6TiSCH
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Example Packets for 6TiSCH Configuration
draft-munoz-6tisch-examples-02

Abstract

This draft contains example packets exchanged by nodes implementing the following ietf documents: RFC 8180: Minimal IPv6 over the TSCH Mode of IEEE 802.15.4e (6TiSCH) Configuration, draft-wang-6tisch-6top-protocol-07, RFC 8138: IPv6 over Low_power Wireless Personal Area Network (6LoWPAN) Routing Header and RFC 8025: IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) Paging Dispatch. All packets are presented both in raw binary and fully parsed contents. This document can be used as a reference when implementing the previous mentioned RFCs and Internet Drafts.

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1. Tools Used

All results presented in this document are collected by running the OpenWSN firmware [OpenWSN] in simulation mode and capturing the packets exchanged using the development branch of Wireshark. At the time of writing this document, the dissection of the RFC 8138 and RFC 8025 implementation has not been merged into the master branch of Wireshark but it will be by the time of the 1st F-Interop 6TiSCH Interoperability Event.

These are the version of the source code used:

1. Wireshark dissector: https://github.com/wireshark/wireshark/commit/1aa8ded9a3de8e6fb5b6a7b7dcca9d93bb50dcdd

2. OpenWSN firmware: https://github.com/openwsn-berkeley/openwsn-fw/commit/4e05d8bc54b59632d5da771818bf8b4a05b3ce11

3. OpenWSN software: https://github.com/openwsn-berkeley/openwsn-sw/commit/e4cdf73cbdbbe88bbe0af48e69abb7cfed84f0d9

2. Network Topology

```
Network prefix: bbbb::/64
MAC address:    14-15-92-cc-00-00-00-0x

        PDR=100%       PDR=100%
 +-----+        +-----+        +-----+
 | x=1 |--------| x=2 |--------| x=3 |
 +-----+        +-----+        +-----+
 DAGroot
```

3. Packet Examples

3.1. Known Errors in These examples

Looks for "FIXME" in the examples below.

3.2. Enhanced Beacon

Enhanced Beacon sent by 1

```
== Dissected packet ==

IEEE 802.15.4 Enhanced Beacon, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xea40, Frame Type: Beacon, PAN ID Compression,
Information Elements Present, Destination Addressing Mode: Short/16-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .000 = Frame Type: Beacon (0x0)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 90
    Destination PAN: 0xcafe
    Destination: 0xffff
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
```

IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE, Length: 0

```
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        MLME IE
            Payload IE TLV: 0x881c, Type: Payload, Id: MLME IE
                1... .... .... .... = Type: Payload (1)
                .000 1... .... .... = Id: MLME IE (0x1)
                .... .000 0001 1100 = Length: 28
            Time Synchronization IE
                Payload Sub IE (short): 0x1a06, Type: Short, Sub Id (Short):
TSCH Synchronization IE
                    0... .... .... .... = Type: Short (0)
                    .001 1010 .... .... = Sub Id (Short): TSCH Synchronization
IE (0x1a)
                    .... .... 0000 0110 = Length: 6
                Absolute Slot Number: 10098
                Join Metric: 0
            TSCH Timeslot IE
                Payload IE TLV: 0x1c03, Type: Short, Sub Id (Short): TSCH
Timeslot IE
                    0... .... .... .... = Type: Short (0)
                    .001 1100 .... .... = Sub Id (Short): TSCH Timeslot IE
(0x1c)
                    .... .... 0000 0011 = Length: 3
                Data: 01eb01
            Channel Hopping IE
                Payload Sub IE (long): 0xc801, Type: Long, Sub Id (Long):
Channel Hopping IE
                    1... .... .... .... = Type: Long (1)
                    .100 1... .... .... = Sub Id (Long): Channel Hopping IE
(0x9)
                    .... .000 0000 0001 = Length: 1
                Hopping Sequence ID: 0x00
            TSCH Slotframe and Link IE
                Payload Sub IE (short): 0x1b0a, Type: Short, Sub Id (Short):
TSCH Slotframe and Link IE
                    0... .... .... .... = Type: Short (0)
                    .001 1011 .... .... = Sub Id (Short): TSCH Slotframe and
Link IE (0x1b)
                    .... .... 0000 1010 = Length: 10
                Number of Slotframes: 1
                Slotframes [1]
                    Slotframe handle: 1
                    Slotframe size: 11
                    Number of Links: 1
                    Link Information
                        Timeslot: 0
```

```
                      Channel Offset: 0
                      Link Options: 15
    FCS: 0xfc89 (Correct)

== Raw Bytes ==

0000  40 ea 5a fe ca ff ff 01 00 00 00 cc 92 15 14 00
0010  3f 1c 88 06 1a 72 27 00 00 00 00 03 1c 01 eb 01
```

```
0020  01 c8 00 0a 1b 01 01 0b 00 01 00 00 00 00 0f 89
0030  fc
```

Enhanced Beacon sent by 2

== Dissected packet ==

```
IEEE 802.15.4 Enhanced Beacon, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xea40, Frame Type: Beacon, PAN ID Compression,
Information Elements Present, Destination Addressing Mode: Short/16-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .000 = Frame Type: Beacon (0x0)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 25
    Destination PAN: 0xcafe
    Destination: 0xffff
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        MLME IE
            Payload IE TLV: 0x881c, Type: Payload, Id: MLME IE
                1... .... .... .... = Type: Payload (1)
                .000 1... .... .... = Id: MLME IE (0x1)
                .... .000 0001 1100 = Length: 28
            Time Synchronization IE
                Payload Sub IE (short): 0x1a06, Type: Short, Sub Id (Short):
TSCH Synchronization IE
                    0... .... .... .... = Type: Short (0)
                    .001 1010 .... .... = Sub Id (Short): TSCH Synchronization
IE (0x1a)
                    .... .... 0000 0110 = Length: 6
                Absolute Slot Number: 10219
                Join Metric: 1
            TSCH Timeslot IE
```

```
                Payload IE TLV: 0x1c03, Type: Short, Sub Id (Short): TSCH
Timeslot IE
                    0... .... .... .... = Type: Short (0)
                    .001 1100 .... .... = Sub Id (Short): TSCH Timeslot IE
(0x1c)
                    .... .... 0000 0011 = Length: 3
                Data: 01eb01
```

```
            Channel Hopping IE
                Payload Sub IE (long): 0xc801, Type: Long, Sub Id (Long):
Channel Hopping IE
                    1... .... .... .... = Type: Long (1)
                    .100 1... .... .... = Sub Id (Long): Channel Hopping IE
(0x9)
                    .... .000 0000 0001 = Length: 1
                Hopping Sequence ID: 0x00
            TSCH Slotframe and Link IE
                Payload Sub IE (short): 0x1b0a, Type: Short, Sub Id (Short):
TSCH Slotframe and Link IE
                    0... .... .... .... = Type: Short (0)
                    .001 1011 .... .... = Sub Id (Short): TSCH Slotframe and
Link IE (0x1b)
                    .... .... 0000 1010 = Length: 10
                Number of Slotframes: 1
                Slotframes [1]
                    Slotframe handle: 1
                    Slotframe size: 11
                    Number of Links: 1
                    Link Information
                        Timeslot: 0
                        Channel Offset: 0
                        Link Options: 15
    FCS: 0xc1b4 (Correct)

== Raw Bytes ==

0000  40 ea 19 fe ca ff ff 02 00 00 00 cc 92 15 14 00
0010  3f 1c 88 06 1a eb 27 00 00 00 01 03 1c 01 eb 01
0020  01 c8 00 0a 1b 01 01 0b 00 01 00 00 00 00 0f b4
0030  c1

   Enhanced Beacon sent by 3

== Dissected packet ==

IEEE 802.15.4 Enhanced Beacon, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:03
    Frame Control Field: 0xea40, Frame Type: Beacon, PAN ID Compression,
Information Elements Present, Destination Addressing Mode: Short/16-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .000 = Frame Type: Beacon (0x0)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
```

```
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 6
    Destination PAN: 0xcafe
    Destination: 0xffff
```

```
    Extended Source: 14:15:92:cc:00:00:00:03 (14:15:92:cc:00:00:00:03)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        MLME IE
            Payload IE TLV: 0x881c, Type: Payload, Id: MLME IE
                1... .... .... .... = Type: Payload (1)
                .000 1... .... .... = Id: MLME IE (0x1)
                .... .000 0001 1100 = Length: 28
            Time Synchronization IE
                Payload Sub IE (short): 0x1a06, Type: Short, Sub Id (Short):
TSCH Synchronization IE
                    0... .... .... .... = Type: Short (0)
                    .001 1010 .... .... = Sub Id (Short): TSCH Synchronization
IE (0x1a)
                    .... .... 0000 0110 = Length: 6
                Absolute Slot Number: 10417
                Join Metric: 31
            TSCH Timeslot IE
                Payload IE TLV: 0x1c03, Type: Short, Sub Id (Short): TSCH
Timeslot IE
                    0... .... .... .... = Type: Short (0)
                    .001 1100 .... .... = Sub Id (Short): TSCH Timeslot IE
(0x1c)
                    .... .... 0000 0011 = Length: 3
                Data: 01eb01
            Channel Hopping IE
                Payload Sub IE (long): 0xc801, Type: Long, Sub Id (Long):
Channel Hopping IE
                    1... .... .... .... = Type: Long (1)
                    .100 1... .... .... = Sub Id (Long): Channel Hopping IE
(0x9)
                    .... .000 0000 0001 = Length: 1
                Hopping Sequence ID: 0x00
            TSCH Slotframe and Link IE
                Payload Sub IE (short): 0x1b0a, Type: Short, Sub Id (Short):
TSCH Slotframe and Link IE
                    0... .... .... .... = Type: Short (0)
                    .001 1011 .... .... = Sub Id (Short): TSCH Slotframe and
Link IE (0x1b)
                    .... .... 0000 1010 = Length: 10
                Number of Slotframes: 1
                Slotframes [1]
```

```
                    Slotframe handle: 1
                    Slotframe size: 11
                    Number of Links: 1
                    Link Information
                        Timeslot: 0
                        Channel Offset: 0
                        Link Options: 15
    FCS: 0x65bf (Correct)
```

```
== Raw Bytes ==

0000  40 ea 06 fe ca ff ff 03 00 00 00 cc 92 15 14 00
0010  3f 1c 88 06 1a b1 28 00 00 00 1f 03 1c 01 eb 01
0020  01 c8 00 0a 1b 01 01 0b 00 01 00 00 00 00 0f bf
0030  65
```

3.3. RPL DIO

RPL DIO sent by 1

```
== Dissected packet ==

IEEE 802.15.4 Data, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xe841, Frame Type: Data, PAN ID Compression,
Destination Addressing Mode: Short/16-bit, Frame Version: IEEE Std
802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements Present: False
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 93
    Destination PAN: 0xcafe
    Destination: 0xffff
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    FCS: 0x04b3 (Correct)
6LoWPAN
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version, traffic
class, and flow label compressed (0x3)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x2)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..11 .... = Source address mode: Compressed (0x0003)
        .... .... .... 1... = Multicast address compression: True
        .... .... .... .0.. = Destination address compression: Stateless
        .... .... .... ..11 = Destination address mode: 8-bits inline (0x0003)
        [Source context: fe80::]
        [Destination context: fe80::]
```

```
    Next header: ICMPv6 (0x3a)
    Source: fe80::1615:92cc:0:1
    Destination: ff02::1a
```

```
Internet Protocol Version 6, Src: fe80::1615:92cc:0:1, Dst: ff02::1a
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic Class: 0x00 (DSCP: CS0,
ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated Services
Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flow Label: 0x00000
    Payload Length: 28
    Next Header: ICMPv6 (58)
    Hop Limit: 64
    Source: fe80::1615:92cc:0:1
    Destination: ff02::1a
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 1 (DODAG Information Object)
    Checksum: 0x171b incorrect, should be 0xd255
    [Checksum Status: Bad]
    RPLInstanceID: 0
    Version: 0
    Rank: 256
    Flags: 0x88, Grounded (G), Mode of Operation (MOP): Non-Storing Mode of
Operation
        1... .... = Grounded (G): True
        .0.. .... = Zero: False
        ..00 1... = Mode of Operation (MOP): Non-Storing Mode of Operation
(0x1)
        .... .000 = DODAG Preference: 0
    Destination Advertisement Trigger Sequence Number (DTSN): 51
    Flags: 0x00
    Reserved: 00
    DODAGID: bbbb::1415:92cc:0:1
== Raw Bytes ==
0000  41 e8 5d fe ca ff ff 01 00 00 00 cc 92 15 14 7a
0010  3b 3a 1a 9b 01 17 1b 00 00 01 00 88 33 00 00 bb
0020  bb 00 00 00 00 00 00 14 15 92 cc 00 00 00 01 b3
0030  04
```

RPL DIO sent by 2

```
== Dissected packet ==

IEEE 802.15.4 Data, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xe841, Frame Type: Data, PAN ID Compression,
Destination Addressing Mode: Short/16-bit, Frame Version: IEEE Std
```

```
802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
```

```
        .... ..0. .... .... = Information Elements Present: False
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 28
    Destination PAN: 0xcafe
    Destination: 0xffff
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    FCS: 0xfc06 (Correct)
6LoWPAN
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version, traffic
class, and flow label compressed (0x3)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x2)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..11 .... = Source address mode: Compressed (0x0003)
        .... .... .... 1... = Multicast address compression: True
        .... .... .... .0.. = Destination address compression: Stateless
        .... .... .... ..11 = Destination address mode: 8-bits inline (0x0003)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1615:92cc:0:2
    Destination: ff02::1a
Internet Protocol Version 6, Src: fe80::1615:92cc:0:2, Dst: ff02::1a
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic Class: 0x00 (DSCP: CS0,
ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated Services
Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flow Label: 0x00000
    Payload Length: 28
    Next Header: ICMPv6 (58)
    Hop Limit: 64
    Source: fe80::1615:92cc:0:2
    Destination: ff02::1a
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 1 (DODAG Information Object)
    Checksum: 0x161a incorrect, should be 0xd154
    [Checksum Status: Bad]
```

RPLInstanceID: 0
Version: 0
Rank: 512
Flags: 0x88, Grounded (G), Mode of Operation (MOP): Non-Storing Mode of Operation

```
        1... .... = Grounded (G): True
        .0.. .... = Zero: False
        ..00 1... = Mode of Operation (MOP): Non-Storing Mode of Operation
(0x1)
        .... .000 = DODAG Preference: 0
    Destination Advertisement Trigger Sequence Number (DTSN): 51
    Flags: 0x00
    Reserved: 00
    DODAGID: bbbb::1415:92cc:0:1

== Raw Bytes ==

0000  41 e8 1c fe ca ff ff 02 00 00 00 cc 92 15 14 7a
0010  3b 3a 1a 9b 01 16 1a 00 00 02 00 88 33 00 00 bb
0020  bb 00 00 00 00 00 00 14 15 92 cc 00 00 00 01 06
0030  fc

   RPL DIO sent by 3

== Dissected packet ==

IEEE 802.15.4 Data, Dst: Broadcast, Src: 14:15:92:cc:00:00:00:03
    Frame Control Field: 0xe841, Frame Type: Data, PAN ID Compression,
Destination Addressing Mode: Short/16-bit, Frame Version: IEEE Std
802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .1.. .... = PAN ID Compression: True
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements Present: False
        .... 10.. .... .... = Destination Addressing Mode: Short/16-bit (0x2)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 8
    Destination PAN: 0xcafe
    Destination: 0xffff
    Extended Source: 14:15:92:cc:00:00:00:03 (14:15:92:cc:00:00:00:03)
    FCS: 0xab62 (Correct)
6LoWPAN
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version, traffic
class, and flow label compressed (0x3)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x2)
        .... .... 0... .... = Context identifier extension: False
```

```
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..11 .... = Source address mode: Compressed (0x0003)
        .... .... .... 1... = Multicast address compression: True
        .... .... .... .0.. = Destination address compression: Stateless
```

```
        .... .... .... ..11 = Destination address mode: 8-bits inline (0x0003)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1615:92cc:0:3
    Destination: ff02::1a
Internet Protocol Version 6, Src: fe80::1615:92cc:0:3, Dst: ff02::1a
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic Class: 0x00 (DSCP: CS0,
ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated Services
Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flow Label: 0x00000
    Payload Length: 28
    Next Header: ICMPv6 (58)
    Hop Limit: 64
    Source: fe80::1615:92cc:0:3
    Destination: ff02::1a
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 1 (DODAG Information Object)
    Checksum: 0x1519 incorrect, should be 0xd053
    [Checksum Status: Bad]
    RPLInstanceID: 0
    Version: 0
    Rank: 768
    Flags: 0x88, Grounded (G), Mode of Operation (MOP): Non-Storing Mode of
Operation
        1... .... = Grounded (G): True
        .0.. .... = Zero: False
        ..00 1... = Mode of Operation (MOP): Non-Storing Mode of Operation
(0x1)
        .... .000 = DODAG Preference: 0
    Destination Advertisement Trigger Sequence Number (DTSN): 51
    Flags: 0x00
    Reserved: 00
    DODAGID: bbbb::1415:92cc:0:1

== Raw Bytes ==

0000  41 e8 08 fe ca ff ff 03 00 00 00 cc 92 15 14 7a
0010  3b 3a 1a 9b 01 15 19 00 00 03 00 88 33 00 00 bb
0020  bb 00 00 00 00 00 00 14 15 92 cc 00 00 00 01 62
0030  ab
```

3.4. RPL DAO

3.4.1. RPL DAO from 2

```
   [RPL DAO from 2] 2->1

== Dissected packet ==

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xec21, Frame Type: Data, Acknowledge Request,
Destination Addressing Mode: Long/64-bit, Frame Version: IEEE Std
802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements Present: False
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 43
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    FCS: 0xe370 (Correct)
6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Protocol Information
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 .... .... .... = Packet direction: UP false, DOWN true: False
        .... 0... .... .... = Error detected: False
        .... .0.. .... .... = No link to destination: False
        .... ..1. .... .... = Context identifier extension: True
        .... ...1 .... .... = Context identifier extension: True
        .... .... 0000 0101 = 6loRH Type: Routing Protocol Information (0x05)
        RPL Instance: 0x00
        Sender Rank: 0x02
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version, traffic
class, and flow label compressed (0x3)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x2)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline (0x0001)
```

```
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Destination address compression: Stateless
        .... .... .... ..01 = Destination address mode: 64-bits inline (0x0001)
```

```
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:2
    Destination: fe80::1415:92cc:0:1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:2, Dst: fe80::1415:92cc:0:1
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic Class: 0x00 (DSCP: CS0,
ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated Services
Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flow Label: 0x00000
    Payload Length: 66
    Next Header: ICMPv6 (58)
    Hop Limit: 64
    Source: fe80::1415:92cc:0:2
    Destination: fe80::1415:92cc:0:1
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 2 (Destination Advertisement Object)
    Checksum: 0x69d6 incorrect, should be 0xe44b
    [Checksum Status: Bad]
    RPLInstanceID: 0
    Flags: 0x40, DODAGID Present (D)
        0... .... = DAO-ACK Request (K): False
        .1.. .... = DODAGID Present (D): True
        ..00 0000 = Reserved: 0
    Reserved: 00
    DAO Sequence: 0
    DODAGID: bbbb::1415:92cc:0:1
    ICMPv6 RPL Option (RPL Target bbbb::1415:92cc:0:3/128)
        Type: RPL Target (5)
        Length: 18
        Reserved
        Target Length: 128
        Target: bbbb::1415:92cc:0:3
    ICMPv6 RPL Option (Transit Information bbbb::1415:92cc:0:1)
        Type: Transit Information (6)
        Length: 20
        Flags: 0x00
        Path Control: 0
        Path Sequence: 1
        Path Lifetime: 170
        Parent Address: bbbb::1415:92cc:0:1
```

```
== Raw Bytes ==
```

```
0000  21 ec 2b fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 f1 83 05 02 7a 11 3a 14 15 92 cc
0020  00 00 00 02 14 15 92 cc 00 00 00 01 9b 02 69 d6
0030  00 40 00 00 bb bb 00 00 00 00 00 00 14 15 92 cc
0040  00 00 00 01 05 12 00 80 bb bb 00 00 00 00 00 00
0050  14 15 92 cc 00 00 00 03 06 14 00 00 01 aa bb bb
0060  00 00 00 00 00 00 14 15 92 cc 00 00 00 01 70 e3
```

3.4.2. RPL DAO from 3

```
   [RPL DAO from 3] 3->2

 == Dissected packet ==

 IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02,
                     Src: 14:15:92:cc:00:00:00:03
     Frame Control Field: 0xec21, Frame Type: Data
         .... .... .... .001 = Frame Type: Data (0x0001)
         .... .... .... 0... = Security Enabled: False
         .... .... ...0 .... = Frame Pending: False
         .... .... ..1. .... = Acknowledge Request: True
         .... .... .0.. .... = Intra-PAN: False
         .... ...0 .... .... = Sequence Number Suppression: False
         .... ..0. .... .... = Information Elements present: False
         .... 11.. .... .... = Destination Addressing Mode:
                               Long/64-bit (0x0003)
         ..10 .... .... .... = Frame Version: 2
         11.. .... .... .... = Source Addressing Mode:
                               Long/64-bit (0x0003)
     Sequence Number: 5
     Destination PAN: 0xcafe
     Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
     Extended Source: 14:15:92:cc:00:00:00:03 (14:15:92:cc:00:00:00:03)
     FCS: 0x1640 (Correct)
 6LoWPAN
     .... 0001 = Page Number: 1
     6LoRH: Routing Protocol Information
         100. .... = Routing Header 6lo: Critical Routing Header (0x04)
         ...0 .... .... .... = Packet direction:
                               UP false, DOWN true: False
         .... 0... .... .... = Error detected: False
         .... .0.. .... .... = No link to destination: False
         .... ..1. .... .... = Context identifier extension: True
         .... ...1 .... .... = Context identifier extension: True
         .... .... 0000 0101 = 6loRH Type: Routing Protocol Information
         RPL Instance: 0x00
         Sender Rank: 0x21
     IPHC Header
```

```
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x0003)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x0002)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline(0x01)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..01 = Dest address mode: 64-bits inline (0x01)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1415:92cc:0:1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:3,
                               Dst: fe80::1415:92cc:0:1
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                               0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                               Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                                 Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 46
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1415:92cc:0:1
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 2 (Destination Advertisement Object)
    Checksum: 0xd31a [incorrect, should be 0x4d90]
    RPLInstanceID: 0
    Flags: 0x40
        0... .... = DAO-ACK Request (K): False
        .1.. .... = DODAGID Present (D): True
        ..00 0000 = Reserved: 0
    Reserved: 00
    DAO Sequence: 0
    DODAGID: bbbb::1415:92cc:0:1
    ICMPv6 RPL Option (Transit Information bbbb::1415:92cc:0:2)
        Type: Transit Information (6)
        Length: 20
        Flags: 0x00
```

```
            0... .... = External: Not set
            .000 0000 = Reserved: 0
         Path Control: 0
         Path Sequence: 0
         Path Lifetime: 170
         Parent Address: bbbb::1415:92cc:0:2

 == Raw Bytes ==

 0000   21 ec 05 fe ca 02 00 00 00 cc 92 15 14 03 00 00
 0010   00 cc 92 15 14 f1 83 05 21 7a 11 3a 14 15 92 cc
 0020   00 00 00 03 14 15 92 cc 00 00 00 01 9b 02 d3 1a
 0030   00 40 00 00 bb bb 00 00 00 00 00 00 14 15 92 cc
 0040   00 00 00 01 06 14 00 00 00 aa bb bb 00 00 00 00
 0050   00 00 14 15 92 cc 00 00 00 02 40 16

   [RPL DAO from 3] 2->1

== Dissected packet ==

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01,
                    Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xec21, Frame Type: Data
        .... .... .... .001 = Frame Type: Data (0x0001)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = Intra-PAN: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements present: False
        .... 11.. .... .... = Destination Addressing Mode:
                              Long/64-bit (0x0003)
        ..10 .... .... .... = Frame Version: 2
        11.. .... .... .... = Source Addressing Mode:
                              Long/64-bit (0x0003)
    Sequence Number: 11
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    FCS: 0x2135 (Correct)
6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Protocol Information
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 .... .... .... = Packet direction:
                              UP false, DOWN true: False
        .... 0... .... .... = Error detected: False
        .... .0.. .... .... = No link to destination: False
```

```
        .... ..1. .... .... = Context identifier extension: True
        .... ...1 .... .... = Context identifier extension: True
        .... .... 0000 0101 = 6loRH Type: Routing Protocol Information
        RPL Instance: 0x00
        Sender Rank: 0x03
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x0003)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x0002)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline (0x01)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..01 = Dest address mode: 64-bits inline (0x01)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1415:92cc:0:1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:3,
                               Dst: fe80::1415:92cc:0:1
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                        0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                      Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                             Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 46
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1415:92cc:0:1
Internet Control Message Protocol v6
    Type: RPL Control (155)
    Code: 2 (Destination Advertisement Object)
    Checksum: 0xd31a [incorrect, should be 0x4d90]
    RPLInstanceID: 0
    Flags: 0x40
        0... .... = DAO-ACK Request (K): False
        .1.. .... = DODAGID Present (D): True
        ..00 0000 = Reserved: 0
    Reserved: 00
```

```
    DAO Sequence: 0
    DODAGID: bbbb::1415:92cc:0:1
    ICMPv6 RPL Option (Transit Information bbbb::1415:92cc:0:2)
        Type: Transit Information (6)
        Length: 20
        Flags: 0x00
            0... .... = External: Not set
            .000 0000 = Reserved: 0
        Path Control: 0
        Path Sequence: 0
        Path Lifetime: 170
        Parent Address: bbbb::1415:92cc:0:2
```

== Raw Bytes ==

```
0000   21 ec 0b fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010   00 cc 92 15 14 f1 83 05 03 7a 11 3a 14 15 92 cc
0020   00 00 00 03 14 15 92 cc 00 00 00 01 9b 02 d3 1a
0030   00 40 00 00 bb bb 00 00 00 00 00 00 14 15 92 cc
0040   00 00 00 01 06 14 00 00 00 aa bb bb 00 00 00 00
0050   00 00 14 15 92 cc 00 00 00 02 35 21
```

3.5. ACK

```
   ACK

== Dissected packet ==
IEEE 802.15.4 Ack, Sequence Number: 69, Dst: 14:15:92:cc:00:00:00:01, Src:
14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee02, Frame Type: Ack, Information Elements Present,
Destination Addressing Mode: Long/64-bit, Frame Version: IEEE Std
802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .010 = Frame Type: Ack (0x2)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..0. .... = Acknowledge Request: False
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 69
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Time Correction IE
        Time Correction IE
            IE Header: 0x0f02, Type: Header, Id: Time Correction IE, Length: 2
                0... .... .... .... = Type: Header (0)
                .000 1111 0... .... = Id: Time Correction IE (0x1e)
                .... .... .000 0010 = Length: 2
            Time Sync Info: 0x0000, Time Correction: 0, Nack: Acknowledgement
                .... 0000 0000 0000 = Time Correction: 0[micro]s
                0... .... .... .... = Nack: Acknowledgement
    FCS: 0xaa9c (Correct)


== Raw Bytes ==

0000  02 ee 45 fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 02 0f 00 00 9c aa
```

3.6. ICMPv6 echo request/reply

3.6.1. ping 2

```
   [ping 2] ICMPv6 echo request 1->2

  == Dissected packet ==

  IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02,
                      Src: 14:15:92:cc:00:00:00:01
```

```
      Frame Control Field: 0xec21, Frame Type: Data
          .... .... .... .001 = Frame Type: Data (0x0001)
```

```
          .... .... .... 0... = Security Enabled: False
          .... .... ...0 .... = Frame Pending: False
          .... .... ..1. .... = Acknowledge Request: True
          .... .... .0.. .... = Intra-PAN: False
          .... ...0 .... .... = Sequence Number Suppression: False
          .... ..0. .... .... = Information Elements present: False
          .... 11.. .... .... = Destination Addressing Mode:
                                 Long/64-bit (0x0003)
          ..10 .... .... .... = Frame Version: 2
          11.. .... .... .... = Source Addressing Mode:
                                 Long/64-bit (0x0003)
      Sequence Number: 42
      Destination PAN: 0xcafe
      Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
      Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
      FCS: 0xd916 (Correct)
  6LoWPAN
      .... 0001 = Page Number: 1
      IPHC Header
          011. .... = Pattern: IP header compression (0x03)
          ...1 1... .... .... = Traffic class and flow label: Version,
                                 traffic class, and flow label
                                 compressed (0x0003)
          .... .0.. .... .... = Next header: Inline
          .... ..00 .... .... = Hop limit: Inline (0x0000)
          .... .... 0... .... = Context identifier extension: False
          .... .... .0.. .... = Source address compression: Stateless
          .... .... ..00 .... = Source address mode: Inline (0x0000)
          .... .... .... 0... = Multicast address compression: False
          .... .... .... .0.. = Dest address compression: Stateless
          .... .... .... ..00 = Dest address mode: Inline (0x0000)
      Next header: ICMPv6 (0x3a)
      Hop limit: 64
      Source: bbbb::1
      Destination: bbbb::1415:92cc:0:2
  Internet Protocol Version 6, Src: bbbb::1, Dst: bbbb::1415:92cc:0:2
      0110 .... = Version: 6
      .... 0000 0000 .... .... .... .... .... = Traffic class: 0x00
                                                 (DSCP: CS0, ECN: Not-ECT)
          .... 0000 00.. .... .... .... .... .... = Differentiated
                                                    Services Codepoint: Default (0)
          .... .... ..00 .... .... .... .... .... = Explicit Congestion
                                                    Notification: Not ECN-Capable Transport (0)
      .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
      Payload length: 64
      Next header: ICMPv6 (58)
      Hop limit: 64
      Source: bbbb::1
```

```
      Destination: bbbb::1415:92cc:0:2
  Internet Control Message Protocol v6
      Type: Echo (ping) request (128)
      Code: 0
      Checksum: 0xf7be [correct]
      Identifier: 0x47c5
      Sequence: 1
      [No response seen]
      Data (56 bytes)

  0000  d0 27 b2 56 00 00 00 00 d5 52 0b 00 00 00 00 00
  0010  10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
  0020  20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
  0030  30 31 32 33 34 35 36 37
          Data: d027b25600000000d5520b0000000000101111213141516l7...
          [Length: 56]

  == Raw Bytes ==

  0000   21 ec 2a fe ca 02 00 00 00 cc 92 15 14 01 00 00
  0010   00 cc 92 15 14 f1 78 00 3a 40 bb bb 00 00 00 00
  0020   00 00 00 00 00 00 00 00 00 01 bb bb 00 00 00 00
  0030   00 00 14 15 92 cc 00 00 00 02 80 00 f7 be 47 c5
  0040   00 01 d0 27 b2 56 00 00 00 00 d5 52 0b 00 00 00
  0050   00 00 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d
  0060   1e 1f 20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d
  0070   2e 2f 30 31 32 33 34 35 36 37 16 d9

   [ping 2] ICMPv6 echo reply 2->1

== Dissected packet ==

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01,
                    Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xec21, Frame Type: Data
        .... .... .... .001 = Frame Type: Data (0x0001)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = Intra-PAN: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements present: False
        .... 11.. .... .... = Destination Addressing Mode:
                               Long/64-bit (0x0003)
        ..10 .... .... .... = Frame Version: 2
        11.. .... .... .... = Source Addressing Mode:
                               Long/64-bit (0x0003)
    Sequence Number: 48
```

```
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    FCS: 0xe105 (Correct)
6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Protocol Information
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 .... .... .... = Packet direction:
                              UP false, DOWN true: False
        .... 0... .... .... = Error detected: False
        .... .0.. .... .... = No link to destination: False
        .... ..1. .... .... = Context identifier extension: True
        .... ...0 .... .... = Context identifier extension: False
        .... .... 0000 0101 = 6loRH Type: Routing Protocol Information
        RPL Instance: 0x00
        Sender Rank: 0x0338
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x0003)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x0002)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline (0x01)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..01 = Dest address mode: 64-bits inline (0x01)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:2
    Destination: fe80::1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:2, Dst: fe80::1
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                        0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                       Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                             Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 64
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: fe80::1415:92cc:0:2
```

```
    Destination: fe80::1
Internet Control Message Protocol v6
    Type: Echo (ping) reply (129)
    Code: 0
    Checksum: 0xf6be [incorrect, should be 0x7134]
    Identifier: 0x47c5
    Sequence: 1
    Data (56 bytes)

0000  d0 27 b2 56 00 00 00 00 d5 52 0b 00 00 00 00 00
0010  10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
0020  20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
0030  30 31 32 33 34 35 36 37
       Data: d027b25600000000d5520b00000000001011121314151617...
       [Length: 56]

== Raw Bytes ==

0000   21 ec 30 fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010   00 cc 92 15 14 f1 82 05 03 38 7a 11 3a 14 15 92
0020   cc 00 00 00 02 00 00 00 00 00 00 00 01 81 00 f6
0030   be 47 c5 00 01 d0 27 b2 56 00 00 00 00 d5 52 0b
0040   00 00 00 00 00 10 11 12 13 14 15 16 17 18 19 1a
0050   1b 1c 1d 1e 1f 20 21 22 23 24 25 26 27 28 29 2a
0060   2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37 05 e1
```

3.6.2. ping 3

```
   [ping 3] ICMPv6 echo request 1->2

  == Dissected packet ==

  IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02,
                      Src: 14:15:92:cc:00:00:00:01
      Frame Control Field: 0xec21, Frame Type: Data
          .... .... .... .001 = Frame Type: Data (0x0001)
          .... .... .... 0... = Security Enabled: False
          .... .... ...0 .... = Frame Pending: False
          .... .... ..1. .... = Acknowledge Request: True
          .... .... .0.. .... = Intra-PAN: False
          .... ...0 .... .... = Sequence Number Suppression: False
          .... ..0. .... .... = Information Elements present: False
          .... 11.. .... .... = Destination Addressing Mode:
                                 Long/64-bit (0x03)
          ..10 .... .... .... = Frame Version: 2
          11.. .... .... .... = Source Addressing Mode:
                                 Long/64-bit (0x03)
      Sequence Number: 34
```

```
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    FCS: 0x0366 (Correct)
  6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Header 3, 8 byte compression
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 0000 .... .... = 6loRH Hop Number - 1: 0x0000
        .... .... 0000 0011 = 6loRH Type: Routing Header 3,
                              8 byte compression (0x0003)
    Source/8, Delta: ::1415:92cc:0:2
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x0003)
        .... .0.. .... .... = Next header: Inline
        .... ..00 .... .... = Hop limit: Inline (0x0000)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..00 .... = Source address mode: Inline (0x0000)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..00 = Dest address mode: Inline (0x00)
    Next header: ICMPv6 (0x3a)
    Hop limit: 64
    Source: bbbb::1
    Destination: bbbb::1415:92cc:0:3
  Internet Protocol Version 6, Src: bbbb::1, Dst: bbbb::1415:92cc:0:3
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                        0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                       Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                             Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 18
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: bbbb::1
    Destination: bbbb::1415:92cc:0:3
  Internet Control Message Protocol v6
    Type: Echo (ping) request (128)
    Code: 0
    Checksum: 0x13f9 [correct]
    Identifier: 0x3943
```

```
      Sequence: 1

      Data (10 bytes)

  0000  00 01 02 03 04 05 06 07 08 09
          Data: 00010203040506070809
          [Length: 10]

  == Raw Bytes ==

  0000   21 ec 22 fe ca 02 00 00 00 cc 92 15 14 01 00 00
  0010   00 cc 92 15 14 f1 80 03 14 15 92 cc 00 00 00 02
  0020   78 00 3a 40 bb bb 00 00 00 00 00 00 00 00 00 00
  0030   00 00 00 01 bb bb 00 00 00 00 00 00 14 15 92 cc
  0040   00 00 00 03 80 00 13 f9 39 43 00 01 00 01 02 03
  0050   04 05 06 07 08 09 66 03

   [ping 3] ICMPv6 echo request 2->3

  == Dissected packet ==

  IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:03,
                      Src: 14:15:92:cc:00:00:00:02
      Frame Control Field: 0xec21, Frame Type: Data
          .... .... .... .001 = Frame Type: Data (0x0001)
          .... .... .... 0... = Security Enabled: False
          .... .... ...0 .... = Frame Pending: False
          .... .... ..1. .... = Acknowledge Request: True
          .... .... .0.. .... = Intra-PAN: False
          .... ...0 .... .... = Sequence Number Suppression: False
          .... ..0. .... .... = Information Elements present: False
          .... 11.. .... .... = Destination Addressing Mode:
                                Long/64-bit (0x03)
          ..10 .... .... .... = Frame Version: 2
          11.. .... .... .... = Source Addressing Mode:
                                Long/64-bit (0x03)
      Sequence Number: 35
      Destination PAN: 0xcafe
      Destination: 14:15:92:cc:00:00:00:03 (14:15:92:cc:00:00:00:03)
      Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
      FCS: 0x793f (Correct)
  6LoWPAN
      IPHC Header
          011. .... = Pattern: IP header compression (0x03)
          ...1 1... .... .... = Traffic class and flow label: Version,
                                traffic class, and flow label
                                compressed (0x0003)
          .... .0.. .... .... = Next header: Inline
```

```
          .... ..00 .... .... = Hop limit: Inline (0x0000)
          .... .... 0... .... = Context identifier extension: False
          .... .... .0.. .... = Source address compression: Stateless
          .... .... ..00 .... = Source address mode: Inline (0x0000)
          .... .... .... 0... = Multicast address compression: False
          .... .... .... .0.. = Dest address compression: Stateless
          .... .... .... ..00 = Dest address mode: Inline (0x0000)
      Next header: ICMPv6 (0x3a)
      Hop limit: 64
      Source: bbbb::1
      Destination: bbbb::1415:92cc:0:3
  Internet Protocol Version 6, Src: bbbb::1, Dst: bbbb::1415:92cc:0:3
      0110 .... = Version: 6
      .... 0000 0000 .... .... .... .... .... = Traffic class:
                                          0x00 (DSCP: CS0, ECN: Not-ECT)
          .... 0000 00.. .... .... .... .... .... = Differentiated
                                         Services Codepoint: Default (0)
          .... .... ..00 .... .... .... .... .... = Explicit Congestion
                               Notification: Not ECN-Capable Transport (0)
      .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
      Payload length: 18
      Next header: ICMPv6 (58)
      Hop limit: 64
      Source: bbbb::1
      Destination: bbbb::1415:92cc:0:3
  Internet Control Message Protocol v6
      Type: Echo (ping) request (128)
      Code: 0
      Checksum: 0x13f9 [correct]
      Identifier: 0x3943
      Sequence: 1

      Data (10 bytes)

  0000  00 01 02 03 04 05 06 07 08 09
          Data: 00010203040506070809
          [Length: 10]

  == Raw Bytes ==

  0000   21 ec 23 fe ca 03 00 00 00 cc 92 15 14 02 00 00
  0010   00 cc 92 15 14 78 00 3a 40 bb bb 00 00 00 00 00
  0020   00 00 00 00 00 00 00 00 01 bb bb 00 00 00 00 00
  0030   00 14 15 92 cc 00 00 00 03 80 00 13 f9 39 43 00
  0040   01 00 01 02 03 04 05 06 07 08 09 3f 79

   [ping 3] ICMPv6 echo reply 3->2
```

```
== Dissected packet ==

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02,
                    Src: 14:15:92:cc:00:00:00:03
    Frame Control Field: 0xec21, Frame Type: Data
        .... .... .... .001 = Frame Type: Data (0x0001)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = Intra-PAN: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements present: False
        .... 11.. .... .... = Destination Addressing Mode:
                              Long/64-bit (0x03)
        ..10 .... .... .... = Frame Version: 2
        11.. .... .... .... = Source Addressing Mode:
                              Long/64-bit (0x03)
    Sequence Number: 23
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:03 (14:15:92:cc:00:00:00:03)
    FCS: 0x84f7 (Correct)
6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Protocol Information
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 .... .... .... = Packet direction:
                              UP false, DOWN true: False
        .... 0... .... .... = Error detected: False
        .... .0.. .... .... = No link to destination: False
        .... ..1. .... .... = Context identifier extension: True
        .... ...1 .... .... = Context identifier extension: True
        .... .... 0000 0101 = 6loRH Type: Routing Protocol Information
        RPL Instance: 0x00
        Sender Rank: 0x07
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x03)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x0002)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline (0x01)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..01 = Dest address mode: 64-bits inline (0x01)
```

```
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:3, Dst: fe80::1
    0110 .... = Version: 6
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                       0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                      Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                            Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 18
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1
Internet Control Message Protocol v6
    Type: Echo (ping) reply (129)
    Code: 0
    Checksum: 0x12f9 [incorrect, should be 0x8d6e]
        [Expert Info (Warn/Checksum): ICMPv6 Checksum Incorrect
    Identifier: 0x3943
    Sequence: 1
    Data (10 bytes)

0000  00 01 02 03 04 05 06 07 08 09
        Data: 00010203040506070809
        [Length: 10]

== Raw Bytes ==

0000   21 ec 17 fe ca 02 00 00 00 cc 92 15 14 03 00 00
0010   00 cc 92 15 14 f1 83 05 07 7a 11 3a 14 15 92 cc
0020   00 00 00 03 00 00 00 00 00 00 00 01 81 00 12 f9
0030   39 43 00 01 00 01 02 03 04 05 06 07 08 09 f7 84

   [ping 3] ICMPv6 echo reply 2->1

== Dissected packet ==

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01,
                    Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xec21, Frame Type: Data
        .... .... .... .001 = Frame Type: Data (0x0001)
        .... .... .... 0... = Security Enabled: False
```

```
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = Intra-PAN: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..0. .... .... = Information Elements present: False
        .... 11.. .... .... = Destination Addressing Mode:
                              Long/64-bit (0x03)
        ..10 .... .... .... = Frame Version: 2
        11.. .... .... .... = Source Addressing Mode:
                              Long/64-bit (0x03)
    Sequence Number: 36
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    FCS: 0x7dbc (Correct)
6LoWPAN
    .... 0001 = Page Number: 1
    6LoRH: Routing Protocol Information
        100. .... = Routing Header 6lo: Critical Routing Header (0x04)
        ...0 .... .... .... = Packet direction:
                              UP false, DOWN true: False
        .... 0... .... .... = Error detected: False
        .... .0.. .... .... = No link to destination: False
        .... ..1. .... .... = Context identifier extension: True
        .... ...1 .... .... = Context identifier extension: True
        .... .... 0000 0101 = 6loRH Type: Routing Protocol Information
        RPL Instance: 0x00
        Sender Rank: 0x03
    IPHC Header
        011. .... = Pattern: IP header compression (0x03)
        ...1 1... .... .... = Traffic class and flow label: Version,
                              traffic class, and flow label
                              compressed (0x0003)
        .... .0.. .... .... = Next header: Inline
        .... ..10 .... .... = Hop limit: 64 (0x0002)
        .... .... 0... .... = Context identifier extension: False
        .... .... .0.. .... = Source address compression: Stateless
        .... .... ..01 .... = Source address mode: 64-bits inline (0x01)
        .... .... .... 0... = Multicast address compression: False
        .... .... .... .0.. = Dest address compression: Stateless
        .... .... .... ..01 = Dest address mode: 64-bits inline (0x01)
        [Source context: fe80::]
        [Destination context: fe80::]
    Next header: ICMPv6 (0x3a)
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1
Internet Protocol Version 6, Src: fe80::1415:92cc:0:3, Dst: fe80::1
    0110 .... = Version: 6
```

```
    .... 0000 0000 .... .... .... .... .... = Traffic class:
                                        0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 00.. .... .... .... .... .... = Differentiated
                                    Services Codepoint: Default (0)
        .... .... ..00 .... .... .... .... .... = Explicit Congestion
                            Notification: Not ECN-Capable Transport (0)
    .... .... .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
    Payload length: 18
    Next header: ICMPv6 (58)
    Hop limit: 64
    Source: fe80::1415:92cc:0:3
    Destination: fe80::1
Internet Control Message Protocol v6
    Type: Echo (ping) reply (129)
    Code: 0
    Checksum: 0x12f9 [incorrect, should be 0x8d6e]
        [Expert Info (Warn/Checksum): ICMPv6 Checksum Incorrect]
    Identifier: 0x3943
    Sequence: 1
    Data (10 bytes)

0000  00 01 02 03 04 05 06 07 08 09
        Data: 00010203040506070809
        [Length: 10]

== Raw Bytes ==

0000   21 ec 24 fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010   00 cc 92 15 14 f1 83 05 03 7a 11 3a 14 15 92 cc
0020   00 00 00 03 00 00 00 00 00 00 00 01 81 00 12 f9
0030   39 43 00 01 00 01 02 03 04 05 06 07 08 09 bc 7d
```

3.7. 6Top Commands and Reponses

```
   6top Command ADD 2->1

IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
```

```
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
```

```
    Sequence Number: 224
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 21
            Payload IE TLV: 0xa815, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0001 0101 = Length: 21
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..00 .... = Type: Request (0x0)
                00.. .... = Reserved: 0x0
                Code: 0x01 (ADD)
                SFID (6top Scheduling Function ID): 0x00
                .... 0000 = SeqNum: 0
                0000 .... = GEN: Clear (0)
                Metadata: 0x0100
                Cell Options: TX (0x01)
                    .... ...1 = Transmit (TX) Cell: 0x1
                    .... ..0. = Receive (RX) Cell: 0x0
                    .... .0.. = SHARED Cell: 0x0
                    0000 0... = Reserved: 0x00
                Number of Cells: 1
                CellList
                    Cell: 08000200
                        Slot Offset: 0x0008
                        Channel Offset: 0x0002
                    Cell: 07000200
                        Slot Offset: 0x0007
                        Channel Offset: 0x0002
                    Cell: 06000200
                        Slot Offset: 0x0006
                        Channel Offset: 0x0002
    FCS: 0x455a (Correct)
== Raw Bytes ==

0000  21 ee e0 fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 00 3f 15 a8 c9 00 01 00 00 00 01
```

```
0020  01 01 08 00 02 00 07 00 02 00 06 00 02 00 5a 45
```

6top Response to ADD 1->2

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 210
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 9
            Payload IE TLV: 0xa809, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 1001 = Length: 9
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..01 .... = Type: Response (0x1)
                00.. .... = Reserved: 0x0
                Code: 0x00 (SUCCESS)
                SFID (6top Scheduling Function ID): 0x00
                .... 0000 = SeqNum: 0
                0000 .... = GEN: Clear (0)
                CellList
                    Cell: 08000200
                        Slot Offset: 0x0008
                        Channel Offset: 0x0002
    FCS: 0xa534 (Correct)

== Raw Bytes ==
```

```
0000  21 ee d2 fe ca 02 00 00 00 cc 92 15 14 01 00 00
0010  00 cc 92 15 14 00 3f 09 a8 c9 10 00 00 00 08 00
0020  02 00 34 a5
```

6top Command COUNT 2->1

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 125
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 8
            Payload IE TLV: 0xa808, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 1000 = Length: 8
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..00 .... = Type: Request (0x0)
                00.. .... = Reserved: 0x0
                Code: 0x04 (COUNT)
                SFID (6top Scheduling Function ID): 0x00
                .... 0001 = SeqNum: 1
                0001 .... = GEN: Lollipop Counter Value (1)
                Metadata: 0x0000
                Cell Options: TX (0x01)
                    .... ...1 = Transmit (TX) Cell: 0x1
                    .... ..0. = Receive (RX) Cell: 0x0
                    .... .0.. = SHARED Cell: 0x0
                    0000 0... = Reserved: 0x00
```

```
    FCS: 0x0e78 (Correct)

== Raw Bytes ==
```

```
0000  21 ee 7d fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 00 3f 08 a8 c9 00 04 00 11 00 00
0020  01 78 0e
```

6top Response to COUNT 1->2

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 99
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 7
            Payload IE TLV: 0xa807, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 0111 = Length: 7
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..01 .... = Type: Response (0x1)
                00.. .... = Reserved: 0x0
                Code: 0x00 (SUCCESS)
                SFID (6top Scheduling Function ID): 0x00
                .... 0001 = SeqNum: 1
                0001 .... = GEN: Lollipop Counter Value (1)
                Total Number of Cells: 1
    FCS: 0x711c (Correct)
== Raw Bytes ==

0000  21 ee 63 fe ca 02 00 00 00 cc 92 15 14 01 00 00
0010  00 cc 92 15 14 00 3f 07 a8 c9 10 00 00 11 01 00
```

6top Command DELETE 2->1

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 174
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 13
            Payload IE TLV: 0xa80d, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 1101 = Length: 13
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..00 .... = Type: Request (0x0)
                00.. .... = Reserved: 0x0
                Code: 0x02 (DELETE)
                SFID (6top Scheduling Function ID): 0x00
                .... 0011 = SeqNum: 3
                0001 .... = GEN: Lollipop Counter Value (1)
                Metadata: 0x0000
                Cell Options: TX (0x01)
                    .... ...1 = Transmit (TX) Cell: 0x1
                    .... ..0. = Receive (RX) Cell: 0x0
                    .... .0.. = SHARED Cell: 0x0
                    0000 0... = Reserved: 0x00
                Number of Cells: 1
                CellList
```

```
                    Cell: 08000200
                        Slot Offset: 0x0008
                        Channel Offset: 0x0002
```

```
    FCS: 0x99e7 (Correct)
== Raw Bytes ==

0000  21 ee ae fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 00 3f 0d a8 c9 00 02 00 13 00 00
0020  01 01 08 00 02 00 e7 99
```

6top Response to DELETE 1->2

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 88
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 9
            Payload IE TLV: 0xa809, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 1001 = Length: 9
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..01 .... = Type: Response (0x1)
                00.. .... = Reserved: 0x0
                Code: 0x00 (SUCCESS)
                SFID (6top Scheduling Function ID): 0x00
                .... 0011 = SeqNum: 3
                0001 .... = GEN: Lollipop Counter Value (1)
                CellList
                    Cell: 08000200
                        Slot Offset: 0x0008
                        Channel Offset: 0x0002
    FCS: 0x23c5 (Correct)
== Raw Bytes ==

0000  21 ee 58 fe ca 02 00 00 00 cc 92 15 14 01 00 00
```

```
0010  00 cc 92 15 14 00 3f 09 a8 c9 10 00 00 13 08 00
0020  02 00 c5 23
```

6top Command RELOCATE 2->1

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 218
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 29
            Payload IE TLV: 0xa81d, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0001 1101 = Length: 29
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..00 .... = Type: Request (0x0)
                00.. .... = Reserved: 0x0
                Code: 0x03 (RELOCATE)
                SFID (6top Scheduling Function ID): 0x00
                .... 1001 = SeqNum: 9
                0100 .... = GEN: Lollipop Counter Value (4)
                Metadata: 0xc400
                Cell Options: TX (0x01)
                    .... ...1 = Transmit (TX) Cell: 0x1
                    .... ..0. = Receive (RX) Cell: 0x0
                    .... .0.. = SHARED Cell: 0x0
                    0000 0... = Reserved: 0x00
```

```
                Number of Cells: 2
                Rel. CellList
                Cand. CellList
```

```
    FCS: 0xbae5 (Correct)
== Raw Bytes ==

0000  21 ee da fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 00 3f 1d a8 c9 00 03 00 49 00 c4
0020  01 02 0a 00 02 00 09 00 02 00 05 00 02 00 08 00
0030  02 00 07 00 02 00 e5 ba
```

6top Response to RELOCATE 1->2

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 245
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 13
            Payload IE TLV: 0xa80d, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 1101 = Length: 13
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..01 .... = Type: Response (0x1)
                00.. .... = Reserved: 0x0
                Code: 0x00 (SUCCESS)
                SFID (6top Scheduling Function ID): 0x00
```

```
.... 1001 = SeqNum: 9
0100 .... = GEN: Lollipop Counter Value (4)
CellList
```

```
                    Cell: 08000200
                        Slot Offset: 0x0008
                        Channel Offset: 0x0002
                    Cell: 05000200
                        Slot Offset: 0x0005
                        Channel Offset: 0x0002
    FCS: 0xd405 (Correct)
== Raw Bytes ==

0000  21 ee f5 fe ca 02 00 00 00 cc 92 15 14 01 00 00
0010  00 cc 92 15 14 00 3f 0d a8 c9 10 00 00 49 08 00
0020  02 00 05 00 02 00 05 d4
```

6top Command CLEAR 2->1

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:01, Src: 14:15:92:cc:00:00:00:02
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 156
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Extended Source: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 7
            Payload IE TLV: 0xa807, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 0111 = Length: 7
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..00 .... = Type: Request (0x0)
                00.. .... = Reserved: 0x0
                Code: 0x06 (CLEAR)
                SFID (6top Scheduling Function ID): 0x00
                .... 1101 = SeqNum: 13
                0101 .... = GEN: Lollipop Counter Value (5)
                Metadata: 0x0f00
    FCS: 0x4962 (Correct)
== Raw Bytes ==

0000  21 ee 9c fe ca 01 00 00 00 cc 92 15 14 02 00 00
0010  00 cc 92 15 14 00 3f 07 a8 c9 00 06 00 5d 00 0f
```

6top Response to CLEAR 1->2

```
IEEE 802.15.4 Data, Dst: 14:15:92:cc:00:00:00:02, Src: 14:15:92:cc:00:00:00:01
    Frame Control Field: 0xee21, Frame Type: Data, Acknowledge Request,
Information Elements Present, Destination Addressing Mode: Long/64-bit, Frame
Version: IEEE Std 802.15.4-2015, Source Addressing Mode: Long/64-bit
        .... .... .... .001 = Frame Type: Data (0x1)
        .... .... .... 0... = Security Enabled: False
        .... .... ...0 .... = Frame Pending: False
        .... .... ..1. .... = Acknowledge Request: True
        .... .... .0.. .... = PAN ID Compression: False
        .... ...0 .... .... = Sequence Number Suppression: False
        .... ..1. .... .... = Information Elements Present: True
        .... 11.. .... .... = Destination Addressing Mode: Long/64-bit (0x3)
        ..10 .... .... .... = Frame Version: IEEE Std 802.15.4-2015 (2)
        11.. .... .... .... = Source Addressing Mode: Long/64-bit (0x3)
    Sequence Number: 150
    Destination PAN: 0xcafe
    Destination: 14:15:92:cc:00:00:00:02 (14:15:92:cc:00:00:00:02)
    Extended Source: 14:15:92:cc:00:00:00:01 (14:15:92:cc:00:00:00:01)
    Header IEs, Header Termination 1 IE
        Header Termination 1 IE (Payload IEs follow)
            IE Header: 0x3f00, Type: Header, Id: Header Termination 1 IE,
Length: 0
                0... .... .... .... = Type: Header (0)
                .011 1111 0... .... = Id: Header Termination 1 IE (0x7e)
                .... .... .000 0000 = Length: 0
    Payload IE
        Payload IE, IETF IE, Length: 5
            Payload IE TLV: 0xa805, Type: Payload, Id: IETF IE
                1... .... .... .... = Type: Payload (1)
                .010 1... .... .... = Id: IETF IE (0x5)
                .... .000 0000 0101 = Length: 5
            Sub-ID: 201
            6top IE
                .... 0000 = 6P Version: 0
                ..01 .... = Type: Response (0x1)
                00.. .... = Reserved: 0x0
                Code: 0x00 (SUCCESS)
                SFID (6top Scheduling Function ID): 0x00
                .... 1101 = SeqNum: 13
                0101 .... = GEN: Lollipop Counter Value (5)
    FCS: 0xc52b (Correct)
== Raw Bytes ==
0000  21 ee 96 fe ca 02 00 00 00 cc 92 15 14 01 00 00
0010  00 cc 92 15 14 00 3f 05 a8 c9 10 00 00 5d 2b c5
```

4. IANA Considerations

This memo includes no request to IANA.

5. Security Considerations

This memo only presents example packets exchanged. It does not define any protocol; there are hence no security considerations in this document.

6. Acknowledgments

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7. References

7.1. Normative References

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7.2. External Informative References

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