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)

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

Roadmap

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
  - Bootstrapping
  - 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
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.
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 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

- LWM2M
- LWM2M Server
- Authz
- Bootstrap Server
- RD
- LWM2M (SMS)
- Objects
- Mngmnt Objects
- App Objects
- CoAP + Observe

Diagram showing connections between devices and servers.
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

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