SLOVENSKI STANDARD
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Inteligentni transportni sistemi - Sistemi upravljanja prometa - Zahteve glede stanja, napak in kakovosti

Intelligent transport systems - Traffic management systems - Status, fault and quality requirements

Intelligente Verkehrssysteme - Verkehrsmanagementsysteme - Status-, Fehler- und Qualitätsanforderungen

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Intelligent transport systems - Traffic management systems - Status, fault and quality requirements

Intelligente Verkehrssysteme - Verkehrsmanagementsysteme - Status-, Fehler- und Qualitätsanforderungen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (CEN/TS 17241:2019) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

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Introduction

General deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport is demanded by Directive 2010/40/EU [3] of the European Parliament. ITS means "applying information technology and communications technology for improving traffic, especially road traffic".

Urban Intelligent Transport Systems (U-ITS) is a term indicating the provisioning of ITS services applying ITS technologies in an urban context. Development of standards dedicated to U-ITS is supported by the European Commission's mandate M/546 [2] with technical details identified in the final report [1] of project team PT1701 funded under M/456. U-ITS standards will complement those for cooperative ITS (C-ITS) developed under the European Commission's mandate M/453, see [4]. Thus the basic ITS technologies applied for U-ITS are the same as those applied for C-ITS.

Provisioning of ITS services typically may require communications between ITS station units (ITS-SU) [20]. Diverging requirements for communications and limitations of capabilities of available communication channels led to the concept of Hybrid Communications providing multiple communication protocol stacks with different access technologies for localized communications and networked communications together with the capability of handover, specified in a series of standards, ISO 21217 [20], ISO 21218 [21], EN ISO 17423 [14], ISO 24102-6 [24], ISO 21215 [19], ISO 17515-3 [16], ISO 21210 [18], ISO 29281-1, and others.

A major characteristics of C-ITS is the sharing of data between ITS applications in the same ITS-SU and in different ITS-SUs. A major service domain of C-ITS is the domain of road safety and traffic efficiency, with a certain focus on wireless communications between ITS-SUs installed in vehicles, also referred to as Vehicle ITS-SU (V-ITS-SU), and wireless communications between V-ITS-SUs and ITS-SUs installed at the roadside, also referred to as Roadside ITS-SU (R-ITS-SU).

Major differences between U-ITS and C-ITS are the data and procedures necessary for the provisioning of dedicated urban ITS services, although data and procedures developed for C-ITS might also be beneficially applied in U-ITS.

Whilst C-ITS focused on the road safety domain, U-ITS deals with the ITS service domains

Multimodal Information Systems;
Traffic Management;
Urban Logistics;

see [1].

A major goal to be achieved with U-ITS standards is to assist urban administration to implement U-ITS, and by this removing barriers for implementing U-ITS [1]:

1) Awareness of what is available;

2) Location referencing;

3) Vendor lock-in;

4) Standards for "new modes" and "new measures";

5) Data exchange / data management;

6) Immaturity of some concepts.

A precise definition of the borderline between U-ITS and ITS for other target domains, e.g. ITS on highways, is impossible. However, this document aims on identifying and specifying ITS issues that are relevant for urban administrations. It is important to understand that ITS issues developed for urban areas also may be applicable outside of urban areas.

Development of standards for U-ITS has to consider automated and autonomous vehicles [1].

This document was developed by project team PT1704 funded by the European Commission under grant agreement SA/CEN/GROW/EFTA/546/2016-08 'Urban ITS - Traffic management systems' (M/546 [2]). The scope of this document results from the High Level Recommendation "1701-HLRd Traffic Management System status, fault and quality standards" identified in Bibliographical Entry [1]. This document is about quality and performance criteria:

— applied for the operation of traffic management systems,

— considering the effective integration of field and centre

  — devices and

  — services,

— and approaches to evaluate them.

PT1704 acknowledges the help of

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to develop the ASN.1 equivalent code from the XSD code produced by the UML design tool (Enterprise Architect [39]). OSS voluntarily processed the XSD files provided by PT1704 with their *XSD- > ASN.1 Translator* tool [38].

Clause 5 is arranged as a text book, introducing and explaining quality and performance criteria, and approaches to their evaluation, for the operation of traffic management systems, including factors affecting the effective integration of field and centre systems and services. Where appropriate, it refers to the data model specified in Clause 6. Normative requirements are avoided in order not to impose requirements on urban administrations on how to perform their work.

Clause 6 specifies a data model for system status and faults of components of traffic management systems using UML and being based on DATEX II. The design is flexible, i.e. supporting communications between central stations, i.e. the original usage of DATEX II, but also communications between a field device and a central station. Further on it introduces the concept of "catalogues" allowing vendors and urban administrators defining their own data sets.

The informative Annex E illustrates the general findings of Clause 5 using a use-case "tunnel project". To a large extent there is a one-to-one mapping of subclauses from Clause 5 with subclauses from Annex E.

The normative Annex A specifies a status and fault dictionary.

The normative Annex B provides an ASN.1 module for the data specified in Annex A.

The normative Annex C provides a contribution to the CEN work item on management of electronic traffic rules (METR).

The normative Annex D provides information about the existence and the content of an electronic attachment to this document.

1 Scope

This document:

— illustrates quality and performance criteria, and approaches to their evaluation, for the operation of traffic management systems, including factors affecting the effective integration of field and centre systems and services, and

— specifies a data model for system status and faults of components of traffic management systems.

This document provides supporting information in a use case for the use of the quality and performance criteria, considering design, procurement, and performance management.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 16157-1:2018, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 1: Context and framework*

EN 16157-2:2019, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 2: Location referencing*

EN ISO 17419[1], *Intelligent transport systems — Cooperative systems — Globally unique identification (ISO 17419)*

ISO 29281-1, *Intelligent transport systems -- Localized communications -- Part 1: Fast networking & transport layer protocol (FNTP)*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Part 1*

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) — Part 2*

ISO/IEC 8825-5, *Information technology — ASN.1 encoding rules: Mapping W3C XML schema definitions into ASN.1 — Part 5*

ISO/IEC 9834-1, *Information technology — Procedures for the operation of object identifier registration authorities: General procedures and top arcs of the international object identifier tree — Part 1*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

1 The next edition of ISO 17419 will be split into a two-part document.

4 Symbols and abbreviations

CCTV	closed circuit television
DATEX II	multi-part standard, maintained by the CEN Technical Committee 278, CEN/TC278, specifying the information model for road traffic and travel information in Europe
DIASER	dialogue standard pour les equipements de régulation NOTE 1 AFNOR standard defining traffic data collection in an urban or peri-urban environment with traffic control via traffic signals. It applies to exchange between a management centre and equipment or actors out on the field (traffic signal equipment used for traffic control purposes, data exchange between a traffic controller and an external system); see [31].
ETR	electronic traffic regulations
HMI	human-machine interface
IT	information technology
ITS	intelligent transport system
METR	management of electronic traffic regulations
MOR	minimum operating requirements
NTCIP	national transportation communications for ITS protocol
OCIT	open communication interface for road traffic control systems
PER	(ASN.1) packed encoding rules
PRINCE2	projects in controlled environments NOTE 2 Standard-like specification from AXELOS.
PTZ	pan, tilt, zoom
QMA	quality management authority
SLA	service level agreement
UA	urban administrator
U-ITS	urban ITS
UML	unified modelling language
UPER	ASN.1 BASIC-PER UNALIGNED
UTMC	urban traffic management control, i.e. initiative in the UK for the development of an approach to ITS in urban areas
VMS	variable message sign

5 Quality and performance criteria

5.1 Quality: fitness for purpose

There is no universally accepted definition of “quality”. In EN ISO 9000:2015, 3.6.2 [6], it is defined as the “degree to which a set of inherent characteristics (…) fulfils requirements”, but while this helps to frame the generic standards for quality management, it is of little practical use in specific contexts.

“Performance”, similarly, may refer generally to the actual behaviour of a system in practice, or more directly to the system's achievement of the desired “quality”.

Definitions in the business context vary widely, but may be broadly categorized into a number of perspectives, including:

— Those that focus on the fulfilment of a functional goal (effectiveness).

— Those that focus on the fulfilment of a contractual goal or policy requirements (compliance).

— Those that focus on the fulfilment of stakeholder expectations (satisfaction).

— Those that focus on the improvement of one or more of the above (excellence).

There are several factors that contribute to the quality of an operational system in practice. In particular, these include:

— Design quality for individual system elements (devices, software packages, etc).

— System management quality (deployment, integration/configuration, maintenance, etc).

— System operation quality (staffing, processes, etc).

In the specific context of traffic management systems, there are a number of complicating factors although they are not unique to this context.

— The “traffic management system” includes not just a set of interacting ITS station units, but also the people that provide and operate them.

— Both ITS station units and people are likely to be spread across multiple organizations.

— “Customers” do not generally pay to use the service – the quality incentive therefore devolves on policymakers rather than market transactions, which is often less transparent and more volatile.

— The traffic management system is not independent of other civic systems – for instance those related to the management of the economy, the environment, education or social care.

— Many elements of the system – expectation, technology, external factors – are changing faster than they can reasonably be addressed.

To achieve all this, approaches to quality management generally involve many aspects of a business operation, including organization, process, communication, documentation, and so on. The general aim of a quality management system is to foster operational structures and behaviour that tends to increase quality, as it is defined and measured within the organization, and simultaneously reduce or remove structures and behaviour that tends to decrease quality.

These complexities impose a number of specific, preliminary, and overarching requirements on owners/operators of traffic management systems in line with the approach of EN ISO 9000 [6].

NOTE Many organizations find it helpful to appoint a quality management authority (QMA), responsible for designing and overseeing the operation of the quality management system. The exact form and role of such a QMA will reflect the nature and context of the organization. In the context of C-ITS, a model on roles and responsibilities was identified and standardized in EN ISO 17427-1 [15]. This might, at least partly, also apply for U-ITS.

The performance goals of a system (i.e. its target quality) should be clearly and unambiguously stated as far as practical, taking into account the relevant provisions of Clause 5 of this document.

Many systems are integrated from multiple components. The stated output goals for any specific system component should not exceed a performance level that can be effectively used by at least one current or anticipated future system function. For example, requiring a detector to providing vehicle location data to 1 m accuracy every 100 ms is inappropriate, if the only user of this data are a flow monitoring system that reports total vehicle flow in 5 min intervals. It may be reasonable, though, if the authority expects shortly to implement a collision warning system. It may also be acceptable if the marginal cost, relative to a much lower-performance unit, is small.

Where externalities - typically, either poor legislation or regulation or poor senior management decisions - impose a specific challenge that will be difficult or impossible to meet, the issue should be raised through the relevant political or legal channels as a matter of urgency. If this is not done, there is a risk that either:

a) the roads authority could be unfairly penalized, or

b) a legal instrument could be rejected as unreasonable by the courts.

The following subclauses address the quality of traffic management systems under the following headings:

— 5.2 covers the technical quality of traffic management systems, including intelligent transport systems, as a whole.

— 5.3 covers the quality of specific devices that are combined into systems.

— 5.4 covers the functional quality of systems: how well they do what they do.

— 5.5 covers the quality of the data that is created, held and processed within systems.

— 5.6 covers the management of system quality and operational aspects, at different stages of system life cycle.

5.2 System quality

5.2.1 Availability and uptime

5.2.1.1 General

One of the most basic quality factors, but often one of the most difficult to describe unambiguously, is “system availability”: loosely, how much of the time the system is working properly. A simple percentage is often quoted, e.g. “99% availability”, but this is rarely adequate for the reasons discussed below.

— What is meant by “how much of the time”.

— What is meant by “the system” or by “the whole system”.

— What is meant by “working properly”.

In order to limit scope for misunderstanding, therefore, and to maximize the intentions of the authority being met, it is essential to attempt to document how these should be understood.

5.2.1.2 Time

The nature of the system may be such that its operation is not equally important throughout the day, and may vary from day to day. This can become important for a number of factors, including when to schedule preventive maintenance and what response time is required in the event of a system failure. It may be more acceptable (or less) to suffer many short outages than a single long outage. Finally, very short outages (say, below one second) may or may not be tolerable at system level.

The system specification should incorporate a statement that describes as fully as possible the specific requirements on system uptime. This should include:

— The period or periods over which availability will be measured;

— Minimum and maximum acceptable outage lengths within each measured period;

— Maximum total outage within each measured period.

5.2.1.3 System

An authority will have requirements for the operational availability of the whole of its traffic management system, as it is deployed and operated. However, if this system contains many different components – possibly from multiple suppliers – it may not be possible to connect and enforce these in a contractual context. In particular, a traffic management system is likely to include hardware such as computers, signal heads, variable message sign (VMS) displays, etc., services such as communications, power supply, etc., and application software such as signal strategies, user interface, etc. This represents an integration challenge. Figure 1 shows a typical limited and artificial example, which indicates a number of procured components linked together into an overall traffic management system:

— The input on the left hand side may include:

  — keyboard and mouse control from the operator;

  — data from road users (vehicles, pedestrians, etc.) and their systems, either directly (e.g. generated by an in-car system) or indirectly (e.g. from a number plate read by a camera);

  — and direct import of external data, e.g. weather systems or police systems.

— Applications of various kinds process the data, and share some of their outputs with each other applications. These elements represent products that are procured, implemented and operated.

— The output on the right hand side may include

  — system displays to the operator;

  — signal aspects, signage, barriers etc. on the road;

  — and directly published data, for example via authority websites, to public transport companies, etc.

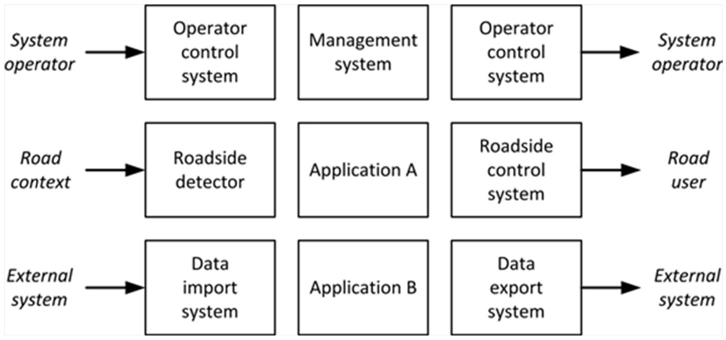

Figure 1 — Example of a system and its components

Failure of one component may or may not affect failure of other components. Some failures will affect the whole system; others may be very localized, e.g. to one junction or to one user workstation.

Not all component failures result in system failure. To take a trivial example, it is clearly unreasonable to declare a system non-operational because an operator screen has a missing pixel. It is important, therefore, to present clearly what counts as a failure; especially for contractual purposes.

Nevertheless, it is important to address the actual operational requirements. To address this, an authority should document the availability of the system as a whole, with reference to the intended output functionality. The purpose of this is to assist the system manager in ensuring continued good operation.

From this, using appropriate analytical tools, such as fault tree analysis, the authority should determine acceptable levels of availability for the separate system components which are the subject of procurement and maintenance contracts. These availabilities should be explicitly referenced in the relevant contracts – noting that in some cases, there may be little or no scope for negotiation; especially with regard to already-acquired systems.

The relationship between system availability and component availability is complex, and the availability target will influence the optimal system architecture. In particular, component redundancy may be a way of boosting the availability of the overall system with relatively inexpensive and less-reliable components. Expert architecture support may well be helpful in this process, either as part of a system integrator contract, or independently of suppliers.

5.2.1.4 Working properly

For the system, "working properly" strictly means "meeting all the explicit and implicit output requirements" – namely, to the right hand side of Figure 1. While correct output generally requires correct operation throughout, this is not necessarily the case; for example, if a component manages relatively static data such as road layout, it may not matter if the input to this component suffers minor interruptions.

Moreover, "working properly" ought not to be treated as a binary distinction. For instance, if a traffic signal control algorithm is faulty, and leads to excessive queuing, clearly the product is not fulfilling its role, and there are grounds for redress against the supplier. However, if the signals are still correctly showing red and green phases, there may be relatively little concern other than a longer-than-expected wait. Similarly, if a car park guidance system shows space information that is 15 min old, it is likely to be only mildly frustrating.

There is therefore a distinction to be made between issues that should be rectified because they cause significant operational issues such as safety concerns, and those which are more a question of optimization. Both are important and shall be addressed, but the obligations to be placed on suppliers will be different in each case.