Constrained Application Protocol

(RFC 6690, RFC 7252, RFC 7959, RFC 7641)

The Constrained Application Protocol (CoAP) is a specialized web transfer protocol for use with constrained nodes and constrained (e.g., low-power, lossy) networks.

CoAP Message Format

```
 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 |  TKL  |      Code     |          Message ID           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Token (if any, TKL bytes) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Options (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|1 1 1 1 1 1 1 1|    Payload (if any) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

01 · 4 · 0-8bytes 5.3.1 · OxFF Payload Marker

Ver: Version, T: Type, TKL: Token Length

Message types

```
+------+-----------------+
| Type | Name            |
+------+-----------------+
|  0   | CONfirmable     |
|  1   | NON-confirmable |
|  2   | ACKnowledgement |
|  3   | ReSeT           |
+------+-----------------+
```

Method codes

```
+------+--------+
| Code | Name   |
+------+--------+
| 0.00 | EMPTY  |
+------+--------+
| 0.01 | GET    |
| 0.02 | POST   |
| 0.03 | PUT    |
| 0.04 | DELETE |
+------+--------+
```

Class 0: Request

Response codes

```
 0
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|class|  detail |
+-+-+-+-+-+-+-+-+
```

```
+----------------+---------------------+----------------+
| Code           | Description         |                |
+----------------+---------------------+----------------+
| 2.01 (65, 0x41)| Created             | Success        |
| 2.02 (66, 0x42)| Deleted             |                |
| 2.03 (67, 0x43)| Valid               |                |
| 2.04 (68, 0x44)| Changed             |                |
| 2.05 (69, 0x45)| Content             |                |
| 2.31 (95, 0x5F)| Continue            |                |
+----------------+---------------------+----------------+
| 4.00 (128, 0x80)| Bad Request        | Client Error   |
| 4.01 (129, 0x81)| Unauthorized       |                |
| 4.02 (130, 0x82)| Bad Option         |                |
| 4.03 (131, 0x83)| Forbidden          |                |
| 4.04 (132, 0x84)| Not Found          |                |
| 4.05 (133, 0x85)| Method Not Allowed |                |
| 4.06 (134, 0x86)| Not Acceptable     |                |
| 4.08 (136, 0x88)| Request Entity Incomplete |         |
```

Class 2 · Class 4

```
| 4.12 (140, 0x8C) | Precondition Failed          |
| 4.13 (141, 0x8D) | Request Entity Too Large     |
| 4.15 (143, 0x8F) | Unsupported Content-Format   |
+------------------+------------------------------+--------------+
| 5.00 (160, 0xA0) | Internal Server Error        | Server Error |
| 5.01 (161, 0xA1) | Not Implemented              |              |
| 5.02 (162, 0xA2) | Bad Gateway                  |              |
| 5.03 (163, 0xA3) | Service Unavailable          |              |
| 5.04 (164, 0xA4) | Gateway Timeout              |              |
| 5.05 (165, 0xA5) | Proxying Not Supported       |              |
+------------------+------------------------------+--------------+
```

Class 5

Options

0-12 OptionNumber
13 8bit extended
14 16bit extender
15 Marker(0xF)/Reserve

```
 0   1   2   3   4   5   6   7
+---------------+---------------+
| Option Delta  | Option Length |   1 byte
+---------------+---------------+
/         Option Delta          /   0-2 bytes
\          (extended)           \
+-------------------------------+
/         Option Length         /   0-2 bytes
\          (extended)           \
+-------------------------------+
/         Option Value          /   0 or more bytes
+-------------------------------+
```

```
+-----+---+---+---+---+----------------+--------+--------+-----------+
| No. | C | U | N | R | Name           | Format | Length | Default   |
+-----+---+---+---+---+----------------+--------+--------+-----------+
|  1  | x |   |   | x | If-Match       | opaque | 0-8    | (none)    |
|  3  | x | x | - |   | Uri-Host       | string | 1-255  | (see note 1)|
|  4  |   |   |   | x | ETag           | opaque | 1-8    | (none)    |
|  5  | x |   |   |   | If-None-Match  | empty  | 0      | (none)    |
|  7  | x | x | - |   | Uri-Port       | uint   | 0-2    | (see note 1)|
|  8  |   |   |   | x | Location-Path  | string | 0-255  | (none)    |
| 11  | x | x | - | x | Uri-Path       | string | 0-255  | (none)    |
| 12  |   |   |   |   | Content-Format | uint   | 0-2    | (none)    |
| 14  |   | x | - |   | Max-Age        | uint   | 0-4    | 60        |
| 15  | x | x | - | x | Uri-Query      | string | 0-255  | (none)    |
| 17  | x |   |   |   | Accept         | uint   | 0-2    | (none)    |
| 20  |   |   |   | x | Location-Query | string | 0-255  | (none)    |
| 28  |   |   | x |   | Size2          | uint   | 0-4    | (none)    |
| 35  | x | x | - |   | Proxy-Uri      | string | 1-1034 | (none)    |
| 39  | x | x | - |   | Proxy-Scheme   | string | 1-255  | (none)    |
| 60  |   |   | x |   | Size1          | uint   | 0-4    | (none)    |
+-----+---+---+---+---+----------------+--------+--------+-----------+
```

C=Critical, U=Unsafe, N=No-Cache-Key, R=Repeatable

Note 1: taken from destination address/port of request message

Content-Formats

```
+--------------------------+------+
| Media type               | Id.  |
+--------------------------+------+
| text/plain;charset=utf-8 |   0  |
| application/link-format   |  40  |
| application/xml           |  41  |
| application/octet-stream  |  42  |
| application/exi           |  47  |
| application/json          |  50  |
| application/cbor          |  60  |
+--------------------------+------+
```

URI schemes   6

```
coap-URI = "coap:" "//" host [ ":" port ] path-abempty [ "?" query ]
coaps-URI = "coaps:" "//" host [ ":" port ] path-abempty [ "?" query ]
```

Transmission parameters

```
+------------------+---------------+      4.8
| name             | default value |
+------------------+---------------+
| ACK_TIMEOUT      | 2 seconds     |
| ACK_RANDOM_FACTOR | 1.5          |
```

```
| MAX_RETRANSMIT   | 4             |
| NSTART           | 1             |
| DEFAULT_LEISURE  | 5 seconds     |
| PROBING_RATE     | 1 Byte/second |
+------------------+---------------+
```

Link Format .well-known/core

Link format can be used to describe hosted resources, their attributes, and other relationships between links. Example:

```
REQ: GET /.well-known/core

RES: 2.05 Content

</sensors>;ct=40;title="Sensor Index",
</sensors/temp>;rt="temperature-c";if="sensor",
</sensors/light>;rt="light-lux";if="sensor",
<http://www.example.com/sensors/t123>;anchor="/sensors/temp";rel="describedby",
</t>;anchor="/sensors/temp";rel="alternate"
```

Block

In order to transfer larger payloads with CoAP — for instance, for firmware updates — the Block option can be used.

```
+-----+---+---+---+---+--------+--------+--------+---------+
| No. | C | U | N | R | Name   | Format | Length | Default |
+-----+---+---+---+---+--------+--------+--------+---------+
| 23  | x | x | - | - | Block2 | uint   | 0-3 B  | (none)  |
| 27  | x | x | - | - | Block1 | uint   | 0-3 B  | (none)  |
+-----+---+---+---+---+--------+--------+--------+---------+
```

```
 0
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
| NUM   |M| SZX |
+-+-+-+-+-+-+-+-+
```

```
 0                   1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          NUM          |M| SZX |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
 0                   1                   2
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  NUM                  |M| SZX |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Observe

In order to follow state changes of CoAP resources the Observe option can be used.

```
+-----+---+---+---+---+---------+--------+--------+---------+
| No. | C | U | N | R | Name    | Format | Length | Default |
+-----+---+---+---+---+---------+--------+--------+---------+
|  6  | x | - |   |   | Observe | uint   | 0-3 B  | (none)  |
+-----+---+---+---+---+---------+--------+--------+---------+
```

References

This cheatsheet is based on and heavily stole from the following documents:

Link-format: http://tools.ietf.org/html/rfc6690
CoAP: http://tools.ietf.org/html/rfc7252
Block: http://tools.ietf.org/html/rfc7959
Observe: http://tools.ietf.org/html/rfc7641