Applications such as fleet management, loading zone management, cooperative navigation, location-based services, and infotainment services require maximum latency of 500 ms.
- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information require low latency.

### **6.2.8 Pre-emption priority of applications**

- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information require pre-emption priority.

### **6.2.9 Quality of service**

- Most of these applications require a high level of QoS.

### **6.2.10 Range**

For further study.

### **6.2.11 Reliability**

- Most of these applications require high reliability.

### **6.2.12 Reserved bandwidth needed**

For further study.

### **6.2.13 Security and privacy**

- Applications including vehicle monitoring, vehicle diagnostic information, and management of electric vehicles require protection against unauthorized access to the CAN bus. Security measures include authentication for the OBE and SIM card, private data transmission, OBE-side encryption, and OBE-side data verification.
- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information require security ranging from moderate to high.
- Applications such as management of electric vehicles and charging spots and vehicle monitoring require moderate or high security, including encryption and VPN capability.
- Navigation, including call-centre assisted navigation, requires security measures including encryption, verification, long-term storage, and user profile protection.
- Location-based services, infotainment, insurance, and financial services also require strong security and privacy measures.

### **6.2.14 Topology**

- Applications such as floating car (probe) data require the capability for the ITS station to broadcast or geocast information.
- Applications such as location-based services and some infotainment services require the roadside unit to have the capability to broadcast availability of the service.
- Applications such as disaster information, evacuation route information, "I am alive" message, person finder, refugee information, and weather information require both one-way, wide-area broadcast and two-way transmission.

## **6.3 Related standardization**

- ISO TC204/CALM
- IEEE 802.11p
- WAVE/DSRC
- 3GPP
- 3GPP2
- ETSI TC ITS
- Vehicle Telematic Service Requirement and General Framework (YDB 064-2011), CCSA TC10 WG2
- GNSS system for operating vehicles – Technical specification for vehicle terminals (JT/T 794-2011)
- GNSS for operating vehicles – Technical specification for platform (JT/T 796-2011)
- Classified criteria for security (GB 17859-1999)
- Standards suggested for infotainment applications:
  - In-vehicle information network architecture;

- The interface specifications between mobile communication equipment (cellular phone, DSRC, etc.) and the in-vehicle information network (LAN)
- The interface specifications of gateway between the in-vehicle information network (LAN) and vehicle CAN bus
- The interface specifications between in-vehicle information network (LAN) and information terminals (nomadic and mobile devices)
- The firewall function of the gateway between the in-vehicle information network (LAN) and vehicle CAN bus

## **6.4 Standards gaps**

For further study.

## **7 Wide-area communications: infrastructure to multiple vehicles (broadcast)**

### **7.1 Related applications**

Disaster information (See also clause 6)

- Japan

Fleet management, hazardous material tracking, vehicle monitoring (See also clauses 0 and 6)

- Arab region, China, Europe, Japan

"I am alive" message (See also clause 6)

- Japan

ITS station lifecycle management

- Europe

– Refugee information (See also clause 6)

- Japan

### **7.2 Requirements**

#### **7.2.1 Addressing**

For further study.

#### **7.2.2 Bandwidth/throughput**

- Applications such as disaster information, "I am alive" message, and refugee information do not require high bandwidth.
- Fleet management and vehicle monitoring applications require moderate to high bandwidth. Some require multiple channels (audio, video, etc.)

#### **7.2.3 Connection type (persistent or not)**

For further study.

#### **7.2.4 Coverage**

For further study.

### **7.2.5 Data integrity**

- Applications such as disaster information, "I am alive" message, and refugee information require robust communication.

### **7.2.6 Directionality**

For further study.

### **7.2.7 Latency**

- Applications such as fleet management and ITS station life cycle management require maximum latency of 500 ms.
- Applications such as disaster information, "I am alive" message, and refugee information require low latency.

### **7.2.8 Pre-emption priority of applications**

- Applications such as disaster information, "I am alive" message, and refugee information require pre-emption priority.

### **7.2.9 Quality of service**

- Most of these applications require a high level of QoS.

### **7.2.10 Range**

For further study.

### **7.2.11 Reliability**

- Most of these applications require high reliability.

### **7.2.12 Reserved bandwidth needed**

- 5.9 GHz spectrum might be used for some public safety applications.
- ITS station life cycle management might use 5.9 GHz.

### **7.2.13 Security and privacy**

- Applications including vehicle monitoring require protection against unauthorized access to the CAN bus. Security measures include authentication for the OBE and SIM card, private data transmission, OBE-side encryption, and OBE-side data verification.
- Applications such as disaster information, "I am alive" message, and refugee information require security ranging from moderate to high.
- Applications such as vehicle monitoring require moderate or high security, including encryption and VPN capability.
- ITS station lifecycle management requires security to prevent unauthorized code or data from being installed on the ITS station.

### **7.2.14 Topology**

- Applications such as disaster information, "I am alive" message, and refugee information require both one-way, wide-area broadcast and two-way transmission.

### **7.3 Related standardization**

- GNSS system for operating vehicles – Technical specification for vehicle terminals (JT/T 794-2011)
- GNSS for operating vehicles – Technical specification for platform (JT/T 796-2011)
- Classified criteria for security (GB 17859-1999)

### **7.4 Standards gaps**

For further study.

## **8 Vehicle-to-vehicle communications**

### **8.1 Related applications**

- Ad hoc, multi-hop V2V safety communications
  - Japan
- Blind spot warning/Lane change warning
  - U.S.A.
- Do not pass warning
  - U.S.A.
- Emergency brake light warning
  - Europe, U.S.A.
- Emergency vehicle warning
  - Arab region, Europe
- Forward collision warning
  - Arab region, Europe, U.S.A.
- Intersection movement assist
  - U.S.A.
- Left turn across path/opposite direction
  - U.S.A.
- Location-based services/infotainment/insurance/financial services
  - Arab region, Europe, Japan
- Motorcycle approaching warning
  - Europe
- Slow vehicle warning
  - Europe
- Wrong-way driving warning
  - Europe

## **8.2 Requirements**

### **8.2.1 Addressing**

- Ad-hoc, multi-hop V2V safety communications requires a routing protocol among vehicles.

### **8.2.2 Bandwidth/throughput**

- Safety applications do not require high bandwidth.
- Infotainment, navigation, and vehicle monitoring applications require moderate to high bandwidth. Some require multiple channels (audio, video, etc.)

### **8.2.3 Connection type (persistent or not)**

For further study.

### **8.2.4 Coverage**

For further study.

### **8.2.5 Data integrity**

- Safety applications require high data integrity.

### **8.2.6 Directionality**

- Safety applications require signals to be broadcast from the threat vehicle to multiple surrounding vehicles.

### **8.2.7 Latency**

- Because of the short distances and high speeds of vehicles in threat situations, safety applications require very low latency. ETSI has suggested maximum latency of 100 ms.
- Location-based services and infotainment services require maximum latency of 500 ms.

### **8.2.8 Pre-emption priority of applications**

- Safety applications require pre-emption priority.

### **8.2.9 Quality of service**

- Ad-hoc, multi-hop V2V safety communications requires a high level of QoS.

### **8.2.10 Range**

- Longitudinal detection distance for safety applications is defined by USDOT as a maximum 300 m from the front bumper of the host vehicle.

### **8.2.11 Reliability**

- Safety applications must function even when the line of sight between the host vehicle and the threat vehicle is blocked by other vehicles, inclement weather, or terrain.

### **8.2.12 Reserved bandwidth needed**

- U.S. safety applications will use the 5.9 GHz band.

### **8.2.13 Security and privacy**

- Ad-hoc, multi-hop V2V safety communications requires encryption and VPN capability.



- Security for ad-hoc, multi-hop V2V safety communications must be high.
- Location-based services, infotainment, insurance, and financial services also require strong security and privacy measures.

#### **8.2.14 Topology**

- Safety applications require signals to be broadcast from the threat vehicle to multiple surrounding vehicles.

#### **8.3 Related standardization**

- ISO TC204/CALM
- IEEE 802.11p
- WAVE
- DSRC
- ITS-F/IVC
- C2CCC
- ETSI TG37

#### **8.4 Standards Gaps**

For further study.

### **9 Communications for automated driving and related advanced safety applications**

Efforts have recently started on determining the requirements for automated driving communications and vehicle-to-pedestrian/vehicle-to-bicycle communications have recently started to be evaluated.

Requirements for automated driving communications are in process of determination. Possible needs are:

- Over-the-air updates of control algorithm software with high latency
- Sending crash event data recorder upon a crash in automated driving mode with low latency
- Sending messages about road safety conditions (construction, ice, obstacle, etc.) with very low latency
- Updates of saved sensor information with high latency.

There is no complete work yet on vehicle-to-pedestrian and vehicle-to-bicycle communications requirements.

## **Appendix I Questionnaire:**

### **Communications requirements for high-priority ITS applications**

This is the reporting form for communications requirements of high-priority ITS applications in different countries and regions.

Please enter at least three ITS applications, in order of priority (highest priority first).

Created by Martin Adolph (ITU/TSB) for the Collaboration on ITS Communication Standards  
<http://itu.int/en/ITU-T/extcoop/cits/>

#### **I.1 Personal details and contact**

**Name \***

*Please enter your full name*

**Organization \***

*Please enter your organization*

**Email \***

*Please enter your email address*

**Country / Region \***

*Please select the country or region you will report on*

#### **I.2 High-priority ITS application 1**

**Application name \***

*Please enter name of ITS application*

**Description**

*Please enter description of application (100-150 words)*

**Communications requirements: functional \***

*Please enter functional communications requirements, separated by semicolon (;)*

**Communications requirements: performance \***

*Please enter communications requirements related to performance, separated by semicolon (;)*

**Security priority \***

*On a scale from 1 (lowest) to 5 (highest), how important is communications security in this application*

**Communications requirements: security**

*Please enter communications requirements related to security, separated by semicolon (;)*

**Security threats and risks**

*Please enter potential threats and vulnerabilities risks associated to this application, separated by semicolon (;)*

### **Communications standards**

*Please enter communications standards (including source) which meet the performance, functional and security requirements identified in the previous questions, separated by semicolon (;)*

### **Communications standards gaps**

*Please list requirements (among those identified in the previous questions) which are not met or insufficiently fulfilled by existing communications standards, separated by semicolon*

### **Comments**

## **I.3 High-priority ITS application 2**

### **Application name \***

*Please enter name of ITS application*

### **Description**

*Please enter description of application (100-150 words)*

### **Communications requirements: functional \***

*Please enter functional communications requirements, separated by semicolon (;)*

### **Communications requirements: performance \***

*Please enter communications requirements related to performance, separated by semicolon (;)*

### **Security priority \***

*On a scale from 1 (lowest) to 5 (highest), how important is communications security in this application*

### **Communications requirements: security**

*Please enter communications requirements related to security, separated by semicolon (;)*

### **Security threats and risks**

*Please enter potential threats and vulnerabilities risks associated to this application, separated by semicolon (;)*

### **Communications standards**

*Please enter communications standards (including source) which meet the performance, functional and security requirements identified in the previous questions, separated by semicolon (;)*

### **Communications standards gaps**

*Please list requirements (among those identified in the previous questions) which are not met or insufficiently fulfilled by existing communications standards, separated by semicolon*

### **Comments**

## **I.4 High-priority ITS application 3**

### **Application name \***

*Please enter name of ITS application*

**Description**

*Please enter description of application (100-150 words)*

**Communications requirements: functional \***

*Please enter functional communications requirements, separated by semicolon (;)*

**Communications requirements: performance \***

*Please enter communications requirements related to performance, separated by semicolon (;)*

**Security priority \***

*On a scale from 1 (lowest) to 5 (highest), how important is communications security in this application*

**Communications requirements: security**

*Please enter communications requirements related to security, separated by semicolon (;)*

**Security threats and risks**

*Please enter potential threats and vulnerabilities risks associated to this application, separated by semicolon (;)*

**Communications standards**

*Please enter communications standards (including source) which meet the performance, functional and security requirements identified in the previous questions, separated by semicolon (;)*

**Communications standards gaps**

*Please list requirements (among those identified in the previous questions) which are not met or insufficiently fulfilled by existing communications standards, separated by semicolon*

**Comments****I.5 Final comments**

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