



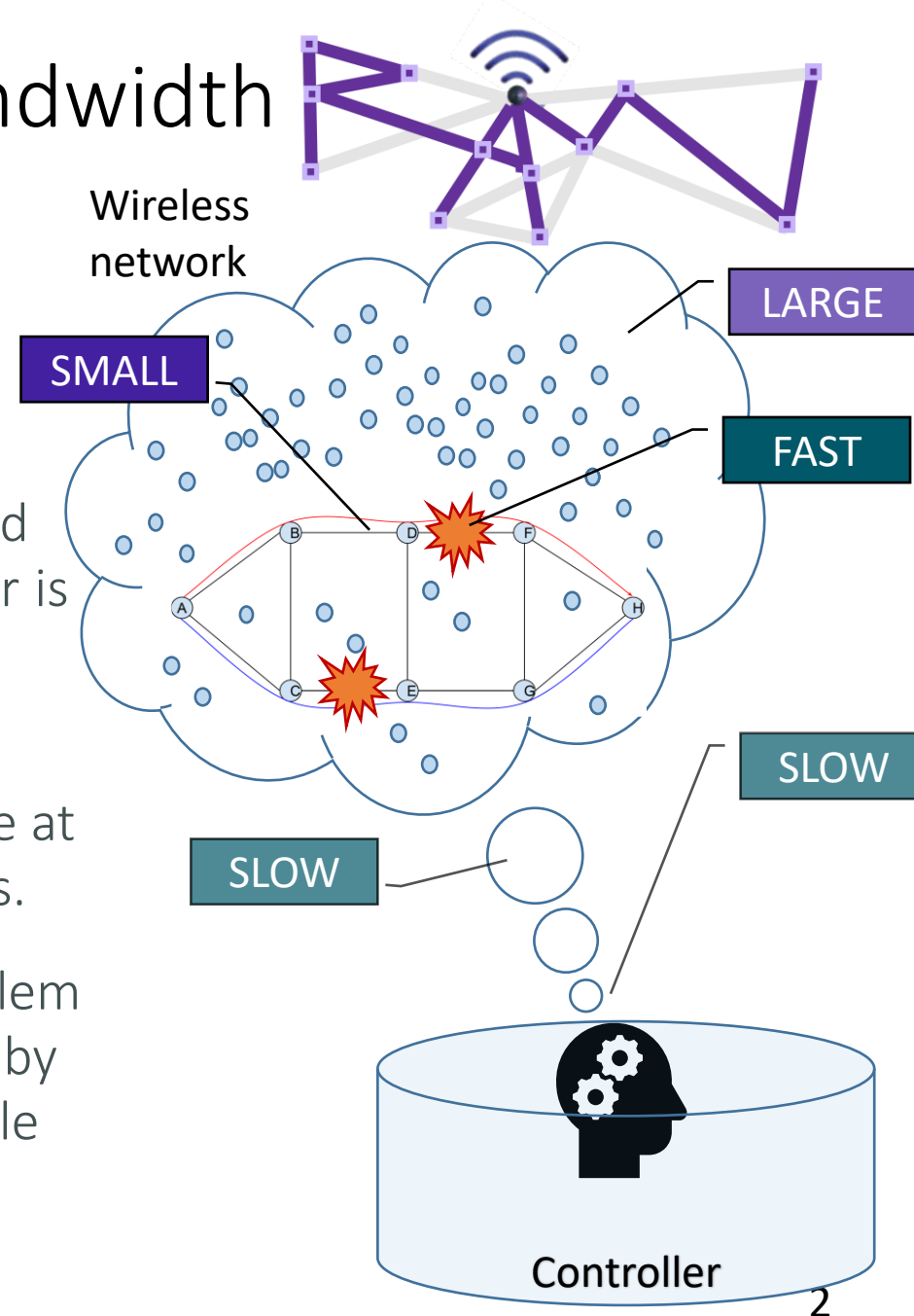
# Reliable and Available Wireless Architecture

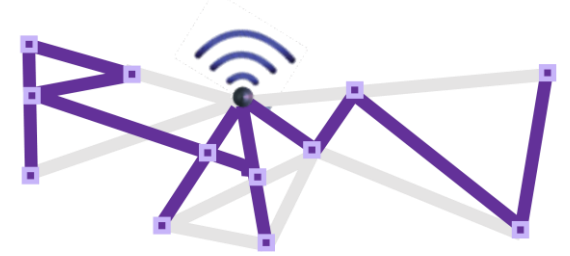
Presenter: Pascal Thubert

Authors: P. Thubert, G.Z. Papadopoulos, (+ contributors)

# Reliability & Availability vs. Energy & Bandwidth

- Due to uncontrolled interferences, including the self-induced multipath fading, deterministic networking can only be approached on wireless links.
- The radio conditions may change -way- faster than a centralized PCE can adapt and reprogram, in particular when the controller is distant and connectivity is slow and limited.
- RAW separates the path computation time scale at which a complex path is recomputed from the path selection time scale at which the forwarding decision is taken for one or a few packets.
- RAW operates at the path selection time scale. The RAW problem is to decide, within the redundant solutions that are proposed by the PCE, which will be used for each packet to provide a Reliable and Available service while minimizing the waste of resources.



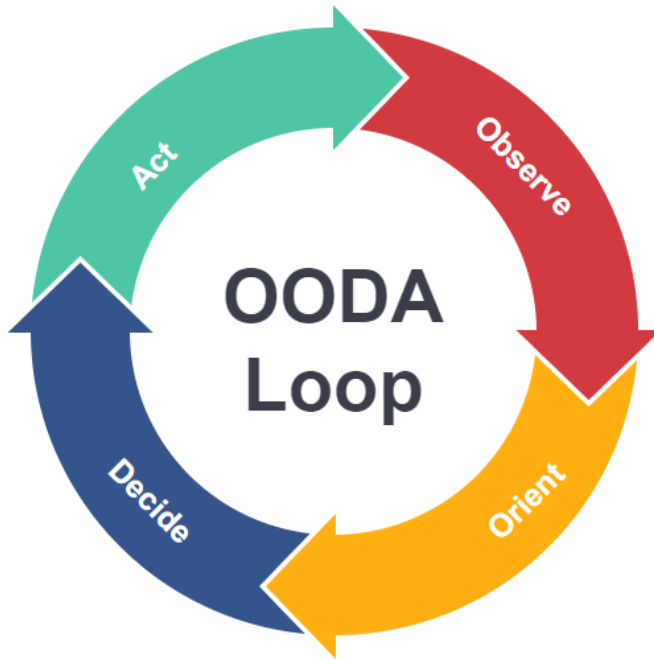


# OODA Loop

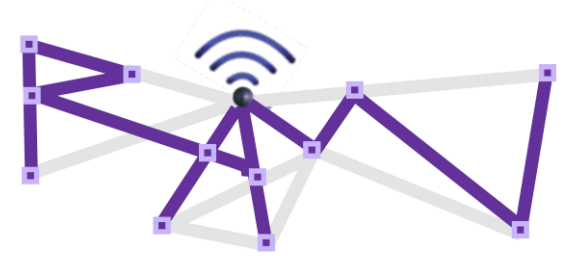
The OODA Loop Enables Continuous Adaptation to Continuously Changing Situations:

- **Observation:** the collection of data by means of the senses
- **Orientation** the analysis and synthesis of data to form one's current mental perspective
- **Decision** the determination of a course of action based on one's current mental perspective
- **Action** the physical playing-out of decisions

Source: <https://imarcai.com/ooda-loop-new>

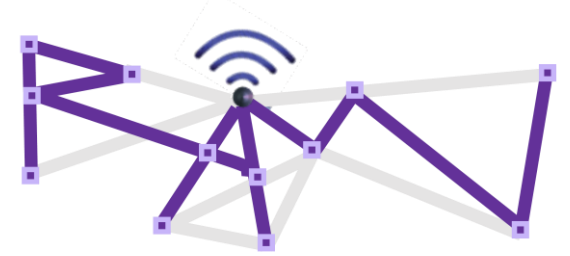


# RAW Architecture / Framework Split



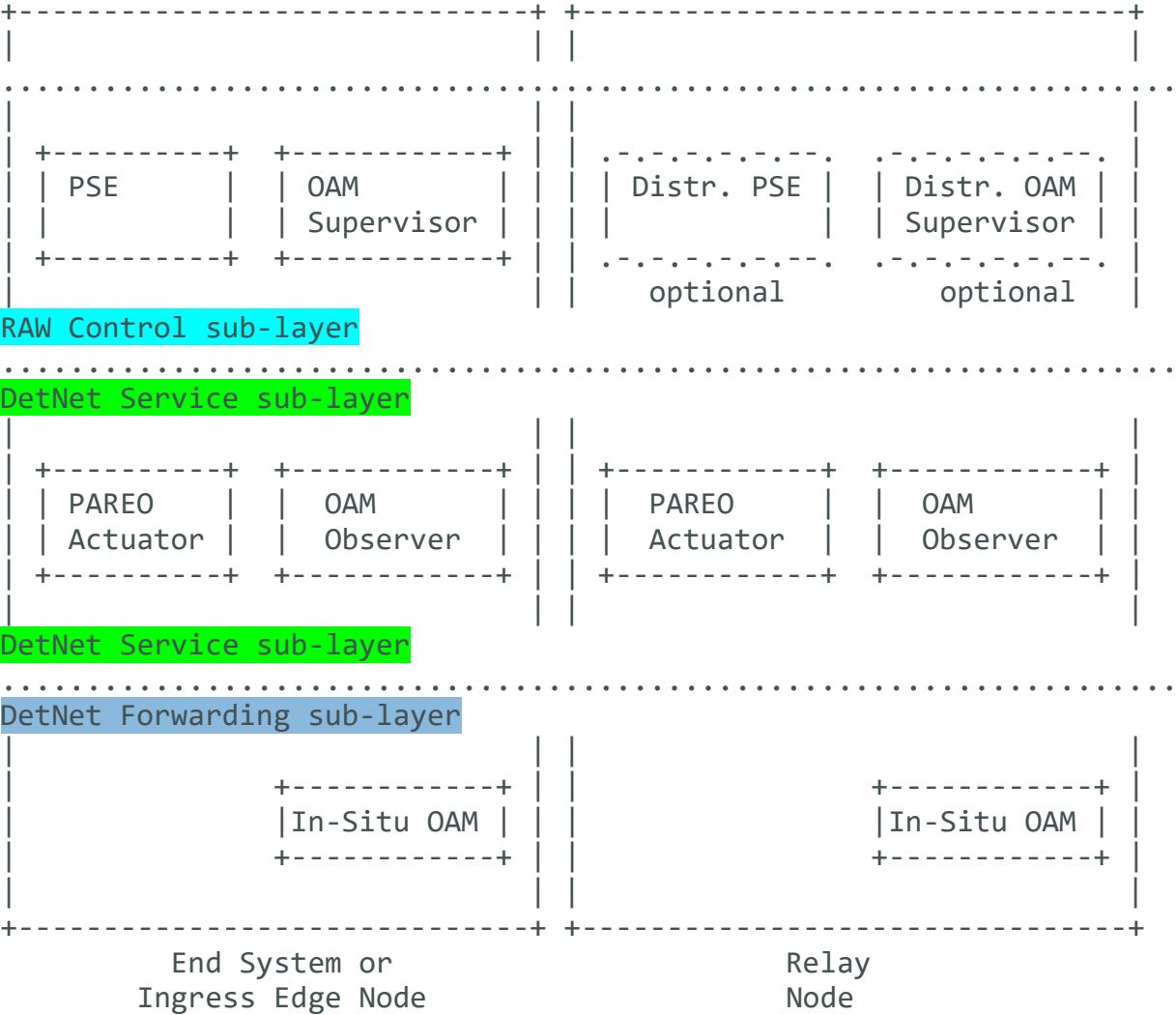
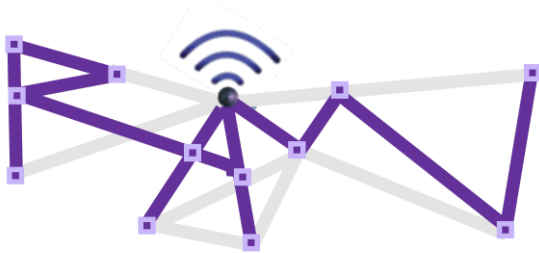
- **Architecture:** what we will do, the broad picture before the work
  - Terminology
  - Reliability and availability in the context of the IETF
  - Conceptual Model with OODA Loop,
  - Introducing the Path Selection Engine (PSE)
- **Framework:** How we did it, selected building blocks and their interaction
  - Use cases and requirements served
  - Scope of the work / applicability
  - Identifying Tracks, Paths, and Flows
  - Source Routing vs distributed PSE
  - OAM and metrics

# Status

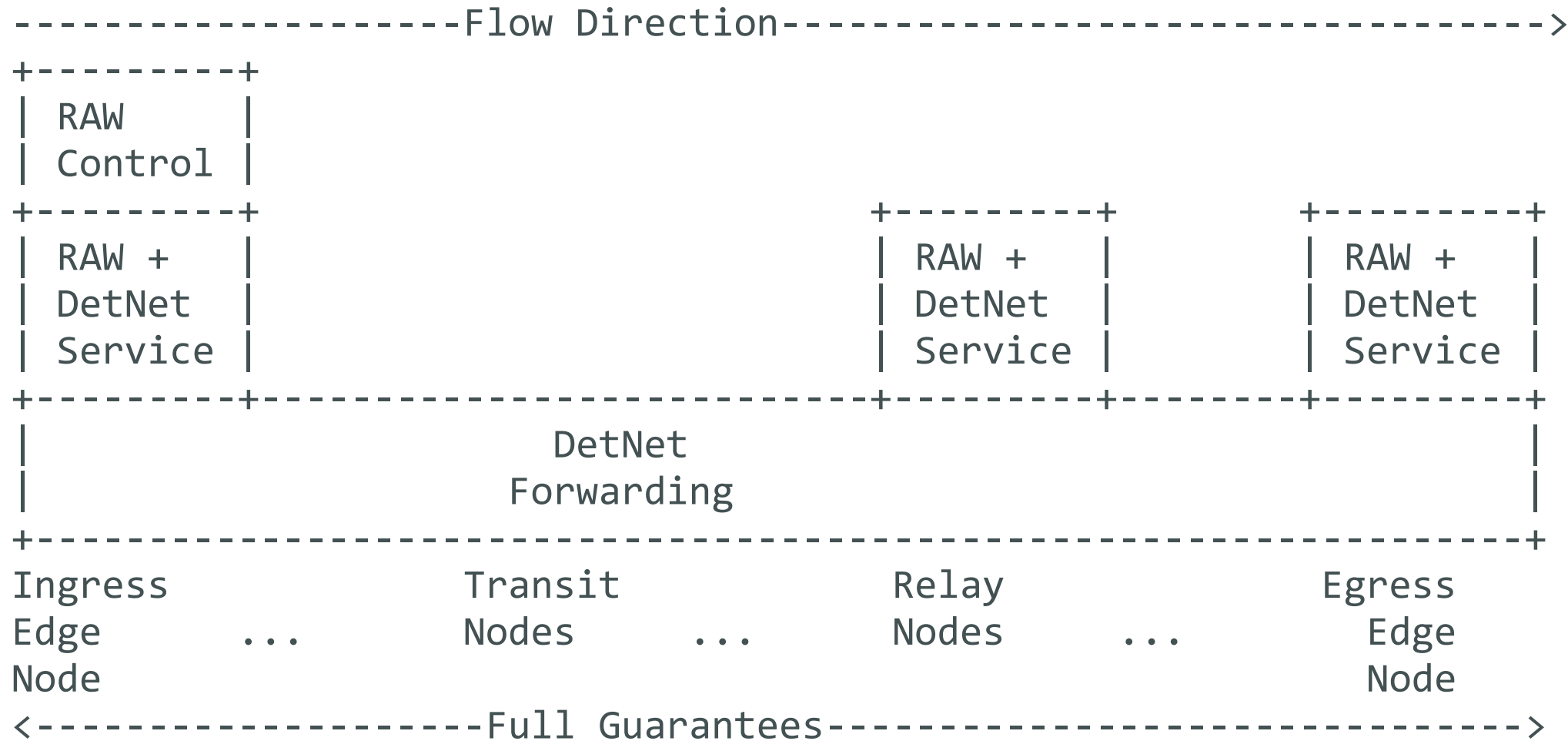
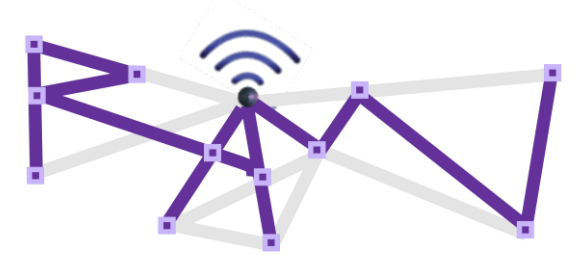


- 02: split architecture / framework after IETF 112
- 03: Fabrice's review
- 04: Dave's pre-WGLC review
- 05: Architecture Interest Informal meeting: Add section on RAW vs DetNet
- 06: Interim Discussion: Add section on RAW dependencies on other layers
- Editor's view: Ready for WGLC

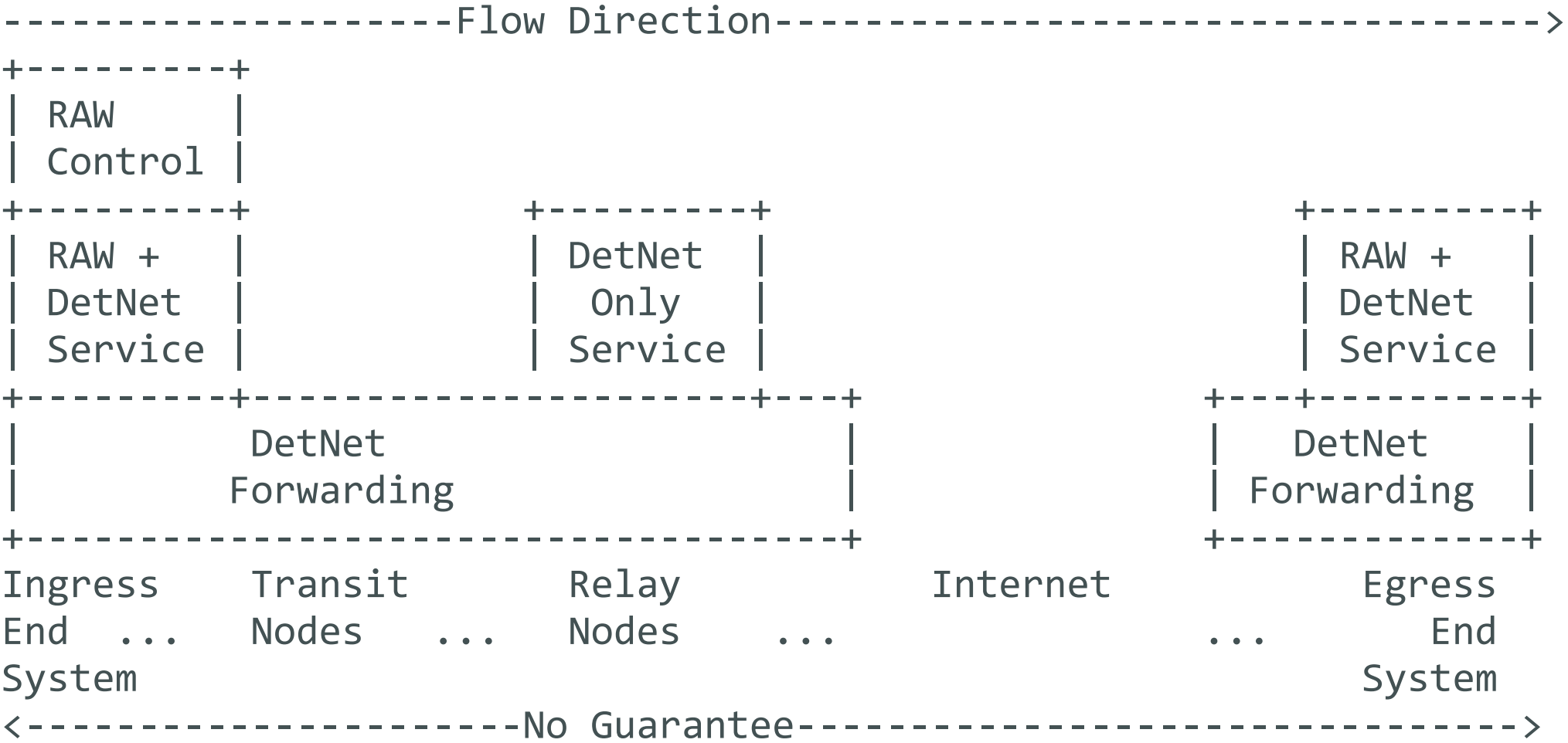
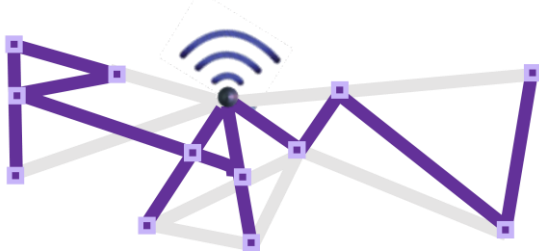
# RAW DetNet Services



# (Strict) RAW over DetNet

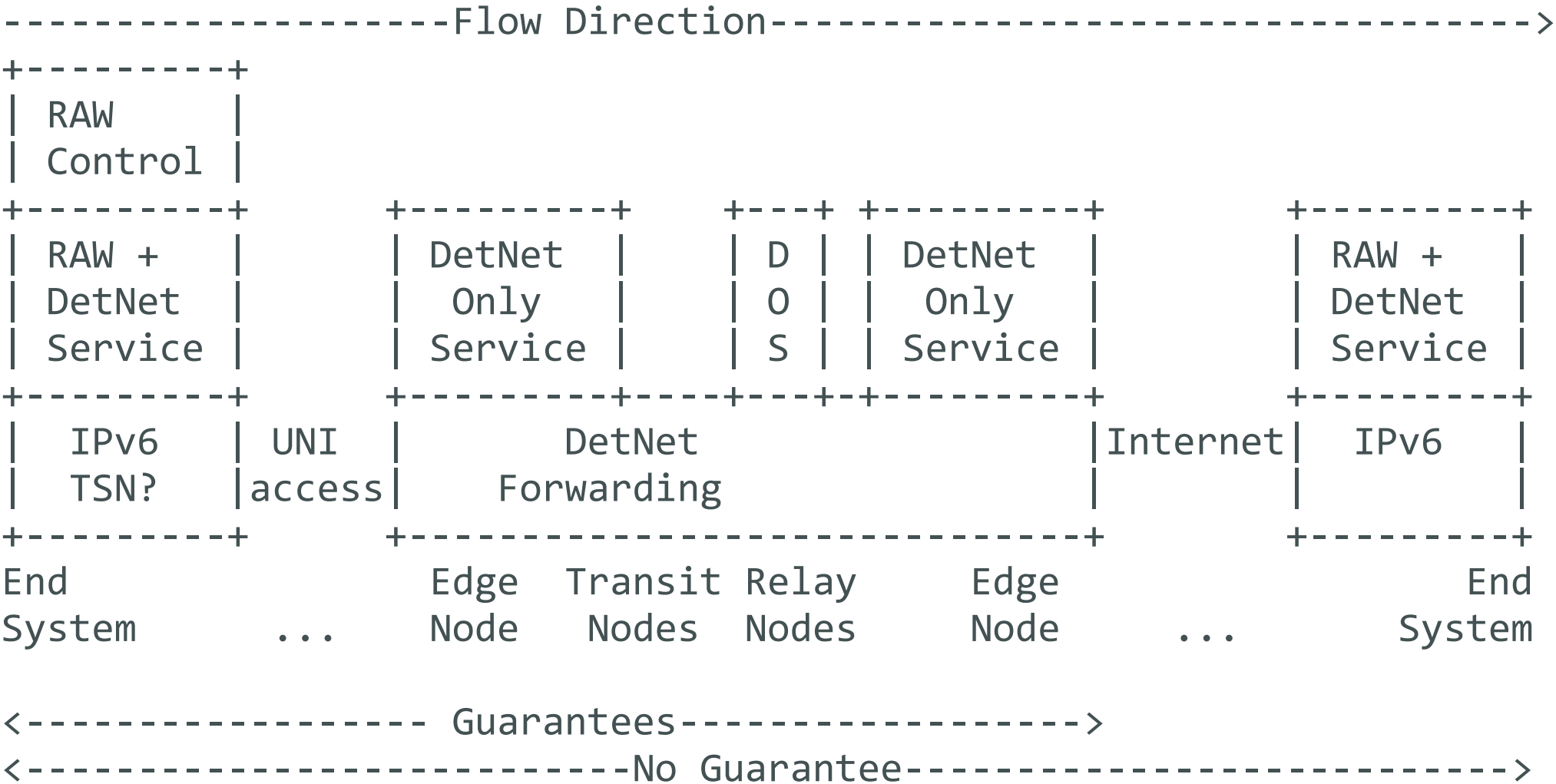
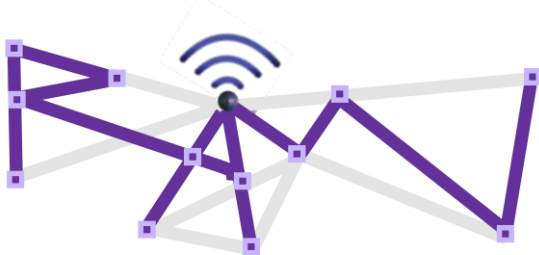


# Loose RAW

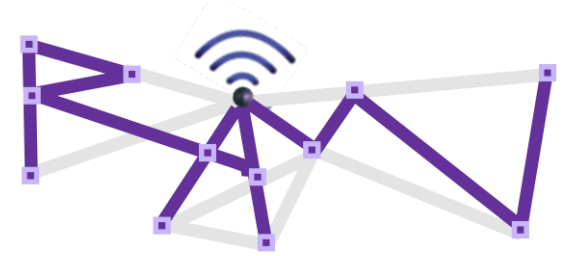




# Variation (not illustrated in doc)



# Dependencies

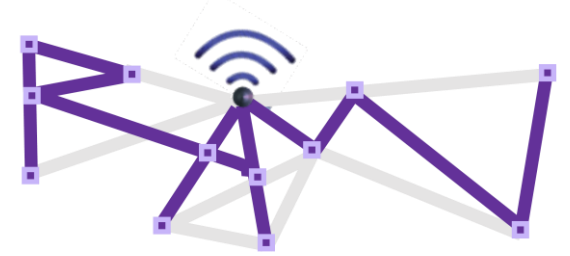


RAW improves the reliability of transmissions and the availability of the communication resources, but does not provide scheduling and shaping, so RAW itself does not provide guarantees such as latency for the application payload. Rather, it should be seen as a Dynamic optimization of the use of redundancy to maintain it within certain boundaries.

Guarantees such as bounded latency depend on the upper layers (Transport or Application) to provide the payload in volumes and at times that match the contract with the DetNet sublayers and the layers below. Excess of incoming traffic at the DetNet Ingress will cause either dropping, queueing, or reclassification of the packets, and entail loss, latency, or jitter, and moot the guarantees that are provided inside the DetNet Network.

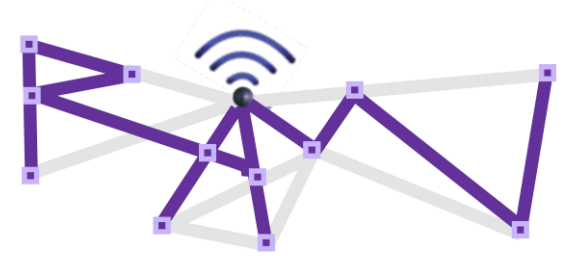
When the traffic from upper layers matches the expectation of the lower layers, RAW still depends on the lower layers to provide the timing and physical resources guarantees that are needed to match the traffic SLA. When the availability of the physical resource varies, RAW will act on the distribution of the traffic to leverage alternates within a finite set of potential resources.

# Balázs Varga 's questions (1of3)



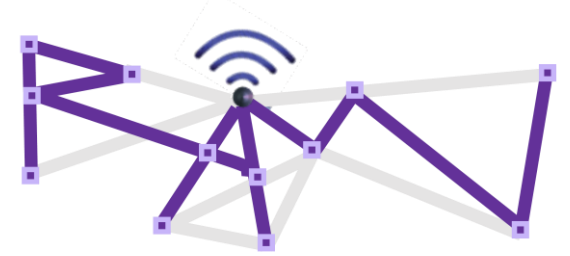
- Mix of various OSI Layer functions: The definition of PAREO seems to be very confusing, as it contains a mix of Radio specific and DetNet specific functions. It is confusing as the referred functions work at different layers (e.g., HARQ is part of Radio at L1/L2 vs. PREOF is part of DetNet at L3) and have different "range" (radio acts on radio links vs. PREOF acts across several hops, maybe even end2end). This mix makes it unclear which OSI layer the RAW architecture belongs to. Could you please clarify?
- DetNet leverages lower layers, and RAW will augment that usage to hint about transmission suggestions. Lower Layers do what they like but if the API allows to pass hints, we'll leverage that. In particular, we'll need reliability and timing hints like suggest X retries (min, max), send unicast (one next hop) or multicast (overhearing). The other way around RAW will need hints about L2 conditions like L2 triggers (RSSI, LQI, ETX...) over all the wireless hops. This will be used by both PCE and PSE. Bottom line: to do its job, L3 works on abstractions of L2; in the (dynamic) case of wireless there's more of it.

## Balázs Varga 's questions (2of3)



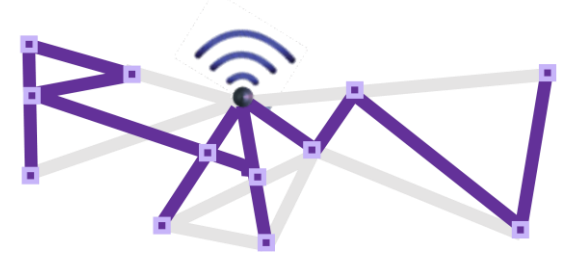
- The modeling of Radio components from deterministic networking perspective seems to be unclear and different from current work of radio related SDOs. The draft states that the concept is agnostic to the radio technology and agnostic to whether or not radio mesh is applied. Nonetheless, the model applied for the Radio layer seems to be unclear. Please note, e.g., that DetNet Study Item ongoing in 3GPP SA2 models the 5G System as a DetNet router
- The case where the 5G network shows as one virtual switch is opaque to RAW as it is opaque to DetNet. I agree we can improve the discussion on interaction with lower layers in the dependency section following your suggestion. I hope we have more details on the mike...

# Balázs Varga 's questions (3of3)



- Related to the Q1, the relationship of RAW and DetNet Layers is unclear. Along the lines of your definition in "Section 3. The RAW Conceptual Model: ... The RAW Nodes are DetNet relays that are capable of additional diversity mechanisms and measurement functions related to the radio interface ..." whereas same section states that " ... the non-RAW subnetwork can be neglected in the RAW computation ...".
- I guess we'll need to clarify. The non-RAW is when RAW is not end to end and latency cannot be guaranteed (loose RAW). Again, I hope there's discussion on the mike.
- See email thread for drawings

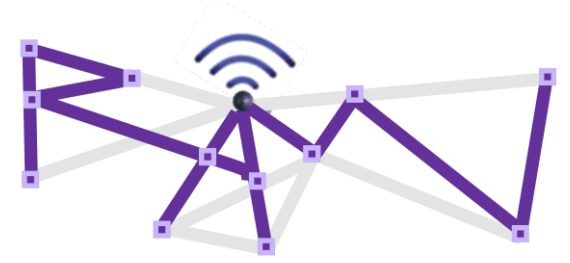
# Next Steps



- An Ad hoc team met, and also the draft was discussed at the last interim
- Lou still has some questions / issues open that we need to sort out
- How far are we from WGLC?
- Note:

The RAW architecture is normative ref. to draft-ietf-roll-dao-projection, which is closing WGLC.

The draft provides a way for the controller to set up RAW Tracks using new signaling in RPL.



# Questions ?