Friday 2021-01-29 14:30 UTC

# ROLL- Virtual Interim Meeting -

## Routing over Low-Power And Lossy Networks

**Chairs:**

Dominique Barthel

Ines Robles

**Secretary:**

Michael Richardson

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BCP 9 (Internet Standards Process)
BCP 25 (Working Group processes)
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BCP 78 (Copyright)
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https://www.ietf.org/privacy-policy/   (Privacy Policy)

Source: https://www.ietf.org/about/note-well/

# Meeting Materials

- Session:  Friday 2021-01-29 14:30 UTC

- Remote Participation

  - Etherpad/codimd: https://codimd.ietf.org/notes-ietf-interim-2021-roll-01-roll

  - Slides: https://datatracker.ietf.org/meeting/interim-2021-roll-01/session/roll

  - Minutes taker:  **Please volunteer, thank you :)**

# Agenda

```
Agenda Roll-Interim Meeting -20210129

Time: 9:30 am Eastern Time = 2:30 pm UTC = 3:30 pm CET

  Topic                              Duration        Presenter
- Introduction/WG-Status:           15 min          [Ines/Dominique]
- draft-hushe-roll-dodag-metric:    30 min          [Huimin She]
- dao-projection status and options 30 min          [Pascal]
- Open Floor                                45 min              Everyone
```

# Milestones

## Done milestones

| Date | Milestone |
|------|-----------|
| Done | Initial submission to the IESG of mechanism to turn on RFC8138 compression feature within a RPL network<br>draft-ietf-roll-turnon-rfc8138 |
| Done | Initial submission of routing for RPL Leaves draft to the IESG<br>draft-ietf-roll-unaware-leaves |
| Done | Initial submission of a reactive P2P route discovery mechanism based on AODV-RPL protocol to the IESG<br>draft-ietf-roll-aodv-rpl |
| Done | Initial Submission of a proposal with uses cases for RPI, RH3 and IPv6-in-IPv6 encapsulation to the IESG<br>draft-ietf-roll-useofrplinfo |
| Done | Initial submission of a solution to the problems due to the use of No-Path DAO Messages to the IESG<br>draft-ietf-roll-efficient-npdao |

# State of Active Internet-Drafts

| Draft | Status |
|---|---|
| **draft-ietf-roll-efficient-npdao-18** | RFC Ed Queue - New version |
| **draft-ietf-roll-turnon-rfc8138-18** | RFC Ed Queue |
| **draft-ietf-roll-unaware-leaves-30** | RFC Ed Queue |
| **draft-ietf-roll-useofrplinfo-44** | IESG Approved-announcement sent |
| **draft-ietf-roll-capabilities-07** | Work in progress |
| **draft-ietf-roll-dao-projection-16** | **Discussion Today** |
| **draft-ietf-roll-enrollment-priority-03** | Reviews needed |
| **draft-ietf-roll-mopex-02** | Work in progress |
| **draft-ietf-roll-nsa-extension-10** | Shepherd write up in progress |
| **draft-ietf-roll-aodv-rpl-08** | AD Evaluation::Revised I-D Needed |
| **draft-ietf-roll-dis-modifications-01** | Stand By |
| **draft-ietf-roll-rpl-observations-05** | Work in progress |

2 IPRs (draft-ietf-roll-efficient-npdao-18)

1 IPR (draft-ietf-roll-dao-projection-16)

2 IPRs (draft-ietf-roll-nsa-extension-10)

# State of inactive Internet-Drafts

| Draft | Status |
|---|---|
| **Draft-ietf-roll-mpl-yang-02 (Expired)** | To be continued |
| **Draft-ietf-roll-bier-ccast-01 (Expired)** | To be continued |

# Related Internet-Drafts

| Draft | Status |
|-------|--------|
| **draft-jadhav-roll-storing-rootack-01** | Adoption call |
| **draft-thubert-roll-eliding-dio-information** | Expired - To be Continued later - |
| **draft-hushe-roll-dodag-metric** | Discussion Today |
| **draft-pthubert-roll-rfc6550bis** | Work in progress |

# Open tickets



https://github.com/roll-wg/efficient-route-invalidation/issues

roll-wg / **efficient-route-invalidation**

<> Code    ⓘ Issues  **1**    Pull requests  **0**    A

Filters ▾    🔍 is:issue is:open

☐    ⓘ **1 Open**    ✓ 0 Closed

☐    ⓘ **RPL Status Code of 130 is incorrect**
      #4 opened on Nov 26, 2019 by nyrahul

roll-wg / **rpl-observations**

<> Code    ⓘ Issues  **3**    ⫙ Pull requests    ⓘ Actions    ▦ Projects    📖 Wiki    🛡 Security    📈 Insig

Filters ▾    🔍 is:issue is:open

☐    ⓘ **3 Open**    ✓ 4 Closed

☐    ⓘ **Parent Address MUST be empty in Transit Information for storing MOP**
      #10 opened on Mar 16, 2020 by nyrahul

☐    ⓘ **Implications of using smaller lollipop counter window**
      #9 opened on Dec 12, 2019 by nyrahul

☐    ⓘ **Path Control bits handling**
      #6 opened on Nov 12, 2019 by nyrahul

https://github.com/roll-wg/rpl-observations/issues

9

# Open tickets

https://github.com/roll-wg/dao-projection/issues

# Open tickets

| Ticket | Summary | Component |
|--------|---------|-----------|
| #179 | Security considerations for dao projection | dao-projection |
| #180 | 13 issues to address in dao projection draft (lifetime, MOP, retransmissions, route cleanup) | dao-projection |
| #187 | New version of RFC6550 - Topics to include | rpl |
| #188 | Should 6LBR be included into the DODAG root? | rpl |
| #199 | Issues in version 08 | aodv-rpl |
| #200 | Issues in version 08 - Part II | aodv-rpl |

https://trac.ietf.org/trac/roll/report/2

# A DODAG Metric Used for DODAG Selection in LLNs

Huimin She (hushe@cisco.com)

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Pascal Thubert (pthubert@cisco.com)

# Motivation

- LLNs consists of a border router (root) and nodes
  - Limited nodes managed by a root
  - Load balance

- Which DODAG to join for a new node?
  - Already exist: Link ETX
  - Missing: DODAG size



□ root

□ root

Which PAN to join?
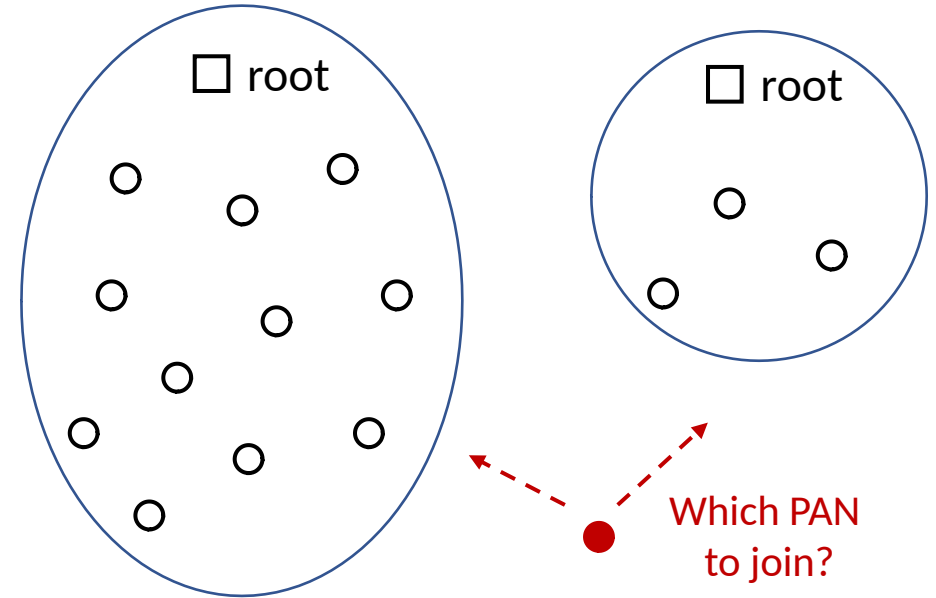
# RFC6550: DAG metric container

- RFC 6550: DAG metric Container Option
  - report metrics along the DODAG

```
 0                   1                   2
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+- - - - - - - -
|   Type = 0x02 | Option Length | Metric Data
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+- - - - - - - -
```

# RFC6551: DAG metric container

- RFC 6551: Routing Metric/Constraint Object Generic Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Routing-MC-Type|Res Flags|P|C|O|R| A   |  Prec | Length (bytes)|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
//                        (object body)                       //
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
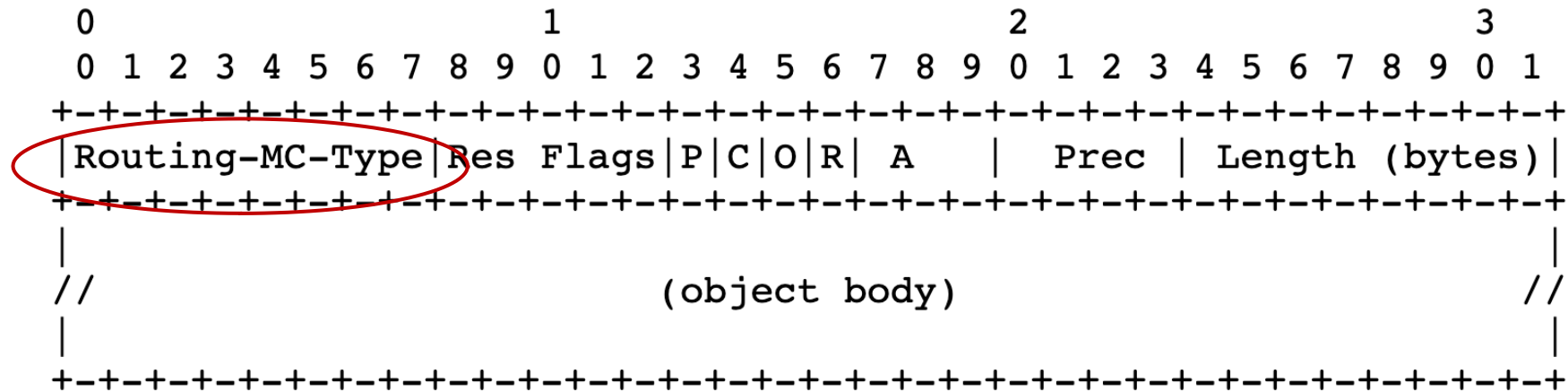
| Value | Meaning | Reference |
|-------|---------|-----------|
| 1 | Node State and Attribute | This document |
| 2 | Node Energy | This document |
| 3 | Hop Count | This document |
| 4 | Link Throughput | This document |
| 5 | Link Latency | This document |
| 6 | Link Quality Level | This document |
| 7 | Link ETX | This document |
| 8 | Link Color | This document |

# DODAG size object

- DODAG size object format
  - Extends RFC 6551

| 8 bits | 5 | 1 | 1 | 1 | 1 | 3 | 4 | 8 | 16 |
|--------|-----------|---|---|---|---|------|-----------------|-----------------|------------|
| Type | Res Flags | P | C | O | R | A | Prec | Length (bytes) | DODAG size |

- Type: 9 (suggested)
- Flags:
  - P = 0,  C = 0, O = 0, R = 1, A = 0
  - Prec: useful when a DAG Metric Container contains several Routing Metric objects. Its value ranges from 0 to 15. The value 0 means the highest precedence.
  - Length: 2

# Disseminate DODAG Size

- DODAG size
    - Collected by the root
    - Periodically disseminated to nodes in the PAN
- Two ways to disseminate DODAG Size
    - DIO
    - DAO-ACK

# Root initiated routing state in RPL

**draft-ietf-roll-dao-projection**

P. Thubert, Ed.; R.A. Jadhav, M. Gillmore

Pascal Thubert

Interim Jan.
2021
ROLL Virtual Meeting

# Status to the draft

See the VIA Info Option as a multihop Transit Info Option

- Published -15 and -16 since last IETF

- Non-Storing Mode SRH may be loose

- Main DODAG MUST be Non-Storing Mode

- Track <=> Non-Storing Mode main DODAG:
    - Root is Track Ingress,
    - Signaled by one or more Non-Storing-Mode P-DAO messages
    - Track Ingress encapsulates external packets (as in useofrplinfo)
    - Track Ingress places the SRH in the packet in source routed tracks
    - There cannot be non-storing segments (only Tracks withing Tracks)

- Storing Mode P-DAO signals Segment of a Track or of main DODAG
    - Does not need re-encapsulation
    - Unless implicit Track => Do we support that ?

# Status to the draft (cont)

- RPI modified to indicate P-Route

- Extending RFC 6553 and RFC 8138

```
    0                   1                   2
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |1|0|E| Length  | 6LoRH Type 7  | RPLInstanceID |
```
-    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
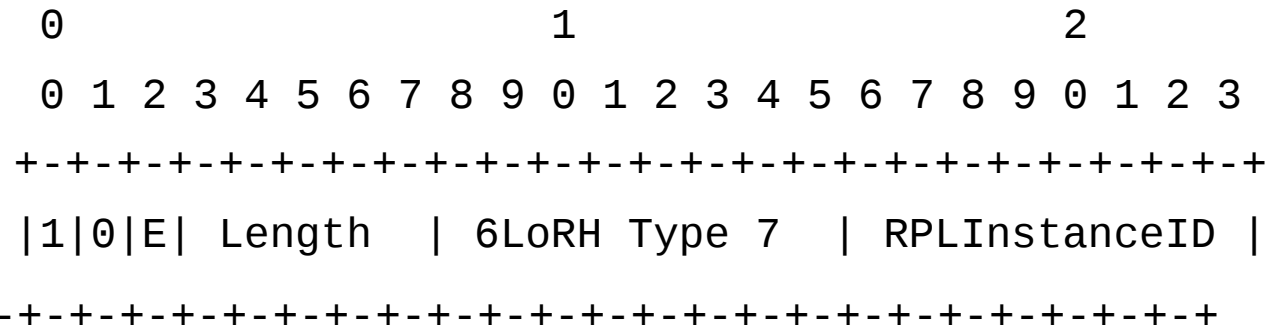
- New P-RPI-6LoRH, both elective and non-elective forms

# Encapsulation Rules

- Source of outer header MUST be Track Ingress

- RPL Instance ID in RPI MUST indicate TrackID (if not main DODAG)

- SR-VIO: Loose from Track Ingress, excluded, to Egress, included
  - Copied Verbatim in inserted SRH-6LoRH,
  - Requires encapsulation (can be recursive)

- SF-VIO: Strict from Segment Ingress to Egress, both included
  - No Encapsulation if Source and RPI both match Segment definition
  - A Segment is an Implicit Track if P-DAO Ingress == 1st SF-VIO entry

- TBD: matching rules, Flow Info option, when to tunnel?

# P-DAO construction

- RPL Target Options can be factorized
- But there is one and only one VIO (SF-VIO or SR-VIO)
- So the Ack management is easier
- VIO sent to egress; SR-VIO sent to ingress
- Track ID is a RPL local instance ID
- Taken from the Track Egress Name Space

# P-DAO Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Type        | Option Length |     Flags     |   SegmentID   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Segm. Sequence | Seg. Lifetime |     SRH-6LoRH header          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                                                               +
.                                                               .
.                      Via Address 1                            .
.                                                               .
+                                                               +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
.                          ....                                 .
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                                                               +
.                                                               .
.                      Via Address n                            .
.                                                               .
+                                                               +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
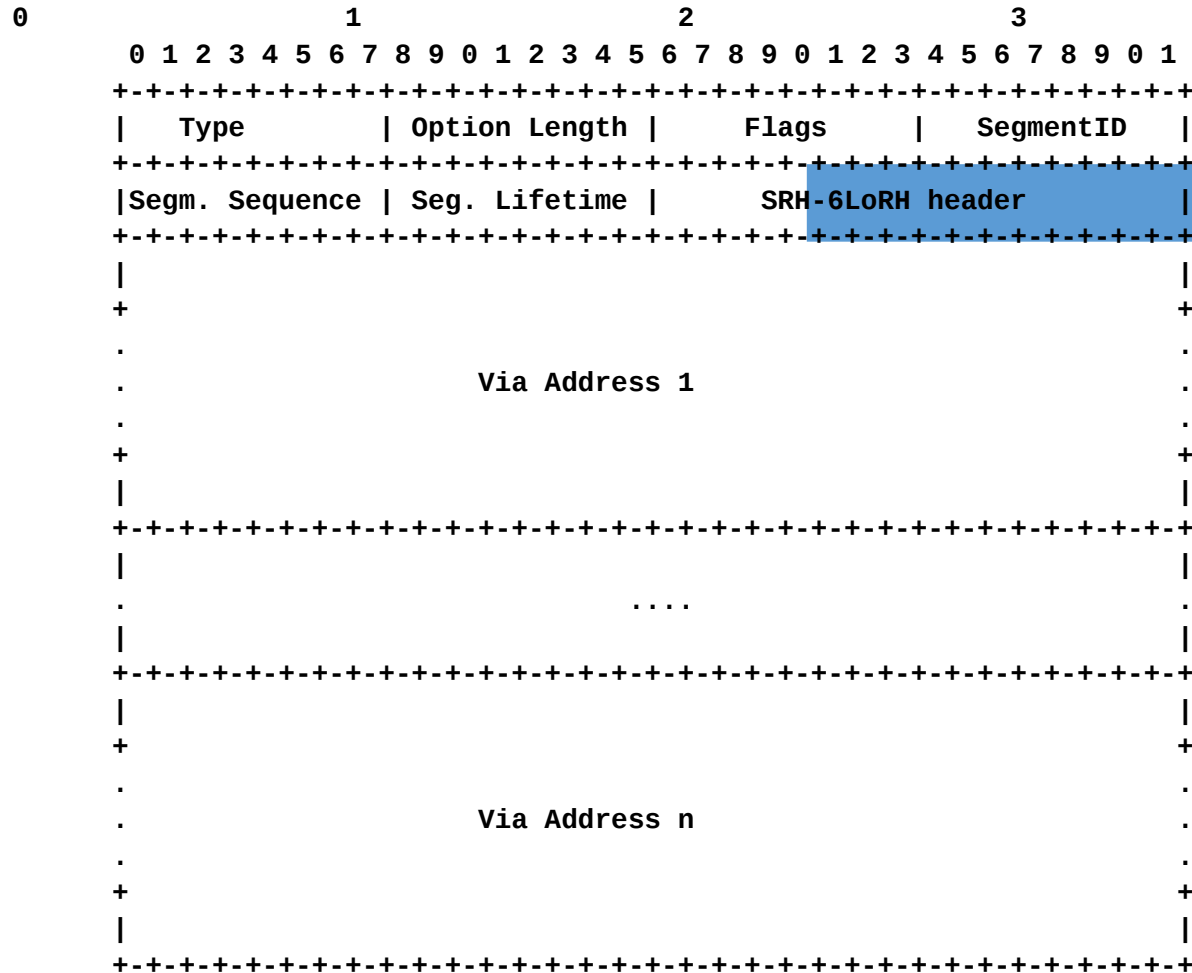
May be more than one in Non-storing Mode

Must be optimized in Non-storing Mode, to be used as is in packets
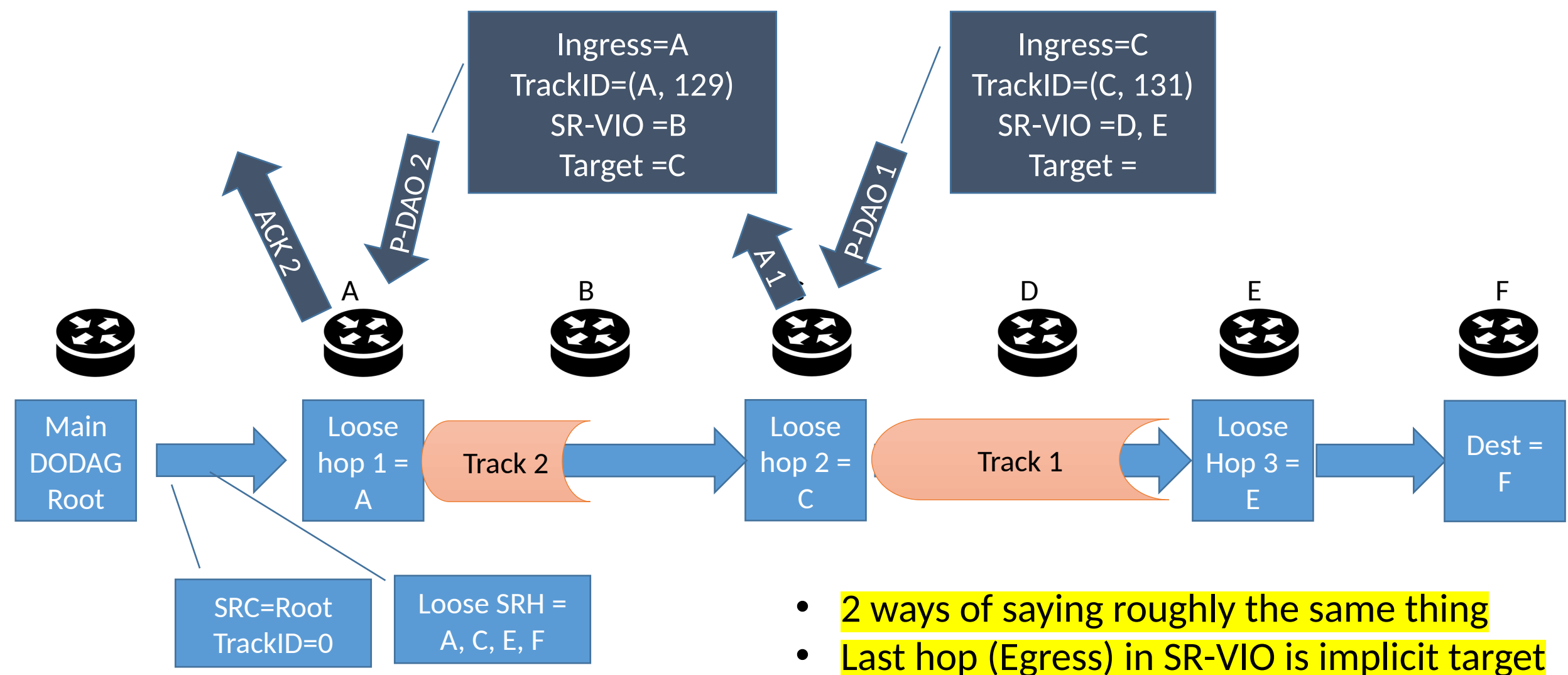
# Topology awareness

- Initially out of scope

- Now we have non storing mode + Sibling info option
  - Acronym conflict with RPL's Solicited Information Option

- Which sibling to advertise is still out of scope
  - Separate draft?

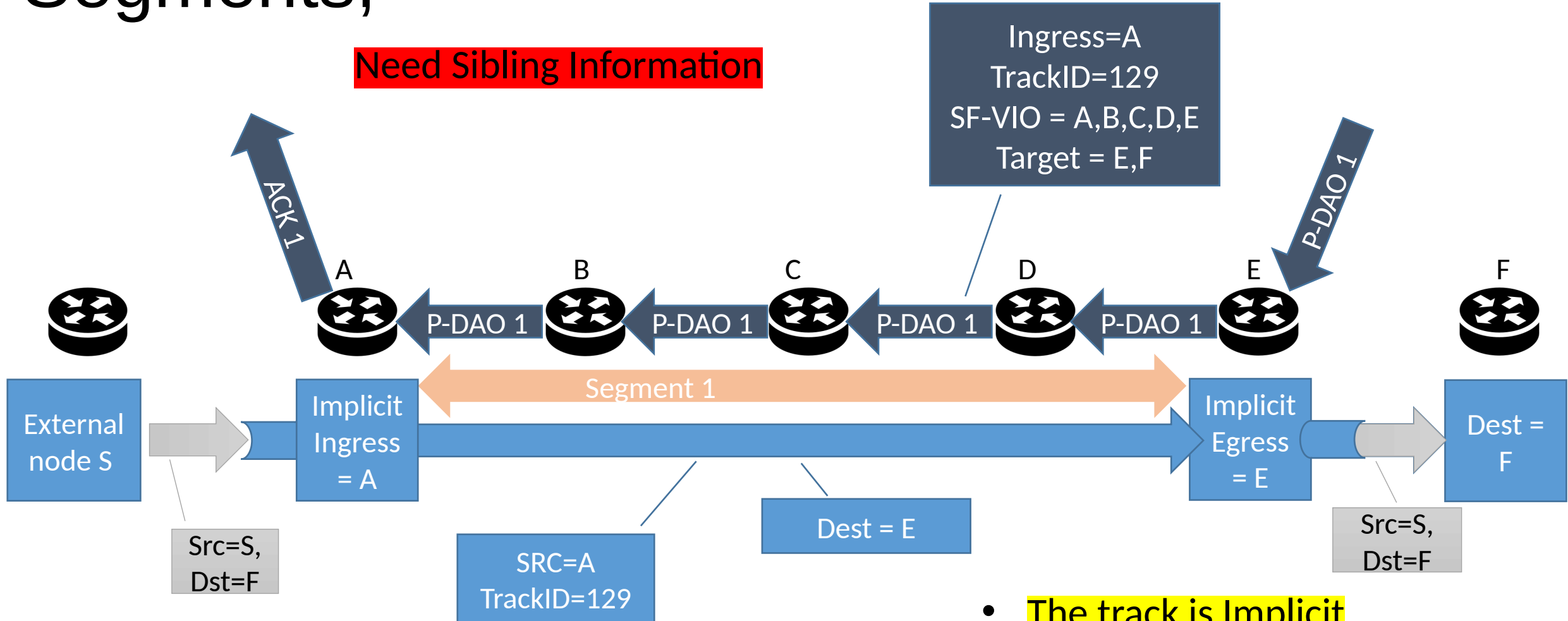# Profile 1:
# Compress SRH in main DODAG with strict SM Segments
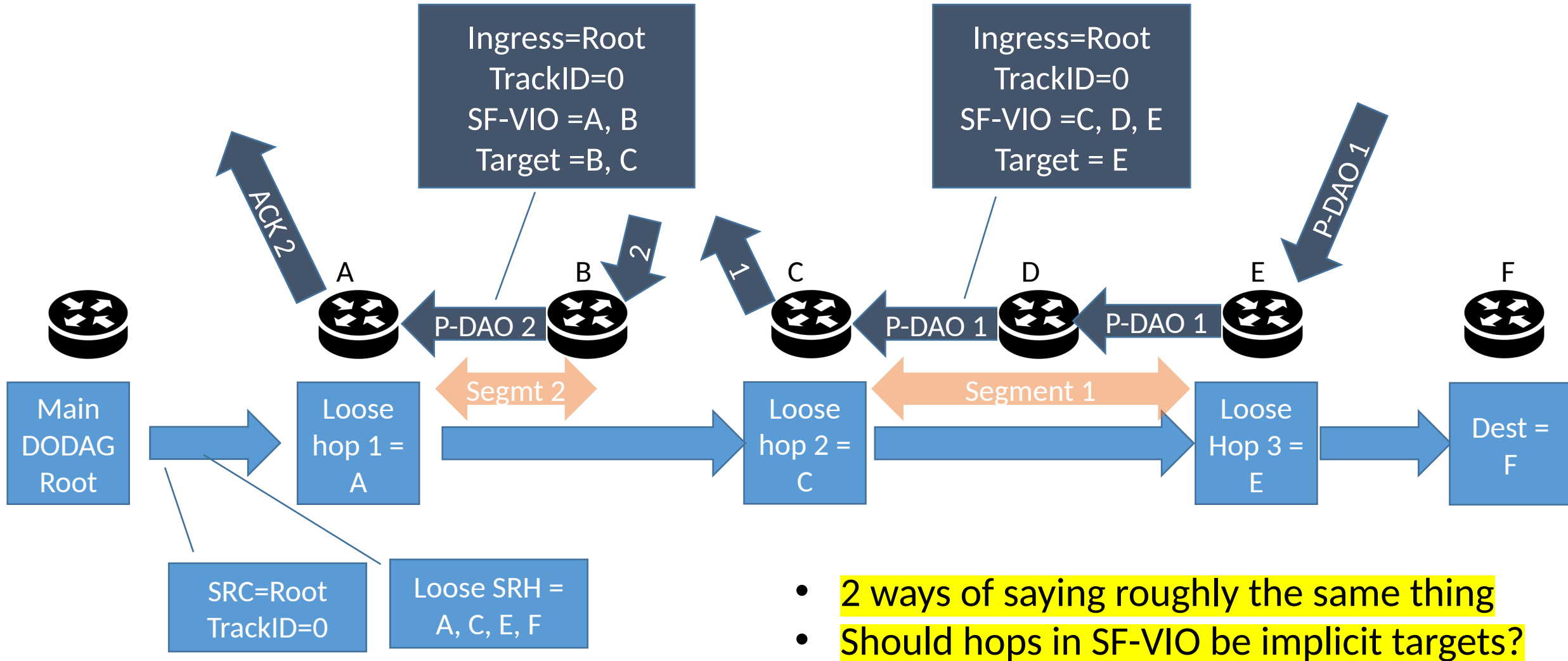
# Profile 2:
# Compress SRH in main DODAG with Strict NSM Tracks

# Profile 3: Implicit Track with Strict SM Segments,

Need Sibling Information

Ingress=A
TrackID=129
SF-VIO = A,B,C,D,E
Target = E,F

ACK 1

P-DAO 1

A  B  C  D  E  F

P-DAO 1    P-DAO 1    P-DAO 1    P-DAO 1

Segment 1

External node S

Implicit Ingress = A

Implicit Egress = E

Dest = F

Src=S, Dst=F

Dest = E

SRC=A TrackID=129

Src=S, Dst=F

- The track is Implicit
- Can we inject packets along?

# Profile 4: Strict NSM Explicit Track



Need Sibling Information

Ingress=A
TrackID=129
SR-VIO = B,C,D,E
Target = F

ACK 1

P-DAO 1

A          B          C          D          E          F

External node S → Ingress = A → Loose hop 1 = B → Loose hop 2 = C → Loose hop 3 = D → Egress = E → Dest = F

Src=S, Dst=F

Src=S, Dst=F

SRC=A TrackID=129

Dest = C SRH = D, E
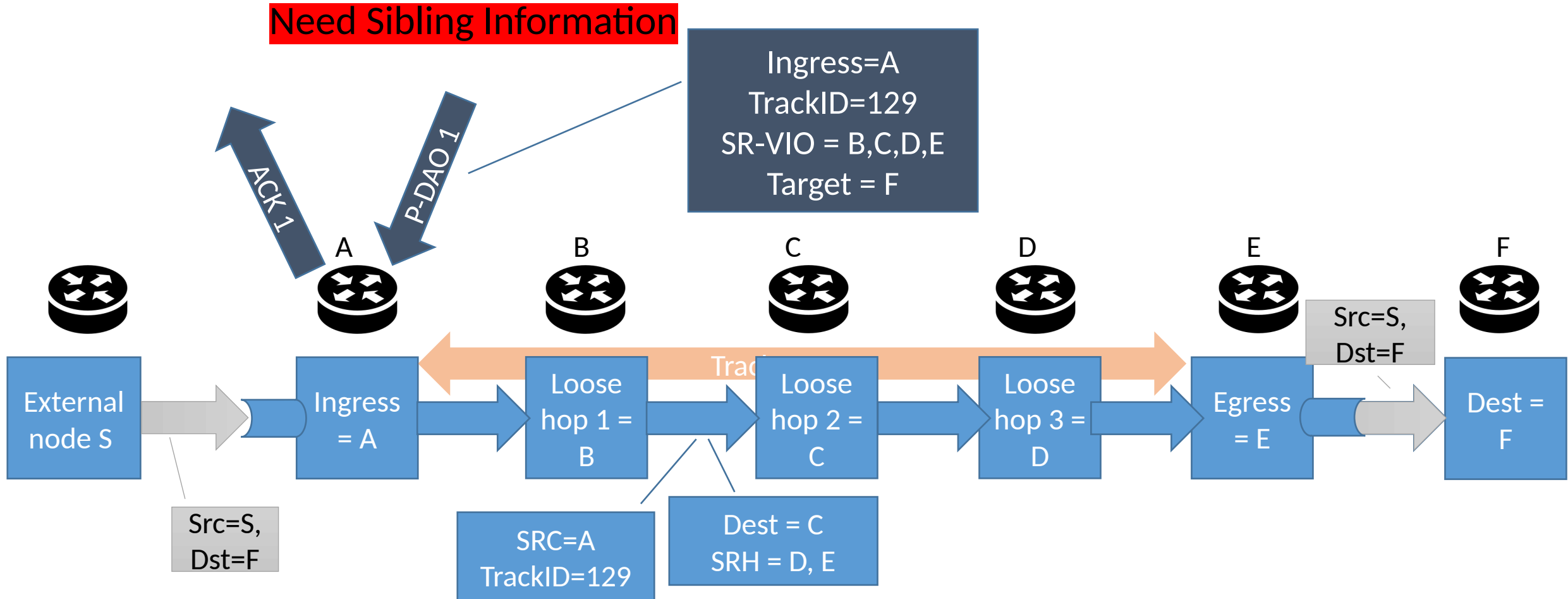
- **The track is Explicit**

# Profile 5: Compress SRH in Track with Strict SM Segments

Need Sibling Information

Ingress=A
TrackID=(A, 129)
SR-VIO =C, E
Target = F

Ingress=A
TrackID=(A, 129)
SF-VIO =A, B
Target =B, C

Ingress=I
TrackID=(A, 129)
SF-VIO =C, D, E
Target = E
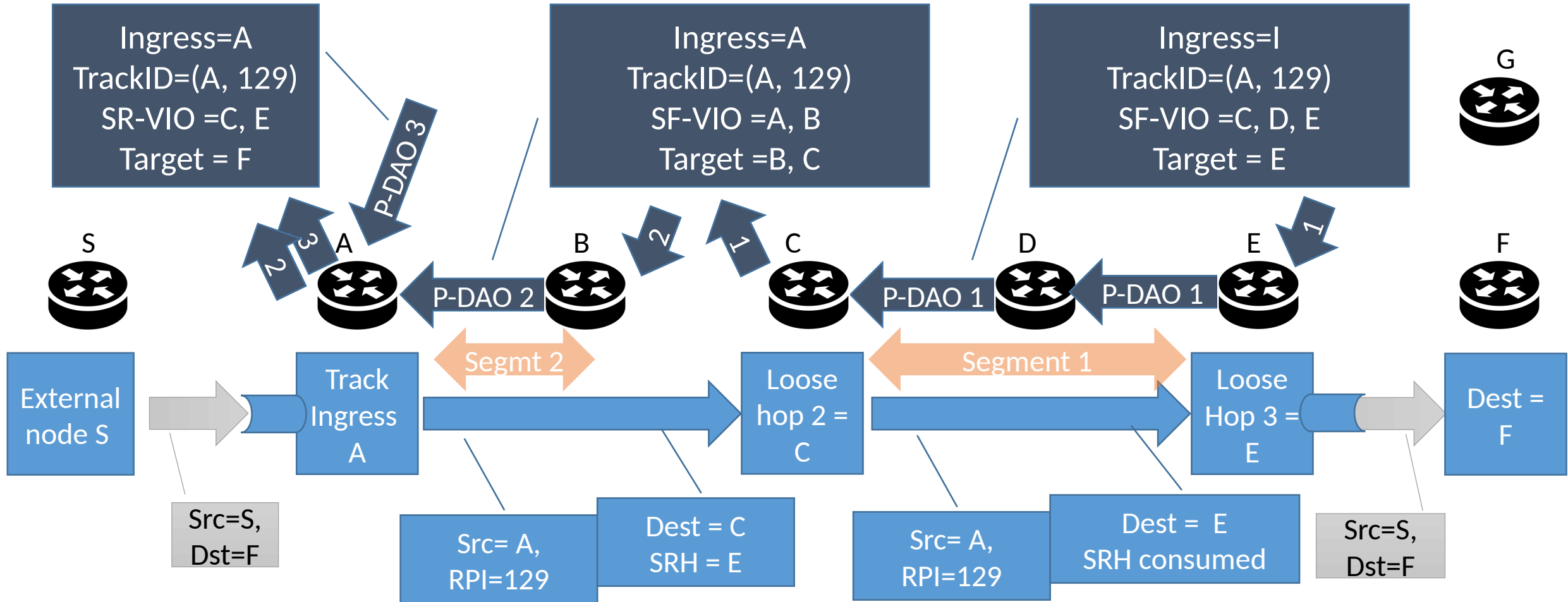
- Same as Profile 1, but for Track

# Profile 6:
# Compress SRH in Track with NSM Tracks (Recursive?)

Ingress=A
TrackID=(A, 141)
SR-VIO =C, E
Target = F

Ingress=A
TrackID=(A, 129)
SR-VIO =B
Target =C

Ingress=C
TrackID=(C, 131)
SR-VIO =D, E
Target =

P-DAO 3
P-DAO 2
P-DAO 1

I    A    B    C    D    E    F

Src= A,
RPI=129

Dest = B

External node S

Loose hop 1 = A

Track 2

Loose hop 2 = C

Track 1

Loose Hop 3 = E

Dest = F

Src=S, Dst=F

Src= A,
RPI=141

Dest = C
SRH = E

- Tunnel within Tunnel

Src=S, Dst=F
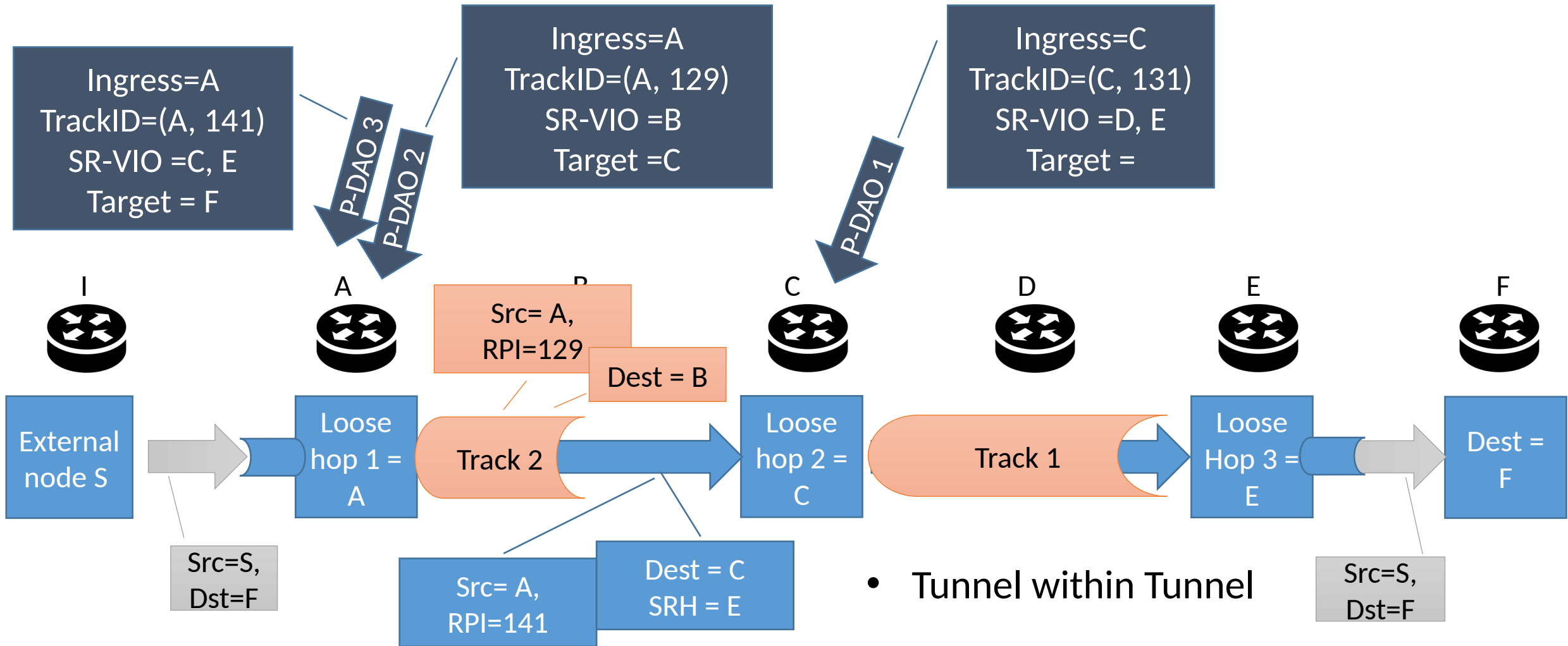
# Huimin's comments / suggestions

- Lifetime unit: ReqLifetime, Track lifetime, and Segment Lifetime are defined as 8 bits. And their lifetime Unit is obtained from the DODAG configuration option. It will lead to inflexibility as all tracks in the PAN use the same lifetime unit. We propose to define lifetime unit separately for each track ( for example adding a 2-bit flag to indicate second, minute, hour, day). Details can be discussed later.

- Now the TrackID has the same meaning as Local RplInstanceID. How does a node judge whether the received message is a P-DAO message or Local RPL instance DAO message? Is it possible to define a flag in the P-DAO message?

- The P-DAO track/segment is single-directional. I suggest to add the possibility for creating bi-directional segments/tracks. We can add a flag in the PDR message to indicate the requested track is single-directional or bi-directional.

- I suggest to add a flow of message exchanges for "PDR, PDR-ACK, P-DAO, P-DAO ACK" in the draft.

# Other to be done

- Loop avoidance

- Who sends PDR? If it was destination, then it could select the trackID from its name space

- ND (RFC 8505) to maintain sibling neighbor state

- Be very specific if Ingress and Egress are listed in RPOs
  - Ingress to indicate which source address to use
  - Egress to build the full SRH 6LoRH

# BAckup

# OPEN FLOOR

Thank you very much!!! ☺