CoRE   M. Becker, Ed.
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Expires: February 9, 2014   Huawei Technologies
                                                             T. Poetsch
                                                        K. Kuladinithi
                                            ComNets, TZI, University Bremen
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Transport of CoAP over SMS
draft-becker-core-coap-sms-gprs-04

Abstract

   Short Message Service (SMS) of mobile cellular networks is frequently
   used in Machine-To-Machine (M2M) communications, such as for
   telematic devices. The service offers small packet sizes and high
   delays just as other typical low-power and lossy networks (LLNs),
   i.e. 6LoWPANs. The design of the Constrained Application Protocol
   (CoAP), that took the limitations of LLNs into account, is thus also
   applicable to other transports. The adaptation of CoAP to SMS
   transport mechanisms is described in this document.

Status of this Memo

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Table of Contents

1. Introduction

This specification details the usage of the Constrained Application
Protocol on the Short Message Service (SMS) of mobile cellular
networks.

1.1. Motivation

In some M2M environments, internet connectivity is not supported by
the constrained end-points, but a cellular network connection is
supported instead. Internet connectivity might also be switched off
for power saving reasons or the cellular coverage does not allow for
Internet connectivity. In these situations, SMS will be supported,
instead of UDP/IP over General Packet Radio Service (GPRS), High
Speed Packet Access (HSPA) or Long Term Evolution (LTE) networks.

In 3GPP, SMS is identified as the transport protocol for small data
transmissions (See [3gpp_ts23_888] for Key Issue on Machine Type
Communication (MTC) Device Trigger and the proposed solutions in
Sections 6.2, 6.42, 6.44, 6.48, 6.52, 6.60, and 6.61). In
[3gpp_ts23_682] 'Architecture Enhancements to facilitate
communications with Packet Data Networks and Applications' SMS is at
the moment the only Trigger Delivery (Trigger Delivery using T4).

M2M protocols using SMS, e.g. for telematics, are using mostly
various diverse proprietary and closed binary protocols with limited
publicly available documentation at the moment.

In Open Mobile Alliance (OMA) LightweightM2M technical specification
[oma_lightweightm2m_ts], SMS is identified as an alternative
transport for CoAP messages.

2. Terminology

This document uses the following terminology:

CoAP Server and Client
   The terms CoAP Server and CoAP Client are used synonymously to
   Server and Client as specified in the terminology section of
   [I-D.ietf-core-coap].

Mobile Station (MS)
   A Mobile Station includes all required user equipment and software
   that is needed for communication with a mobile network. As
   defined in [etsi_ts101_748].

3. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in RFC 2119 [RFC2119].

4. Scenarios

Several scenarios are presented first for M2M communications with
CoAP over SMS. First Mobile-Originating Mobile-Terminating (MO-MT)
scenarios are presented, where both CoAP endpoints are in devices in
a cellular network. Next, Mobile-Terminating (MT) scenarios are
detailed, where only the CoAP server is in a cellular network.
Finally, Mobile-Originating (MO) scenarios where the CoAP client is
in the cellular network.

4.1. MO-MT Scenarios

Two mobile cellular terminals communicate by exchanging a CoAP
Request and Response embedded into short message protocol data units
(PDUs) (depicted in Figure 1). Both terminals are connected via a
Short Message Service Centre (SMS-C).

```
                CoAP-REQ              CoAP-REQ
        +------+   (SMS)   +-------+   (SMS)   +------+
        |  A   | --------> | SMS-C | -------> |  B   |
        |(cell)| <-------- |       | <------- |(cell)|
        +------+ CoAP-RES  +-------+ CoAP-RES +------+
                  (SMS)                (SMS)
```
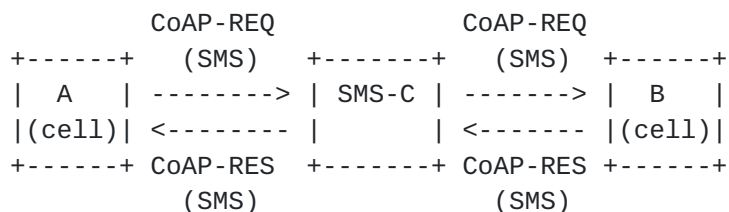
   Figure 1: Cellular and Cellular Communication (only SMS-based)

4.2. MT Scenarios

An IP host and a mobile cellular terminal communicate by exchanging
CoAP Request and Response. The IP host uses protocols offered by the
SMS-C (e.g. Short Message Peer-to-Peer (SMPP [smpp]), Computer
Interface to Message Distribution (CIMD [cimd]), Universal Computer
Protocol/External Machine Interface (UCP/EMI [ucp])) to submit a
short message for delivery, which contains the CoAP Request (depicted
in Figure 2).

```
                   CIMD                     CoAP-REQ
          +------+    SMPP      +-------+    (SMS)     +------+
          |  A   | -------->  | SMS-C | --------->  |  B   |
          | (IP) | <--------  |       |   | <--------- |(cell)|
          +------+               +-------+  CoAP-RES   +------+
                                                (SMS)
```

                  Figure 2: IP and Cellular Communication

   There are service providers that offer SMS delivery and notification
   using an HTTP/REST interface (depicted in Figure 3).

```
          HTTP-REQ                   CIMD              CoAP-REQ
  +------+ (CoAP-DATA) +-----------+  SMPP    +-----+    (SMS)     +------+
  |      |             | SMS       | SS7      |SMS-C|              |      |
  |  A   | ----------> | Service   | ------>  |  /  | --------->  |  B   |
  | (IP) | <---------- | Provider  | <------  | HLR | <---------  |(cell)|
  +------+  HTTP-RES   +-----------+          +-----+  CoAP-RES   +------+
           (CoAP-DATA)                                   (SMS)
```

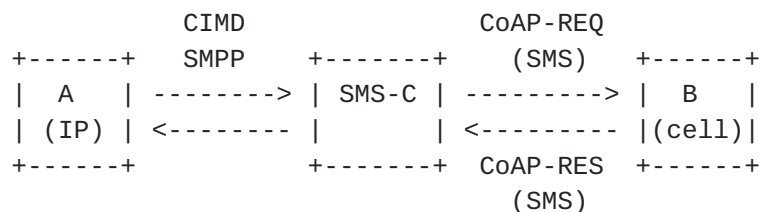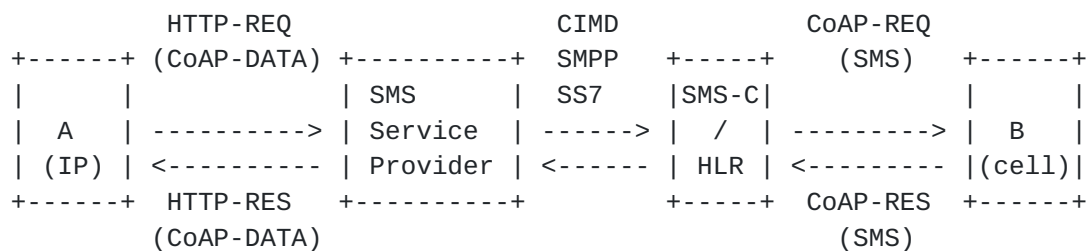   Figure 3: IP and Cellular Communication (using an SMS Service
                                Provider)

4.3. MO Scenarios

   A mobile cellular terminal and an IP host communicate by exchanging
   CoAP Request and Response. The mobile cellular terminal sends a CoAP
   Request in a short message, which is in turn forwarded by the SMS-C
   (e.g. with Short Message Peer-to-Peer (SMPP [smpp]), Computer
   Interface to Message Distribution (CIMD [cimd]), Universal Computer
   Protocol/External Machine Interface (UCP/EMI [ucp])) as depicted in
   Figure 4). This scenario can be a fall-back for mobile-originating
   communication, when IP connectivity cannot be setup (e.g. due to
   missing coverage).

```
                  CoAP-REQ                  CIMD
          +------+    (SMS)     +-------+    SMPP      +------+
          |  A   | -------->  | SMS-C | --------->  |  B   |
          |(cell)| <--------  |       |   | <--------- | (IP) |
          +------+  CoAP-RES   +-------+              +------+
                    (SMS)
```
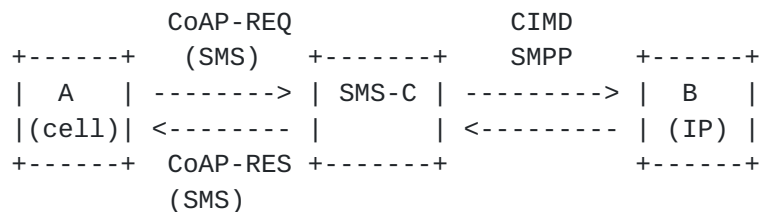
                  Figure 4: Cellular and IP Communication

   There are service providers offering SMS delivery and notification
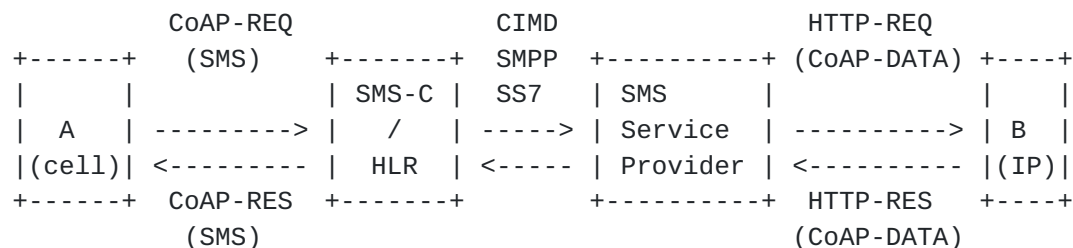   using an HTTP/REST interface (depicted in Figure 5).

```
              CoAP-REQ              CIMD              HTTP-REQ
  +------+     (SMS)     +-------+  SMPP  +----------+ (CoAP-DATA) +----+
  |      |               | SMS-C |  SS7   | SMS      |             |    |
  |  A   | --------->    |   /   |  ----> | Service  | ----------> | B  |
  |(cell)| <---------    |  HLR  |  <---- | Provider | <---------- |(IP)|
  +------+    CoAP-RES   +-------+        +----------+  HTTP-RES    +----+
               (SMS)                                    (CoAP-DATA)
```

             Figure 5: IP and Cellular Communication (using an SMS Service
                                    Provider)

5. Message Exchanges

5.1. Message Exchange for SMS in a Cellular-To-Cellular Mobile-Originated and Mobile-Terminated Scenario

   The CoAP Client works as a Mobile Station to send the short message,
   and the CoAP Server works as another Mobile Station to receive the
   short message. All short messages are stored and forwarded by the
   Service Center. The message exchange between the CoAP Client and the
   CoAP Server is depicted in the figure below:

```
       MS/CoAP CLIENT          Service Center          MS/CoAP SERVER
           |                         |                       |
           |    ---SMS-SUBMIT--->    |                       |
           | <-SMS-SUBMIT-REPORT--   |                       |
           |                         |                       |
           |                         |    --SMS-DELIVER--->   |
           |                         | <-SMS-DELIVER-REPORT-- |
           |                         |                       |
           | <-SMS-STATUS-REPORT--   |                       |
           |                         |                       |
```
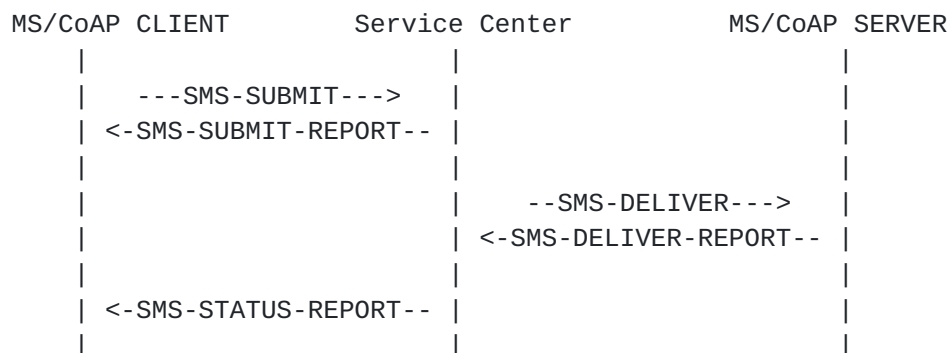
                   Figure 6: CoAP Messages over SMS

   Note that the message exchange is just for one request message from
   CoAP Client and CoAP Server. It includes the following steps:

   Step 1: The CoAP Client sends a CoAP request in a SMS-SUBMIT message
   to the Service Center. The CoAP Server address is specified as TP-
   Destination-Address (see [3gpp_ts_23_040]).

   Step 2: The Service Center returns a SMS-SUBMIT-REPORT message to the
   CoAP Client.

   Step 3: The Service Center stores the received SMS message and

   forwards it to the CoAP Server, using an SMS-DELIVER message. The
   CoAP Client address is specified as a TP Originating Address (see
   [3gpp_ts_23_040]).

   Step 4: The CoAP Server returns an SMS-DELIVER-REPORT message to the
   Service Center.

   Step 5: The Service Center returns the SMS-STATUS-REPORT message to
   the CoAP Client to indicate the SMS delivery status, if required by
   the CoAP Client.

   Note that the SMS-STATUS-REPORT message just indicates the transport
   layer SMS delivery status and has no relationship with the
   confirmable message or non-confirmable message. If the CoAP Client
   has sent a confirmable message, the CoAP Server MUST use a separate
   SMS message to transmit the ACK.

6. Encoding Schemes of CoAP for SMS transport

   Short messages can be encoded by using various alphabets: GSM 7 bit
   default alphabet ([3gpp_ts23_038]), 8 bit data alphabet, and 16 bit
   USC2 data alphabet ([iso_ucs2]). These encodings lead to message
   sizes of 160, 140, and 70 characters, respectively. The support of 7
   bit encoding is mandatory on a MS. The 7 bit and 16 bit encodings
   are dependent on the language that needs to be encoded, e.g. USC2
   for Arabic, Chinese, Japanese, etc. 8 bit encoding can be used for
   user specific encoding. Furthermore, the supported encoding scheme
   highly depends on the implementations of the MS itself.

   According to [3gpp_ts23_038], GSM 7 bit encoding shall be supported
   by all MSs offering SMS services. Since not all MSs support 8 bit
   short message encoding, the prefered encoding scheme for CoAP
   messages over SMS is therefore 7 bit, e.g. together with Base64
   ([RFC4648]) or SMS encoding in [I-D.bormann-coap-misc].

   More considerations about SMS encoding can be found in
   [I-D.bormann-coap-misc].

7. Message Size Implementation Considerations

   By using 7 bit encoding, a maximum length of 160 characters is
   allowed in one short message [3gpp_ts23_038]. Consequently, the
   maximum length for a CoAP message results in 140 bytes. 160
   characters = (140 bytes * 8)/7.

   Possible options for larger CoAP messages are:

Concatenated short messages
   Most MSs are able to send concatenation short messages in order to
   tranmsit longer messages. The total length of a concatenated
   short message can consist of up to 255 single messages and result
   in total length of 39015 7 bit characters or 34170 bytes.
   Resulting from this, the maximum length of each individual message
   reduces to 153 (160 - 7) characters (133 bytes).

CoAP blockwise transfer
   According to [I-D.ietf-core-block], the Block Size (SZX) of
   blockwise transfer in CoAP is represented as a three-bit unsigned
   integer. Thus, the possible block sizes are to the power of two.
   (Block size = 2**(SZX + 4)). Due to the limitations of 160
   characters (140 bytes) for one short message, the maximum value of
   SZX is 3 (Block size = 128 byte).

   However, it is RECOMMENDED that SMS is not used to transfer very
   large resource data using blockwise transfer.

8. Addressing

   For SMS in cellular networks, the CoAP endpoints have to work with a
   SIM (Subscriber Identity Module) card and have to be addressed by the
   MSISDN (Mobile Station ISDN (MSISDN) number).

   To allow the CoAP client to detect that the short message contains a
   CoAP message, the TP-DATA-Coding-Scheme SHOULD be included.

9. Options for mixed IP operation

   In case a CoAP Server has more than one network interface, e.g. SMS
   and IP, the CoAP Client might want the server to send the response
   via an alternative transport, i.e. to it's alternative address.
   However, that implies that the initiating CoAP Client is aware of the
   presence of the alternative interface. For this reason the new
   options Response-To-Uri-Host and Response-To-Uri-Port are proposed.

No.	C	U	N	R	Name	Format	Length	Default
34					Response-To-Uri-Host	string	1-270 B	(none)
38					Response-To-Uri-Port	uint	0-2 B	5683

                     Table 1: New CoAP Option Numbers

   If the Response-To-Uri-Host is present in the request, server MUST
   send the response to the indicated URI address, instead of the
   client's original request URI.

   The options SHOULD NOT be used in the response.

   The options MUST NOT occur more than once.

10. URI Scheme

   The coap:// scheme defines that a CoAP server is reachable over
   UDP/IP. Hence, a new URI scheme is needed for CoAP servers which are
   reachable over SMS.

   TODO: Update whenever it has been clarified in
   [I-D.silverajan-core-coap-alternative-transports]

11. Transmission Parameters

   It is RECOMMENDED to configure the RESPONSE_TIMEOUT variable for a
   higher duration than specified in [I-D.ietf-core-coap] for the
   applications described here. The actual value SHOULD be chosen based
   on experience with SMS .

12. Multicast

   Multicast is not possible with SMS transports.

13. Security Considerations

   It is possible that a malicious CoAP Client sends repeated requests,
   and it may cost money for the CoAP Server to use SMS to send back
   associated responses. To avoid this situation, the CoAP Server
   implementation can authenticate the CoAP Client before responding to
   the requests. For example, the CoAP Server can maintain an MSISDN
   white list. Only the MSISDN specified in the white list will be
   allowed to send requests. The requests from others will be ignored
   or rejected.

14. IANA Considerations

14.1. CoAP Option Number

   The IANA is requested to add the following option number entries to
   the CoAP Option Number Registry:

```
   +--------+---------------------+---------------------------+
   | Number |        Name         | Reference                 |
   +--------+---------------------+---------------------------+
   |   34   | Response-To-Uri-Host | Section 9 of this document |
   +--------+---------------------+---------------------------+
   |   38   | Response-To-Uri-Port | Section 9 of this document |
   +--------+---------------------+---------------------------+
```

14.2. URI Scheme Registration

   According to [I-D.silverajan-core-coap-alternative-transports] this
   document requests the registration of the Uniform Resource Identifier
   (URI) scheme "coap+alt". The registration request complies with
   [RFC4395].

15. Acknowledgements

16. References

16.1. Normative References

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16.2. Informative References

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Appendix A. Changelog

Changed from draft-03 to draft-04:

o Various editorial changes.

o Removed USSD and GPRS related parts.

o Removed section 5: Examples

o Removed section 14: Proxying Considerations

o Added more block size considerations.

o Added more concatenated SMS considerations.

o Rewrote encoding scheme section; 7 bit encoding only.

Changed from draft-02 to draft-03:

o Added reference to OMA LightweightM2M Technical Specification in
   "Motivation" section.

o Chose CoAP option numbers and updated the option number table to
   meet draft-ietf-core-coap-13.

Changed from draft-01 to draft-02:

o Added security considerations: Transport and Object Security.
   Section 13

o Reply-To-* changed to Response-To-*. Section 14

o Added URI scheme.

o Added possible CON/NON/ACK interactions.

o Added possible M2M proxy scenarios.

o Added reference to bormann-coap-misc for other SMS encoding.
   Section 6

o Updated requirements on Uri-Host and Uri-Port for coap+tel://.

o Chose CoAP option numbers and updated the option number table to
   meet draft-ietf-core-coap-10. />

o Added an IANA registration for the URI scheme. Section 14.2

Authors' Addresses

   Markus Becker (editor)
   ComNets, TZI, University Bremen
   Bibliothekstrasse 1
   Bremen 28359
   Germany

   Phone: +49 421 218 62379
   Email: mab@comnets.uni-bremen.de

   Kepeng Li
   Huawei Technologies
   Huawei Base, Bantian, Longgang District
   Shenzhen, Guangdong 518129
   P. R. China

   Phone: +86-755-28974289
   Email: likepeng@huawei.com

   Thomas Poetsch
   ComNets, TZI, University Bremen
   Bibliothekstrasse 1
   Bremen 28359
   Germany

   Phone: +49 421 218 62379
   Email: thp@comnets.uni-bremen.de

Koojana Kuladinithi
ComNets, TZI, University Bremen
Bibliothekstrasse 1
Bremen 28359
Germany

Phone: +49 421 218 62382
Email: koo@comnets.uni-bremen.de