

# CoAP usages for Device Management

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Managing Networks of Things workshop  
draft-jimenez-t2trg-coap-functionality-lwm2m



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# Constrained Application Protocol (CoAP)

- It is a RESTful protocol for constrained devices and networks, very similar to HTTP.
  - Client/server & Request/Response
  - GET, POST, PUT, DELETE but also PATCH, iPATCH, FETCH Methods.
  - Same concepts (Media types, URL, URN...)
- The well-known URI
  - GET `coap://[ip6address]/.well-known/core`
- IPv6 oriented (using 6LowPAN)
  - IP Multicast support

# Constrained Application Protocol (CoAP)





- Resource discovery via the Resource Directory (RD)
- Compact 4-byte Header
- Can run on UDP or SMS
  - Reliability is ensured by using with different message types:
    - Confirmable (CON), non-confirmable (NON), acknowledgement (ACK) and reset (RST).
- TCP currently being standardised.
- Observe/Notify, adding an “observe” flag in the CoAP GET Request
  - Introduces a Publish/Subscribe model for constrained devices.
- Facilitates new ways of interacting with devices and managing them
  - CoMI/CoOL
  - LWM2M

# Constrained Management and Objects Language (CoOL/CoMI)




## Roadmap

- Describes a management function set adapted for constrained devices and constrained networks using YANG.
- Interactions with objects use CoAP a application protocol.
- Payloads are encoded in CBOR data format.

### Current targets

-  **Encoding**  
I-D.ietf-core-yang-cbor
-  **Identifiers**  
I-D.somaraju-core-sid
-  **Protocol operations**  
I-D.veillette-core-cool
-  **Discovery**  
I-D.veillette-core-cool-library

### Future work

-  **Security**
  - Boot strapping
  - Authorization  
(Profile of existing methods)
-  **Protocol extensions**
  - Multicast
  - Binding table
  - Application management
  - OTA upgrade
-  **Support for LWM2M**

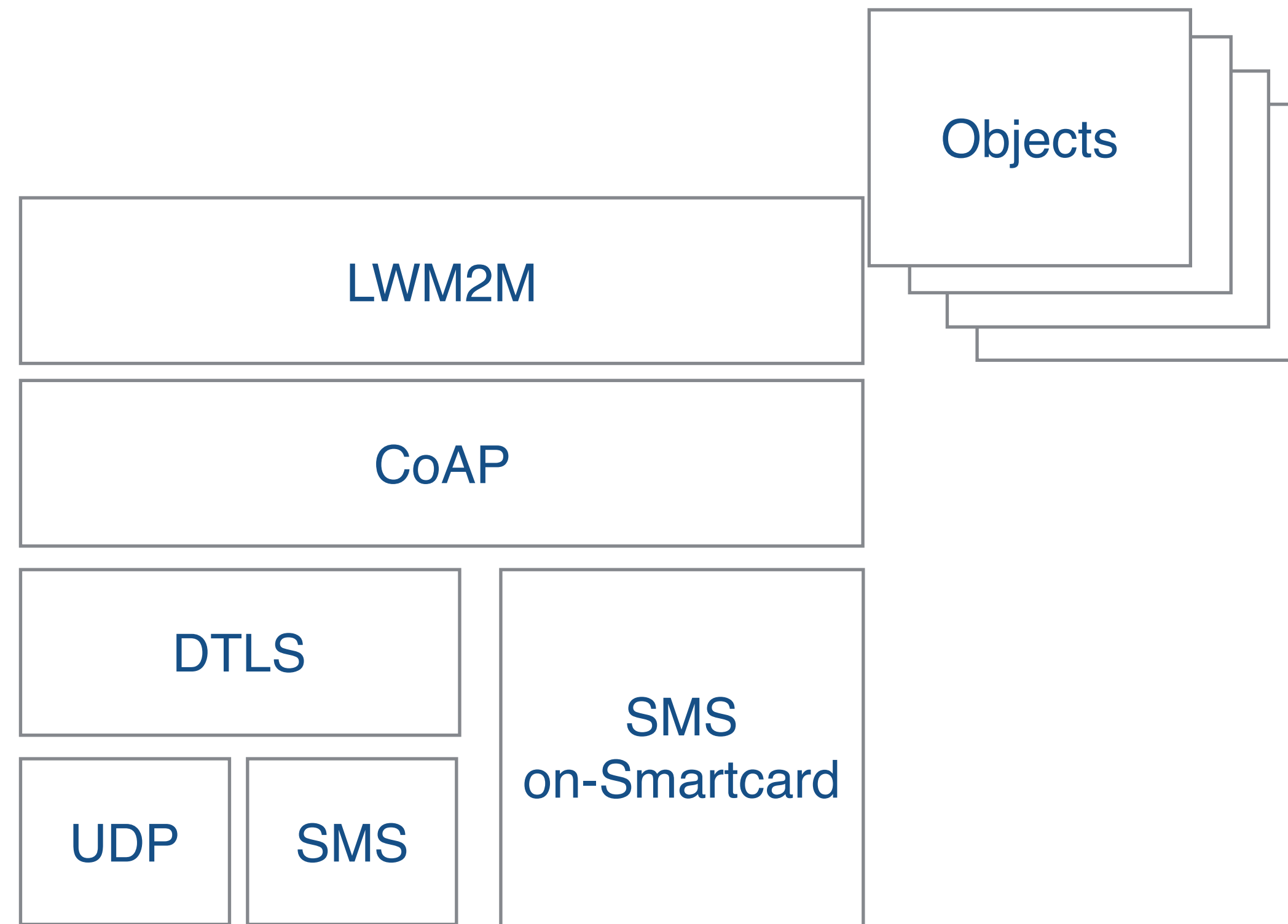
# Constrained Management and Objects Language (CoOL/CoMI)

- Similar to RESTCONF but:
  - uses CoAP/UDP as transfer protocol. RESTCONF uses HTTP/TCP.
  - uses YANG-CBOR as payload format. RESTCONF uses YANG-JSON or YANG-XML.
  - *CoMI encodes YANG identifiers as numbers, where RESTCONF encodes them into strings (WIP).*
  - CoMI uses the methods FETCH and iPATCH, not used by RESTCONF (because HTTP does not have that)
  - RESTCONF uses the HTTP methods HEAD, and OPTIONS, which are not used by CoMI (because CoAP does not have that).
  - *YANG used as modelling language but no specific data model (WIP).*
  - ... and many more at <https://tools.ietf.org/html/draft-vanderstok-core-comi-10#page-7>

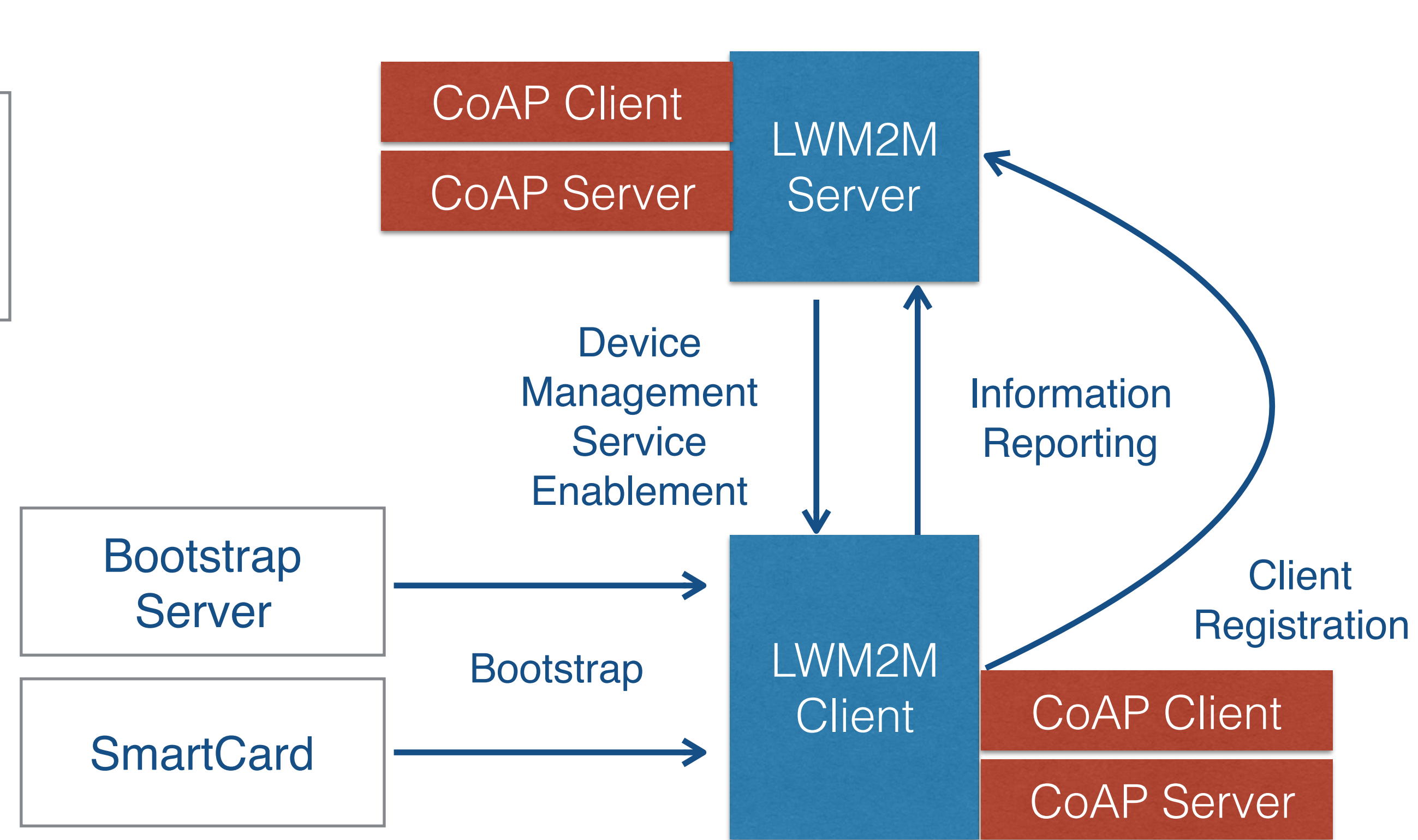
# OMA Lightweight M2M (LWM2M)

- Management Interfaces for CoAP.
  - Bootstrap: bootstrapping and upgrading a device.
  - Registration: taking a device into a logical group.
  - Device Management: by writing / creating objects inside the device.
  - Information Reporting: reading objects inside a device.
- LWM2M defines the Object Model.
  - Objects can correspond to sensors or actuators.
  - *Defines data model but has no modelling language (XML kinda).*

# OMA Lightweight M2M (LWM2M)



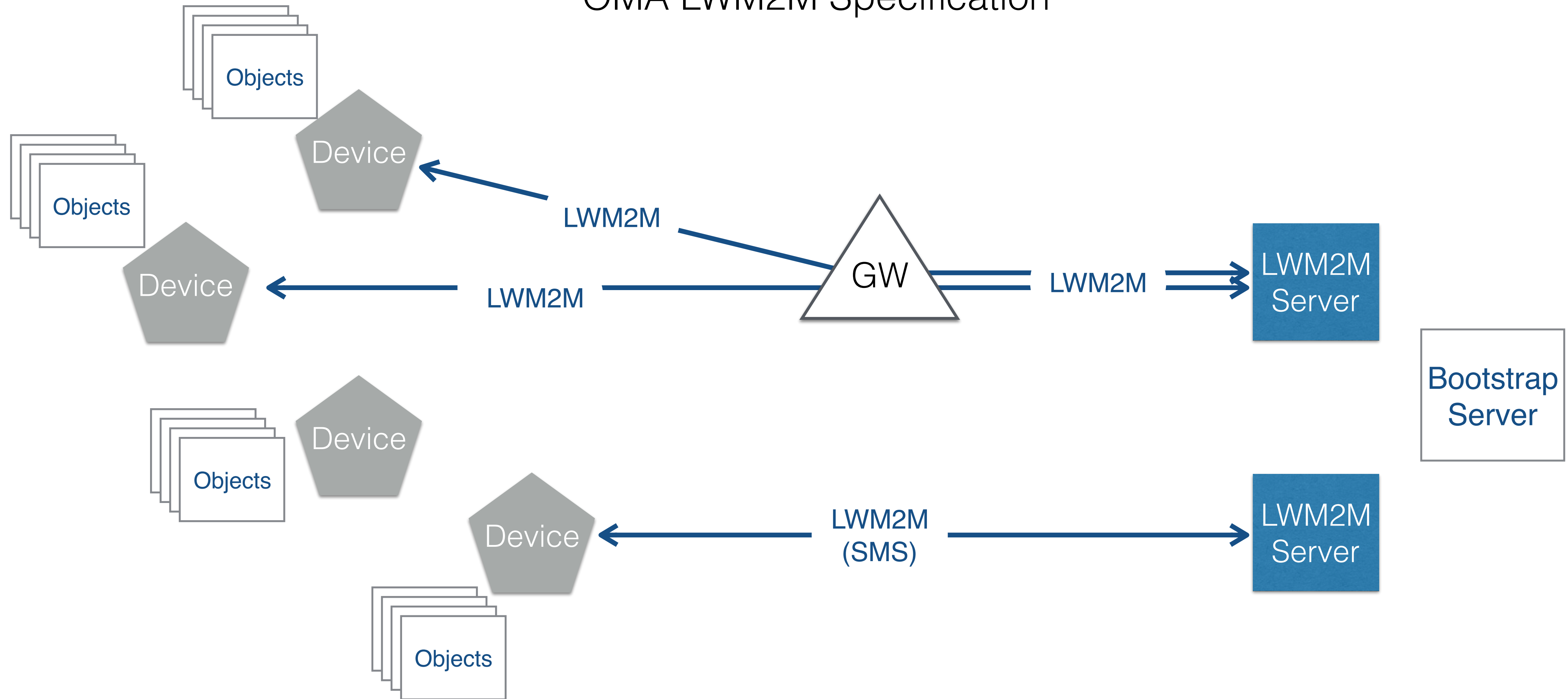
LWM2M Device Stack



LWM2M Architecture

# LWM2M Interactions

OMA LWM2M Specification





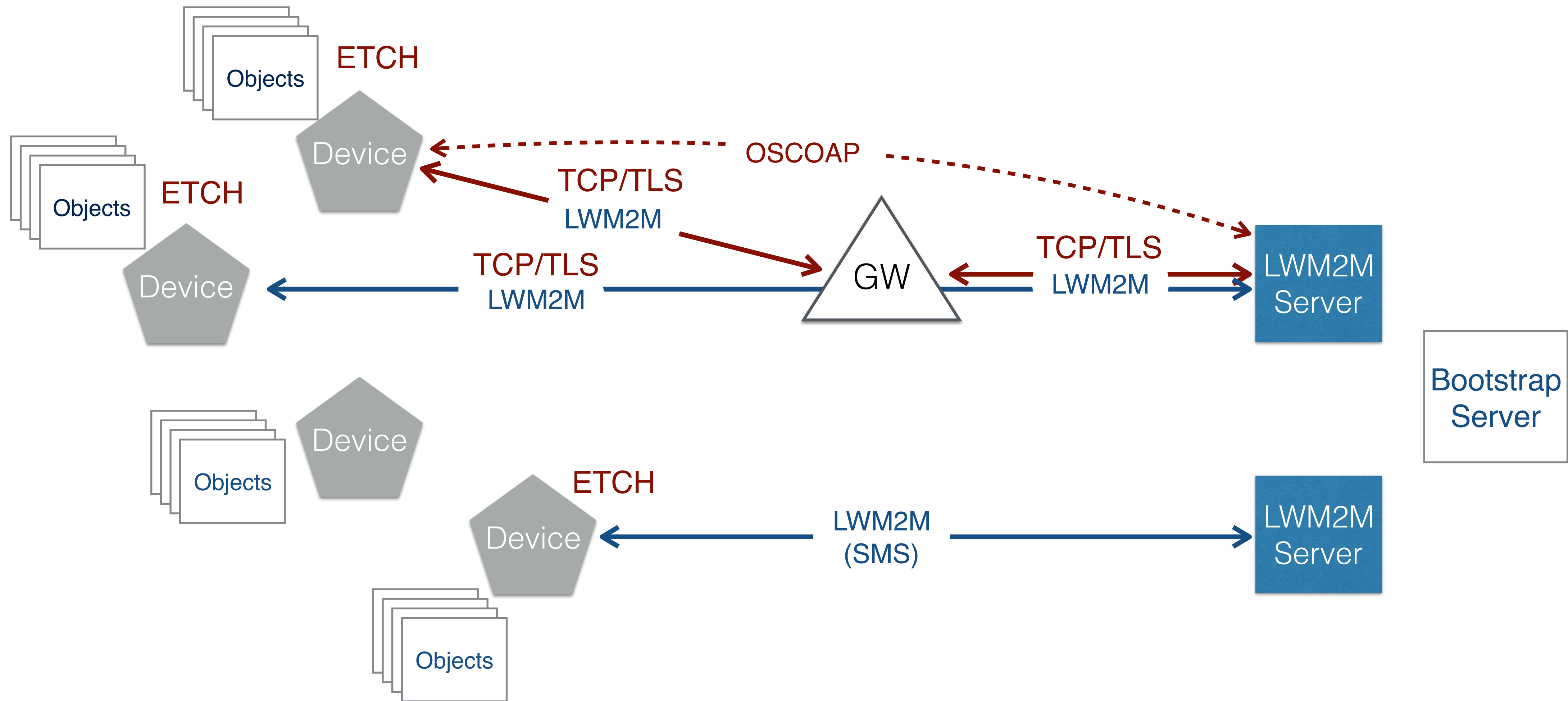
# Possible LWM2M Additions

## 1. Device and Manager configuration.

Currently covered by LWM2M.

- *[I-D.ietf-core-coap-tcp-tls]* outlines the changes required to use CoAP over TCP, TLS, and WebSockets transports.
- *[I-D.ietf-core-object-security]* For systems in which endpoints work behind a gateway or use LWM2M for managing the gateways, it might be good to implement other types of cryptographic protection than TLS/DTLS.
- *[I-D.ietf-core-etch]* Support for features like PATCH/FETCH could be greatly beneficial for things like firmware upgrade or observing relatively large sets of resources.

# Possible LWM2M Additions



# Possible LWM2M Additions

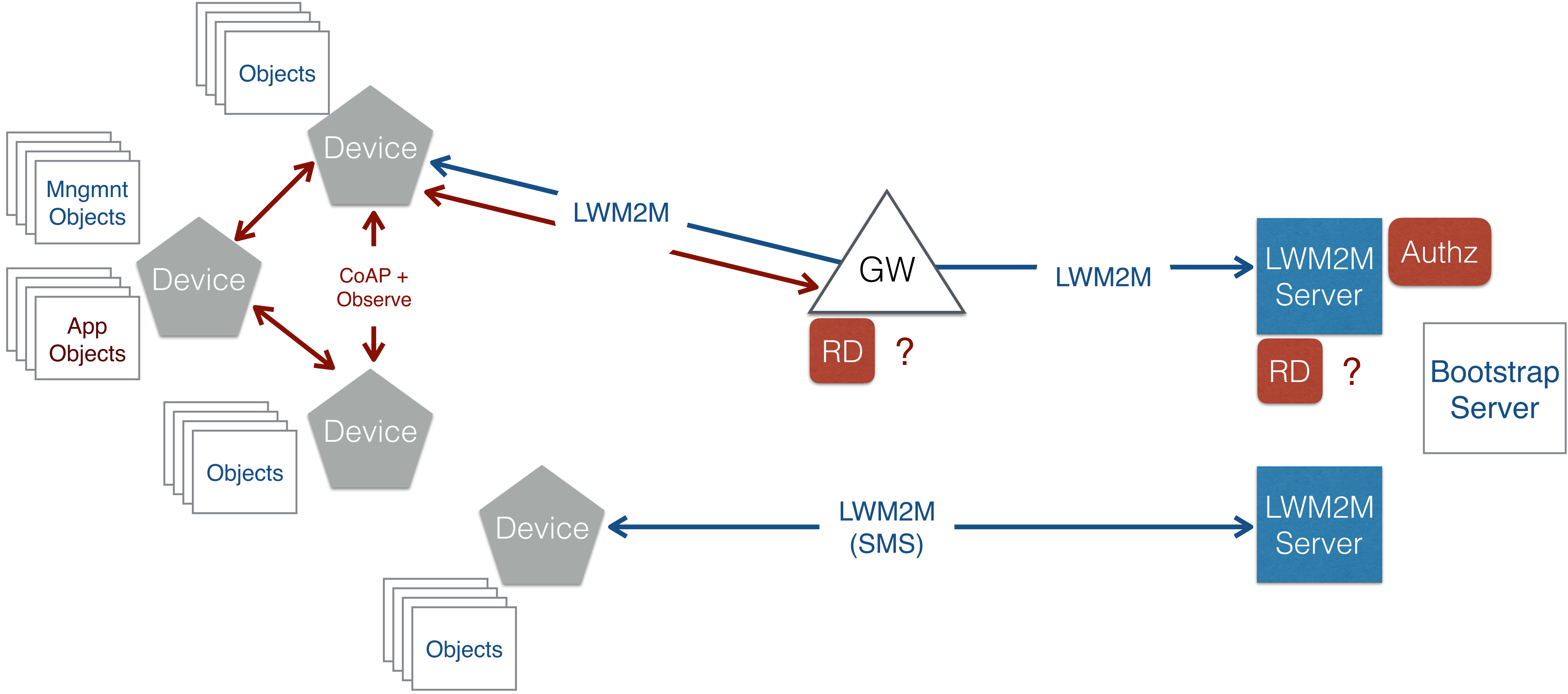
## 2. Device to Device configuration.

- *[I-D.ietf-core-resource-directory]* CoAP's in-built discovery would be beneficial to support cases in which devices talk to each other or in which a more autonomous management approach is preferred. For now devices under the same subnet can use IP multicast as expressed on *[RFC7390]* and through */.well-known/core*.

Devices would support CoAP Observe *[RFC7641]* between each other in order to subscribe to updates from one another.

- *[I-D.ietf-ace-oauth-authz]* could be used as security framework and the LWM2M Server would act as Authorization Server.

# Possible LWM2M Additions



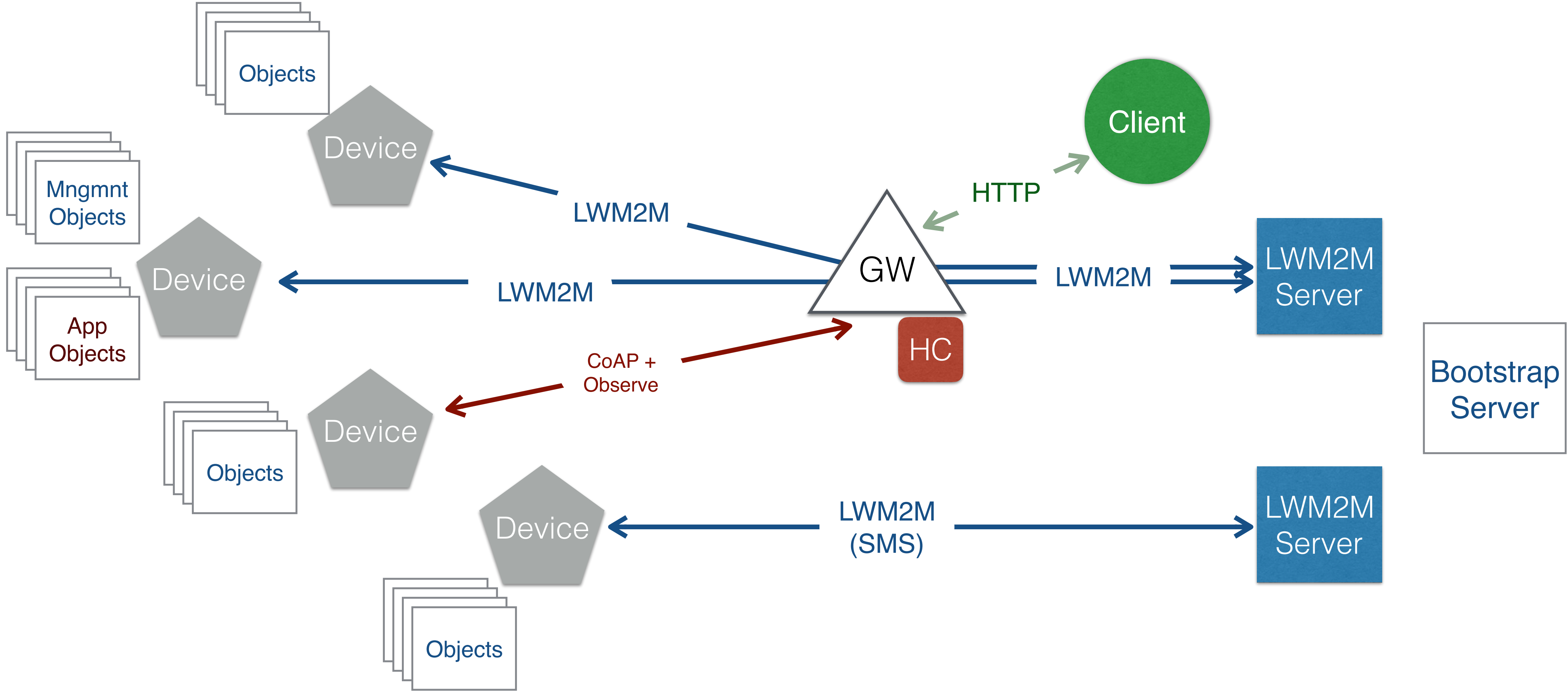
# Possible LWM2M Additions

## **3. Device to Application configuration.**

Including the aforementioned on (1) and (2).

[I-D.ietf-core-http-mapping] in cases of phone talking to GW. GW should implement a HC proxy.

# Possible LWM2M Additions



# LWM2M Data Model

- [RFC6690] Web Linking. ObjectLinks (String<ObjectID:InstanceID>) are not sufficient to represent links between devices or applications.
- Use unique ResourceIDs and register them to consistently use the same identifiers for the same resources.
- Update the serialization format [RFC7049]. JSON can be greatly compressed to CBOR format.
- A lot of work has happened on the Data Model space, perhaps it is time to revisit the Object Model. [IOTSI]

# Assorted References

REST	<a href="https://www.ics.uci.edu/~fielding/pubs/dissertation/rest_arch_style.htm">https://www.ics.uci.edu/~fielding/pubs/dissertation/rest_arch_style.htm</a>
<i>CoAP</i>	<a href="https://tools.ietf.org/html/rfc7252">https://tools.ietf.org/html/rfc7252</a>
CoRE Link-Format	<a href="https://tools.ietf.org/html/rfc6690">https://tools.ietf.org/html/rfc6690</a>
CoAP Observe	<a href="https://tools.ietf.org/html/rfc7641">https://tools.ietf.org/html/rfc7641</a>
CBOR	<a href="https://tools.ietf.org/html/rfc7049">https://tools.ietf.org/html/rfc7049</a>
IOTSI	<a href="https://www.iab.org/activities/workshops/iotsi/">https://www.iab.org/activities/workshops/iotsi/</a>
IOTSU	<a href="https://www.iab.org/activities/workshops/iotsu/">https://www.iab.org/activities/workshops/iotsu/</a>
<i>CoRE RD</i>	<a href="https://datatracker.ietf.org/doc/draft-ietf-core-resource-directory/">https://datatracker.ietf.org/doc/draft-ietf-core-resource-directory/</a>
LWM2M	<a href="https://github.com/OpenMobileAlliance/">https://github.com/OpenMobileAlliance/</a>
CoMI	<a href="https://tools.ietf.org/wg/core/draft-ietf-core-yang-cbor/">https://tools.ietf.org/wg/core/draft-ietf-core-yang-cbor/</a>
<i>CoAP-SNMP Interworking</i>	<a href="https://tutcris.tut.fi/portal/files/1076133/lindholm_ventola_coap_snmp_interworking.pdf">https://tutcris.tut.fi/portal/files/1076133/lindholm_ventola_coap_snmp_interworking.pdf</a>
CoAP TCP+TLS	<a href="https://tools.ietf.org/wg/core/draft-ietf-core-coap-tcp-tls/">https://tools.ietf.org/wg/core/draft-ietf-core-coap-tcp-tls/</a>
IPSO	<a href="http://ipso-alliance.github.io/pub/">http://ipso-alliance.github.io/pub/</a>
LWM2M to YANG	<a href="https://tools.ietf.org/html/draft-vanderstok-core-yang-lwm2m-00">https://tools.ietf.org/html/draft-vanderstok-core-yang-lwm2m-00</a>
OSCOAP	<a href="https://tools.ietf.org/wg/core/draft-ietf-core-object-security/">https://tools.ietf.org/wg/core/draft-ietf-core-object-security/</a>
<i>CoAP for LWM2M</i>	<a href="https://tools.ietf.org/html/draft-jimenez-t2trg-coap-functionality-lwm2m">https://tools.ietf.org/html/draft-jimenez-t2trg-coap-functionality-lwm2m</a>