6th ETSI ITS-Workshop

The globally applicable concept of a Local Dynamic Map

Results from CEN TC278 PT1604

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The global applicable LDM

Localization of dynamic objects, like moving vehicles, is not a new thing.
It was used since more than a century in the military area to detect and locate incoming enemy aircrafts and other vehicles.

History of LDM in Cooperative ITS

The idea of LDM in C-ITS, where applications utilizing bi-directional c2c and c2x communication, came up in the automotive research departments around 2000. One of the very early projects in Europe incorporating LDM information was the “Inter Truck Communication Project” by DaimlerChrysler Telematics Research(2001 - 2004).
The goal of the ITC units was to collect relevant time-stamped and geo-referenced road traffic information by the vehicle, and to share its experience with oncoming vehicles. From this experience, essential warnings were derived and presented to the driver.

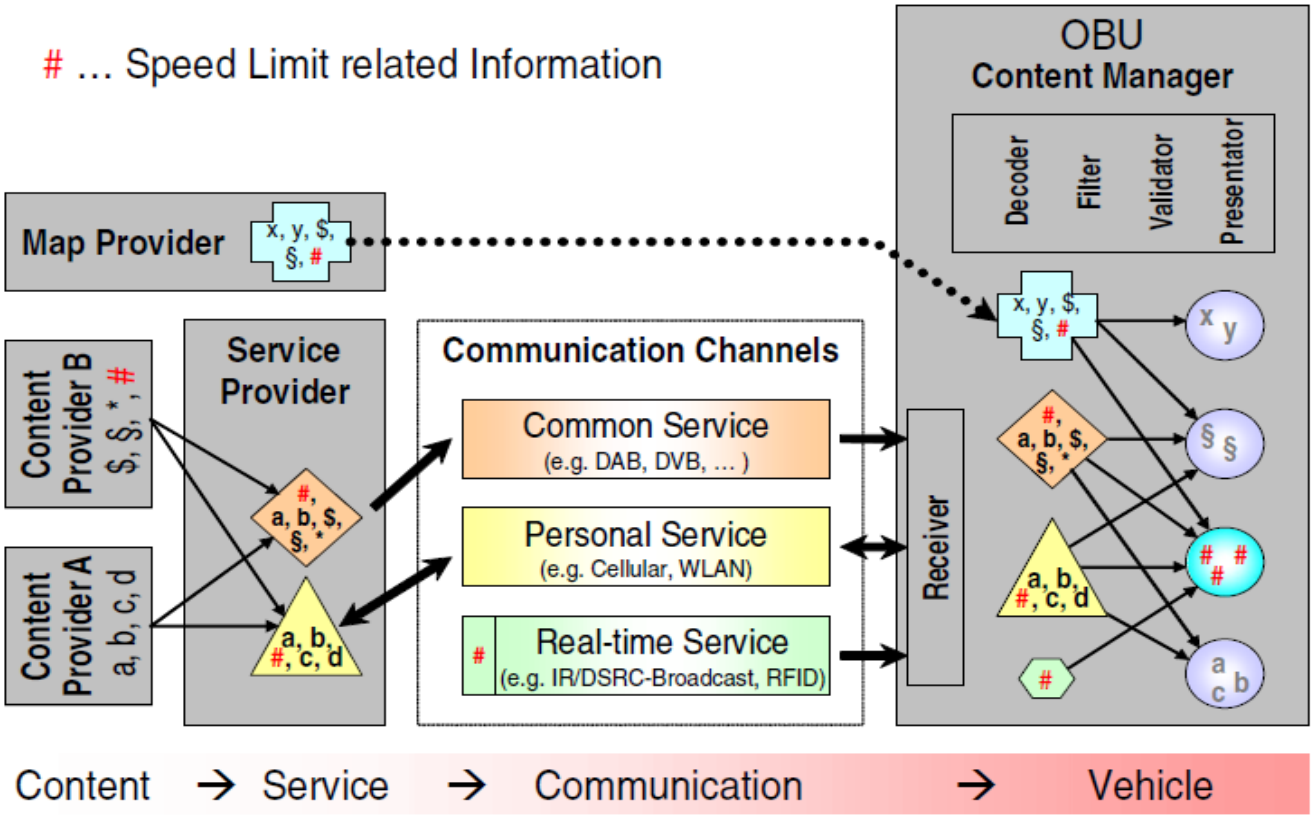
Traffic Information

Curve-Warning

Hazard-Warning

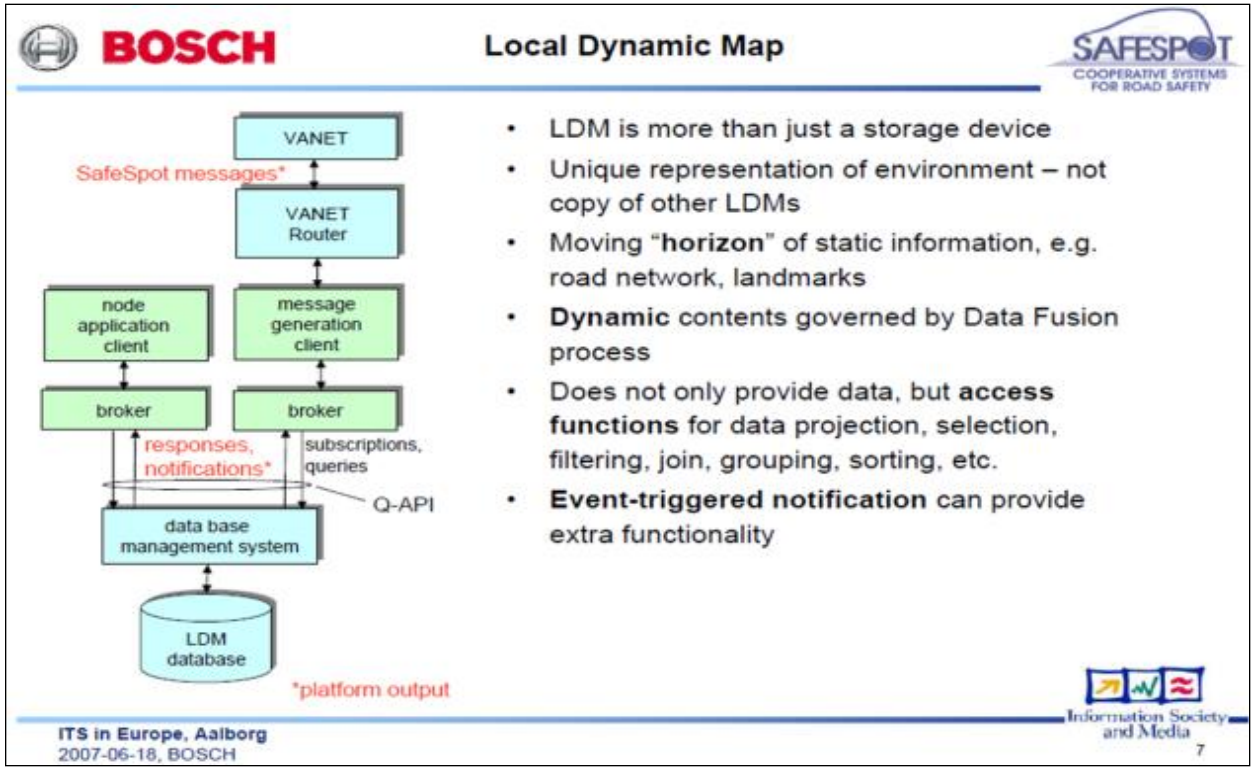
LDM in FP5 - SpeedAlert (2004)

The FP-5 “SpeedAlert” project was another project utilizing LDM data objects (even if they did not call it LDM) where time-stamped and geo-located information was distributed and exchanged also by the means of bidirectional communication.



LDM in CVIS / COOPERS / SAFESPOT

The “Cooperative Systems Call” of the EC was released in 2005 and finally the three ground laying C-ITS projects COOPER, CVIS and SAFESPOT were funded. All of them incorporated a LDM concept as a core element, but still each in a different proprietary architecture.
The drawing below reflects the SAFESPOT view on LDM in 2007.



LDM - Essential Findings and Requirements

During the execution of the projects it became obvious that

- Available information shall be shared among all application in an CITS-S to avoid overloads of communication channels
- International harmonized LDM standards are needed as key-elements for the successful deployment of CITS.
- Another essential outcome was, that two basic sets of requirements are given which could not be covered by a single standard. The specific LDM-requirements are too much depending on the role of the CITS-Station.
- Therefore, the development of LDM-standard for automotive real-time safety-applications EN 308 295 is developed at ETSI by the EC funded STF 448, while the LDM-Standard for global applicability TS18750 (later EN) is executed in CEN by the PT1604. Both Standards shall become published in 2014.

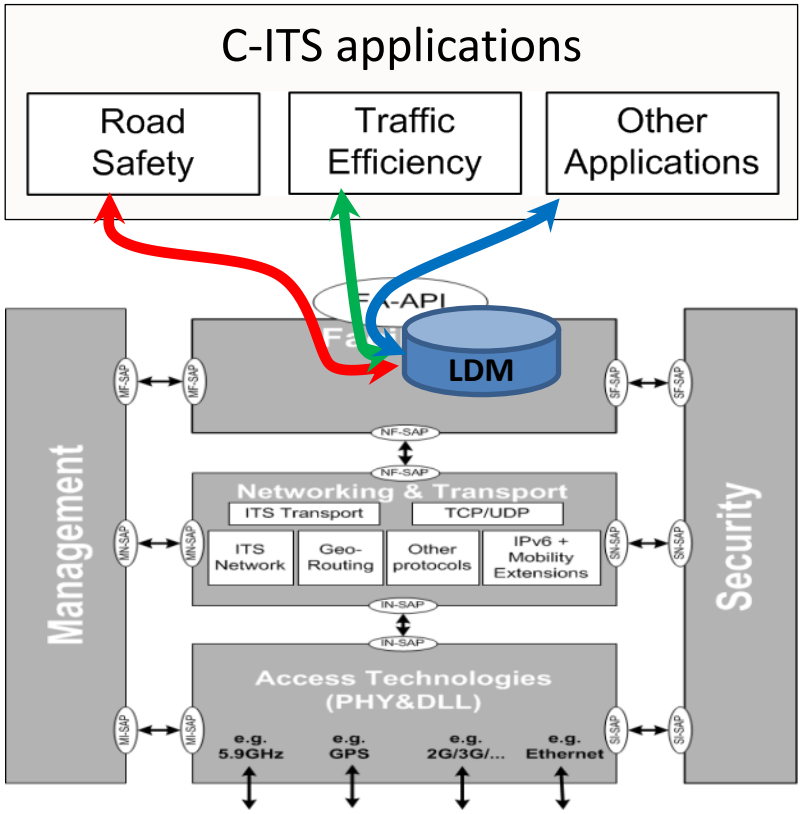
Concept of a global applicable LDM

- The PT1604 develops the CEN ISO TS18750 “Definition of a global concept for Local Dynamic Maps”. It defines a LDM concept for global applicability in respect of use-cases and all kinds of C-ITS-Stations
- A local dynamic map (LDM) is a kind of data store inside an ITS station unit (ITS-SU) which communicates locally with ITS-S application processes of the same ITS-SU
- The CEN TC278/WG16-DT3 is the home base of PT1604
- The WI is under the EC-Mandate 453 and is developed in a close cooperation with the ETSI STF448 and TC204/WG3

Benefit of using a global LDM concept

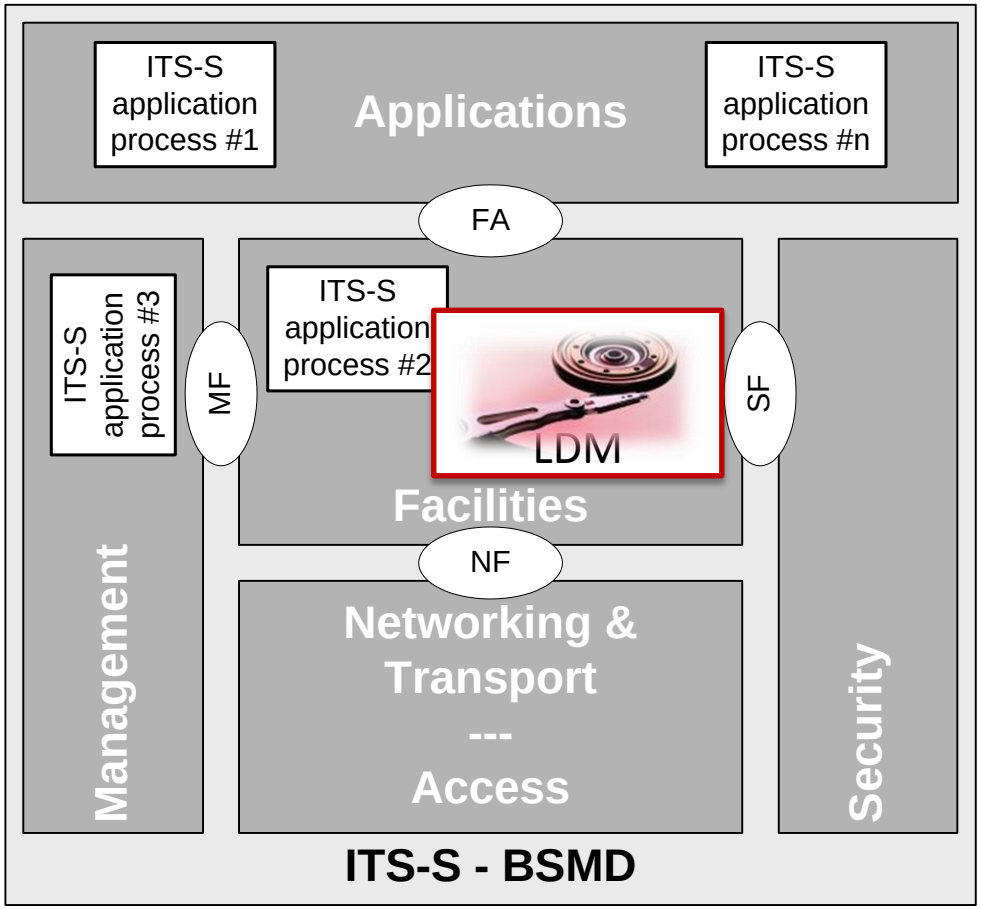
The implementation of an global LDM will radically change the way applications are developed and implemented.

It will improve the performance of C-ITS applications by shorten the response time to queries and reduce data traffic.



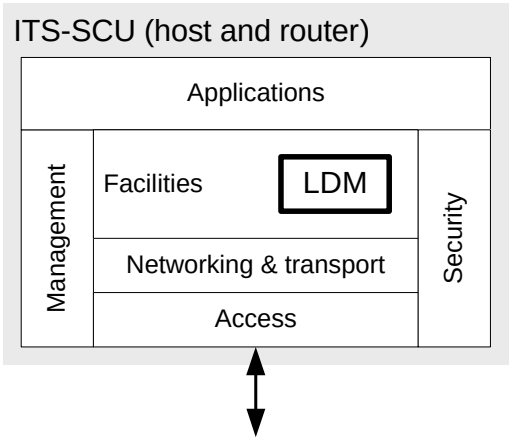
LDM functionality in a trusted environment

- LDM is located in the ITS-S facilities layer of an ITS station (ISO 21217) operated as a bounded secured managed domain (BSMD).
- LDM serves ITS-S application processes located somewhere in an ITS-S.
- LDM interfaces are specified by means of functions of FA-SAP and MF-SAP allowing for different implementations (ISO 24102-3).

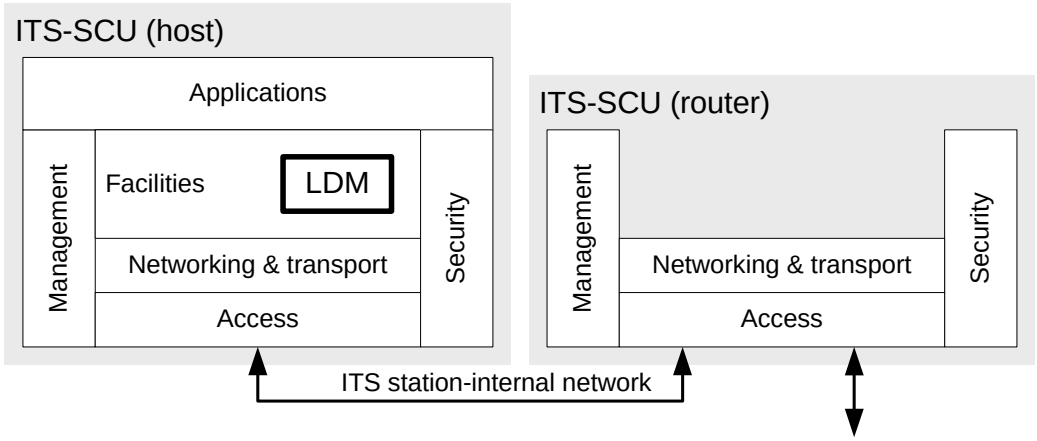


LDM and ITS-S application processes in an ITS station

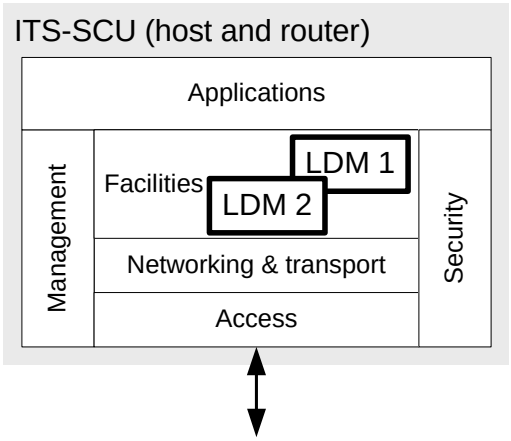
Implementation architecture examples



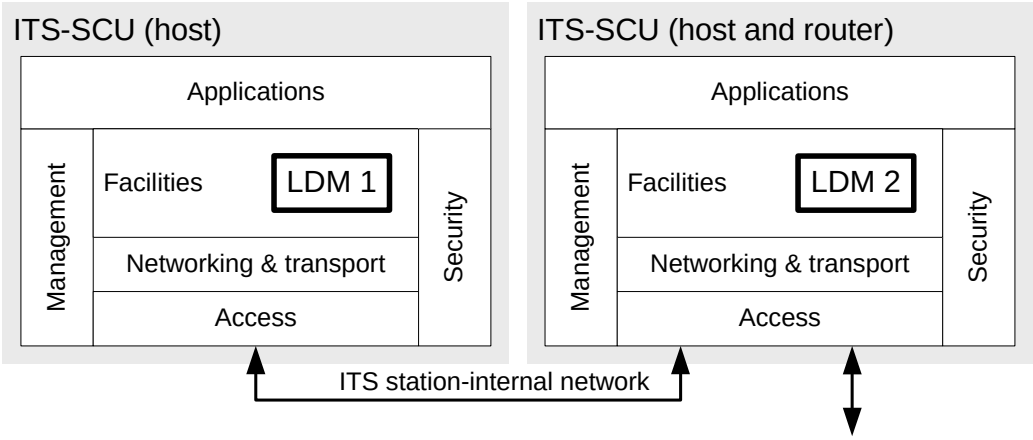
Single LDM in a "single-box ITS-SU"



Single LDM in a "double-box ITS-SU"



Two LDMs in a "single-box ITS-SU"



Two LDMs in a "double-box ITS-SU"

ITS-S management communications over the ITS station-internal network is specified in ISO 24102-4.

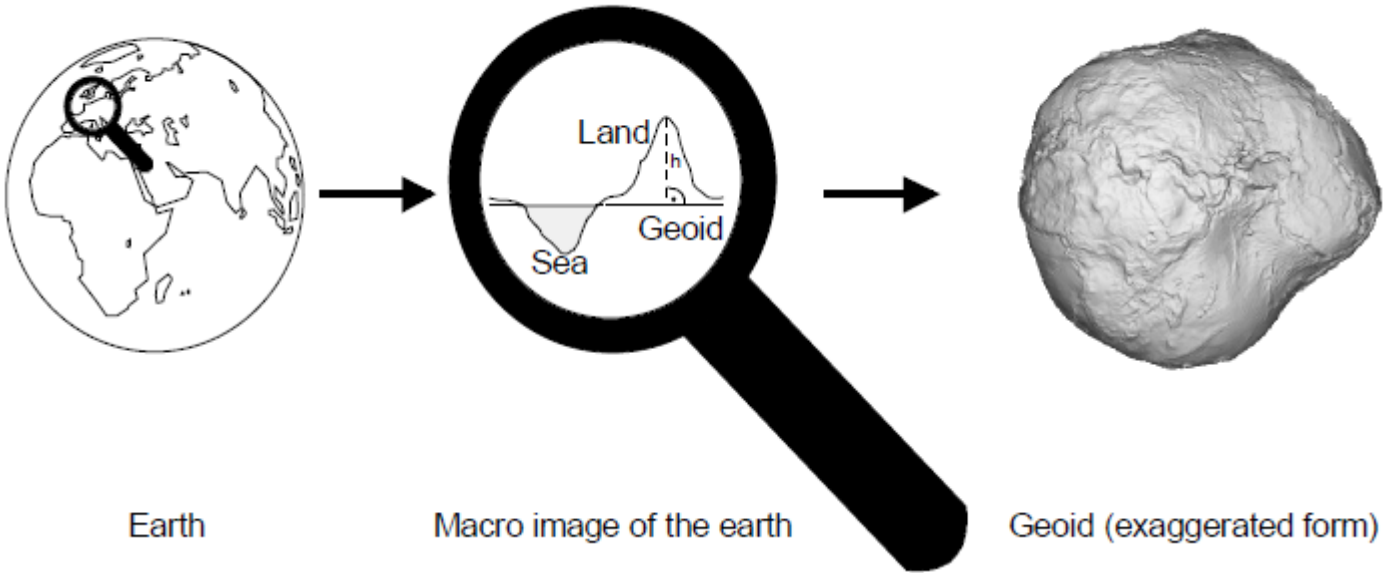
Trusted environment

LDM access control

- Builds on trust provided by the BSMD.
- ITS-S application processes have to register at the LDM prior to first usage of the LDM, presenting their access rights together with means allowing online validation of the claimed rights. LDM is using security services in the ITS-S security entity for this purpose.
- Subsequent attempts of a registered ITS-S application process to use the LDM within the context of claimed and approved rights will be granted without further involvement of the ITS-S security entity.
- The ITS-S security entity continuously may check for updates of the access rights of registered ITS-S application processes, and may revoke already confirmed granted rights.

The crux with geo location

The earth is in no way a sphere, it's is indeed looking like a potato!

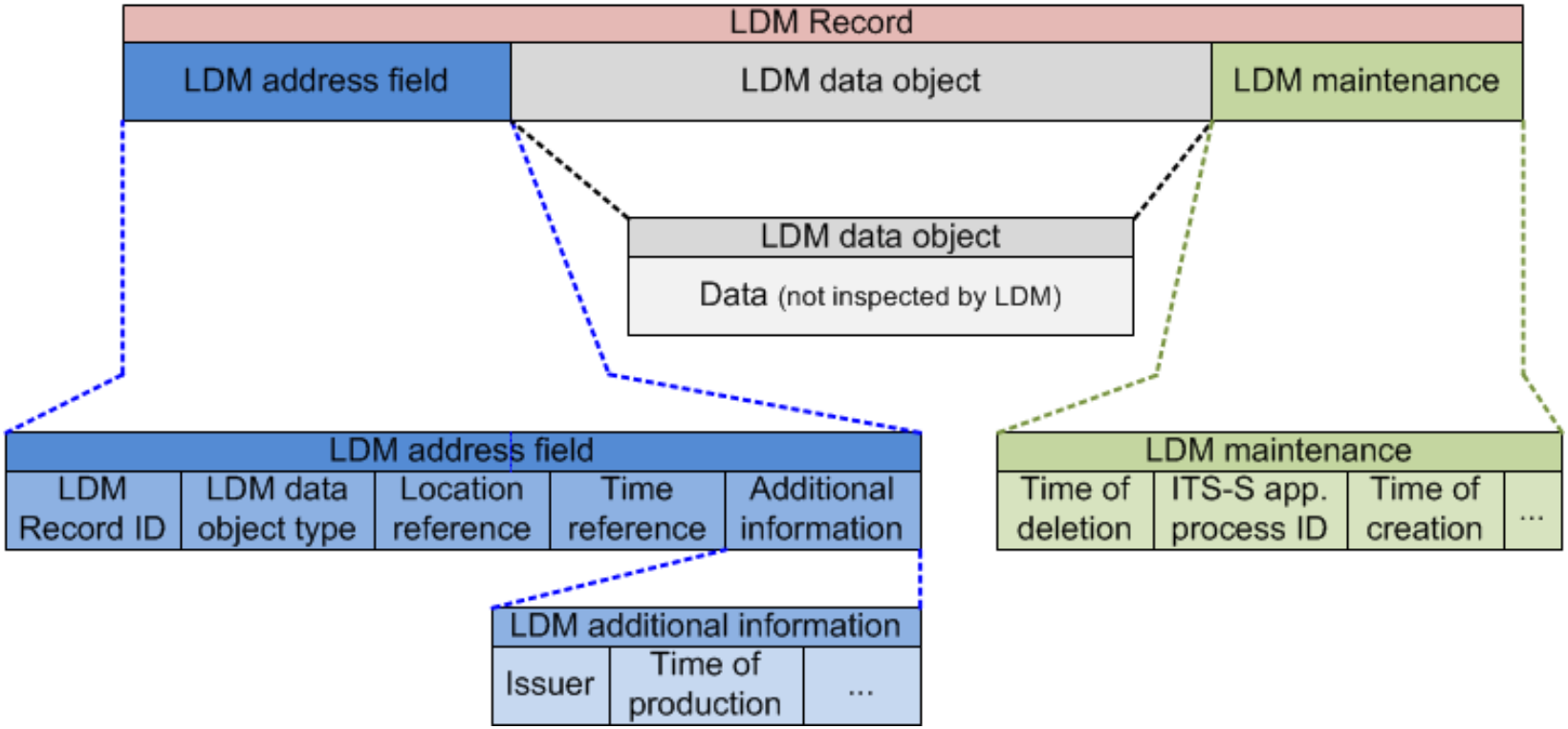


From satellite to location – several calculations!

Source: "Essentials of Satellite Navigation" published by μ-blox AG and can be downloaded from www.u-blox.com

Structure of LDM Records

- The LDM data store contains LDM Records
- The LDM record is build in a way to enable fast queries and short response times on one hand and maintain the initial precision of the geo-location given by the data source on the other



LDM Basic

LDM data objects must have at least these 4 attributes:

- It shall be “real object”
  A real object like a vehicle, a pedestrian, a road construction site …)
  Therefore it needs to carry a **type information**
- It shall be “local”
  The LDM-element shall be in a pre-defined area of interest.
  Therefore it needs to carry a **geo-location**
- It shall be “dynamic” in its nature
  e.g. a vehicle, even it may be in standstill at the moment
  Therefore it needs to carry a **time-stamp**
- They shall be associated with a “map”
  Therefore it needs to be connected to a **geo-referencing** system.

LDM data object

o Information on a real object

- Vehicle, Pedestrian, ...
- Event zone (black ice area, road construction site, ...)

✓ with location reference

- Absolute GPS coordinates (spot, polygon, pre-defined area shape: two or three dimensional)
- Abstract, e.g. Street name, section, direction
- Relative to a given reference point

✓ and time reference

- Absolute time interval (IAT, UTC);
- Abstract Year, month, day, hour, minute, second; Week-day
- Relative to a given reference point

✓ and with associated attributes

The information part may be inspected by the LDM if and only if it consists of elements identified by registered (standardized) reference numbers.

The information part may be empty as the type info might be sufficient.

Using the LDM

Write / query / subscribe / delete

- Four access modes are specified, i.e. write LDM data objects into the LDM, query the LDM for LDM data objects, subscribe at LDM for updates of LDM data objects, delete LDM data objects.
- Access rights may be different for write and quere / subscribe, and service may depend on a priority.
- At time of writing an LDM data object, as a minimum the type of the LDM data object and the location reference and time reference of the real object are to be provided by the ITS-S application process. This information is stored together with the LDM data object – which itself could be empty. Further attributes may also be presented and will be stored. A unique reference ID is returned.
- In queries, LDM data object type, location and time references and attributes as presented by an ITS-S application process are used to retrieve appropriate LDM data objects from the LDM. Direct access using the unique reference ID is also possible, e.g. to delete a specific LDM data object.

LDM Data Dictionary

- Several data dictionaries / ITS message sets already exist for ITS, and new ones are under development at CEN / ISO / SAE
- An ITS-S application should not know about different sources of the same information, e.g. black ice area

  → LDM related information contained in messages received in an ITS-SU are converted by the message parser into the globally standardized format of LDM Data Objects as specified in an LDM Data Dictionary. The LDM Data Dictionary will be implemented by means of a continuously growing web based registry.

- CEN/ISO 18750 specifies the "mechanics" on how to create elements of the LDM Data Dictionary, and provides examples for existing message sets

Implementing a LDM

Implementing is now your task! ;-)

Thank you for your kind attention!

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References:

COMeSafety: http://www.comesafety.org; COOPERS: http://www.coopers-ip.eu; CVIS: http://www.cvisproject.org
SafeSpot: http://www.safespot-eu.org; SEVECOM: http://www.sevecom.org; GeoNet: http://www.geonet-project.eu
ITSSv6: http://www.itssv6.eu; FRAME: http://www.frame-online.net; CAR2CAR: http://www.car-to-car.org
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