LwM2M v1.1

Lightweight Machine to Machine

Open Mobile Alliance

LightweightM2M (LwM2M) is a Device Management Protocol

H/W Sensors

Driver Sensors

Sensor(s)
Object/Resource Data Model

One object for each sensor

Constrained Device /
Client LwM2M

10KB RAM, 100KB Flash, 40 MHZ

Remote Server LwM2M
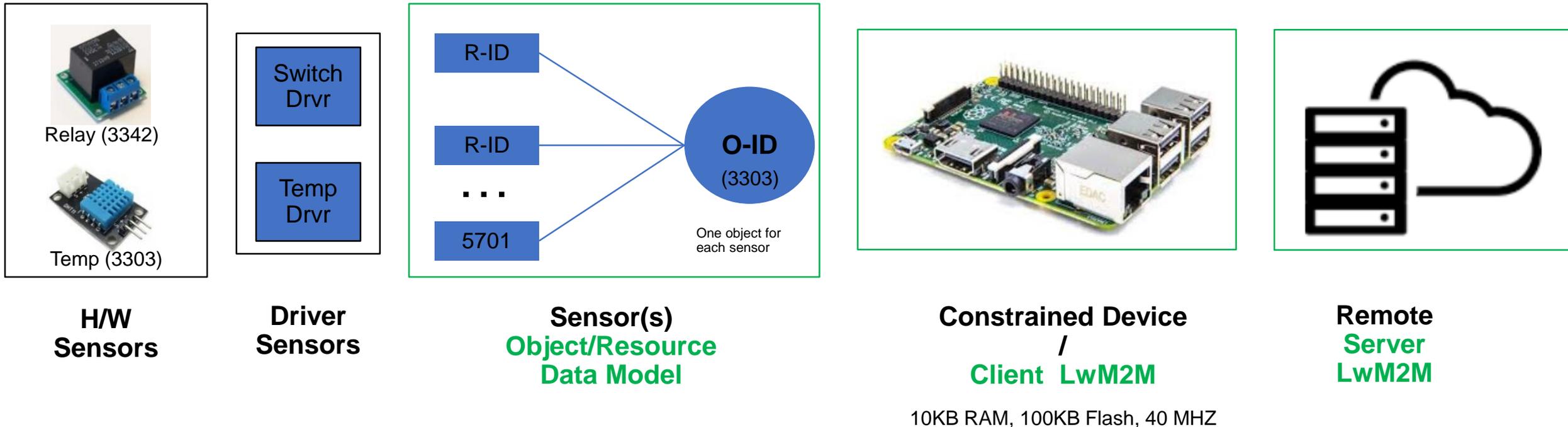
Bootstrapping | *Device Configuration* | *Firmware Update* | *Fault Management* | *Configuration & Control* | *Reporting*

*Device Management Functions

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LwM2M Protocol stack

Application	
IPSO WG	Objects
LightweightM2M specified at oma	LwM2M
I E T F	CoAP
	OSCORE

DTLS			SMS on-Device (no Sec)	SMS on-Smartcard	UDP	TCP	TLS / TCP	LoRa WAN	CIoT
UDP	SMS on-Device	CIoT							

Data Model

Messaging Resource Model

Device Management Onboarding

CRUDN

Security

Security Authentication
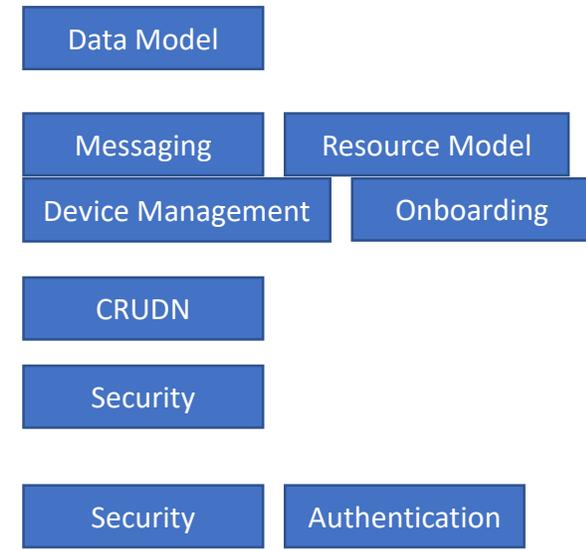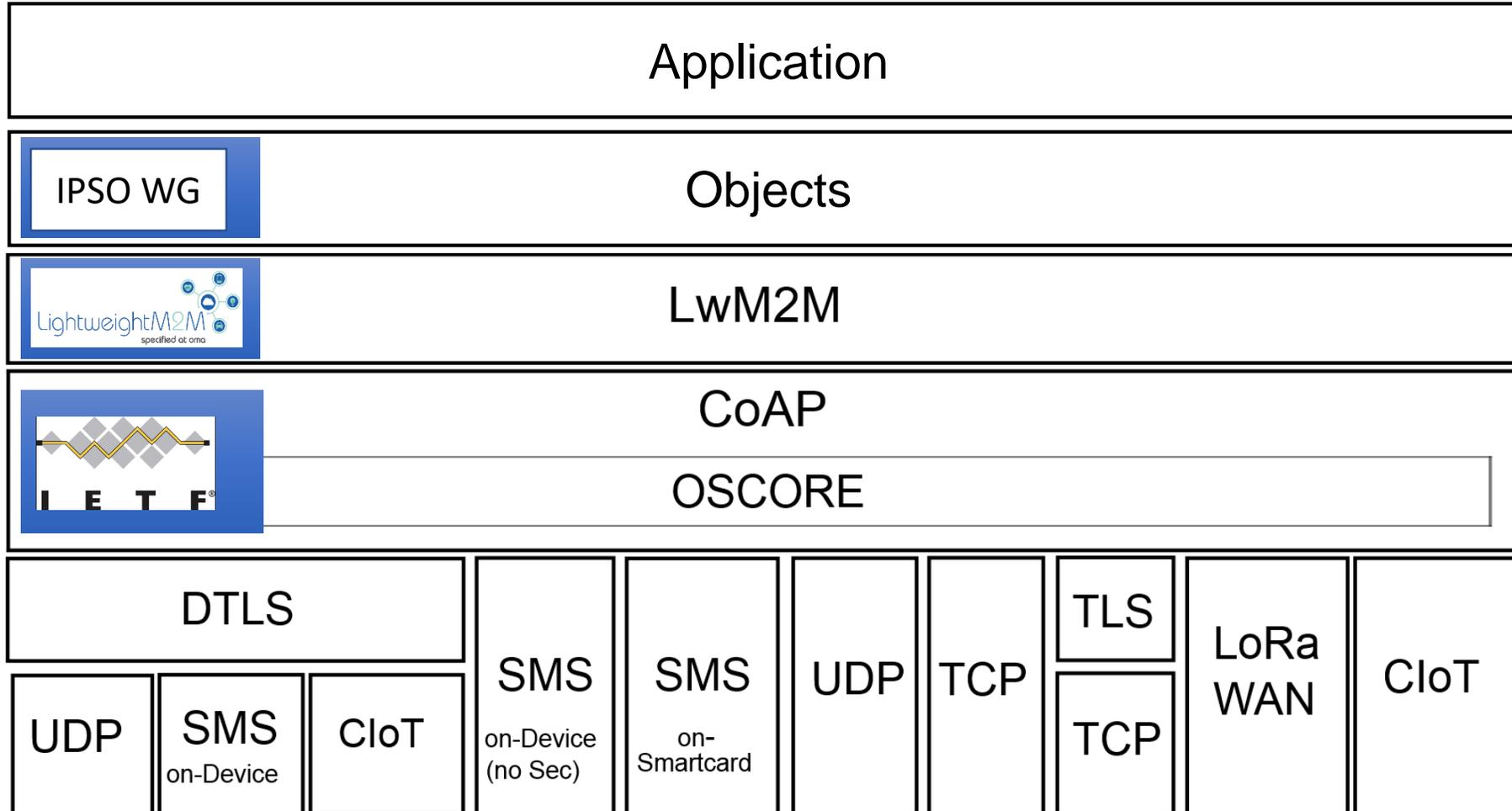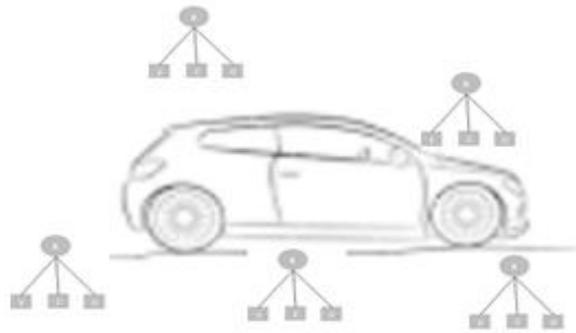
Data Model

Connected Car
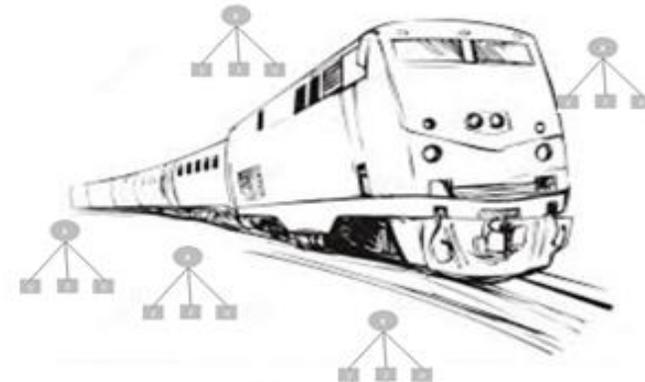
Transport
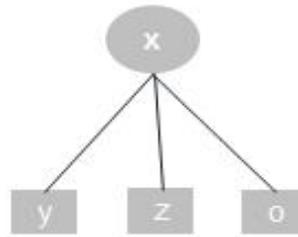
IPSO V1.0
Data Model

Smart Cities

Industry

M2M in the Telecom Network: The target for LwM2M Devices

Smart City

Public Safety

Energy

Automotive

Industrial Automation

Health Care

Services

M2M Service Layer

M2M Devices

Telecom Network

Source: Open Mobile Alliance

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Introduction

LwM2M is recommended for Device Management and Service Enablement because its benefits include:

- Increased bandwidth efficiency based on COAP bandwidth optimization
- Transport-agnostic design that supports UDP, TCP, SMS
- Developer toolkit for application development
- DTLS-based security based on CoAP (IETF)
- Low power client foot print designed for battery constrained devices
- End to end security using IETF OSCORE

Secure & BW efficient

Billing and Usage

Application

Device Management & Service Enablement

LwM2M server

Objects

Interfaces
- Bootstrapping
- Registration
- Object/resource access
- Reporting

Stack
- Efficient payload
- CoAP protocol
- DTLS security
- TCP or UDP or SMS bearer
- NIDD

Managed remote asset(s)

LwM2M client

Objects

M2M device

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Strengths of LwM2M

LwM2M can be used for both data plane (data reporting and devices actuations) and device management.

- LwM2M is a standard defined by OMA
- Suitable for both fixed and mobile devices
- Appropriate for both data plane and device management
- Designed for constrained devices (e.g < 20 kB RAM)
- Suitable for low powered battery devices because of its low client footprint
- Minimizes bandwidth due to optimized bandwidth consumption by utilizing COAP (COAP is a simplified HTTP; COAP header = 4bytes)
- Simple, stateless protocol
- Crosses FW and NAT systems thanks to support of COAP/UDP and COAP/TCP
- Offers security by design; COAP over UDP or TCP relies on DTLS or TLS respectively
- Provides opportunities for e2e security

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LwM2M: Core functionalities
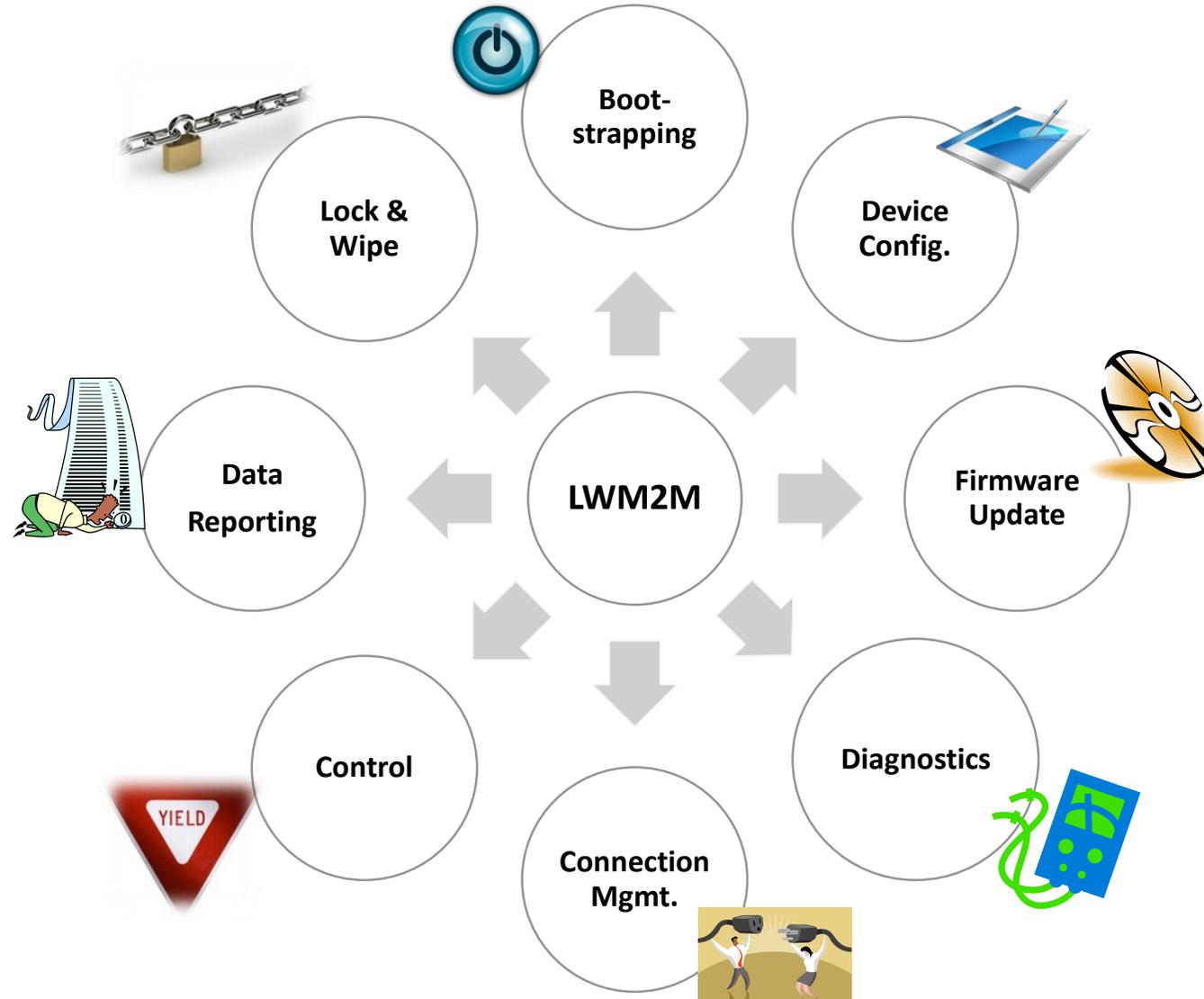
Bootstrap Interface
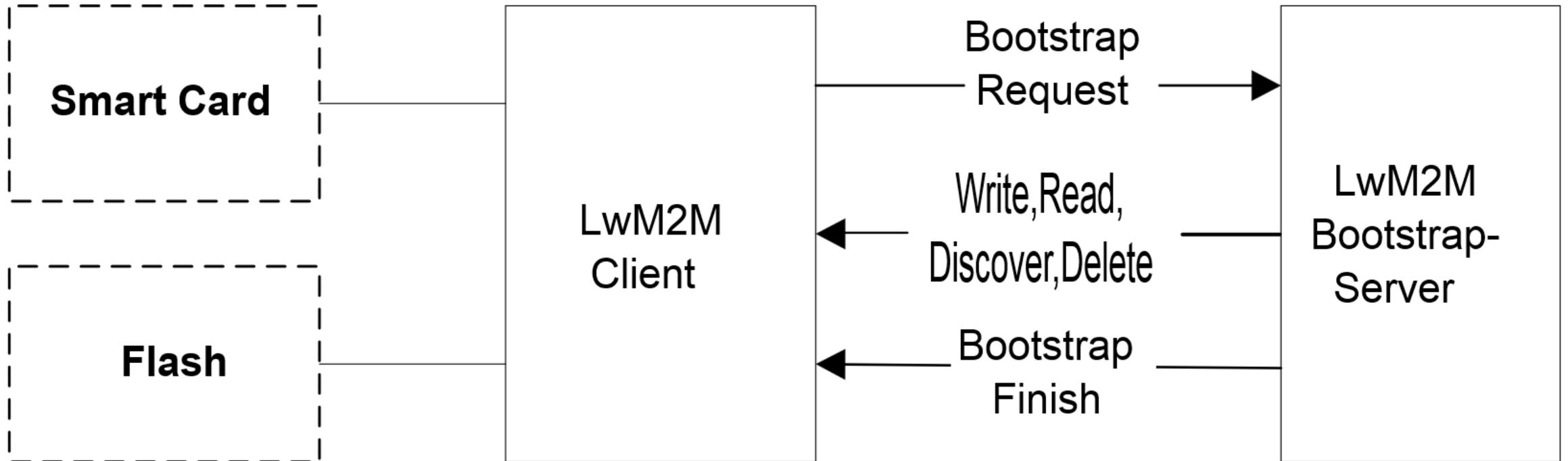
Device Configuration
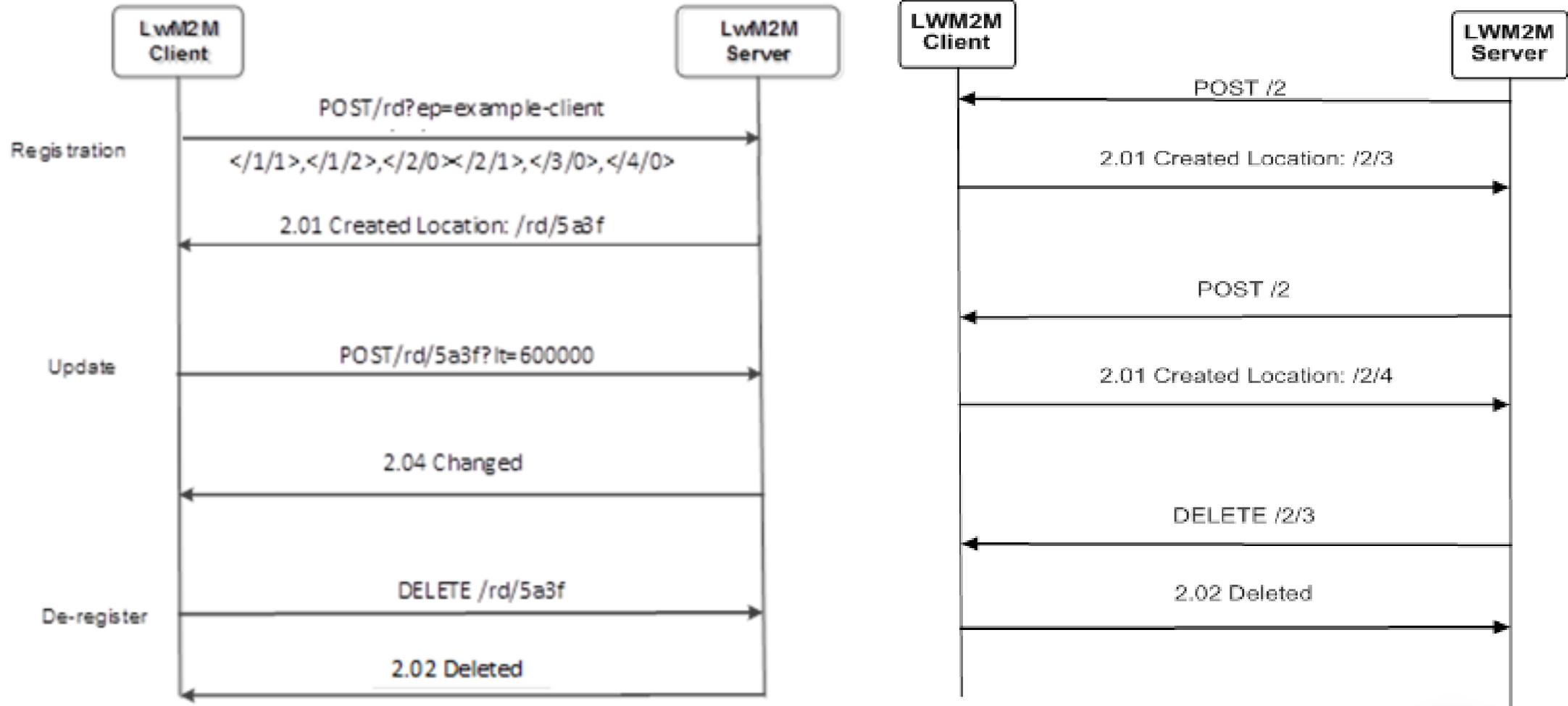
Firmware Update
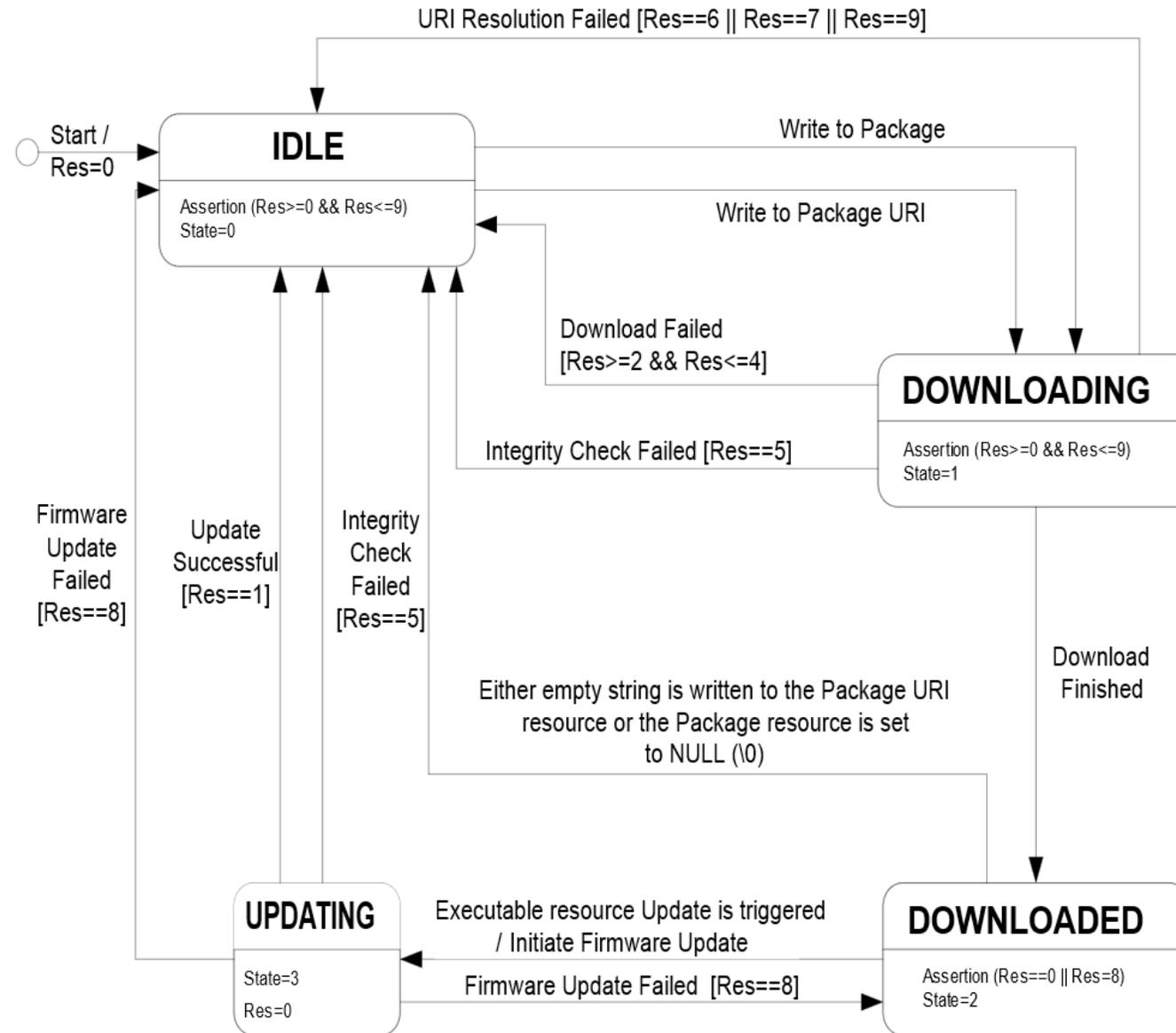
Diagnostics

- Power sources and LwM2M Device settings

- Battery level of the LwM2M Device

- Memory status of the LwM2M Device

- Supported binding modes of the LwM2M Device

- Version of hardware/software of the LwM2M Device

- Capabilities of the LwM2M Device

LWM2M Client — LWM2M Server sequence diagram:
- GET /4/0/2 Observe Token: 1234 (Observe)
- 2.05 Content Message ID: 23 Token: 1234 / 92
- ......
- Notify: 2.05 Content Message ID: 65 Token: 1234 / 87
- ......
- Notify: 2.05 Content Message ID: 81 Token: 1234 / 76
- Reset Message ID:81 (Cancel Observation)

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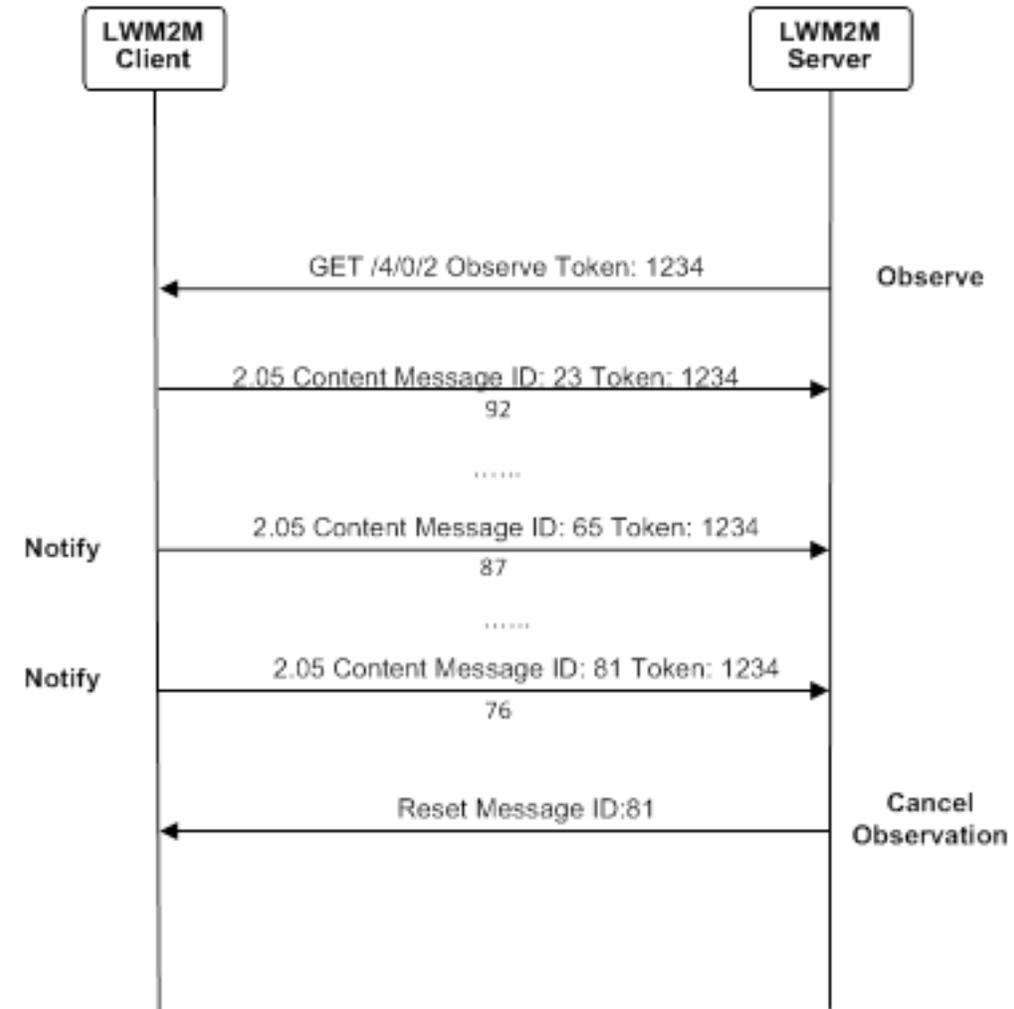
Connection Management

- Mapping of necessary Cellular and Wi-Fi technologies

- Managing basic parameters needed for the technologies to function e.g. APN, WEP keys etc.

- Adding relevant parameters for bearer selection for cellular connectivity

- Security is covered by DTLS

Control

- Ability to setup access control on Objects for various LwM2M servers

- Wake up the LwM2M Device using SMS

- Reboot the LwM2M Device

- Disable the LwM2M Device for a specified time

- Ask the LwM2M Device to perform registration
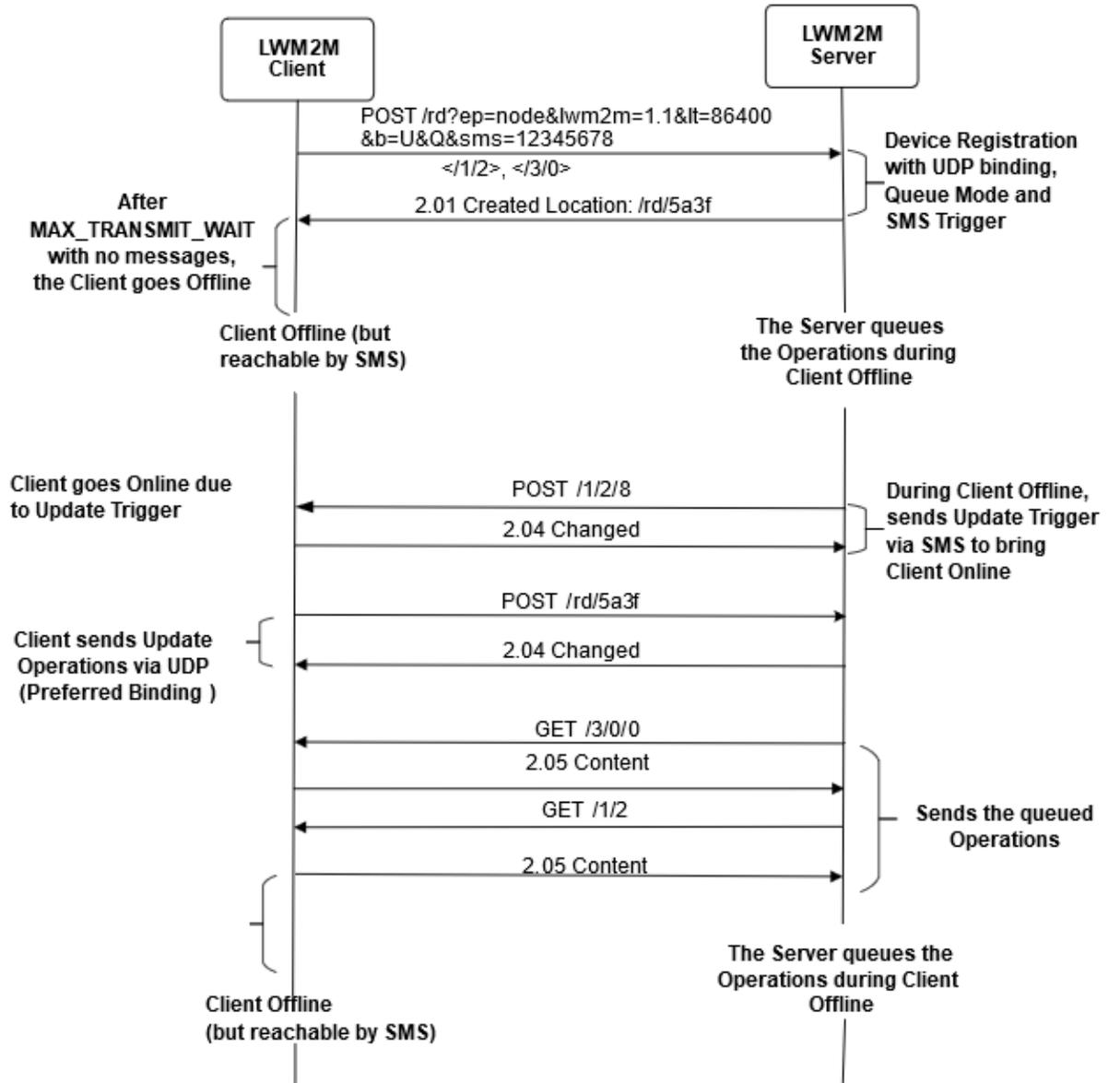
Data Reporting
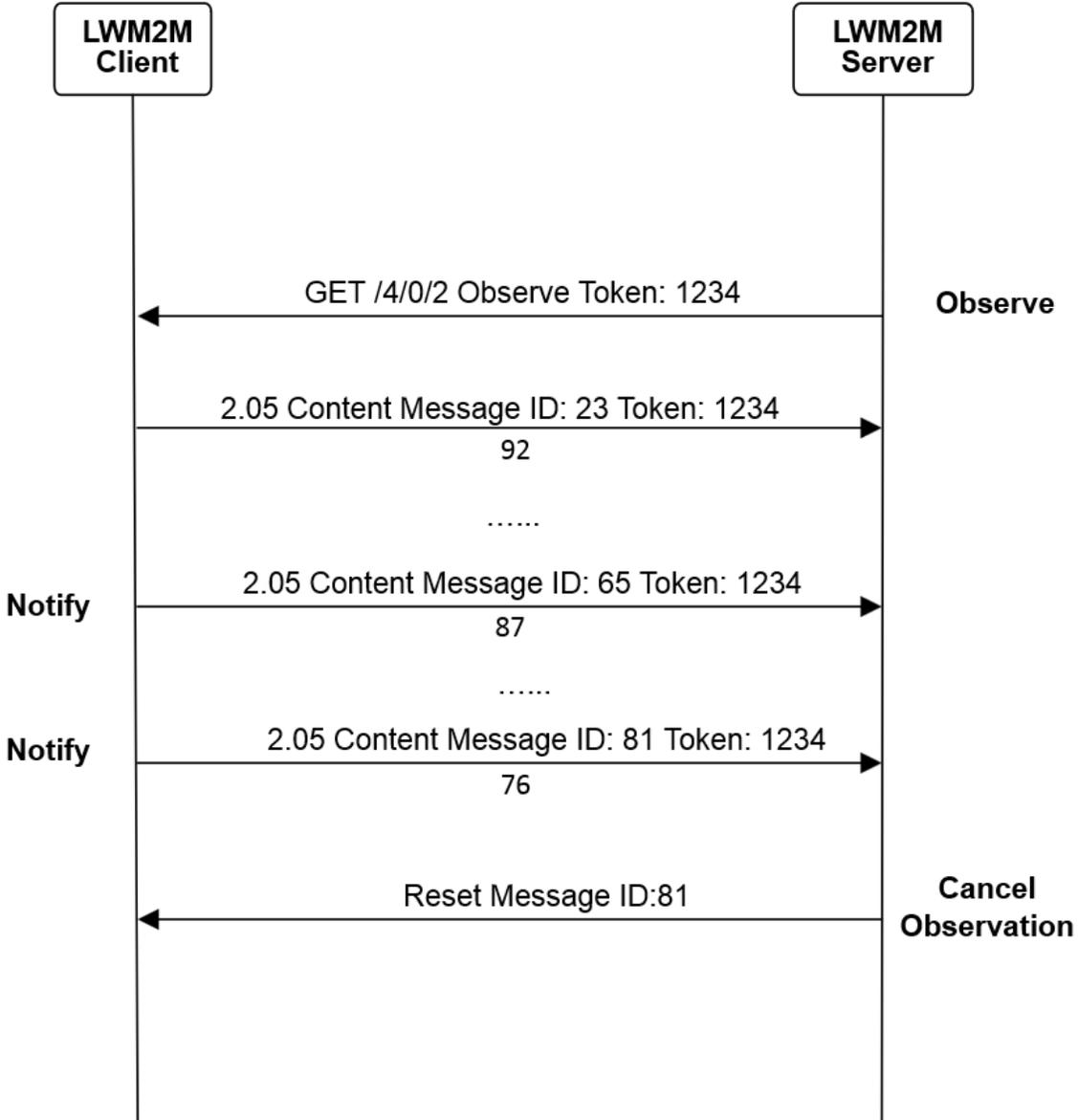
Lock & Wipe
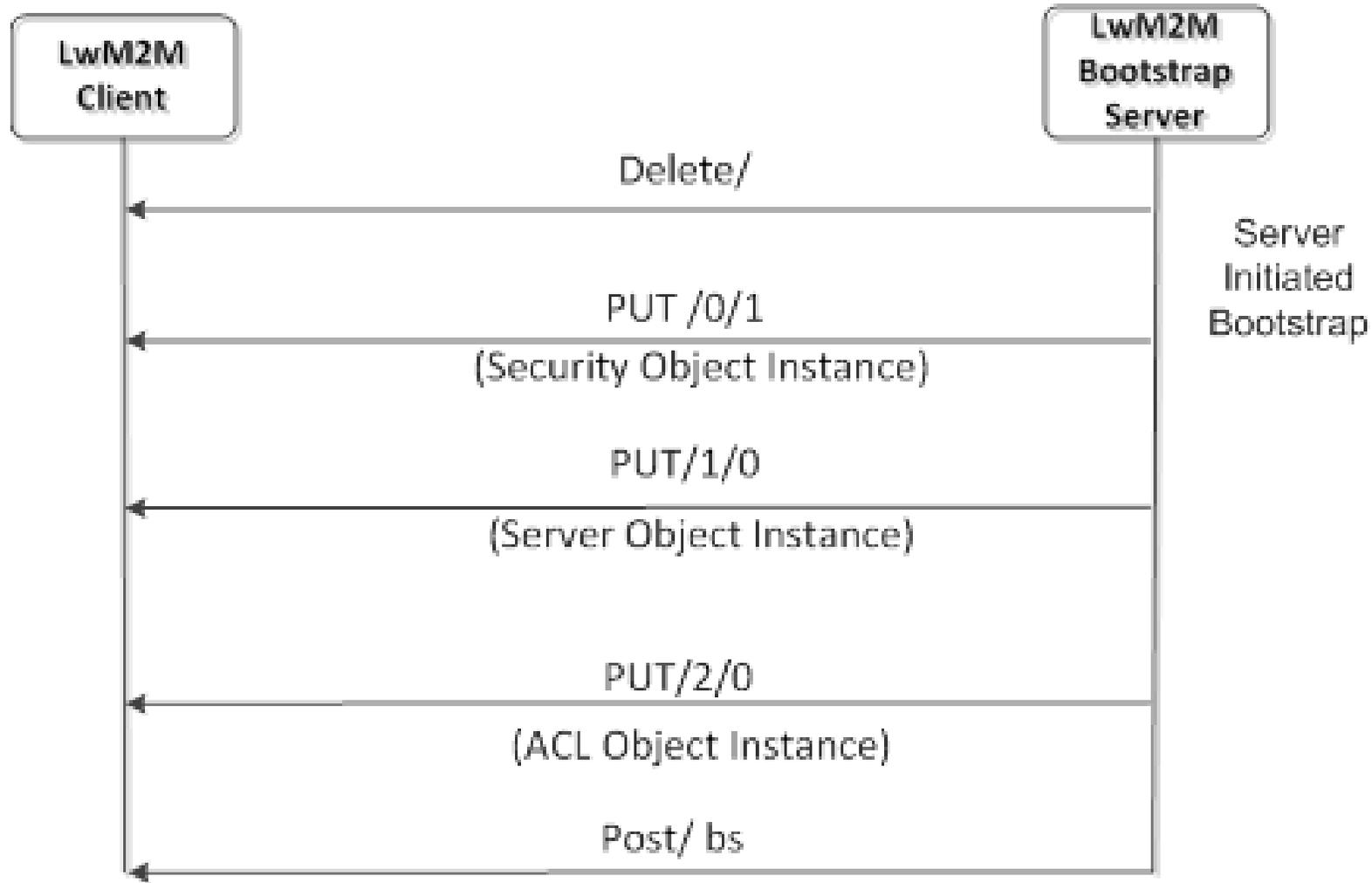
LwM2M Security

Types of credential procedures supported

- Certificates
- Pre-shared key
- Public Raw Key
- PKI deployments

Security paths

- DTLS
- SMS
- DTLS over SMS
- OSCORE

LwM2M Security abilities

- Initial keys can be replaced during bootstrap procedure
- Multiple servers could be added with different credentials
- Provide security in every path

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LwM2M security – continued
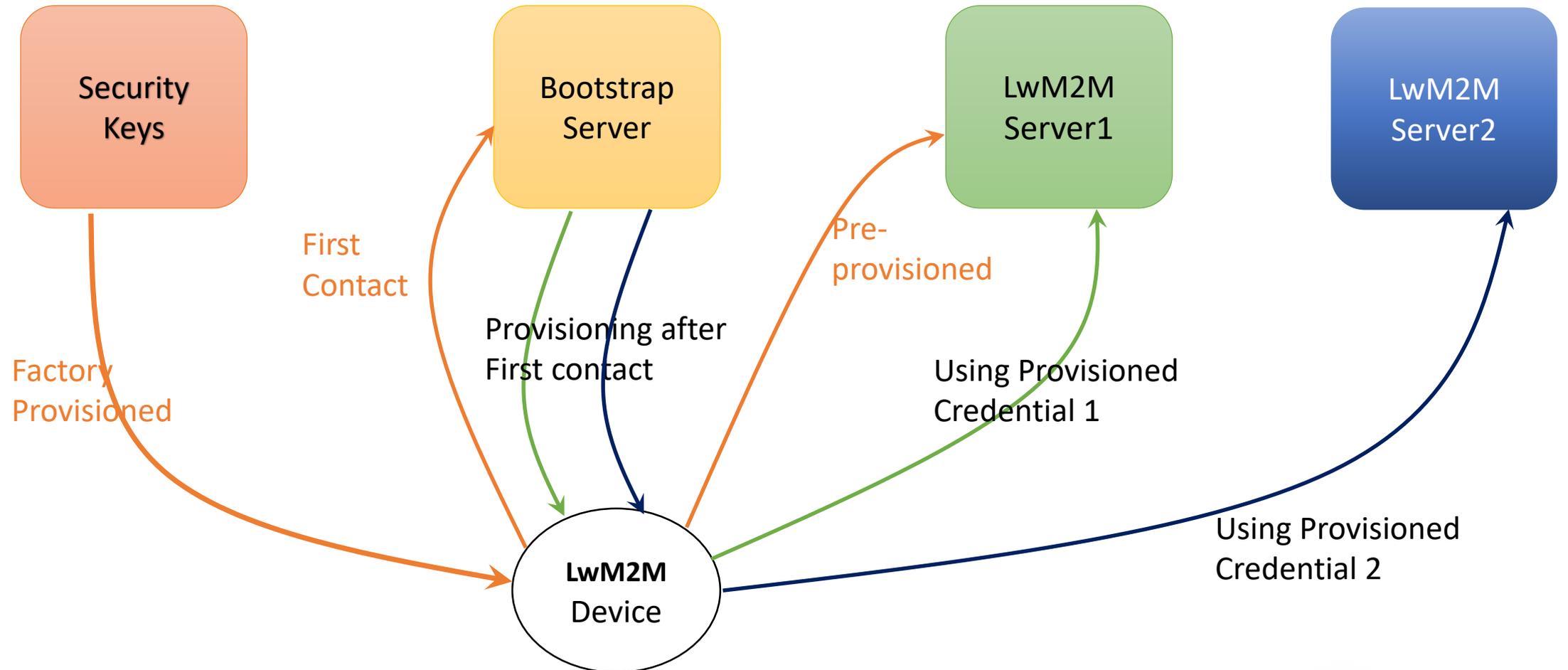
LwM2M v1.0 features

- Simple resource model with the core set of objects and resources defined in the specification. The full list of registered objects can be found in the LwM2M registry.

- Operations for creation, update, deletion, and retrieval of resources.

- Asynchronous notifications of resource changes.

- Support for several serialization formats, namely TLV, JSON, Plain Text and binary data formats and the core set of LightweightM2M Objects.

- UDP and SMS transport support.

- Communication security based on the DTLS protocol supporting different types of credentials.

LwM2M v1.0 features continued

- Queue Mode offers functionality for a LwM2M Client to inform the LwM2M Server that it may be disconnected for an extended period of time and also when it becomes reachable again.

- Support for use of multiple LwM2M Servers.

- Provisioning of security credentials and access control lists by a dedicated LwM2M bootstrap-server.

LwM2M v1.1 features

- Improved support for Public Key Infrastructure (PKI) deployments.

- Introduction of enhanced registration sequence mechanisms by the LwM2M Client to LwM2M Server(s).

- Support for LwM2M over TCP/TLS to better support firewall and NAT traversal.

- Support for application layer security for LwM2M based on OSCORE.

- Better support of LwM2M over Low Power WANs, including 3GPP CIoT & LoRaWAN.

- Extended LwM2M commands to enable Resource Instance level access.

- Performance improvement for retrieving and updating Resources of multiple objects.

- Support for JSON using SenML with CBOR serialization for compressed payload with highly efficient transmission.

Enhanced Registration Sequence
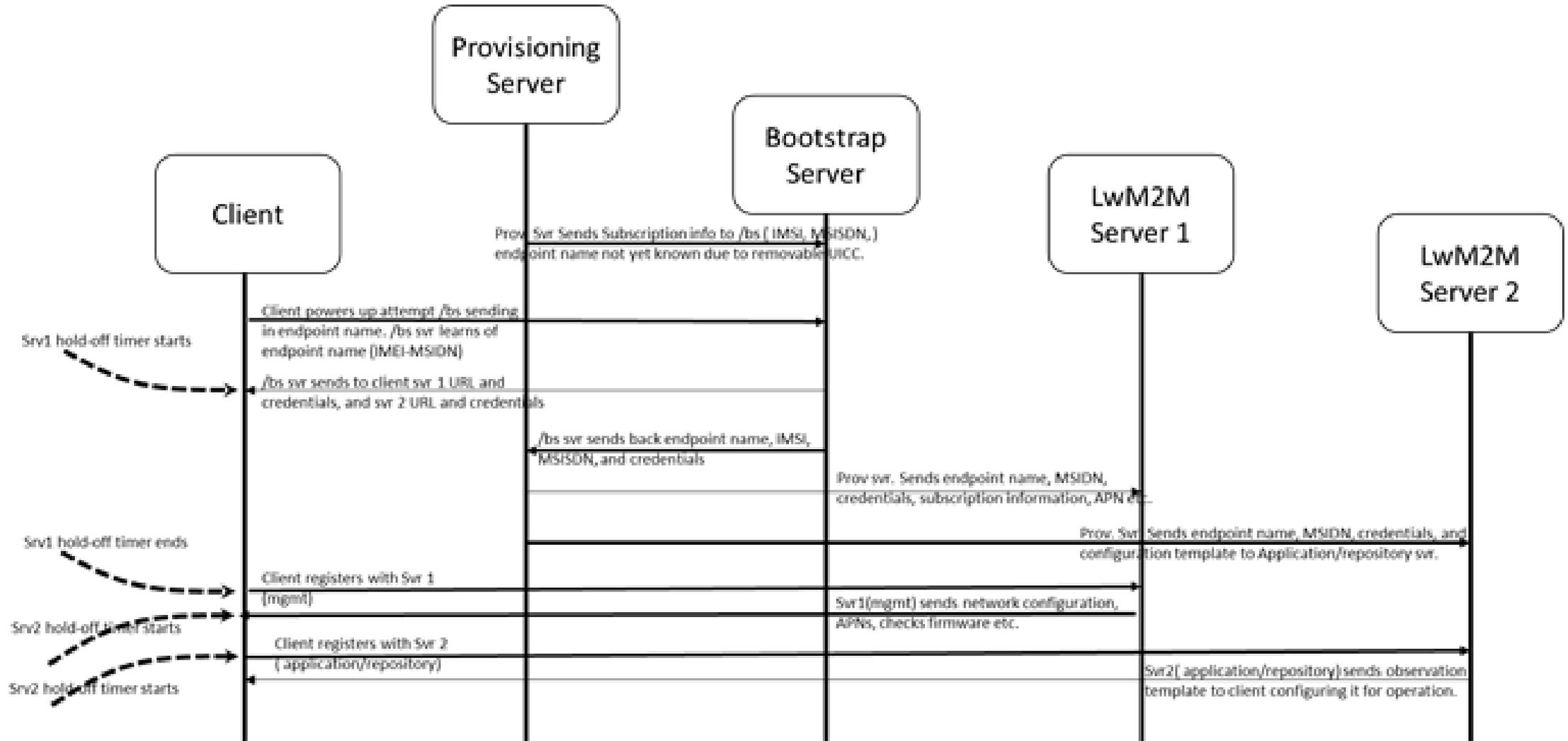
Security & additions to v1.1
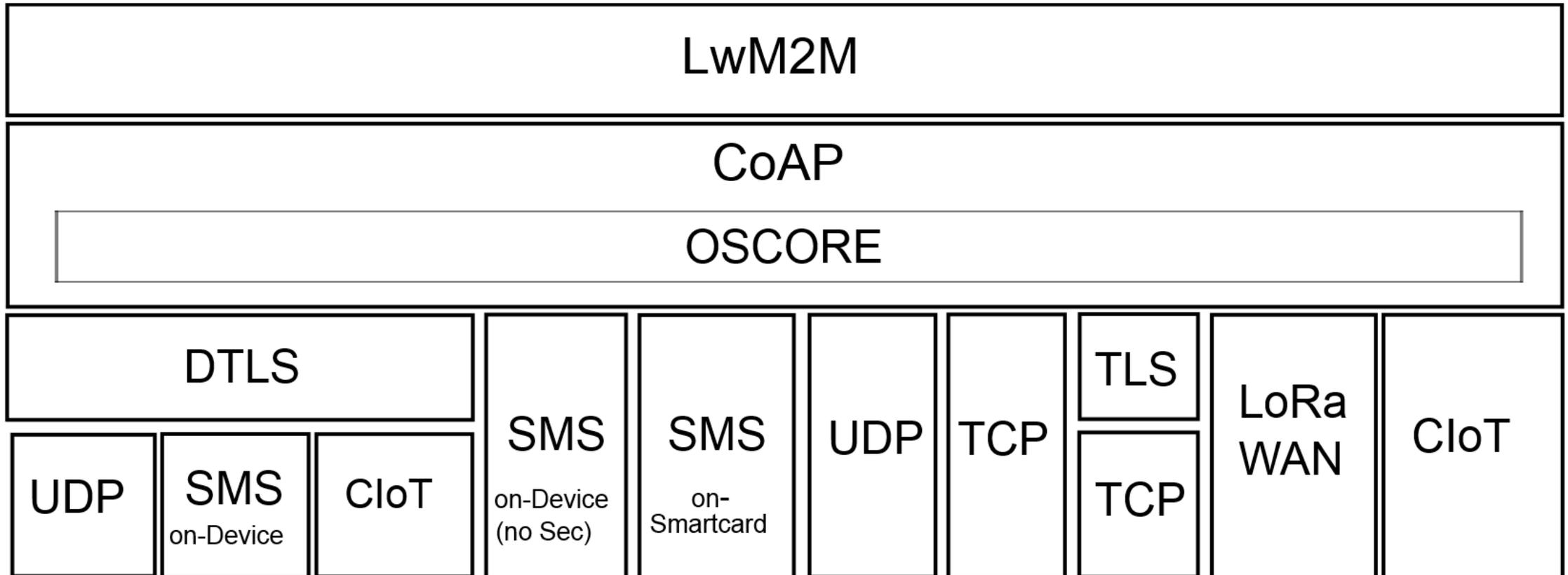
Support of LPWAN – 3GPP CIoT
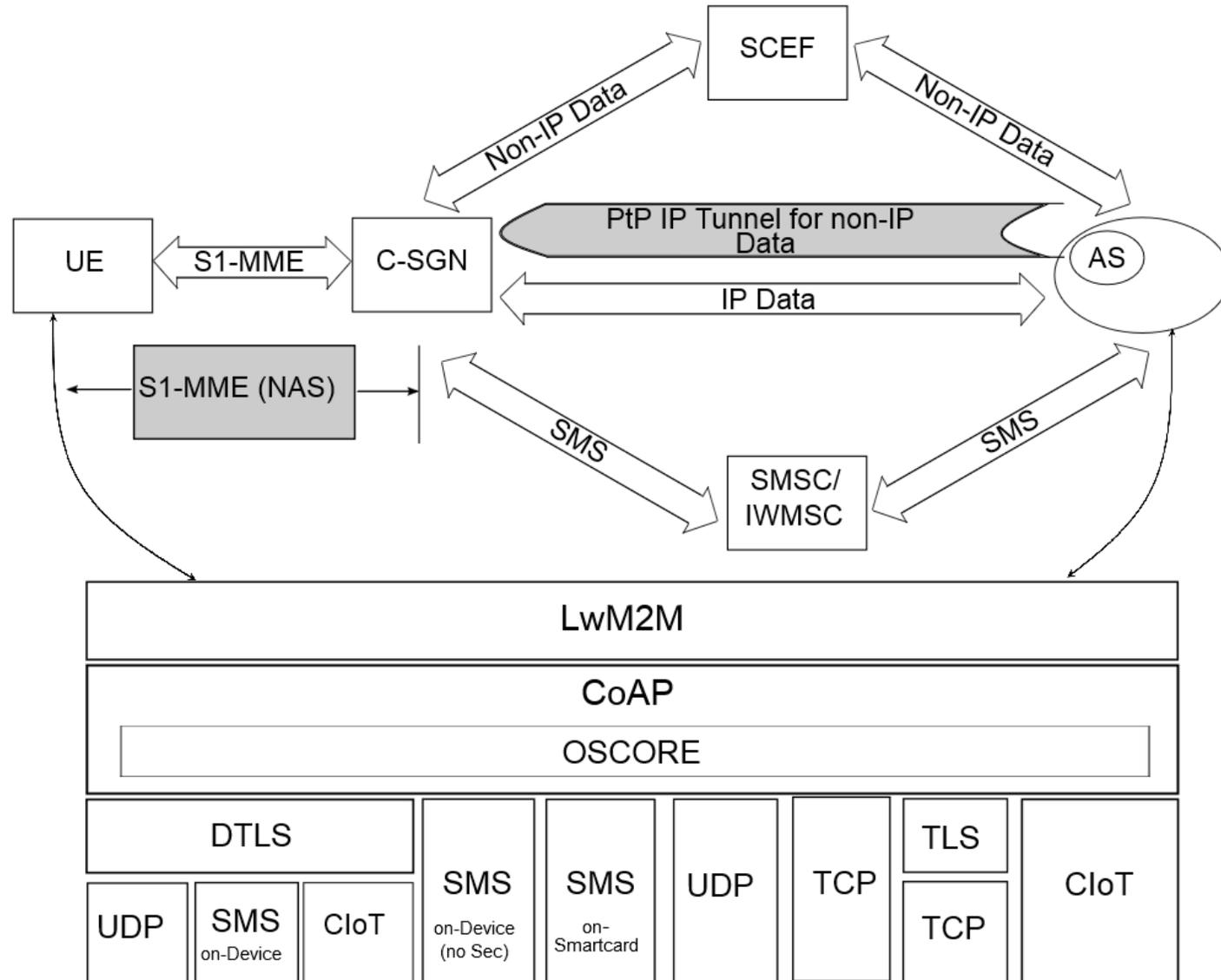
Support of LPWAN – LoRaWAN
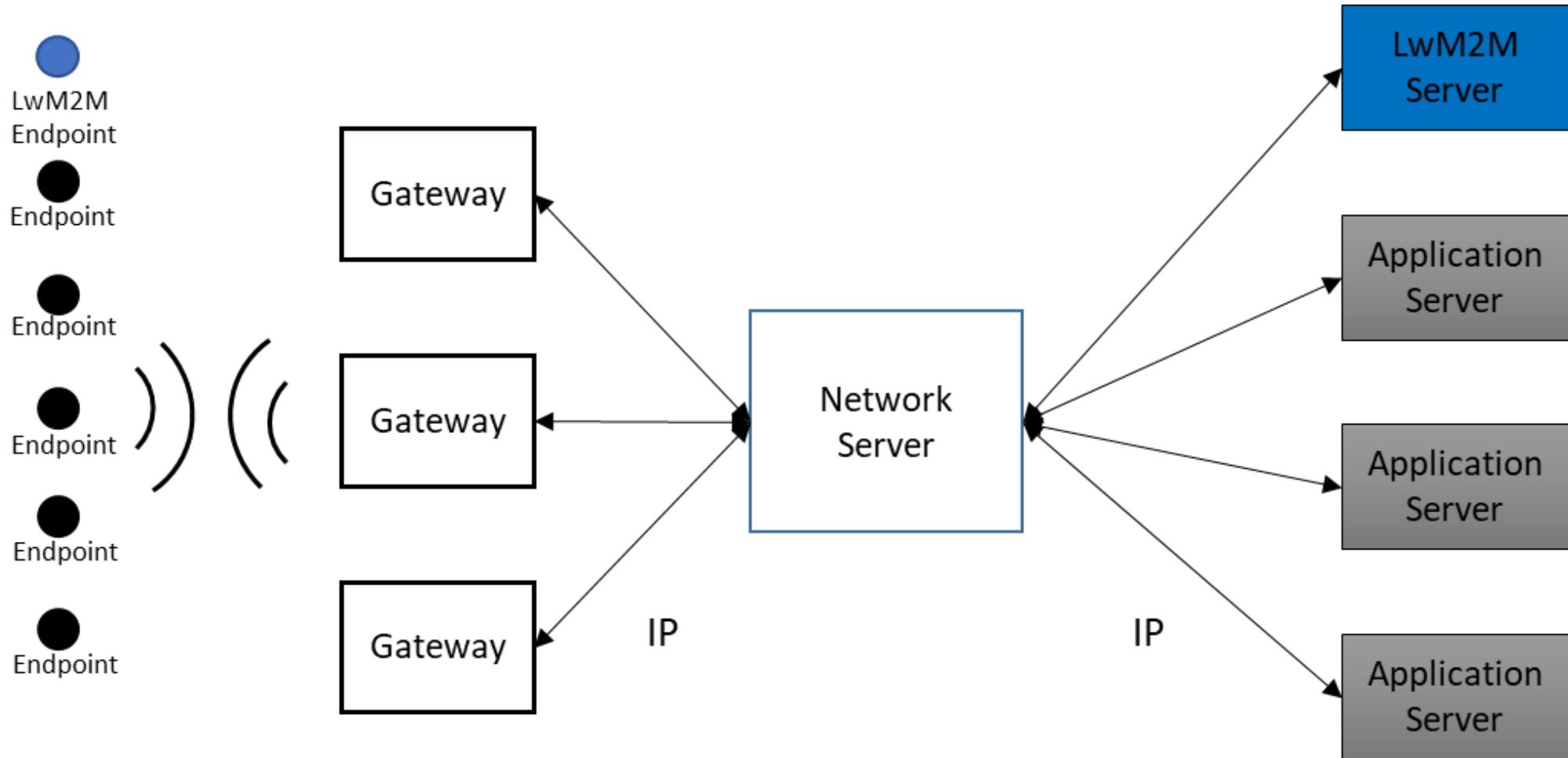
Objects from OMASpecWorks

- LwM2M Security
- LwM2M Server
- LwM2M Access Control
- Device
- Connectivity Monitoring
- Firmware Update
- Location
- Connectivity Statistics

- Cellular Connectivity
- APN Connection Profile
- WLAN Connectivity
- Bearer Selection
- Communication Characteristics
- Non-Access Stratum (NAS) Configuration
- LwM2M OSCORE

- Lock and Wipe
- DevCapMgmt
- Portfolio
- LwM2M Software Management
- LwM2M Software Component
- BinaryAppDataContainer
- Event Log

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Objects registered OMASpecWorks

- Power Control
- Light Control
- Accelerometer
- Magnetometer
- Barometer
- Altitude
- Load
- Pressure
- Loudness
- Gyrometer

- Addressable Text Display
- Multiple Axis Joystick
- Multi-state selector
- Dimmer

- powerupLog
- radioLinkFailureEvent
- cellBlacklistEvent
- NeighborCellMeasurements
- ServingCellMeasurement
- PagingDRX
- txPowerBackOffEvent
- SipRegistrationEvent
- sipSubscriptionEvent
- VolteCallEvent
- volteCallStateChangeEvent

Refer LwM2M registry for full list -
http://www.openmobilealliance.org/wp/OMNA/LwM2M/LwM2MRegistry.html

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Comparing Equivalent Standards in mobile space

Areas	OMA-DM 1.x	LwM2M v1.1
Device Management	Established and stable	Growing
Firmware Updates	Partial Standardized	Partial Standardized and expanding
Scalability	Targeting bigger devices	Wide Range feasible
Use in Constrained Devices	No	Yes
IoT enablement	Bigger devices feasible but data model needs evolution	Data Model evolved for IoT enablement and is expanding
Active Standardization members	None	Stable with additional standards working on top
Service Enablement	Limited to Telecom Features	Expanding into other IoT/verticals
Service level standardization	- NA -	IRTF T2TRG actively collaborating to expand semantic interoperability on top of LwM2M (OCF, W3C WoT, Fairhair Alliance)
Supporting Standardization Groups	GSMA, 3GPP	GSMA, IPSO (assimilated into OMA), IETF, IRTF, OpenAIS, oneM2M and expanding..

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Status with Industry & market

- ARM
- AVSystem
- Cumulocity
- Ericsson
- Friendly Technologies
- Gemalto
- Huawei
- IOTECC
- IoTerop

- Itron
- Nokia
- Orange
- Qualcomm
- Sierra Wireless
- Smith Micro
- Telit
- u-blox

Note: A large number of companies around the world are working on LwM2M implementations including many small and medium sized companies.

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LwM2M Forecast

- 235 million of LwM2M-enabled devices are expected to be deployed by 2022

  - "IDATE explored the market opportunities over four markets including automotive, utilities, building automation and logistics. The total installed base of LwM2M-enabled devices will reach over 235 million units in 2022, from less than 0.5 million units in 2015," said Samuel Ropert, Head of IoT Practice at IDATE Digiworld. "This represents a CAGR of 154% in the 2015-2022 period."

    https://www.omaspecworks.org/oma-lightweightm2m-v1-0-approved-by-board-of-directors/