



■ An LDM standard – CEN/ISO 18750

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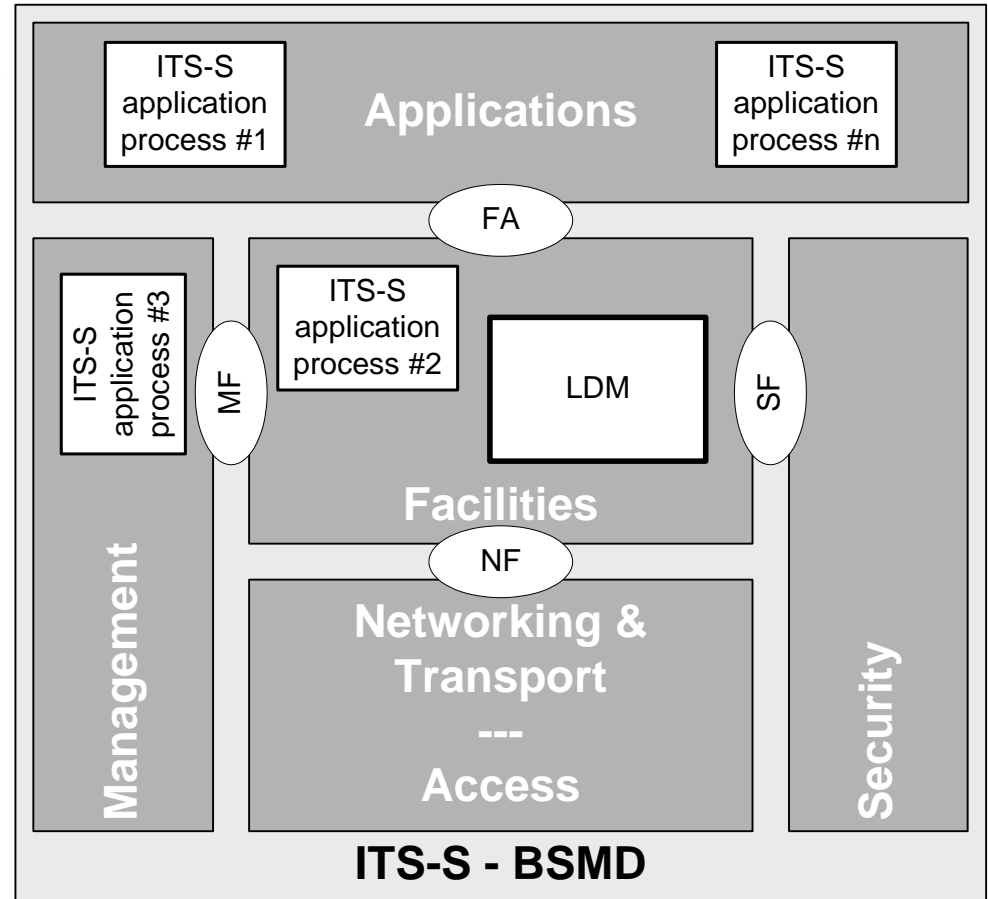
○ A local dynamic map (LDM) is a kind of data store inside an ITS station unit (ITS-SU) which communicates only locally with ITS-S application processes of the same ITS-SU.

→ Why to have a standard?

✓ ITS-S application processes may be downloaded in an ITS-SU. Consequently a reason for a standard is to enable portability of ITS-S application processes, i.e. by specifying a common interface between the LDM and the ITS-S application processes.

LDM functionality in a trusted environment

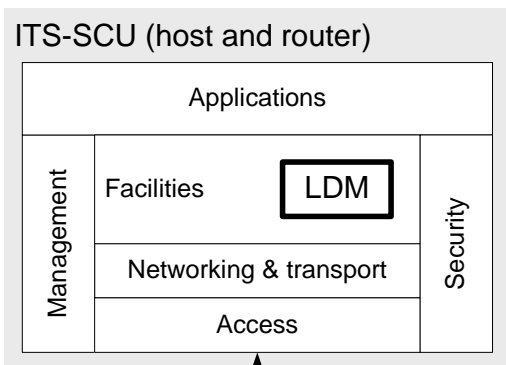
- LDM is located in the ITS-S facilities layer of an ITS station (ISO 21217) operated as a bounded secured managed domain (BSMD).
- LDM serves ITS-S application processes located somewhere in an ITS-S.
- LDM interfaces are specified by means of functions of FA-SAP and MF-SAP allowing for different implementations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



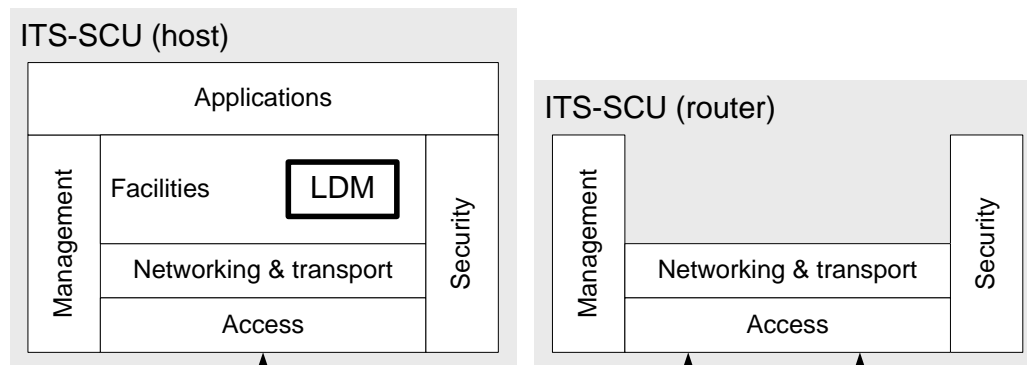
LDM and ITS-S application processes in an ITS station

- o ISO 21217 describes implementation architectures, where an ITS-SU is composed of several physical units (ITS-SCUs). In each ITS-SCU there may be LDMs and ITS-S application processes. These ITS-SCUs may be from different suppliers.
- ✓ The LDM interfaces become observable on the ITS station internal network, and thus testable. A precise specification of the interfaces is needed to enable interoperability.

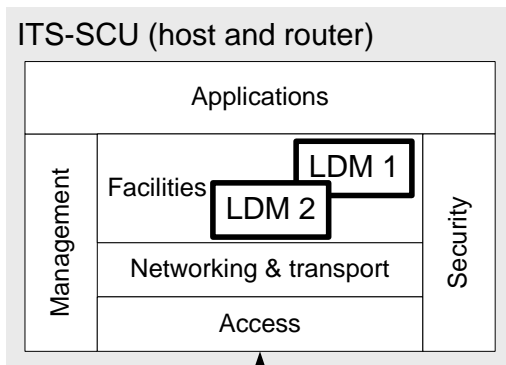
Implementation architecture examples



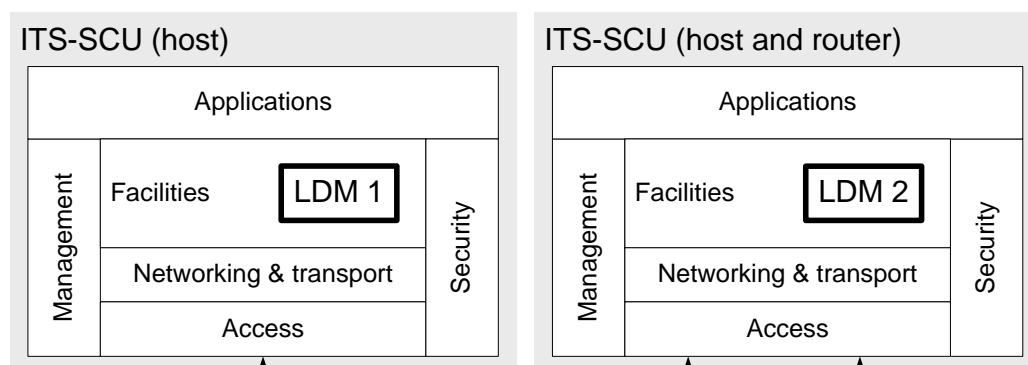
Single LDM in a "single-box ITS-SU"



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



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



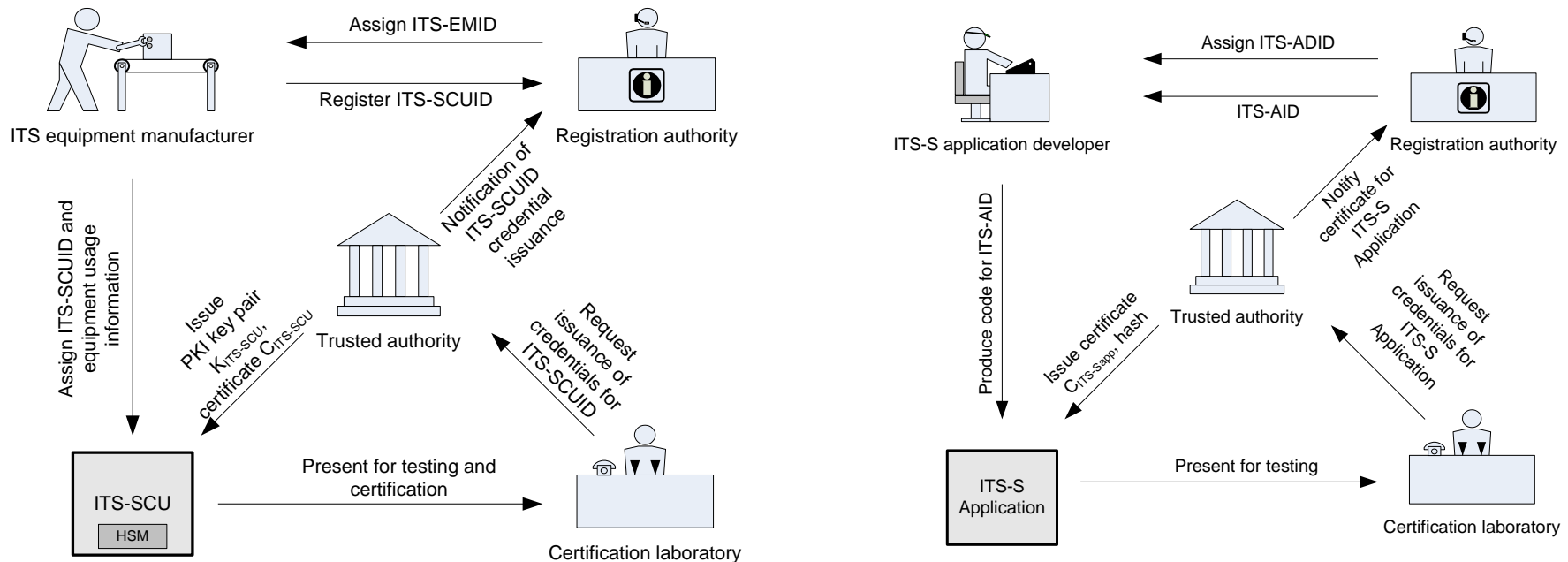
Two LDMs in a "double-box ITS-SU"

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

- ✓ A standard ensures a minimum level of functionality by specifying mandatory features.
- ✓ A standard is also used to simply describe usage of an LDM in the context of an ITS-SU.

o BSMD

- An ITS-SU is operated as a Bounded Secured Managed Domain, i.e. controls usage of the functionality of an ITS-SU by ITS-S application processes (**ISO 21217**).
- Trust is provided by applying security principles (**CEN/ISO 17419**) with a Public Key Infrastructure (PKI), a trusted ITS-SCU configuration management centre, certificates for real-time communication, prioritization of activities, ...



o 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.

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 is not inspected by the LDM. In case it consists of elements identified by registered (standardized) reference numbers, the LDM can perform filtering on these elements.

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

LDM data object and its attributes

○ LDM data object type

- globally unique identifier

○ LDM data object attribute type

- globally unique identifier (allows LDM to filter for attributes)

○ Source of LDM data object

- issuer
- time of information production

○ Required time of deletion of LDM data object from LDM store

○ Quality indicators

- raw / fused data
- private entity / authority

○ Provisioner

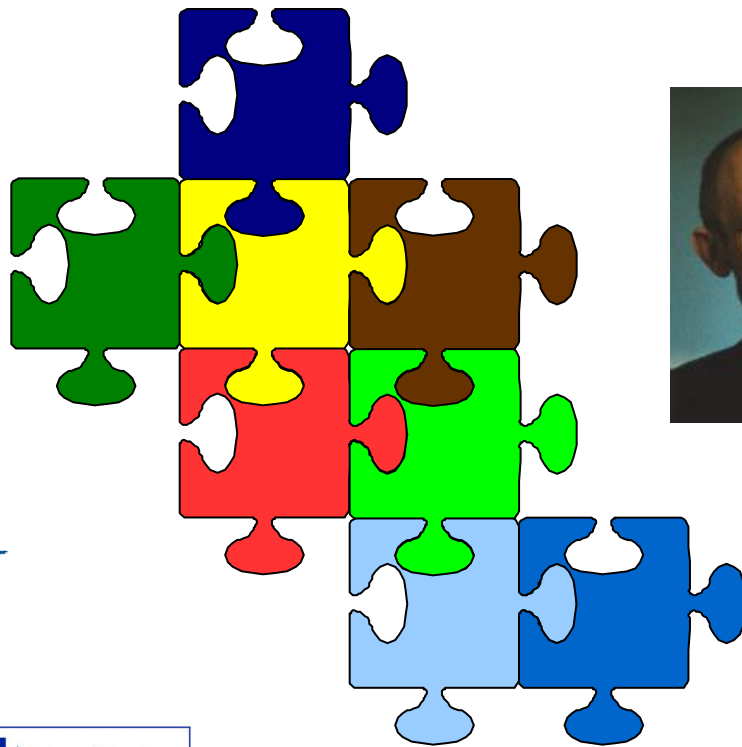
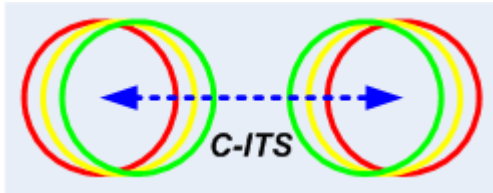
- source of information, e.g. BSM, DATEX, TPEG, CAM etc.

o 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 query / 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.

- 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.

We put jigsaw pieces together



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