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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is a single part deliverable.

National transposition dates	
Date of adoption of this EN:	22 September 2014
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Modal verbs terminology

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Introduction

In cooperative Intelligent Transport Systems (ITS), the Local Dynamic Map (LDM) is a key facility supporting various ITS applications by maintaining the information on objects influencing or being part of ITS. The Local Dynamic Map therefore is relevant to the development of technical standards and specifications in order to ensure deployment and interoperability of cooperative systems and services described in the EC's ICT Standardization Work Programme [i.7].

The LDM is a facility within the ITS station facilities layer as defined in the ITS communication architecture given in EN 302 665 [i.1]. Cooperative Awareness Messages (CAMs) as defined in EN 302 637-2 [4] and Decentralized Environmental Notification Messages (DENMs) as defined in EN 302 637-3 [5] are important sources of data for the LDM.

Moreover the LDM will support the Basic Set of Applications (BSA) outlined in TS 102 637-1 [i.2] by providing plausible authorized, area related information in a time relevant manner. The BSA provides the application specific requirements for the LDM.

The following applications from the BSA are considered:

- Driving assistance - Cooperative awareness.
- Driving assistance - Road Hazard Signalling (see TS 101 539-1 [i.3]).
- Speed management.
- Cooperative navigation Location based services.
- Community services.
- ITS station life cycle management.

1 Scope

The present document defines functional behaviour associated with a Local Dynamic Map (LDM) for usage in an ITS station unit (ITS-SU). It specifies functions and interfaces supported by a LDM. These functions and interfaces provide secure access to the LDM to manage LDM data objects stored in a LDM. It defines LDM data objects for safety-related and Vehicle to Vehicle (V2V)-related applications.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 102 860 (V1.1.1) (2011-05): "Intelligent Transport Systems (ITS); Classification and management of ITS application objects".

[2] ISO/IEC 8824-1:2008: "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".

[3] ETSI TS 102 894-2: "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

[4] ETSI EN 302 637-2 (V1.3.1) (2014-09): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[5] ETSI EN 302 637-3 (V1.2.1) (2014-09): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 302 665 (V1.1.1) (2010-09): "Intelligent Transport Systems (ITS); Communications Architecture".

[i.2] ETSI TS 102 637-1 (V1.1.1) (2010-09): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 1: Functional Requirements".

[i.3] ETSI TS 101 539-1 (V1.1.1) (2013-08): "Intelligent Transport Systems (ITS); V2X Applications; Part 1: Road Hazard Signalling (RHS) application requirements specification".

[i.4] ETSI TS 102 723-5 (V1.1.1) (2012-11): "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 5: Interface between management entity and facilities layer".

[i.5] ETSI TR 102 863 (V1.1.1) (2011-06): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Local Dynamic Map (LDM); Rationale for and guidance on standardization".

[i.6] ISO/IEC 19505-2:2012(E): "Information technology - Object Management Group Unified Modeling Language (OMG UML), Superstructure".

[i.7] European Commission: "2010-2013 ICT Standardisation Work Programme for industrial innovation", 2nd update - 2012.

NOTE: Available at: http://ec.europa.eu/enterprise/sectors/ict/files/ict-policies/2010-2013_ict_standardisation_work_programme_2nd_update_en.pdf.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

area of interest: geographical area specified by data consumer limiting the LDM to satisfying the data consumers' subsequent requests for information only from data originating within that area

LDM area of maintenance: geographical area specified by the LDM for LDM maintenance

LDM data consumer: facility or an application that is authorized to request data from the LDM

LDM data object: object with attributes that can be accessed by the LDM Interfaces

LDM data object identifier: unique identifier within the LDM for a LDM Data Object added by a LDM Data Provider

LDM data provider: facility or an application that is authorized to provide the data to the LDM

Local Dynamic Map (LDM): facilities layer data store for storing LDM Data Objects that are timestamped and location referenced

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ASN	Abstract Syntax Notation
BSA	Basic Set of Applications
CA	Co-operative Awareness
CAM	Co-operative Awareness Message
DEN	Decentralized Environmental Notification
DENM	Decentralized Environmental Notification Message
FA-SAP	Facilities/Applications Service Access Point
ICRW	Intersection Collision Risk Warning
ICT	Information and Communication Technology
ITS	Intelligent Transport System
ITS-AID	ITS Application IDentifier
ITS-S	Intelligent Transport System Station
ITS-SU	Intelligent Transport System Station Unit
LCRW	Longitudinal Collision Risk Warning
LDM	Local Dynamic Map
MF-SAP	Management/Facilities Service Access Point
NF-SAP	Networking & Transport/Facilities Service Access Point
RHS	Road Hazard Signalling
SF-SAP	Security Facilities - Service Access Point
UML	Unified Modelling Language
V2V	Vehicle to Vehicle

4 General description of a LDM

A Local Dynamic Map (LDM) is a facility in cooperative Intelligent Transport Systems (ITS). It supports ITS applications by maintaining information on objects influencing or influenced by road traffic. ITS applications require information on moving objects such as vehicles nearby or on stationary objects such as traffic road signs. Information required by, or useful to active applications, can be maintained in a LDM.

The LDM is a conceptual data store located within an ITS-S as outlined in EN 302 665 [i.1] containing information which is relevant to the operation of ITS applications and related road safety and traffic efficiency. Data can be received from a range of different sources such as vehicles, infrastructure units, traffic centres, personal ITS stations, and on-board sensors and applications. The LDM offers mechanisms to grant secure access to the data that it holds. For example, the LDM can provide information on the surrounding vehicles and Road Side Units to any authorized application that requests it.

The information stored in the LDM can be accessed in the form of objects called LDM Data Objects. LDM Data Objects are provided from for example basic services for ITS Message Sets such as those defined in EN 302 637-2 [4] and EN 302 637-3 [5]. LDM Data Objects can be composed of sub objects, similar to the hierarchical structure of data frames in messages, and the objects contain attributes representing data elements from TS 102 894-2 [3]. Information on a vehicle or road side ITS-S for example is provided by a cooperative awareness basic service as defined in EN 302 637-2 [4] and is accessed from the LDM as a LDM Data Object with sub-objects representing the information from the CAM Basic Container. Information on an event for example is provided by a distributed environmental notification basic service as defined in EN 302 637-3 [5] and is accessed from the LDM as a LDM Data Object with sub-objects for the situation, location and a la carte containers.

The LDM can also store LDM Data Objects from applications and other facilities. For example, the LDM may maintain information on the ITS-S it is part of.

The LDM does not modify the data provided by LDM Data Providers. No permanent, static information is required to be stored in the LDM.

4.1 Functionality provided by the LDM

The basic functionality of the LDM is to provide a repository of information for facilities and applications. Facilities such as the CA and DEN basic services can store information into the LDM. Applications can retrieve information from and store information into the LDM. Additional functionality of the LDM includes:

- Registration/Deregistration of facilities and applications as LDM Data Providers/sinks to the LDM via the security layer (authorization) (see clause 6.1.1).
- Subscribe/Unsubscribe for notifications (see clause 6.3.4).
- Information retention by applying rules, e.g. based on time and/or location (see clause 5.3.2).
- Prioritization of requests (see clause 6.3.3).

5 LDM functional specification

5.1 LDM requirements

5.1.1 LDM functional requirements

A LDM may communicate with other entities within the ITS-S architecture outlined in EN 302 665 [i.1] in order to:

- receive incoming information such as decoded CAMs in accordance with EN 302 637-2 [4] and DENMs in accordance with EN 302 637-3 [5];
- store and protect information according to constraints of time and LDM Area of Maintenance;

- provide information to authorized applications as requested:
  - by means of a subscription/notification method; or
  - by means of queries including spatial queries;
- prioritize data requests;
- store and protect LDM Data Objects so that it can be shared with applications;
- provide a mechanism for facilities and applications to register and deregister as LDM Data Providers;
- provide a mechanism for applications to register and deregister as LDM Data Consumers;
- ensure data access by LDM Data Providers and LDM Data Consumers is authorized.

5.1.2 LDM other requirements

In addition to the functional requirements listed in clause 5.1.1, a LDM may be constrained by a range of other requirements such as reliability (system maturity, fault tolerance and restorability) and scalability. However, within communications systems such requirements are normally considered to be related to procurement and, consequently, are not specified in the present document.

5.2 The LDM within the ITS-S communication architecture

The LDM collects, qualifies (ensures that it is valid and from an authorized source) and stores data received from other ITS-Ss. The LDM may also collect, qualify and store information from other sources such as traffic information providers, or from its own sensors and applications.

As shown in Figure 1, the LDM receives data from other ITS-Ss through a common interface which is available to all message services such as CA and DEN within the ITS-S Facilities layer. Information is exchanged with other services or applications by invoking functions located at the FA-SAP as outlined in EN 302 665 [i.1]. Security and management permissions are provided by functions which are located at the SF-SAP and the MF-SAP respectively.

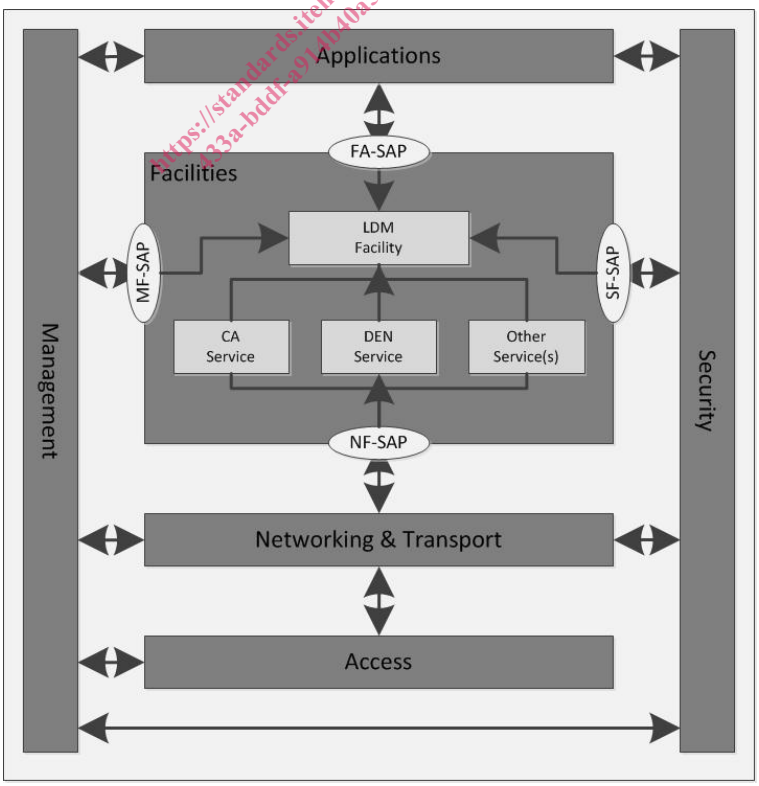

Figure 1: LDM and logical interfaces

5.3 LDM functional architecture

The rationale for and guidance on standardization of the LDM outlined in TR 102 863 [i.5] specify two main components of the LDM; the LDM Maintenance component and the LDM Service component (see clause 5.3.1). Figure 2 shows these two components of the LDM and its main interfaces in a Unified Modelling Language (UML) component diagram in accordance with ISO/IEC 19505-2 [i.6]. The interfaces are separated into those required by the LDM (IF.LDM.1 and IF.LDM.2) and those exposed to other facilities and applications (IF.LDM.3 and IF.LDM.4).

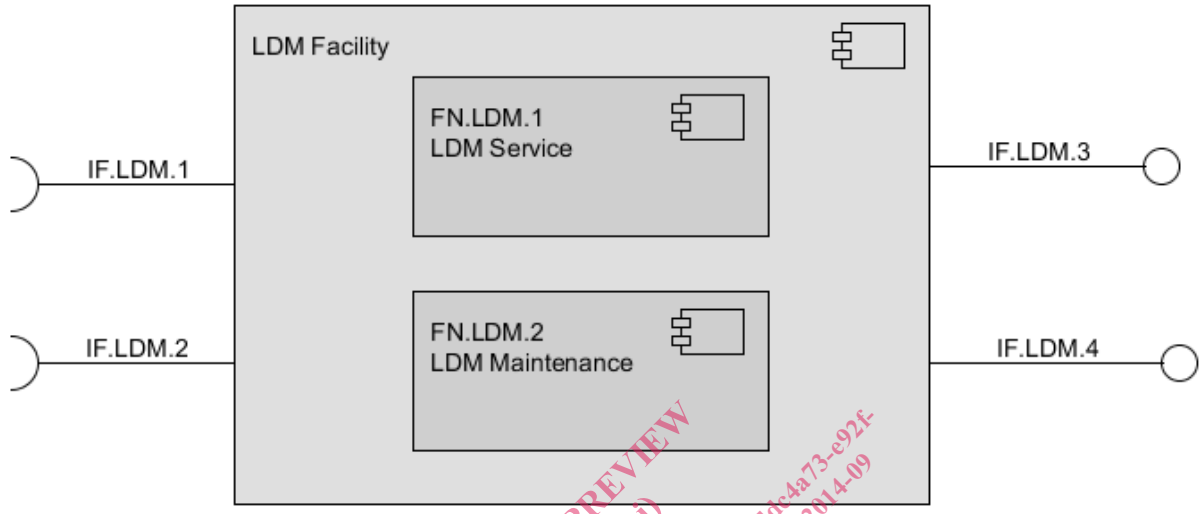

Figure 2: LDM Functional architecture

The LDM shall provide the functions defined in Table 1 and illustrated in Figure 2.

Table 1: LDM Functions

Function	Description
FN.LDM.1	The LDM Service component (see clause 5.3.1) is responsible for providing functionalities to authorized LDM Data Providers for LDM data manipulation (such as adding new data, modifying existing data, delete existing data), direct access to data (query data) and a publish/subscribe mechanism for data access by LDM Data Consumers. It also provides registration and deregistration functionalities to LDM Data Providers and LDM Data Consumers.
FN.LDM.2	The LDM Maintenance component (see clause 5.3.2) is responsible for storing and maintaining the data and its integrity as well as for the garbage collection of persistent data held within the LDM.

5.3.1 Function FN.LDM.1 - LDM Service

The LDM is connected to authorized LDM Data Providers and LDM Data Consumers. LDM Data Providers provide information to the LDM which makes these data available to LDM Data Consumers. The LDM offers three different types of interfaces:

- a transaction interface for LDM Data Providers, where a transaction describes a sequence of LDM Data Object exchanges between a LDM Data Provider and the LDM (see clause 6.2.3);
- a query interface for LDM Data Consumers (see clause 6.3.3); and
- a publish/subscribe interface for LDM Data Consumers (see clause 6.3.4).