IETF94 - Yokohama

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IPv6 over the TSCH mode of IEEE 802.15.4e

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Administrivia

- Blue Sheets
- Scribes
- Jabber

Agenda

Intro and Status (Chairs) [5min]

Note-Well, Blue Sheets, Scribes, Agenda Bashing

New Charter [25min]

Status Document
New Charter
Milestones
Action Plan

Dynamic Scheduling

<draft-wang-6tisch-6top-sublayer-03> (Xavi Vilajosana) [20min]
<draft-dujovne-6tisch-6top-sf0-00> (Maria Rita Palattella) [20min]

Tracks in 6TiSCH

<draft-thubert-6tisch-4detnet-01> (Pascal Thubert) [20min]

Any Other Business

Announcement second ETSI 6TiSCH Plugtests (Miguel Angel Reina Ortega) [10min]

Rechartering

Description of Working Group

The Working Group will focus on enabling **IPv6** over the **TSCH mode of the IEEE802.15.4e standard**. The extent of the problem space for the WG is **one or more LLNs**, eventually federated through a common backbone link via one or more LLN Border Routers (**LBRs**).

The WG will rely on, and if necessary extend, existing mechanisms for authenticating LBRs. **Initially, the WG will limit its scope to distributed routing over a static schedule**. In that case, a node's schedule can be either preconfigured, or learnt by a node when joining the network, but it remains unchanged after the node has joined a network.

The Routing Protocol for LLNs (**RPL**) is used on the resulting network. The WG will interface with other appropriate groups in the IETF Internet, Operations and Management, Routing and Security areas.

Milestones

Date	Milestone
Nov 2016	Initial submission of 6TiSCH data model for CoAP to the IESG draft-ietf-6tisch-coap
Nov 2016	Initial submission of 6top draft(s) to the IESG draft-ietf-6tisch-6top-interface
Dec 2015	6TiSCH architecture and terminology in RFC publication queue
Jun 2015	6TiSCH Minimal and 6top draft(s) in RFC publication queue
Dec 2014	Evaluate WG progress, propose new charter to the IESG
Dec 2014	Initial submission of 6TiSCH architecture to the IESG draft-ietf-6tisch-architecture
Dec 2014	Initial submission of 6TiSCH terminology to the IESG draft-ietf-6tisch-terminology
Done	Initial submission of 6TiSCH TSCH to the IESG draft-ietf-6tisch-tsch
Done	Initial submission of 6TiSCH minimal configuration to the IESG draft-ietf-6tisch-minimal
Done	Submit YANG data model in 6top draft for preliminary OPSDIR review
Done	WG to adopt 6TiSCH terminology
Done	WG to adopt 6TiSCH data model for CoAP
Done	WG to adopt 6top draft(s)
Done	WG to adopt 6TiSCH minimal configuration
Done	WG to adopt 6TiSCH architecture
Done	WG to adopt IEEE802.15.4e TSCH overview

Charter 1

1. Produce "6TiSCH architecture" to describe the design of 6TiSCH networks. This document will highlight the different architectural blocks and signalling flows, including the operation of the network in the presence of multiple LBRs. Initially, the document will focus on distributed routing operation over a static TSCH schedule.

2. Produce an Information Model containing the management requirements of a 6TiSCH node. This includes describing how an entity can manage the TSCH schedule on a 6TiSCH node, and query timeslot information from that node. A data model mapping for an existing protocol (such as Concise Binary Object Representation (CBOR) over the Constrained Application Protocol (CoAP)) will be provided.

3. Produce "Minimal 6TiSCH Configuration" defining how to build a 6TiSCH network using the Routing Protocol for LLNs (RPL) and a static TSCH schedule. It is expected that RPL and the Objective Function 0 (OF0) will be reused as-is.

The work will include a best practice configuration for RPL and OF0 operation over the static schedule. Based on that experience the group may produce a requirements draft for OF0 extensions, to be studied in ROLL.

New charter

- Proposed on the ML, sent to Brian
- Still questions on limiting “OTF” to IP
- 3 new W-I:
  - Dynamic scheduling (6top, SF0)
  - secure bootstrap
  - Track definition and detnet requirements
- Non-milestone Interop sustaining guides
- https://bitbucket.org/6tisch/meetings/wiki/charter2

Proposed recharter

1. Produce "6TiSCH architecture" to describe the design of 6TiSCH networks. This document will highlight the different architectural blocks and signaling flows, including the operation of the network in the presence of multiple LBRs. The existing document will be augmented to cover dynamic scheduling and application of the DetNet work.
2. Describe the mechanisms offered by the 6top sublayer. This includes a protocol for neighbor nodes to negotiate adding/removing cells. The work on the protocol and associate packet formats could be continued at the IEEE.
3. Produce a specification for a default 6top Scheduling Function including the policy to enable distributed dynamic scheduling of time slots for IP traffic. This may include the capability for IoT routers to appropriate chunks of the matrix without starving, or interfering with other 6TiSCH nodes. This particular work will focus on IP traffic since the work on tracks is not yet advanced enough to specify their requirements for dynamic scheduling operations.
4. Produce a specification for a secure 6TiSCH network bootstrap, adapted to the constraints of 6TiSCH nodes and leveraging existing art when possible.
5. Produce requirements to the detnet WG, detailing 6TiSCH chunks and tracks, and the data models to manipulate them from an external controller such as a PCE.

… for IP traffic

3. Produce a specification for a default 6top Scheduling Function including the policy to enable distributed dynamic scheduling of time slots for IP traffic. This may include the capability for IoT routers to appropriate chunks of the matrix without starving, or interfering with other 6TiSCH nodes. This particular work will focus on IP traffic since the work on tracks is not yet advanced enough to specify their requirements for OTF operations.

- Tracks are not specified yet,

⇒ we do not want to delay dynamic scheduling till they are

- It may be that on-demand track created to transport IP behave like L3 track

⇒ In that case they could be covered by this text,

⇒ But we will not delay this work if we are not sure

- G-MPLS track are described in archie but their behavior is yet unknown

⇒ Not covered

Current non milestone Work Items

The Working Group will develop 6TiSCH Test Description documents which will be updated as the technology evolves, and will be used for running interoperability events, under ETSI support (i.e., ETSI 6TiSCH Plugtests). Such documents will be helpful for implementers, providing details and clarifications needed for running code, and implementing the 6TiSCH technology. Each document may address specific 6TiSCH features, in scope of the specific Plugtests edition.

Action Plan

Agile, Agile

Polling WG about Review Discussions

draft-ietf-6tisch-minimal-12

Summary review and action items at http://www.ietf.org/mail-archive/web/6tisch/current/msg04117.html

To progress the work, I have put a discussion after each point, and included a recommended change.
- @Editor action items are for the editor
- **@WG indicates we need to poll the WG**
- @AD remarks are for our AD
- @Chairs are action points for 6TiSCH co-chairs

draft-ietf-6tisch-minimal-12

Status of the draft (now “Proposed Standard”)

Suresh:
This looks more like a recommended set of network configuration parameters than a new protocol definition. Has the wg considered whether the Proposed Standard status is appropriate (as opposed to Info or BCP)?

Brian:
Suresh raised this same point, but I want to echo it. Is Standards Track the approach the WG wants to proceed with this document? Do you expect this to advance to Internet Standard at some point? Would Best Current Practice be a better fit if it is expected that the advice will change?

Thomas:
TW> Ideally, we'd like to keep the "proposed standard" track as:
TW> - 6TiSCH builds upon it as a foundation
TW> - this spec is to be followed for interoperation
TW> We need to poll the WG on this.
TW> @WG, we will discuss this at the IETF94 6TiSCH WG meeting.
TW> @AD, we welcome your input/recommendation on this decision.

6TiSCH Operation Sublayer (6top)

draft-wang-6tisch-6top-sublayer-04

Qin Wang (Ed.)
Xavier Vilajosana

Status

Latest version published on 2015-11-03
http://www.ietf.org/id/draft-wang-6tisch-6top-sublayer-04.txt

Content

Introduction

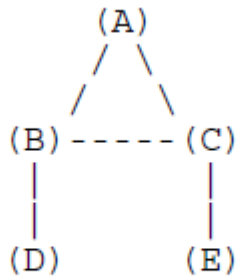


Figure 1: A simple 6TiSCH network.

Distributed cell scheduling from C to A:
-Add cells
-Delete cells
-Relocate cells

6top stack

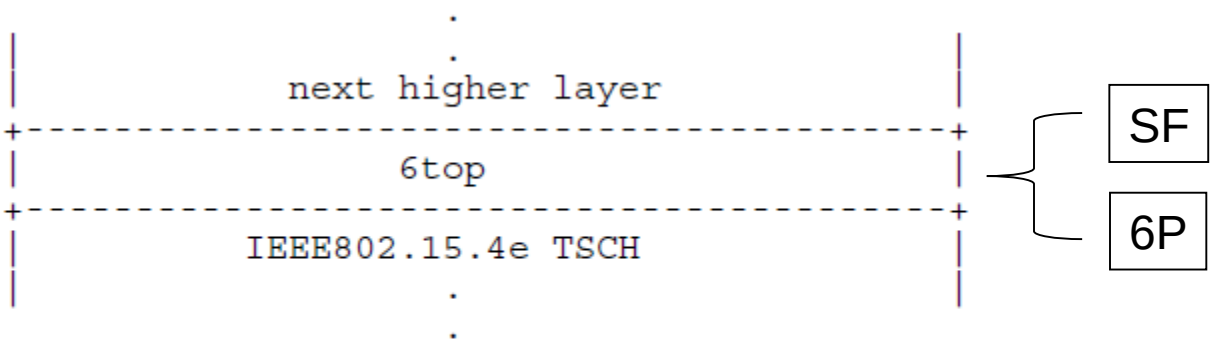


Figure 2: The 6top sublayer in the protocol stack.

Using 6top with the Minimal 6TiSCH Configuration

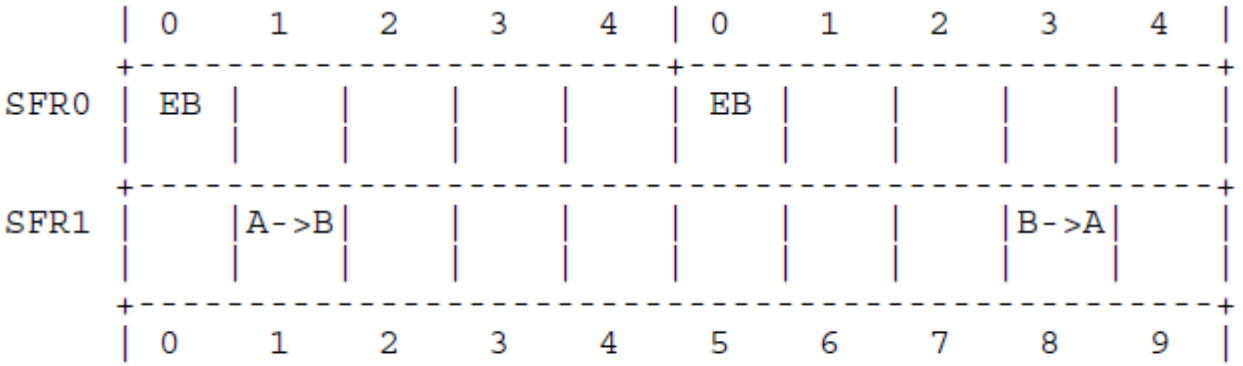
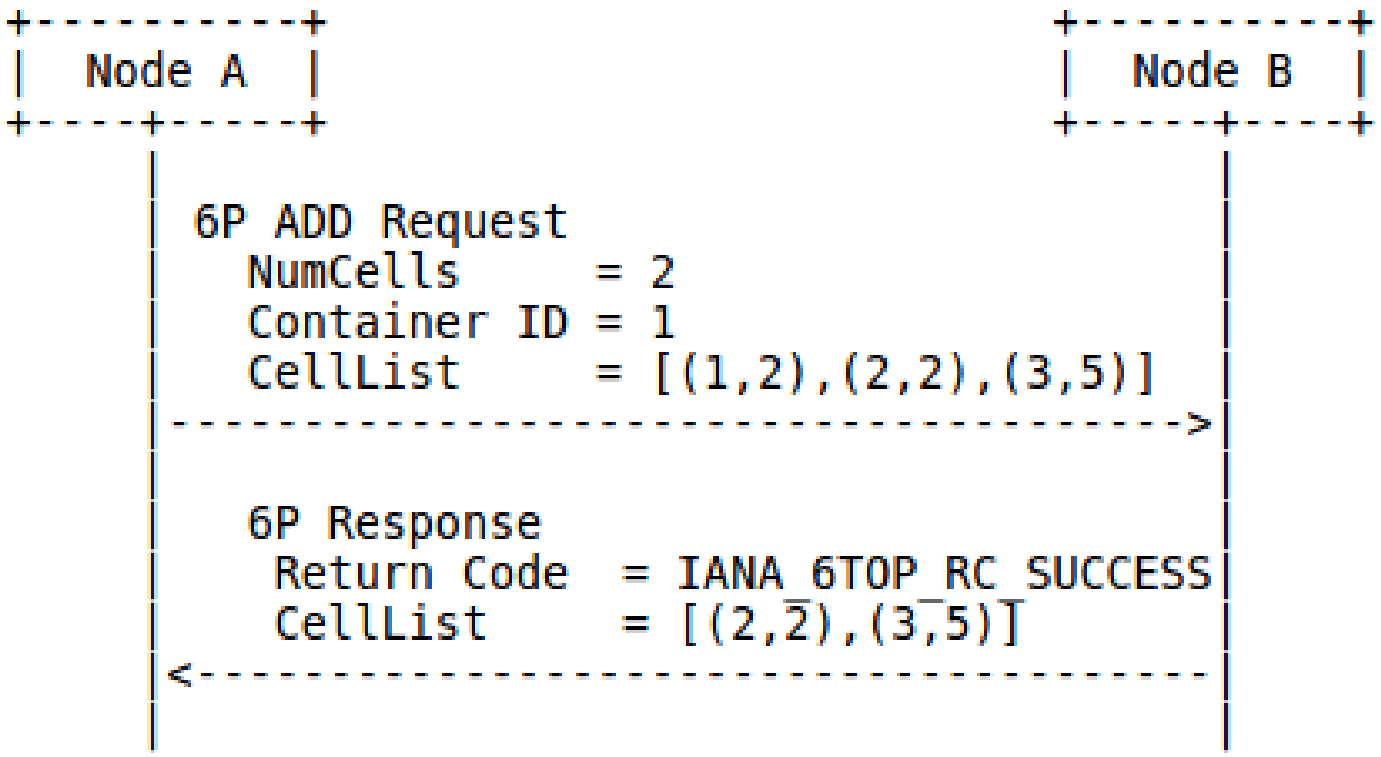


Figure 3: 2-slotframe structure when using 6top alongside the Minimal 6TiSCH Configuration.

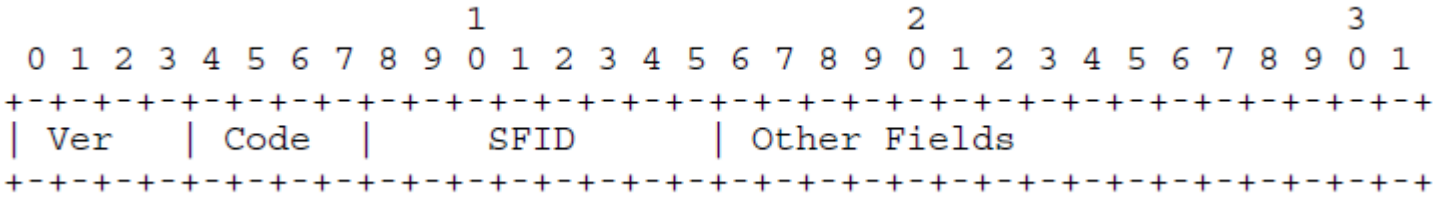
6top Protocol (6P)



General Message Format

The 6P messages are carried in a payload IE, i.e. IETF Information Element:

-Group ID: IANA_IETF_IE_GROUP_ID
-Length: variable
-Content: defined as follows



General Message format (cont)

Value	Command ID	Description
IANA_6TOP_CMD_ADD	CMD_ADD	add one or more cells
IANA_6TOP_CMD_DELETE	CMD_DELETE	delete one or more cells
IANA_6TOP_CMD_COUNT	CMD_COUNT	count scheduled cells
IANA_6TOP_CMD_LIST	CMD_LIST	list the scheduled cells
IANA_6TOP_CMD_CLEAR	CMD_CLEAR	clear all cells
TODO-0xf	reserved	

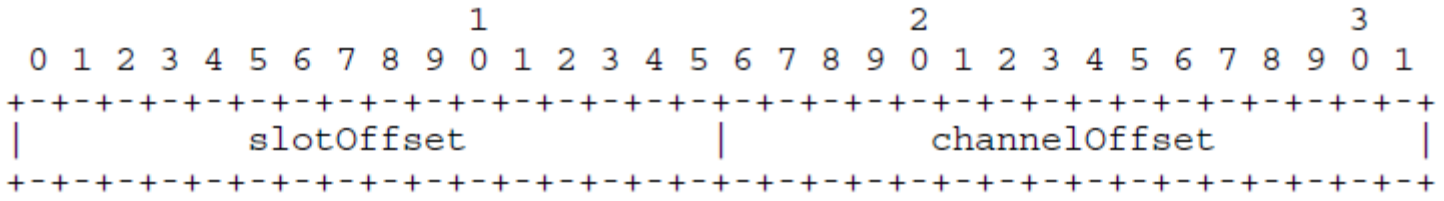
Code in Request Message: CMD Identifier

Figur

Value	Return Code	Description
IANA_6TOP_RC_SUCCESS	RC_SUCCESS	operation succeeded
IANA_6TOP_RC_VER_ERR	RC_VER_ERR	unsupported 6P version
IANA_6TOP_RC_SFID_ERR	RC_SFID_ERR	unsupported SFID
IANA_6TOP_RC_BUSY	RC_BUSY	handling previous request
IANA_6TOP_RC_RESET	RC_RESET	abort 6P transaction
IANA_6TOP_RC_ERR	RC_ERR	operation failed
TODO-0xf	reserved	

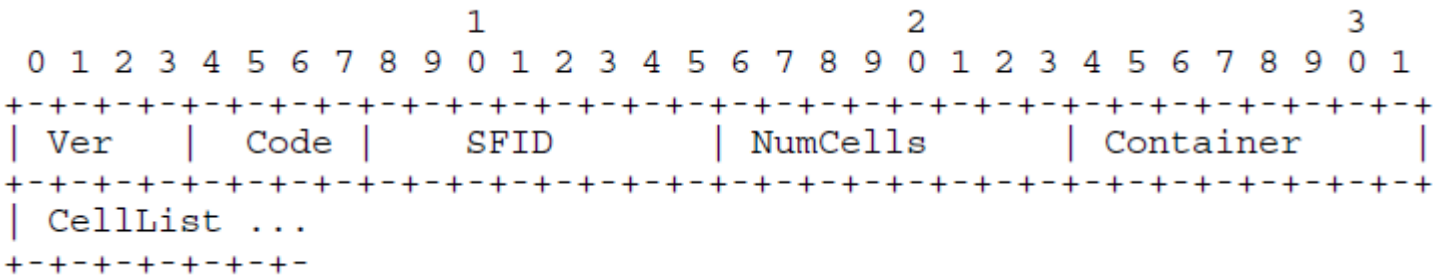
Code in Response Message: Return codes.

6P cell format

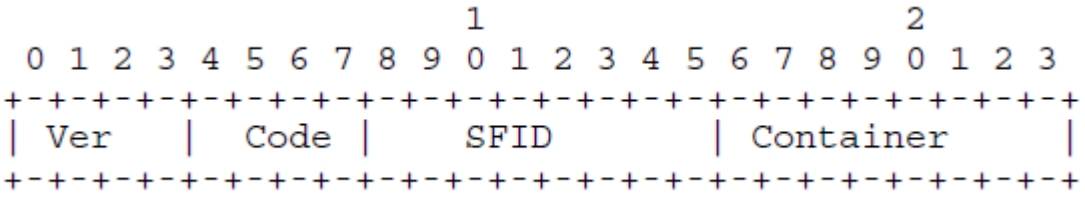


6P Request Message Format

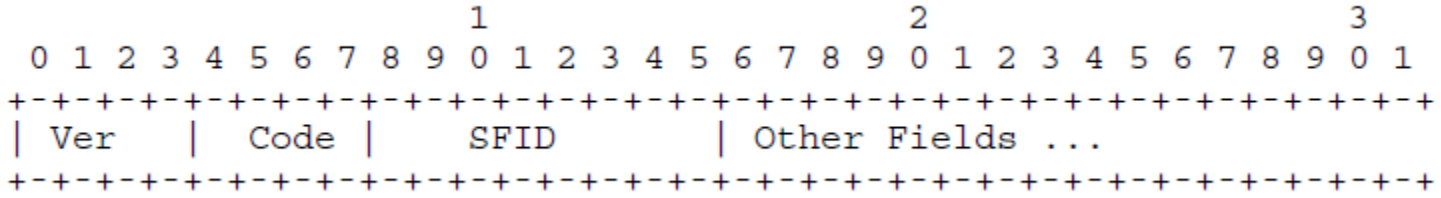
ADD /DELETE



COUNT /LIST /CLEAR



6P Response Message Format



Response to an ADD, DELETE or LIST command: A list of 0, 1 or multiple 6P Cells. The format of a 6P Cell is defined in Section 3.1.5.

Response to COUNT command: The number of cells scheduled from the requestor to the receiver by the 6P protocol, encoded as a 2-octet unsigned integer.

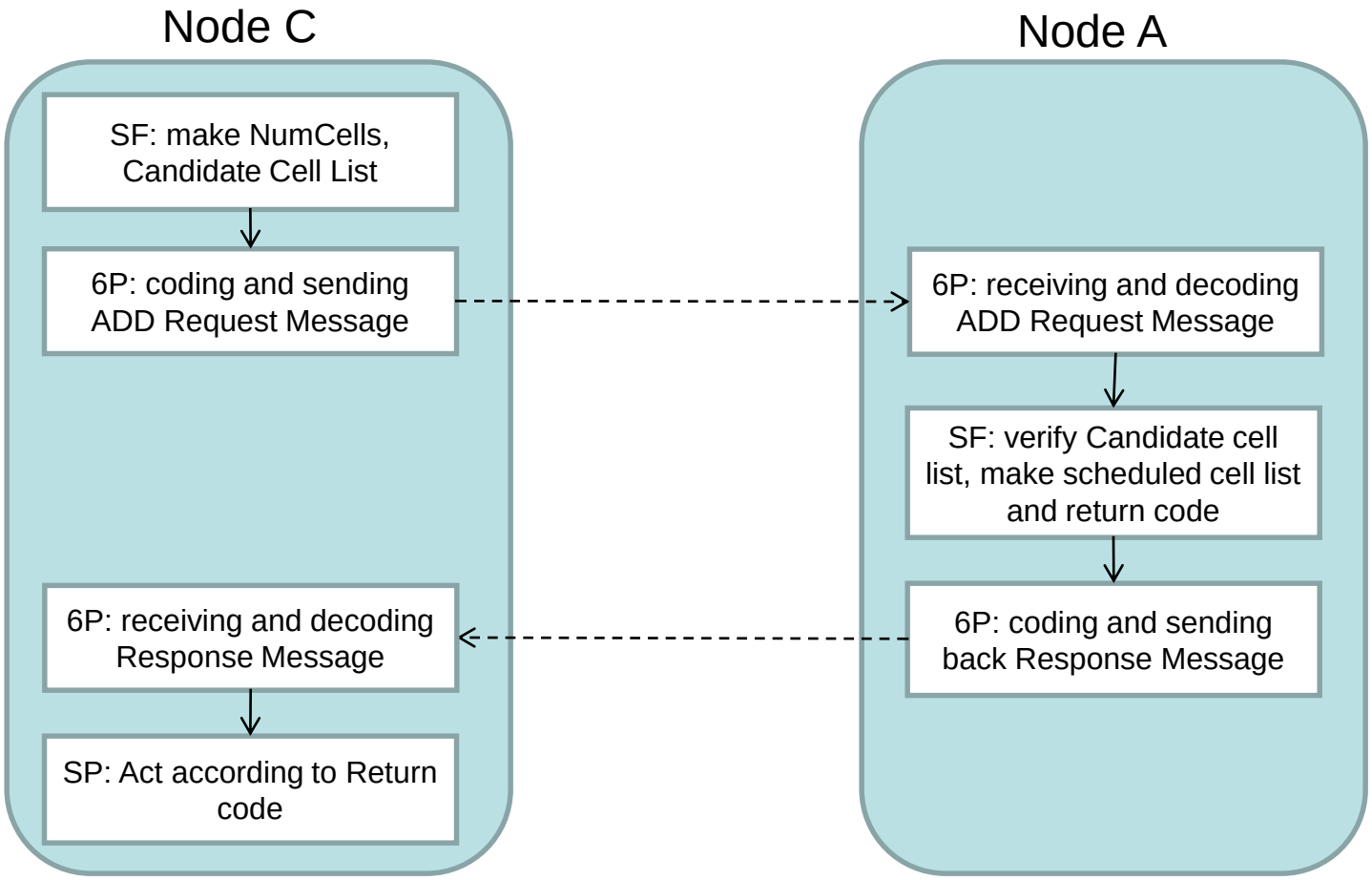
Response to CLEAR command: No other fields are present in the response.

6P behavior

- Version checking
- SFID checking
- Concurrent 6P Transaction
- Timeout
- Adding cells
- Aborting a 6P Transaction
- Deleting cells
- Handling error response

6P behavior (Example)

Assume: Node C decides to add cells to node A



Guideline for SF

SF Identifier

Range	Meaning
0x00	reserved
0x01-0xef	managed
0xf0-0xfe	unmanaged
0xff	reserved

Figure 7: SFID range.

Recommended structure of SF

- Introduction
- Scheduling Function Identifier
- Rules for Adding/Deleting Cells
- Rules for CellList
- 6P Timeout Value
- Meaning of Container Field
- Node Behavior at Boot
- 6P Error Handling
- Examples
- Implementation Status
- Security Considerations
- IANA Considerations

Next Step

- IEEE Liaison Considerations

  If the specification described in this document is supported by the 6TiSCH WG, the authors of this document ask the 6TiSCH WG chairs to liaise with the IEEE to request a Payload Information Element Group ID to be assigned to the IETF (Group ID IANA_IETF_IE_GROUP_ID described in Appendix A).

Issues Raised

Important points raised:

1) Need for non-local statistics, for instance flow statistics. Deal with unstable local stats.
2) Where the 6top commands are sent? Relation to minimal.
3) Retry policy. Let it to the SF or provide recommendation?
4) need of the IE defined at the IETF vs IEEE defined IE. Coordinate with IEEE802.15LLC ?
5) 2 Bytes for frequency offset and slot offset → we do not want to restrict future PHY technologies with thousands of narrow band channels for example.
6) Container. Important concept which in 6top Protocol is something generic able to identify any abstraction .. e.g chunk, track, etc…
7) role of the SF at boot. Should it describe some initial behaviour?
8) Role of SF w.r.t monitoring and actuation. Should be clarified in the draft.

Thanks!

- Q&A

draft-dujovne-6tisch-6top-sf0-00

D. Dujovne, Ed.
L.A. Grieco
M.R. Palattella
N. Accettura

Status

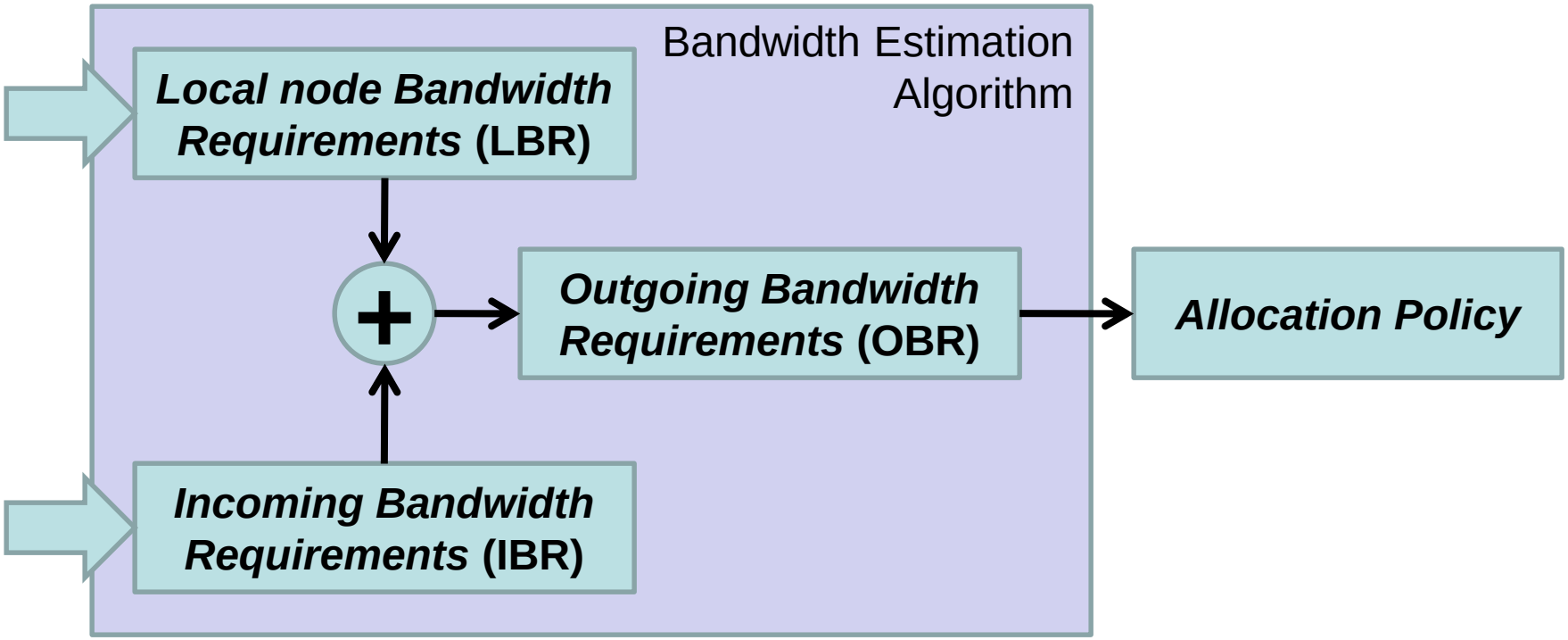
- **Goal:**
  - Define the Scheduling Function for the 6top sublayer, called Scheduling Function Zero, SF0.
- **Background/History:**
  - On the Fly Scheduling (draft-dujovne-6tisch-on-the-fly-06)
- **Next:**
  - TODO

Rules for Adding/Deleting Cells

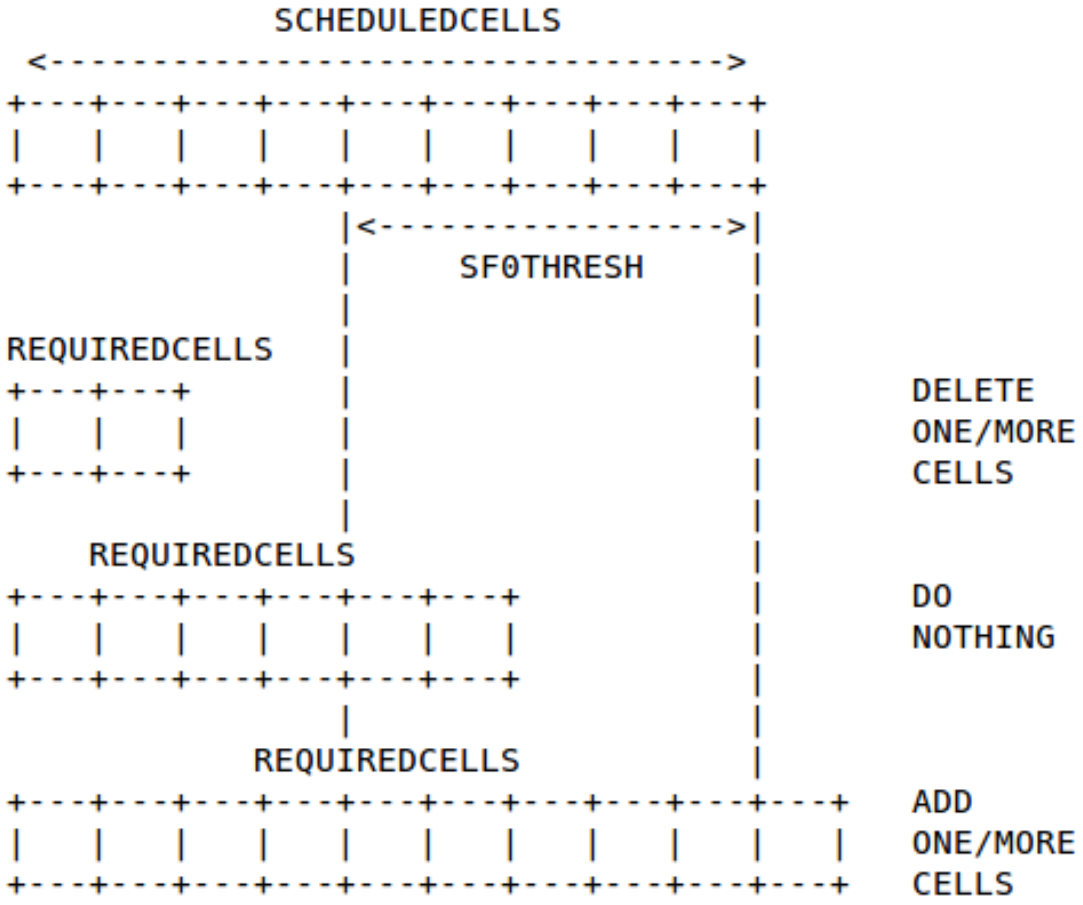
- *3 steps* procedure
  - **Monitor** traffic per node (locally generated, and/or incoming from neighbors)
  - **Estimate** the required bandwidth for that node, based on traffic/network condition
  - **Determine** the # of cells to add/delete based on the allocation policy

SF0 Bandwidth Estimation Algorithm

- Requirements-based algorithm:



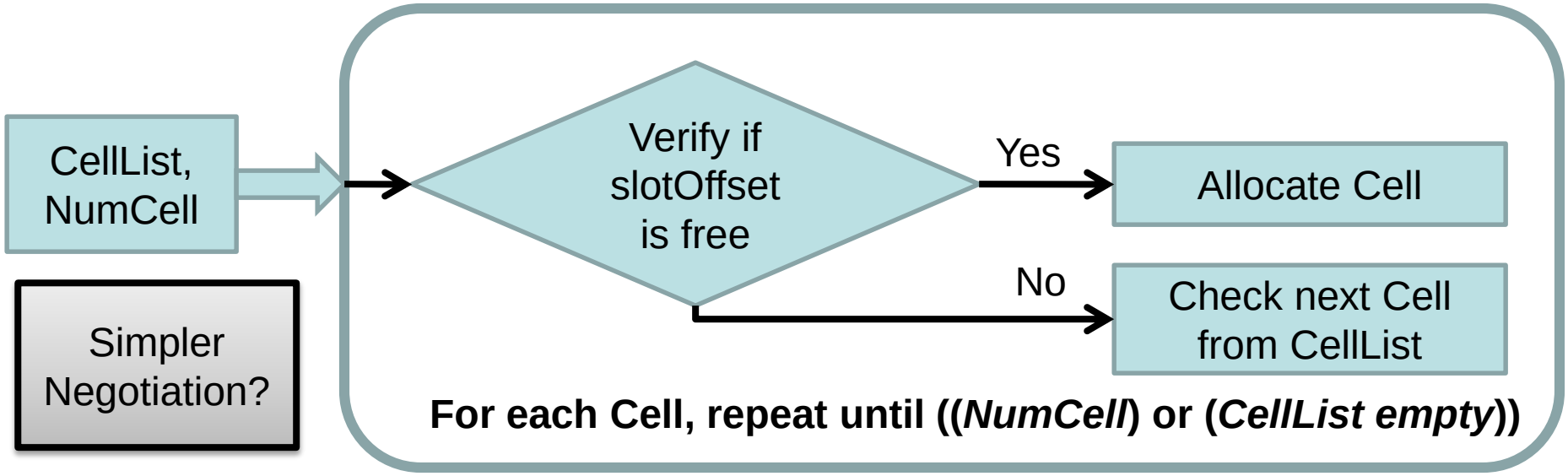
SF0 Allocation Policy



CellList Rules

- *Transaction Source Node*

- *Transaction Destination Node*



Boot and Relocation

- *Node behavior at boot:* At startup, issues a **CLEAR** command; the *Source Node* asks the *Destination Node* to **delete all** the **previously allocated cells** to that neighbour.
- *Cell Relocation:*
  - Uses PDR statistics, changes slotOffset and/or channelOffset.

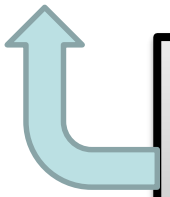
How to compute **PDR**?
PDR calculation **out of scope**?

  - Relocates when ***one or more cells*** have PDR ***lower than average***.

Random selection for the reallocated cells?

6P Return code handling

- RC_SUCCESS:
  - **(number of cells in CellList)=NumCells** in 6P **ALL** request -> Operation **OK**.
  - **(number of cells in CellList)<NumCells in** 6P **ALL** request -> Not all cells allocated.
    - Node MAY retry immediately with a **different CellList** or build **new random CellList**.



This depends on the nodes' available resources to remember the list of previously rejected cells.
Any other possibilities?

6P Return code handling

- RC_ERR_VER, RC_SFID_ERR:
  - Node MUST NOT retry immediately
  - MAY add neighbour node on a blacklist
  - MAY retry to contact neighbour later
- RC_ERR_RESET:
  - Wait for Timeout and **restart scheduling process**
- RC_ERR_BUSY:
  - Issue a Reset command.

IANA

- *Ask IANA for SF Function Identifier:*
  - IANA_SFID_SF0

TODO

- Meaning of the **container** field
- Add that we pick cells from the set of cells identified by the **container**
- Examples of **error handling**
- **Security** considerations
- **Chunks** – include them as a possible container
- Adjust error IDs to new specification from *draft-wang-6tisch-6top-sublayer-03*
- **Typos**

draft-thubert-6tisch-4detnet

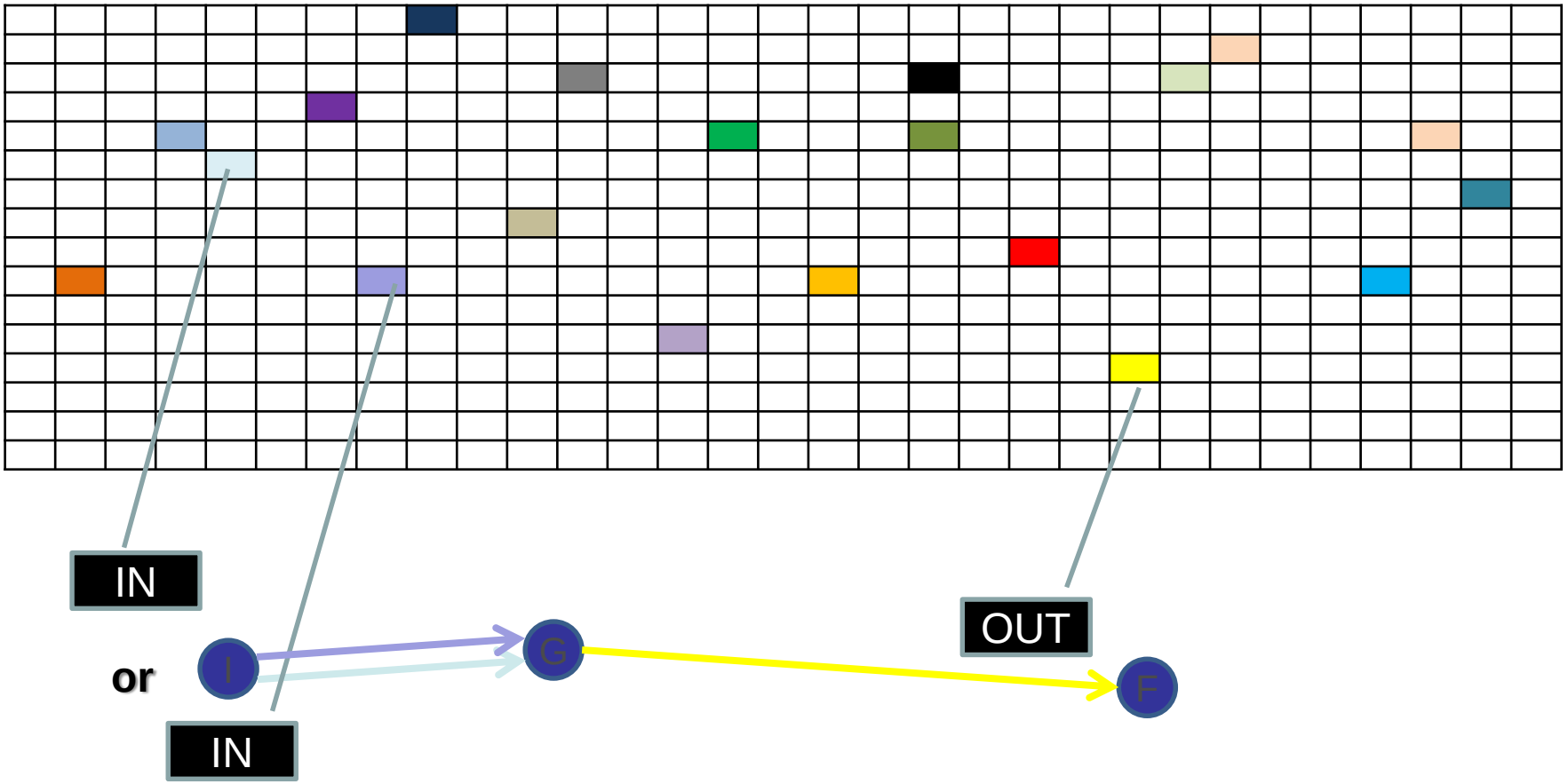
Pascal Thubert

Status

- Describe 6TiSCH tracks
- For use as reqs. by DetNet and PCE
- Reach consensus on operation at 6TiSCH
  - Replication, Retries and Elimination
  - Tagging for flow identification
  - Differentiated Services Per-Hop-Behavior
  - Forwarding
- Now inline in draft-grossman-detnet-use-cases

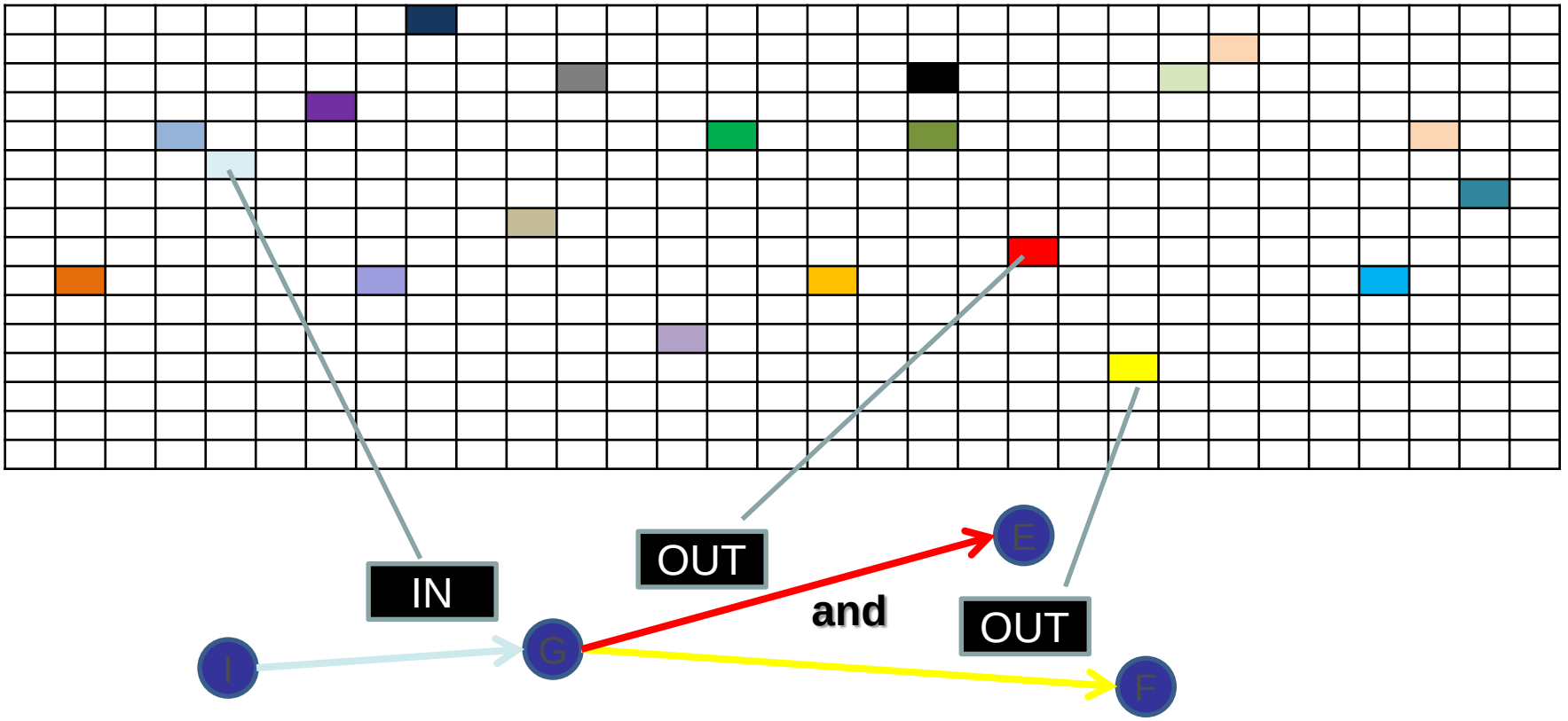
Track operation

- ARQ (retry)



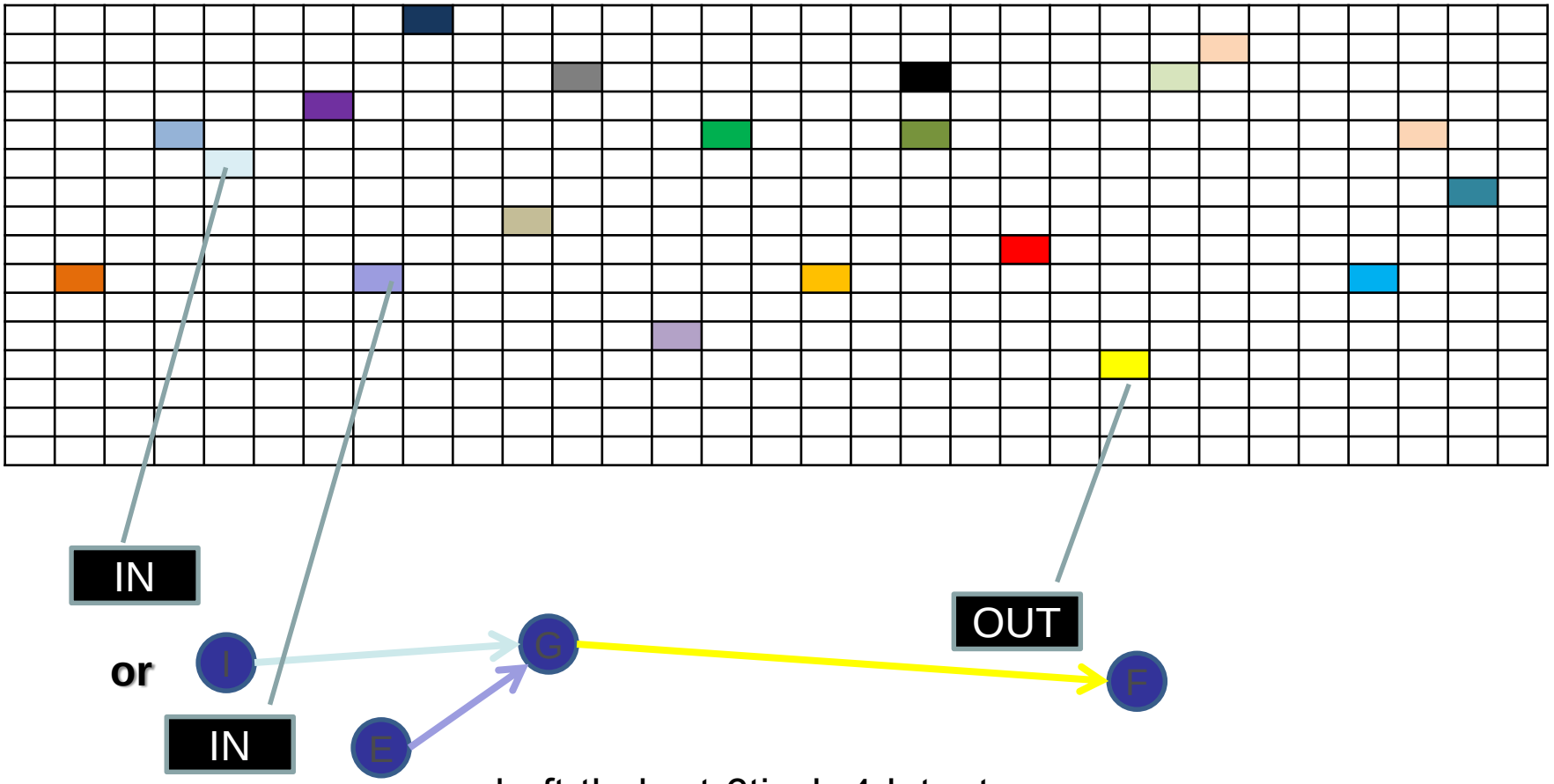
Track operation

- Replication



Track operation

- Elimination



Asks

- Review on ML
- Discussion on soft tracks for IP traffic
- Should we derive a Track specification?

ETSI 2ND 6TISCH PLUGTESTS

IETF#94 - UPDATE

Miguel Angel Reina Ortega

Centre for Testing and Interoperability

2015, November

Agenda

- Memories of 1st 6TiSCH Plugtests
- 2nd 6TiSCH Plugtests – Basics
- Technical organization
- Logistic information
- Next steps

Memories of 1st 6TiSCH Plugtests

- Scope – To test interoperability of 6TiSCH implementations based on **draft-ietf-6tisch-minimal** specification
- When – **17-19 July 2015**
- Where - At **IETF#93** (Prague)

2nd 6TiSCH Plugtests - Basics

- Scope – To test interoperability of 6TiSCH implementations based on **xxx** specification
- When – **02- 04 February 2016**
- Where – Paris (France) hosted by INRIA

Technical organization (1/2)

- Group of experts has been formed:
  - Maria Rita Palattella (University of Luxembourg)
  - Xavier Vilajosana (OpenMote)
  - Tengfei Chang (Inria)
  - Thomas Watteyne (Inria)
- Tasks of experts group:
  - 1) 6TiSCH test spec development – ETSI GS IP6-017
  - 2) Plugtests technical support
  - 3) 6TiSCH Technical report. A summary of results and findings to feedback 6TiSCH WG

Technical organization (2/2)

- Work planning:
  - Milestone 1 (18th December). First draft of test specs available for feedback
  - Milestone 2. (22nd January). Stable draft of test spec for feedback. Golden device ready for pre-testing.
  - Milestone 3 (1st February). Final draft of test spec.
  - Milestone 4 (02-04 February). ETSI 2nd 6TiSCH Plugtests
  - Milestone 4. (26th August). 6TiSCH Technical report ready

Logistic organization

- Website has been launched
  - at http://www.etsi.org/news-events/events/1022-6TiSCH-2-plugtests
  - General information about the event
  - Registration information
  - Logistic information
- Registration to the event:
  - Is open, free of charge
  - will close 15th January 2016

Next steps

- 3rd 6TiSCH ETSI Plugtests:
  - When:
    - At IETF#96 (Germany)
  - What:
    - Security ?
    - Backbone?
    - Dynamic scheduling?
    - To be discussed ...

Contact

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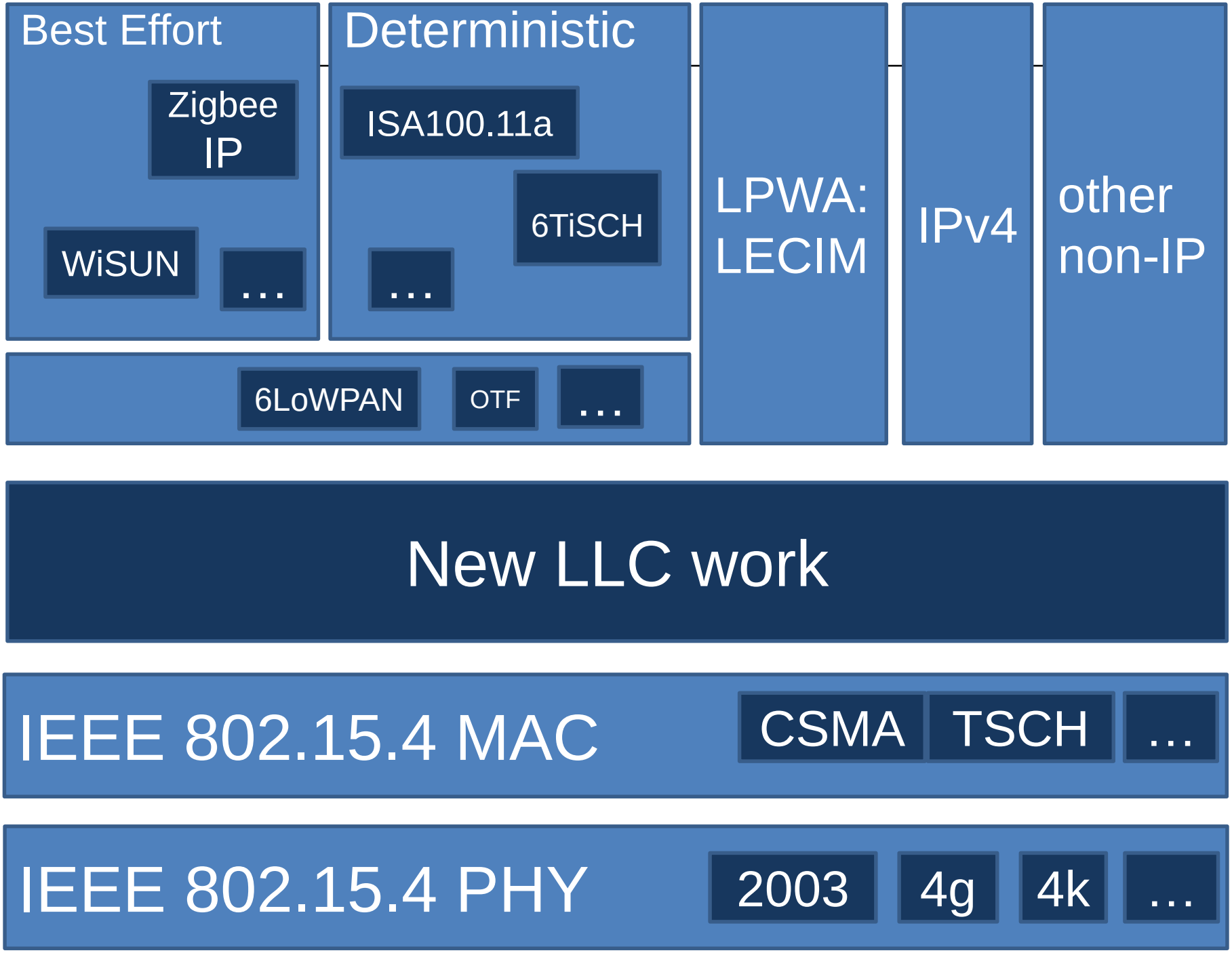
Thank you!

AOB ?

IEEE 802.15.llc (Proposed work on Logical Link Control)

- Study Group meets next week; target acceptance of PAR / CSD in March
  - Want input from IETF for the SG meeting
- For 802.15.4 to make it as easy to use as 802.11 (WiFi) and 802.3 (Ethernet)
  - Enable use of the higher layer protocols used by IEEE 802.11 and IEEE 802.3 without changes
  - New applications & backward compatibility
- Provide LLC for KMP, L2R


Best Effort
Zigbee IP
WiSUN
…
Deterministic
ISA100.11a
6TiSCH
…
LPWA: LECIM
IPv4
other non-IP
6LoWPAN
OTF
…
New LLC work
IEEE 802.15.4 MAC
CSMA
TSCH
…
IEEE 802.15.4 PHY
2003
4g
4k
…

Prioritized Functionality (first release)

1. Protocol differentiation (dispatch)
2. Align 802.15.9 and 802.15.10 with LLC
3. Architecture to provide extendibility
4. Regulatory configuration, e.g. PHY Configuration as per country of operation, Device class, Duty cycle constraints, CCA settings (time, threshold, mode)
5. L2 protocol extensions from other organizations, e.g. IETF 6TiSCH 6top, Thread™

Links for LLC information; Proposed Timeline

- https://mentor.ieee.org/802.15/dcn/15/15-15-0838-00-0llc-ietf-intarea-presentation-introducing-802-15-llc.pptx
- https://mentor.ieee.org/802.15/dcn/15/ - pick SG LLC for all LLC documents
- Next Week: Study Group (SG) discuss input from IETF, review PAR and CSD
- January Interim: SG Submit PAR & CSD
- March Plenary: EC approval
  - If not in March, then not until July
- Projected Date for Sponsor Ballot:12/2017
- Projected Completion: 08/2018

Thank you!