



IETF92 - Dallas

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Thomas Watteyne

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Etherpad for minutes:

<http://etherpad.tools.ietf.org:9000/p/notes-ietf-92-6tisch>

IPv6 over the TSCH
mode of IEEE 802.15.4e



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Minutes are taken *

This meeting is recorded **

Presence is logged ***

* Scribe: please contribute online to the minutes at
<http://etherpad.tools.ietf.org:9000/p/notes-ietf-91-6tisch>

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*** Please make sure you sign the blue sheets



Administrivia

- Blue Sheets
- Scribes
- Jabber

Objectives

- **Monday** (1520-1650 CDT, Continental)
 - Security
- **Thursday** (0900-1130 CDT, Continental)
 - WG drafts, including in last call
 - Plugtest
 - Distributed scheduling
 - Rechartering discussion

Agenda



- Intro and Status [2min] (Chairs)
- Note-Well, Blue Sheets, Scribes, Agenda Bashing
- Last Call Status
- * <draft-ietf-6tisch-tsch-06> [10min] (Thomas Watteyne)
 - * <draft-ietf-6tisch-minimal-06> [10min] (Nicola Accettura)
 - * <draft-ietf-6tisch-architecture-06> [10min] (Pascal Thubert)
 - * <draft-ietf-6tisch-terminology> [10min] (Maria-Rita Palattella)
- Other Drafts
- * <draft-ietf-6tisch-6top-interface-03> [10min] (Xavi Vilajosana)
 - * <draft-wang-6tisch-6top-sublayer-01> [10min] (Xavi Vilajosana)
 - * <draft-ietf-6tisch-coap-03> [10min] (Xavi Vilajosana)
- Plugtest [10min] (Miguel Angel Reina Ortega)
- Distributed Scheduling
- * <draft-dujovne-6tisch-on-the-fly-05> [30min] (Diego Dujovne)
- Rechartering [38min] (Chairs)
- * Summary of Monday's meeting
 - * Scheduling goals and deliverables
 - * Security goals and deliverables

draft-ietf-6tisch-tsch

Using IEEE802.15.4e TSCH in an IoT context:
Overview, Problem Statement and Goals

Thomas Watteyne (Ed.)

Maria Rita Palattella

Luigi Alfredo Grieco

Status [1/2]

- Status:

- Adopted at IETF88 (Vancouver)
- Latest version -06 published on March 9, 2015
<https://tools.ietf.org/html/draft-ietf-6tisch-tsich-06>

- Update

- Sheperd is Pascal Thubert (**thanks!**)
- WGLC started 11/28/2014 (ML), discussed at discussed at 12/5 interim, published in minutes on 12/6
- IESG Evaluation of -05

Yes
Ted Lemon

No Objection
Adrian Farrel 
Alia Atlas
Jari Arkko
Joel Jaeggli
Kathleen Moriarty
Richard Barnes 
Spencer Dawkins
Stephen Farrell 

Status [2/2]

- Changes between -05 and -06
 - Addressing points raised by Roni Even
<https://www.ietf.org/mail-archive/web/gen-art/current/msg11355.html>
 - comments Adrian Farrel and Deborah Brungard, Richard Barnes and Stephen Farrell
<https://datatracker.ietf.org/doc/draft-ietf-6tisch-tsch/ballot/>
 - Addressing Adrian Farrel's comments
<http://www.ietf.org/mail-archive/web/6tisch/current/msg03028.html>
 - cleaning up references, per Ted Lemon's recommendation
 - **Thanks a million for the very effective process!**
- Current status: RFC Ed Queue

draft-ietf-6tisch- minimal-06

Xavi Vilajosana (Ed.)
Kris Pister

Status

- Status:
 - Adopted at IETF88 Vancouver
 - Latest version (06) published on 8 March 2015
<https://datatracker.ietf.org/doc/draft-ietf-6tisch-minimal/>
 - Very stable draft.
- Changes since IETF91
 - Clarify HbH (RPI, RH3 and IP in IP)
 - Minimal security requirements
 - Added Timeslot template for non-default setting in IE
 - Several minor changes

RPI and RH3 Headers

- Problem
 - A lot of the packet space used by
 - RH3
 - RPI
 - IP in IP
- Studied Solutions
 - Flow Label (6man, roll)
 - NHC (6lo)
 - Leave it as is
 - Zigbee IP approach
- Status
 - Strict stability requirement to support ETSI plugtest
 - Conclusion: “Leave it as is” – IP in IP + RH3 or RPI
 - Study Zigbee IP approach

RPI and RH3 Headers (II)

Section 9.2 RPL Configuration

“In addition to the Objective Function (OF), a minimal configuration for RPL SHOULD indicate the preferred mode of operation (either Storing Mode or Non-Storing Mode) so different RPL implementations can inter-operate.

RPL information and hop-by-hop extension headers MUST follow [RFC6553] and [RFC6554] specification. In the case that the packets formed at the LLN need to cross through intermediate routers, these MUST obey to the IP in IP encapsulation requirement specified by the [RFC6282] and [RFC2460]. RPI and RH3 extension headers and inner IP headers MUST be compressed according to [RFC6282].”

Security

Two security mechanisms are considered, authentication and encryption, authentication applies to the all packet content while encryption applies to header IEs and MAC payload. Key distribution is out of scope of this document, but examples include pre-configured keys at the nodes, shared keys among peers or well-known keys. Refer to the 6TiSCH architecture document [I-D.ietf-6tisch-architecture] for further details on key distribution and advanced security aspects.

The present document assumes the existence of two keys, which can be well-known by the network devices and/or pre-configured. One of the keys (K1) is used to authenticate EBs (all frame). As defined in Section 4 EBs MUST be authenticated but payload not encrypted. This prevents two independent networks to interfere or enable non-allowed nodes to join a particular network. A second key (K2) is used to authenticate and encrypt the payload of DATA, ACKNOWLEDGEMENT, MAC COMMAND frame types and respective header IEs.

TimeSlot Template IE

- Section 4.2.2
- Added information about the TS IE in case the default is not used.

“In the case that a different than the default timeslot template is used, the IE Content MUST follow the following specification as defined in [IEEE802154e], Section 5.2.4.15.”

Timeslot Template ID (b0-b7)

macTsCCAOffset (b8-b23)

macTsCCA (b24-b39)

Other changes

- + Clarified synchronization, TS must be captured when the first bit of packet after SFD leaves/is received
- + Remove reference to discontinued [I-D.phinney-roll-rpl-industrial-applicability]
- +Indicated precedence of IEEE802.15.4e where it applies
- +Typos and minor grammar corrections.

6tisch-architecture

draft-ietf-6tisch-architecture-06

P. Thubert (Ed.), K. Pister
T. Watteyne, R. Assimiti
Xavi Vilajosana, Qin Wang
R. Struik, M. Richardson

...

Why 6TiSCH?

- The TSCH Breakthrough: Determinism
 - To enhance delivery ratio (as in any TSN network)
 - Also to reduce power consumption and extend life
- Demonstrated in Industrial Networks
 - ISA100.11a, wireless HART,
 - Needed generalization to IETF protocol stacks
- Too complex for my Network?
 - Once technology is burnt in the silicon, only the benefits remain visible
 - Already applied outside industrial
 - Time sync also bring value for security (ASN)

Why Archie?

- Incomplete IETF suite
 - 6LoWPAN and RPL integration
 - PCE, CCAMP, TEAS...DetNet extensions needed
- Real new stuff
 - 6top
 - Dynamic routing and scheduling
 - Security (join...)
- Putting it all together and promoting work
 - [draft-vanderstok-core-comi](#)
 - [draft-thubert-6lo-rfc6775-update-reqs](#)
 - [draft-thubert-6lo-routing-dispatch](#)

About Archie

- Compiling the 6TiSCH design decision so far
 - Only first volume,
 - Second volume to follow new charter items
- Huge amount of work
 - Inheritance from TSMP, and industrial standards
 - Weekly then biweekly interims for 2 years
 - Weekly security DT meeting
- Many authors and huge ack section
 - Pascal, editor and 6 main authors,
 - Thomas, Robert, Qin, Xavi, René, Michael and Kris
 - By rule, moving all authors to Contributors section

Status

- Status:
 - Adopted at IETF88
 - Latest version (06) published March 9, 2015
<http://tools.ietf.org/html/draft-ietf-6tisch-architecture>
- Changes since IETF91
 - Final Cleanup for Last call (using term volume)
 - Fixed references
 - Addressed Last Call comments
 - Diffs at <https://tools.ietf.org/rfcdiff?url2=draft-ietf-6tisch-architecture-06.txt>
 - But remaining convergence on
 - Security text => apparently solved now, just conforming
 - Some of Michael's comments, to be sorted soon

draft-ietf-6tisch-terminology-04

draft-ietf-6tisch-terminology-04

M.R. Palattella (Ed.)

P. Thubert

T. Watteyne

Q. Wang

Status

- Status:
 - Adopted at IETF88
 - Latest version -04 published on 23.03.2015
available at: <http://tools.ietf.org/html/draft-ietf-6tisch-terminology-04>
 - Changes since IETF91
 - Added new terms
 - Improved definition of some terms
 - Deleted terms (not really needed or not used in current 6TiSCH drafts)
- Based on comments received from Rene and Chonggang

Main changes 1/2

1) Improved definition of

- CDU matrix
- Chunk
- EB
- ASN
- Blacklist of frequencies
- 6F
- DAR/DAC
- JCE and JA

2) Added definition of

- Deterministic Network
- Interference Domain
- Centralized cell/track reservation (replacing PCE cell/track reservation)

Main changes 2/2

3) Deleted definition of

- CoAP
- Chunk ownership appropriation/delegation
- Security-related terms: DevID, DTLS, IDevID, LDevID, PANA, unique join key, JN, KMP, SA, Peer-to-peer L2 Key

4) Fixed format of each term (upper case for first letter of a word)

5) Provided missing full spelling of acronyms

(e.g., 6LoWPAN, RPL, LLN, P2P, P2MP, MP2MP)

draft-ietf-6tisch-6top-interface-03

draft-wang-6tisch-6top-sublayer-01

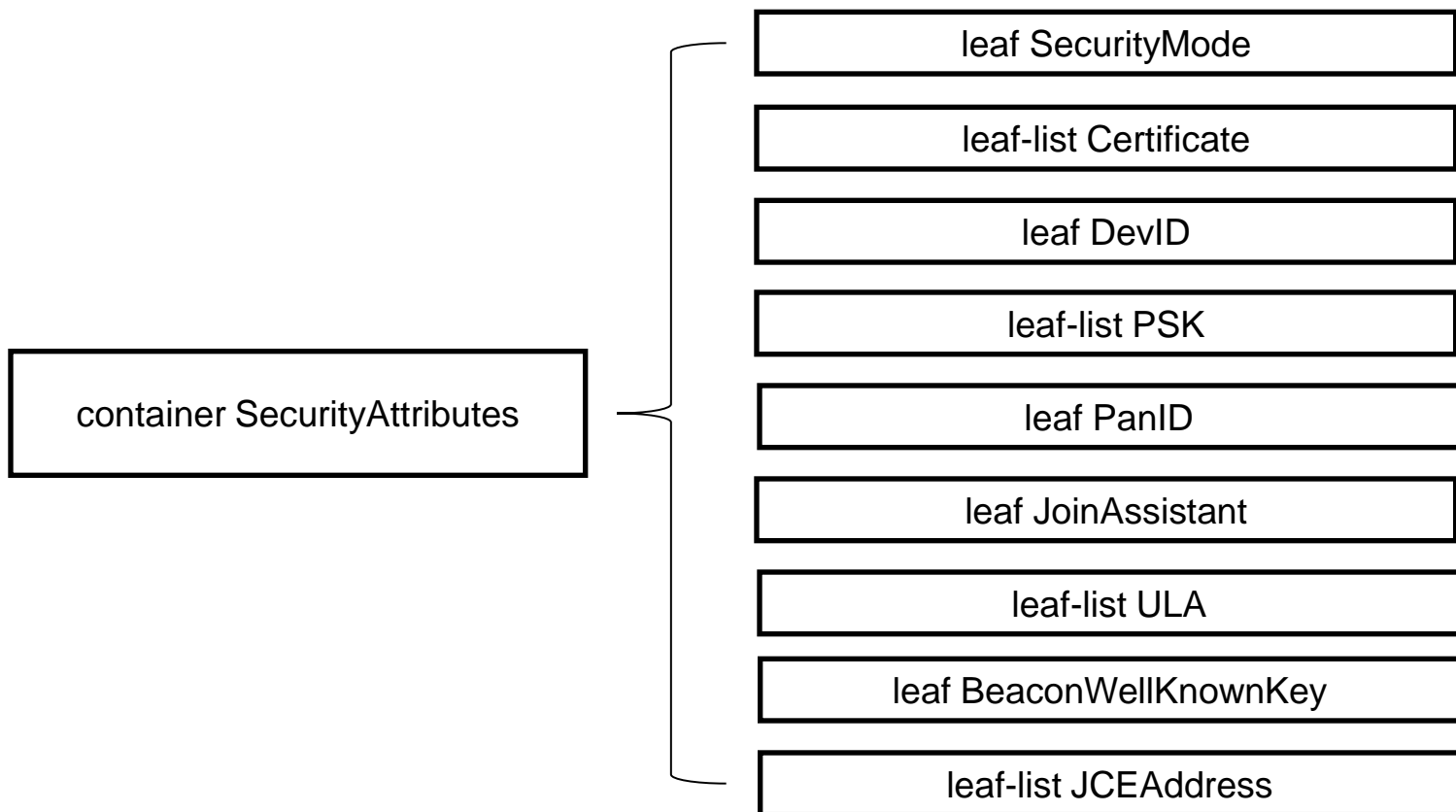
Qin Wang (Ed.)
Xavier Vilajosana
Thomas Watteyne

Status

- Status:
 - Adopted at IETF89
 - Latest version published on 2015-03-09
<http://tools.ietf.org/html/draft-ietf-6tisch-6top-interface>
- Changes since IETF91
 - See the following pages.

Change (1)

- Add section 4.3 “YANG Model for the Security Aspects of 6top” according to <http://www.ietf.org/mail-archive/web/6tisch/current/msg02739.html>



Change (1) cont.

```
leaf SecurityMode {
  type enumeration {
    enum NO_SECURITY;
    enum NETWORK_WIDE_MIC;
    enum NETWORK_WIDE_DHE_PSK;
    enum NETWORK_WIDE_IKE2_PSK;
    enum PK_DTLS_ECDSA;
    enum OTHER;
  }
  description
    "The security mode is to be used.";
}

leaf-list Certificate{
  type uint8;
  min-elements 128;
  description "A list of bytes for the
               certificate ECDSA PKIX or PSK";
}
```

Change (1) cont.

```
leaf DevID {
    type enumeration {
        enum IDevID;
        enum LDevID;
    }
    description " indicate the feature of DevID.";
}

leaf-list PSK{
    type uint8;
    min-elements 128;
    description "A list of bytes for the PSK while using PSK method";
}

leaf PanID {
    type uint16;
    description "2 Bytes the network PANID";
}
```

Change (1) cont.

```
leaf JoinAssistant {
    type enumeration {
        enum TRUE;
        enum FALSE;
    }
    description "a toggle which enables a node to
                become a join assistant.";
}

leaf-list ULA{
    type uint8;
    min-elements 16;
    description "A ULA to be announced in the
                RA for joining nodes. It is 128bits+prefixlen.
                A device with multiple interfaces
                should configure different 64-bit prefixes.";
}
```

Change (1) cont.

```
leaf BeaconWellKnownKey{
    type string;
    default "6TISCHJOIN";
    description "the well known beacon key";
}

leaf-list JCEAddress{
    type uint8;
    min-elements 8;
    description "the address of the JCE,
                for the ACL about
                who can contact joining nodes.";
}
```


Change (2)

Refining/rewording according to <http://www.ietf.org/mail-archive/web/6tisch/current/msg02605.html>

Discussion

- How to expose the 15.4/15.4e PIB and the primitives, which are used to initialize/config PIB, to 6top users?
- Which attributes should be mandatory? Which attributes should be optional?

Next Step

- Complete 4.3 along with the progress in 6top security
- Define a generic method to expose 15.4 PIB and related primitives to 6top users.
- Coordinate with <http://tools.ietf.org/html/draft-wang-6tisch-6top-coapie-00.txt>, and merge softcell negotiation RPC into YANG model.

Status

- Status:
 - Latest version published on 2014-07-04
<http://tools.ietf.org/html/draft-wang-6tisch-6top-sublayer-01.txt>
- No changes since IETF91

Next Step

- Coordinate with <http://tools.ietf.org/html/draft-wang-6tisch-6top-coapie-00.txt>, to change section 4 “6top communication protocol” and related parts.
- Add example schemes regarding to the policies, e.g.
 - The policy to build a candidate cell set
 - The policy to select cells from the candidate cell set to reserve
 - The behavior of the nodes when the soft cells negotiation fails
 - The policy to select cells corresponding to a delete soft cell command

6TiSCH Resource Management and Interaction using CoAP

Raghuram Sudhaakar

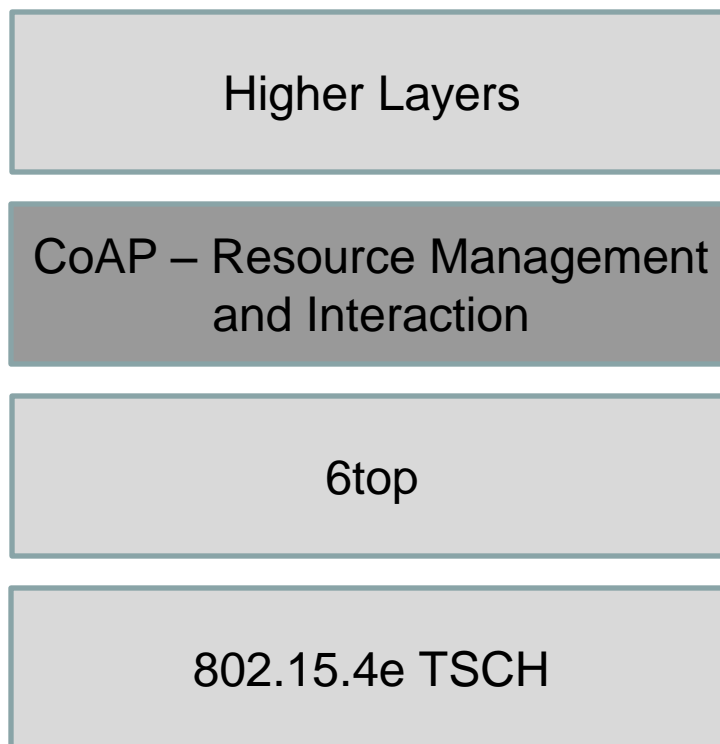
Pouria Zand

Status

- Currently adopted as a 6TiSCH WG draft
- Current version - draft-ietf-6tisch-coap-03
- Changes – draft 03
 - Language referencing CoMI
 - Fixed bibliography references
 - Minimal changes in regard to typos and language compared to draft 02

Introduction

- Logical positioning of layers



Introduction

- This draft defines -
 - How to interact with 6top, control and modify schedules, monitor parameters etc.
 - Message exchanges and the formats of the messages that the network layer uses to interact with the 6top sub-layer.
- We also presents a particular implementation of the model based on CoAP and CBOR

Naming Convention for URI schemes



- All URIs naming 6top resources **MUST** use the 'coap' scheme
- The authority **MUST** have the username '6top' and the IP address of 6top node
- The root path **MUST** always start with '6top'
- Each component of the path **SHOULD** be of minimum possible length while being self descriptive.



Convention for accessing URIs

Mapping between CoAP methods and 6top commands

CoAP method	6top command	Description
GET	READ	Retrieves 6top resources
POST	CREATE / UPDATE	Creates/Updates a new entry
DELETE	DELETE	Deletes an entry
POST	CONFIGURE	Configures a setting

6TiSCH Resources

- Management Resources

A few 6top management resources and the related URI

Name paths	Accessibility 6top Commands	URI path
Neighbor List	CREATE/READ/DELETE/UPDATE	6top/nbrList
Slotframe List	CREATE/READ/DELETE/UPDATE	6top/slotFrame

An example on how Neighbor table attributes can be addressed

Field name	URI path
Target Neighbor Addr	6top/nbrList/tna
ASN	6top/nbrList/asn
RSSI	6top/nbrList/rssi
Link Quality	6top/nbrList/linkQ

6TiSCH Resources

- Informational Resources

6top informational resources and the related URI

Name paths	Accessibility 6top Commands	URI path
Version	READ	6top/version
Queue stats	READ/CONFIGURE	6top/queue
Monitoring status	READ/CONFIGURE	6top/monitStatus
Statistics metrics	READ/CONFIGURE	6top/stats

Message Formats

- GET

Header	GET
Uri-Path	/6t/Neighbor
Options	Accept: application/cbor Uri-Query: ABNF(TargetNodeAddr==0x1234)

- POST

Header	POST
Uri-Path	/6t/Neighbor
Payload	CBOR({TargetNodeAddr: 0x1234})

- DELETE

Header	DELETE
Uri-Path	/6t/Neighbor
Options	Uri-Query: ABNF(TargetNodeAddr==0x1234)

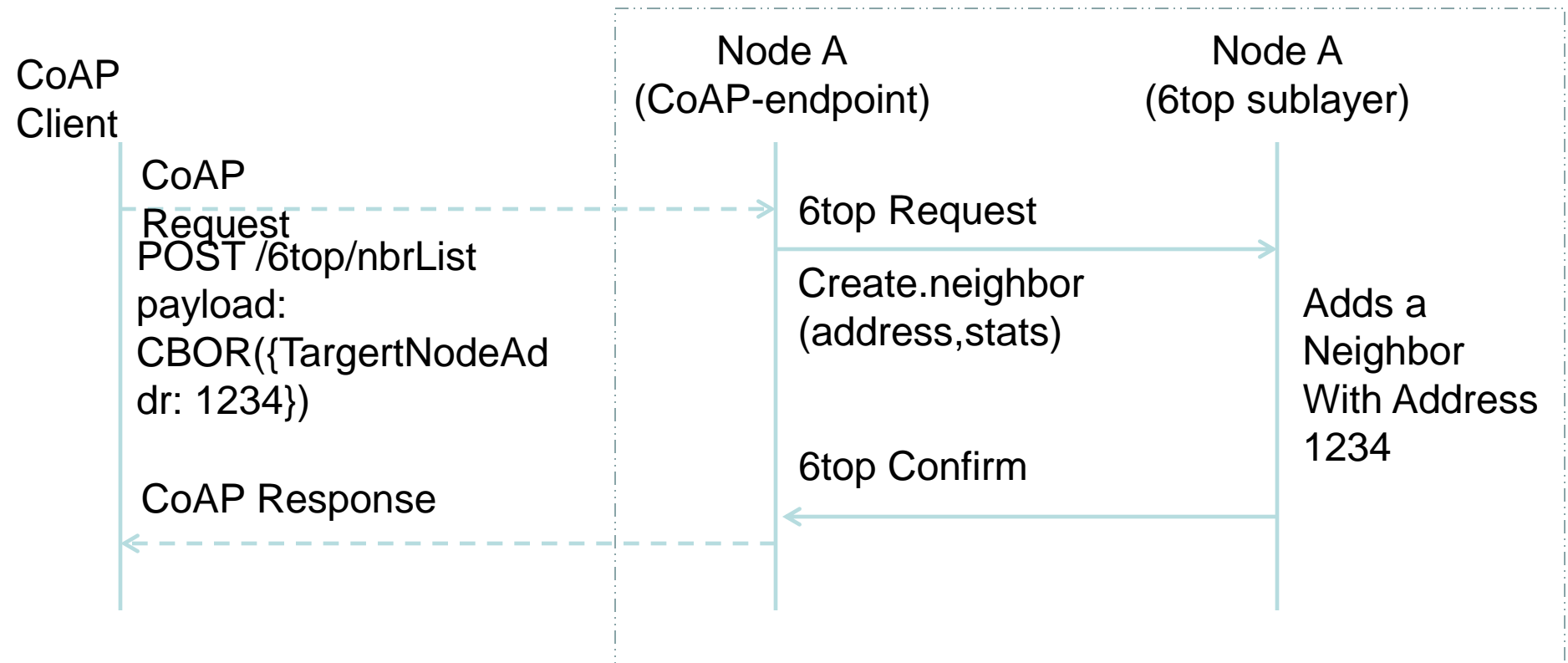
CoAP methods and resulting invocation of 6top commands



CoAP method	6top command	6top behavior	CoAP Response
POST /6top/nbrList CBOR({TargetNodeAddr: 1234})	Create.neighbor (address,stats)	Adds a neighbor	2.01 Created
GET /6top/nbrList	Read.all. neighbor()	Reads all neighbors	2.05 Content CBOR(Neighbor table)
GET /6top/nbrList Uri-Query – ABNF(TargetNodeAddr==1234)	Read.neighbor (address)	Reads neighbor information	2.05 Content CBOR(Neighbor table)
POST /6top/nbrList CBOR({TargetNodeAddr: 1234})	Update.neighbor (address,stats)	Updates an entry	2.04 Changed
DELETE /6top/nbrList ABNF(TargetNodeAddr==1234)	Delete.neighbor (address)	Removes the neighbor	2.02 Deleted

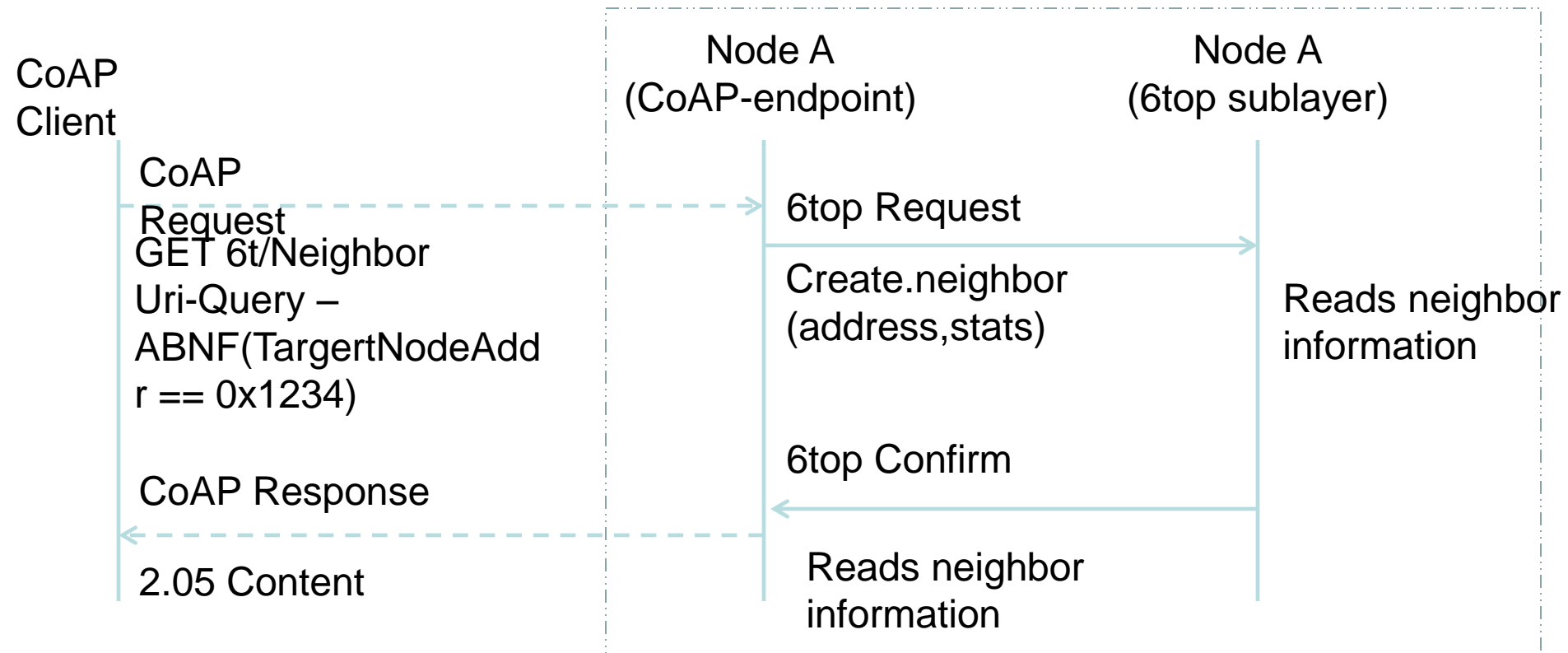
Example - Adding a neighbor

- Request-Response



Example - Reading a neighbor

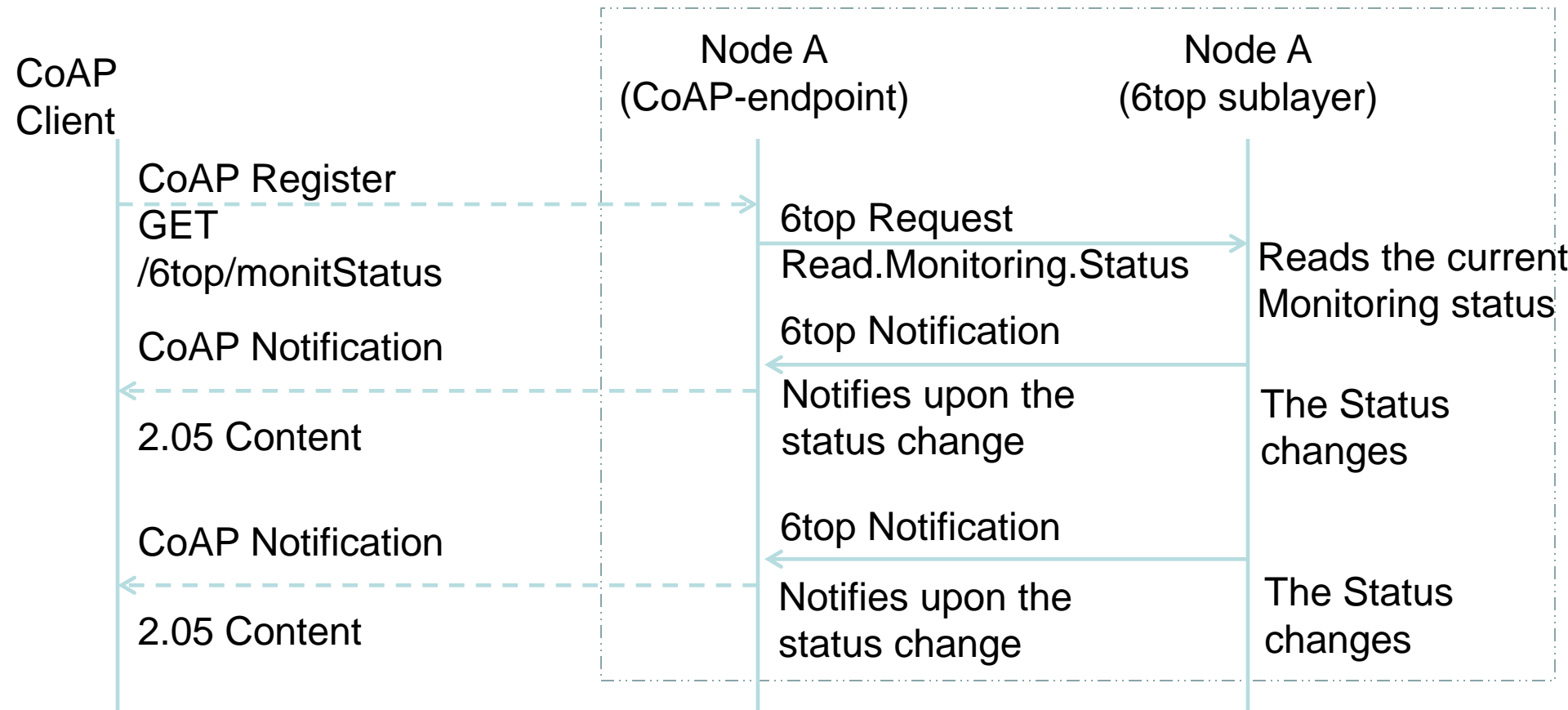
- Request-Response



Example - Subscribing to Monitoring Status



- Publish-Subscribe





1ST ETSI 6TISCH PLUGTESTS

Miguel Angel Reina Ortega

Centre for Testing and Interoperability

2015, March, IETF#92

- 6TiSCH Plugtests details
- 1st 6TiSCH Plugtests website
- 6TiSCH experts group
 - Tasks
 - Milestones
 - Who they are

1st 6TiSCH ETSI Plugtests details



- Co-located to IETF#93
- 17th – 19th July 2015
- Scope: draft-ietf-6tisch-minimal

- Website: <http://www.etsi.org/news-events/events/942-6TiSCH-plugtests>
- Registration:
<http://webapp.etsi.org/plugtests/Register.asp?EventID=218>

Test specification

- Scope: minimal draft
 - Mainly on TSCH and RPL
 - No CoAP, neighbor-wide common L2 key (optional)

Golden Device






- One or more golden images
 - One image for all test sections
 - One image for each test section

Technical report

- Summary of the Plugtests

6TiSCH experts group milestones



-  Milestone 1 (24th April):
 - first draft of test specs available
-  Milestone 2: (1st June):
 - stable test specs draft available to be distributed to 6TiSCH community to get early feedback
 - golden device implemented and sent to each participant
-  Milestone 3: (10th July):
 - Final draft of test specs
-  Milestone 4: (19th July):
 - Support to 6TiSCH Plugtests and compilation of findings/results
-  Milestone 5 (28th August):
 - Finished 6TiSCH Technical report

- Thomas Watteyne (Technical coordinator)
- Xavier Vilajosana (Technical coordinator)
- Maria Rita Palattella (Test specs leader)
- Tengfei Chang (Golden image leader)
- Miguel Angel Reina Ortega (Plugtests Team leader)

Bring your board to the Plugtests !!



Your Board?



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MiguelAngel.ReinaOrtega@etsi.org

Thank you!

6TiSCH On-the-Fly Scheduling

draft-dujovne-6tisch-on-the-fly-05

Diego Dujovne (Ed.)

Luigi Alfredo Grieco

Maria Rita Palattella

Nicola Accettura

Status

- Status:
 - Individual Submission
 - Latest version -**05** published on **07.03.15**
available at: www.ietf.org/id/draft-dujovne-6tisch-on-the-fly-05.txt

Brief Evolution

- -00 December 5, 2013
- -01 January 24, 2014
- -02 February 14, 2014
- -03 July 4, 2014
- -04 January 4, 2015
- -05 March 7, 2015
- -06 ---?
- Started with lots of contributions from the list
- Stabilization with further periodic discussions to define mechanisms to interact with 6top
- Last updates to add compatibility to recent changes on 6top plus proposals from the ML

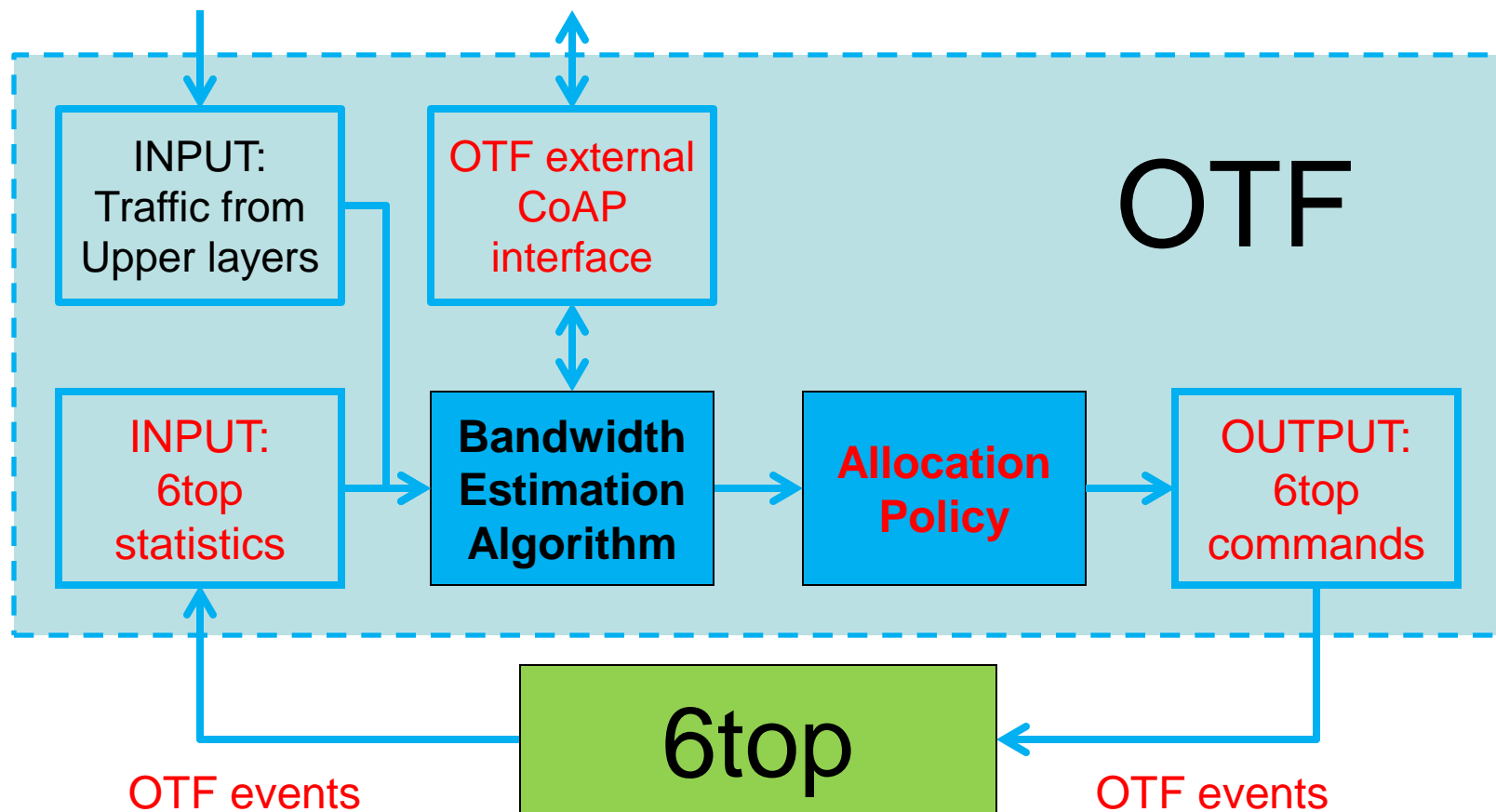
Distributed vs. Centralized

- **Centralized**, either static or low rate change for requests, using PCE
- **Distributed**, no central entity, all nodes negotiate bandwidth among them (the route to destination must be known in advance)
- **Hybrid**: Centralized (PCE-enabled) with pairwise bandwidth negotiation to fulfill eventual/critical BW requests.
- On-the-Fly provides the framework for the **last two methods**.

On-The-Fly scheduling 1/2

- OTF defines the **environment and methods** to enable Distributed resource scheduling in 6TiSCH.
- BW requests trigger **6top-6top soft cell allocation** negotiation between neighbors
- The BW allocation algorithm **calculates BW requirements** from different statistics, e.g. queue size and data rate.
- The allocation algorithm is **user-defined**, but there is a **default** algorithm.
- OTF is a **Layer-3 module**, operating on the **best effort track**

On-The-Fly scheduling 2/2



Changes since IETF91 1/3

- Two versions: -04 and -05 published.

For the -04 version:

- Eliminated the **reactive/proactive discussion** which remained (before the implementation of Thresholds in the Allocation Policy).
- Evolution from **PROACTIVETHRESH** to **OTFTHRESH**
- Corrected **OTF Events**

Changes since IETF91 2/3

For the -05 version:

- Changed the text to uniform the idea that OTF operates on **best-effort layer-3 bundles**
- Made clear that OTF only works **using the Best-Effort track**: new cells will not be allocated in other tracks.
- Explained that it is a task of 6top to **translate OTF requirements to cell or bundle allocations**, according to the number of cells requested
- Added a **figure** to better illustrate the Allocation Policy Thresholds
- Fixed the item where **multiple cell deletion** triggered the deletion of the **best-effort bundle**. This is managed by 6top.

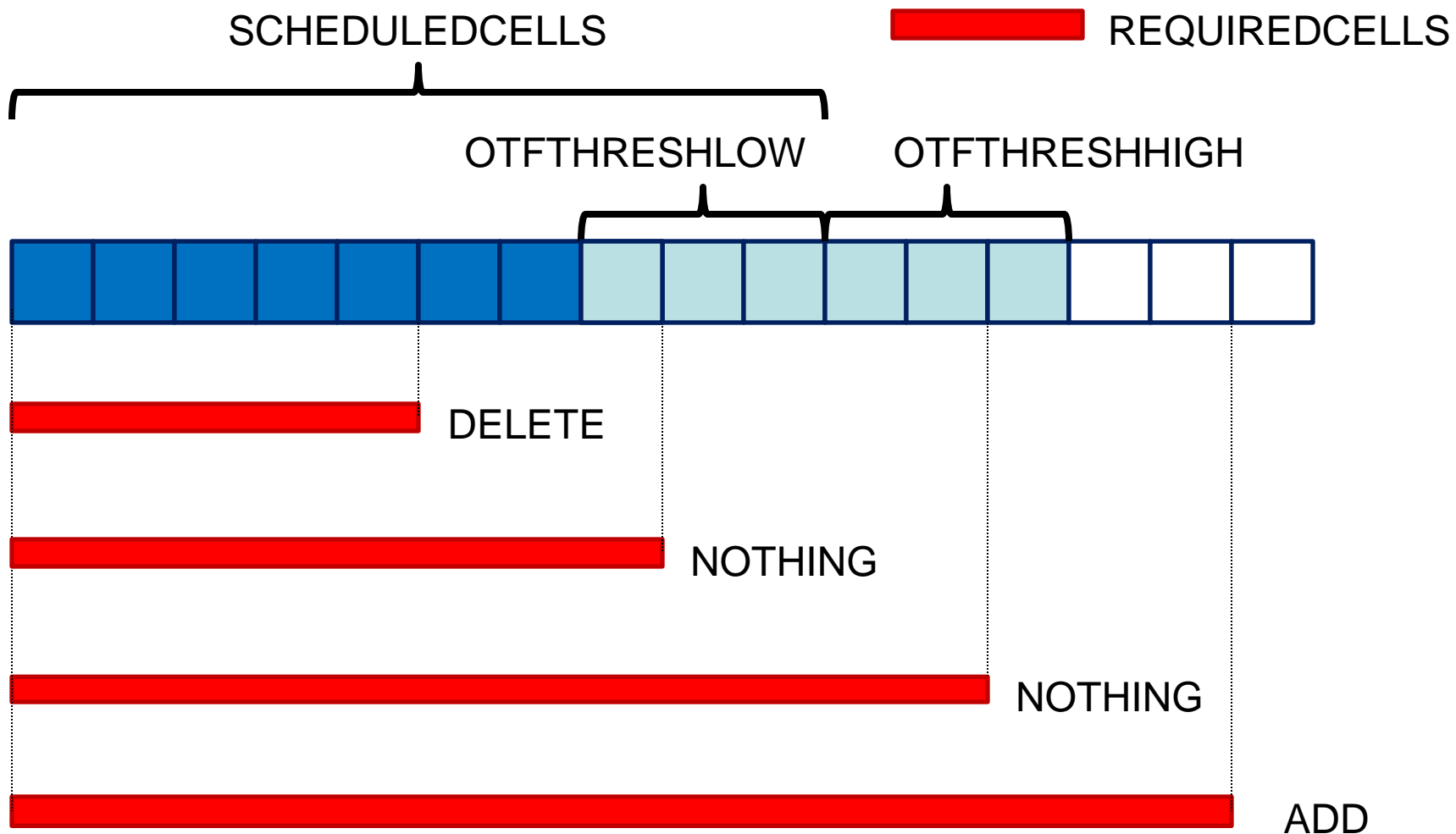
Changes since IETF91 3/3

- Removed **LQI** as an input to OTF.
- Inverted **section order** 5 and 6 to follow a cause-consequence order.
- Improved the text on the **Allocation policy section** to connect the paragraphs
- Corrected typos

Allocation Policy 1/2

- Adds hysteresis to the allocation algorithm to **improve stability**
- It can be **parameterized** so as to increase the reactivity of the allocation algorithm
- Becomes an **energy compromise** between an increase in management traffic (due to probable oscillation) with under/overprovision
- In version -05 we defined two thresholds: OTFTHRESHLOW and OTFTHRESHHIGH to improve **underprovisioning** and **overprovisioning** thresholds independently.

Allocation policy 2/2



OTF Events – common structure

- In version -05, a common structure **replaced the former list of events.**
- Event handling elements:
 - A set of **parameters $P(E)$** : parameters used to define E and its triggering conditions;
 - A set of **triggering variables $V(E)$** : variables that can trigger the event;
 - A set of **triggering conditions $C(E)$** : conditions to satisfy on the variables $V(E)$ to trigger E ;
 - A set of **process handlers $H(E)$** : handlers required to respond and process the triggering conditions $C(E)$.

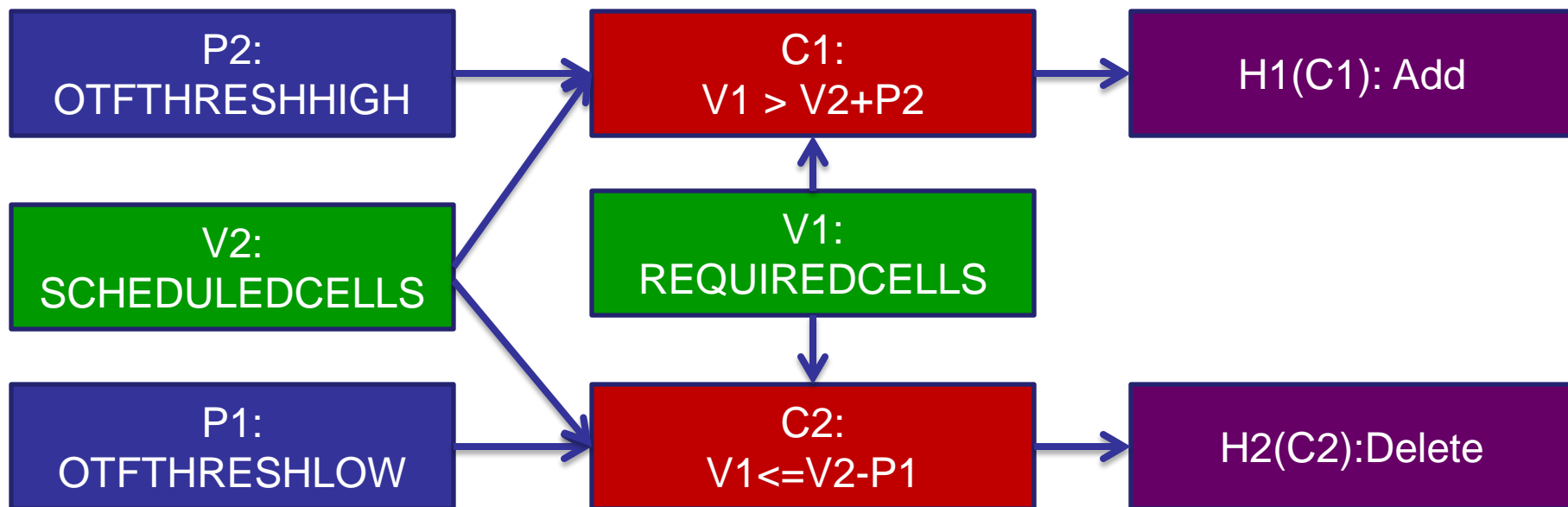
OTF Events – example 1/3

- Configuring an Allocation Policy event:
- P(E) consists of the **OTFTHRESHLOW** and **OTFTHRESHHIGH** parameters (P1 and P2);
- V(E) consists of the **REQUIREDCELLS** and **SCHEDULEDCELLS** variables (V1 and V2);
- C(E) consists of the following conditions:
 - C1: $V1 > V2 + P2$
 - C2: $V1 \leq V2 - P1$

OTF Events – example 2/3

- H(E) consists of the following handlers:
 - H1(C1): OTF asks 6top to **add one or more soft cells** to the L3 best effort bundle.
 - H2(C2): OTF asks 6top to **delete one or more soft cells** from the L3 best effort bundle.

OTF Events – example 3/3



TODO towards -06

- Include this draft in the **6TiSCH WG Charter?**
- Refer to **softcells instead of bundles**. Level-3 bundles are managed by 6top
- **Link option on cells** for OTF: TX or RX (no shared cells) on Best effort track – no contention -> open to discussion
- Fix **text redundancy** between Sec. 3 and Sec. 4
- Typo: **ADD and DELETE reversed** on Figure 1
- Terminology draft **compliance**
- Use CoAP to define parameters of the **Allocation Policy**
- Other ideas or corrections?



Questions?

Rechartering

Rechartering items

- Current charter: IEEE reference on 802.15.4^e
 - Suggestion to remove the “e”,
 - inherit 802.15.4-2015 when approved
- Update charter for Security:
 - Charter work on join Process? Up into configuration?
- Update charter for Centralized Scheduling
 - Contribute TSCH/LLN requirements to PCE, TEAS, CCAMP or DetNet if created
- Update charter for Distributed Scheduling
 - 6top and OTF documents mature. Charter in?
 - Need implementations to progress, must be made mainstream
 - Also work needed on bandwidth allocation (chunks etc...)

IEEE 802.15.4 Revision Report for IETF 92



Changes required for TSCH

IEEE 802.15.4 Revision Overview

- Latest draft is D5 (limited availability)
- Revision consists of :
 - Roll-up of amendments: 4e, 4f, 4g, 4j, 4k, 4m, 4p onto 802.15.4-2011
 - Corrigenda and editorial changes
- Presently in final stages of 802.15 letter ballot
- 802 Sponsor Ballot due to start in April 2015
 - Draft is publicly available upon start of ballot
- IEEE-SA approval target – 802.15.4-2015 (Dec 2015)

Corrections to TSCH operation

- **Terminology**

- Change to harmonize terms in TSCH with rest of standard, e.g. definition of *macTsTxOffset* should refer to the PPDU rather than the frame which is the MAC portion of the PPDU.

- **Default Values (ID=0, Table 137)**

- *macTsRxOffset* –changed from 1120 μ s to 1116 μ s to align center of *macTsRxWait* with *macTsTxOffset*
- Added 915 MHz SUN defaults (also ID=0)
 - Numbers based upon 100 kb/s, 1522 byte payload, 1 ms Transmit to Receive turnaround

Corrections to TSCH operation



- CSMA-CA flow chart has been merged with TSCH CSMA-CA flow chart
- Flow chart corrections for all modes:
 - TschCca flag (required for optional CCA operation)
 - PCA operation ([see next slide](#))
- TSCH Timeslot IE errors have been corrected

TSCH CSMA-CA harmonization with Priority Channel Access (PCA)



- PCA provides mechanism to give priority frames faster access to the medium within shared time-slots compared to lower priority frames
- Priority is assigned by a layer above the MAC
- PCA is complementary to 6top's priority queue mechanism
- Flow charts have been modified such that the PCA option fits within constraints of TSCH

Corrections to IEEE Std. 802.15.4 Security



- Security state machine figures are now cited in the bibliography
 - Figures are informative to those who found the text confusing:
<https://mentor.ieee.org/802.15/dcn/15/15-15-0106-03-0mag-security-section-pictures.doc>
- Security is Key Management Protocol (TG9) friendly
- Frame counters can be per key, not per device
 - Part of the changes for KMP
 - Allows specific links to be reset without resetting the whole network
- Removed security level 4 (encrypt only)
- Specified how security is done on new frame types
 - i.e. which parts are encrypted and which are not

Corrections to IEEE Std. 802.15.4 Security (cont'd)



- IEs
 - An excerpt of the IE security draft text is contained in document: <https://mentor.ieee.org/802.15/dcn/15/15-15-0275-00-0mag-security-functional-description-from-p802-15-4-revc-df5.pdf>
 - IE constructs were inconsistent with appropriate security procedures
 - Security levels for IEs are now independent of frame security level
- IEs in MLME, Data, and Command frames are now declared as primitive parameters so higher layer can identify which IEs are present
- Specified how security is done on new frame types
 - i.e. which parts are encrypted and which are not

TSCH Corrections to IEEE Std. 802.15.4 Security



- Added section to describe nonce generation for TSCH
 - Always use 5-octet ASN (absolute slot number)
 - Do not allow short addresses in the address field
- There was 5-octet frame counter option in the security header, but as 5-octet nonce generation is now used only in TSCH, and that always uses ASN, removed the whole 5-octet frame counter field.
- Specified that frame counter suppression can only be used when using ASN or similar (i.e. not copy the frame counter from inbound frame for Enh-Acks)



Updated Revision Schedule

- **Letter Ballot (LB)**
 - **Start** 14 June 2014
 - **End** 13 July 2014 (San Diego)
- **LB Recirculations**
 - **Start** 20 Oct 2014
 - **End** Mar 2015 (Atlanta)
- **Sponsor Ballot (SB)**
 - **Start** Apr, 2015
 - **Ends** May, 2015
- **SB Recirculations**
 - **Start** Jun, 2015
 - **End** Sep, 2015
- **EC submittal** 13 Nov, 2015 (Dallas)
- **RevCom** 4 Dec 2015

Any Other Business?

Thank you!