



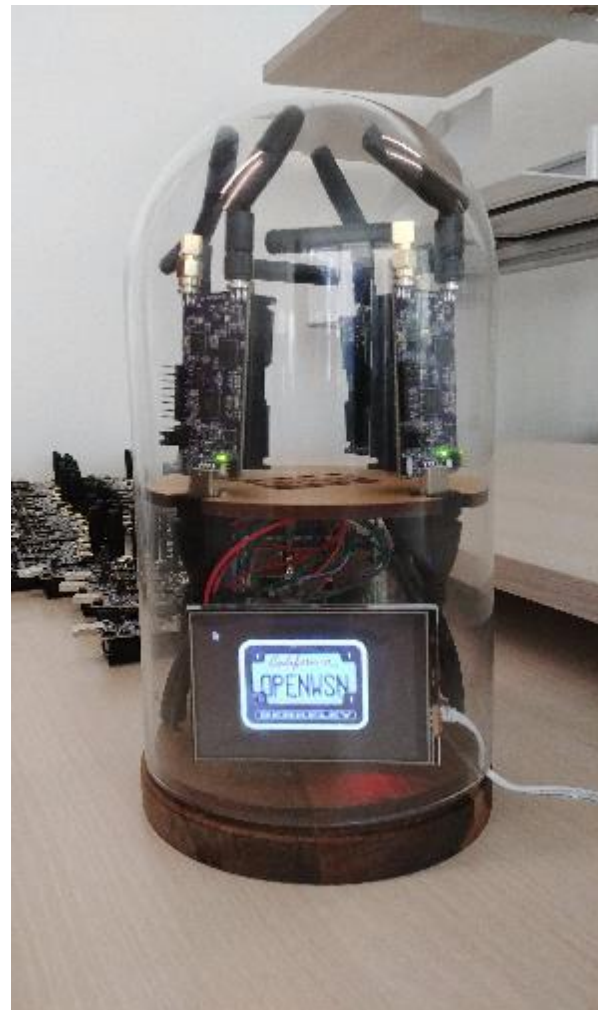
draft-ietf-6tisch-msf-01

experimental campaign

Tengfei Chang

Experimental testbed

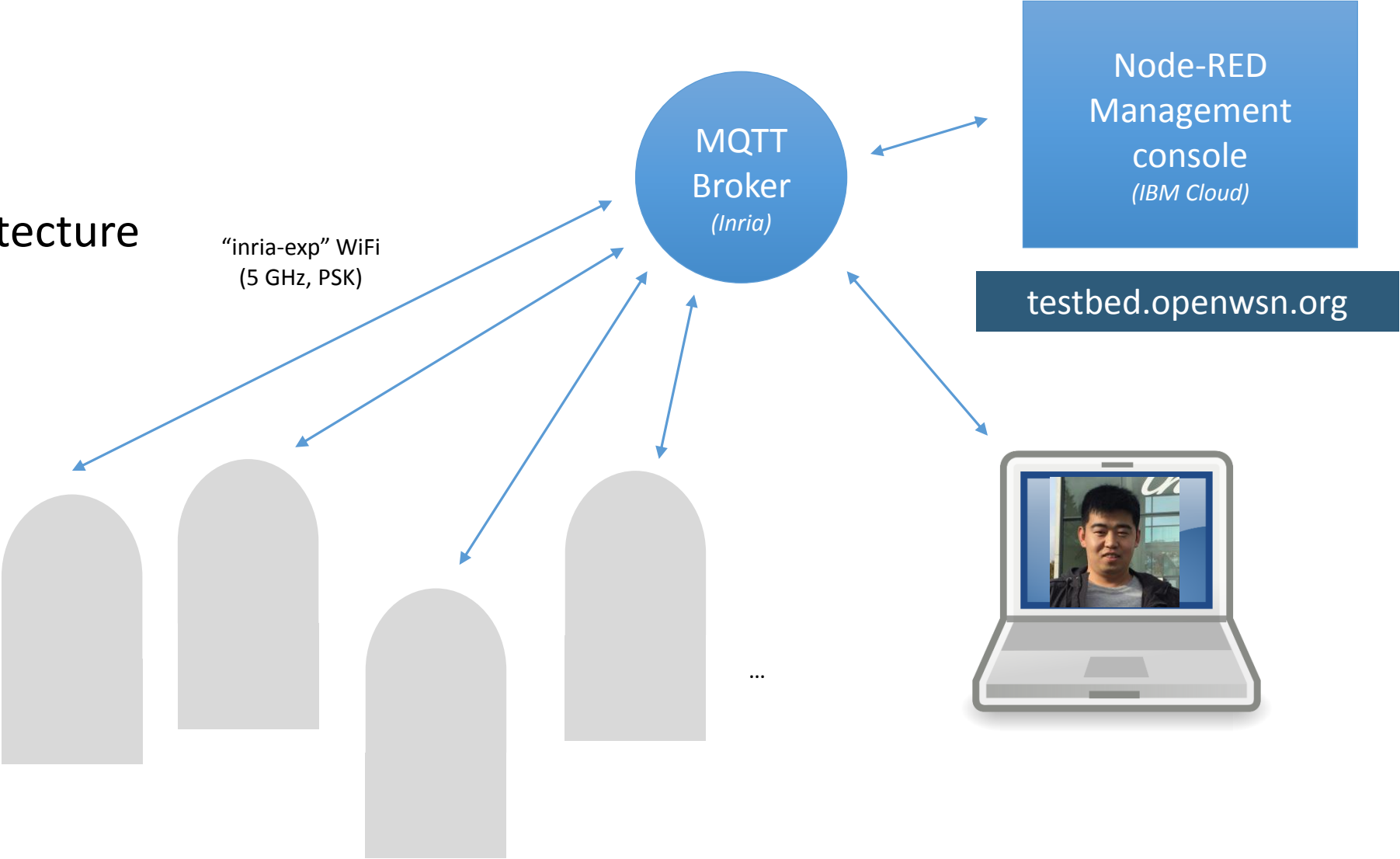
- OpenTestbed
 - OTBox
 - Raspberry Pi + 4 OpenMote-B
 - Single-file Python program
 - Open-source
 - Offers simple API to:
 - Reprogram motes
 - Reset motes
 - Interact with serial port
 - Update software
 - Deployed in Inria-Paris office building



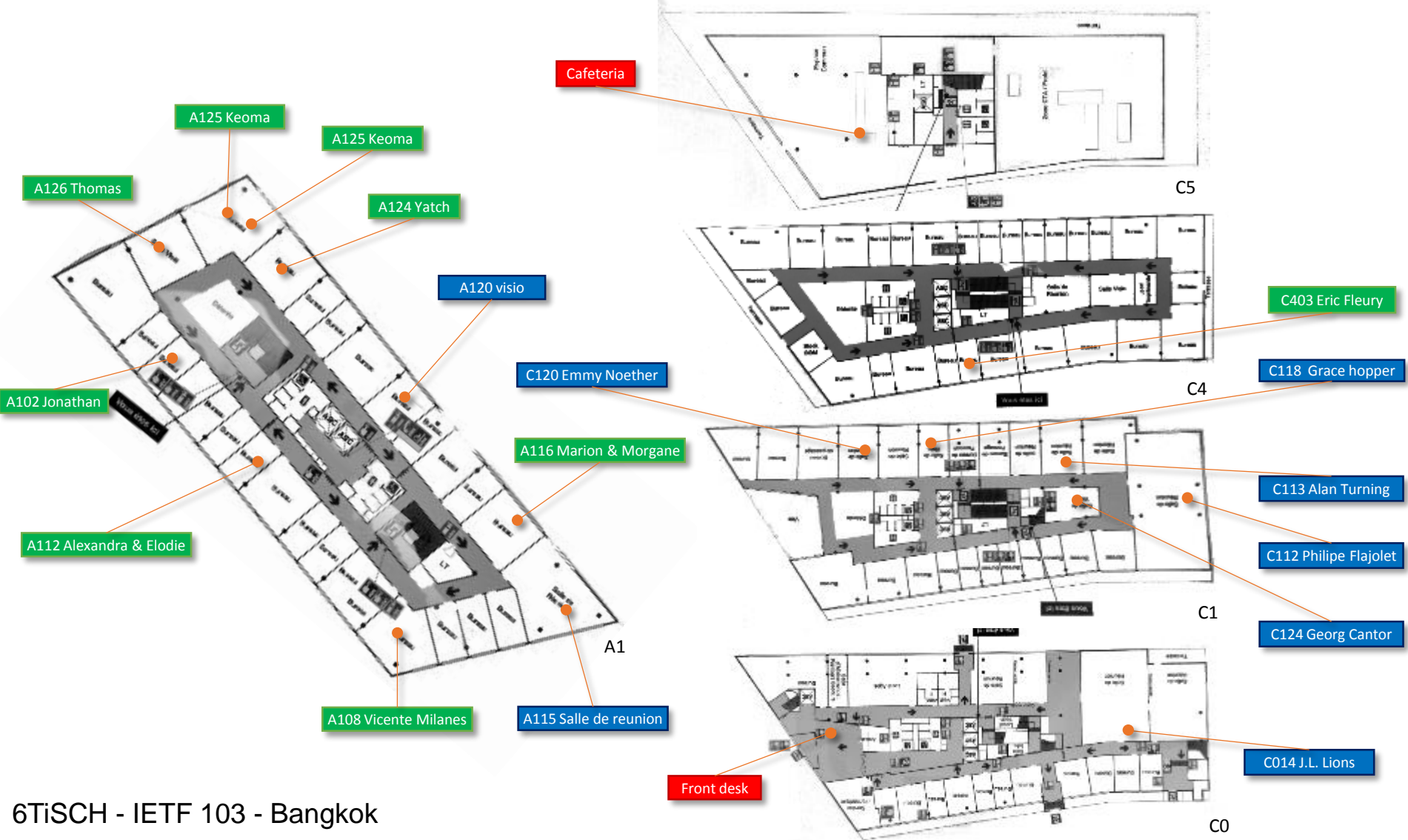
<https://github.com/openwsn-berkeley/opentestbed>

Experimental testbed

- OpenTestbed
 - MQTT based architecture




Experimental testbed



6TiSCH implementation

- OpenWSN
 - Latest Release: REL-1.22.0
 - OpenMote-B port only for 2.4GHz
 - Range test over opentestbed
 - Xon/Xoff feature
 - Enable 100% serial communication with Motes
 - Implementation of draft-ietf-msf-01
 - Bug fix:
 - Motes stopped communicating unwished:
<https://openwsn.atlassian.net/browse/FW-737>
(Reported during last 6TiSCH plugtest event)
 - Support firmware uploading to OpenTestbed

OpenTestbed				
 REFRESH	EUI64	testbox	serial	firmware
Total Number of Motes	00-12-4b-00-14-b5-b5-d5	otbox10	/dev/openmote-b_1	0300s_openwsn_prog.ihex
76	00-12-4b-00-14-b5-b5-af	otbox10	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-db	otbox10	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-fb	otbox10	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-8c	otbox11	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-a9	otbox11	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-f8	otbox11	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-57	otbox11	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b4-d1	otbox18	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-79	otbox18	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-28	otbox18	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-4f	otbox18	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-e9	otbox13	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-1f	otbox13	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-49	otbox13	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-24	otbox13	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-7d	otbox06	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-8a	otbox06	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-fa	otbox06	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-d2	otbox06	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-65	otbox08	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-48	otbox08	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-97	otbox08	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-0b	otbox08	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-d0	otbox09	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-95	otbox09	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-f3	otbox09	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-d1	otbox09	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-3d	otbox15	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-c4	otbox15	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-7b	otbox15	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-e7	otbox15	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-38	otbox14	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b6-2b	otbox14	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-58	otbox14	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-5b	otbox14	/dev/openmote-b_4	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-9a	otbox07	/dev/openmote-b_1	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-45	otbox07	/dev/openmote-b_2	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-ed	otbox07	/dev/openmote-b_3	0300s_openwsn_prog.ihex
	00-12-4b-00-14-b5-b5-a4	otbox07	/dev/openmote-b_4	0300s_openwsn_prog.ihex

<https://github.com/openwsn-berkeley/openwsn-fw/releases/tag/REL-1.22.0>

Evaluation 6TiSCH implementation

- OpenVisualizer
 - Support connecting to OpenTestbed
 - Receiving debug information from mote
 - Sending command to mote
 - Optimization on serial frame parsing
 - Support 76 motes sending 10 debugging message every one second at same time.

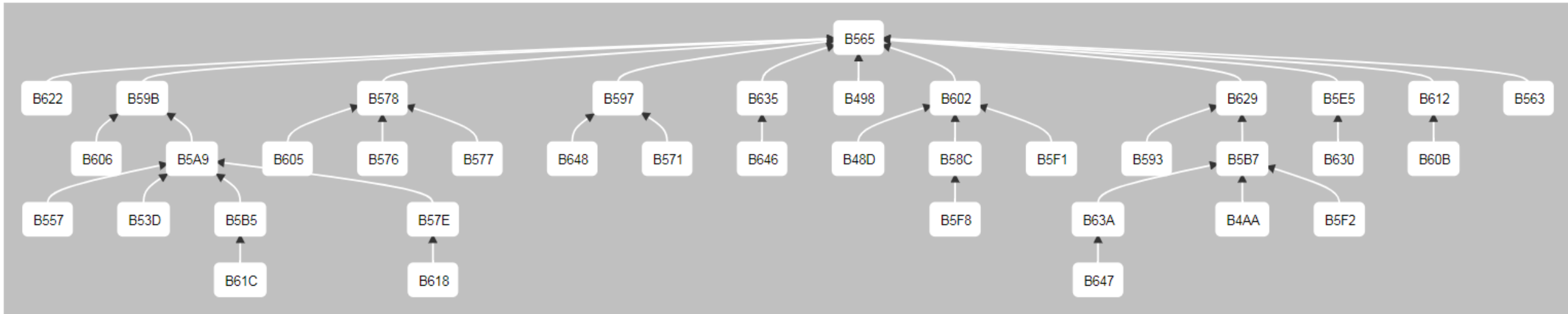
Type	Shared?	Channel	Nbr Type	RX	TX	TX ACK	Last ASN
2 (RX)	0	11	00-12-4b-00-14-b5-b5-5b (64b)	33	0	0	0x00000025fc
0	3 (TXRX)	1	0	30	24	24	0x0000002645
24	1 (TX)	1	15	0	2	2	0x00000011d9
49	1 (TX)	1	8	0	0	0	0x0000000ac3
36	1 (TX)	1	11	0	5	4	0x0000002341
25	1 (TX)	1	8	0	1	1	0x000000149d
29	1 (TX)	1	4	0	1	1	0x0000001cea
66	1 (TX)	1	9	0	1	1	0x00000017ee
70	1 (TX)	1	9	0	0	0	0x00000021a5
0	0 (OFF)	0	(None)	0	0	0	0x0000000000
0	0 (OFF)	0	(None)	0	0	0	0x0000000000

<https://github.com/openwsn-berkeley/openvisualizer>

Experimental Result

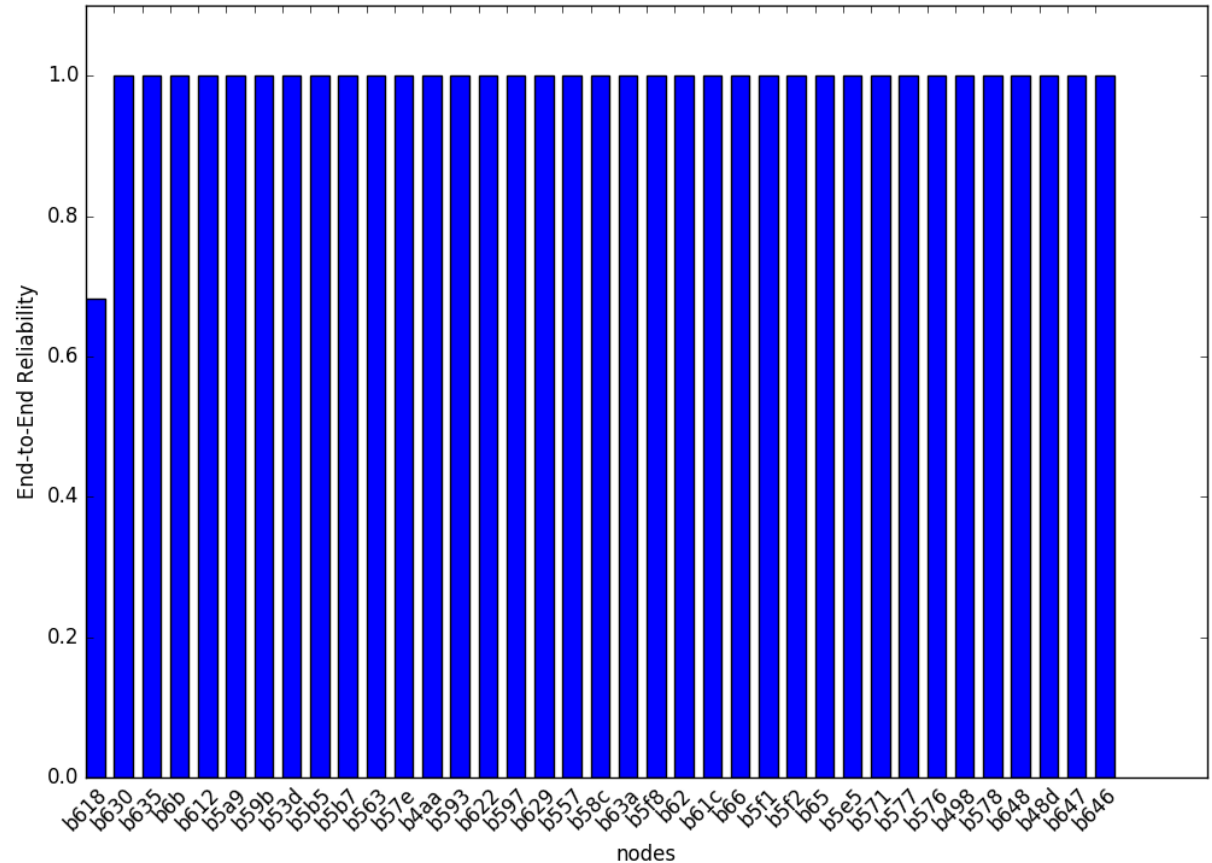
Routing

Current RPL Routing



Experimental Result

- End-to-End Reliability
 - Configuration
 - NUMTRIES: 3
 - Average: 99.14%
 - Experiment in Office building
 - Need to understanding what happened with mote b6-18, should be 100%



Lessons Learnt from MSF experiments

- MSF-01:
 - Probability broadcasting EB/DIO sometime makes the synchronization taking longer (depending on the topology)
 - Reserve a TX autonomous cell for each neighbor could cause schedule overflow problem.
 - The Tx autonomous is in a CSMA fashion, this will cause App packet drop because collide with other packet sent by siblings.
 - The adapting to traffic could be triggered because of colliding on Tx autonomous cell, which shouldn't
- Propose in MSF-02:
 - Only reserve autonomous cell to parent
 - Reserve TxRx shared autonomous cell to parent (unicast cell)
 - Reserve TxRx non shared autonomous cell (anycast)
 - Bring back the one managed Tx cell (reserved by Sixtop) aside with autonomous cell
 - Only send DIO when one managed Tx cell is installed