SLOVENSKI STANDARD
SIST-TS CEN/TS 13149-7:2016

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Javni prevoz - Sistemi za časovno razporejanje in nadzor cestnih vozil - 7. del: Sistem in arhitektura omrežja

Public transport - Road vehicle scheduling and control systems - Part 7: System and Network Architecture

Öffentlicher Verkehr - Planungs- und Steuerungssysteme für Straßenfahrzeuge - Teil 7: IP-basierende Vernetzung in einem Fahrzeug, Netzwerk- und Systemarchitektur

Transport public - Systèmes de planification et de contrôle des véhicules routiers - Partie 7 : Architecture Système et Réseau

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Public transport - Road vehicle scheduling and control systems - Part 7: System and Network Architecture

Transport public - Systèmes de planification et de contrôle des véhicules routiers - Partie 7 : Architecture Système et Réseau

Öffentlicher Verkehr - Planungs- und Steuerungssysteme für Straßenfahrzeuge - Teil 7: System- und Netzwerkarchitektur

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European foreword

This document (CEN/TS 13149-7:2015) has been prepared by Technical Committee CEN/TC 278 "Intelligent transport systems", the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This Technical Specification is Part 7 of a series of European Standards and Technical Specifications that includes:

— EN 13149-1:2004, *Public transport - Road vehicle scheduling and control systems - Part 1: WORLDFIP definition and application rules for onboard data transmission*

— EN 13149-2:2004, *Public transport - Road vehicle scheduling and control systems - Part 2: WORLDFIP cabling specifications*

— CEN/TS 13149-3:2007, *Public transport - Road vehicle scheduling and control systems - Part 3: WorldFIP message content*

— EN 13149-4:2004, *Public transport - Road vehicle scheduling and control systems - Part 4: General application rules for CANopen transmission buses*

— EN 13149-5:2004, *Public transport - Road vehicle scheduling and control systems - Part 5: CANopen cabling specifications*

— CEN/TS 13149-6:2005, *Public transport - Road vehicle scheduling and control systems - Part 6: CAN message content*

— CEN/TS 13149-7:2015, *Public transport - Road vehicle scheduling and control systems - Part 7: System and Network Architecture*

— CEN/TS 13149-8:2013, *Public transport - Road vehicle scheduling and control systems - Part 8: Physical layer for IP communication*

— prCEN/TS 13149-9, *Public Transport - Road Vehicle Scheduling and Control Systems - Part 9: IP-based Networking Inside A Vehicle, Information Services*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This Technical Specification is Part 7 of a series of European Standards and Technical Specifications. The scope of this series is on-board data communication systems on public transport vehicles.

Public Transport (PT) vehicles have an increasing array of information and communications systems, including ticket machines, Automated Vehicle Location (AVL) systems, destination displays, passenger announcement systems, vehicle monitoring systems, etc. Other systems are beginning to be included such as advertising screens, tourist guides, WiFi "hotspots" and infotainment.

In addition, equipped PT vehicles will usually have a communications facility to enable voice and data to be exchanged with the control centre, other PT vehicles, PT infrastructure and roadside devices for instance in requesting priority at traffic signals. Many types of communication channel are used including public and private wireless communication networks.

These systems may be provided by a number of different suppliers and may need to be integrated. For instance:

— a ticket machine may need location information to update fare stages;

— next-stop and destination information may be drawn from schedule information held in the ticket machine;

— vehicle location systems may be used to drive signal priority requests.

As data exchange between functional units becomes more widespread, a networked approach begins to become efficient. With standardized underlying technology, the PT vehicle begins to look like a local area network: making use of IEEE 802 communications and the Internet Protocol (IP) suite.

Without a clear technology framework, integrating these systems would require complex technical discussions every time a device is procured. The existing EN 13149 standards recognized this long ago in respect of the core vehicle systems, but these have not been adapted to IP networking.

Existing Parts 1 to 6 of EN 13149 specify two independent frameworks, generally referred to as "WorldFIP" (Parts 1 to 3) and "CANbus" (Parts 4 to 6). These have not been developed with IP as a networking protocol and there has been strong interest in the community to migrate towards this approach. Parts 7 to 9 are therefore intended to provide an IP-based approach, with updated content (i.e. independent of Parts 1 to 6).

— CEN/TS 13149-7:2015 specifies the Network and System Architecture for on board equipment. It describes basic principles of communications including a general description of the network topology, addresses schematics, basic network services, a system overview and basic module architecture.

— CEN/TS 13149-8 specifies the Physical Layer for IP-communication networks on board PT vehicles. This part specifies the cables, connectors and other equipment including pin assignment and environmental requirements.

— prCEN/TS 13149-9[1] specifies in detail the profiles of basic and generic Services as well as profiles of specific services.

It is expected that EN 13149 Parts 1 to 6 will no longer be adopted once Parts 7 to 9 are complete. With these Technical Specifications, it will be easier to achieve:

1) In development and registered as CEN/WI 00278382.

— more efficient development of PT components;

— lower cost, lower risks and a smoother on board integration of PT equipment;

— more efficient operation and maintenance of on board PT equipment;

— high quality intermodal passenger services based on intermodal PT information;

— integration of new PT services.

As an IP based solution, this Technical Specification draws on a range of IETF Requests for Comment (RFCs), not all of which may be formal standards. A list of those cited is presented in the Bibliography.

1 Scope

This Technical Specification specifies the general rules for an on-board data communication system between the different systems that may be used within public transport vehicles. This includes operational support systems, passenger information systems, fare collection systems, etc.

This Technical Specification describes:

— the requirements for an on board IP network;

— the overview architecture and components for an IP based on-board network;

— the modular structure of the network architecture;

— the Service Oriented Architecture (SOA) approach, and approach to defining services.

Systems directly related to the safe operation of the vehicle (including propulsion management, brake systems, door opening systems) are excluded from the scope of this Technical Specification and are dealt with in other standardization bodies. However, the architecture described in this Technical Specification may be used for support services such as safety information messages. Interfaces to safety-critical systems should be provided through dedicated gateways with appropriate security provisions; for the purposes of this Technical Specification, these are regarded as simply external information sources.

This Technical Specification is designed primarily for vehicles with a fixed primary structure, where networks can be installed on a permanent basis and the system configuration task consists largely of the integration, adjustment or removal of the functional end systems that produce and/or consume data. Public transport vehicles consisting of units linked temporarily for operational purposes (specifically, trains in which individual engines, cars or consists are routinely connected and disconnected) require additional mechanisms to enable the communications network itself to reconfigure. Such mechanisms are provided through other standards, notably the IEC 61375 series. (See also 5.9.)

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
application
piece of software constructed to capture, process and/or interpret data within the context of a business process; for example estimating vehicle location within the transport network

2.2
function
logical set of data processing activities that fulfils a business need

EXAMPLE Automated Vehicle Monitoring System (AVMS).

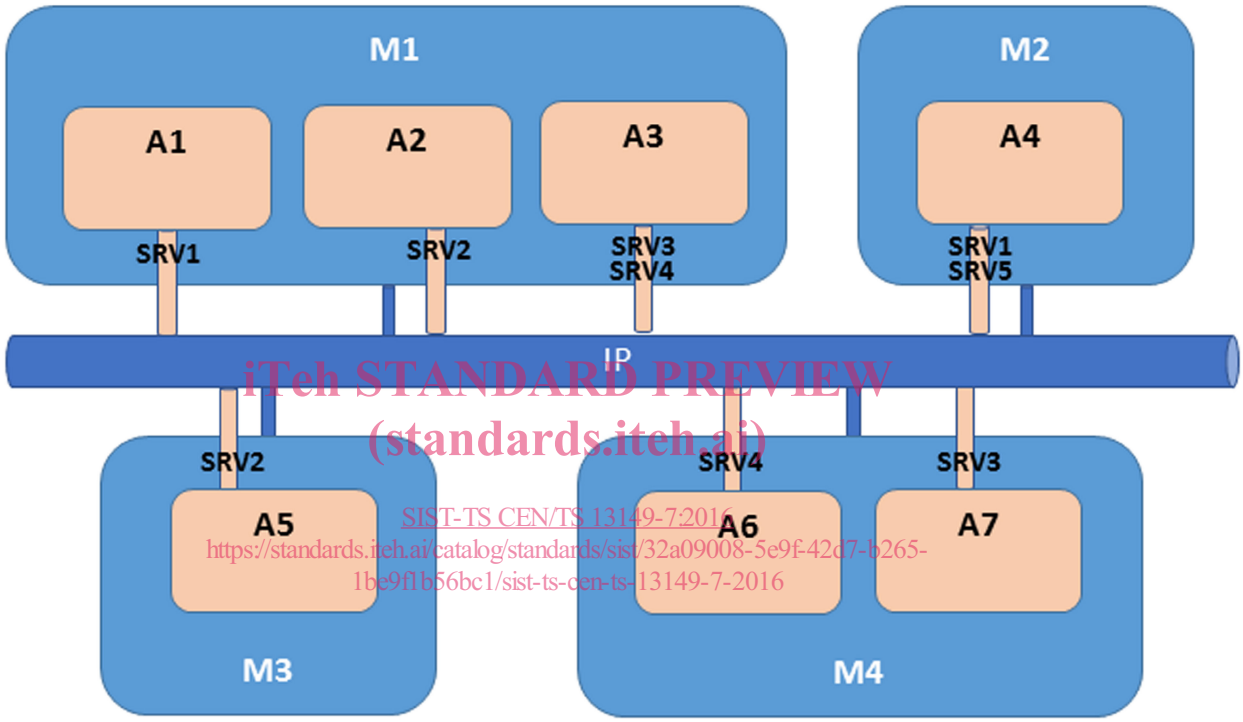
2.3
module
hardware or virtual component with an IP address on the IP network

EXAMPLE OnBoardUnit (on board computer).

2.4
service
mechanism to deliver data on the IP architecture

EXAMPLE Provision of information about the vehicle location within the transport network.

Note 1 to entry: Thus, a module will host one or more applications which are designed to implement functions; a service is provided by an application via a module (using an IP port), and communicates across the IP network. In particular, a module can host several applications, an application can provide several services, and identical services can be provided multiple times by different applications. Figure 1 depicts this relationship diagrammatically.



Key

M1 – M4	Modules
SRV1 – SRV5	Services
A1 – A7	Applications
IP	Primary network

Figure 1 — Relationship between terms (example)

Applications, and the functions they support, are liable to regularly change and are independent of the technical features described in this Technical Specification. prCEN/TS 13149-9 addresses the definition of specific data structures for some key functions.

3 Symbols and abbreviations

API	Application Programming Interface
AVMS	Automated Vehicle Monitoring System
AVL	Automated Vehicle Location
CAN	Controller Area Network
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DNS-SD	DNS based Service Discovery
DPI	Dynamic Passenger Information
FTP	File Transfer Protocol
GPS	Global Positioning System
HTTP	HyperText Transfer Protocol
IP	Internet Protocol
IT	Information Technologies
LAN	Local Area Network
mDNS	Multicast DNS
MMI	Man Machine Interface
PT	Public Transport
PTA	Public Transport Authority
PTO	Public Transport Operator
QoS	Quality of Service
SOA	Service Oriented Architecture
SSH	Secure Shell protocol
TELNET	TErminaL NETwork
UDP	User Datagram Protocol
WLAN	Wireless Local Area Network

4 Design principles

4.1 Introduction

This clause describes the design principles adopted in the development of EN 13149, Parts 7 to 9. These consist of:

— the operational characteristics which are routinely required of an integrated on-board systems network, and the goals for which this Technical Specification has been designed;

— the language used to describe the systems and their connectivity.

4.2 Design goals

4.2.1 Enabling communications

Different systems on the vehicle may benefit from exchanging data with each other, in an automated and sometimes real-time manner. This requires a framework which identifies clearly the approach to configuration and structure of data exchanges through standard mechanisms. IP-based communications is very mature and capable of delivering this goal.

4.2.2 Enabling interoperability

Similarly, there are advantages in adopting a standard for system architecture and data structures which is independent of manufacturer. Interconnection between modules of different suppliers will be facilitated by the use of standardized software and hardware interfaces. The Service Oriented Architecture approach is now widely used and accepted.

4.2.3 Ease of configuration

The need for manual intervention in the configuration and operation of units can be avoided by ensuring that there is maximum opportunity for them to self-identify and self-describe to the network. Manual configuration also needs to be supported, for example where system parameters are subject to operator policy choices.

4.2.4 Quality of monitoring

The system has to include mechanisms to monitor the health of modules and services and prevent failures. Helpful alerts can then be provided to the people responsible for managing the system.

4.2.5 Maintainability

It is desirable to make on-board systems simple to maintain, through software updates, device interrogation, problem diagnosis, etc. Remote monitoring and maintenance of IT systems is now commonplace, but requires suitably designed communications access.

In the case of on-board systems, it is particularly important to be able to interrogate a system from a convenient point on the vehicle, and to avoid the need to access or uninstall deeply-buried equipment.

4.2.6 Migration

Currently there already exist several IP and non-IP systems and different IT architecture in PT vehicles, and it will not be practical to migrate them all to a fully-functional IP network immediately. Therefore, the architecture has to allow for the gradual roll-out of new modules and services onto an IP backbone, while still enabling the inclusion of proprietary systems while they remain important operational components. This raises interoperability challenges and would imply the need for some kind of gateway access and data translation.

4.2.7 Supporting fleet changes

Vehicles will typically be liable to change the PT service they are running, which alters the way in which they need to be integrated into the operator's control systems. This includes a number of special cases, such as:

— where an operator "shares" a vehicle with another operator during operation;

— where an operator uses the same vehicle for several authorities, during the same day.

Operators/authorities may therefore need to operate fleets of vehicles using different IT architectures or systems. These again emphasize the need for the on-board systems and networks to be secure, configurable and adaptable.