No-Path DAO of RPL

Problem Statement

https://tools.ietf.org/html/draft-jadhav-roll-no-path-dao-ps-01

Rahul, Rabi, Zhen@ Huawei

Hui Deng @China Mobile

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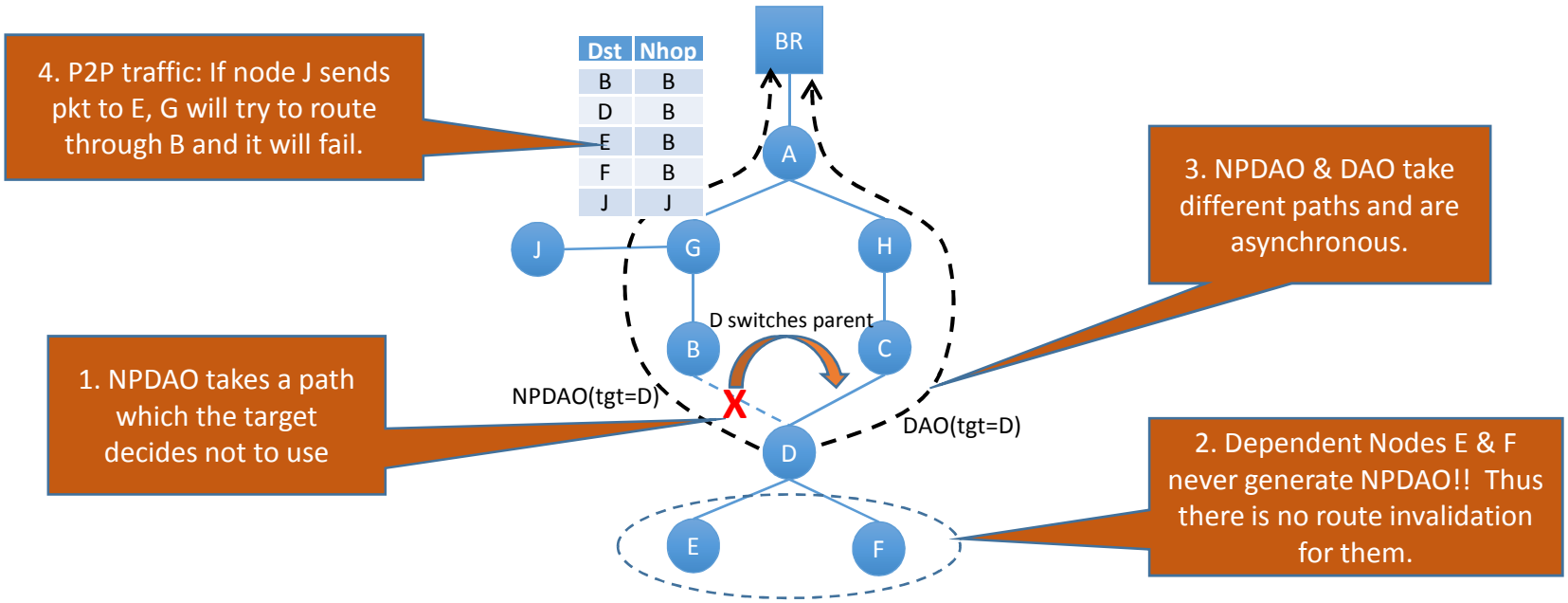
No-Path DAO is important to handle network dynamics

- **NPDAO Recap**
  - NPDAO = DAO (lifetime:=0)
  - Used for route invalidation
    - Release resources (for e.g. routing entries) along the previous path
  - Traverses upwards along the path from previous best parent towards the sink

- **Why NPDAO is important?**
  - Routing entries are the biggest memory-hogging component (especially in bigger storing-mode RPL networks)
    - In case of contention, its better to know which entries are non-active.
  - When a node switches parent, the sub-tree rooted at that node switches. Thus a high possibility of invalid route entries.
  - Impacts P2P traffic

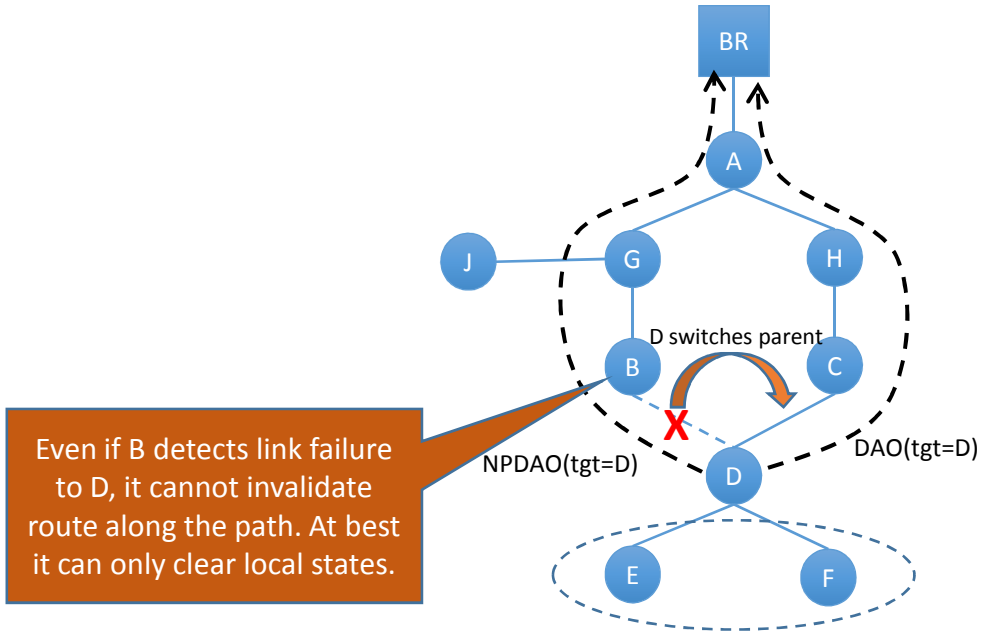
Problems with NPDAO

1. NPDAO messaging depends on previous link which the node decided to no longer use
2. No route invalidation for dependent nodes
3. Possibility of Route downtime caused by async operation of NPDAO and DAO.
   - If NPDAO reaches before DAO, then the route will be unavailable till the time DAO reaches the all common parent nodes (A & BR in the example below).
4. Impact on P2P traffic because of NPDAO inefficiency



Possible existing solutions and corresponding problems…

- It may be possible for the parent to detect child unavailability*
  - Problem is parent cannot act unilaterally based on this info
  - On error detection, RFC6550 section 11.2.2.3 mentions parent can send "a packet" to clear the RPL states*… The provisions are vaguely stated…

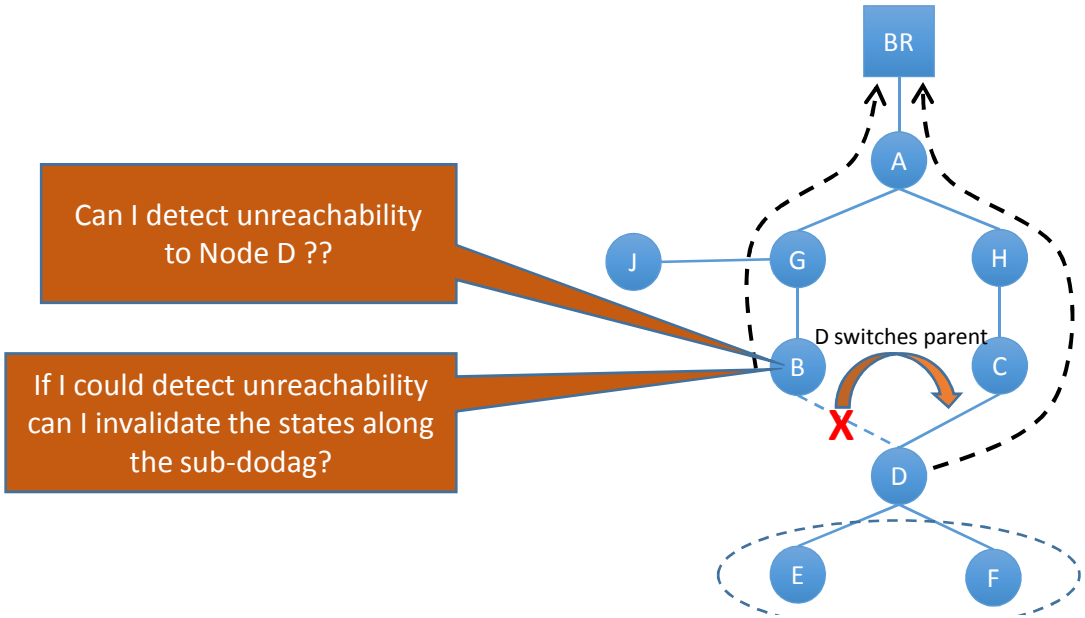


Section 11.2.2.3 states:
"With DAO inconsistency loop recovery, a packet can be used to recursively explore and clean up the obsolete DAO states along a sub-DODAG."

[*] Thanks to Cenk for pointing this out

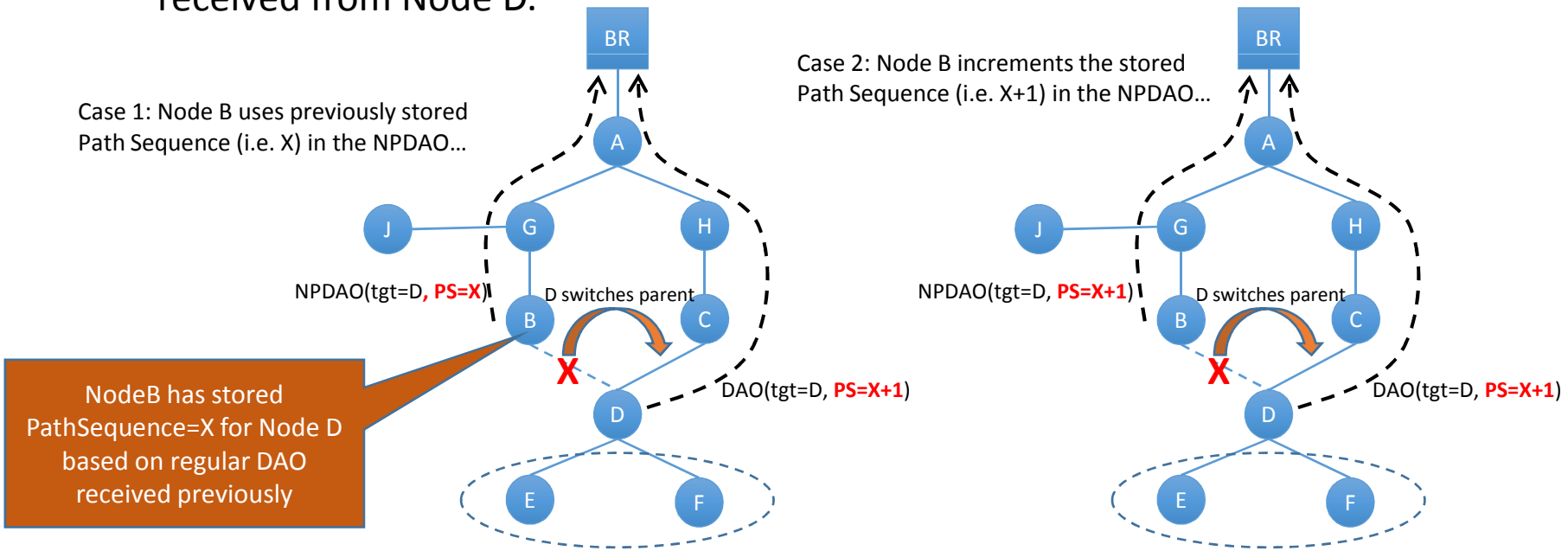
Async NPDAO generation by parent node - Scenarios

- We received several comments describing possibility that the parent node can detect that child node is no more available and can initiate route cleanup along the previous path
  - Such detection can work only if there is any unicast P2P traffic to the child node originated along the previous path!
  - Or if the parent has some explicit detection for child node reachability which is seldom used in LLNs.
  - In case of sleepy leaf nodes such detection may not be feasible.



Impact of DAO state information - PathSequence

- *Assuming a parent node detects child unreachability and can generate an NPDAO on behalf of child node… What PathSequence can be used in the NPDAO ?*
- Every target is associated with a PathSequence number which relates to the latest state of the target. Every router en-route stores this sequence number to identify the freshness of the DAO.
- Consider two scenarios, Node B has stored PathSeq=X from previous DAO received from Node D.



PS = PathSequence

Requirements for NPDAO improvements

- Should be tolerant to link failures to previous parent
- Should be possible to invalidate routes for dependent nodes as well
- Avoid route downtime because of NPDAO, DAO operation
- Should not introduce new memory requirement to handle route invalidation

Next Step

- Shall we work on this problem within ROLL WG?
- WG Adoption?

Thank you