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Radiocommunication Sector of ITU

Recommendation ITU-R M.1890

(04/2011)

Intelligent transport systems – Guidelines and objectives

M Series

Mobile, radiodetermination, amateur and related satellite services

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SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R M.1890

Intelligent transport systems – Guidelines and objectives

(Question ITU-R 205-4/5)

(2011)

Scope

This Recommendation provides the guidelines for radio interface requirements of intelligent transport systems (ITS). ITS utilize a combination of technologies such as computers, telecommunications, positioning, and automation to improve the safety, management, efficiency, usability and environmental sustainability of terrestrial transportation systems.

Technical and/or operational requirements for the various radio systems referred to in the Annex as options or examples are outside the scope of this Recommendation.

The ITU Radiocommunication Assembly,

considering

a) that there is a need to integrate various technologies including radiocommunications into land transportation systems;

b) that many new land transportation systems use intelligence in land vehicles coupled with advanced vehicle, advanced traffic management, advanced traveller information, advanced public transportation, and advanced fleet management systems to improve traffic management;

c) that ITS are being planned and implemented in various Regions by administrations;

d) that a wide variety of applications and services are defined;

e) that international standards would facilitate worldwide application of ITS and provide for economies of scale in bringing ITS equipment and services to the public;

f) that worldwide compatibility of ITS may be dependent on harmonized radio spectrum allocations;

g) that the ISO is standardizing ITS (non-radio aspects) in ISO/TC204 including applications for “cooperative systems” which require vehicle-to-vehicle and vehicle-to-infrastructure radiocommunications;

h) that next generation vehicular radiocommunication technologies and ITS broadcast systems are emerging,

noting

a) that Recommendation ITU-R M.1452 – Millimetre wave radiocommunication systems for intelligent transport systems applications, provides low power short-range vehicular radar equipment at 60 GHz and 76 GHz, and technical characteristics of millimetre wave radiocommunication systems for data communications for vehicle-to-vehicle and vehicle-to/from-infrastructure communications;

b) that Recommendation ITU-R M.1453 – Intelligent transport systems – Dedicated short-range communications at 5.8 GHz, details the technologies and characteristics for DSRC in the 5.8 GHz band;

c) that Recommendation ITU-R M.1797 – Vocabulary of terms for the land mobile service, provides terminology on ITS;

d) that the land mobile Handbook (Volume 4 on ITS) contains information on ITS radiocommunications such as DSRC, millimetre wave communications;

e) that IEEE 802.11p for "Wireless Access in Vehicular Environment (WAVE)" was published by the Institute of Electrical and Electronics Engineers (IEEE),

recommends

that the radio interface options and objectives shown in the Annex should be used as guidelines for deployment of ITS.

Annex

Guidelines for ITS radio interfaces and objectives

1 Elements of ITS

Based on major services required for ITS, the elements of ITS and the associated RF interfaces are listed in the following sections. For rural area applications, it may be necessary to appropriately tailor these technologies to meet the operational requirements.

1.1 Advanced vehicle control systems

Advanced vehicle control systems are oriented to complementing major portions of the driving task.

Elements	Radio interface options
Longitudinal collision avoidance: helps to prevent head-on, rear-end or backing collision between vehicles, vehicles to objects or pedestrians	Short-range radar, high-resolution short-range radar, millimetre-wave communications
Lateral collision avoidance: helps prevent collisions when vehicles leave their lane of travel	Short-range radar, high-resolution short-range radar
Intersection collision avoidance: helps prevent collisions at intersections	Short-range vehicle-to-vehicle, or to infrastructure communication, millimetre-wave communications, short-range radar
Vision enhancement systems: improves driver's ability to see the roadway and objects on or along the roadway	Forward looking infrared radar, high-resolution short-range radar (short-range radar)
Pre-crash restraint deployment: anticipates an imminent collision and activates passenger safety systems before the collision occurs earlier than is currently feasible	Short-range radar, high-resolution short-range radar
Automated road systems	Short-range vehicle-to-vehicle communication, short-range radar, short-range vehicle-to-infrastructure communication
Safety readiness: provides warnings about the condition of the driver, the vehicle and the roadway	Short-range vehicle-to-infrastructure communication, wide area communication

1.2 Advanced traffic management systems

Advanced traffic management systems are intended to improve traffic flow and result in more efficient use of the road systems.

Elements	Radio interface options
Traffic network monitoring and control: manages the movement of traffic on streets and highways	Radar, short-range vehicle-to-infrastructure communication, broadcast, wide area communications
Travel demand management: supports policies and regulations designed to mitigate the environmental and social impacts of traffic congestion	Short-range vehicle-to-infrastructure communication, broadcast, wide area communication
Incident detection and management: helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic	Radar, short-range vehicle-to-infrastructure communication, broadcast, wide area communication
Emissions testing and mitigation: provides information for monitoring air quality and developing air quality improvement strategies	Wide area communication
Parking management: provides information of parking lots or manages the entry and exit of vehicles	Radar, short-range vehicle-to-infrastructure communication, broadcast, wide area communication

1.3 Advanced traveller information systems

Advanced traveller information systems are intended to assist travellers in trip planning and with route navigation and traffic conditions.

Elements	Radio interface options
Pre-trip travel information: provides information for selecting the best transportation mode, departure time and route	Broadcast, wide area communication
En-route driver information: provides driver advisory and in-vehicle signing for convenience and safety during travel	Broadcast, wide area communication, short-range vehicle-to-infrastructure communication
En-route transit information: provides information to travellers using public transportation after the start of the trip	Broadcast, wide area communication, short-range vehicle-to-infrastructure communication
Route guidance: provides travellers with simple instruction on how to best reach their destinations	Broadcast, wide area communication, short-range vehicle-to-infrastructure communication
Ride matching and reservation: makes ride sharing easier and more convenient	Wide area communication

1.4 Advanced public transportation systems

Advanced public transportation systems are designed to improve the efficiency of public transportation and make it more desirable by providing real-time scheduling and rider information.

Elements	Radio interface options
Public transportation management: automates operations, planning and management functions of public transit systems	Wide area communication, GNSS (AVL)
Personalized public transportation: offers flexibly routed transit vehicles for more convenient service to customers	Wide area communication, GNSS (AVL)

GNSS: Global navigation satellite system (GPS, GALILEO, GLONASS, etc.) including satellite-based augmentation system.

AVL: Automated vehicle location.

1.5 Advanced fleet management systems

Advanced fleet management systems are intended to improve efficiency and productivity of commercial vehicle operations.

Elements	Radio interface options
Vehicle administration: provides electronic purchasing of credentials and automated mileage and fuel reporting and auditing	Wide area communication
Safety monitoring and tracking: senses the safety status of a commercial vehicle, cargo and driver	Wide area communication, short-range vehicle-to-infrastructure communication, GNSS
Fleet management	Wide area communication, GNSS
Vehicle preclearance: facilitates domestic and international border clearance, minimizing stops	Short-range vehicle-to-infrastructure communication
Automated roadside safety inspections: facilitates roadside inspections	Short-range vehicle-to-infrastructure communication
Hazardous material incident response: provides immediate description of hazardous materials to emergency responders	Wide area communication, GNSS

1.6 Emergency management systems

Emergency management systems are intended to improve the response times of emergency vehicles involving transportation and other emergency related incidents.

Elements	Radio interface options
Emergency notification and personal security: provides immediate notification of an incident and an immediate request for assistance	Short-range vehicle-to-infrastructure communication, short-range vehicle-to-vehicle communication, wide area communication, short-range radar, high resolution short-range radar
Public travel security: creates a secure environment for public transportation operators	
Emergency vehicle management: reduces the time it takes emergency vehicles to respond to an incident	

1.7 Electronic payment services

Elements	Radio interface options
Electronic payment services: allows travellers to pay for transportation services electronically based on short-range vehicle-to-infrastructure communication	Short-range vehicle-to-infrastructure communication
Electronic payment services: allows travellers to pay for transportation services electronically based on GNSS and wide area communication	Wide area communication, GNSS

1.8 Pedestrian supporting systems

Pedestrian supporting systems are intended to assist pedestrians in traffic situations such as crossing intersections.

Elements	Radio interface options
Pedestrians route guidance: helps pedestrians to find appropriate directions to go to destinations	Wide area communication, short-range vehicle-to-infrastructure communication, GNSS
Vehicle-pedestrian accident avoidance: detects dangerous situations, and to provide necessary alarm both for pedestrians and drives	Short-range vehicle-to-infrastructure communication, radio frequency identification, high-resolution short-range radar

2 ITS radio service objectives

2.1 Radio interface options

ITS functions will be most effectively achieved through the single or combined use of the following radiocommunication applications:

– *Broadcast*: point-to-multipoint one way transmission.

– *Short-range radiocommunications*: vehicle-to-infrastructure radiocommunications (e.g. DSRC, WAVE, digital cellular mobile telecommunication systems (GSM, PDC, etc.), IMT-2000, IMT-Advanced).

– *Short-range radiocommunications*: vehicle-to-vehicle radiocommunications (e.g. WAVE (IEEE Std 802.11p), Wireless LAN).

– *Millimetre wave communications*.

– *Short-range radar*.

– *High-resolution short-range radar*.

– *Wide area communication*: mobile two-way communications using networks of terrestrial base stations (e.g. cellular) or using satellites.

– *GNSS*: for location-based services such as AVL one way communication.

2.2 Service objectives

Tables 1 and 2 provide ITS radio interface technology for communication and radio determination. Table 3 provides ITS service objectives for radiocommunication.

TABLE 1

ITS Radio interface technology – Communication

Category		Coverage area	System examples
Broadcast		Large coverage area including underground car park tunnels and rural areas	Digital TV Multimedia broadcast Digital radio FM multiplex broadcasting (DARC, RDS, etc.)
Radiocommunication	Short-range vehicle-to/ from-infrastructure radiocommunication	Small coverage area	DSRC (Recommendation ITU-R M.1453-2, etc.) Wireless LAN WAVE (IEEE802.11p) Digital cellular mobile telecommunication systems (GSM, PDC, etc.) IMT-2000 IMT-Advanced
	Short-range vehicle-to-vehicle radiocommunication	Small coverage area	Wireless LAN WAVE (IEEE 802.11p)
	Wide area radiocommunication	Nearly ubiquitous coverage	Digital cellular mobile telecommunication systems (GSM, PDC, etc.) IMT-2000 IMT-Advanced

TABLE 2

ITS Radio interface technology – Radio determination

Radio determination		Coverage area	Range resolution	Velocity resolution
Radar	Short-range radar	Small coverage area	Less than 3% of the detection distance or less than 1 m	Less than 3% of the vehicle speed or less than 1 km/h.
	High-resolution short-range radar	Small coverage area: tens of metres	Less than 20 cm detection distance	N/A
Global navigation satellite systems		Nearly ubiquitous coverage	N/A	N/A

TABLE 3

ITS Service objectives for radiocommunication

Application	Data Rate	Data integrity	Transmission latency	Radio Interface Technology Radio determinations
Safety	middle	Less than one undetected message error per 100 messages	very low	Short-range vehicle-to-infrastructure communication Short-range vehicle-to-vehicle communication Short-range radar High-resolution short-range radar
Payment	middle to high	Less than one undetected message error per 1 000 messages to less than one detected message error per one million messages (ratio of undetected message error per one million messages should be negligibly small)	low	Short-range vehicle-to-infrastructure communication Global navigation satellite systems Wide area communication
Data casting	high	Very high: low probability of undetected error	middle	Short-range vehicle-to-infrastructure communication Wide area radiocommunication Broadcast
Data clipping	high	Medium	best effort	Short-range vehicle-to-infrastructure communication Wide area radiocommunication Broadcast

3 International standardization

For safety reasons international standardization of ITS is desirable in respect to the short-range vehicle-to-vehicle or vehicle-to/from-infrastructure radiocommunications and any short-range radar employing cooperative techniques.

From a user's perspective, international standardization is also highly desirable, at a minimum on a regional basis, for the convenience of users moving within that region and for the broadcast and short-range vehicle-to-vehicle or vehicle-to/from-infrastructure radiocommunications.

4 Interconnection requirements

The largest data capacity needs will probably be required for the purpose of data collection from roadside sensors. Other services include control of signals and variable message signs, distribution of data between traffic authorities, service providers and fleet managers and for distribution of data to/from broadcast and roadside communications facilities. A mix of dedicated and switched connections is anticipated. Multipoint distribution will benefit from the use of packet mode communications.

5 Use of evolving mobile telecommunication services

It is expected that the evolving mobile telecommunication will be able to support the ITS applications requiring terrestrial, two-way, wide area communications, particularly when combined with the GNSS.