10 June 2016 Webex

IPv6 over the TSCH mode of IEEE 802.15.4e

Chairs:
 Pascal Thubert
 Thomas Watteyne
Etherpad for minutes:
 http://etherpad.tools.ietf.org:9000/p/6tisch?useMonospaceFont=true

Note Well

This summary is only meant to point you in the right direction, and doesn't have all the nuances. The IETF's IPR Policy is set forth in BCP 79; please read it carefully.

The brief summary:
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- You understand that meetings might be recorded, broadcast, and publicly archived.

For further information, talk to a chair, ask an Area Director, or review the following:
- BCP 9 (on the Internet Standards Process)
- BCP 25 (on the Working Group processes)
- BCP 78 (on the IETF Trust)
- BCP 79 (on Intellectual Property Rights in the IETF)

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/6tisch?useMonospaceFont=true
** Recordings and Minutes are public and may be subject to discovery in the event of litigation.
*** From the Webex login

Agenda

- Administrivia   [3min]
  - Agenda bashing
  - Approval minutes from last meeting
- 6TiSCH architecture update   [10min]
  - Also news on Minimal
- 6TiSCH security update   [10min]
- 6TiSCH ML topics   [10min]
- New draft: draft-satish-6tisch-6top-sf1   [10min]
- IETF96 Berlin update   [15min]
  - plugtest update
  - Agenda bashing
  - Introduction to 6LPWA
- AOB   [2min]

Administrivia

Admin is trivia

- Approval Agenda
- Approval minutes

6TiSCH architecture update

WG doc news

- Published Archi 10
  - Diff: http://tools.ietf.org/rfcdiff?difftype=--hwdiff&url2=draft-ietf-6tisch-architecture-10.txt

- Minimal: Expecting Charlie's return early next week, then move to IESG

4.2.2. Scheduling Functions and the 6P protocol

In the case of soft cells, the cell management entity that controls the dynamic attribution of cells to adapt to the dynamics of variable rate flows is called a Scheduling Function (SF). There may be multiple SFs with more or less aggressive reaction to the dynamics of the network. The 6TiSCH 6top Scheduling Function Zero (SF0) [I-D.ietf-6tisch-6top-sf0] provides a simple scheduling function that can be used by default by devices that support dynamic scheduling of soft cells.

The SF may be seen as divided between an upper bandwidth adaptation logic that is not aware of the particular technology that is used to obtain and release bandwidth, and an underlying service that maps those needs in the actual technology, which means mapping the bandwidth onto cells in the case of TSCH.

```
 +------------------------+           +------------------------+
 |   Scheduling Function  |           |   Scheduling Function  |
 |   Bandwidth adaptation |           |   Bandwidth adaptation |
 +------------------------+           +------------------------+
 |   Scheduling Function  |           |   Scheduling Function  |
 | TSCH mapping to cells  |           | TSCH mapping to cells  |
 +------------------------+           +------------------------+
 | 6top cells negotiation | <- 6P -> | 6top cells negotiation |
 +------------------------+           +------------------------+
         Device A                              Device B
```
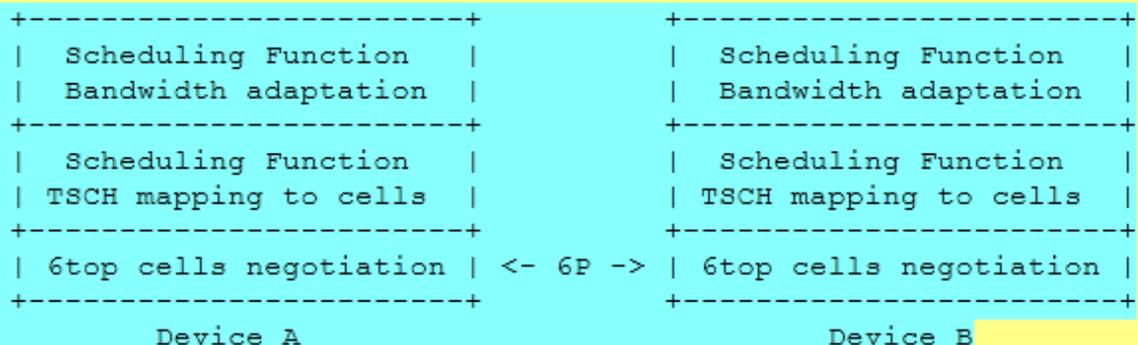
Figure 6: SF/6P stack in 6top

The SF relies on 6top services that implement the 6top Protocol (6P) [I-D.ietf-6tisch-6top-protocol] to negotiate the precise cells that will be allocated or freed based on the schedule of the peer. It may be for instance that a peer wants to use a particular time slot that is free in its schedule, but that timeslot is already in use by the other peer for a communication with a third party on a different cell. The 6P protocol enables the peers to find an agreement in a transactional manner that ensures the final consistency of the nodes state.

4.2.3. 6top and RPL Objective Function operations

fashion, whereby all active slots may be used for emission or reception of both unicast and multicast frames.

The 6LoWPAN Header Compression [RFC6282] is used to compress the IPv6 and UDP headers, whereas the 6LoWPAN Routing Header [I-D.ietf-roll-routing-dispatch] is used to compress the RPL artifacts in the IPv6 data packets, including the RPL Packet Information (RPI), the IP-in-IP encapsulation to/from the RPL root, and the Source Route Header (SRH) in non-storing mode.

6TiSCH has adopted the general direction of CoAP Management Interface (COMI) [I-D.vanderstok-core-comi] for the management of devices. This is leveraged for instance for the implementation of the generic data model for the 6top sublayer management interface [I-D.ietf-6tisch-6top-interface]. The proposed implementation is based on CoAP and CBOR, and specified in 6TiSCH Resource Management and Interaction using CoAP [I-D.ietf-6tisch-coap].

The Datagram Transport Layer Security (DTLS) [RFC6347] is represented as an example of a protocol that could be used to protect CoAP

distributed through the native methods in the TSCH MAC layer. This operation leverages RPL to maintain a loopless graph for routing and time distribution. It is specified in the Minimal 6TiSCH Configuration [I-D.ietf-6tisch-minimal] specification. and does not preclude other scheduling operations to co-exist on a same 6TiSCH network.

Neighbor-to-Neighbor Scheduling: This refers to the dynamic adaptation of the bandwidth of the Links that are used for IPv6 traffic between adjacent routers. Scheduling Functions such as SF0 [I-D.ietf-6tisch-6top-sf0] influence the operation of the 6top sublayer [I-D.wang-6tisch-6top-sublayer] to add and remove cells in peers schedule, using the 6top protocol [I-D.ietf-6tisch-6top-protocol] for the negotiation on the MAC resources.

6TiSCH security update

6TiSCH ML topics

Topics of the day

- Rank calculation before ETX settles
- CEBOT: Certificate Enrollment in Billions of Things.

draft-satish-6tisch-6top-sf1-00

Scheduling Function One (SF1) for hop-by-hop Scheduling in 6tisch Networks

Why do we need SF1 ?

•SF0 :
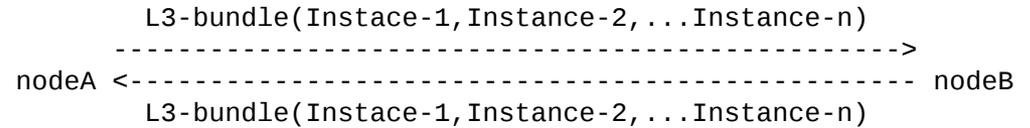
- 1-Hop scheduling protocol

- Schedule for aggregate traffic flows (L3-bundle).

- Dynamic cell adaptation (OTF Scheduling).

- Support best effort-traffic flows.

- Applications (Industrial-M2M) need Time critical traffic flows.

```
                       L3-bundle(Instace-1,Instance-2,...Instance-n)
                ------------------------------------------------------>
        nodeA <----------------------------------------------- nodeB
                       L3-bundle(Instace-1,Instance-2,...Instance-n)
```

•SF1 :

- End-to-end scheduling protocol.

- Schedule isolated traffic flows.

- Dedicated end-to-end L2-bundles.

- Support time-critical traffic flows.

```
        L2-bundle(Instace-1)             L2-bundle(Instace-1)
       ---------------------->          ----------------->
       <----------------------          <-----------------
        L2-bundle(Instace-1)             L2-bundle(Instace-1)

        L2-bundle(Instace-2)             L2-bundle(Instace-2)
       ---------------------->          ----------------->
 Source<---------------------nodeB <---------------    Destination
        L2-bundle(Instace-2)             L2-bundle(Instace-2)
                 .                               .
                 .                               .
        L2-bundle(Instace-n)             L2-bundle(Instace-n)
       ---------------------->          ------------------>
       <----------------------          <-----------------
        L2-bundle(Instace-n)             L2-bundle(Instace-n)
```
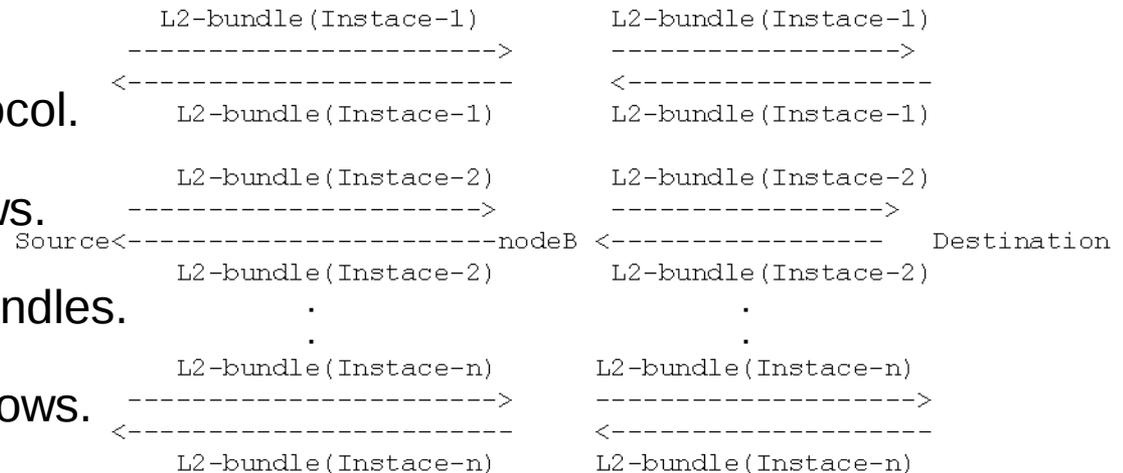
Scheduling Function One (SF1)

Objective of SF1

- When to schedule end-to-end L2-bundles for each instance.

- How to associate the TrackID for each L2-bundle.

- When to adapt(Increase/Decrease) the cells in ongoing instance.

Assumption

- End-to-end route path is available [storing or non-storing mode].

- End-to-end resources are assumed to be reserved with RSVP-TE[].

  1. Implement RSVP-TE in PCE (Use CoAP messages) : Centralized

  2. Design Distributed RSVP-lite : Distributed.

Chunk and cell scheduling

Hybrid Cell Scheduling

- New Instance : Request chunk from PCE (Centralized).

- On-going Instance : Dynamically adapt the cells from allocated chunk (Distributed).

End-to-end Scheduling with SF1

Source

IP	RPI

IP	RPI

6P transactions

TrackID

IP

6top | SF1

6P

TSCH-MAC

PHY

nodeB

IP	RPI

IP	RPI

6P transactions

TrackID

IP

6top | SF1

6P

TSCH-MAC

PHY

IP	RPI

6P transactions

TrackID

6P-Request(TrackID)

6P-Response(TrackID)

Destination

IP	RPI

IP

6top | SF1

6P

TSCH-MAC

PHY

IP	RPI

6P transactions

TrackID

6P-Request(TrackID)

6P-Response(TrackID)
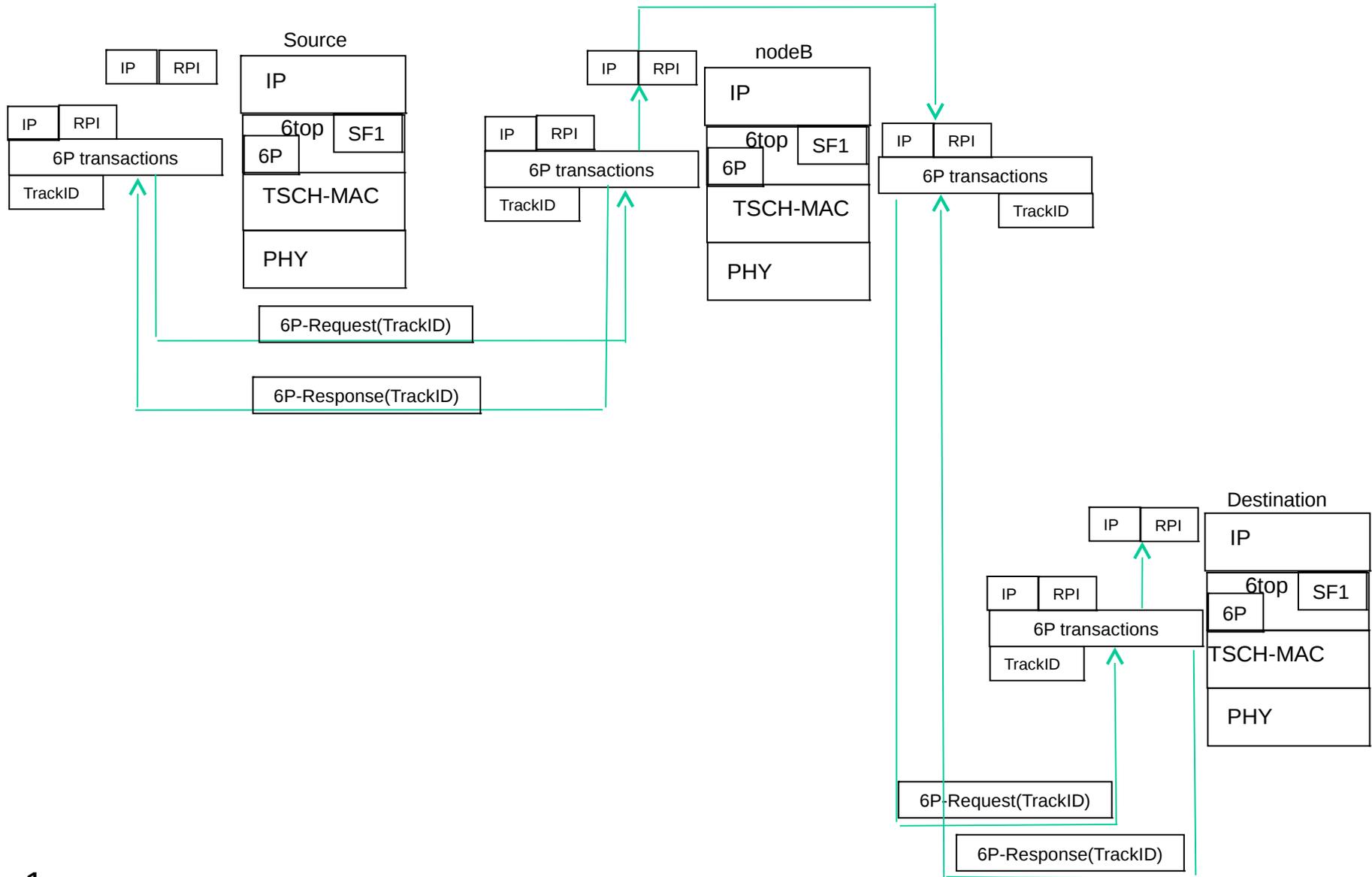
End-to-End Track forwarding

Source

nodeB

Destination

L2-bundle

L2-bundle

IP | RPI | Data

IP | RPI | Data | TrackID

IP | RPI | Data | TrackID

IP | RPI | Data | TrackID

IP | RPI | Data | TrackID

IP | RPI | Data | TrackID

IP
6top   SF1
6P
TSCH-MAC
PHY

IP
6top   SF1
6P
TSCH-MAC
PHY

IP
6top   SF1
6P
TSCH-MAC
PHY
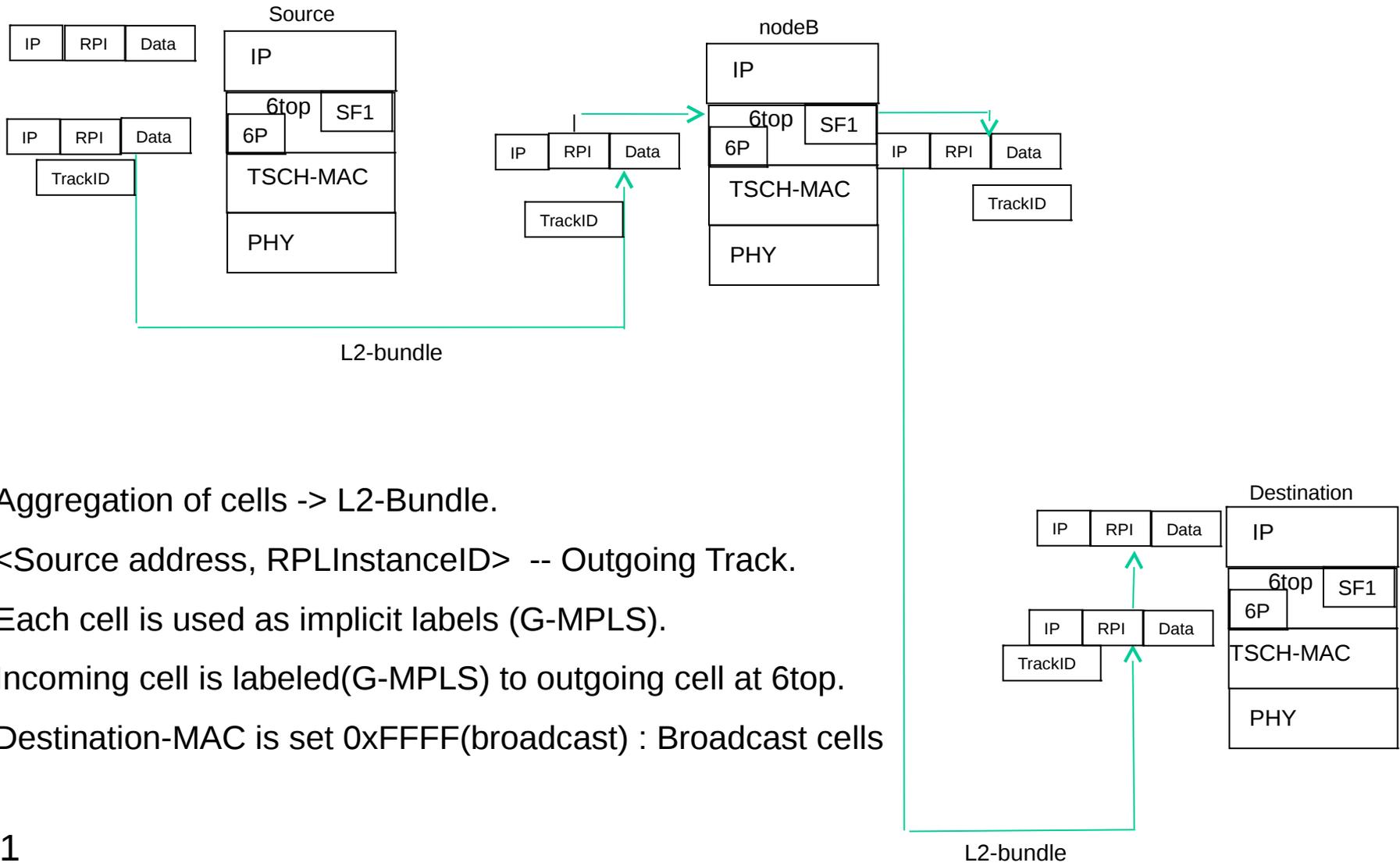
- Aggregation of cells -> L2-Bundle.

- \<Source address, RPLInstanceID\> -- Outgoing Track.

- Each cell is used as implicit labels (G-MPLS).

- Incoming cell is labeled(G-MPLS) to outgoing cell at 6top.

- Destination-MAC is set 0xFFFF(broadcast) : Broadcast cells

SF1 Triggering Events

- **Triggering event.**

    - If Source node has any Outgoing Bandwidth Requirement for new instance (OB.Instance).

    - If Source node has New Outgoing Bandwidth Requirement for Ongoing Instance (NOB.Instance).

- **Bandwidth Estimation Algorithm (BEA)**

    - **New Instance**

        - With RSVP admission control, SF1 gets the allocated bandwidth for New Instance.

        - Obtain Outgoing Bandwidth requirement for new Instance (OB.Instance).

            - Assign OB.NewInstance <- SB.NewInstance.

        - Map OB.NewInstance to required number of cells(NumCells).

    - **Ongoing Instance**

        - Re-routing Traffic through "make-before-break" operation in RSVP-TE.

        - Obtain Increased Bandwidth Information(IB.Instance) from "make before- break operation".

        - Obtain New Scheduled Bandwidth (NSB.Instance = SB.instance+IB.Instance).

        - Obtain New outgoing Bandwidth (NOB.Instance) requirement .

            - Assign NOB.NewInstance <-NSB.NewInstance.

        - Map NOB.NewInstance to required number of cells(NumCells).

SF1 Allocation policy

```
          +---+---+---+---+---+--+--+---+---+---+
          |Resource Reservation Admission Control|
          +---+---+---+---+---+--+--+---+---+---+
                          |
                          |
                         \|/
          SCHEDULED BANDWIDTH TO NEXT-HOP NEIGHBOR NODE
     <------------------------------------------------------------->
     +---+---+---+---+---+---+---+---+---+       +---+---+---+
     |INSTANCE-1 |INSTANCE-2 |INSTANCE-3 |........... |INSTANCE-N |
     +---+---+---+---+-+-+---+---+---+---+       +---+---+---+
                     |
                     |
                    \|/
        SCHEDULEDCELLS OF INSTANCE-2
      <------------------------------ >
      +---+---+---+---+---+---+---+---+---+
      |   |   |   |   |   |   |   |   |   |
      +---+---+---+---+---+---+---+---+---+
                     |<----------------->|
                     |      SF1THRESH    |
                     |                   |
     REQUIREDCELLS   |                   |
     +---+---+       |                   |        DELETE
     |   |   |       |                   |        ONE/MORE
     +---+---+       |                   |        CELLS
                     |                   |
        REQUIREDCELLS                    |
     +---+---+---+---+---+---+           |        DO
     |   |   |   |   |   |   |           |        NOTHING
     +---+---+---+---+---+---+           |
                     |                   |
           REQUIREDCELLS                 |
     +---+---+---+---+---+---+---+---+---+---+    ADD
     |   |   |   |   |   |   |   |   |   |   |    ONE/MORE
     +---+---+---+---+---+---+---+---+---+---+    CELLS
```

IETF96 Berlin update

6TiSCH related Activities

- PlugTest
- Hackathon
- Meeting (2Hours?)
- 6LPWA BoF
- DetNet

Plugtest update

- Time and location: 15-17 July 2016, in Berlin
- Registration Link
  http://www.etsi.org/news-events/events/1077-6tisch-6lo-plugtests
  .

- ETSI called to recruit technical expertise on:

  The development of interoperability tests

  Technical preparation of the event

  Technical support during the event pertaining to 6TiSCH and 6lo specifications

  Supervision of the test sessions and recording of results

  Compilation of the daily wrap-up meetings

  Compilation of the event technical report and roadmap for future events.

Berlin Agenda bashing

- Administrivia   [3min]
  - Agenda bashing
  - Approval minutes from last meeting
- WG docs status and new Charter <the chairs>   [10min]
  - Minimal, Archie, Terminology
  - 6top?
- 6TiSCH SF0   [20min]
- 6P   [20min]
- Security DT   [10min]
- PlugTest news   [10min]
- 6LPWA news   [15min]
- New drafts   [QS]
  - SF1
- AOB   [2min]

Introduction to 6LPWA

IPv6 over Low-Power Wide Area Networks

LoRa, SigFox, 802.15.4g (Wi-SUN), NB-IOT

Candidate WG, WG-forming BoF in Berlin

Agenda

General introduction, 6LPWA architecture

Selected technologies:

Applicability and gap analysis of Internet

Charter and work Items Discussions

AOB ?

Thank you!