

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**FG M2M**

D2.1 – Version 1.0  
(04/2014)

ITU-T Focus Group on M2M Service Layer

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**M2M service layer: Requirements and  
architectural framework**

Focus Group Technical Report



## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. The ITU-T Focus Group on the M2M service layer (FG M2M) was established further to ITU-T TSAG agreement at its meeting in Geneva, 10-13 January 2012. ITU-T Study Group 11 is the parent group of FG M2M.

Deliverables of focus groups can take the form of technical reports, specifications, etc. and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

### **SERIES OF FG M2M TECHNICAL REPORTS**

Deliverable 0.1: M2M standardization activities and gap analysis: e-health

Deliverable 0.2: M2M enabled ecosystems: e-health

Deliverable 1.1: M2M use cases: e-health

**Deliverable 2.1: M2M service layer: requirements and architectural framework**

Deliverable 3.1: M2M service layer: APIs and protocols overview

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# Deliverable D2.1 “M2M service layer: Requirements and architectural framework”

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## **M2M service layer: Requirements and architectural framework**

### **1 Scope**

The objective of this Deliverable is to identify requirements of the M2M service layer, which are common to all M2M verticals or specific to e-health application support, and to provide an architectural framework of the M2M service layer.

In particular, the scope of this Deliverable includes:

- Definition of the M2M service layer
- Requirements of the M2M service layer
- Architectural framework of the M2M service layer
- Reference points of the M2M service layer

### **2 References**

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Deliverable. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Deliverable are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Deliverable does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2060] ITU-T Recommendation Y.2060 (2012), *Overview of the Internet of things*

### **3 Definitions**

#### **3.1 Terms defined elsewhere**

This Deliverable uses the following terms defined elsewhere:

**3.1.1 IoT** [ITU-T Y.2060]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

### **4 Abbreviations and acronyms**

This Deliverable uses the following abbreviations and acronyms:

BAN	Body Area Network
DA	Device Application
GA	Gateway Application

IoT	Internet of Things
M2M	Machine to Machine
NA	Network Application
SCL	Service Capabilities Layer
SL	Service Layer

## 5 Conventions

None

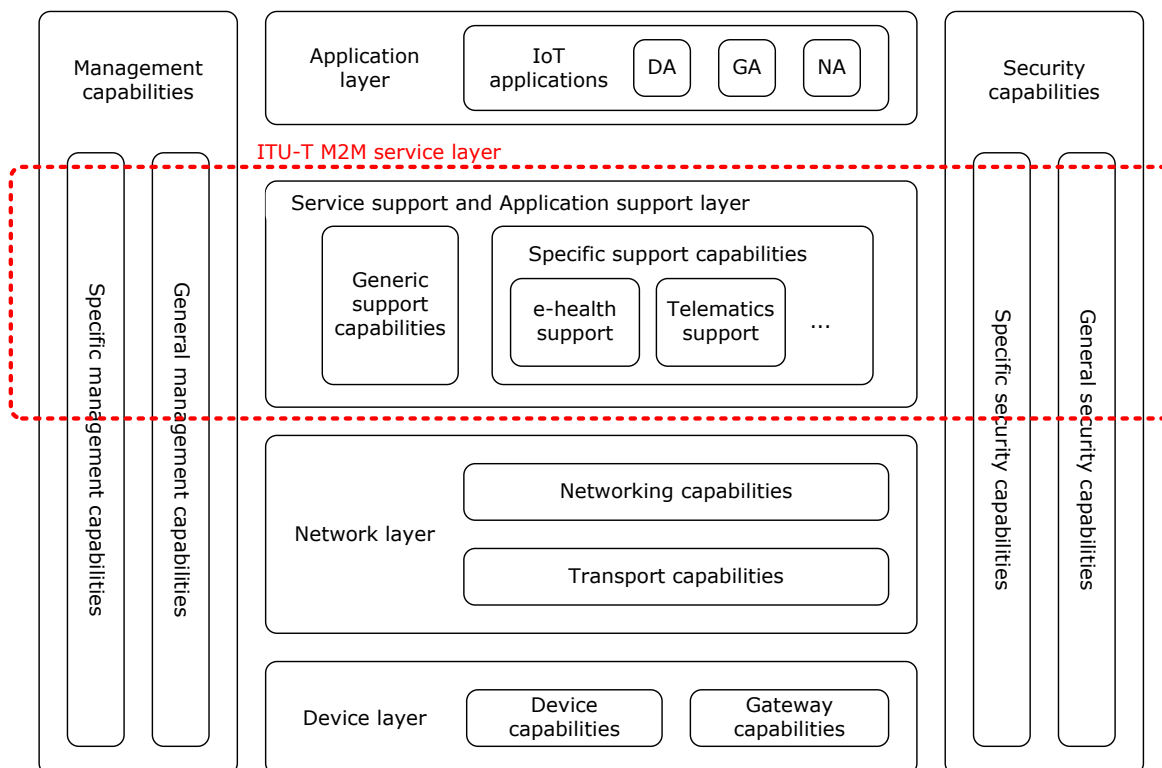
## 6 Definition of the ITU-T M2M service layer

### 6.1 The ITU-T M2M service layer and its relationship with the IoT reference model

From the ITU-T perspective, the machine to machine (M2M) technologies are a key enabler of the Internet of Things (IoT) [ITU-T Y.2060].

The M2M service layer in the ITU-T scope – the “ITU-T M2M service layer” – includes a set of generic and specific functions for the support of a variety of applications enabled by the M2M technologies. These functions include management functions and security functions as well as service support and application support functions. The capabilities of the ITU-T M2M service layer are a subset of the whole set of capabilities of the IoT.

Figure 1 shows the ITU-T M2M service layer and its position in the IoT reference model [ITU-T Y.2060].



**Figure 1 – The ITU-T M2M service layer in the IoT reference model**

The layered architectural approach, as illustrated in Figure 1, reduces the implementation complexity while providing interoperability between different applications enabled by the M2M technologies.

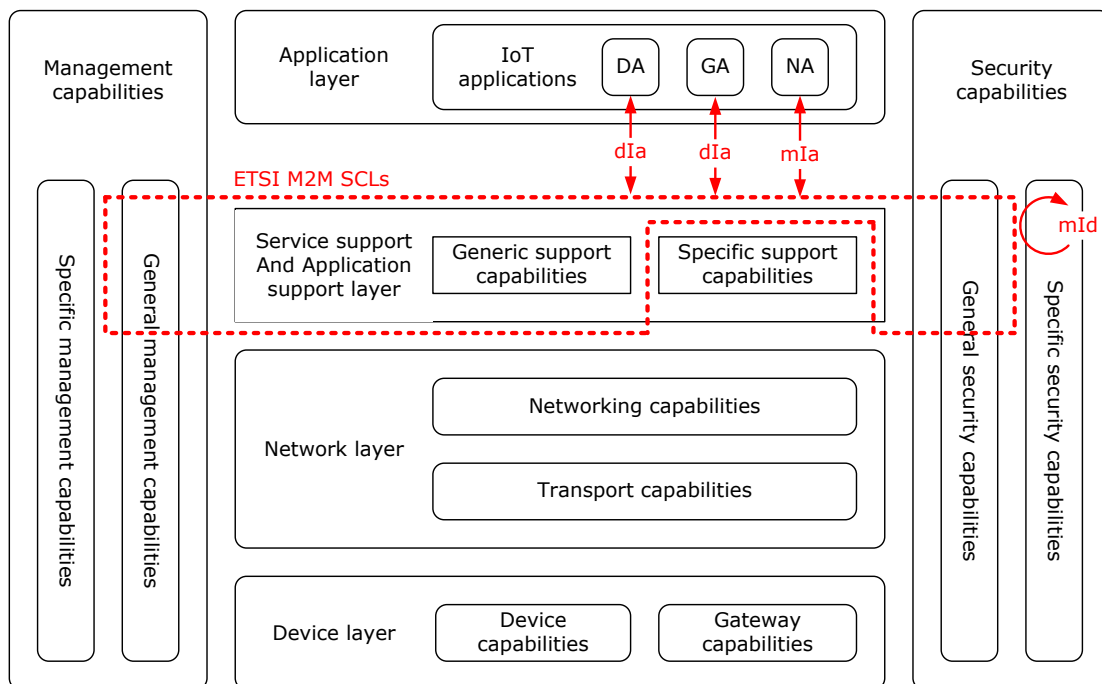
NOTE – Other architectural approaches are out of scope of this document. It has to be noted that cross layer architectural approaches can show higher performances but at the expense of higher implementation complexity.

The specific support capabilities in the service support and application support layer include application specific support capabilities (e.g., the e-health support and telematics support capabilities as shown in figure 1).

Three types of applications are identified on top of the ITU-T M2M service layer (Application layer): device applications (DAs), gateway applications (GAs) and network application servers (NAs). DA, GA and NA reside, respectively, in a device, gateway and network application server. All these applications can use capabilities provided by the ITU-T M2M service layer.

## 6.2 The ETSI M2M service capabilities layer and its relationship with the ITU-T M2M service layer

The ETSI M2M service capabilities layer (SCL) [b-ETSI 102 690] provides functions that are shared by different applications enabled by the M2M technologies, and can be positioned with respect to the IoT reference model described in [ITU-T Y.2060] as shown in Figure 2.



**Figure 2 – ETSI M2M SCL in the IoT reference model**

In Figure 2, dIa and mIa from [b-ETSI 102 690] can be considered as reference points between IoT applications and the service support and application support layer with inclusion of the general management capabilities and general security capabilities. mId from [b-ETSI 102 690] can be considered as the reference point between the service support and application support layer of different devices.

As shown in Figure 2, the ETSI M2M SCL includes only general functions of service support and application support layer, general management capabilities and general security capabilities.

Compared to the ETSI M2M SCL, the ITU-T M2M service layer includes specific support capabilities in the service support and application support layer, specific management capabilities and specific security capabilities as shown in Figure 1.

It is then anticipated that dIa, mIa and mId from [b-ETSI 102 690] may need extension to include the support of the specific support capabilities in the service support and application support layer, the specific management capabilities and the specific security capabilities.

## **7 Requirements of the ITU-T M2M service layer**

### **7.1 Common requirements**

#### **7.1.1 Communication management**

- Message scheduling

The ITU-T M2M service layer is required to support various priorities of messages.

- Various types of communications

The ITU-T M2M service layer is required to support various types of communication (e.g., on-demand or continuous communications) requested by applications. It should also support notification of communication failure.

- Various underlying network technologies support

The ITU-T M2M service layer is required to support underlying network technologies.

#### **7.1.2 Application management**

- Multiple applications support

The ITU-T M2M service layer is required to support multiple applications concurrently.

#### **7.1.3 Service and device discovery and registration**

- Service and device discovery and registration

The ITU-T M2M service layer is required to support service and device discovery and registration.

#### **7.1.4 Service accounting and charging**

- Service accounting and charging

The ITU-T M2M service layer is required to support service accounting and charging.

#### **7.1.5 Device management**

- Auto configuration

The ITU-T M2M service layer is required to support auto configuration and configuration management of devices and upgrading of software on the devices in a secure way.

- Management of multiple devices and various types of devices

The ITU-T M2M service layer is required to support management of multiple devices and various types of devices.

#### **7.1.6 Data processing**

- Data storage and notification



The ITU-T M2M service layer is recommended to provide capability of data storage for applications. Once data are updated, the ITU-T M2M service layer should inform subscribed applications.

- Data formatting and translation

The ITU-T M2M service layer is recommended to provide capability of data formatting and translation to facilitate semantic interoperation between applications.

- Data collection and reporting

The ITU-T M2M service layer is required to support both on-demand and periodic reporting as requested by applications.

### **7.1.7 Diagnostics and fault recovery**

- Diagnostics and fault recovery

The ITU-T M2M service layer is required to support diagnostic mechanisms for applications and devices. Also it should support fault recovery and fault management to recognize, isolate, correct and log faults that occur.

### **7.1.8 Identification, naming and addressing**

- Reachability of devices by identification

The ITU-T M2M service layer is required to support reachability of devices based on device identification.

### **7.1.9 Security**

- Authentication

The ITU-T M2M service layer is required to provide authentication mechanisms for applications and devices and prevent unauthorized use of the devices.

- Privacy

The ITU-T M2M service layer is required to support privacy protection capabilities, such as anonymity of identity and location, according to regulation and laws.

- Confidentiality

The ITU-T M2M service layer is required to support data transfer confidentiality.

- Integrity

The ITU-T M2M service layer is required to support data integrity protection.

- Support of security for service scenarios involving multiple actors

The ITU-T M2M service layer is required to support security capabilities, such as supporting user access control of protected data, for M2M service scenarios involving multiple actors inside a single administrative domain and across different administrative domains (e.g., countries, operators).

### **7.1.10 Location provisioning**

- Location information

The ITU-T M2M service layer is recommended to support collection, tracking and reporting of location information according to different collection, tracking and reporting strategies.

### 7.1.11 Group management

- Group management

The ITU-T M2M service layer is required to support a mechanism to create and manage virtual group of devices.

## 7.2 e-health specific requirements

- Security for personal health information

The ITU-T M2M service layer is required to provide security capabilities in compliance with regulation and laws regarding personal health information (personal data and medical data).

- Privacy protection

The ITU-T M2M service layer is required to provide privacy protection capabilities for personal health information in compliance with regulation and laws (personal data and medical data when they are associated with person's identification).

- e-health device profile support

The ITU-T M2M service layer is required to support e-health device profile according to international standards (e.g., medical BAN [b-IEEE802.15.6], Bluetooth [b-Bluetooth]).

- Time synchronization and time stamping

The ITU-T M2M service layer is required to support time stamping since health conditions vary over time. With time stamping, e-health applications can obtain useful information according to the health condition history. For support of time stamping, the ITU-T M2M service layer is also required to retrieve time parameters from authoritative time servers and publish time parameters according to the requests from e-health applications.

- Audit trail support

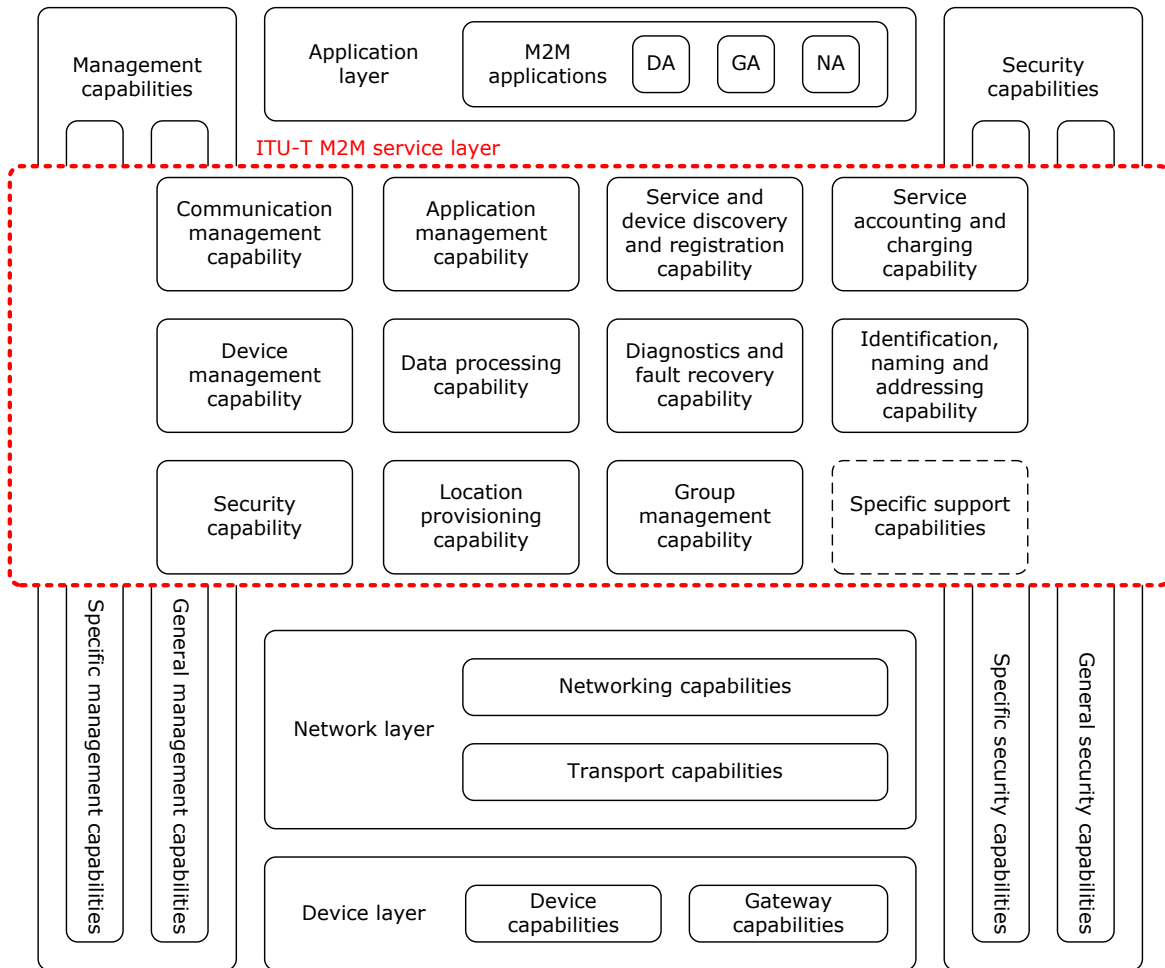
The ITU-T M2M service layer is required to support audit trails ensuring that any access or attempt to access personal health information is fully transparent, traceable and reproducible.

## 8 Architectural framework of the ITU-T M2M service layer

### 8.1 Overview of the architectural framework of the ITU-T M2M service layer

As described in clause 6, the ITU-T M2M service layer is positioned between the application layer and the network layer, and provides different types of capabilities, including generic support capabilities, specific support capabilities, general and specific management capabilities, general and specific security capabilities.

Figure 3 shows the architectural framework of the ITU-T M2M service layer.



**Figure 3 – The ITU-T M2M service layer architectural framework**

NOTE – The following references can be used for further development of the architectural framework.

- m2m-i-014r1 [b-m2m-i-014r1]
- m2m-i-015 [b-m2m-i-015]
- m2m-i-091 [b-m2m-i-091]
- m2m-i-092 [b-m2m-i-092]
- m2m-i-115 [b-m2m-i-115]
- m2m-i-204 [b-m2m-i-204]
- Recommendation ITU-T Y.2240 [b-ITU-T Y.2240]
- Recommendation ITU-T Y.2025 [b-ITU-T Y.2025]
- Recommendation ITU-T Y.2061 [b-ITU-T Y.2061]

## 8.2 The capabilities of the ITU-T M2M service layer

### 8.2.1 Communication management capability

This capability supports message scheduling, various types of communications and various underlying network technologies.

### **8.2.2 Application management capability**

This capability supports multiple applications.

### **8.2.3 Service and device discovery and registration capability**

This capability supports service and device discovery and registration.

### **8.2.4 Service accounting and charging capability**

This capability supports accounting and different charging models, including both online and offline charging.

### **8.2.5 Device management capability**

This capability supports auto configuration, management of multiple devices and various types of devices.

### **8.2.6 Data processing capability**

This capability supports data storage, notification, formatting, translation, collection and reporting.

### **8.2.7 Diagnostics and fault recovery capability**

This capability supports recognition, isolation, correction and logging of the faults that occur in the application layer and the ITU-T M2M service layer.

### **8.2.8 Identification, naming and addressing capability**

This capability supports reachability of devices based on device identification, naming and addressing.

### **8.2.9 Security capability**

This capability supports authentication, privacy protection, confidentiality, integrity and support of security for service scenarios involving multiple actors.

### **8.2.10 Location provisioning capability**

This capability supports the acquisition and management of location information based on the requests from applications.

### **8.2.11 Group management capability**

This capability supports mechanisms to create and manage virtual group of devices.

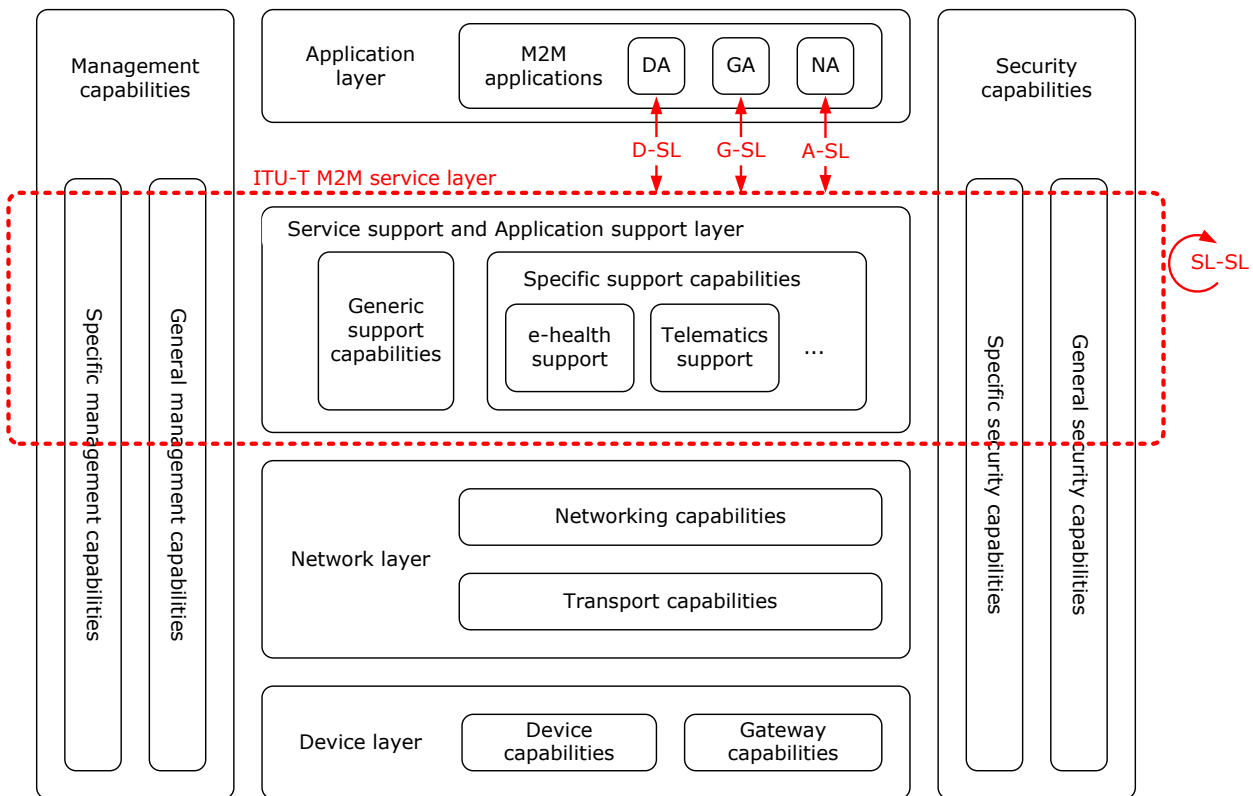
### **8.2.12 Specific support capabilities**

These capabilities are support capabilities that apply to specific applications. These capabilities are out of scope of this Deliverable.

## **9 Reference points of the ITU-T M2M service layer**

### **9.1 Overview of the reference points**

Figure 4 shows the reference points of the ITU-T M2M service layer.



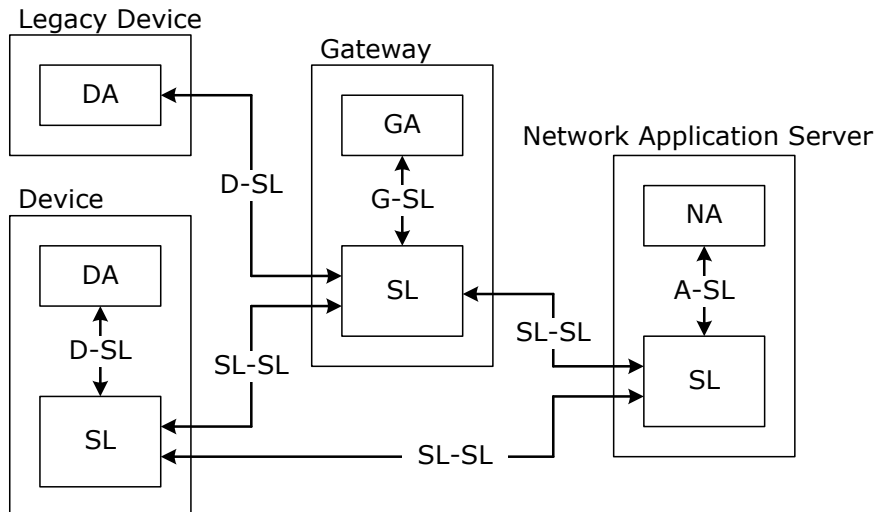
**Figure 4 – Reference points of the ITU-T M2M service layer**

As described in clause 6.1, three types of applications are identified on top of the ITU-T M2M service layer (Application layer): device applications (DAs), gateway applications (GAs) and network application servers (NAs). DA, GA and NA reside, respectively, in a device, gateway and network application server. All these applications can use capabilities provided by the ITU-T M2M service layer.

Four different reference points are identified for the ITU-T M2M service layer: D-SL, G-SL, A-SL and SL-SL. D-SL is the reference point between DA and the ITU-T M2M service layer, G-SL is that one between GA and the ITU-T M2M service layer, A-SL is that one between NA and the ITU-T M2M service layer, and SL-SL is that one between the ITU-T M2M service layers residing, respectively, in devices, gateways and network application servers.

## 9.2 Details on the reference points

Figure 5 provides a detailed illustration of the reference points described in Figure 4.



**Figure 5 – Reference points between device, gateway and network application server**

D-SL reference point allows a device application in a device to access the ITU-T M2M service layer in the same device or in the gateway. D-SL reference point between device application and service layer in gateway is for the legacy devices which do not have the ITU-T M2M service layer capabilities.

G-SL reference point allows a gateway application in a gateway to access the ITU-T M2M service layer in the same gateway.

A-SL reference point allows a network application server to access the ITU-T M2M service layer in the same network application server.

SL-SL reference point allows the ITU-T M2M service layer in a device, gateway or network application server to access the ITU-T M2M service layer in a different device, gateway or network application server.

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