CoAP an introduction

CSD kick-off
2013
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History

- John Ericsson/(Wargentin) Östersund
- Linux/Kernel/fib_trie.c/pktgen.c/NAPI
- Zebra/Quagga IRDP/PIM-SM/mBGP
- Bifrost/Linux – workshops
- WSN/Contiki/Low-Power/Energy

SLU/UU/KTH...
CoAP/overview

- Internet-Of-Things (IoT) motivated
- CoAP (Constrained Application Protocol)
- IETF standard (draft-18)
  
  Shelby/Sensinode(fi), Hartke, Bormann. U. Bremen
CoAP/overview

- Machine-to-Machine possible (M2M)
- Very small footprint, RAM, ROM
- URI (Uniform Resource Identifier)
  User-agent/plugin for Firefox Copper (Cu), ETH ETSI test (2012)
CoAP/overview

- RESTful client-server. Compare http:
- Resource Discovery
- UDP
  - Reliable unicast
  - Best effort multicast
- Proxy and Caching is simple
CoAP/message types

- Comfirmable message
- Non-comfirmable message
- Ack message
- Reset message
  - Piggy-backed
  - Separate
CoAP/transport

- Default UDP but required
  DTLS (Datagram TLS)
- TCP SCTP is discussed

UDP Port 5683 (mandatory)
UDP Ports 61616-61631 compressed 6lowPAN
CoAP/protocol

- 4 byte header
- Options
- Payload
  - uint (unsigned integer)
  - string
  - opaque
- Endpoint
  - IP addr, UDP port
CoAP/protocol header

Figure 7: Message Format

3.1. Header Format

The fields in the header are defined as follows:

Version (Ver): 2-bit unsigned integer. Indicates the CoAP version number. Implementations of this specification MUST set this field to 1. Other values are reserved for future versions.

Type (T): 2-bit unsigned integer. Indicates if this message is of type Confirmable (0), Non-Confirmable (1), Acknowledgement (2) or Reset (3). See Section 4 for the semantics of these message types.

Option Count (OC): 4-bit unsigned integer. Indicates the number of options after the header (0-14). If set to 0, there are no options and the payload (if any) immediately follows the header. If set to 15, then an end-of-options marker is used to indicate the end of options and the start of the payload. The format of options is defined below.
Message size

- Must fit in a single IP datagram

- Default MTU 1280 bytes
- 6LOWPAN 127 bytes
- WSN based on IEEE 802.15.4 127 bytes
CoAP/RESTful

- CoAP Request/Response semantics
  - GET, POST, PUT, DELETE
    Easy to map to HTTP
- Cache and Proxy possible
CoAP/URI

coap URI:
coap://example.se:5683/~sensors./temp1.xml

coaps URI:
coaps://myPAN.se/bike/lock
CoAP/Secure

- DTLS (Datagram TLS) RFC4347
- IPSEC alternative
  - Key sharing problems
  - Resource problems
  - Certificate problems
- Area for work...
CoAP/implementations

- Contiki-2.6 / Erbium
  - ETH Zurich
    - 8.5 kB ROM
    - 1.5 kB RAM

- Linux → libcoap
- TinyOs (libcoap)
- Firefox CoAP Copper Cu plugin – install an test.
- Wikipedia has an upated list. Check it!
CoAP/example

Client       Server
|            |            |
| +---------+ | +---------+ |
| GET      |  1 |     GET=1 |     MID=0x7d34 |
| Header: GET (T=CON, Code=1, MID=0x7d34) | 1 | 0 | 1 | "temperature" (11 B) ...
| Uri-Path: "temperature" |
|               | 11 | 11 |
| <---------+ | +---------+ | "22.3 C" (6 B) ...
| Header: 2.05 Content (T=ACK, Code=69, MID=0x7d34) | 1 | 2 | 0 | 2.05=69 | "22.3 C" (6 B) ...
| Payload: "22.3 C" |

Figure 16: Confirmable request; piggy-backed response
CoAP/additional standards

- Blockwise transfers in CoAP (16-1024 bytes)
  draft-ietf-core-block-12

- CoRE Link Format  (GET /.well known/core)
  RFC 6690

- Observing Resources in CoAP (Observe option)
  draft-ietf-core-observe-09
CoAP/programming

- Write plain C-code. Socket programming

- libcoap
  Both ways needs some knowledge about CoAP protocol

- Within MCU OS'es like Contiki or TinyOs etc..
References

- The Contiki OS. http://www.contiki-os.org/
- IETF RFC 6690 Link Format


- 6LowPAN, Zach Shelby, Carsten Borman (2009)

- IANA: RFCUniform Resource Identifier (URI) Schemes. [RFC4395]


IoT-grid control unit

ARM Bidir. Step-Up/down-DC-DC converter/Contiki/CoAP/Ethetnet
IoT-grid/CoAP app.
22Watt/DC router/700kpps/4SFP

Low-power rugged router w. passive cooling and power options

Made in Sweden, Powered by Bifrost/Linux
Ultra-Capacitor bank with 16 caps @ 3000 Farad
Questions