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
  - Seprate

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

  - opague

- Endpoint

  - IP addr, UDP port

CoAP/protocol header

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver| T |  OC   |      Code     |          Message ID           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Options (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Payload (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
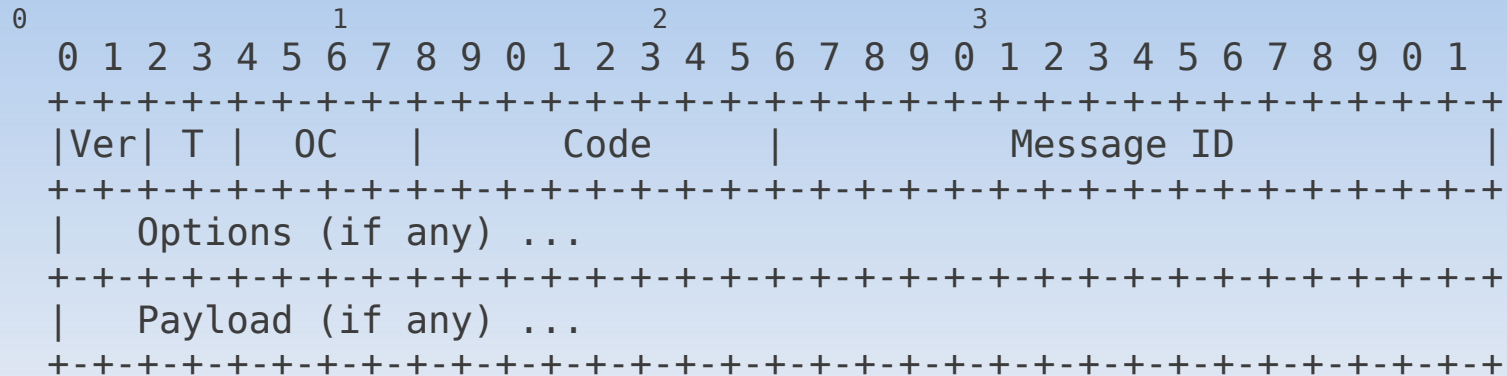   Figure 7: Message Format

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.

CoAP/pkt-size

- 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
  - Cerificate 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
   |      |
   |      |
   +----->|        Header: GET (T=CON, Code=1, MID=0x7d34)
   | GET  |     Uri-Path: "temperature"
   |      |
   |      |
   |<-----+        Header: 2.05 Content (T=ACK, Code=69, MID=0x7d34)
   | 2.05 |     Payload: "22.3 C"
   |      |
```

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 1 | 0 |   1   |     GET=1     |          MID=0x7d34           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  11   |  11   |     "temperature" (11 B) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 1 | 2 |   0   |    2.05=69    |          MID=0x7d34           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       "22.3 C" (6 B) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
          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/progamming

- 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/

- draft-ietf-core-coap-18   https://datatracker.ietf.org/doc/draft-ietf-core-coap/
- draft-ietf-core-block-12   https://datatracker.ietf.org/doc/draft-ietf-core-block/
- draft-ietf-core-observe-09   https://datatracker.ietf.org/doc/draft-ietf-core-observe/
- IETF RFC 6690 Link Format

- M. Kovatsch, S. Duquennoy, and A. Dunkels, A Low-Power CoAP for Contikiâ in Mobile Adhoc and Sensor Systems (MASS), 2011 IEEE 8th International Conference on, 2011, pp. 855-860, DOI:10.1109/MASS.2011.100.

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

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

- Nanoservice. Sensinode.Security Whitepaper www.sensinode.com

- R. Olsson and J. Laas, Sensd. http://github.com/herjulf/sensd.

IoT-grid control unit

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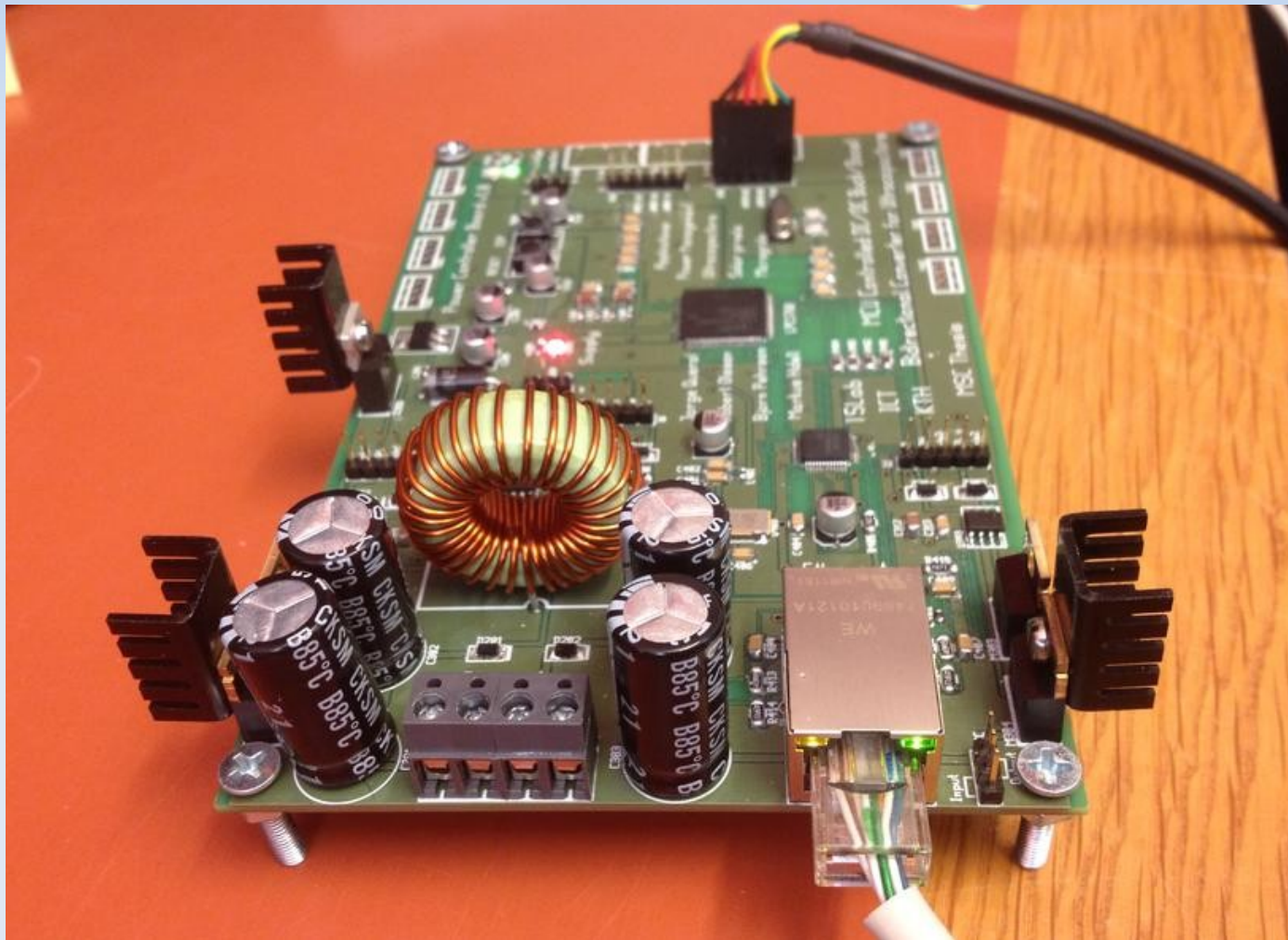
IoT-grid/CoAP app.
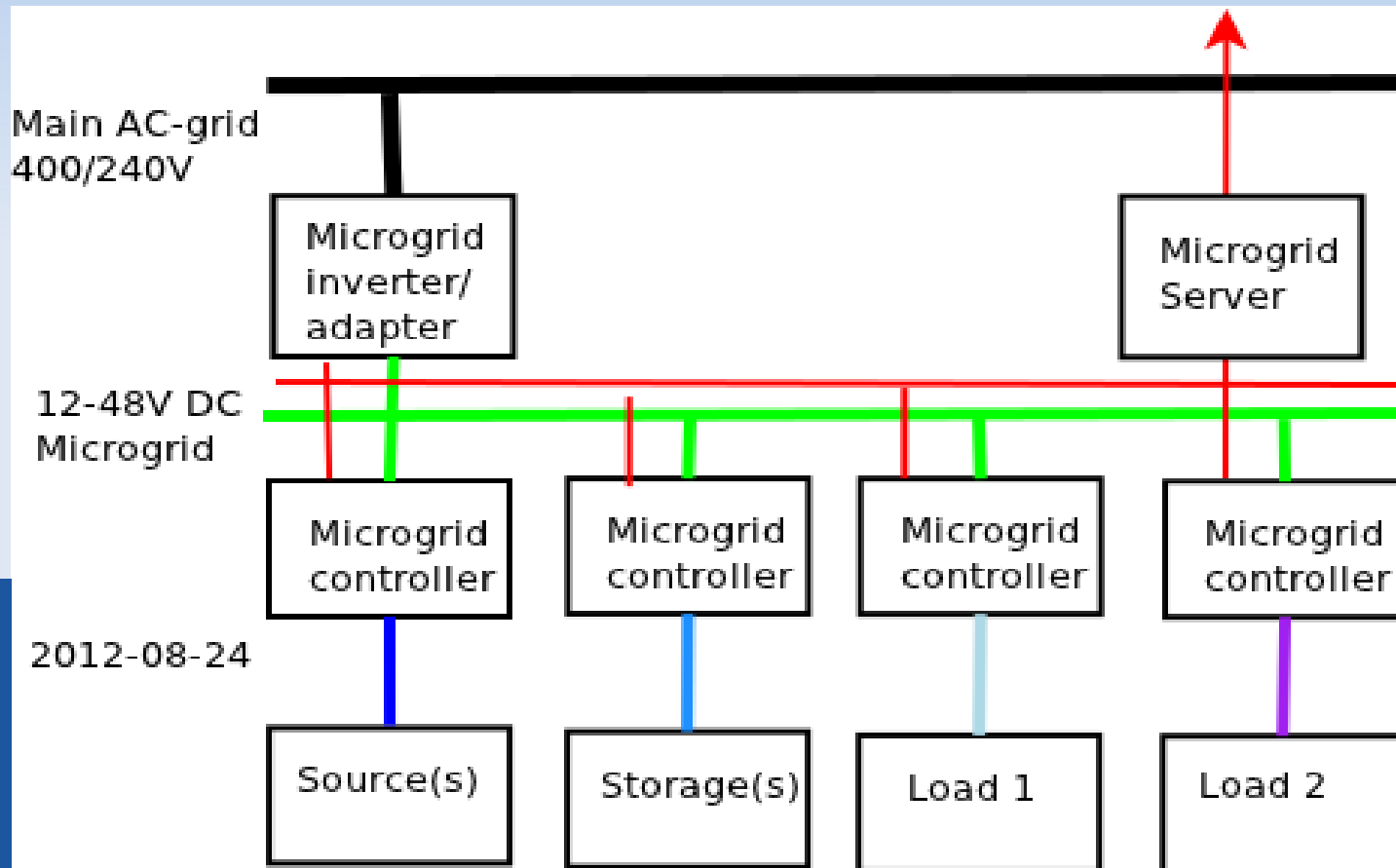
22Watt/DC router/700kpps/4SFP

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

Made in Sweden, Powered by Bifrost/Linux

Ultracapacitor Effort

Ultra-Capacitor bank with 16 caps @ 3000 Farad

Router upgrade/Serengeti

Questions

Savonius VAWT   Modern HAWT   Giromill/Darrieus VAWT