

# Intermittent Opportunistic Routing Components for the INET Framework

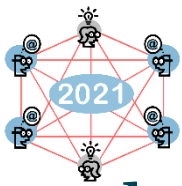
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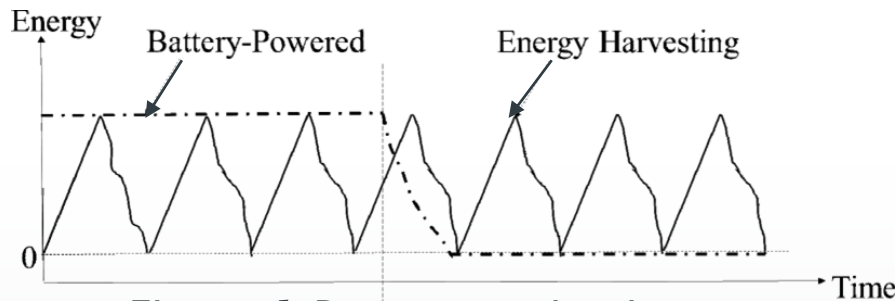
[github.com/UoS-EEC/INET-opportunistic-routing](https://github.com/UoS-EEC/INET-opportunistic-routing)





# Background: What are intermittent devices and why are they useful?

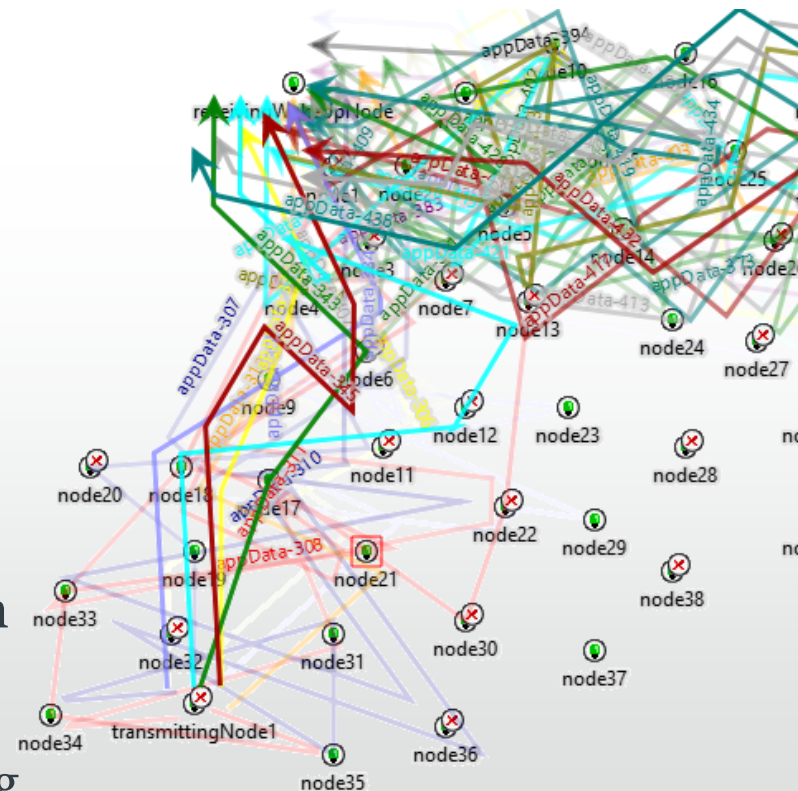
- Intermittent devices remove the need for large energy storage by energy harvesting instead.



*Figure 1: Battery expiration compared with EH*

Continuous Sensing on Intermittent Power, A.Y. Majid et al. 2020  
IPSN'20

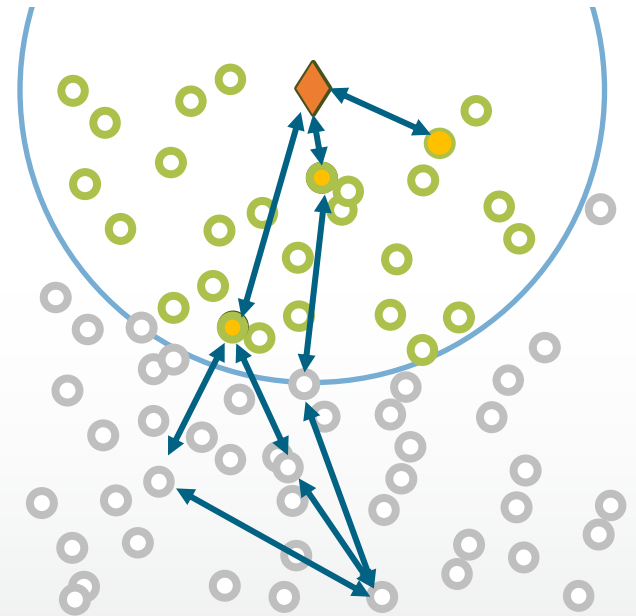
- They can operate for longer but often with limited duty cycles.
- Routing is therefore challenging, requiring opportunistic methods to reach the destination.

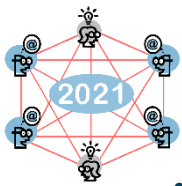




# Opportunistic Protocols are promising, but how can we compare them?

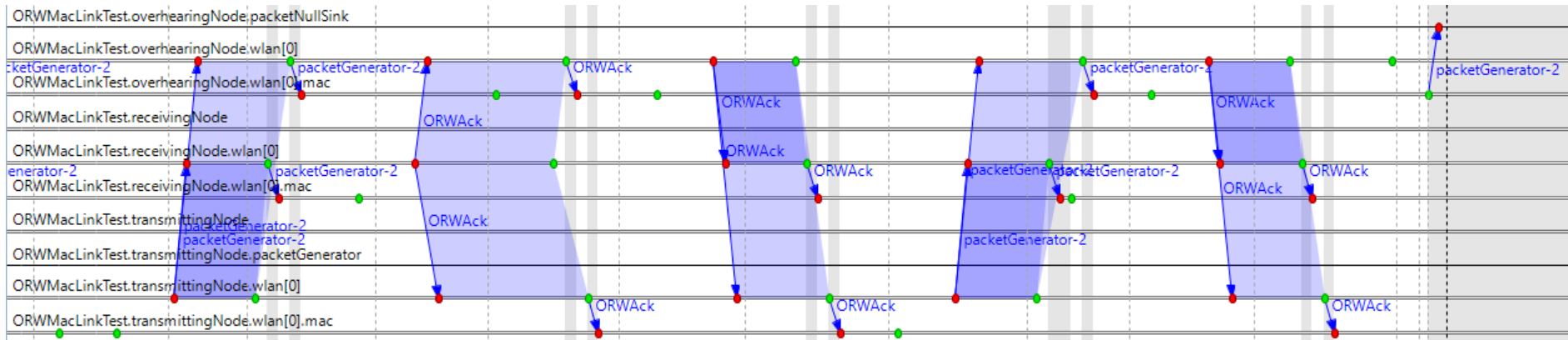
- First, what are the key components?
  - Neighbor modelling (forwarding set)
  - Point to Point Data Transfer (DLL)
  - Network route modelling
  - Opportunistic Forwarding (with attempt receive hooks)
- Could these components be interchangeable and interoperable, yes!
  - But only with common interfaces



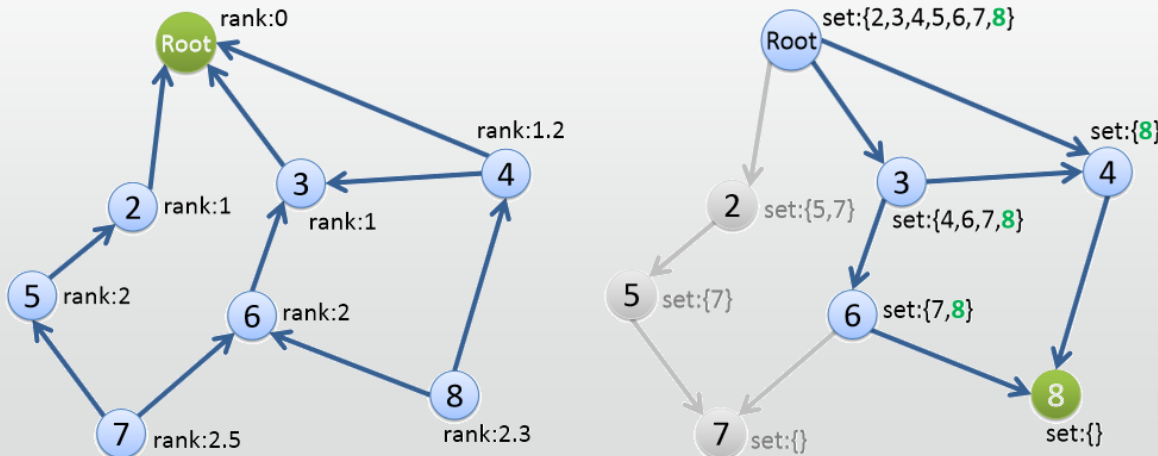


# New implementation of Opportunistic RPL

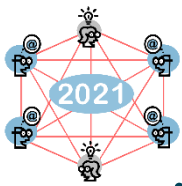
- A combination of Opportunistic MAC Forwarding:



- And: A routing metric and routing set sharing to get to the sink:

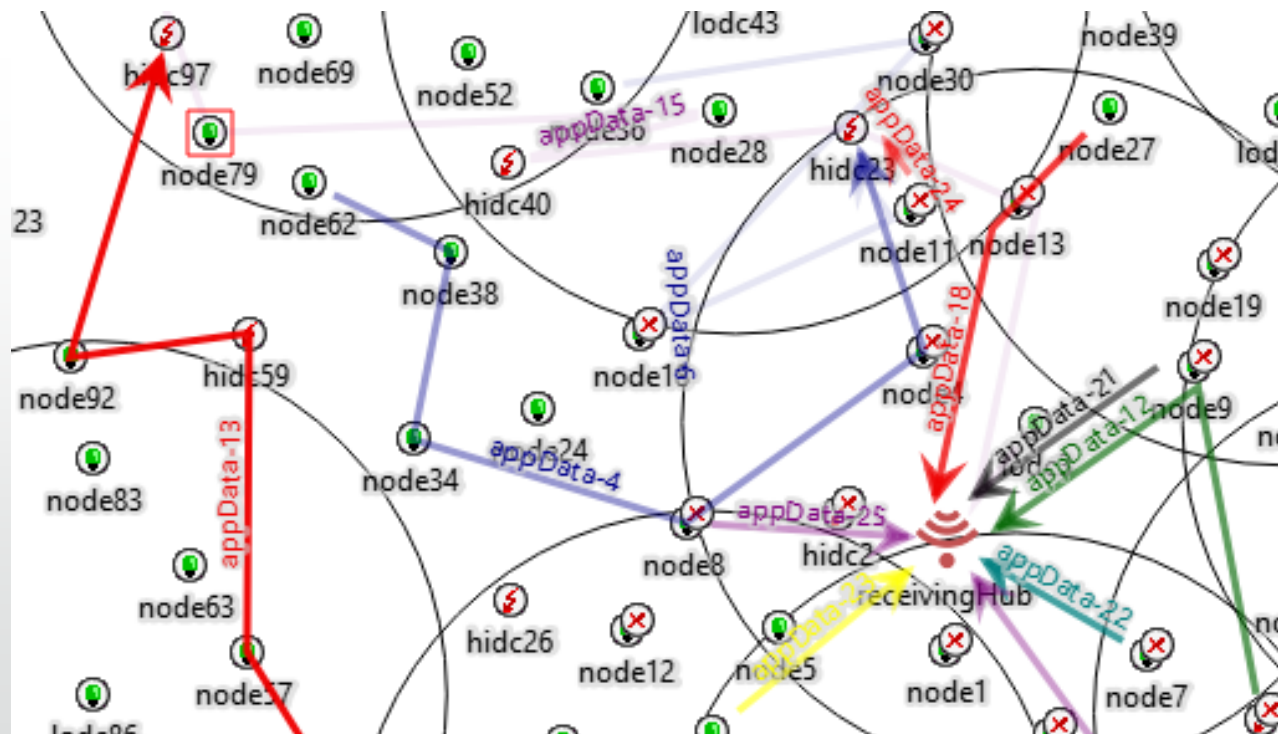


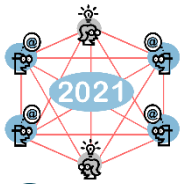
“Let the tree Bloom:  
scalable opportunistic  
routing with ORPL”  
(2013, S. Duquennoy, O.  
Landsiedel, and T. Voigt.)



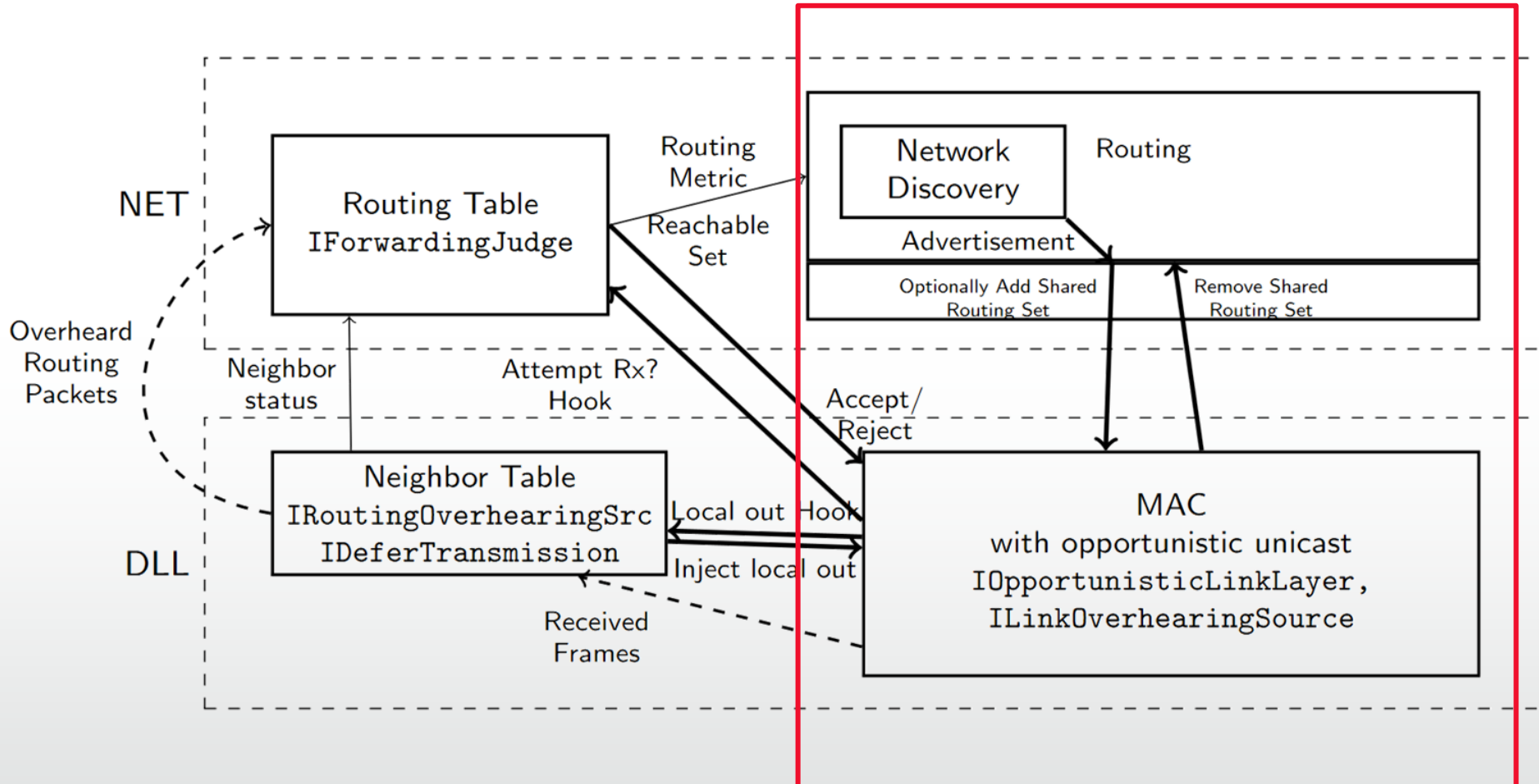
# New implementation of Opportunistic RPL

- Never before has multi-hop networking for intermittent devices been demonstrated.
- Devices can communicate without the need for tight synchronization



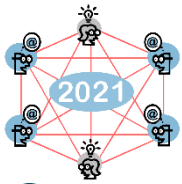


# Common interfaces defined

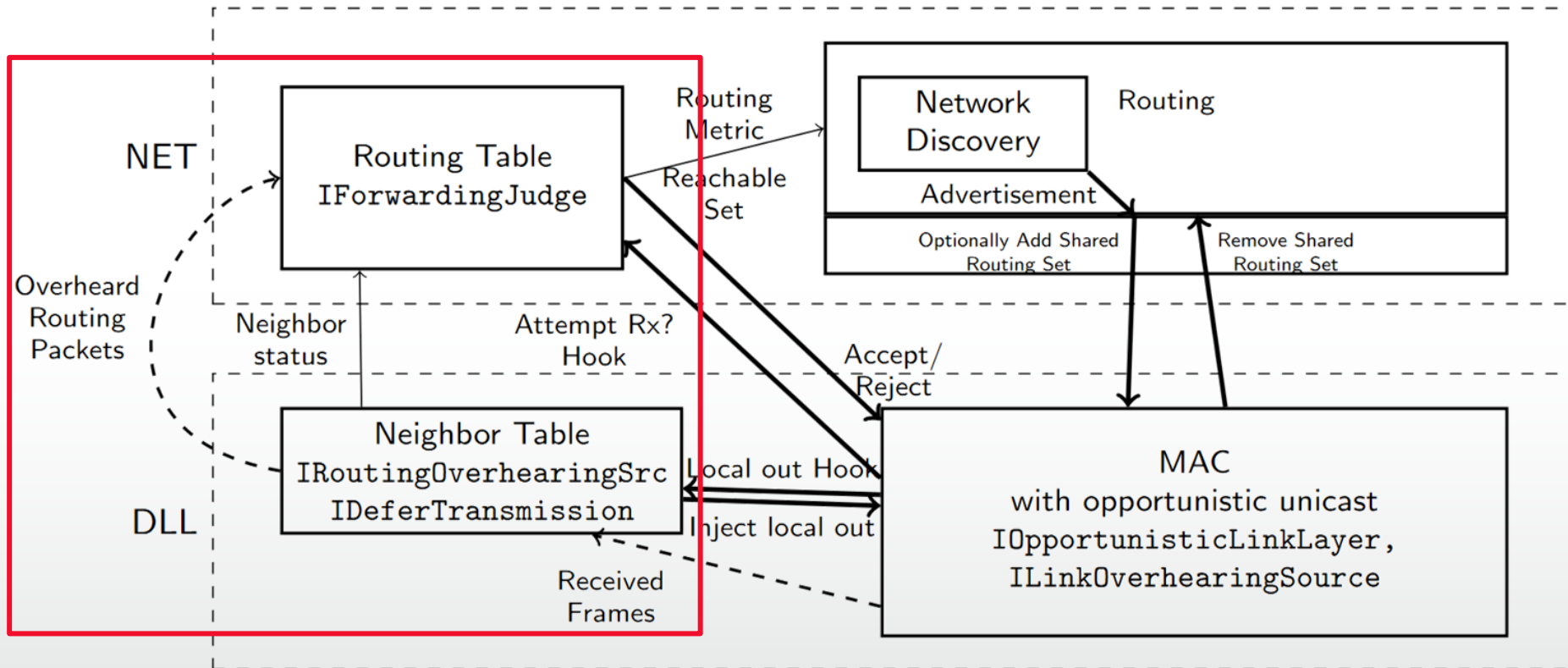


- Standard Layers

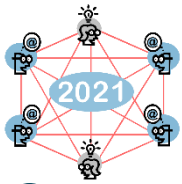




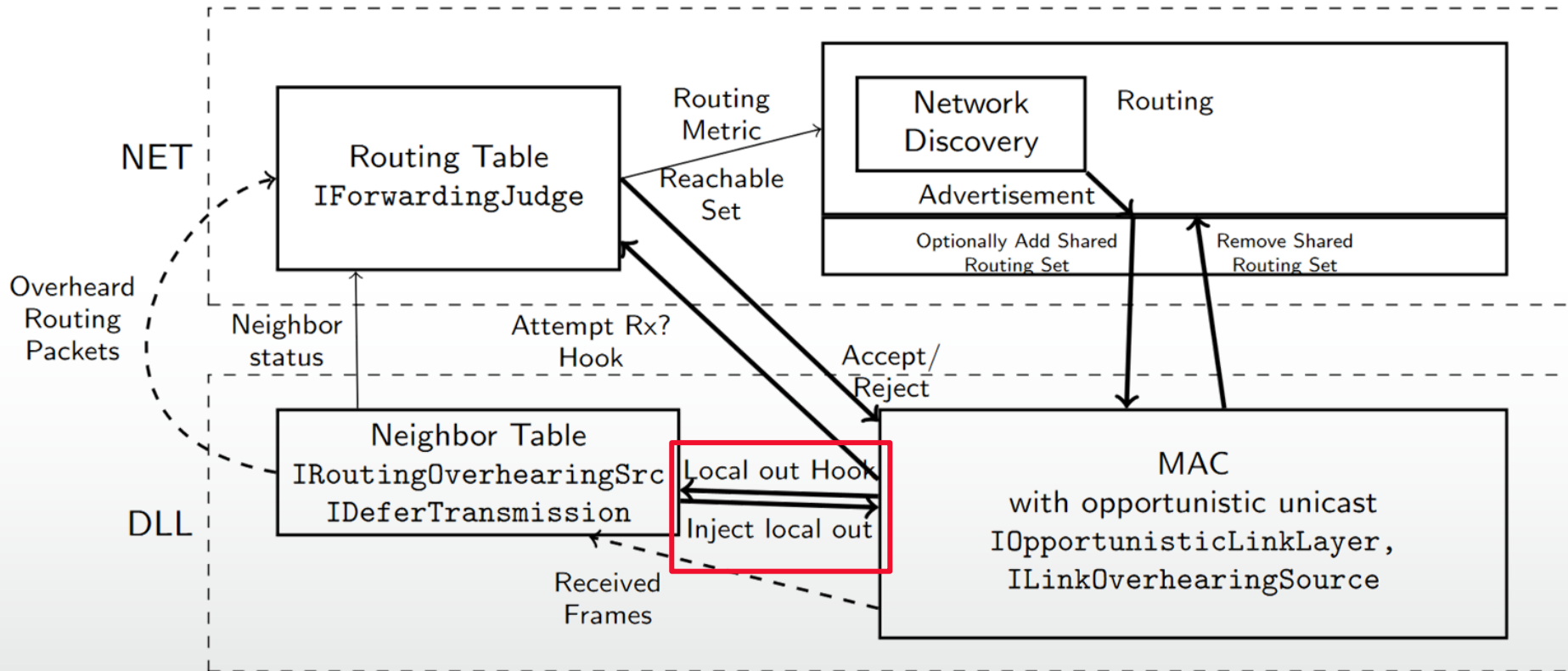
# Common interfaces defined



- Network Model – including overhearing of frames

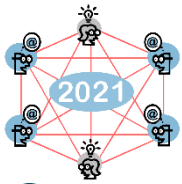


# Common interfaces defined

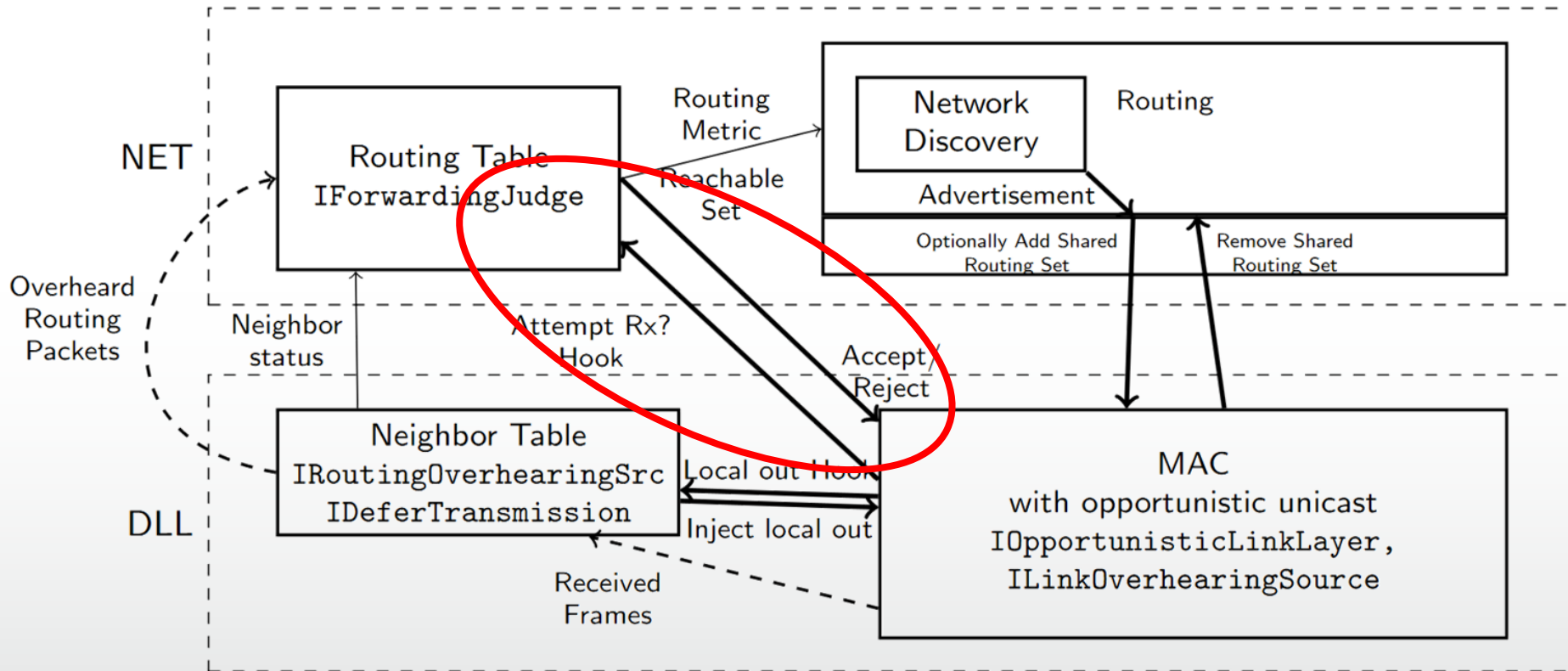


- Packet deferral

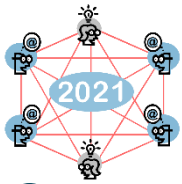




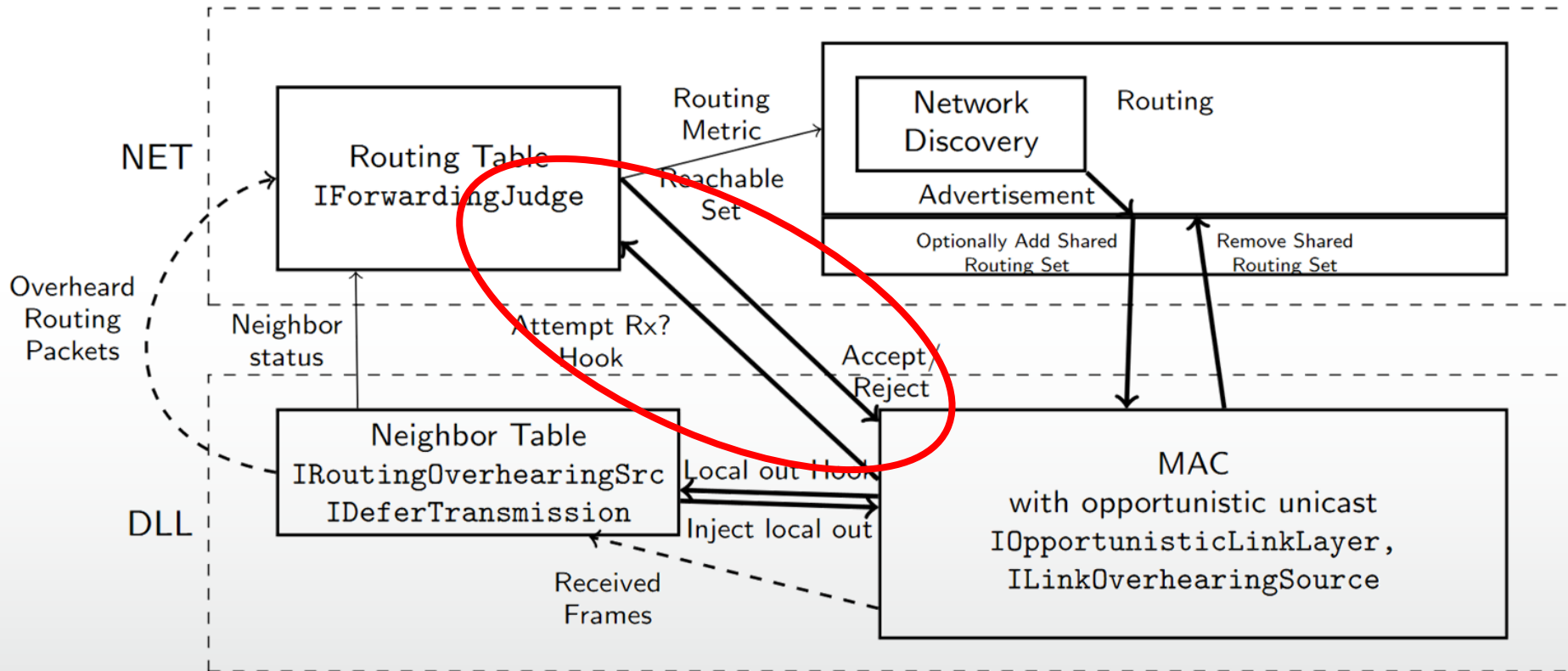
# Common interfaces defined



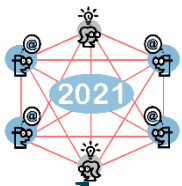
- Opportunistic Acceptance



# Common interfaces defined

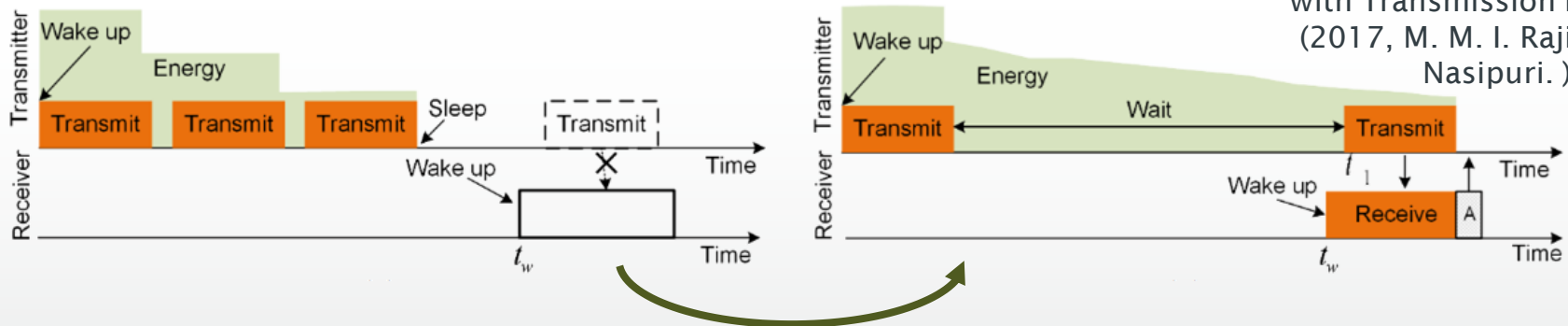


- Opportunistic Acceptance



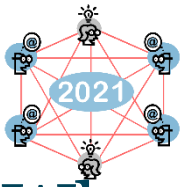
# What other candidate components exist?

- Message deferral to improve delivery probability
  - Find & Flync K. Geissdoerfer and M. Zimmerling
  - Predictive (delayed) Retransmissions




“Predictive Retransmissions for Intermittently Connected Sensor Networks with Transmission Diversity”  
(2017, M. M. I. Rajib and A. Nasipuri.)

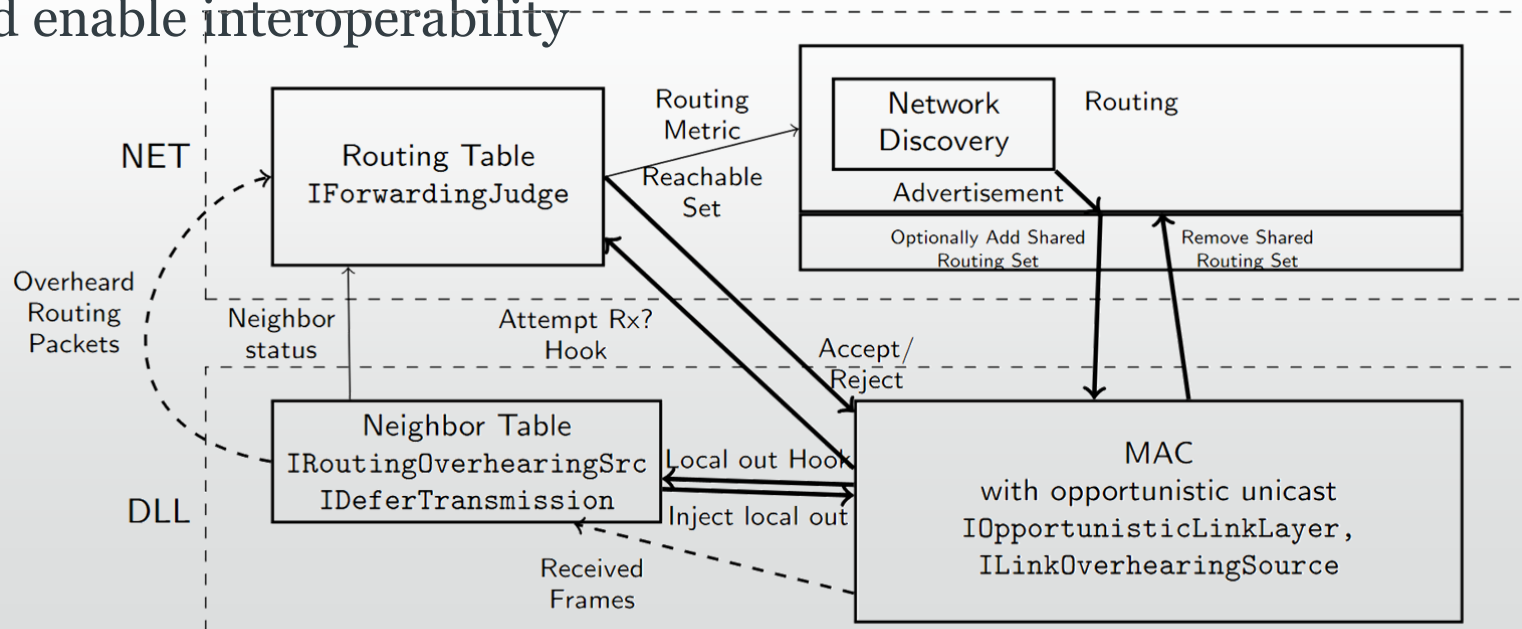
- Many other potential routing protocols also available
- Common interfaces allow like-for-like performance comparisons



## What now?

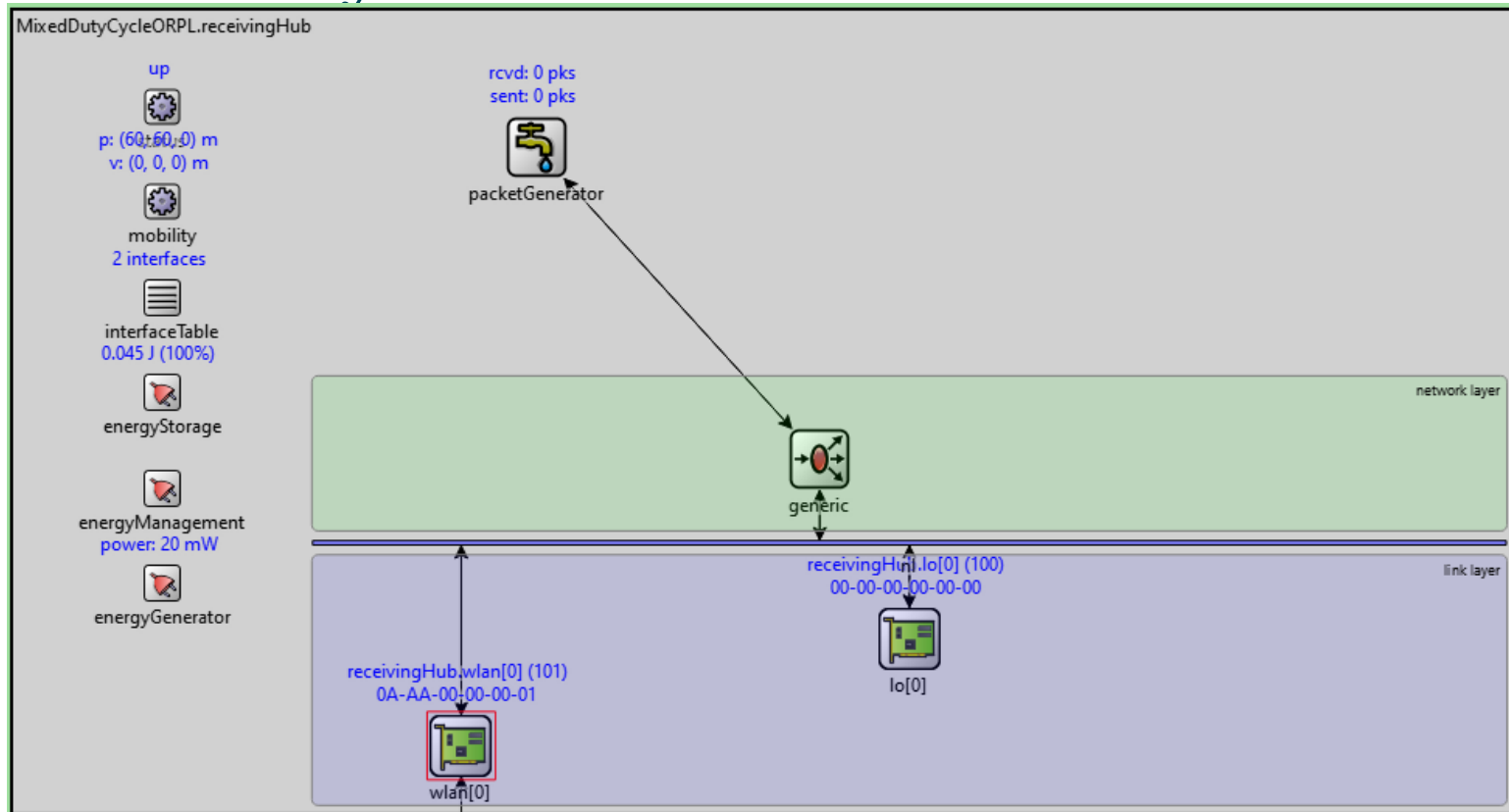
- Opportunistic protocols can enable communication in these energy scarce environments
- Protocols share common cross-layer interface requirements
- Common interfaces encourage and enable interoperability
- Run our demonstration code from [github.com/UoS-EEC/INET-opportunistic-routing](https://github.com/UoS-EEC/INET-opportunistic-routing) 
- Please let us know what you think!

[el7g15@ecs.soton.ac.uk](mailto:el7g15@ecs.soton.ac.uk)



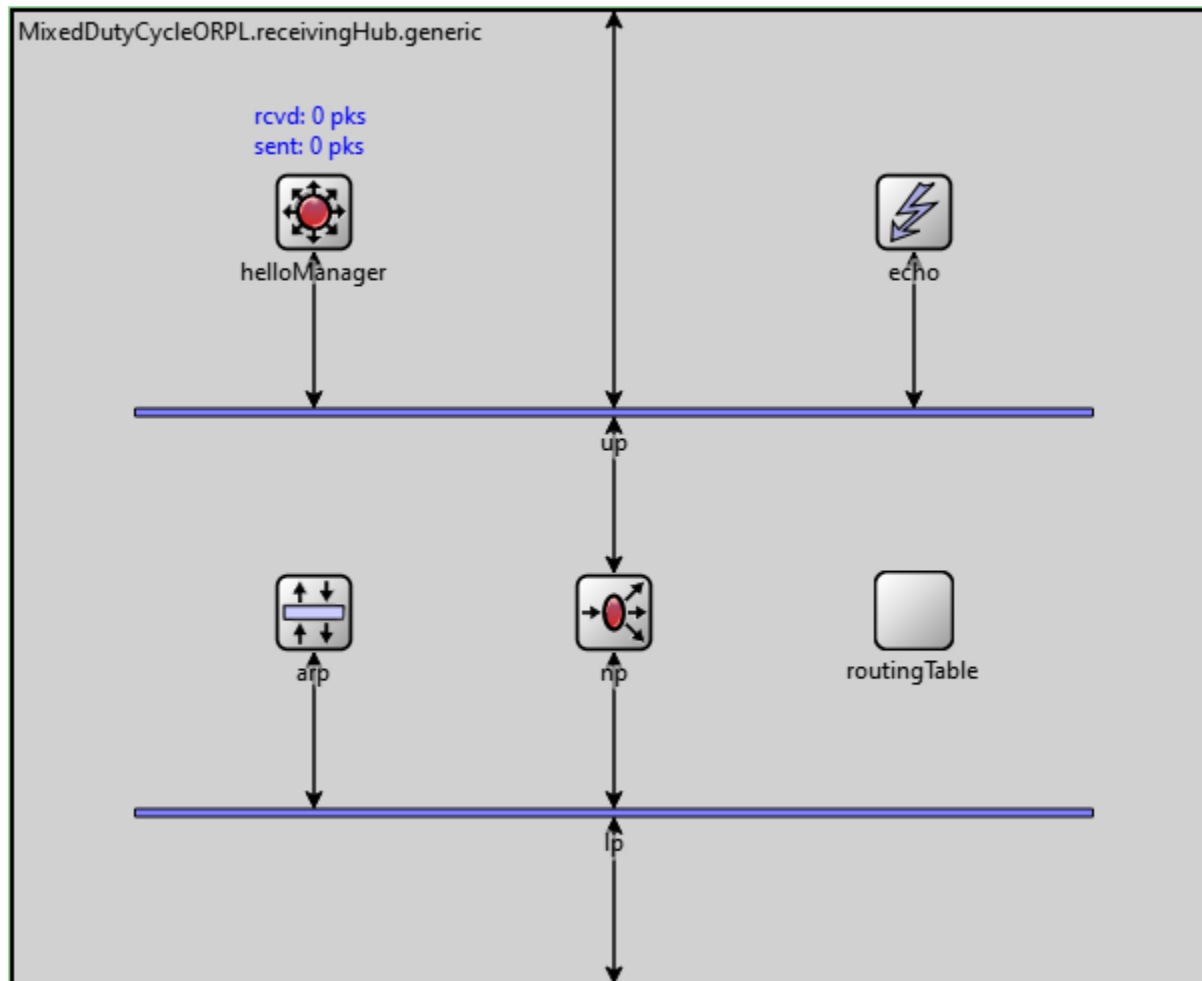
# Extras

# NetworkLayerNodeBase derived node





# Network Layer (overrides generic)



# MAC Layer

