Routing under heterogeneity and mobility for the Internet of Things: a centralized control approach

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IoT /WSN Routing problem

Routing is challenging network function in IoT:

power storage memory

Processing and signal limitations

Also, in view of characteristics such as:

large-scale deployment Dynamicity

Heterogeneity Mobility

One of dominant protocols is RPL (Routing Protocol for Low-power and Lossy Networks)

DODAG is the network depiction in RPL

RPL organizes network nodes as a Destination-Oriented Directed Acyclic Graph (DODAG) rooted at a single destination (root or sink node), the only node that can launch the DODAG's construction,

Based upon the exchange of routing control messages

- DODAG Information Object (DIO)
- Destination Advertisement Object (DAO)
- DODAG Information Solicitation (DIS)

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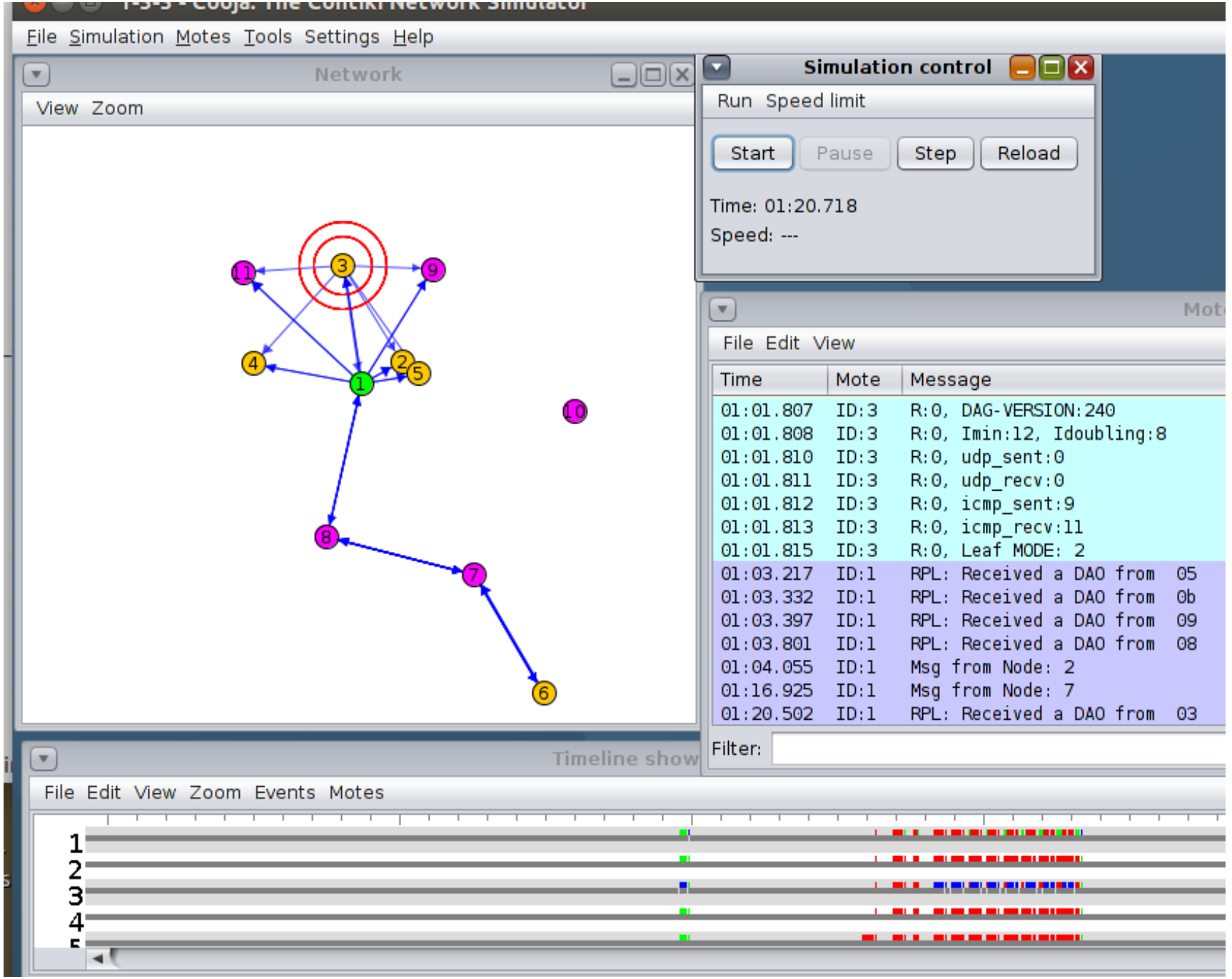
COOJA Contiki OS Simulator



RPL Parameters

Tackling the parameters that RPL sends/receives DIO, DIS (i.e. Imin, Idouble), but also routing algorithms (i.e., Objective Function), can significantly improve the protocol's communications.

Combined with SDN inspired **centralized management**, we can adapt the protocol ad-hoc and in real-time

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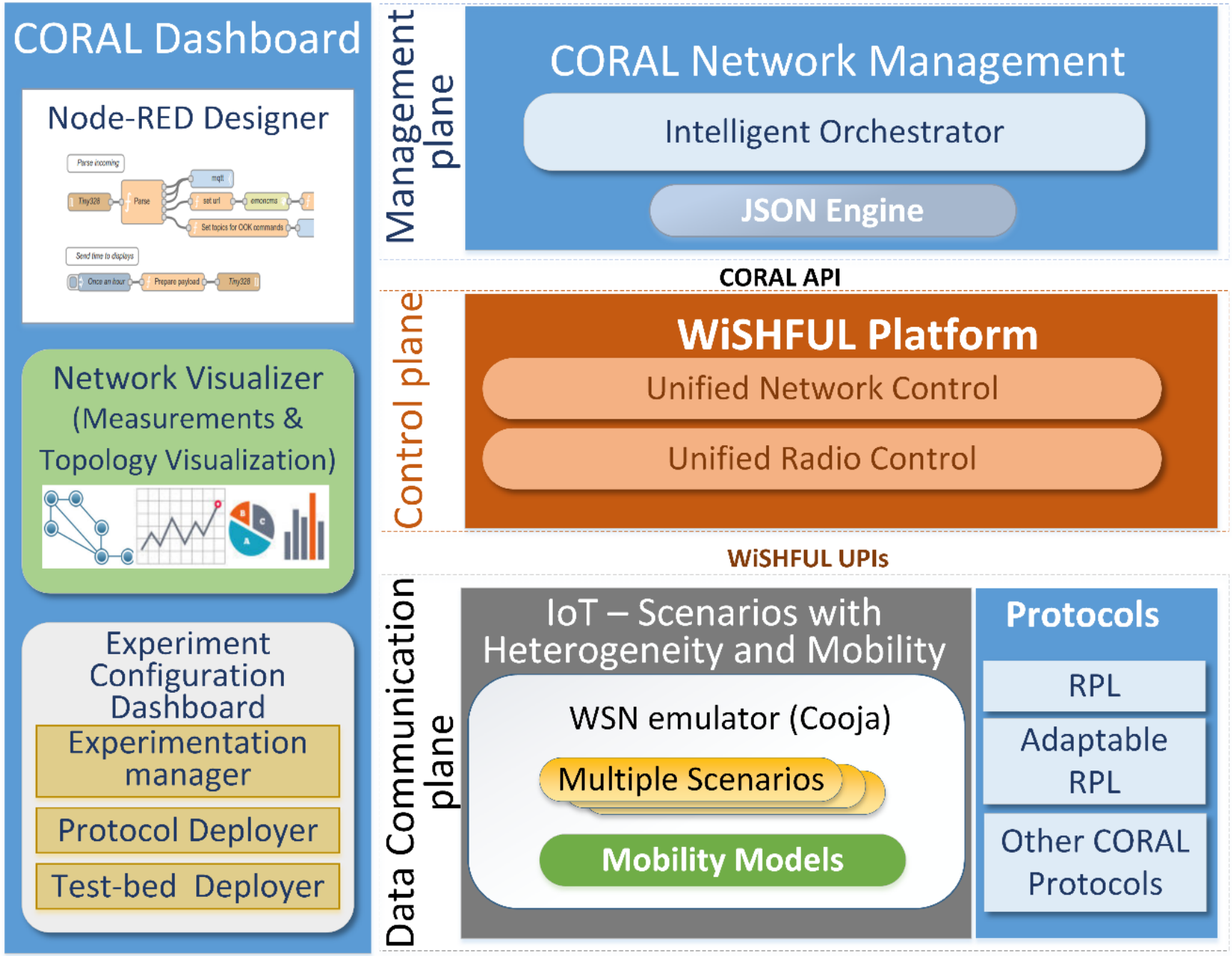
CORAL Platform: Can easily be expanded, adapted, adjusted



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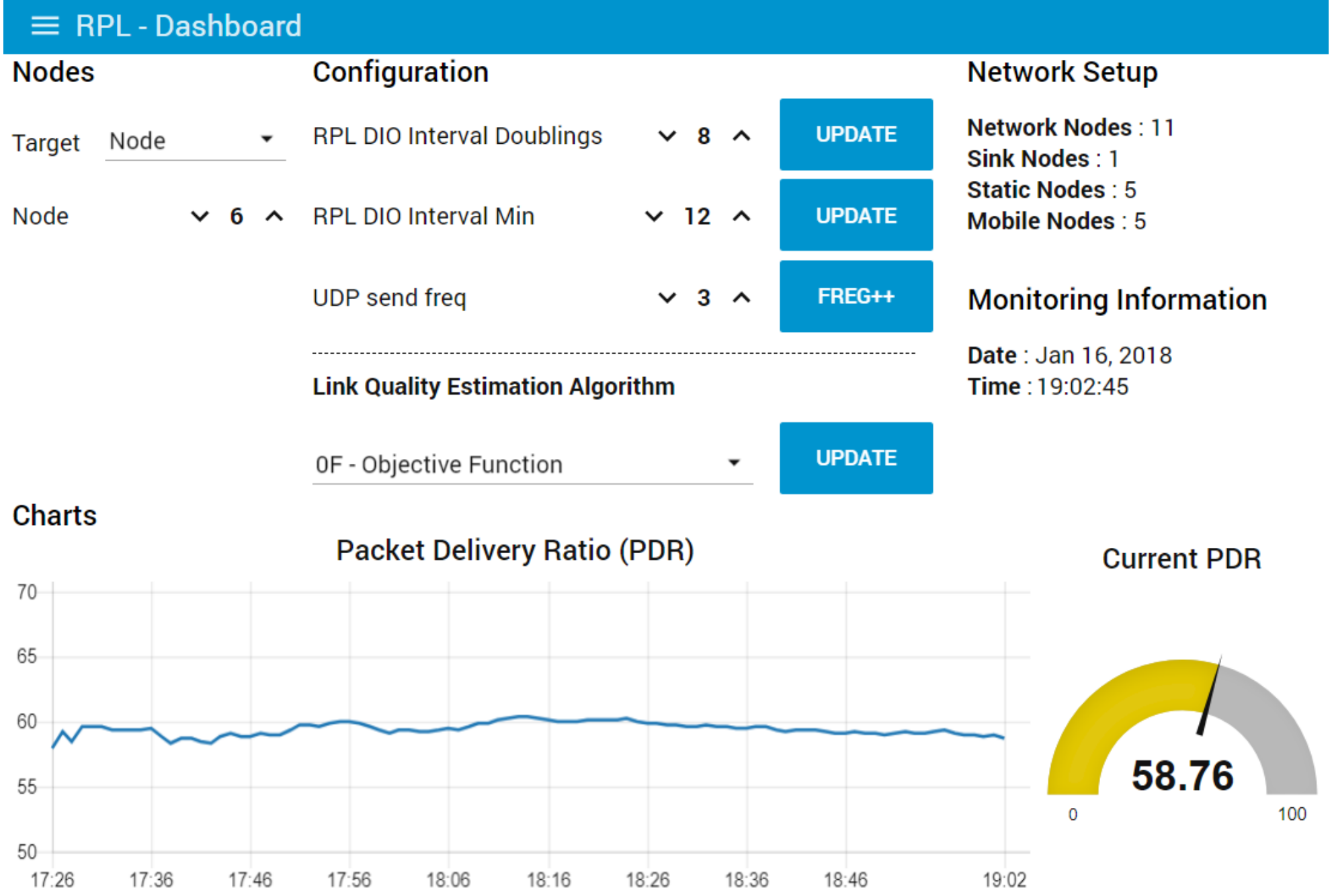
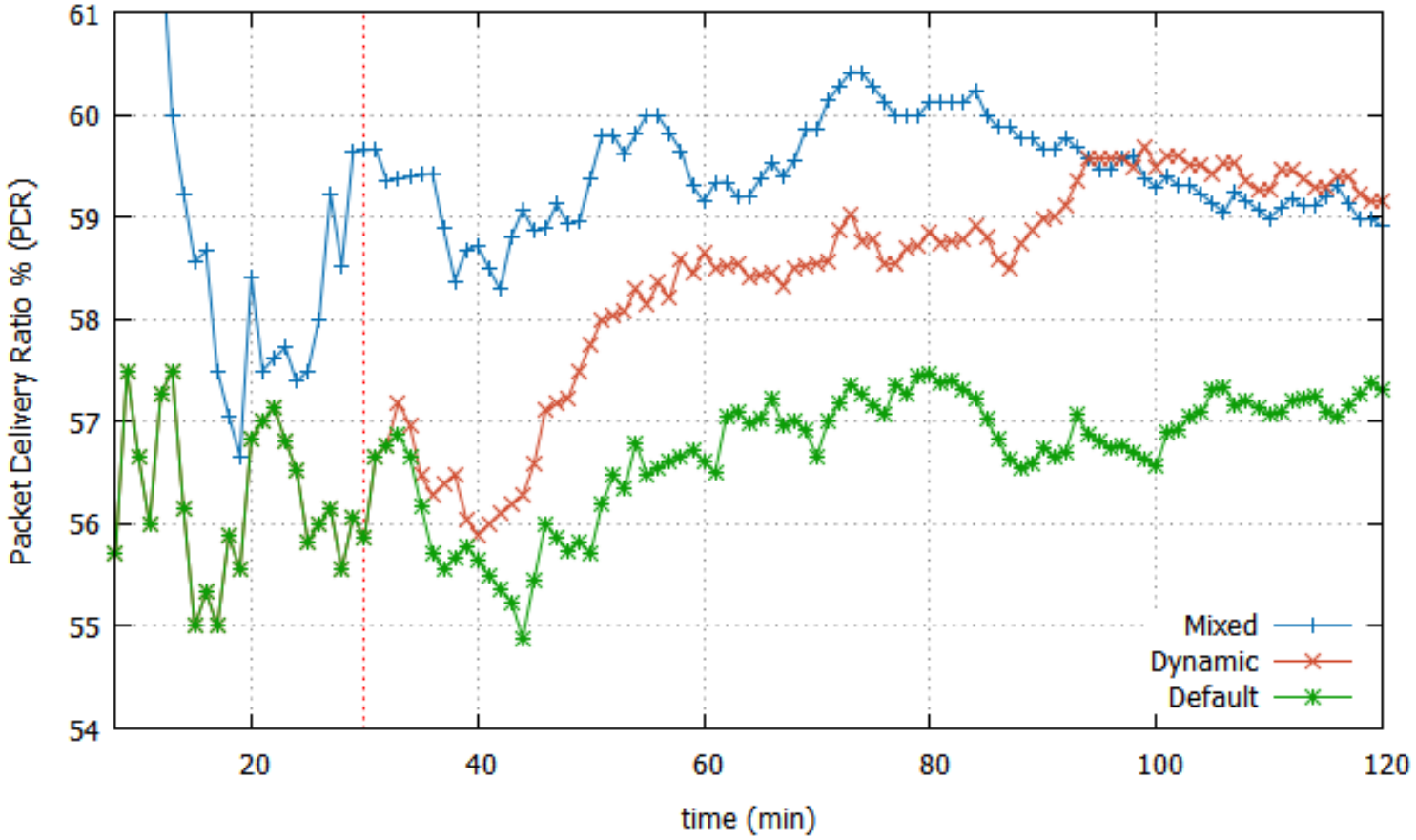
CORAL Cross-Layer Control of Data Flows



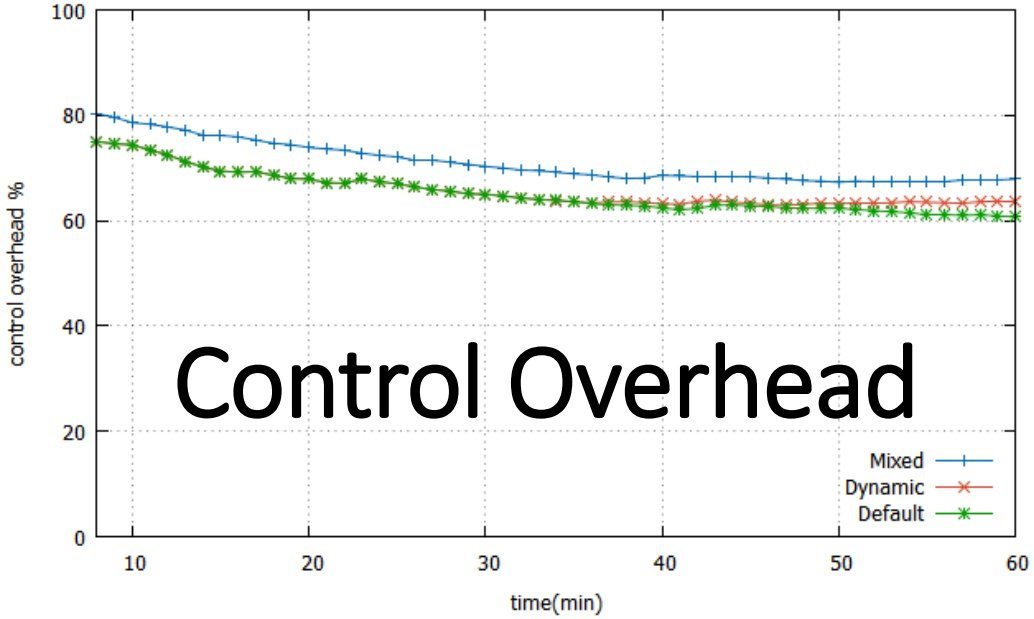
Network Initialization (DODAG setup time)

#	No. of nodes	Heterog.	Topology	I_{min}	Setup time (sec)
1	11	Y	Fig 1a	8 12	13.8 45.0
2	15	N	chain	8 12	6.2 50.9
3	15	N	lambda (Λ) - sink on top	8 12	4.8 26.8
4	30	N	as in [3]	8 12	5.1 23.0
5	30	N	chain	8 12	11.3 107.4
6	50	N	random	8 12	10.2 27.3
7	100	N	random	8 12	32.4 68.1

2 hrs simulation in Cooja
1 sink – 5 fixed - 5 mobile nodes



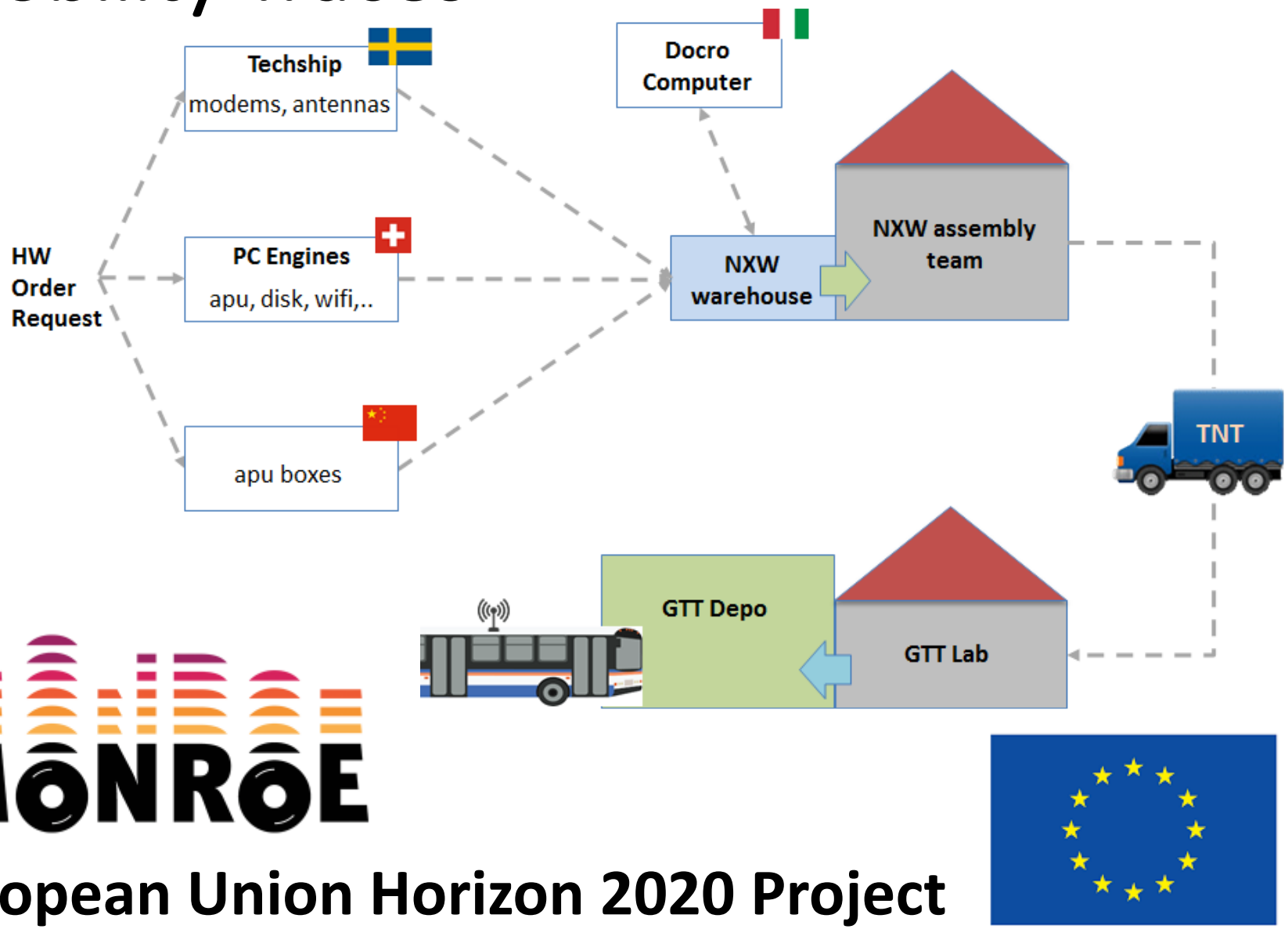
Avg Packet Delivery Ratio



Control Overhead

Real Mobility Traces

Stockholm, Sweden buses traces used



Measuring Mobile Broadband Networks in Europe

MONROE

European Union Horizon 2020 Project

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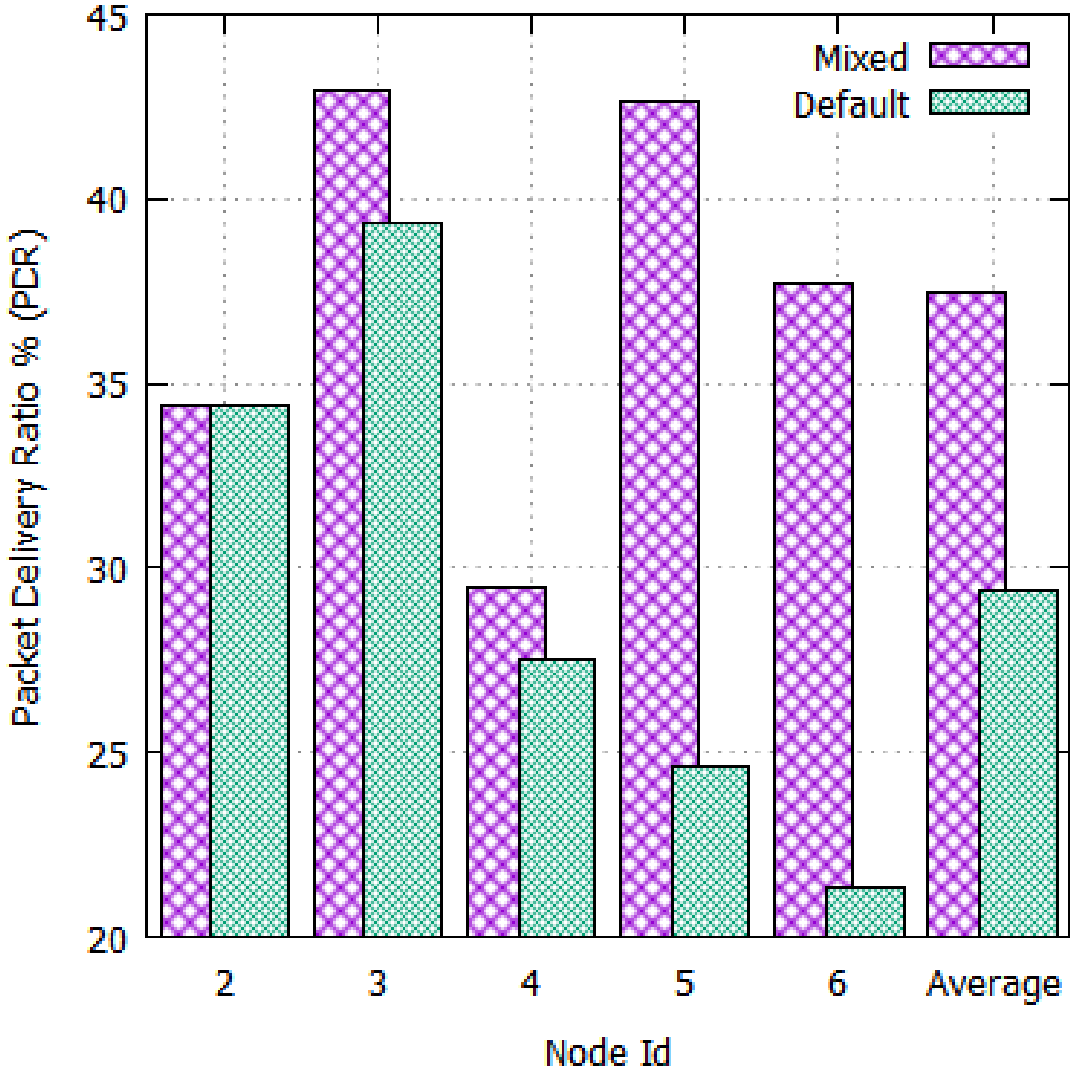
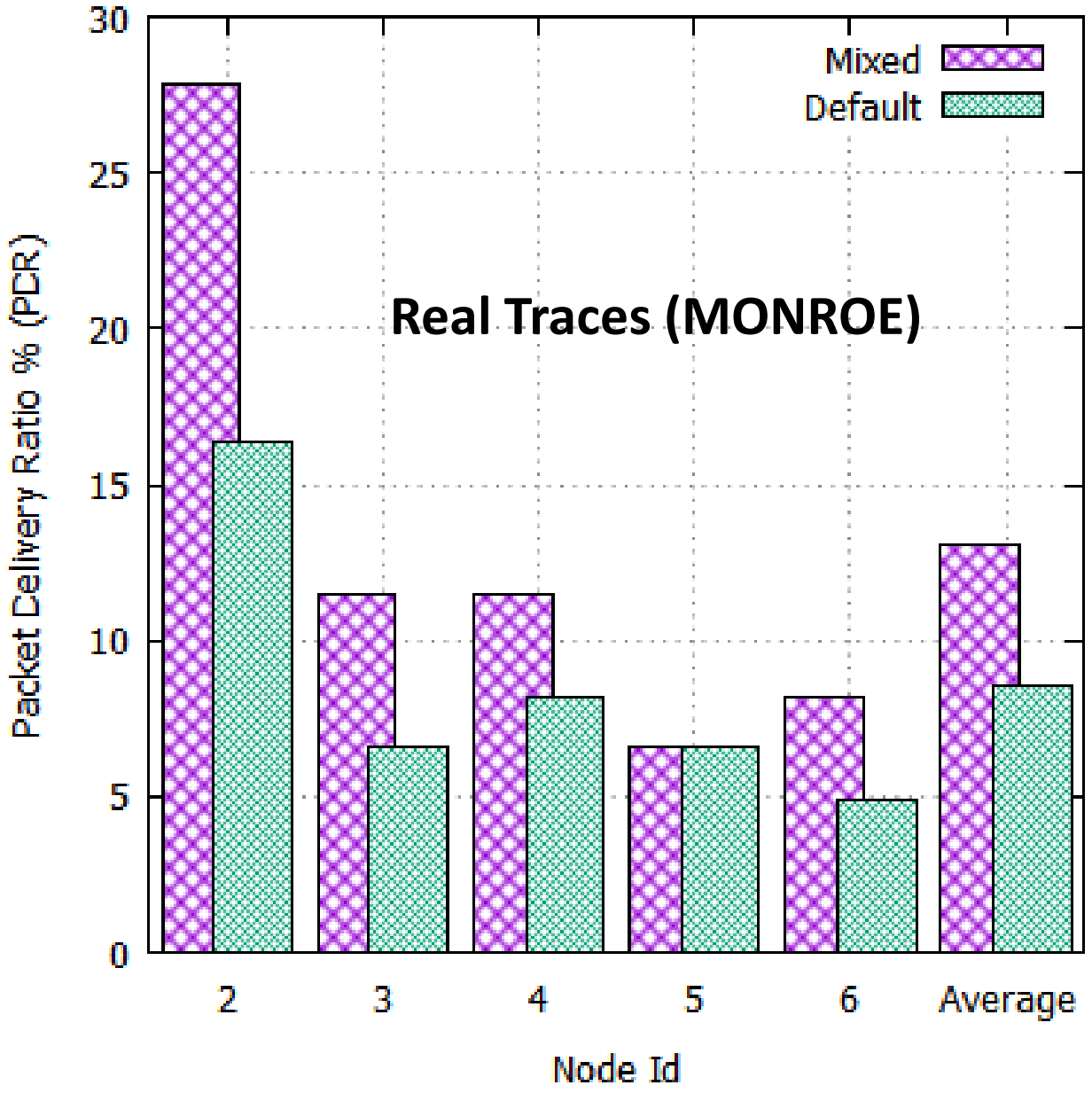
Mobile Nodes Only

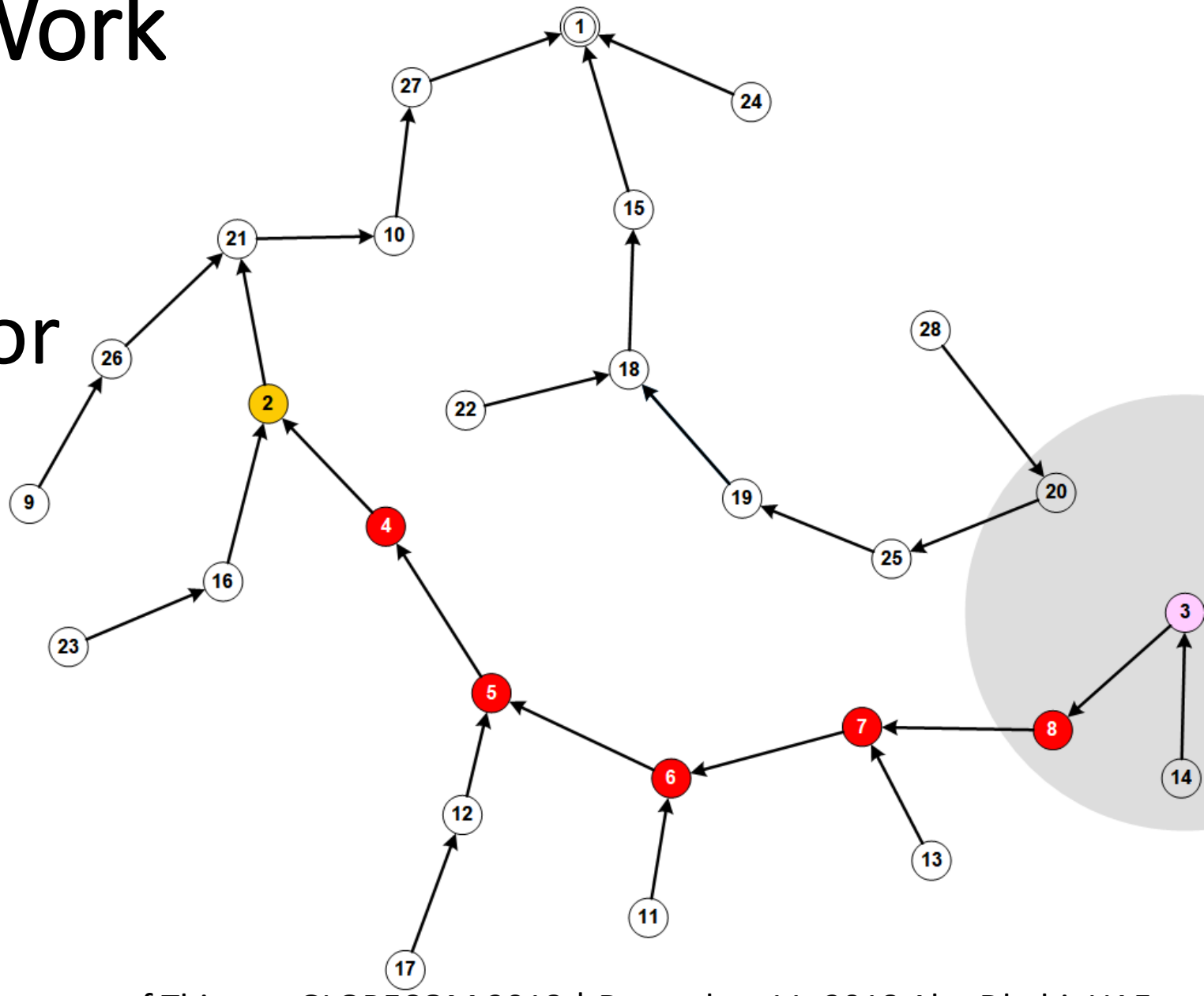




Future Work

Created new algorithms (new Objective Function) for peer-to-peer routing for

- Low latency
- High reliability



Conclusion

- RPL has issues with mobility
- Centralized Administration (SDN logic) can improve it /adapt it
- Ad-hoc, real time solutions are needed for IoT/WSN complex networks

QUESTIONS?

Paper title:

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Speaker: George

Thank you