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Intelligent transport systems — Cooperative ITS — Test architecture

Systèmes intelligents de transport — SIT coopératifs — Architecture d'essai

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Foreword

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

For conformance testing in C-ITS, ETSI developed a generic initial test architecture, published in Reference [6]. Considering the ITS station and communication architecture for C-ITS specified in ISO 21217 and implementations of ITS station units being compliant with the ITS-S station-internal management communications protocol (IICP) specified in ISO 24102-4, conformance testing can be simplified and related effort and cost can be reduced by applying the extended test architecture specified in this document. IICP enables remote access to all points of control and observation (PCO) of the implementation under test (IUT) without the need to implement IUT-specific upper tester applications and lower tester access.

Understanding of this document requires knowledge of:

— the ITS station and communication architecture specified in ISO 21217,

— the IICP specified in ISO 24102-4, and

— the related MX-SAP service primitive functions specified in ISO 24102-3.

Further knowledge of standards related to conformance testing with TTCN-3 is also recommended, for example:

— Reference [6] on the framework on C-ITS conformance testing, and

— Reference [7] on the TTCN-3 core language.

Intelligent transport systems — Cooperative ITS — Test architecture

1 Scope

This document specifies an extension of the ETSI C-ITS test architecture for conformance testing of protocols and applications in ITS station units. It specifies usage of the ITS station-internal management communication protocol (IICP) for the purpose of connecting an ITS test system to an implementation under test (IUT) residing in a system under test (SUT).

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.

ISO 21217:2014, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 24102-3, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 3: Service access points*

ISO 24102-4, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 4: Station-internal management communications*

3 Terms and definitions

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

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/

3.1
implementation under test
IUT
part of a real system which is to be studied by testing

3.2
system under test
SUT
real system in which an *IUT* (3.1) resides

4 Abbreviated terms

CI	communication interface
IIC	ITS-S internal management communications
IICA	IIC agent

IICM	IIC manager
IICP	IIC protocol
ITS	intelligent transport systems
ITS-SCU	ITS station communication unit
ITS-SCU-ID	ITS-SCU identifier
PCO	point of control and observation
PDU	protocol data unit
TTCN-3	testing and test control notation version 3

5 Conventions

In this document, text presented in `Courier` font indicates ASN.1 codes.

6 Test system architecture

6.1 General

The general test system architecture is illustrated in Figure 1. It shows how an implementation under test (IUT) contained in a system under test (SUT) is connected to the ITS test system via a lower layers link and an upper tester transport link and a configuration/notification link. These links allow accessing the points of control and observation (PCO) of the IUT.

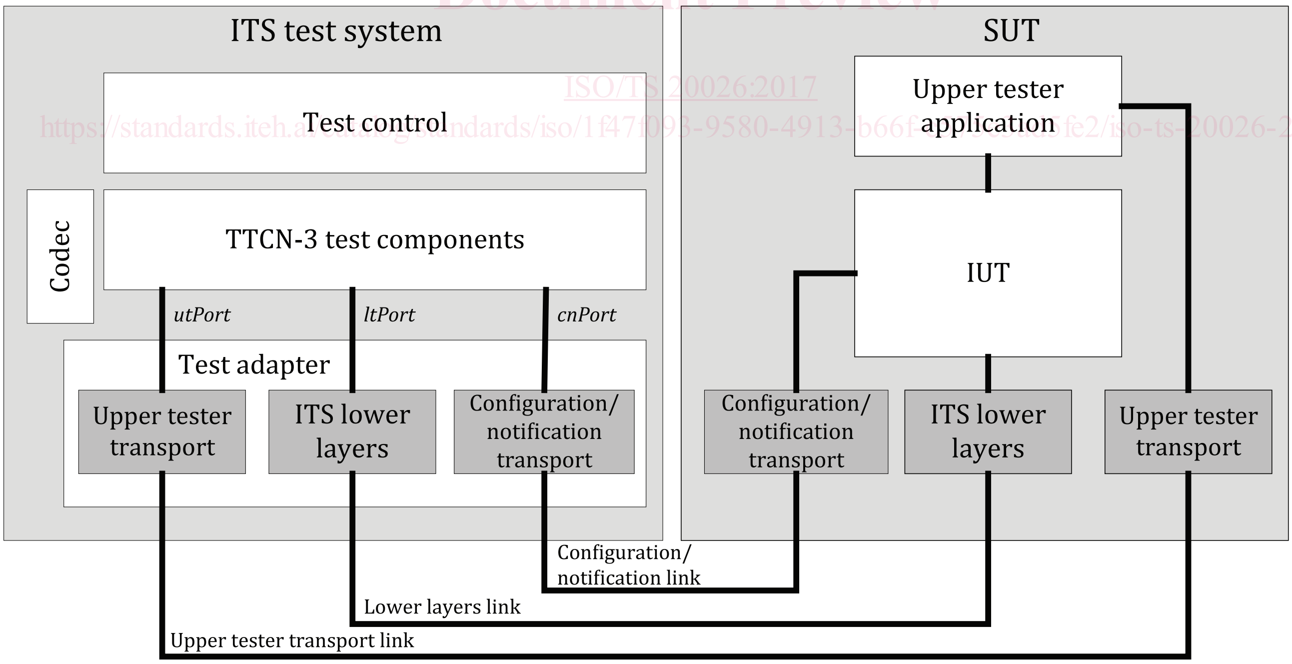

Figure 1 — General conformance test system architecture

The lower layers link may end up in the SUT at the block "ITS lower layers", in case lower layers are used during testing, or directly at the lower interface of the IUT. The upper tester transport link ends up in the SUT at the block "upper tester transport". This "upper tester transport" block together with the "upper tester application" block provides the test access to the upper interface of the IUT. The configuration and event notification link is needed for testing of some IUTs, e.g. to set initial conditions and to retrieve status information, allowing remote access to the management/security SAPs in the SUT.

The links shown in Figure 1 between the ITS test system and the SUT indicate connectivity between entities in the two systems and the physical implementation of these links is implementation dependent. For example, the three logical links shown may be implemented on a single physical communication medium such as a single Ethernet connection between the ITS test system and the SUT.

Following the ITS station and communication architecture specified in ISO 21217 (see Figure 2), an IUT can be a protocol or an ITS-S application process located in the

— ITS-S access layer (e.g. ITS-M5 specified in ISO 21215/ISO 21218),

— ITS-S networking and transport layer (e.g. FNTP specified in ISO 29281-1),

— ITS-S facilities layer (e.g. the LDM specified in ISO 18750),

— ITS-S management entity, or

— ITS-S security entity.

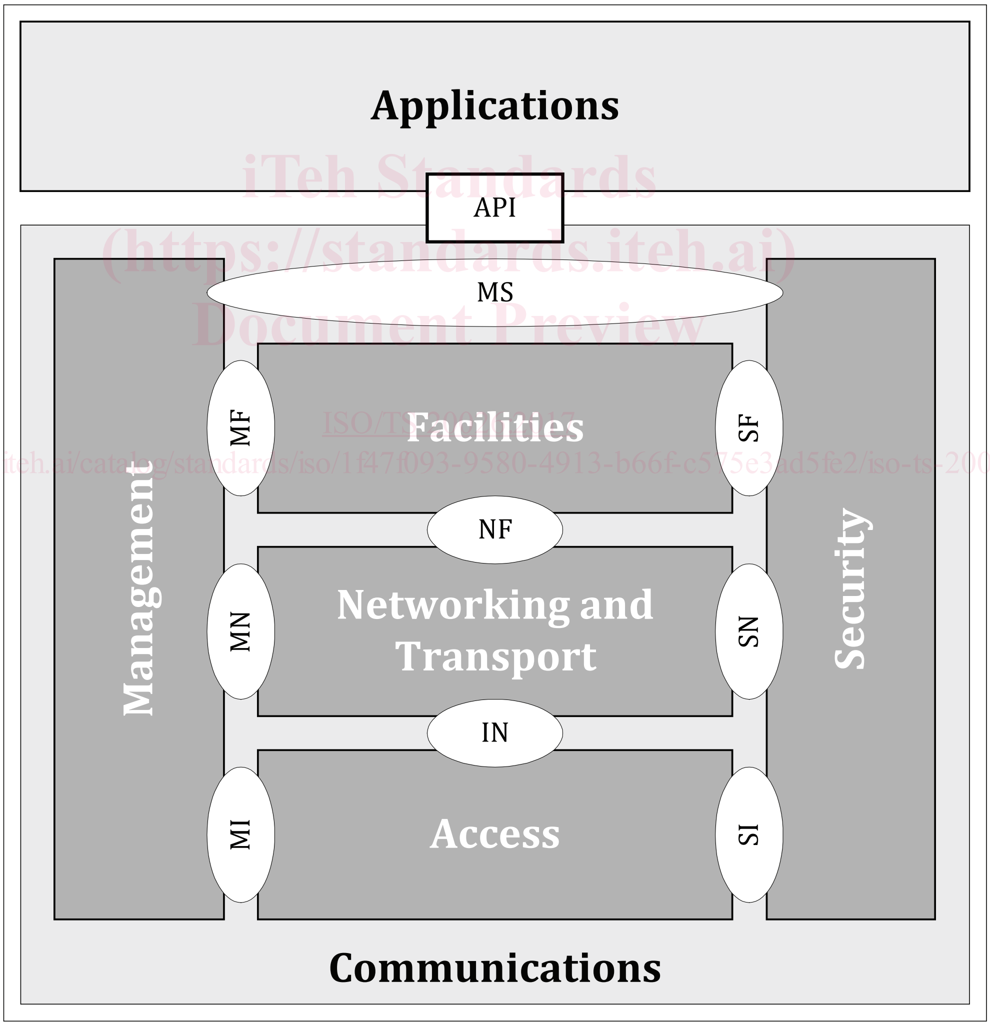

Figure 2 — ITS station architecture

An IUT may include functionalities in more than one architectural layer, for example, functionality in the:

— ITS-S access layer and the ITS-S networking and transport layer;

— ITS-S networking and transport layer and the ITS-S facilities layer;

— ITS-S facilities layer and the ITS-S applications entity;

— ITS-S access layer and the ITS-S networking and transport layer and the ITS-S facilities layer;

— ITS-S networking and transport layer and the ITS-S facilities layer and the ITS-S applications entity;

— ITS-S access layer and the ITS-S networking and transport layer and the ITS-S facilities layer and the ITS-S applications entity.

Additionally, an IUT may also include functionality in the ITS-S management entity and the ITS-S security entity.

Regardless of the functionalities under test, the IUT in principle has these three PCOs shown in Figure 1.

The IUT may be accessed using the ITS station-internal management communications protocol (IICP) specified in ISO 24102-4, as illustrated in 6.2 and 6.3. 6.2 describes the general IICP test architecture, while 6.3 describes the extention of 6.2 needed in case the ITS-S access layer is used in the SUT. The general IICP reference architecture is illustrated in 6.4.

6.2 IICP test system architecture without test CI

When the IUT does not involve access layer functionality, and applying IICP, the three links in Figure 1 are reduced to one physical link, e.g. an Ethernet cable with RJ45 connectors, as illustrated in Figure 3. The ITS test system and the SUT, together, act as parts of a "virtual" ITS station unit (ITS-SU) where each of these two units constitutes an ITS station communication unit (ITS-SCU) as specified in ISO 21217. The ITS-SCU-ID (address of an ITS-SCU) of the ITS test system has the value 3 as specified in ISO 24102-4. The ITS-SCU-ID of the SUT for the purpose of conformance testing is within the valid range specified in ISO 24102-4.

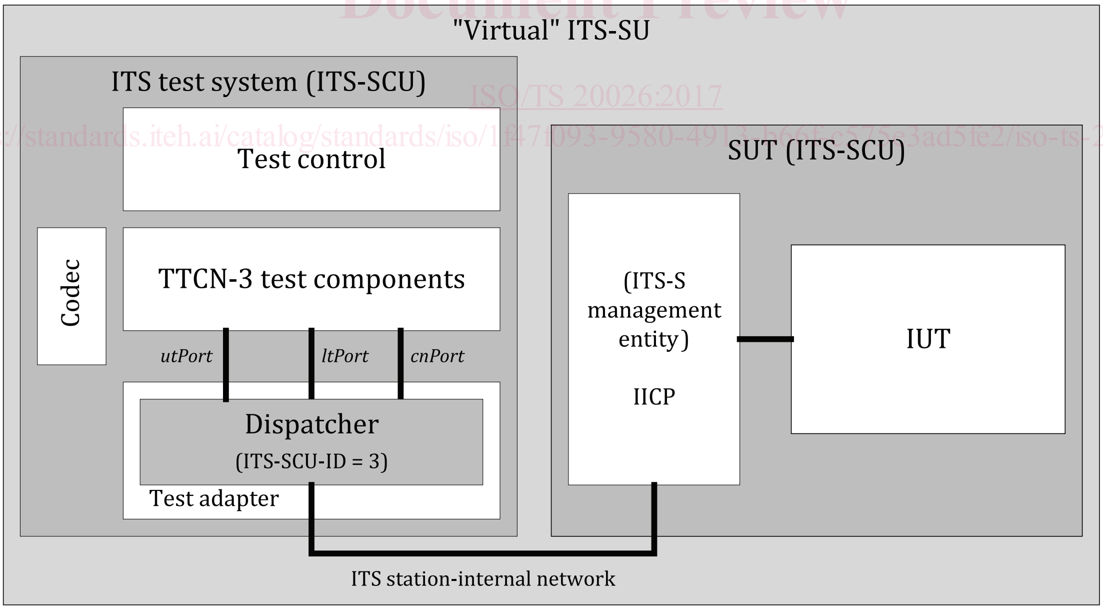

Figure 3 — IICP-based simple conformance test system architecture

The dispatcher in Figure 3 needs to know the actually valid configuration of the ITS-SCU and the IUT in order to properly establish the three links between SUT and ITS test system. Details of the dispatcher are specified in Clause 10.

6.3 IICP test system architecture with test CI

For some conformance tests (e.g. testing of an ITS-S access technology or using an ITS-S access technology as “lower layer” below an IUT), a separate test CI is used as illustrated in Figure 4. This test CI constitutes a third ITS-SCU of the “virtual” test ITS-SU. The ITS-SCU-ID of the test CI has the value 4 as specified in ISO 24102-4.

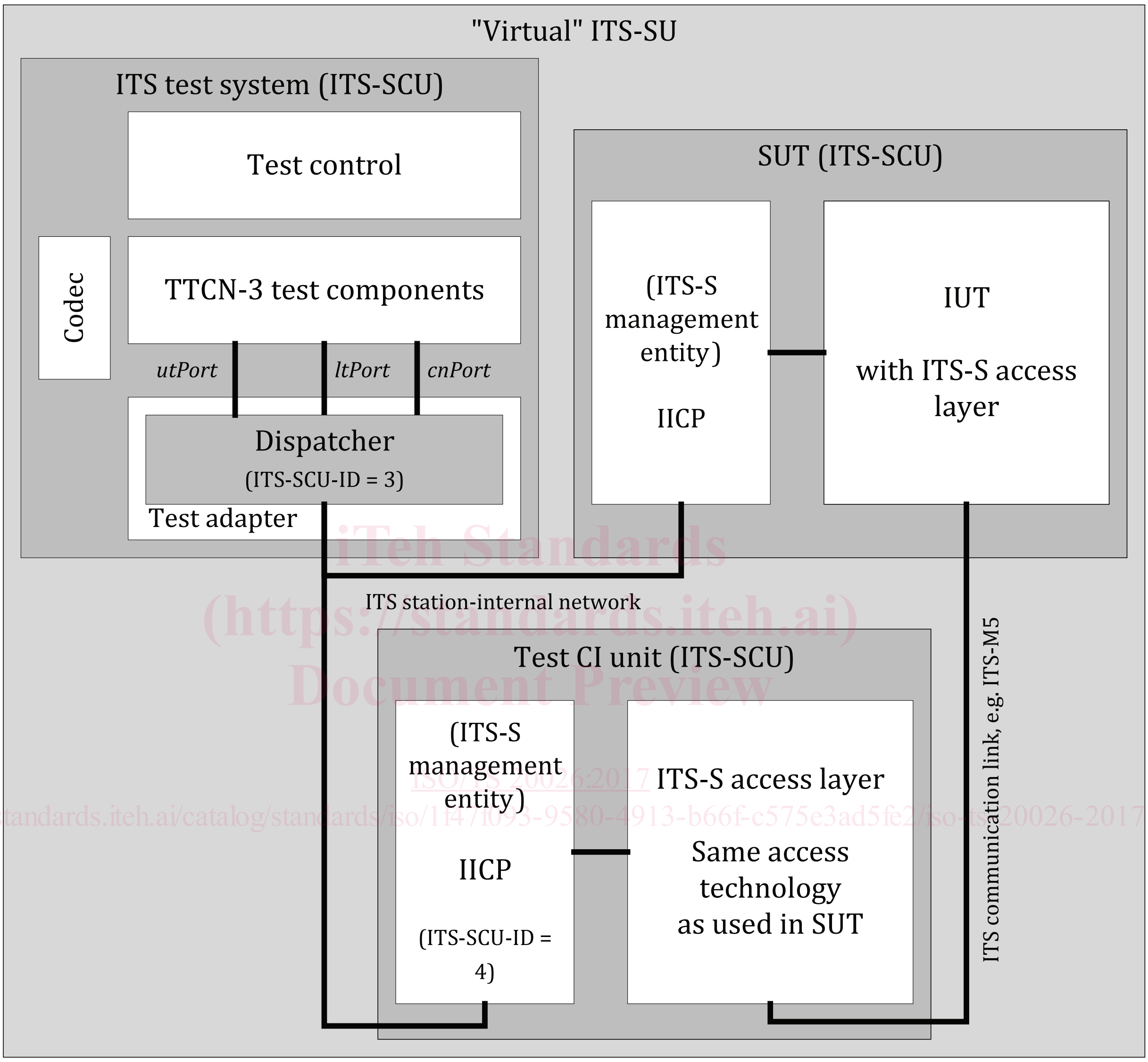

Figure 4 — IICP-based conformance test system architecture with test CI

The *ltPort* connects to the test CI using IICP. The test CI connects to the IUT using the respective ITS communication link. Thus, the test CI just performs a conversion between the ITS-S access layer stream and the ITS-ASDU of the IN-SAP (see ISO 21217:2014, Figure 12). The test CI is considered to be a “golden device” that does not introduce any errors that could lead to a wrong result in conformance testing.

The dispatcher in Figure 4 needs to know the actual valid configuration in order to properly establish the three links between the SUT and ITS test system. By detecting ITS-SCU-ID=4, the dispatcher knows that a test CI is involved.

6.4 IICP reference architecture

The IICP reference architecture specified in ISO 24102-4 is illustrated in Figure 5.

