22 September 2017 Webex

Chairs:
Pascal Thubert
Thomas Watteyne

Etherpad for Minutes: https://etherpad.tools.ietf.org/p/6tisch

IPv6 over the TSCH mode of IEEE 802.15.4

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*** From the Webex login

Agenda bashing

7:05	Opening, agenda bashing (Chairs) • Note-Well, Scribes, Agenda Bashing, Approval minutes from last meeting • Status of drafts (WGLC / forthcoming WGLC) • Last meeting todos	10mn
7:15	Using the datapath for faster local repair (Pascal)	15mn
7:30	Influence of Link Metric on reliability; ETX^n (Simon)	10mn
7:40	Open Discussion	18mn
7:58	AOB	QS

Milestones

Before

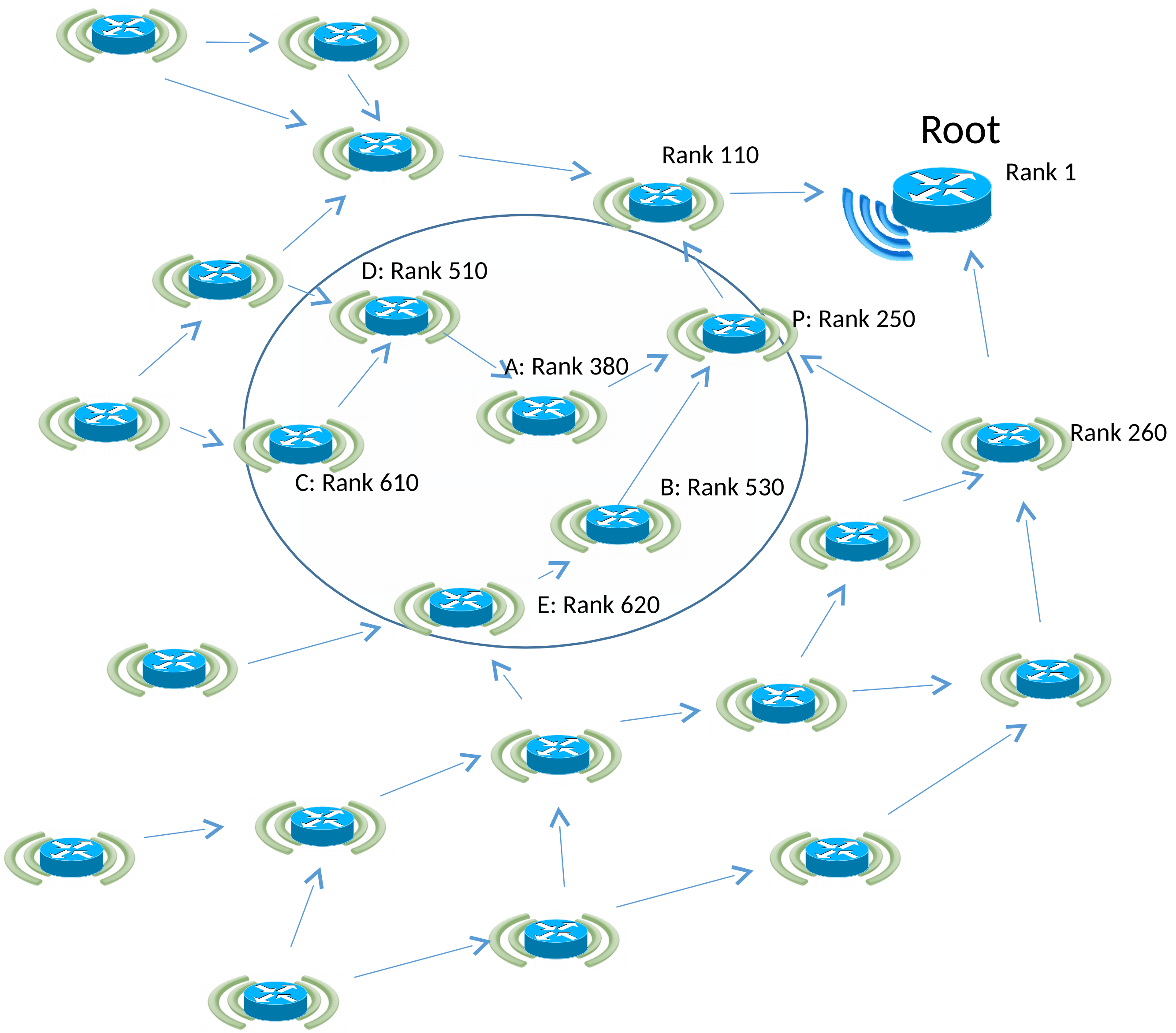
Date	Milestone
Dec 2017	6TiSCH architecture and terminology in RFC publication queue
Apr 2017	Initial submission of 6TiSCH architecture to the IESG draft-ietf-6tisch-architecture
Apr 2017	Initial submission of 6TiSCH terminology to the IESG draft-ietf-6tisch-terminology
Dec 2016	Evaluate WG progress, propose new charter to the IESG
Dec 2016	Initial submission of draft-ietf-6tisch-6top-sf0 to the IESG
Dec 2016	Initial submission of draft-ietf-6tisch-6top-protocol to the IESG draft-ietf-6tisch-6top-protocol

After

Date	Milestone
Dec 2018	6TiSCH architecture and terminology in RFC publication queue
Nov 2018	Initial submission of 6TiSCH architecture to the IESG draft-ietf-6tisch-architecture
Oct 2018	Initial submission of 6TiSCH terminology to the IESG draft-ietf-6tisch-terminology
Jul 2018	Initial submission of draft-ietf-6tisch-dtsecurity-zerotouch-join to the IESG draft-ietf-6tisch-dtsecurity-zerotouch-join
Feb 2018	Initial submission of draft-ietf-6tisch-minimal-security to the IESG draft-ietf-6tisch-minimal-security
Oct 2017	Initial submission of draft-ietf-6tisch-6top-sfx to the IESG draft-ietf-6tisch-6top-sfx
Oct 2017	Initial submission of draft-ietf-6tisch-6top-protocol to the IESG draft-ietf-6tisch-6top-protocol

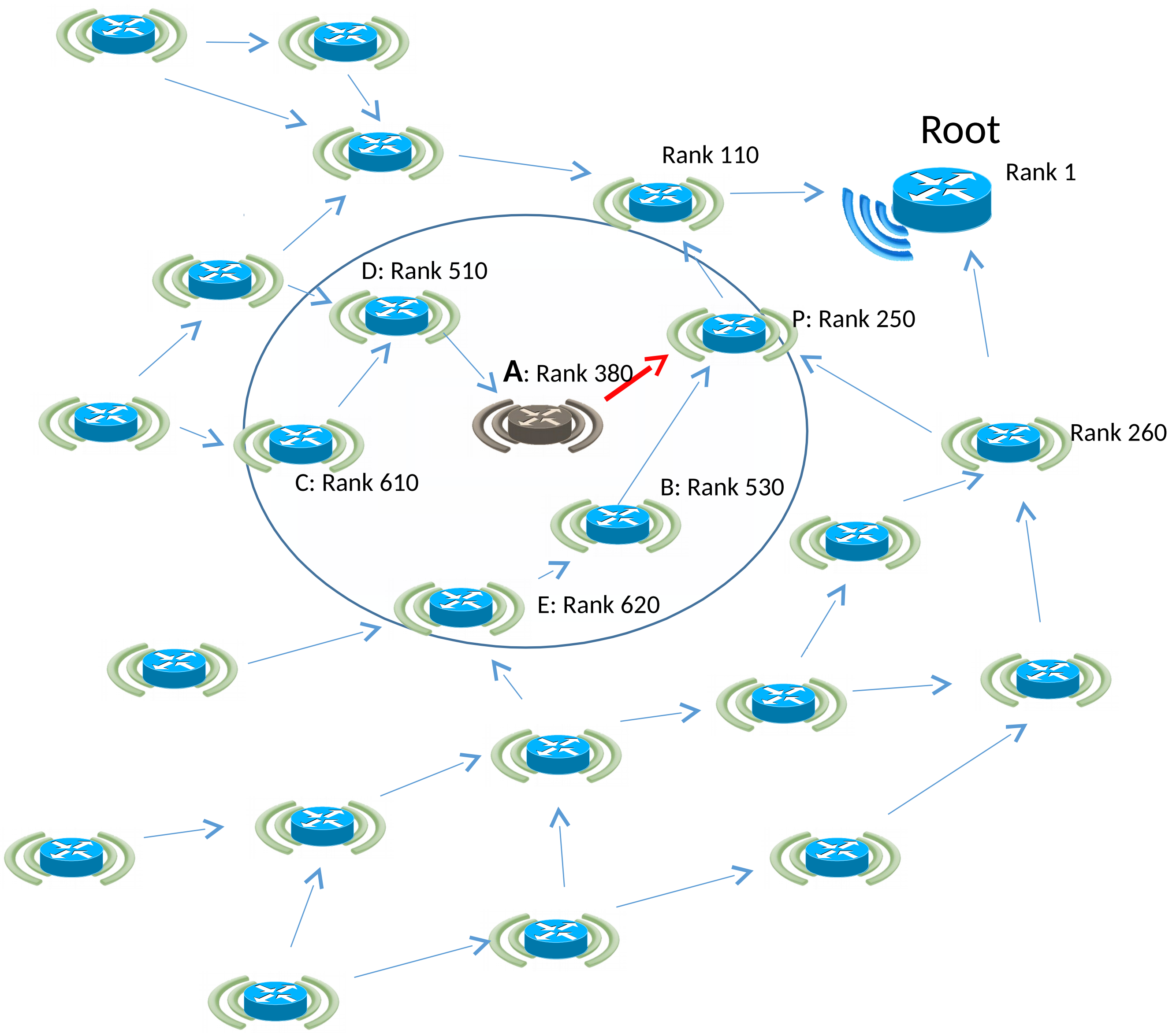
Fast reroute in RPL

Using the datapath to determine feasible successors



Initial situation;

- Rank is computed on some metric e.g. LQI.
- Node A has a single parent, node P
- A can hear D and C which are in its subdag
- A can hear B and E which are not

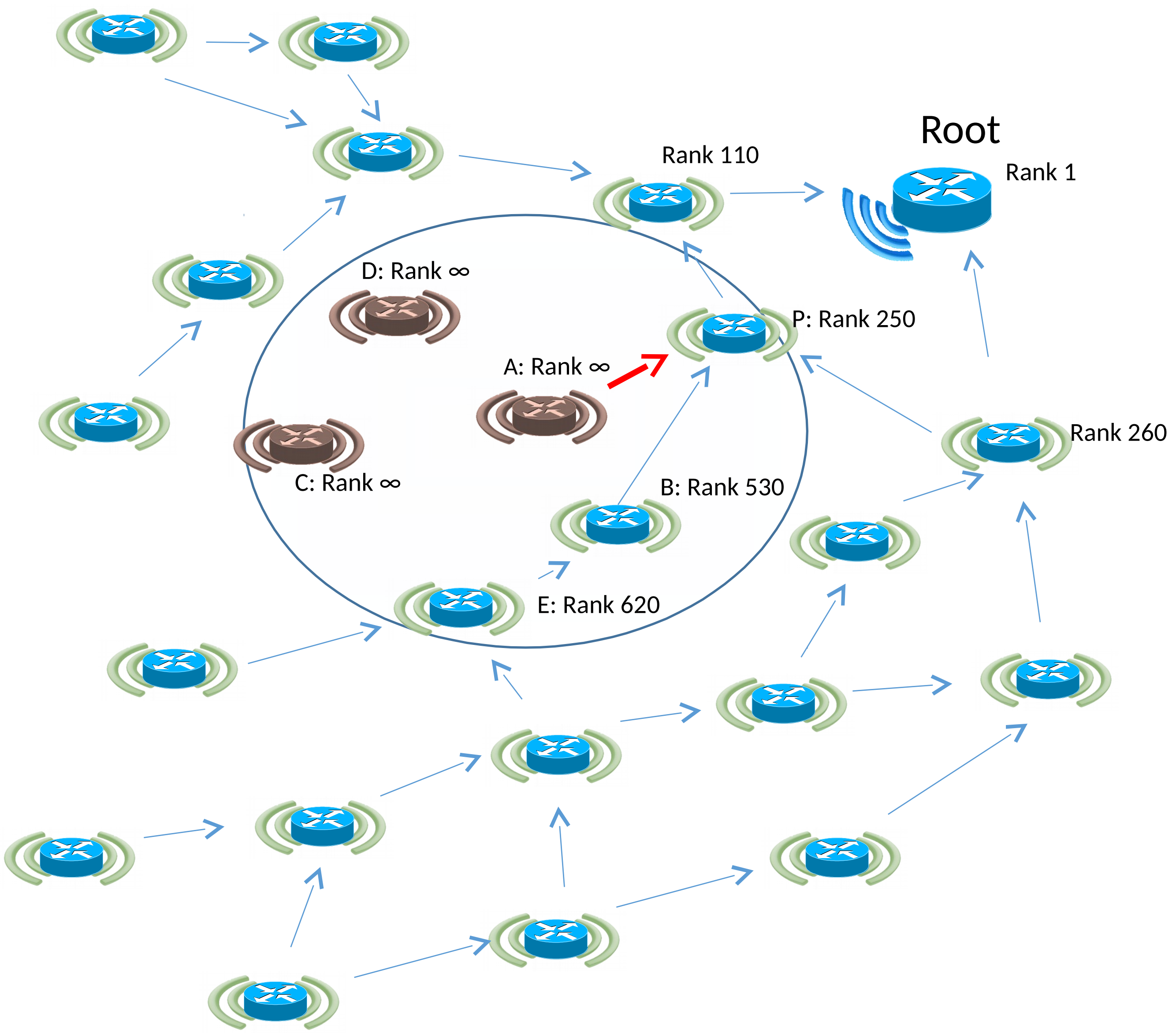


Say that the radio connectivity between A and P dies. A looses it only feasible parent.

Its neighbors are all deeper (higher Rank) so it cannot reattach without risking a loop.

Attaching to D and C would create a loop.
Attaching to E or B would note create a loop.

Trouble is A does not know.



RPL RFC 6550 says that node A must detach, poison, and wait for the resulting of poisoning.

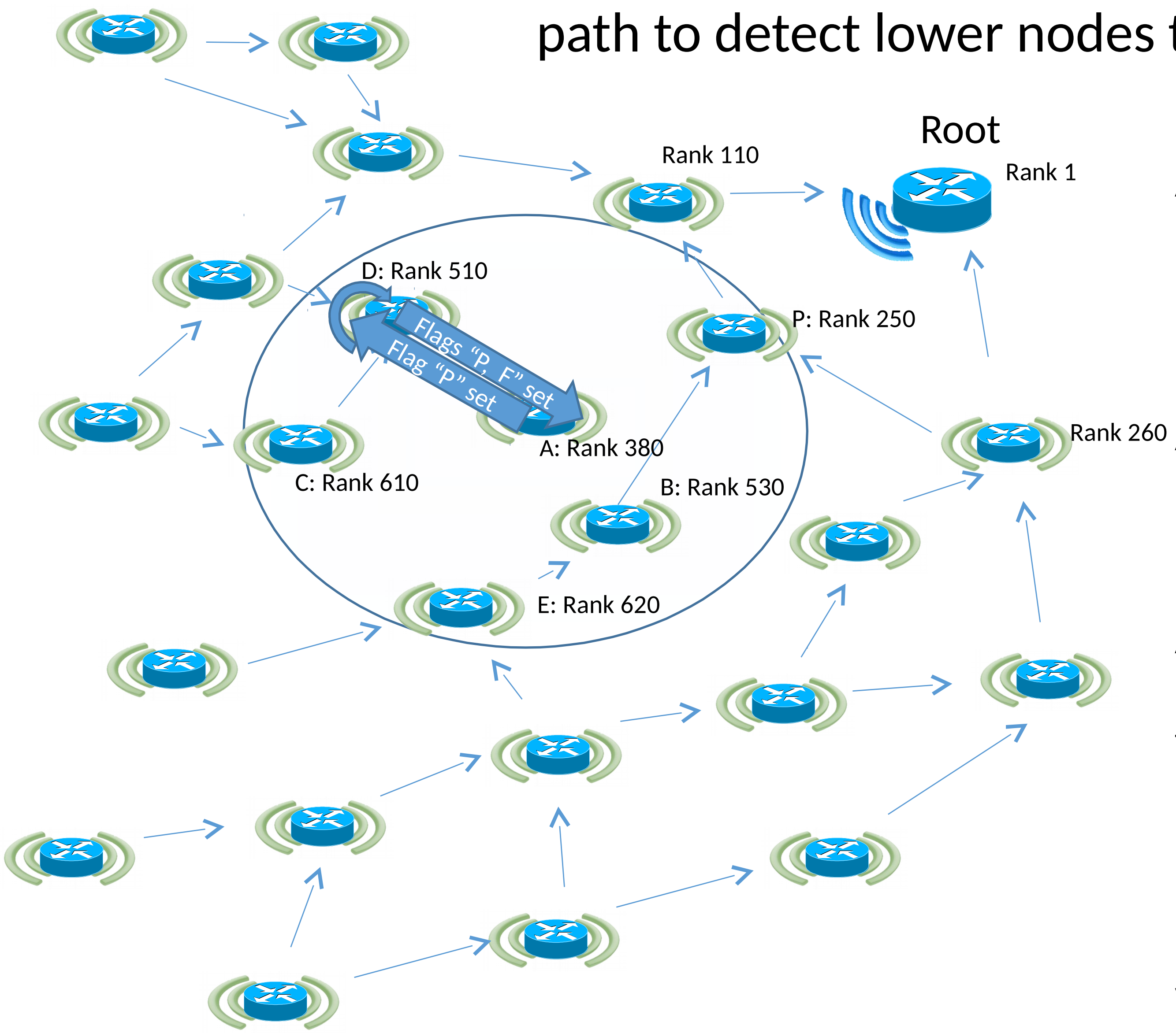
A (preferable IMHO) alternative is to form a floating DAG, which spreads the poisoning differently with the advantage to maintain the shape of the DODAG in place

After some time, the devices that depended on A are (mostly) poisoned or re-parented elsewhere.

From that point, RPL says that the poisoned nodes can all reparent, that's A, D and C here, and then the network is fixed

The problem is the “After some time” above. That is disruptive to traffic, which can be unacceptable

Proposal use to keep forwarding and to use the data path to detect lower nodes that are feasible successors:



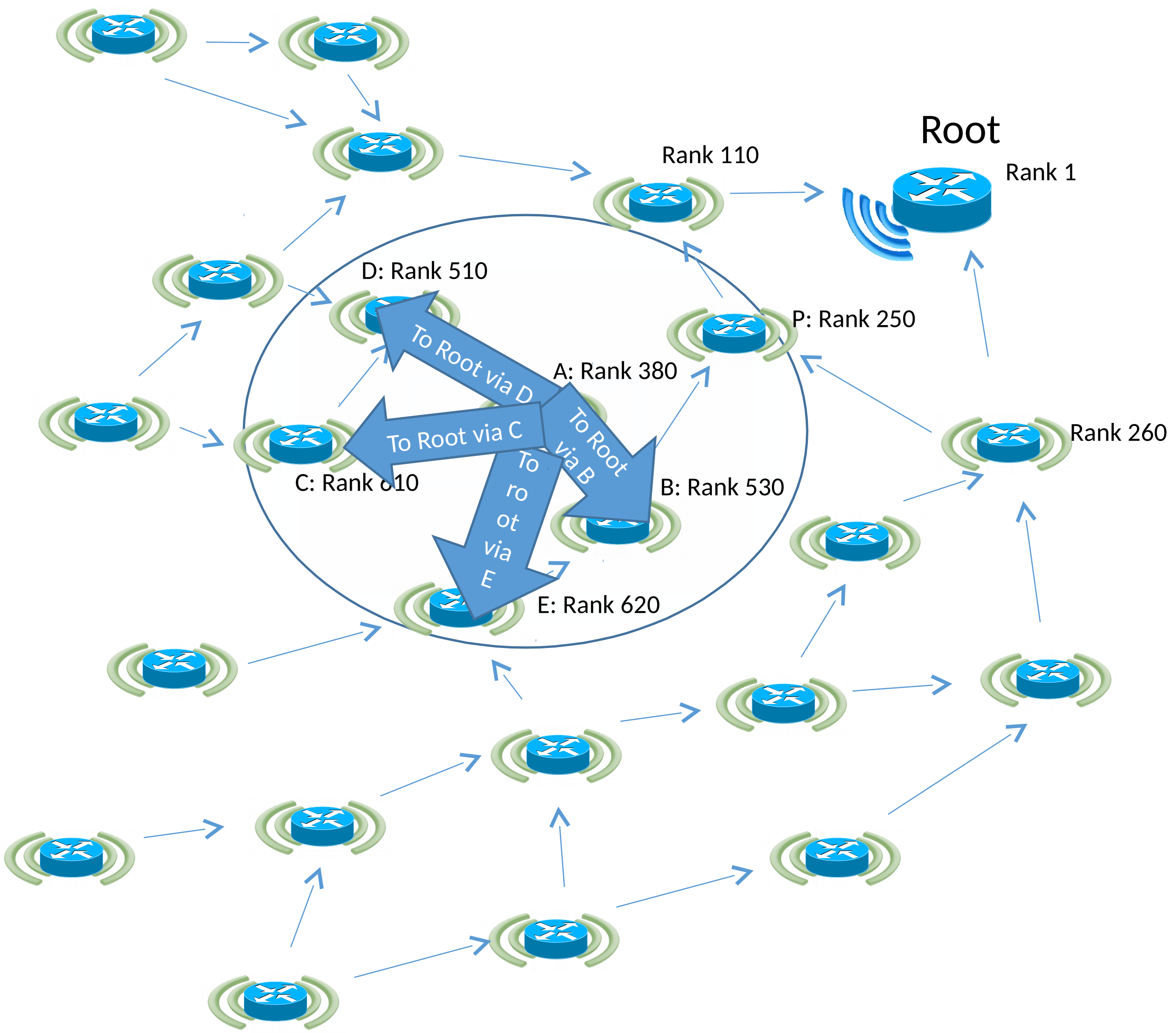
A selects a number if neighbors as prospective parents.

(Optional) We create a new RPI flag for loop detection.

A sends packets using them randomly setting its Rank in RPI to OxFFFF, and sets a new RPI "P" flag. (Alt is set rank to 0xFFFE)

A node that receives a packet with RPI "P" flag from a parent returns it with the RPI "F" flag set, indicating forwarding error and A removes it from the prospective parents. Alt, it may forward via another parent.

During that period, A destroys any packet coming back with the RPI "P" flag on.



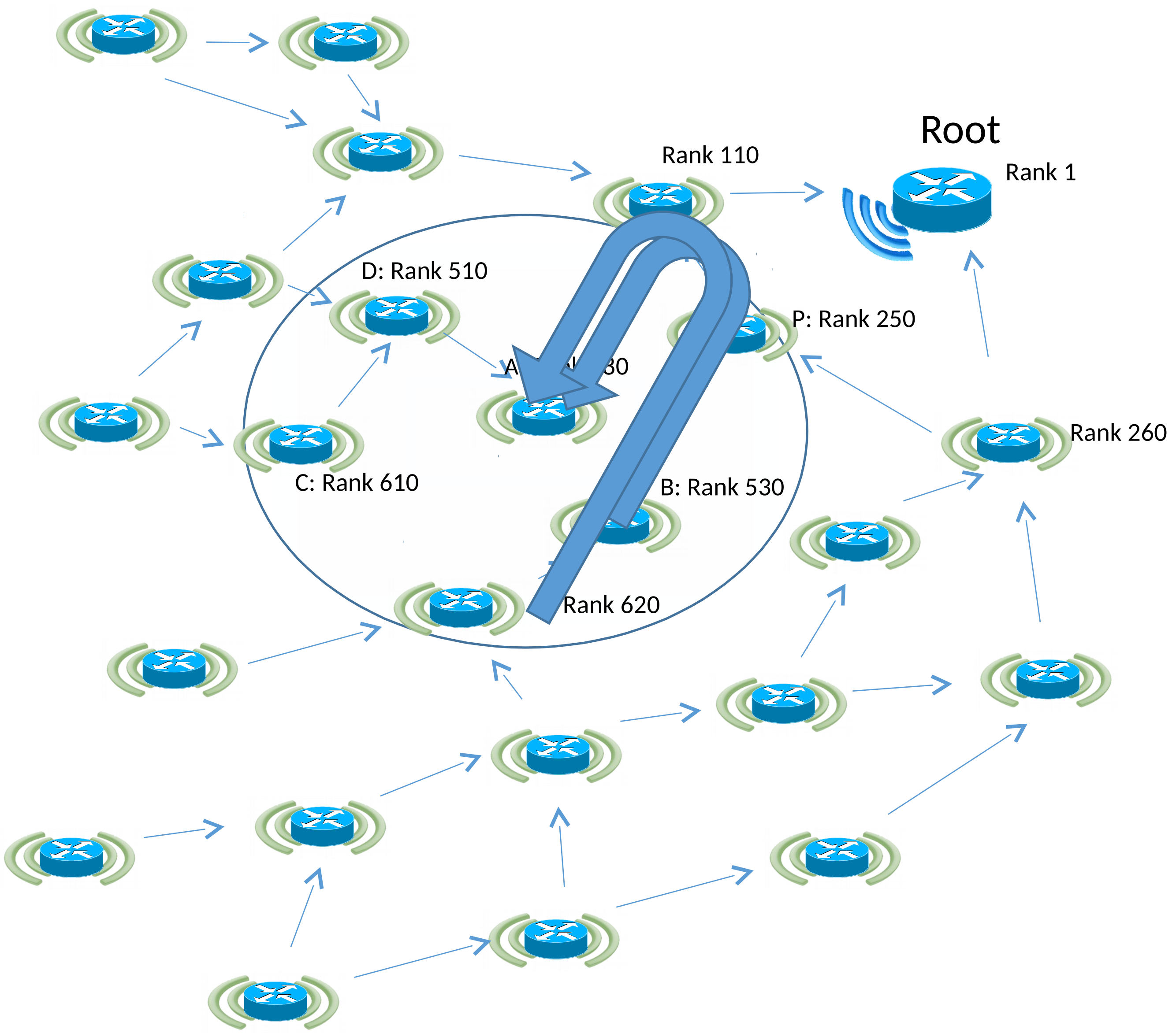
Proposal use the datapath to select a parent faster:

A selects a number if neighbors as prospective parents.

We create a new OAM which allows A to “ping” the Poot. The packet indicates the selected parent.

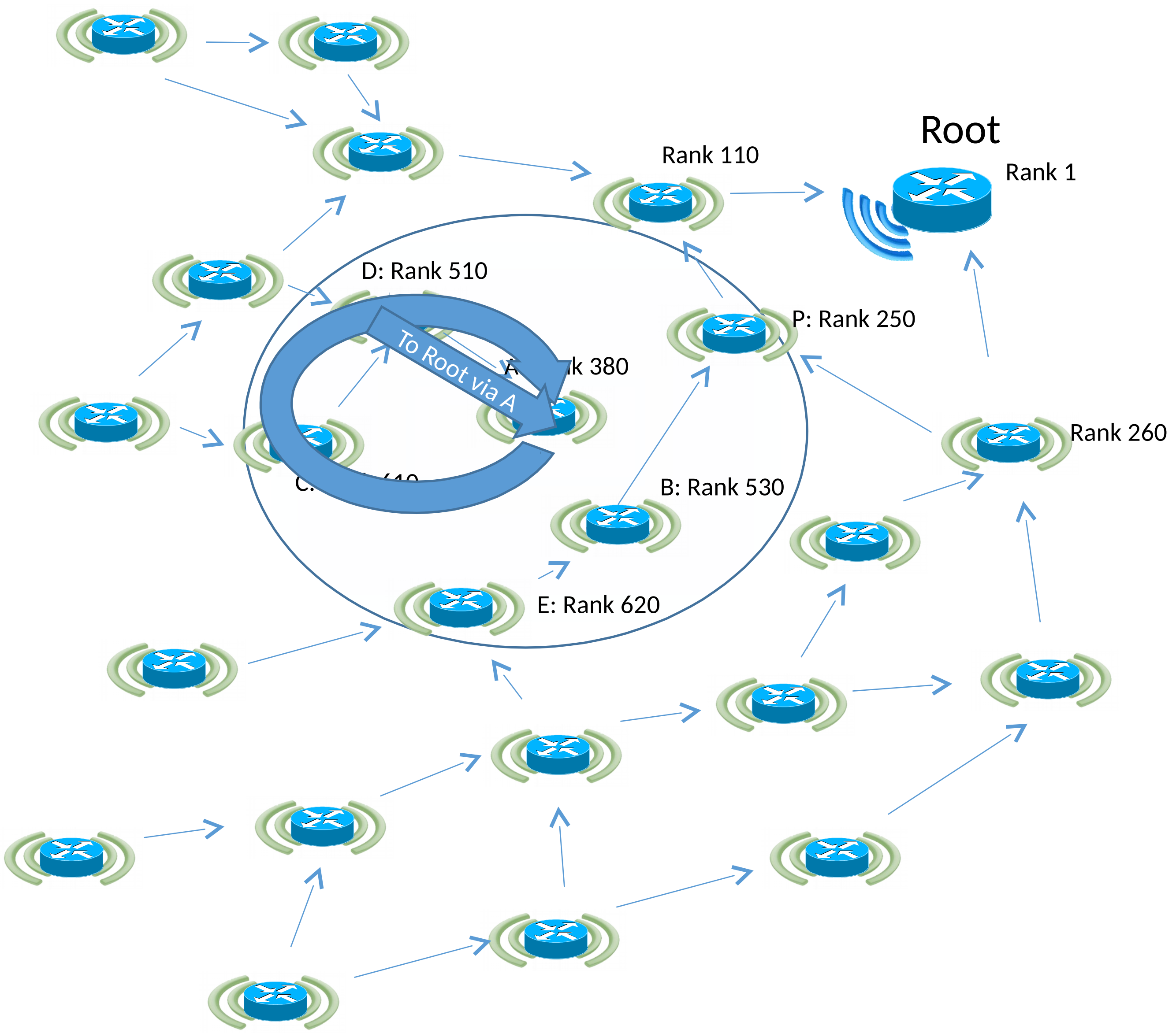
(Optional) The nodes that forward the packet add their IP address as a trace root

A sends a version of that packet unicast to all the selected neighbors



The messages that are responded by the root contain feasible successors. Getting that back may be slow.

A picks them as they come, keeping the best so far as preferred parent



Loops will cause the packet to come back to A.

A recognizes them (e.g. source address is A, a new flag in RPI), and eliminates the neighbor indicated in the packet from the potential parents

Metrics

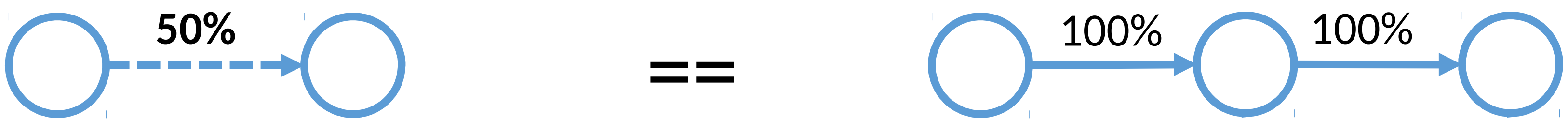
Five-nine Reliable Downward Routing in RPL

- Reliable downward routing
  - Goal: reach 99.999% delivery (1 loss per 100,000)
- Preliminary study
  - IoTLAB Grenoble: 352 nodes, avg 3.3 hops
  - 6TiSCH stack
  - Root sends to a random node at 4 Hz
  - Total packet send: 11,700 per 1h xp

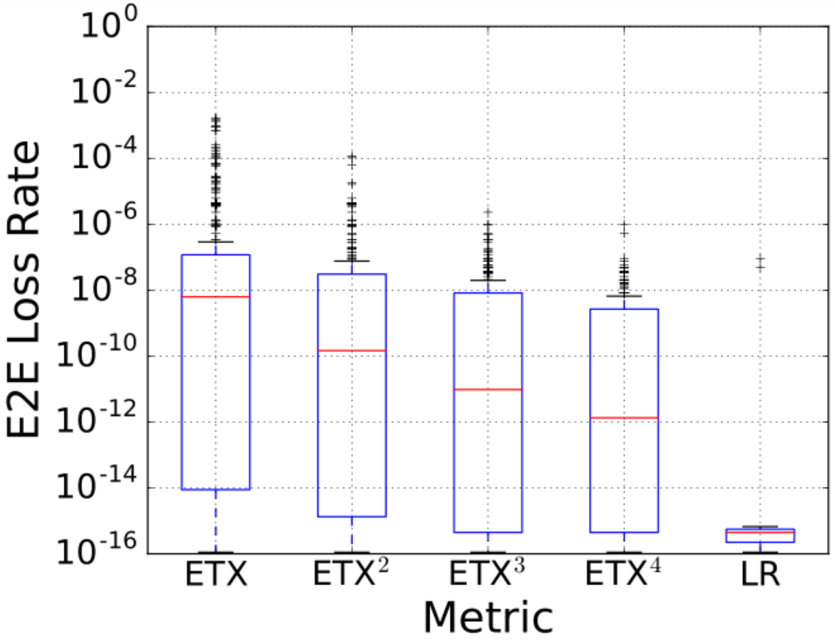
Cause of Loss	Loss Count	Loss Rate
MAC-layer drop	42	4e-3 (0.36%)
Route not found	32	3e-3 (0.27%)
Spurious duplicate	8	7e-4 (0.07%)
Total	82	7e-3 (0.70%)

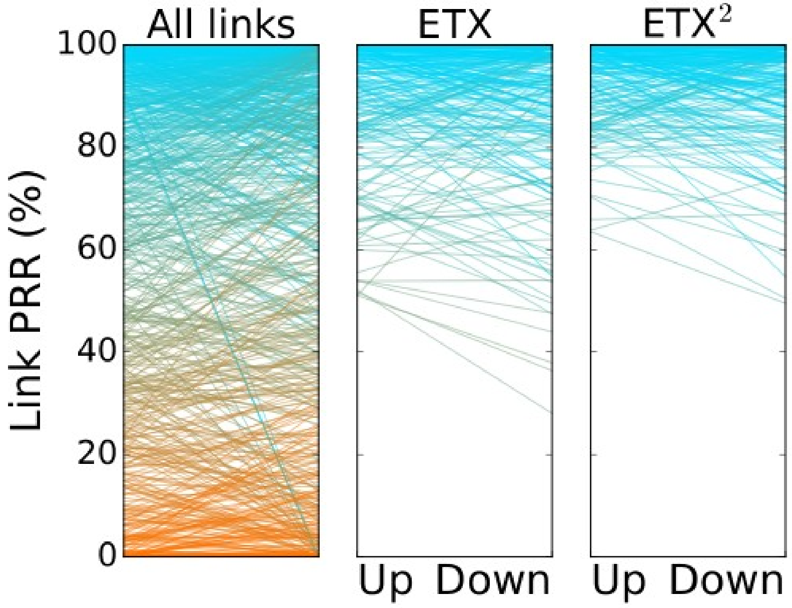
Gearing ETX Towards Reliability

- Problem: ETX does not select robust links



- Alternative metric: ETX^n
  - More reliable links
  - More symmetric links





Reliability Mechanisms

- #1. Reliable version of ETX
  - Strong, more symmetric links
- #2. Link probing
  - Keep current parent link estimate up-to-date
    - *TSCH already does that with KA*
  - Keep all other neighbor link estimates up-to-date
    - *Don't switch parent blindly*
    - *Keep discovering good neighbors*
- #3. Non-storing mode to avoid inconsistent routing state
- #4. Fix duplciate detection problem

Evaluation

Setup							Loss rate			
Testbed	Node	Size	Density*	Radius**	Configuration	#packets	MAC	Route	Dup	**Total**
IoT-LAB Gre.	M3	352	72	6.7	Storing *(baseline)*	117K	3e-3	3e-3	4e-4	**6e-3**
					Non-storing *(baseline)*	117K	9e-3	0	9e-4	**1e-2**
					Storing	151K	4e-4	5e-5	0	**4e-4**
					Non-storing	157K	9e-5	0	0	**9e-5**
					Storing *(Wifi-free, 32 rtx)*	227K	9e-6	3e-5	0	**4e-5**
					Non-storing *(Wifi-free, 32 rtx)*	585K	8e-6	0	0	**8e-6**
IoT-LAB Gre.-52	M3	52	8.4	5.9	Non-storing *(baseline)*	131K	8e-2	0	0	**8e-2**
					Non-storing	606K	2e-5	0	0	**2e-5**
					Non-storing *(Orchestra)*	608K	3e-5	0	0	**3e-5**
					Non-storing *(Wifi-free, 32 rtx)*	762K	0	0	0	**0**
IoT-LAB Lille	M3	240	237	2.4	Non-storing *(baseline)*	35K	7e-4	0	0	**7e-4**
					Non-storing	103K	8e-5	0	0	**8e-5**
					Non-storing *(Wifi-free, 32 rtx)*	522K	0	0	0	**0**
Flocklab	OpenMote	9	5.4	3.9	Non-storing *(baseline)*	82K	8e-1	0	0	**8e-1**
					Non-storing	179K	5e-5	0	0	**5e-5**
					Non-storing *(Wifi-free, 32 rtx)*	584K	2e-5	0	0	**2e-5**
JN-IoT	JN5168	24	16	3.8	Non-storing *(baseline)*	128K	1e-2	0	0	**1e-2**
					Non-storing	166K	4e-4	0	0	**4e-4**
					Non-storing *(Wifi-free, 32 rtx)*	371K	2e-5	0	0	**2e-5**

Open Discussion

AOB