IETF95 – Buenos Aires

Chairs:
Pascal Thubert
Thomas Watteyne
Mailing list:
6tisch@ietf.org
Jabber:
6tisch@jabber.ietf.org

IPv6 over the TSCH mode of IEEE 802.15.4e

Etherpad for minutes:
http://etherpad.tools.ietf.org:9000/p/notes-ietf-95-6tisch

Note Well

Any submission to the IETF intended by the Contributor for publication as all or part of an IETF Internet-Draft or RFC and any statement made within the context of an IETF activity is considered an "IETF Contribution". Such statements include oral statements in IETF sessions, as well as written and electronic communications made at any time or place, which are addressed to:

- The IETF plenary session
- The IESG, or any member thereof on behalf of the IESG
- Any IETF mailing list, including the IETF list itself, any working group or design team list, or any other list functioning under IETF auspices
- Any IETF working group or portion thereof
- Any Birds of a Feather (BOF) session
- The IAB or any member thereof on behalf of the IAB
- The RFC Editor or the Internet-Drafts function

All IETF Contributions are subject to the rules of RFC 5378 and RFC 3979 (updated by RFC 4879).

Statements made outside of an IETF session, mailing list or other function, that are clearly not intended to be input to an IETF activity, group or function, are not IETF Contributions in the context of this notice. Please consult RFC 5378 and RFC 3979 for details.

A participant in any IETF activity is deemed to accept all IETF rules of process, as documented in Best Current Practices RFCs and IESG Statements.

A participant in any IETF activity acknowledges that written, audio and video records of meetings may be made and may be available to the public.

Reminder:

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-95-6tisch
** Recordings and Minutes are public and may be subject to discovery in the event of litigation.
*** Please make sure you sign the blue sheets

Administrivia

- Blue Sheets
- Scribes
- Jabber

Agenda

- Intro and Status (Chairs) [5min]
  - Note-Well, Blue Sheets, Scribes, Agenda Bashing
- New Charter and status docs [20min]
  - Status Document
  - Status 6lo / ROLL
  - New Charter
  - Milestones
  - Action Plan
- PlugTest News ((Miguel Angel Reina Ortega) [10min]
  - Report ETSI 6TiSCH #2 Plugtests (Paris)
  - Announcement ETSI 6TiSCH #3 Plugtests (Berlin)
- Dynamic Scheduling
  - <draft-wang-6tisch-6top-protocol-00> (Xavier Vilajosana) [15min]
  - <draft-dujovne-6tisch-6top-sf0-01> (Diego Dujovne) [15min]
- Security
  - status of the work and action plan (Michael Richardson) [10min]
- Unchartered items, time permitting
  - <draft-satish-6tisch-aodv-rpl-00> (Satish Anamalamudi) [QSP]
- Any Other Business

IEEE 802.15.4 Information Element allocation

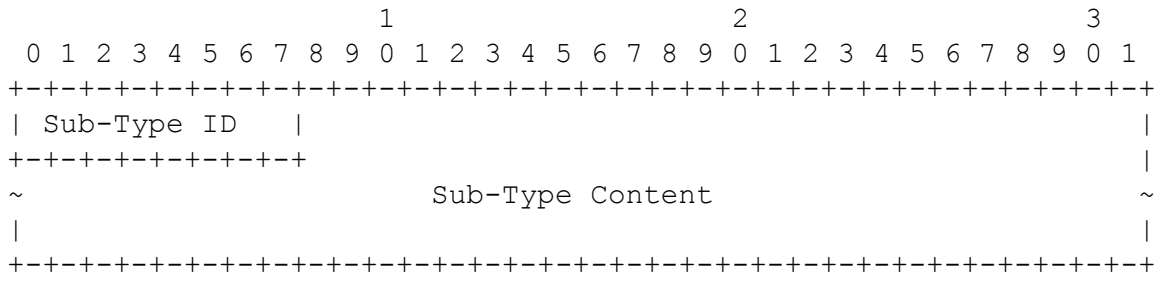
draft-kivinen-802-15-ie-00

Tero Kivinen <kivinen@iki.fi>
Pat Kinney <pat.kinney@kinneyconsultingllc.com>

What

IEEE 802.15.4 has Information Elements, but there is only 16 of them, and they will allow other standardization organizations to get one, but only one.

- Meaning the whole IETF will get one, and we need to define how that is subtyped so we can show to IEEE 802.15.4 that we do not need another ever. This draft also creates IANA registry for subtypes.
- This draft will provide subtype formatting and make official request from IETF to the IEEE 802.15.4 WG to ask them to allocate one for IETF.
- Users in the IETF: 6tisch, 6lo, core etc.
- Allows putting information in to the 802.15.4 frames without too much extra overhead.
- This draft will most likely need to be AD sponsored, as this is not directly related to only one WG.



New Charter and status docs

Status Documents

- draft 6tisch minimal
  - Completed INT AREA comments handling
  - Expecting feedback from INT DIR reviewers

News from ROLL and 6lo

Separated draft-ietf-6lo-paging-dispatch

From draft-ietf-roll-routing-dispatch

Paging Dispatch remains at 6lo,

Routing Dispatch moved to ROLL,

Both now in last call

News from 6MAN

Use of HbH being challenged (obsolete?)

Use of control bits even more challenged

Current RPL option code point is 63

Done under 6MAN

-> to drop packets escaping the RPL domain

MCR: proposed moving to 43 to allow ignore by non RPL aware end hosts

Rechartered!

From: **The IESG** <iesg-secretary@ietf.org>
Date: 2016-03-04 13:38 GMT-03:00
Subject: [6tisch] WG Action: Rechartered IPv6 over the TSCH mode of IEEE 802.15.4e (6tisch)
To: IETF-Announce <ietf-announce@ietf.org>
Cc: 6tisch@ietf.org, 6tisch-chairs@ietf.org, The IESG <iesg@ietf.org>

The IPv6 over the TSCH mode of IEEE 802.15.4e (6tisch) WG in the Internet Area of the IETF has been rechartered. For additional information, please contact the Area Directors or the WG Chairs.

Work Items

- Produce a specification of the 6top sublayer that describes the protocol for neighbor nodes to negotiate adding/removing cells. This work will leverage cross participation from IEEE members including the IEEE 6TiSCH Interest Group (IG 6T) to define protocol elements and associated frame formats.

Work Items

- Produce a specification for a default 6top Scheduling Function
  including the policy to enable distributed dynamic scheduling of
  timeslots for IP traffic. This may include the capability for nodes to
  appropriate chunks of the matrix without starving, or interfering with
  other 6TiSCH nodes <snip>.

Work Items

- Produce a specification for a secure 6TiSCH network bootstrap, adapted to the constraints of 6TiSCH nodes and leveraging existing art when possible.
- Keep updating the "6TiSCH architecture" that describes the design of 6TiSCH networks <snap>

Work Items

- 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.
- Producing YANG Data Models to manage 6tisch is foreseen, but left to a later phase.

Milestones

Apr 2016 - Second submission of draft-ietf-6tisch-minimal to the IESG

Apr 2016 - WG call to adopt draft-ietf-6tisch-6top-sf0

Apr 2016 - WG call to adopt draft-ietf-6tisch-6top-sublayer

Jul 2016 - ETSI 6TiSCH #3 plugtests

Jul 2016 - Initial submission of draft-ietf-6tisch-6top-sublayer to the IESG

Oct 2016 - Initial submission of draft-ietf-6tisch-6top-sf0 to the IESG

Dec 2016 - Evaluate WG progress, propose new charter to the IESG

Apr 2017 - Initial submission of 6TiSCH terminology to the IESG

Apr 2017 - Initial submission of 6TiSCH architecture to the IESG

Dec 2017 - 6TiSCH architecture and terminology in RFC publication queue

Action Plan

- Agile I-Draft->code->test then plugtest
- Kickstart security

World Class Standards

2ND 6TISCH PLUGTESTS REPORT

02 – 04 February 2016

Paris, France

Agenda

- Overview of the event
- Participating Companies / Observers
- Plugtests agenda
- Summary of Event Planning
- Results reporting : ETSI Test Session Report tool
- Test Cases list
- High-Level Test Results
- Global Results for Test Cases
- Conclusions
- Roadmap
- Social Event

Overview of the Event

- Event organized by:
  - ETSI (European Telecommunications Standards Institute)
- Supporting Companies:
  - OpenMote, OpenWSN
- 12 Participating Companies
  - 5 different implementations
- 5 Observer companies
- 10 total test pairings, each 2 hour duration
  - Single hop configuration consisting of 8 tests cases
  - Star configuration consisting of 2 test cases
  - Multi hop configuration consisting of 4 optional tests cases

Plugtests Agenda

	6TiSCH 2 Plugtests Agenda - FEBRUARY 2016		
Time	Tuesday 02	Wednesday 03	Thursday 04
08:30 09:00	Registration & Set up	Room Opening	Room Opening
09:00 12:00		TEST SESSIONS	TEST SESSIONS
12:00 13:00	NETWORKING LUNCH		
13:00 14:00	Weclome Presentation	NETWORKING LUNCH	NETWORKING LUNCH
14:00 18:00	TEST SESSIONS	TEST SESSIONS	Tear Down
18:00 18:30	WRAP UP SESSION	WRAP UP SESSION	

Summary of Event Planning

- Several preparation calls
  - ETSI/Experts group led and organized
  - Collaborating Web conf (GotoMeeting)
  - One preparation call including participants
- Test Plan Development
  - Led by Thomas Watteyne, Xavier Vilajosana, Maria Rita Palattella and Tengfei Chang
  - 14 test cases, including 8 Single Hop + 2 Star + 4 Multi Hop.

Results Reporting

- The results of each interoperability test session have been recorded in a dedicated web application software: the ETSI Test Report Tool (TRT)
  - After each test execution the interoperability result is agreed among all participants and then recorded
  - After each test session the report is submitted to ETSI

Single Hop Test List

TD_6TiSCH_SYN_01	Check that a 6N can synchronize to the EB sent by the DR and parse all the IEs with their default values.
TD_6TiSCH_SYN_02	Check that a 6N can synchronize to the EB sent by the DR and parse all the IEs. (Time slot IE does not contain the default template. To simply the test, only the slot duration is changed to 15ms and keep the other values as used in default template (10ms)).
TD_6TiSCH_RPL_01	Check the value of EB join priority of child 6N and a parent DR
TD_6TiSCH_RPL_02	Check the rank of 6Ns is computed correctly, according to OF0 function, as specified in draft-ietf-6tisch-minimal-14
TD_6TiSCH_6P_02	Check a 6N can COUNT the cells allocated in the schedule to a given neighbour, according to draft-wang-6tisch-6top-sublayer-04.
TD_6TiSCH_6P_03	Check a 6N can obtain the LIST of cells in the schedule, according to draft-wang-6tisch-6top-sublayer-04.
TD_6TiSCH_6P_04	Check a 6N can CLEAR the schedule of a node, according to draft-wang-6tisch-6top-sublayer-04.
TD_6TiSCH_6P_06	Check the timeout after a 6P request, is implemented according to draft-wang-6tisch-6top-sublayer-04.

Star Test List

TD_6TiSCH_6P_01	Check a 6N can ADD a cell in the schedule according to draft-wang-6tisch-6top-sublayer-04
TD_6TiSCH_6P_05	Check a 6N can DELETE a cell in the schedule according to draft-wang-6tisch-6top-sublayer-04

Multi Hop Test List

TD_6TiSCH_6LoRH_01	Check that the source routing header is correctly encoded as a 6LoRH Critical RH3, according to draft-ietf-6lo-routing-dispatch-02
TD_6TiSCH_6LoRH_02	Check that, when the packet's sent towards the DR, the RPL Information Option is correctly encoded as a 6LoRH RPI, according to draft-ietf-6lo-routing-dispatch-02
TD_6TiSCH_6LoRH_03	Check that, when the packet's travel inside the RPL domain, the IP in IP 6LoRH is not be presented in the packet.
TD_6TiSCH_6LoRH_04	Check that, when the packet travel outside a RPL domain, IP in IP 6LoRH is present in the packet.

High level test results

Interoperability			Not Executed		Totals	
OK	NO		NA/OT		Run	Results
48 (100.0%)	0 (0.0%)		32 (40.0%)		48 (60.0%)	80

On the 80 mandatory test cases planned, 48 have been executed and 32 not executed.

On the 48 Mandatory TC performed, 48 have been OK, which represents a success rate of 100.0%.

Note: This high level of interoperability can be attributed to the fact that participants received a Golden Device prior to the event to perform pretesting.

Global Results per tests

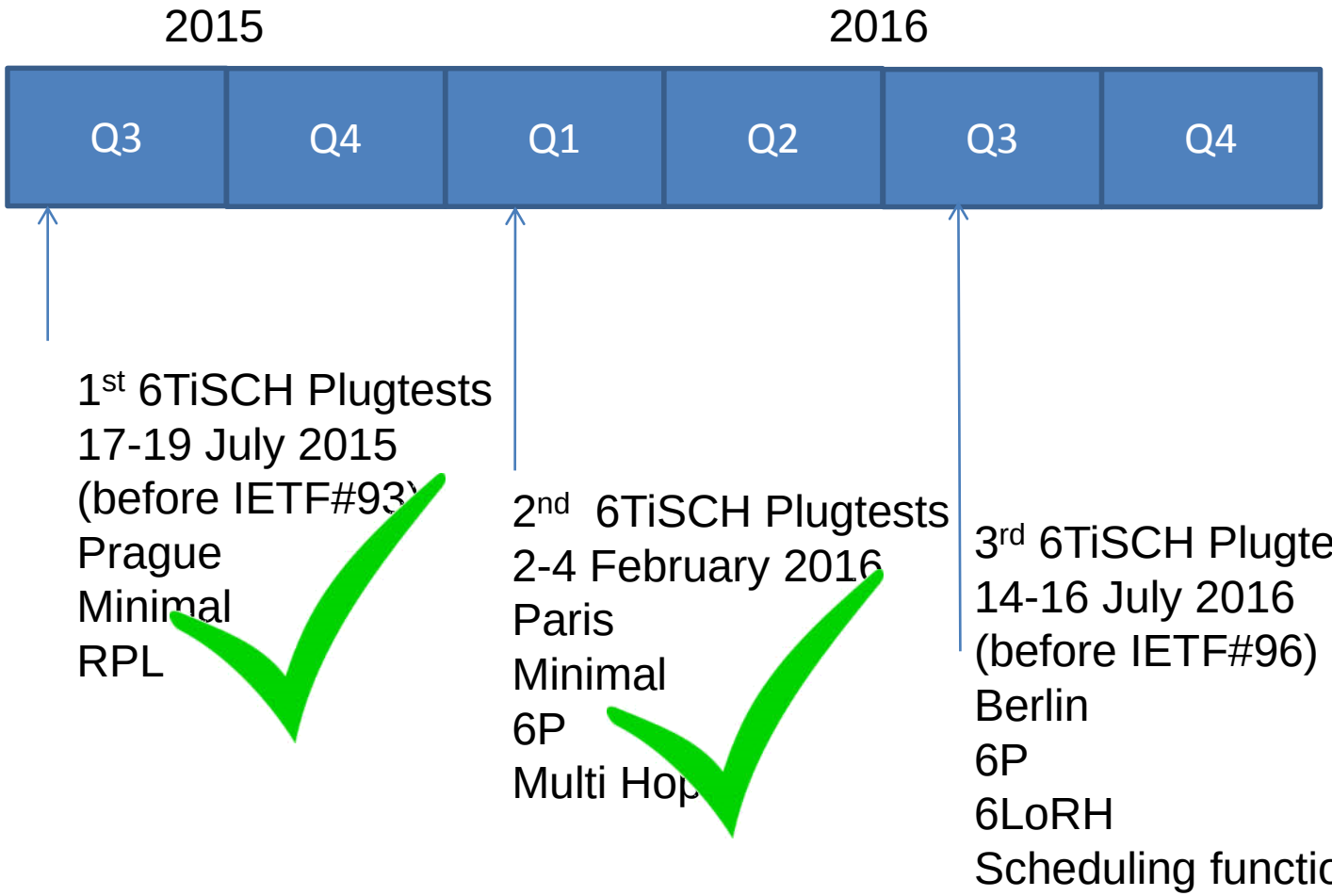
	Interoperability		Not Executed	Totals	
	OK	NO	NA/OT	Run	Results
TD_6TiSCH_SYN_01	10 (100.0%)	0 (0.0%)	0 (0.0%)	10 (100.0%)	10
TD_6TiSCH_SYN_02	2 (100.0%)	0 (0.0%)	8 (80.0%)	2 (20.0%)	10
TD_6TiSCH_RPL_01	10 (100.0%)	0 (0.0%)	0 (0.0%)	10 (100.0%)	10
TD_6TiSCH_RPL_02	10 (100.0%)	0 (0.0%)	0 (0.0%)	10 (100.0%)	10
TD_6TiSCH_6P_01	3 (100.0%)	0 (0.0%)	4 (57.1%)	3 (42.9%)	7
TD_6TiSCH_6P_05	2 (100.0%)	0 (0.0%)	4 (66.7%)	2 (33.3%)	6
TD_6TiSCH_6P_02	3 (100.0%)	0 (0.0%)	4 (57.1%)	3 (42.9%)	7
TD_6TiSCH_6P_03	3 (100.0%)	0 (0.0%)	4 (57.1%)	3 (42.9%)	7
TD_6TiSCH_6P_04	3 (100.0%)	0 (0.0%)	4 (57.1%)	3 (42.9%)	7
TD_6TiSCH_6P_06	2 (100.0%)	0 (0.0%)	4 (66.7%)	2 (33.3%)	6
TD_6TiSCH_6LoRH_01	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
TD_6TiSCH_6LoRH_02	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
TD_6TiSCH_6LoRH_04	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
TD_6TiSCH_6LoRH_03	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0

Conclusions

- The event has been successful and gave excellent interoperability results
- Regression testing on IEEE802.15.4e TSCH synchronization and RPL
- Basic 6P functionality tested and working
- The first 6LoRH implementation was presented and triggered interesting discussions about some aspects (feedback to 6lo WG)
- Running code is the only way of working out all details
- Dissector and golden image continue to be essential tools
- The participants were satisfied and gave excellent feedback in the satisfaction survey.
- The number of participants allowed that all the vendors met each other in test sessions during the event
- Participants made the testing go smoothly within a magnificent and friendly ambience

THANKS TO ALL PARTICIPANTS!!

Roadmap for next 6TiSCH Plugtests



ETSI

World Class Standards

THANK YOU!

Miguel Angel Reina Ortega
Centre for Testing and Interoperability (CTI)
MiguelAngel.ReinaOrtega@etsi.org

6top Protocol (6P)
draft-wang-6tisch-6top-protocol-00

Qin Wang (Ed.)
Xavier Vilajosana

Status

Latest version published on 2016-03-20

http://www.ietf.org/id/draft-wang-6tisch-6top-protocol-00.txt

This draft is renamed from draft-wang-6tisch-6top-sublayer-04, which was presented at the IETF94.

New in this version:

- Renamed container -> metadata (2B)
- Renamed token -> seqNum (2B)
- 2 and 3 way transaction
- Indication that the SF must specify the statistics to gather

Content

Introduction

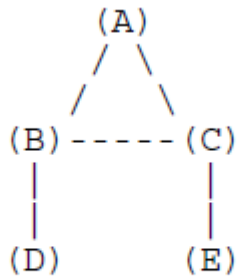


Figure 1: A simple 6TiSCH network.

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

6top stack

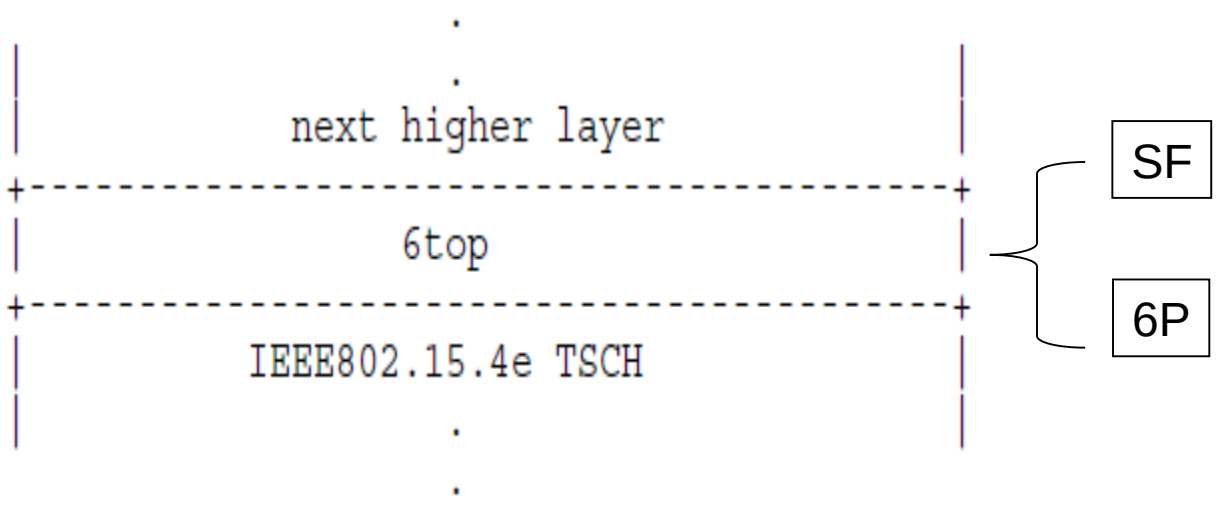


Figure 2: The 6top sublayer in the protocol stack.

Using 6top with the Minimal 6TiSCH Configuration

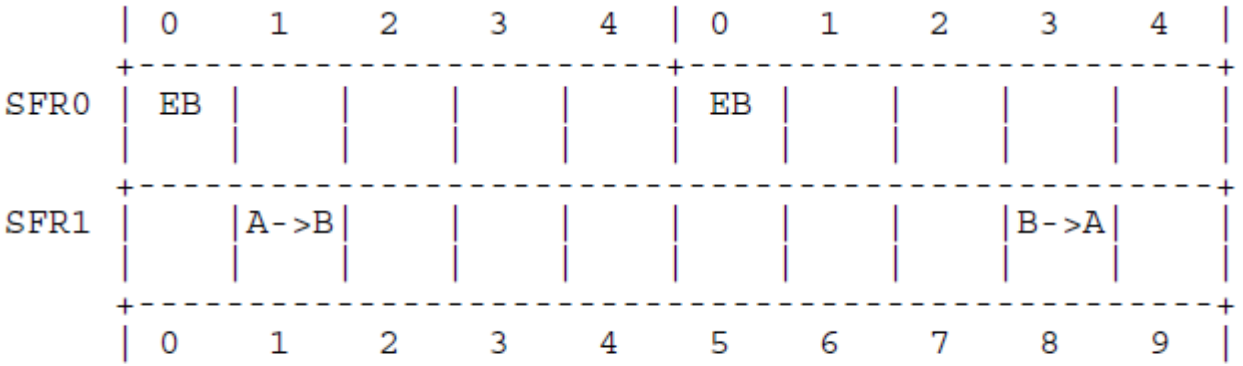


Figure 3: 2-slotframe structure when using 6top alongside the Minimal 6TiSCH Configuration.

6top Protocol (6P) – 2 Steps transaction

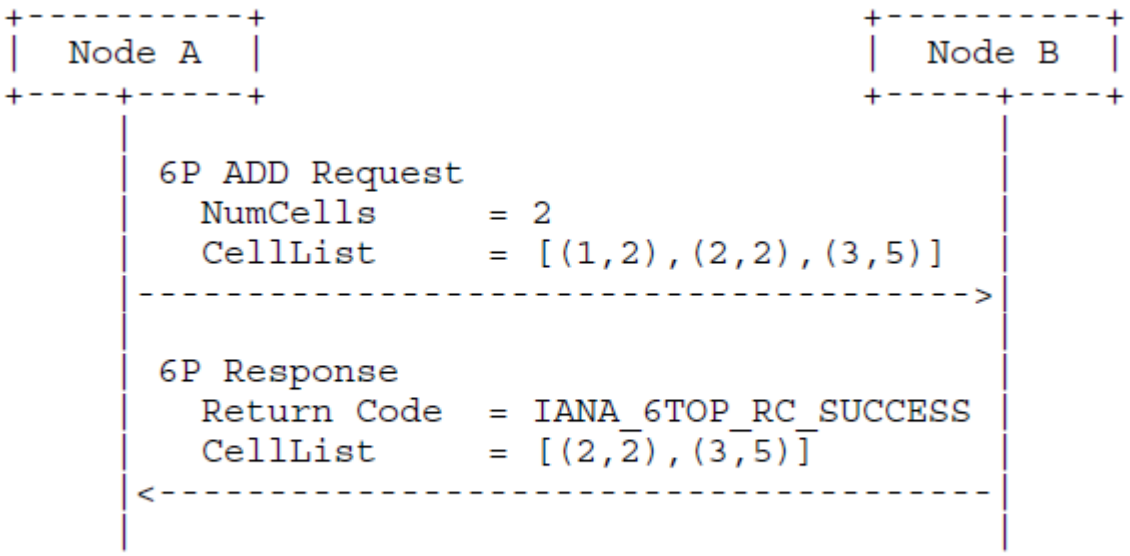


Figure 4: A 2-step 6P transaction.

6top Protocol (6P) – 3 Steps transaction

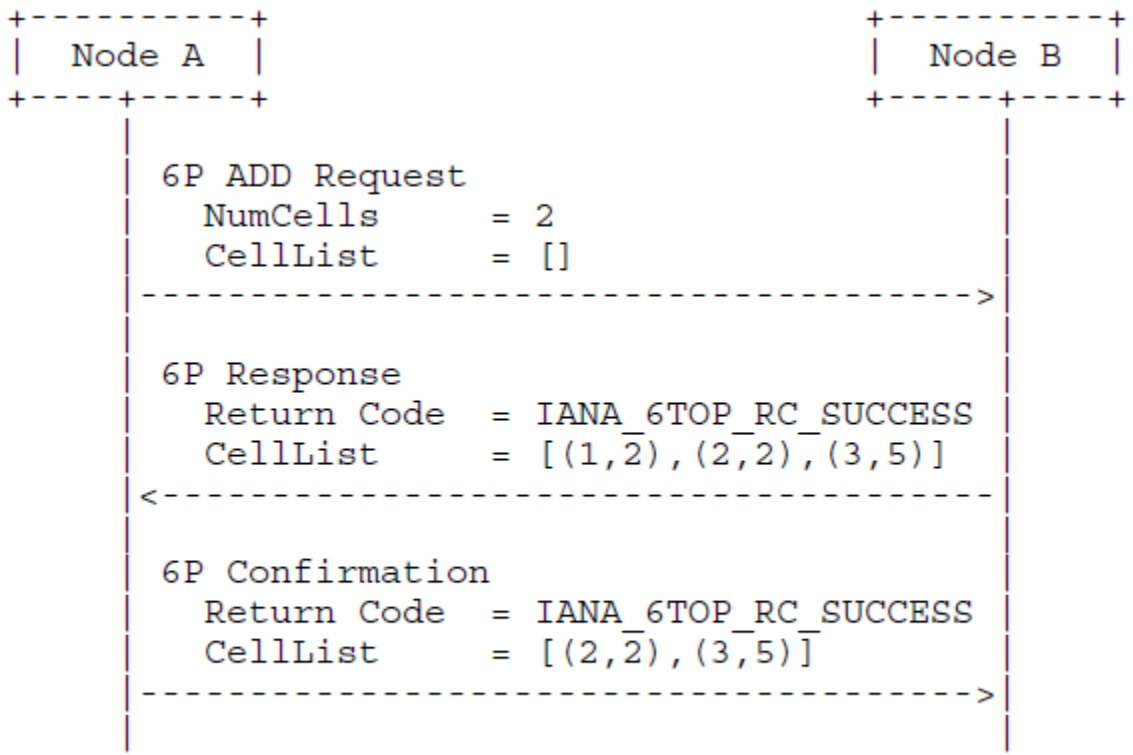
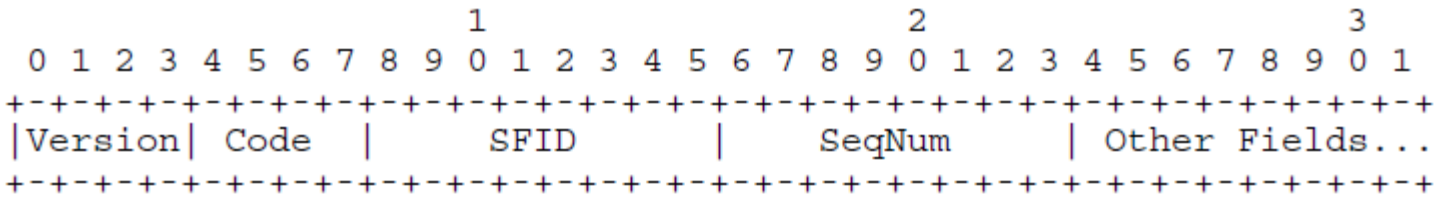


Figure 5: A 3-step 6P transaction.

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)

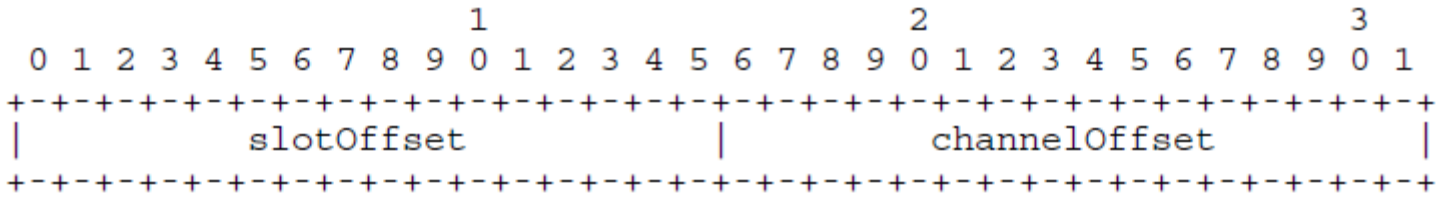
Value	Command ID	Description
IANA_6TOP_CMD_ADD	CMD_ADD	add one or more cells
IANA_6TOP_CMD_DELETE	CMD_DELETE	delete one or more cells
IANA_6TOP_CMD_COUNT	CMD_COUNT	count scheduled cells
IANA_6TOP_CMD_LIST	CMD_LIST	list the scheduled cells
IANA_6TOP_CMD_CLEAR	CMD_CLEAR	clear all cells
TODO-0xf	reserved	

Code in Request Message: CMD Identifier

Code in Response Message: Return codes.

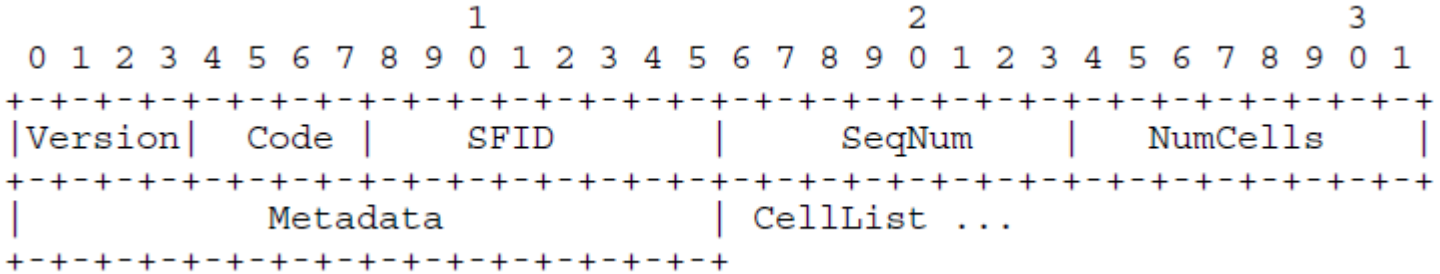
Value	Return Code	Description
IANA_6TOP_RC_SUCCESS	RC_SUCCESS	operation succeeded
IANA_6TOP_RC_VER_ERR	RC_VER_ERR	unsupported 6P version
IANA_6TOP_RC_SFID_ERR	RC_SFID_ERR	unsupported SFID
IANA_6TOP_RC_BUSY	RC_BUSY	handling previous request
IANA_6TOP_RC_RESET	RC_RESET	abort 6P transaction
IANA_6TOP_RC_ERR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

6P cell format

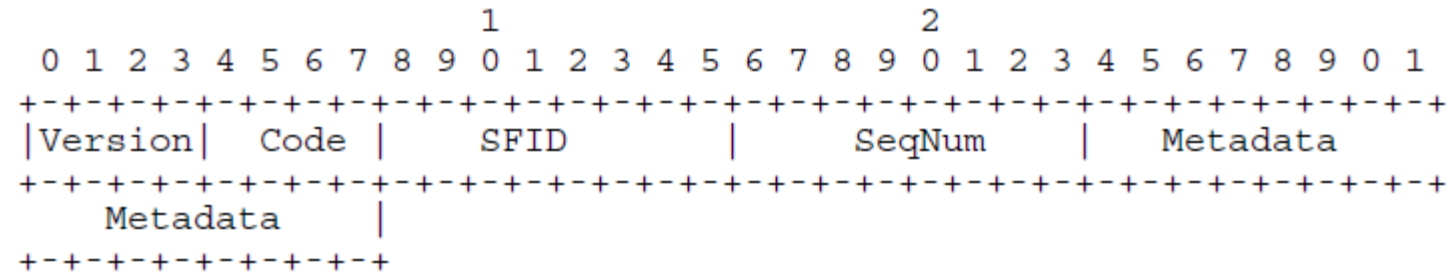


6P Request Message Format

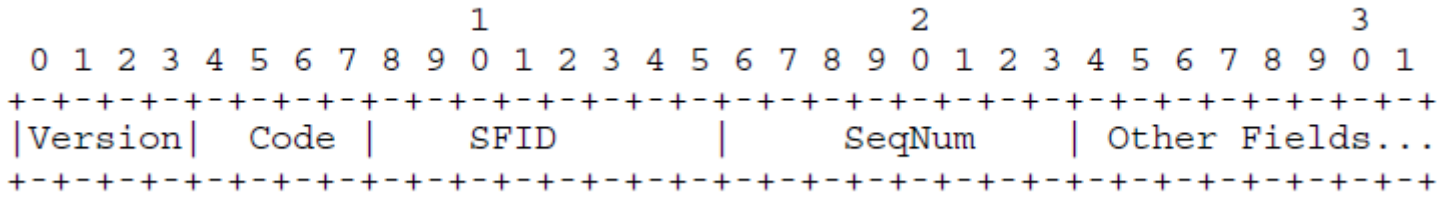
ADD /DELETE



COUNT /LIST /CLEAR



6P Response Message Format

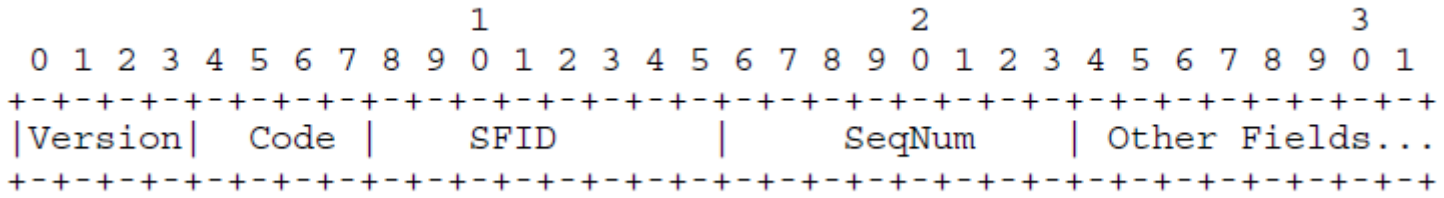


Response to an ADD, DELETE or LIST command: A list of 0, 1 or multiple 6P Cells. The format of a 6P Cell is defined in Section 4.2.5.

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

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

6P Confirmation Message Format



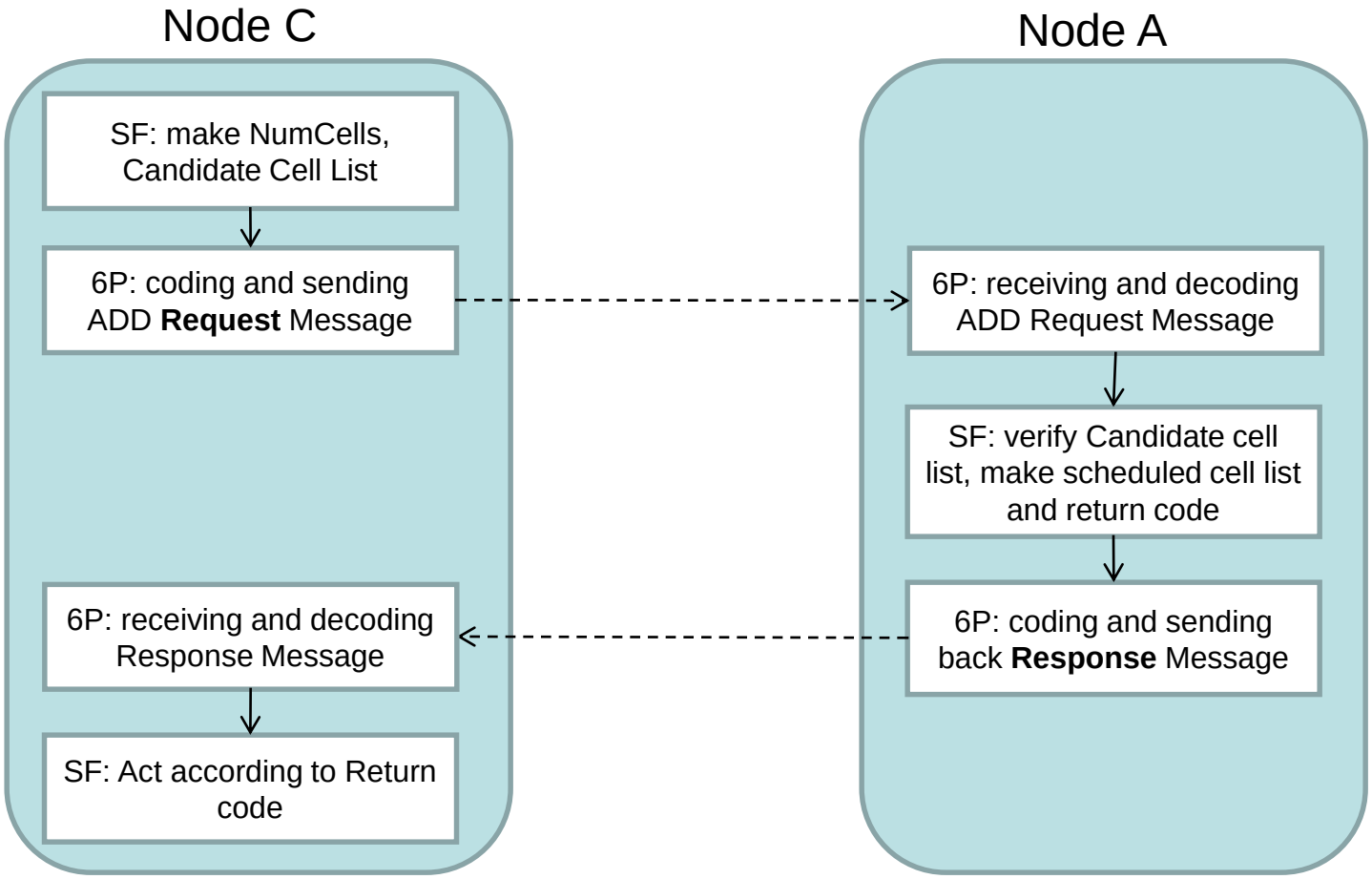
Code: same as the return code in Response message
Other field: same as that in Response message

6P behavior

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

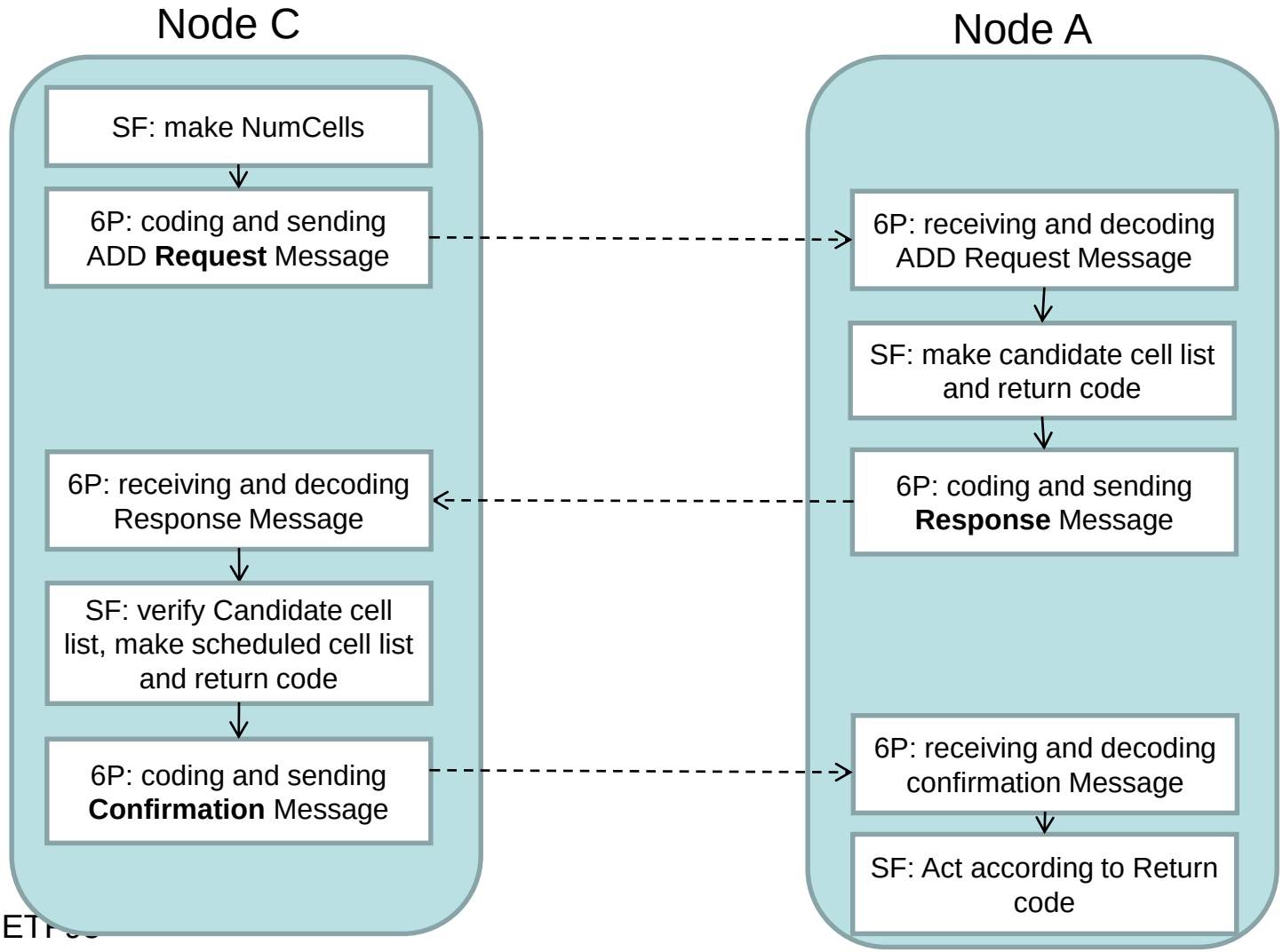
6P behavior (Example1)

Assume: Node C decides to add cells to node A in 2-steps transaction



6P behavior (Example2)

Assume: Node C decides to add cells to node A in 3-steps transaction



Guideline for SF

SF Identifier

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

Figure 8: SFID range.

Recommended structure

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

Guideline for SF(cont)

The specification for an SF

- MUST specify an identifier for that SF.
- MUST specify the rule for a node to decide when to add/delete one or more cells to a neighbor.
- MUST specify the rule for a Transaction source to select cells to add to the CellList field in the 6P ADD Request.
- MUST specify the rule for a Transaction destination to select cells from CellList to add to its schedule.
- MUST specify a value for the 6P Timeout, or a rule/equation to calculate it.
- MUST specify a meaning for the "Metadata" field in the 6P ADD Request.
- MUST specify the behavior of a node when it boots.
- MUST specify what to do after an error has occurred (either the node sent a 6P Response with an error code, or received one).
- MUST specify the list of statistics to gather. An example statistic if the number of transmitted frames to each neighbor. In case the SF requires no statistics to be gathered, the specific of the SF MUST explicitly state so.

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).

Thanks!

- Q&A

draft-dujovne-6tisch-6top-sf0-01

Diego Dujovne
Luigi Alfredo Grieco
Maria Rita Palattella
Nicola Accetura

Status

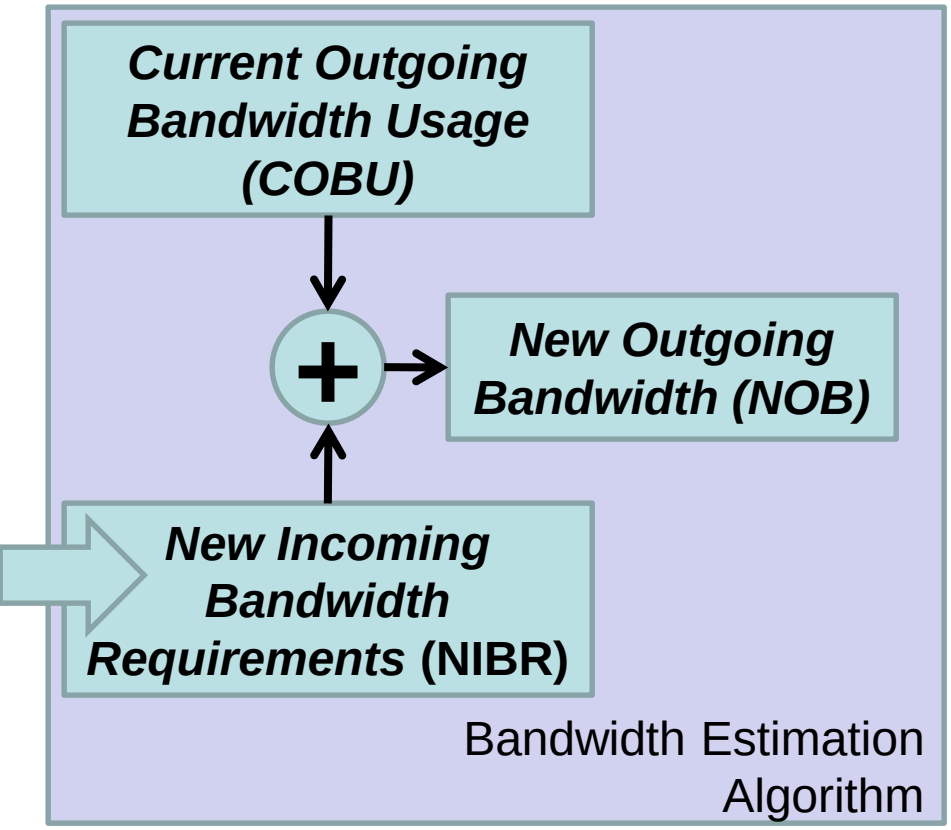
- Define the default **Scheduling Function** for the 6top layer
- News:
  - New *Bandwidth Estimation Algorithm*
  - Added *Differentiation between bandwidth and Cells*
  - Added *Whitelist/Blacklist*
- TODO list at the end.

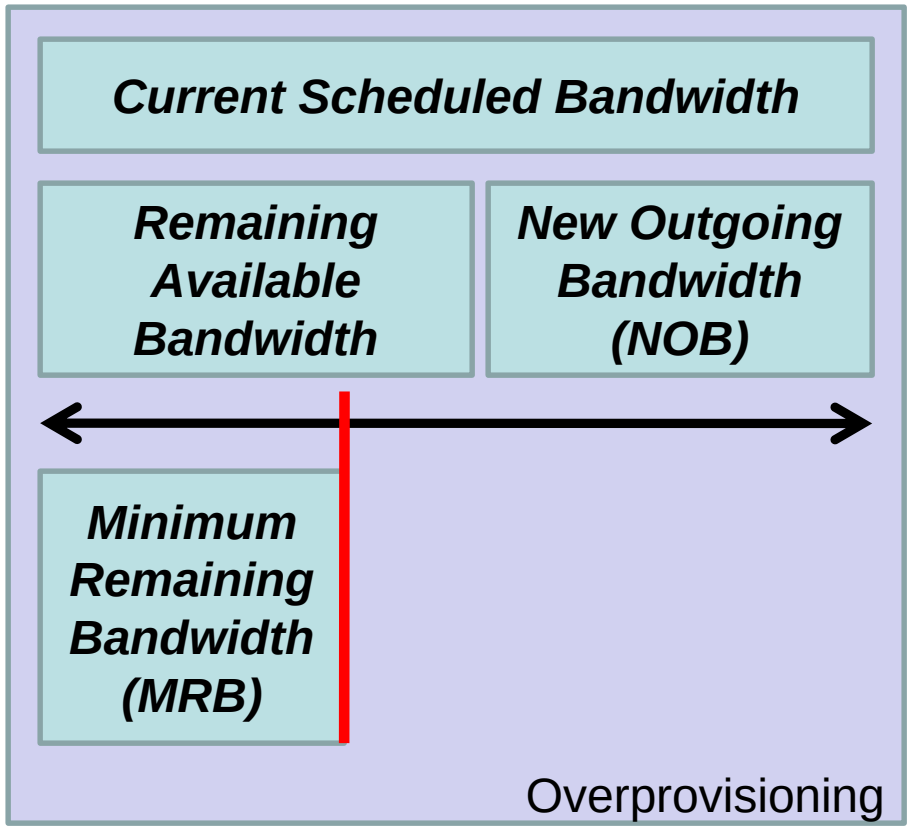
Bandwidth Estimation Algorithm (BEA)

- The original BAE was based on the availability of **neighbour bandwidth** requests and **local bandwidth** requests.

- This assumed the Application had a way to **establish requests**. This assumption **does not apply** anymore.

Bandwidth Estimation Algorithm (BEA) / Current

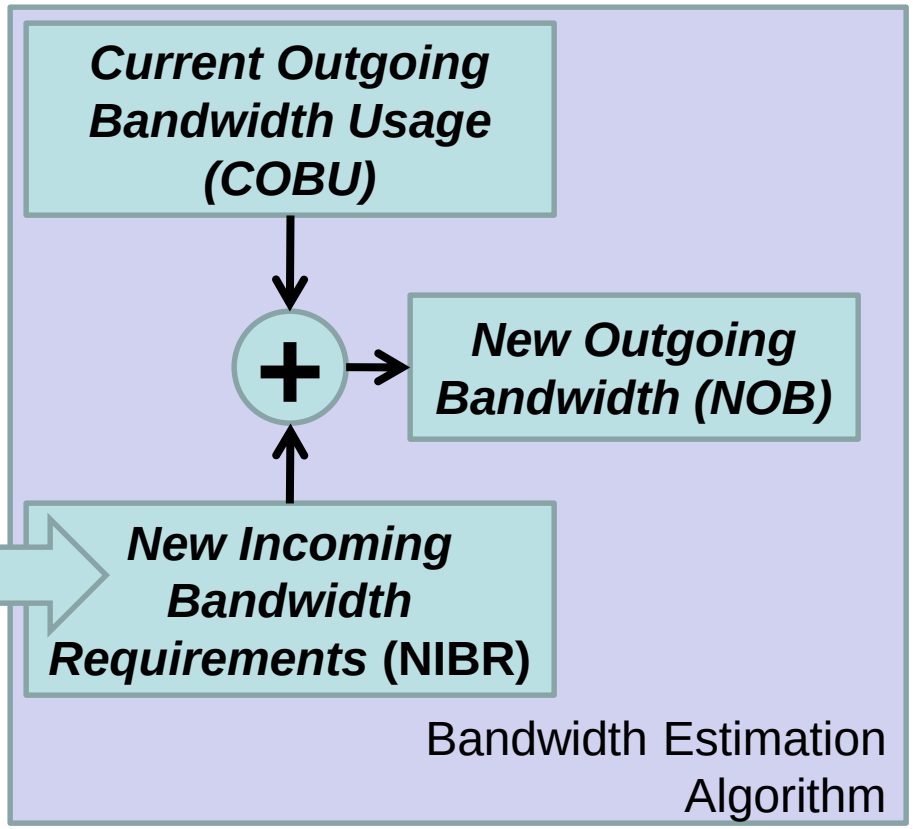


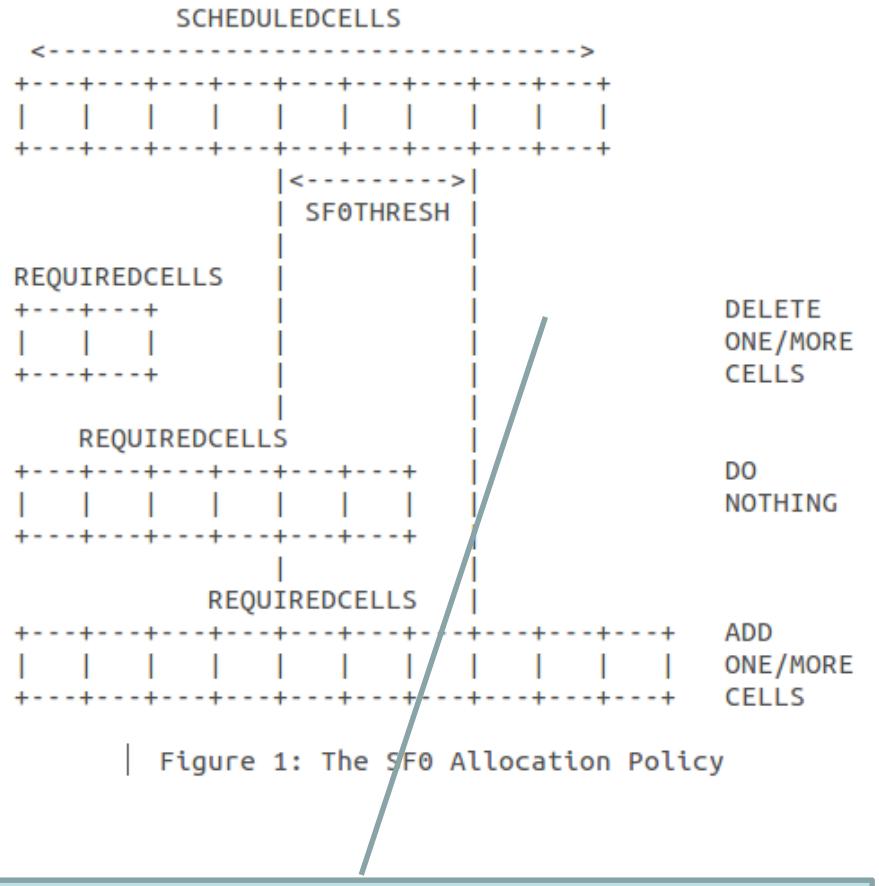


Bandwidth Estimation Algorithm (BEA) / Current

- The new BAE considers the **Current Outgoing Bandwidth Usage** as an **indirect estimator** of local bandwidth requirements.
- There is an **Overprovisioning** stage to compensate **underestimated** local bandwidth requirements

Bandwidth Estimation Algorithm (BEA) / Alternative





Establish an high SF0THRESH to replace MRB and obtain Overprovisioning

Bandwidth Estimation Algorithm (BEA)

- A **relocation request** from the neighbour is considered as an **Incoming Bandwidth Requirement**;
  - It is expected to **Increase** Packet Delivery Rate on the relocated cells
  - Thus **Increasing** the Required Bandwidth

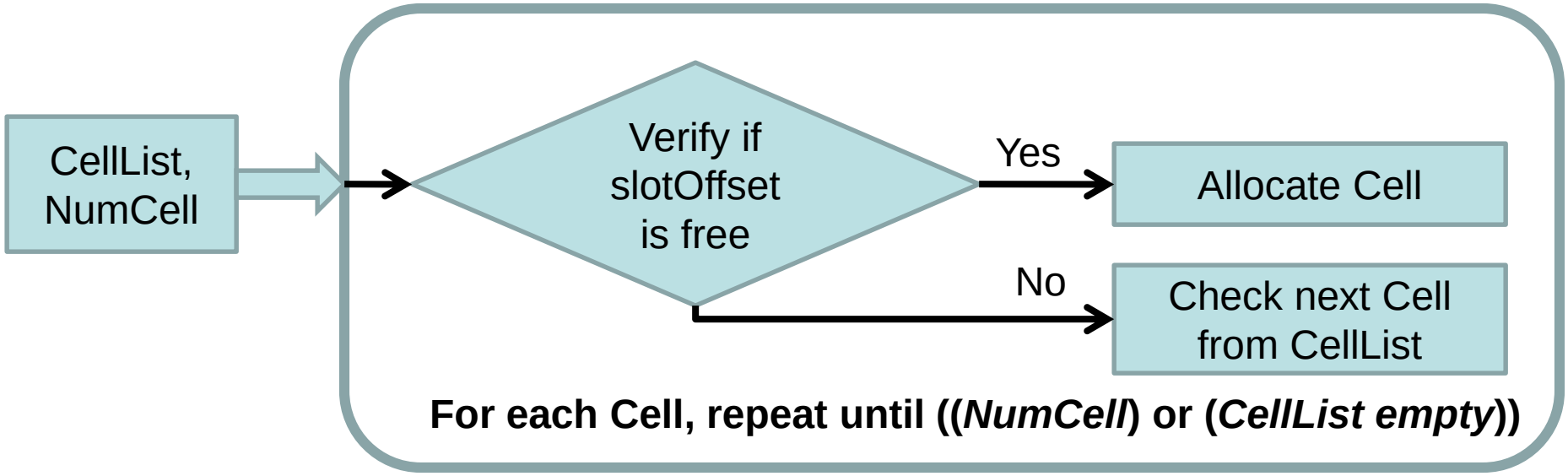
Bandwidth and Cells

- The **Bandwidth** is related to the **Number of Cells** by each cell`s **Packet Delivery Rate.**
- The BEA estimates the Bandwidth and the **Allocation Policy translates** this request into cells.

CellList / WhiteList

- *Transaction Source Node*

- *Transaction Destination Node*

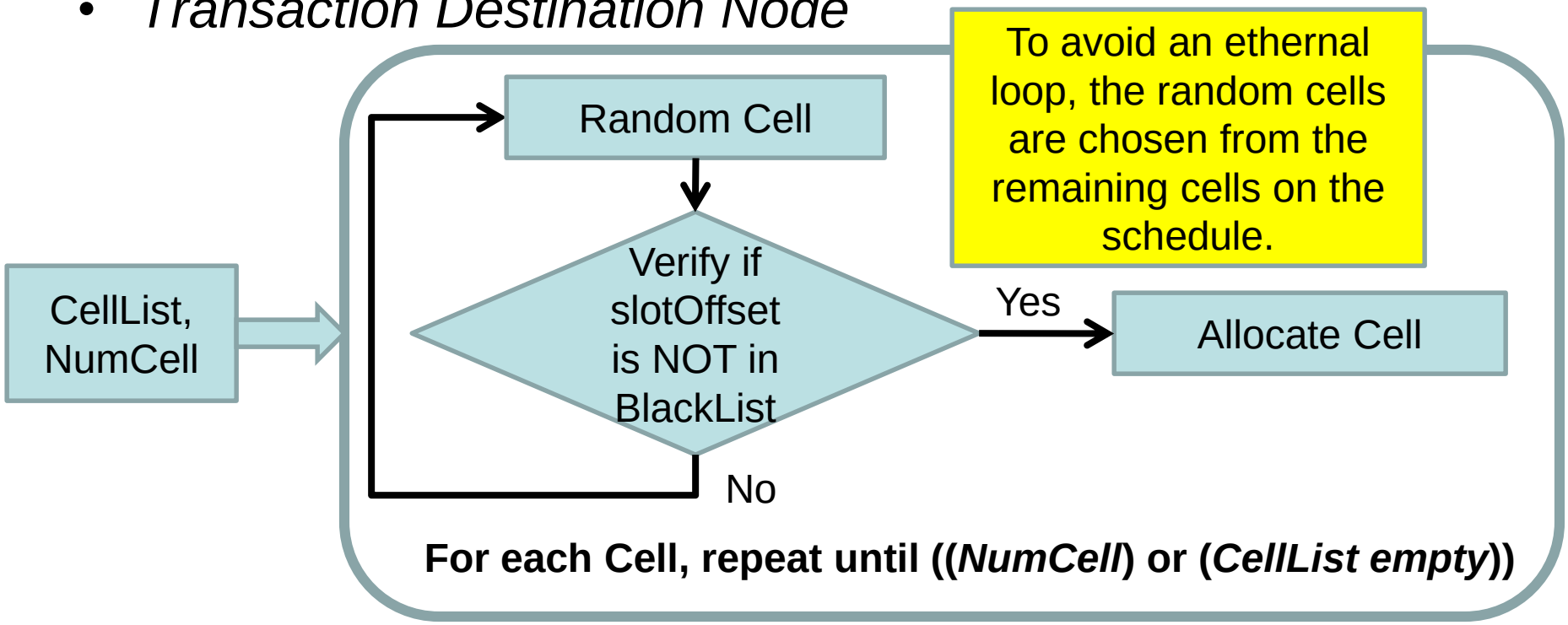


CellList / BlackList

- *Transaction Source Node*

List of currently Scheduled Cells

- *Transaction Destination Node*



TODO: Timeout

- The current timeout:

```
The 6P Timeout Value provided by SF0 allows the maximum number of
TSCH link-layer retries.  Given the TSCH parameters for the backoff
mechanism, macMinBE and macMaxBE, and the length in seconds of the
minimal Slotframe, SM, the timeout value is computed as: timeout =
(2^(macMaxBE+1)-2^macMinBE) * SM
```

- Considers the **worst-case** for Minimal in the starting phase, with a high number of retransmissions.
- **Proposal:**
  - Move this to the “Behaviour at Boot” section
  - Define the Timeout in steady state condition as the time until the next scheduled cell

TODO: Metadata

- The current Metadata usage:

```
The Metadata 16-bit field is used as follows:

   BITS 0-7 [SLOTFRAME] are used to identify the slotframe number
   BITS 8-14 are RESERVED
   BIT 15 [WBLIST] is used to indicate that the CellList provided is
   a Whitelist (value=0) or a Blacklist (value=1).
```

- Defines only the **Slotframe number** and the **WhiteList/BlackList** indicator.
- What to do with the reserved bits?

TODO: Node behavior at boot

- The current Node behaviour:

```
In order to define a known state after the node is restarted, a CLEAR
command is issued to each of the neighbour nodes to enable a new
allocation process.
```

- **Proposal 1:** Should add the Max timeout to use when only Minimal cells are available
- **Proposal 2:** Distribute a number of temporary cells from a limited pool of cells to accelerate the join (and SF0 allocation) process

TODO: Cell Relocation

- The current Cell Relocation Policy:

  SF0 uses Packet Delivery Rate (PDR) statistics to monitor the currently allocated cells for cell re-allocation (by changing their slotOffset and/or channelOffset) when it finds out that the PDR of one or more softcells below 20% of the average PDR.

- **Proposal:** 20% is an arbitrary value. Do you have another value for this relocation threshold?

TODO: Forced deletion

- In a distributed allocation process the **only entity** allowed to define cell allocation is the SF.
- As a consequence, we need to **add a function to the SF** to **free cells** in specific cases, for example if a node dissapears from the Neighbour list.

TODO

- Define a **formula to calculate the statistics**, and which fields from the 6top MIB required for SF0.
  - We are only using now the Packet Delivery Rate as the percentage of packets successfully transmitted to/from the neighbor
  - We do not specify the timeframe for this calculation. The average over a minute? A second? An hour?
- Define a **policy for cell depletion** (no more available cells):
  - All cells are temporary and must be renewed periodically (à la DHCP)
  - Periodically monitor cell usage and delete unused cells
  - Any other options?

Questions?

Security

Michael Richardson

IETF95 Summary of summary slides of IETF94

Simplying assumption 1: 6tisch like has a PCE/JCE
- draft-pritikin-bootstrapping-keyinfrastructures-00
  - → draft-ietf-anima-bootstrapping-keyinfra-02

For 6tisch WG
And netconf
And ANIMA

Term mapping
- JCE → ANIMA Registrar
- Joint Assistant → ANIMA “Proxy”

Simplying assumption 2: leverage 802.1AR work
- Fundamental to anima-bootstrapping

Challenge 1: how does the network authenticate?
- ANIMA bootstrap defines “ownership voucher”

Contrast ANIMA and 6tisch

- Goal of ANIMA bootstrap is to create Enrollment over Secure Transport (RFC7030)
- ANIMA accomodates HTTPS or DTLS/CoAP + Blockwise. Hard sell to make DTLS Mandatory to Implement.
- Network is not constrained
  - After bootstrap, may be multi-gigabit
- While device is not constrained in aggregate, ANIMA ACP code may run on control plane/line-card CPU: some hardware offload available, but not universal.

ANIMA

VS

- Goal of 6tisch bootstrap is to create secured CoAP/6top transport from JCE/PCE to new node to transport YANG.
- DTLS/CoAP only + 6top, blockwise may be controversial?
- Network is constrained (not challenged)
- Devices are very code and ram constrained.
- Battery power is common (but not universal)

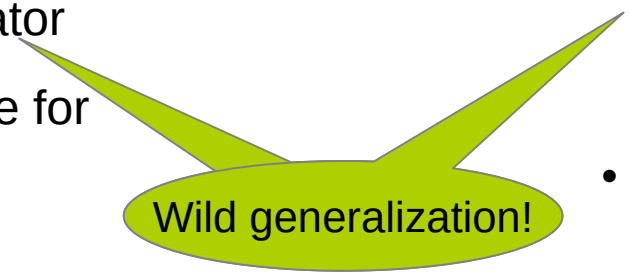
6TiSCH

Contrast ANIMA and NETCONF

- Goal of ANIMA bootstrap is to create Enrollment over Secure Transport (RFC7030)
- ANIMA accomodates HTTPS or DTLS/CoAP + Blockwise. Hard sell to make DTLS Mandatory to Implement.
- ANIMA replaces IDevID with LDevID ASAP.
- ANIMA assumes link-local connectivity, device owner is link network operator
- ANIMA tends to be for “infrastructure”

VS

- Goal of NETCONF is to provide signed bootstrap data (YANG) to device.
- Variety of sources: HTTP, HTTPS, DNS, mDNS, DHCP, removable storage...
- NETCONF uses IDevID directly
- NETCONF assumes device owner likely is not link operator, or operator is unsophisticated (home user)
- NETCONF more appliance, and high-volume access device focused, rather than core infrastructure.



ANIMA

NETCONF

Contrast 6tisch and NETCONF!

- Goal of 6tisch bootstrap is to create secured CoAP/6top transport from JCE/PCE to new node to transport YANG.
- Devices and networks constrainted.
- 6tisch will replace IDevID with LDevID for use with 802.15.9 or other per-link KMP
- No cheap broadcast/multicast, or service discovery
- Device owner is network owner.

ANIMA

VS

- Goal of NETCONF is to provide signed bootstrap data (YANG) to device.
- Variety of sources: HTTP, HTTPS, DNS, mDNS, DHCP, removable storage...
- NETCONF uses IDevID directly
- NETCONF assumes device owner likely is not link operator, or operator is unsophisticated (home user)
- NETCONF more appliance, and high-volume access device-focused

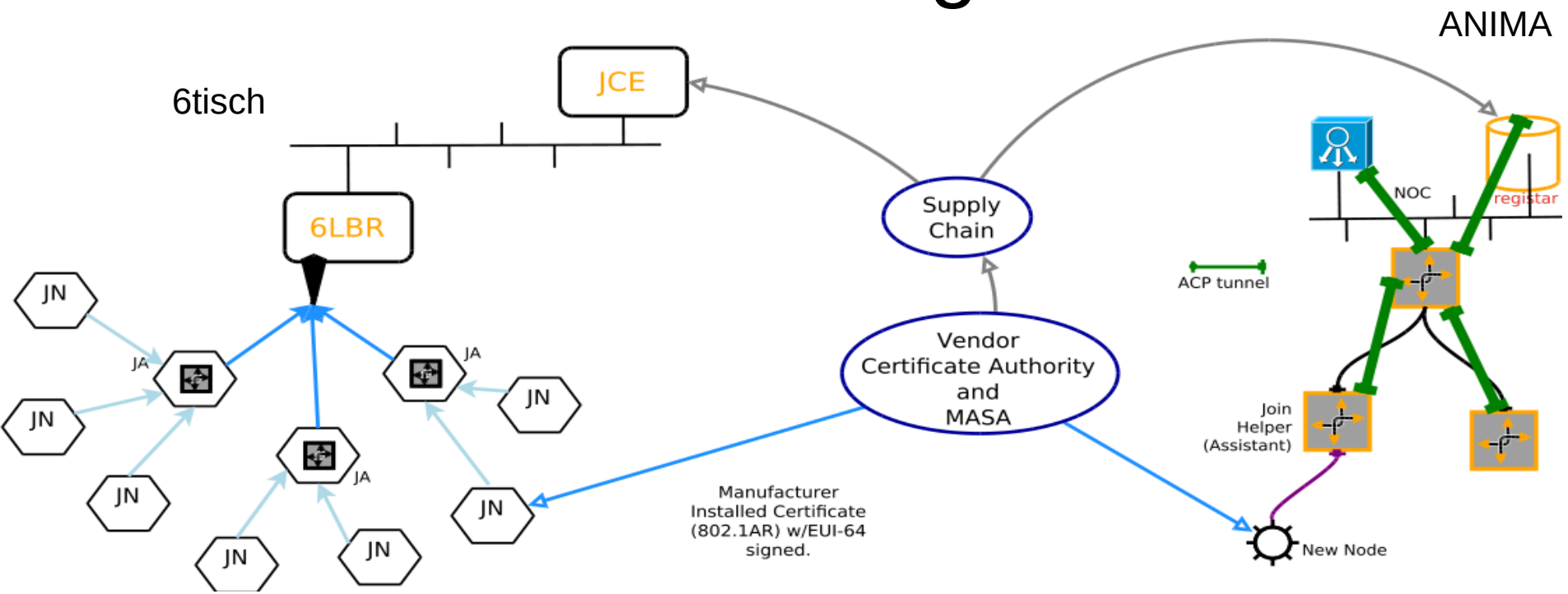
NETCONF

Join Problem

How to let random uninitialized, “drop shipped”, potentially malicious nodes into your network without destroying the network.

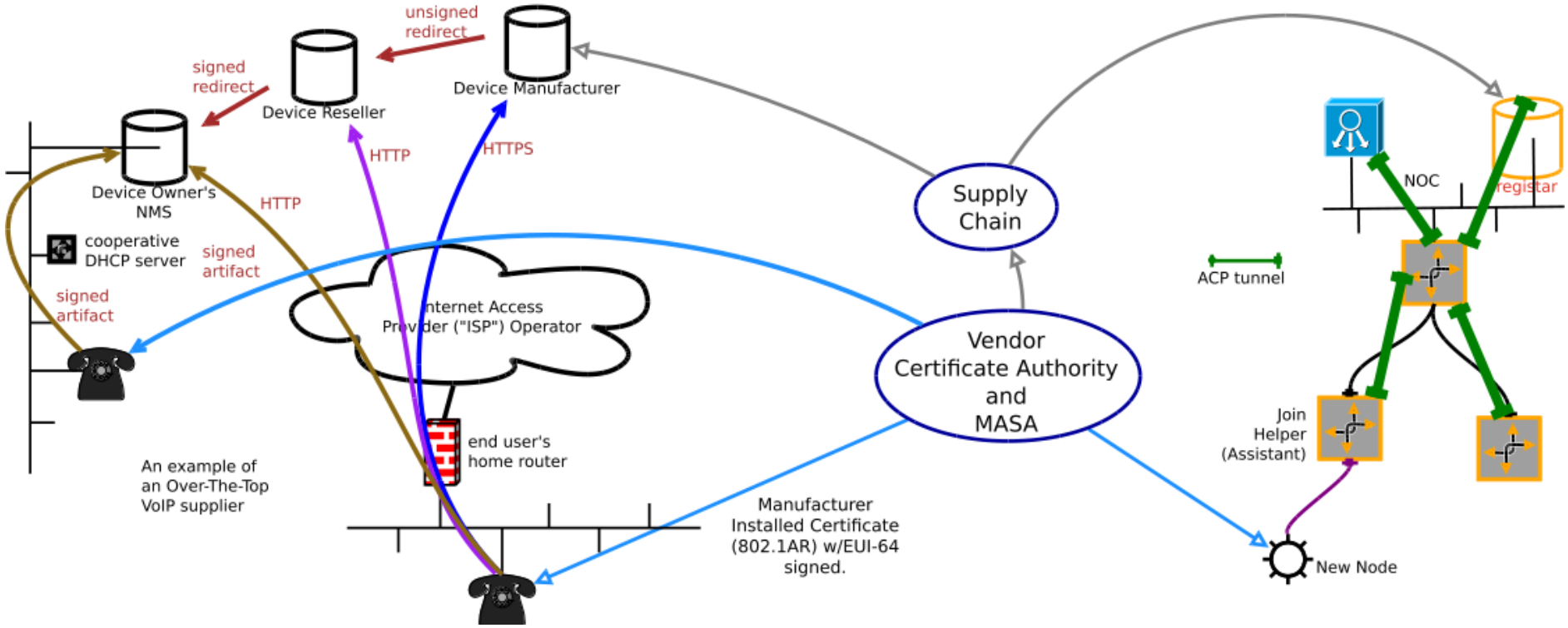
- 802.1x/EAP/PANA has this “solved” for initialized nodes which know which network they want to join; need to be pre-provisioned with certificates.
  - needs EAP-TLS to make this work, which then includes new layers of fragmentation. This code is used once.
  - PANA/1x authenticator function scales with number of nodes attempting to join, is subject to DoS attack, defending against may be too expensive for constrained nodes
  - 1x function for ANIMA **ACP** bootstrap may interfere with 1x function being provided by routers/switches for end-hosts!
- The goal is to provision new nodes with certificates, at which point “traditional” methods may be used to join network.

Network Diagram



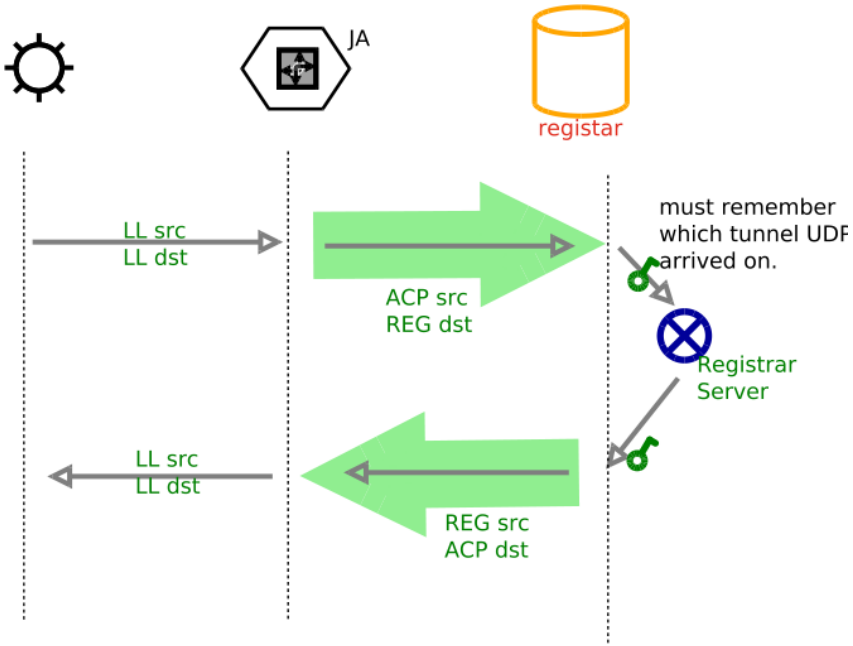
Both 6tisch/LLN, ANIMA and NETCONF share Manufacturer Installed Certificates (“MIC”) [IDevID], and have a supply chain relationship with network operator via which Ownership Vouchers can be communicated.

Network Diagram: NETCONF



New Node /Registrar communications

- New Node ↔ Proxy use Link Local addresses.
- Communication is CoAP/DTLS over UDP
  - (or HTTPS/TCP)
- Proxy ↔ Registrar communication is forwarded (D)TLS traffic; proxy is uninvolved in security.
  - Proxy is neither trusted, nor needs to be truthworthy
- Green Encapsulation arrow can be implemented in different ways



Proxy/Join Assistant proxy methods

HTTPS

1. Via circuit proxy (process per connection), or HTTP proxy.
2. Via NAT66 of link-layer enrollment addresses to ACP ULA address
3. Stateless IPIP encapsulation of link-local traffic to registar

CoAP/DTLS

1. UDP circuit proxy
2. NAT66 of link-layer to ACP ULA address
3. Stateless IPIP encapsulation of link-local traffic to registrar
   a) Essentially this is routing-dispatch IPIP encapsulation

Brian Carpenter was visibly ill

Least amount of new Code for constrained Devices, highest Resistance to DoS Costs some bandwidth

See draft-richardson-anima-state-for-joinrouter-00: Considerations for stateful vs stateless join router in ANIMA bootstrap, for longer discussion

Asymmetrical AODV-P2P-RPL in 6tisch Networks

draft-satish-6tisch-aodv-rpl-00

Satish Anamalamudi
Mingui Zhang
Charlie Perkins
Dongxin Liu
S.V.R Anand
satish.anamalamudi@huawei.com

Overview

- AODV route discovery mode
  - Instance-1 Route Discovery.
  - Instance-2 Route Discovery.

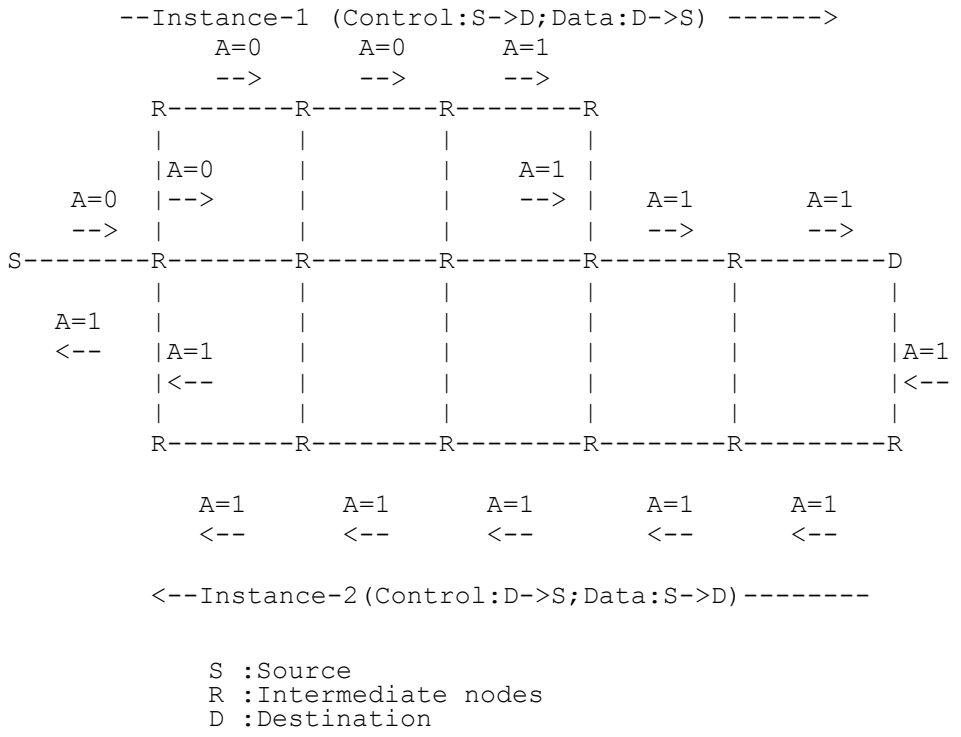
  - AODV-RPL Resource Reservation at 6TOP.
  - Asymmetrical links
  - Symmetrical links

Overview of AODV-RPL

- Works on the top of RPL [RFC6550]
  - Hop-by-hop based P2P traffic flows.
  - Bi-directional asymmetric links with PairedDODAG's . (Motivated from the discussions in mailing list).

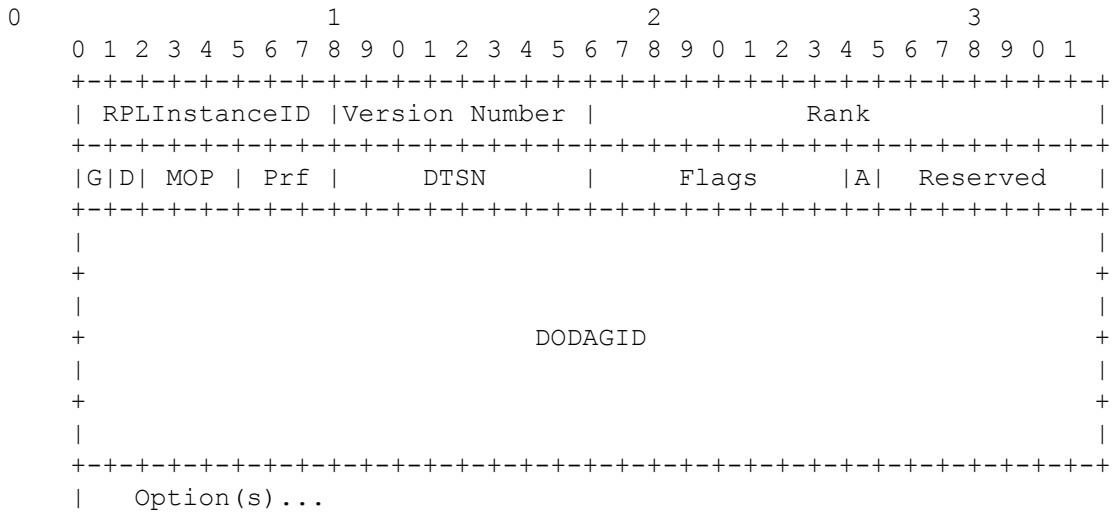
- Route Control messages
  - Instance-1 from Source to Destination.
  - Instance-2 from Destination to Source.

- Data transmission
  - Instance-1 from Destination to Source.
  - Instance-2 from Source to Destination.



Instance-1 Route Discovery

- Link Nature
  - "A" bit is added in DIO message.
  - Describe the link nature (Asymmetric or Symmetric).
  - Source reset “A” bit to “0” during Instance-1 route discovery.
  - Intermediate node set ’A’ bit to 1 if link is asymmetric.
  - ‘A’ bit is set to mean that the route is asymmetric.
  - Link nature at destination for Instance-2 is decided by “A” bit.



Instance-2 Route Discovery

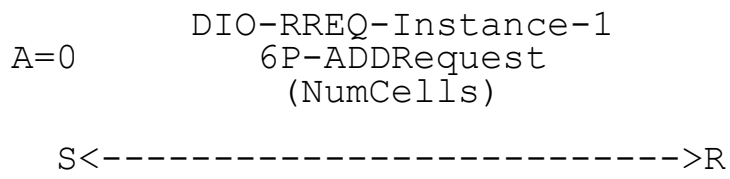
- Symmetric Links
- Destination:
  - If “A” bit is “0” then Instance-2 control message is unicast.
  - Same links for Instance-1 and Instance-2.

- Asymmetric Links
- Destination :
  - If “A” bit is “1” then Instance-2 control message is multicast.
  - Different links for Instance-1 and Instance-2.

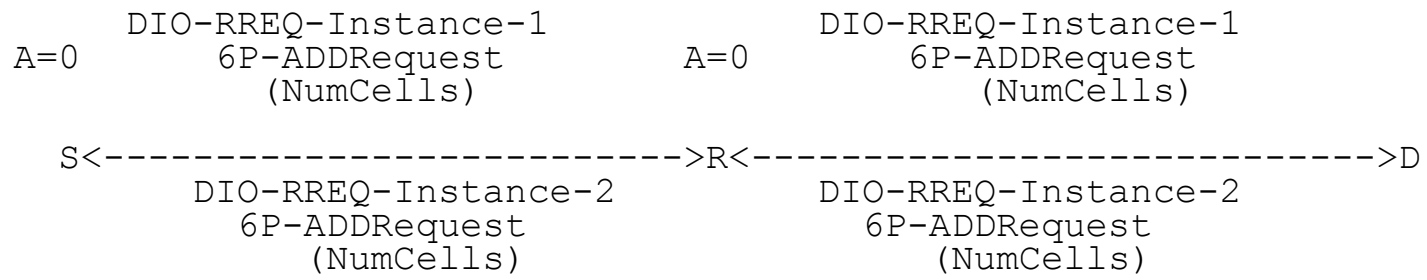
  - Intermediate routers set “A” bit based on available radio resources (cells).

AODV-RPL Resource reservation at 6TOP

- Source run Bandwidth Estimation Algorithm (BEA) .
- Check required cells for application data.
- NumCells in 6P ADDRequest is set to “Required cells”.
- Append 6PADD Request to DIO-RREQ-Instance-1.
- CellList(slotoffset, channeloffset) is set to zero.
- Intermediate nodes will re-multicast if it has radio resources.
- “A” bit changes based on available radio resources(cells).

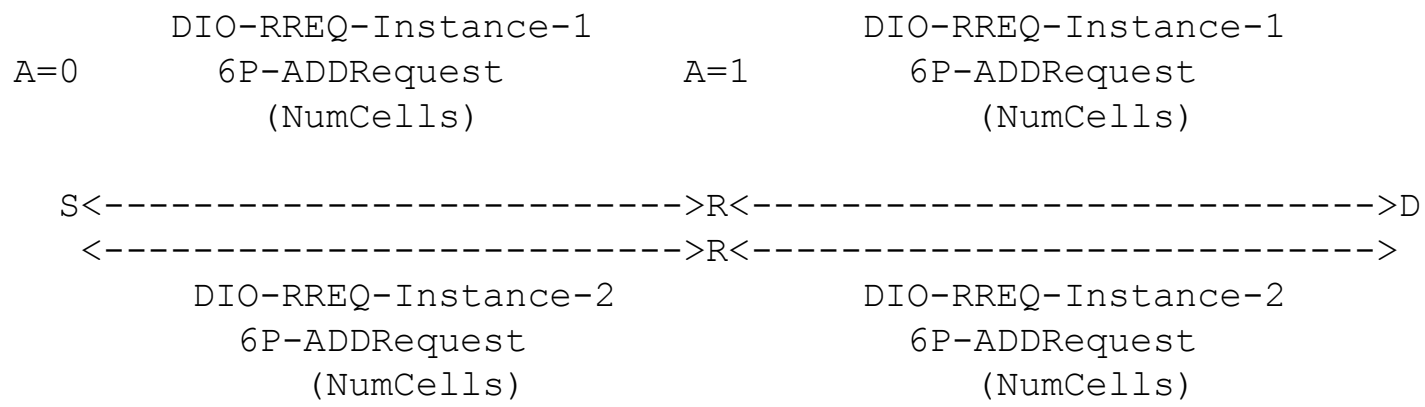


Resource reservation for Symmetrical links



- Path from Source to Destination have transmit and receive cells for both directions.
- ’A’ bit is remain to set to ’0’.
- Destination unicast Instance-2 in same path.
- Symmetric links
  - transmit-receive cells for Instance-1 and transmit-receive cells for Instance-2 in same path.

Resource reservation for Asymmetrical links



- Intermediate node may have cells available only for one direction .
- ’A’ bit is set to ’1’ during route discovery in Instance-1.
- For “A=1”, Destination multicast the Instance-2 message.
- Available Cells and “A” bit decide the link nature.

Cell Scheduling for Data transmission

- Source know the path to Destination in Instance-2.
- Destination know the path to Source in Instance-1.
- Actual 6P negotiation (6P ADD Request, 6P ADDResponse).
- Request and allocates the CellList (slotoffset, channeloffset).
- Data transmission in scheduled cells.

- Advantages of AODV-RPL
  - Address vector is completely removed.
  - Address size overhead is minimized.

Next Steps

- Comments and Questions
- Ask for WG adoption.

Thanks!

AOB ?