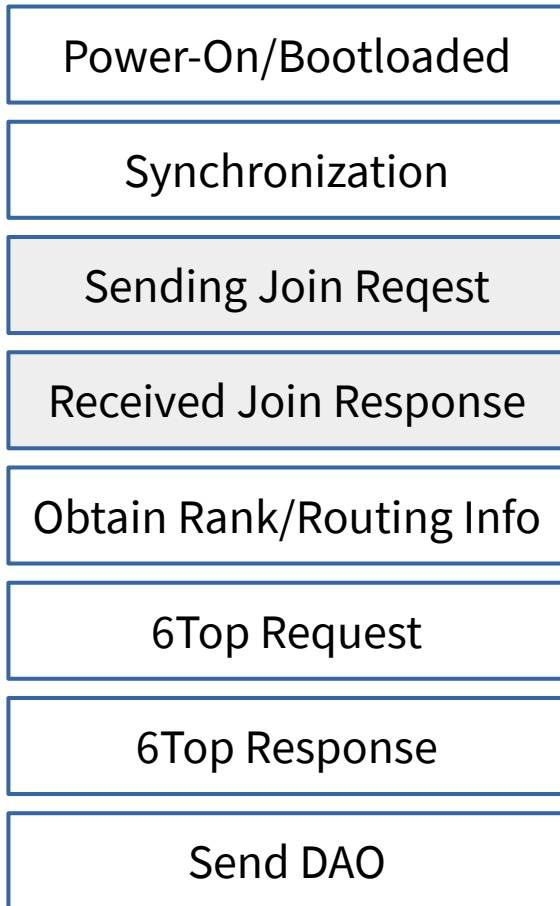


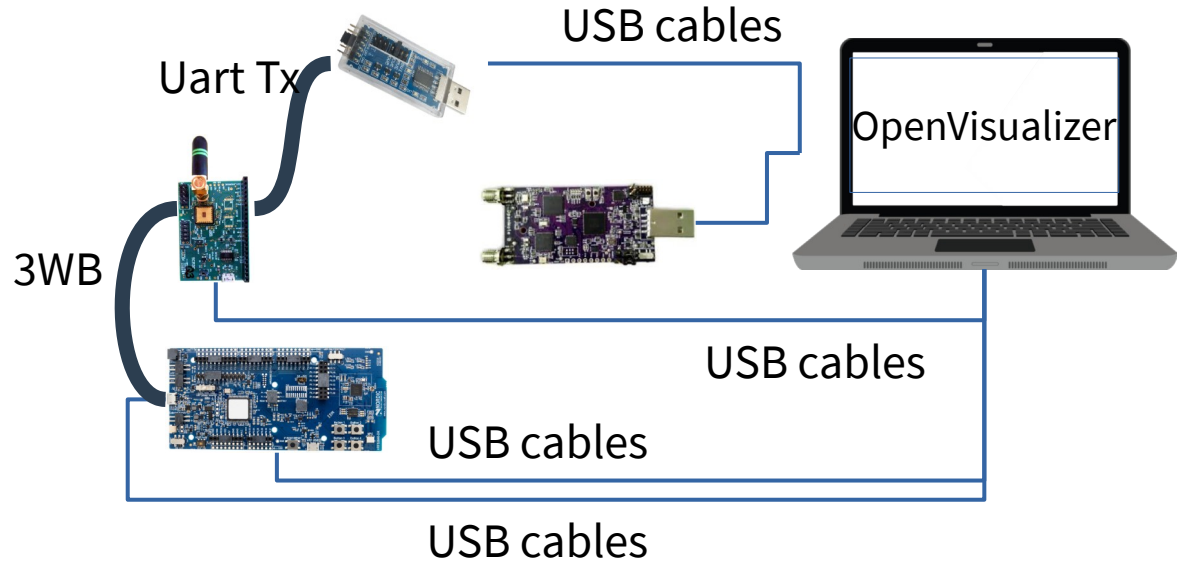
SCuM running OpenWSN Stack

Tengfei Chang

OpenWSN Network Establishing Process



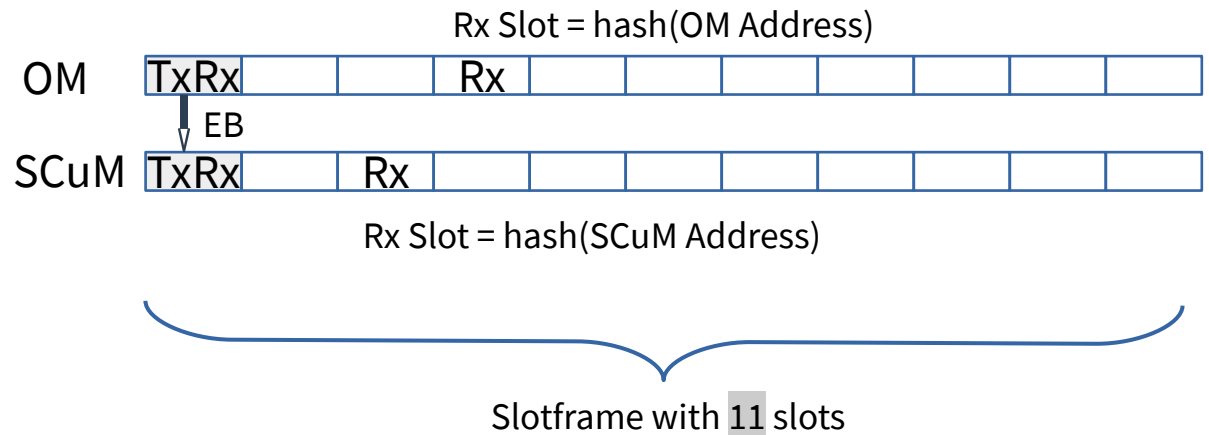
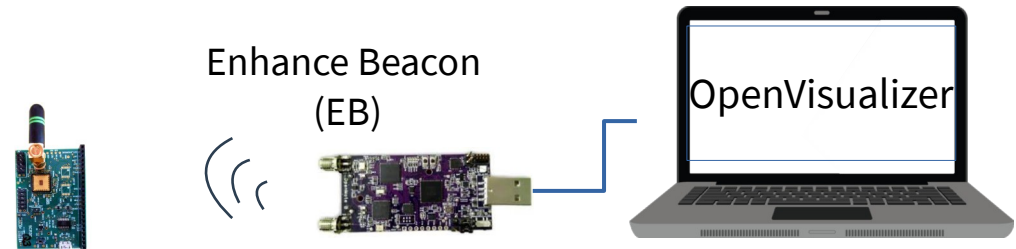
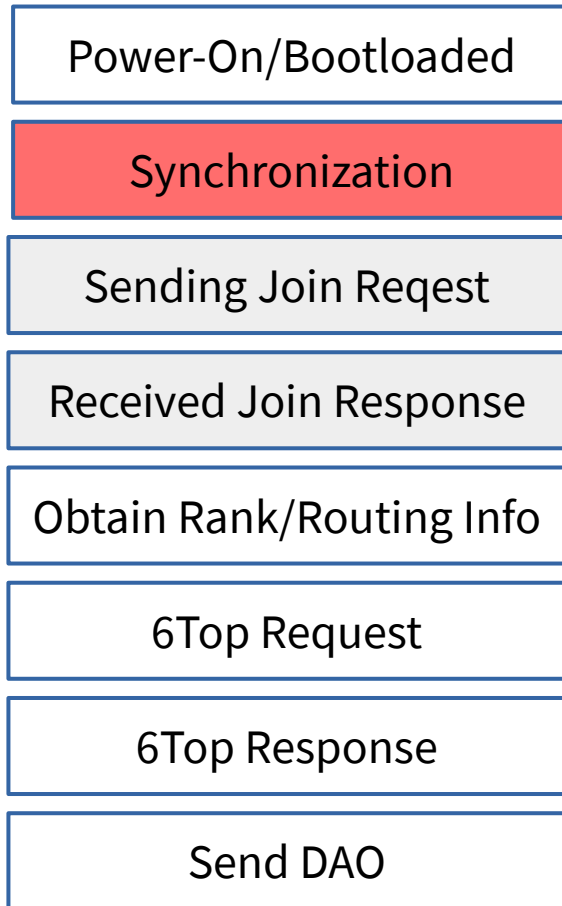
Demo Setup



https://github.com/openwsn-berkeley/openwsn-fw/tree/develop_FW-892
https://github.com/openwsn-berkeley/openvisualizer/tree/develop_FW-892

For the firmware code, channel 11 radio settings in radio.c need to update per ScuM board.

Synchronization



Debugging info for EB & synchronization

```
COM224
D
-UfwD00m-pkt sync in network 6606 us
pkt sync in network -36 us
pkt sync in network -434 us
pkt sync in network -32 us
pkt sync in network -76 us
pkt sync in network -32 us
DIO received!
pkt sync in network -68 us
DIO received!
pkt sync in network -66 us
DIO received!
sixtop operation code 1
pkt sync in network -60 us
pkt sync in network -2 us
six top response received: RC 0 status 1
pkt sync in network -16 us
six top response received: RC 6 status 0
sixtop operation code 7
pkt sync in network -38 us
DIO received!
pkt sync in network -110 us
DIO received!
pkt sync in network -28 us
ack received
sixtop senddone 0 state 6
pkt sync in network -26 us
six top response received: RC 0 status 12
pkt sync in network -144 us
DIO received!
pkt sync in network -148 us
sixtop operation code 1
pkt sync in network -250 us
ack received
sixtop senddone 0 state 1
pkt sync in network -52 us
pkt sync in network -4 us
six top response received: RC 0 status 7
slot add 1
six top add cell
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
pkt sync in network -656 us
```

EB received!
Keep synchronized
for any packet
received

UART Tx

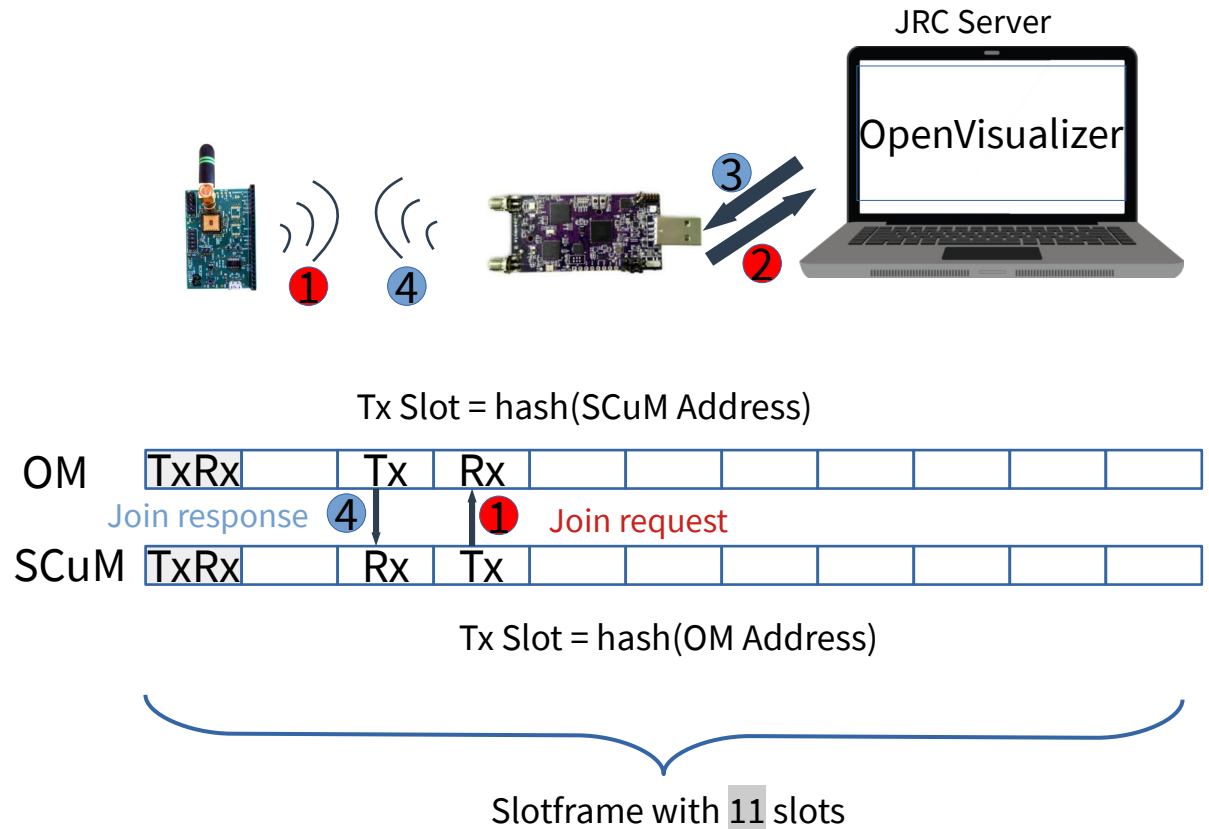
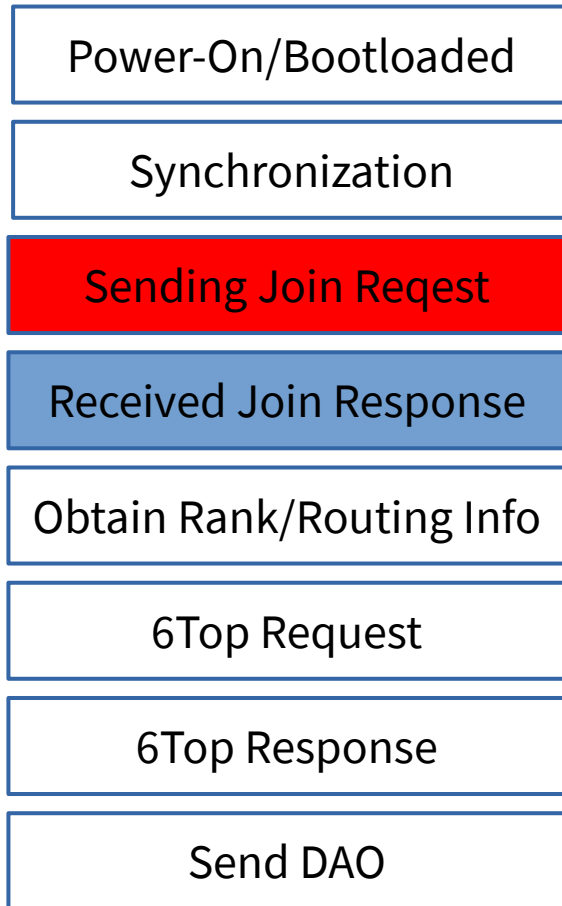
USB cables

SCuM
Serial Output

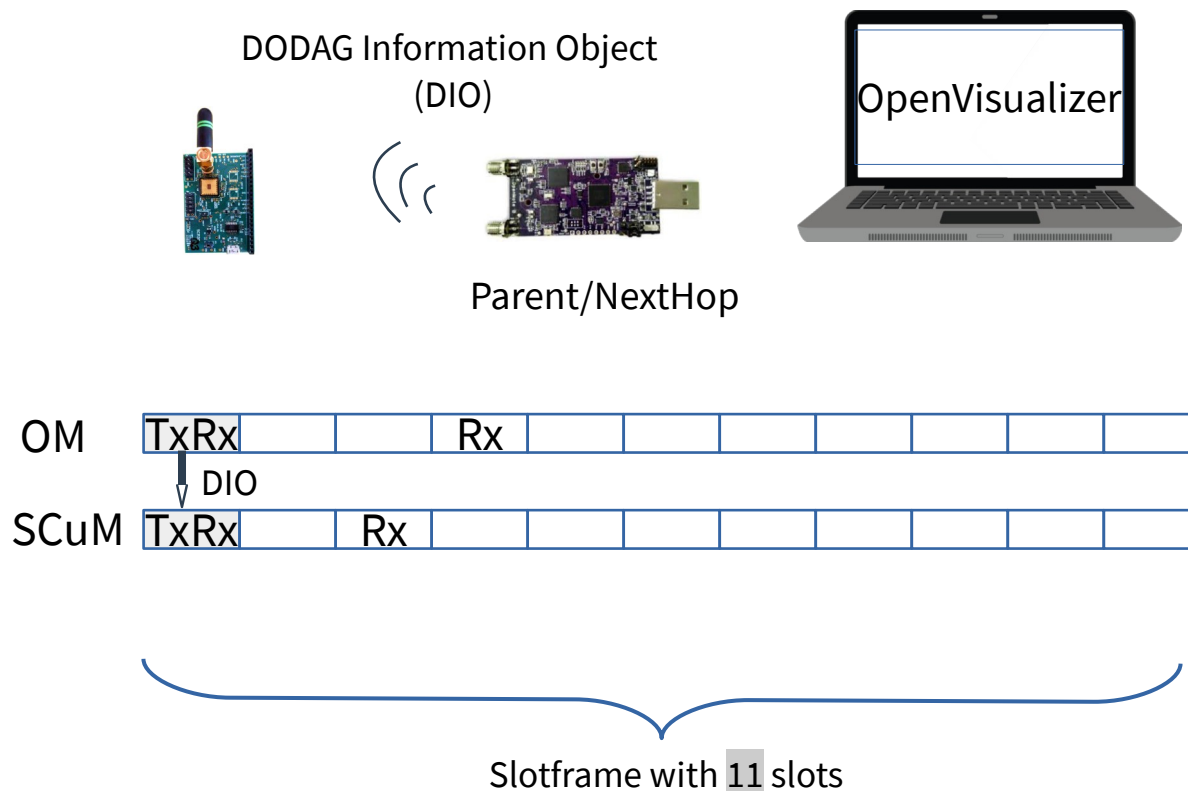
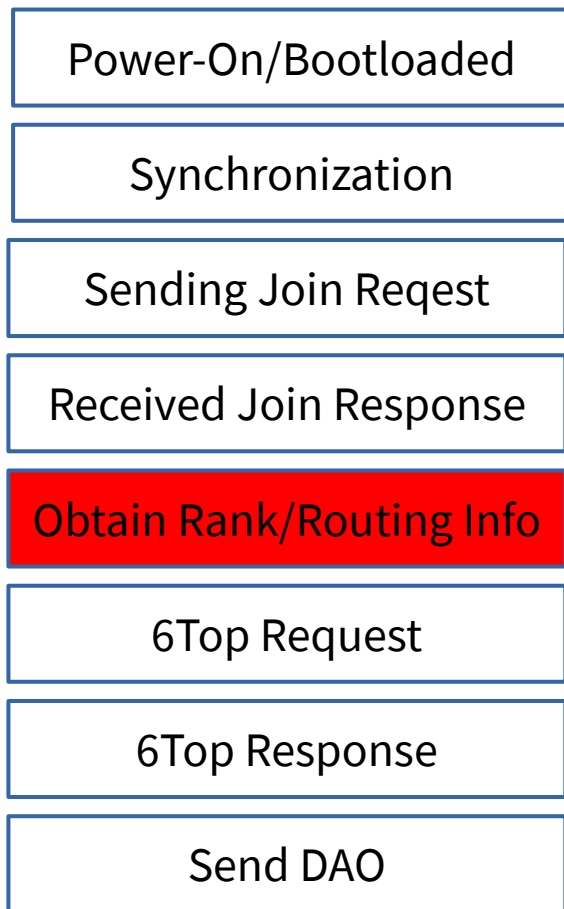
Autoscroll Show timestamp

Newline 19200 baud Clear output

Joining Process



Select Parent/Nexthop



Debugging info for DIO

```
COM224
D
car complete
~UfwDQm-pkt sync in network 6606 us
pkt sync in network -36 us
pkt sync in network -434 us
pkt sync in network -32 us
pkt sync in network -76 us
pkt sync in network 38 us
DIO received!
pkt sync in network 88 us
DIO received!
pkt sync in network -66 us
DIO received!
sixtop operation code 1
pkt sync in network -60 us
pkt sync in network -2 us
six top response received: RC 0 status 1
pkt sync in network -16 us
six top response received: RC 6 status 0
sixtop operation code 7
pkt sync in network -38 us
DIO received!
pkt sync in network -110 us
DIO received!
pkt sync in network -28 us
ack received
sixtop senddone 0 state 6
pkt sync in network -26 us
six top response received: RC 0 status 12
pkt sync in network -144 us
DIO received!
pkt sync in network -148 us
sixtop operation code 1
pkt sync in network -250 us
ack received
sixtop senddone 0 state 1
pkt sync in network -52 us
pkt sync in network -4 us
six top response received: RC 0 status 7
slot add 1
six top add cell
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
pkt sync in network -656 us
```

UART Tx

USB cables

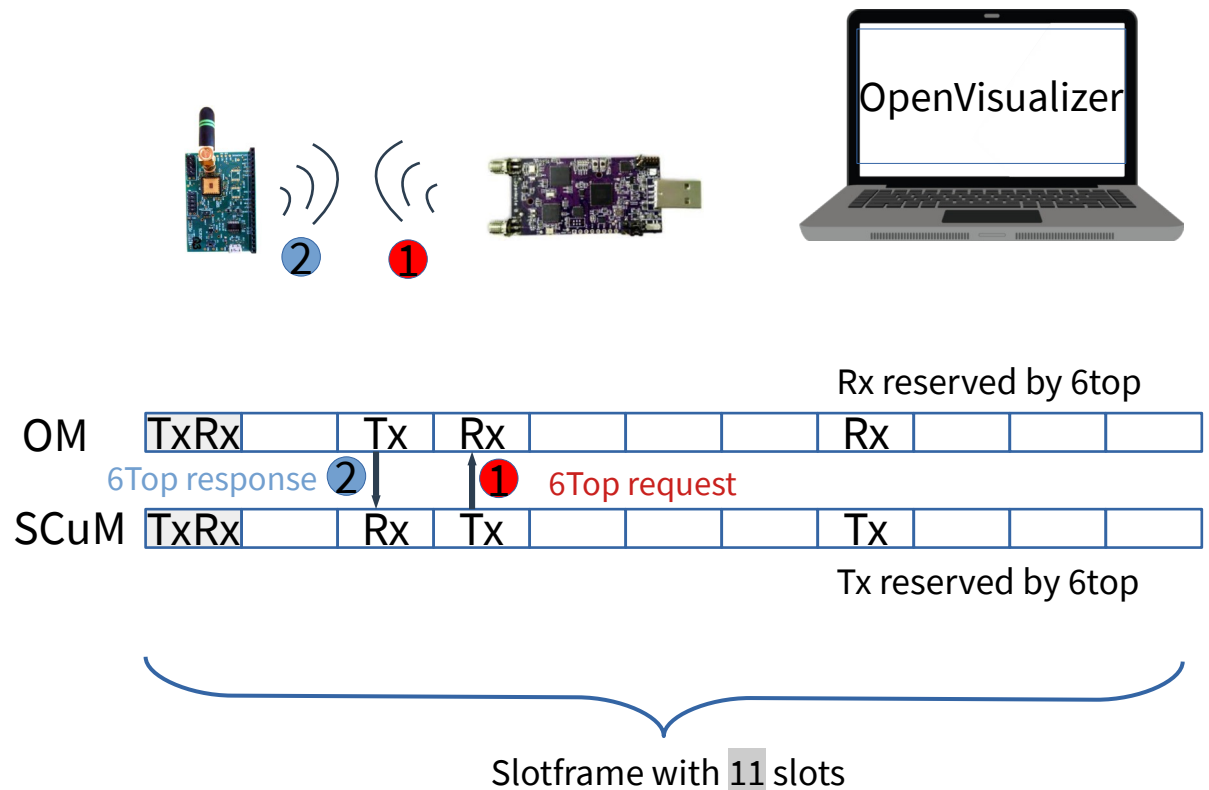
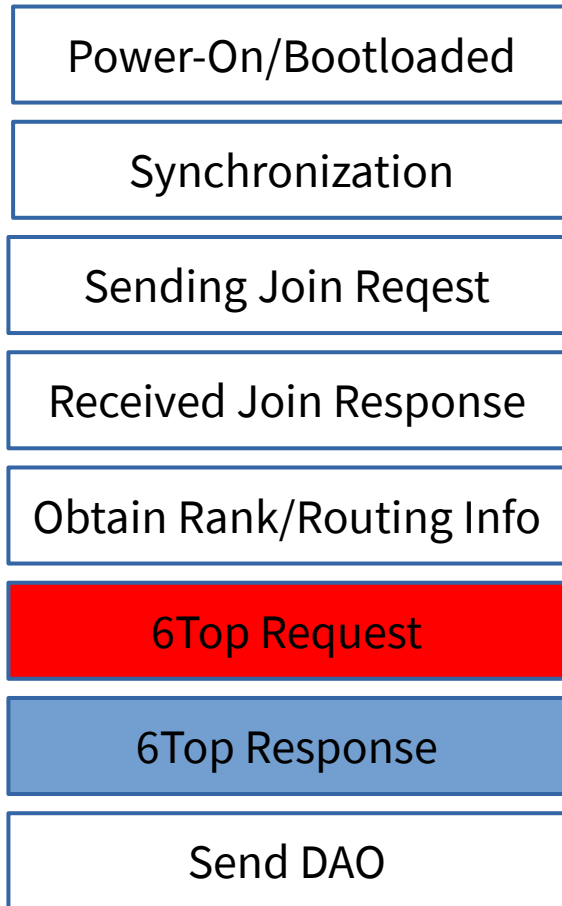
SCuM
Serial Output

DIO received!

Autoscroll Show timestamp

Newline 19200 baud Clear output

6Top Transaction



Debugging info for 6Top (1/2)

UART Tx

USB cables

SCuM
Serial Output

```
COM224
D
car complete
~UfwDQm-pkt sync in network 6606 us
pkt sync in network -36 us
pkt sync in network -434 us
pkt sync in network -32 us
pkt sync in network -76 us
pkt sync in network -32 us
DIO received!
pkt sync in network -68 us
DIO received!
pkt sync in network -66 us
DIO received!
sixtop operation code 1
pkt sync in network -60 us
pkt sync in network -2 us
six top response received: RC 0 status 1
pkt sync in network -16 us
six top response received: RC 6 status 0
sixtop operation code 7
pkt sync in network -38 us
DIO received!
pkt sync in network -110 us
DIO received!
pkt sync in network -28 us
ack received
sixtop senddone 0 state 6
pkt sync in network -26 us
six top response received: RC 0 status 12
pkt sync in network -144 us
DIO received!
pkt sync in network -148 us
sixtop operation code 1
pkt sync in network -258 us
ack received
sixtop senddone 0 state 1
pkt sync in network -52 us
pkt sync in network -4 us
six top response received: RC 0 status 7
slot add 1
six top add cell
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
pkt sync in network -656 us
```

6Top Add request sent!

6Top response received! (wrong status)

6Top Clear request sent!

6Top Add request sent!

6Top response received! (correct status)
And slot added

Debugging info for 6Top (2/2)

Verify 6Top Transaction on OpenVisualizer Web View

Motes

6813 Toggle DAGroot state

Mote

Prefix	bb-bb-00-00-00-00-00-00
EUI-64	00-12-4b-00-19-35-68-13

Root Status

DAG Root?

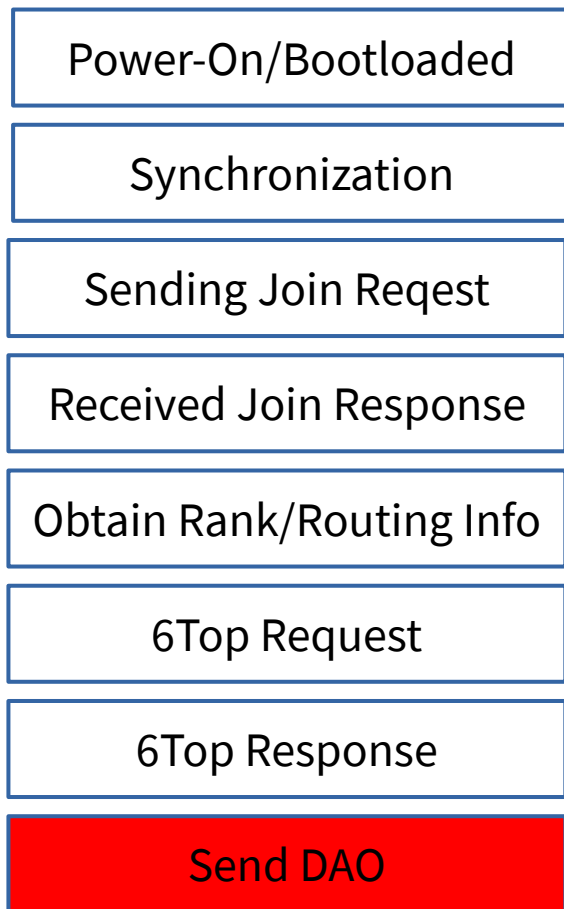
Data

Network Schedule Neighbors

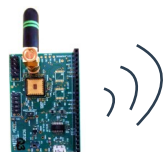
Slot Schedule

Offset	Type	Shared?	Channel	Nbr Type	RX	TX	TX ACK	Last ASN
0	3 (TXRX)	1	0	(anycast)	248	194	194	0x000000b4db
4	2 (RX)	0	3	(anycast)	4	0	0	0x000000031c
9	2 (RX)	0	10	00-11-22-33-44-55-66-77 (64b)	78	0	0	0x0000006bac
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	0	(None)	0	0	0	0x0000000000

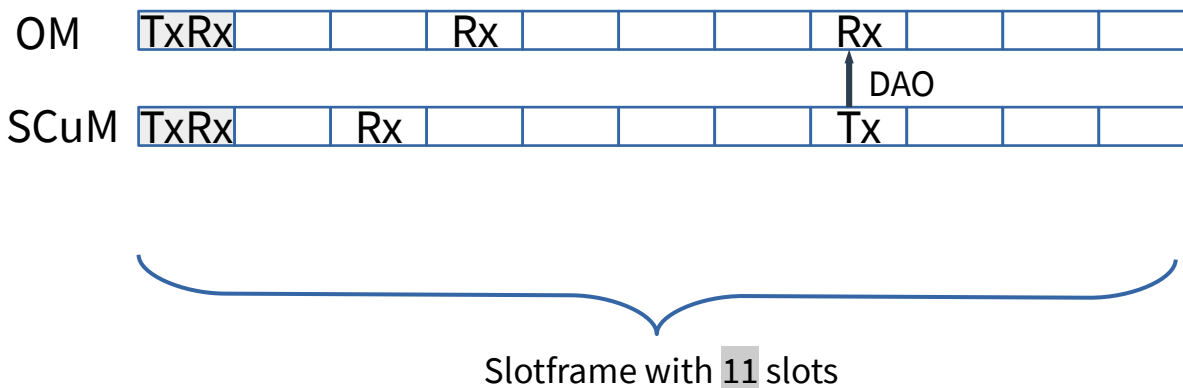
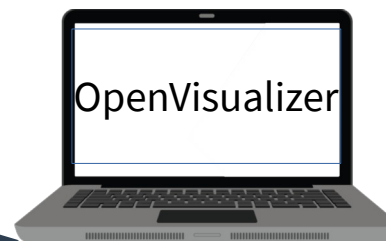
Send DAO to Parent



Destination Advertisement Object (DAO)



DAO



Debugging info for DAO (1/2)

```
COM224
D
UART complete
~UfwDQm-pkt sync in network 6606 us
pkt sync in network -36 us
pkt sync in network -434 us
pkt sync in network -32 us
pkt sync in network -76 us
pkt sync in network -32 us
DIO received!
pkt sync in network -68 us
DIO received!
pkt sync in network -66 us
DIO received!
sixtop operation code 1
pkt sync in network -60 us
pkt sync in network -2 us
six top response received: RC 0 status 1
pkt sync in network -16 us
six top response received: RC 6 status 0
sixtop operation code 7
pkt sync in network -38 us
DIO received!
pkt sync in network -110 us
DIO received!
pkt sync in network -28 us
ack received
sixtop senddone 0 state 6
pkt sync in network -26 us
six top response received: RC 0 status 12
pkt sync in network -144 us
DIO received!
pkt sync in network -148 us
sixtop operation code 1
pkt sync in network -250 us
ack received
sixtop senddone 0 state 1
pkt sync in network -52 us
pkt sync in network -4 us
six top response received: RC 0 status 7
slot add 1
six top add cell
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
DAO sent
ack received
pkt sync in network -656 us
Autoscroll Show timestamp
Newline 19200 baud Clear output
```

UART Tx

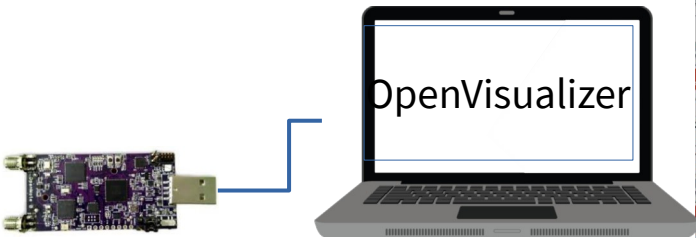
USB cables

SCuM
Serial Output

DAO sent!

Debugging info for DAO (2/2)

Verify DAO on OpenVisualizer Terminal



```
Command Prompt - openv-server --fw-path=openwsn-fw
openwsn.org
23:24:13 VERBOSE loading logging configuration: config/logging.conf
23:24:13 INFO initializing OV Server with options:
- log files directory = C:\Users\tchang\AppData\Local\openvisualizer\openvisualizer\Logs
- data files directory = C:\Users\tchang\AppData\Local\openvisualizer\openvisualizer
- host address server = localhost
- port number server = 9000
- firmware path = openwsn-fw
- use page zero = False
- use VCD logger = False
- baudrates to probe = [115200]
23:24:13 WARNING Probing motes: ['COM230'] at baudrates [115200]
23:24:13 SUCCESS Discovered serial-port(s): ['COM230']
23:24:13 INFO extracting firmware definitions.
23:24:13 VERBOSE extracting firmware component names
23:24:13 VERBOSE extracting firmware log descriptions.
23:24:13 VERBOSE extracting 6top return codes.
23:24:13 VERBOSE extracting 6top states.
23:24:13 INFO starting RPC server
23:24:14 SUCCESS connected to broker (argus.paris.inria.fr) for mote on port: COM230
23:24:14 INFO registering DAGroot 00-12-4b-00-19-35-68-13
23:27:43 SUCCESS 6813 [OPENWSN] booted
23:29:02 ERROR 6813 [IEEE802154E] wdDataDuration overflows while at state 19 in slotOffset 4
23:29:02 ERROR 6813 [IEEE802154E] wdDataDuration overflows while at state 19 in slotOffset 4
23:29:00 ERROR 6813 [IEEE802154E] invalid packet from radio
23:29:11 INFO received RPL DAO from bbbb:0:0:0:11:2233:4455:6677
- parents:
  bbbb:0:0:0:12:4b00:1935:6813
- children:
23:29:11 INFO received RPL DAO from bbbb:0:0:0:11:2233:4455:6677
- parents:
  bbbb:0:0:0:12:4b00:1935:6813
- children:
23:29:11 INFO received RPL DAO from bbbb:0:0:0:11:2233:4455:6677
- parents:
  bbbb:0:0:0:12:4b00:1935:6813
- children:
23:29:13 INFO received RPL DAO from bbbb:0:0:0:11:2233:4455:6677
- parents:
  bbbb:0:0:0:12:4b00:1935:6813
```