Study for In-Vehicle-Network and New V2X Architecture by New IP

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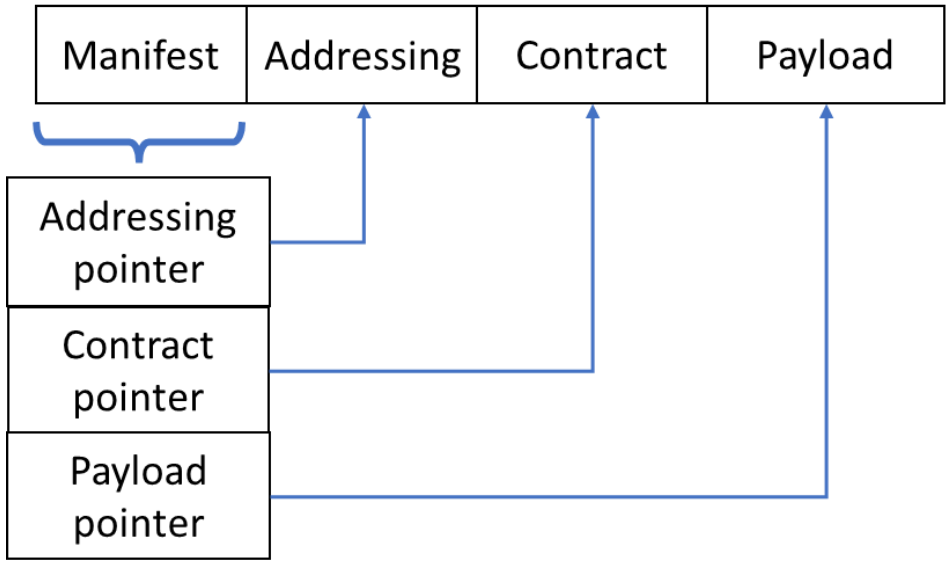
Reference

- Paper: International Journal on Advances in Internet Technology https://www.iariajournals.org/internet_technology/inttech_v14_n12_2021_paged.pdf
- New IP:
  - “New IP, Shaping Future Network: Propose to initiate the discussion of strategy transformation for ITU-T”, TSAG C-83
  - “A New Framework and Protocol for Future Networking Applications,” ACM Sigcomm NEAT workshop, 2018, pp 21–26.
  - “A New Framework and Protocol for Future Networking Applications,” ACM Sigcomm NEAT workshop, 2018, pp 21–26.
  - “6G Needs New Networking Technologies,” 6G’s Coming – Is a New Network Architecture? - 6GSymposium Spring 2022, https://youtu.be/PwB0eWvETiw.

New IP Introduction
a new protocol for LEO satellite routing solution



Addressing (for Omni-Convergence)
- Free Choice Addressing
  IPv4, IPv6, Lisp, Flexible Addressing System, Others
- Mix and Match

Contract
- KPI guarantee
  - In-time guarantee
  - On-time guarantee
  - Lossless networking
- User Programmable networking

Payload
- Native stream of Bits and Bytes
- Qualitative Payload
- Semantic Payload

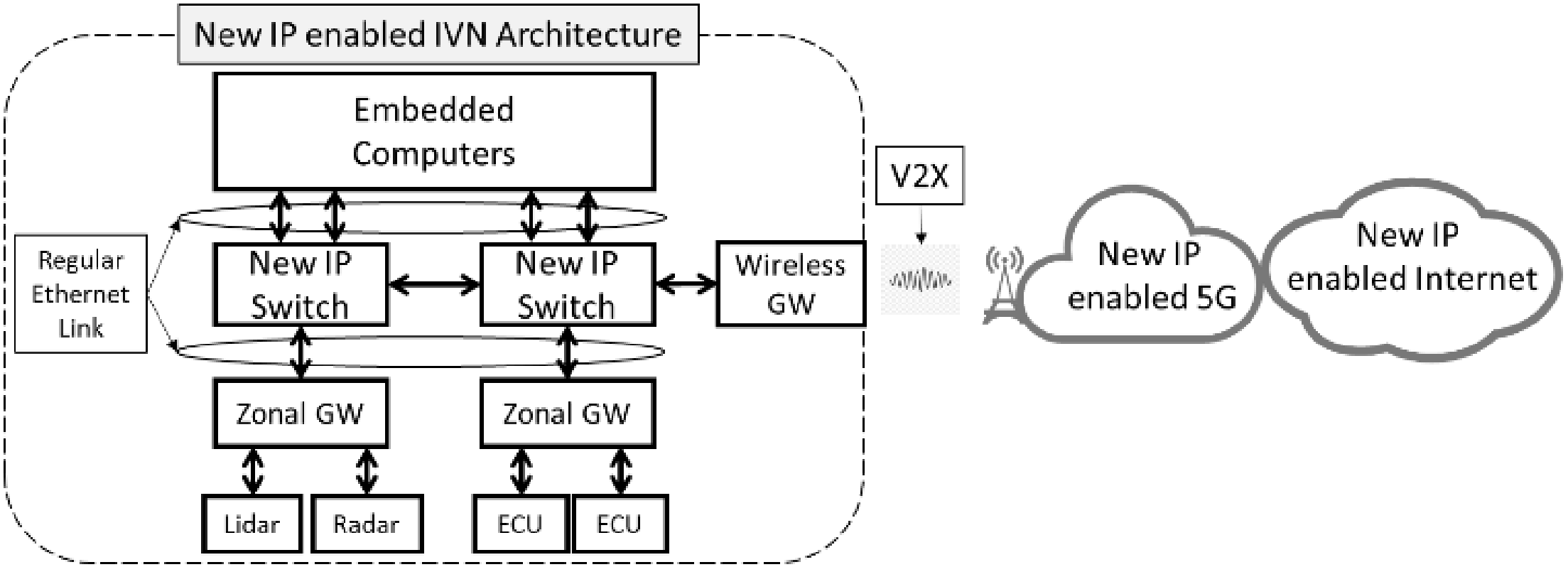
- Routing protocol packet hdr use Non-IPv6 address
- 32-bit or shorter length is enough for IVN nodes

- User packet use Programmability for path setup with SLA

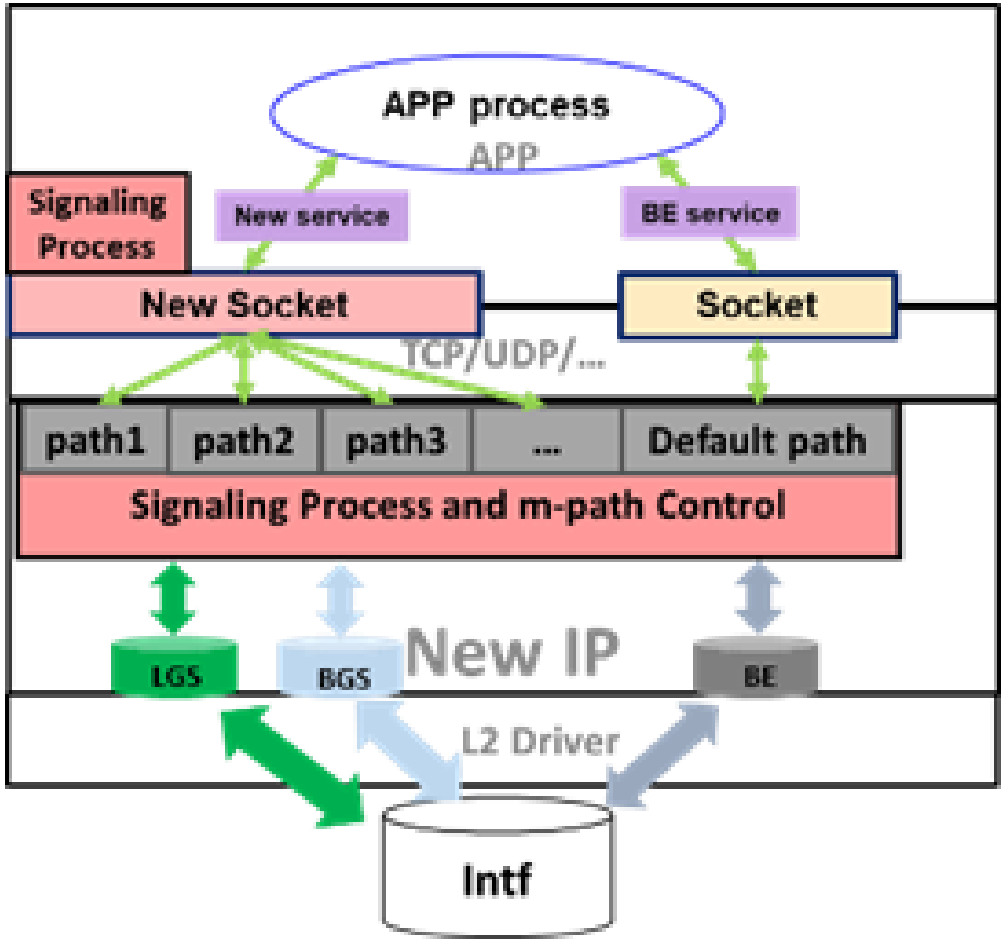
5G vs Future Internet

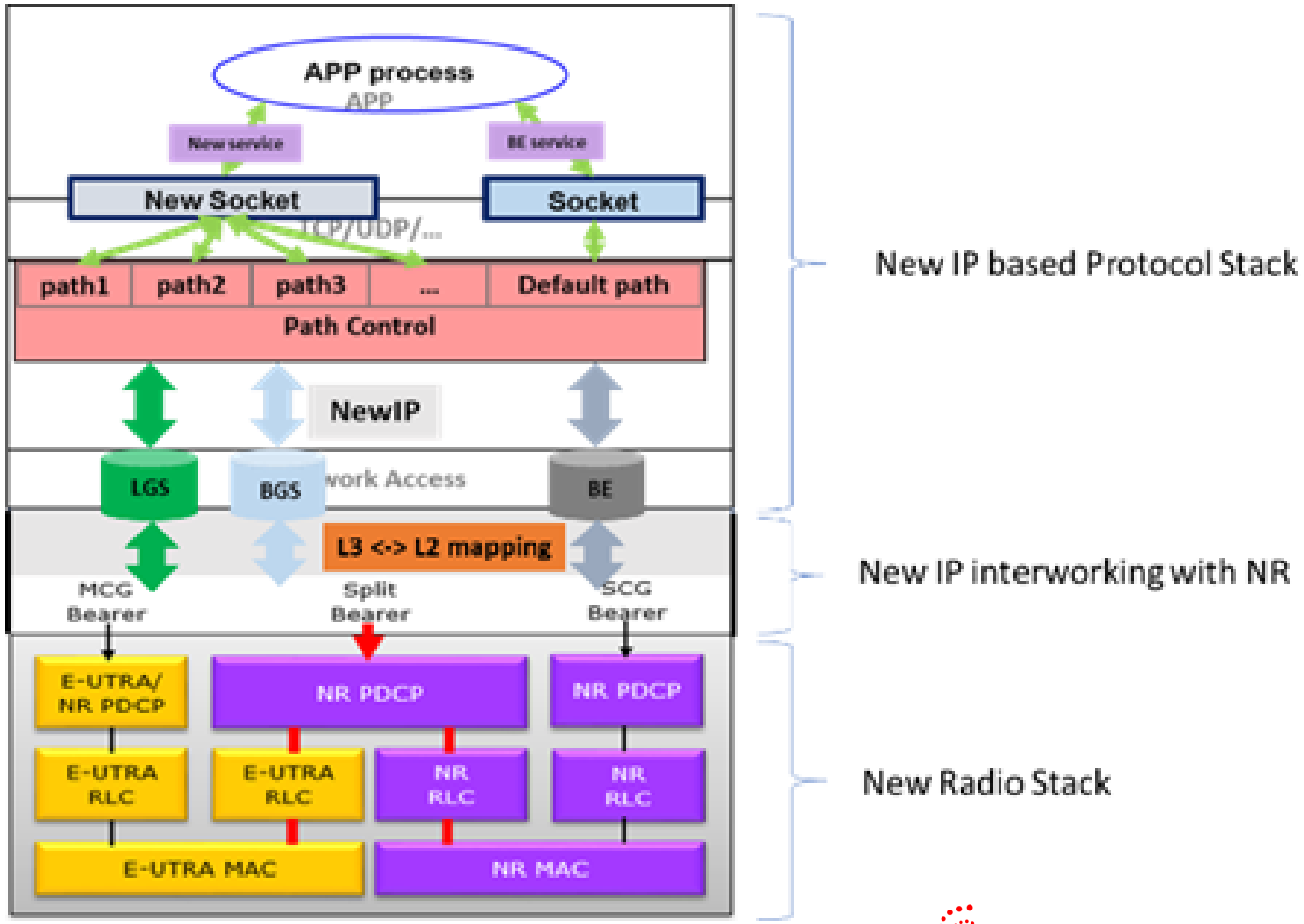
	5G	Future Internet
Purpose and Requirements	• eMBB • mMTC • uRLLC	• Ultra-high through put • All things connected • High Precision Communication
Solutions	• New Radio (5G NR) • Service Based Architecture (SBA)	• New IP
Technologies	• New spectrum • MIMO • New protocol stack at UE • 5G NR QoS • Grant Free Dynamic Scheduling	• Flexible addressing • Network Layer Multiple path • New protocol stack at host and UE • In-band signaling • New queuing and scheduling

New IP enabled IVN, V2X and Internet



New IP stack and integration with 5G-NR





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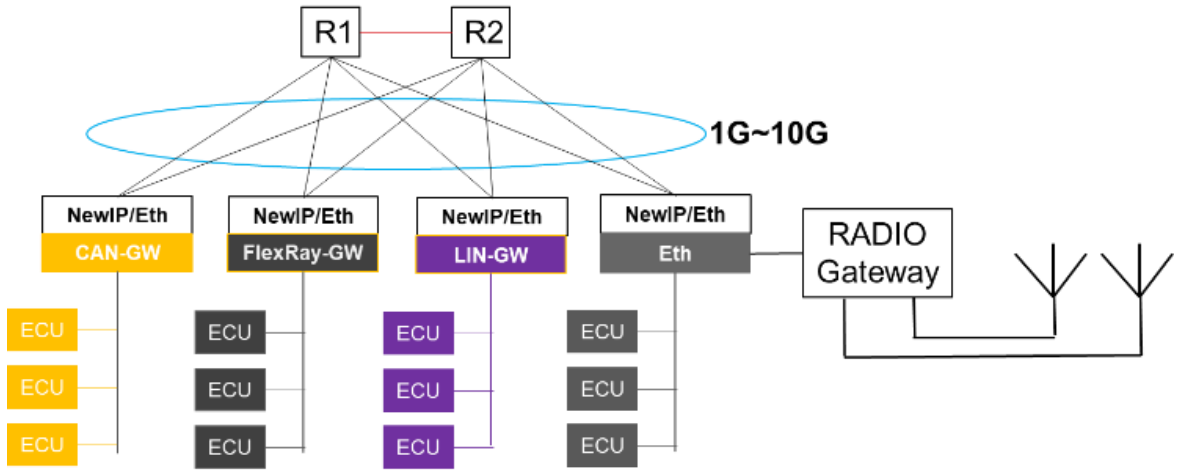
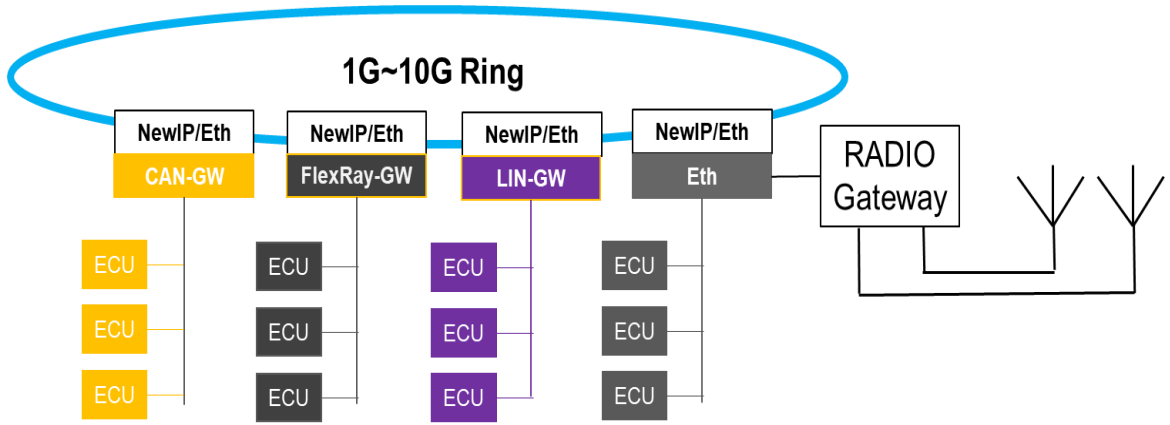
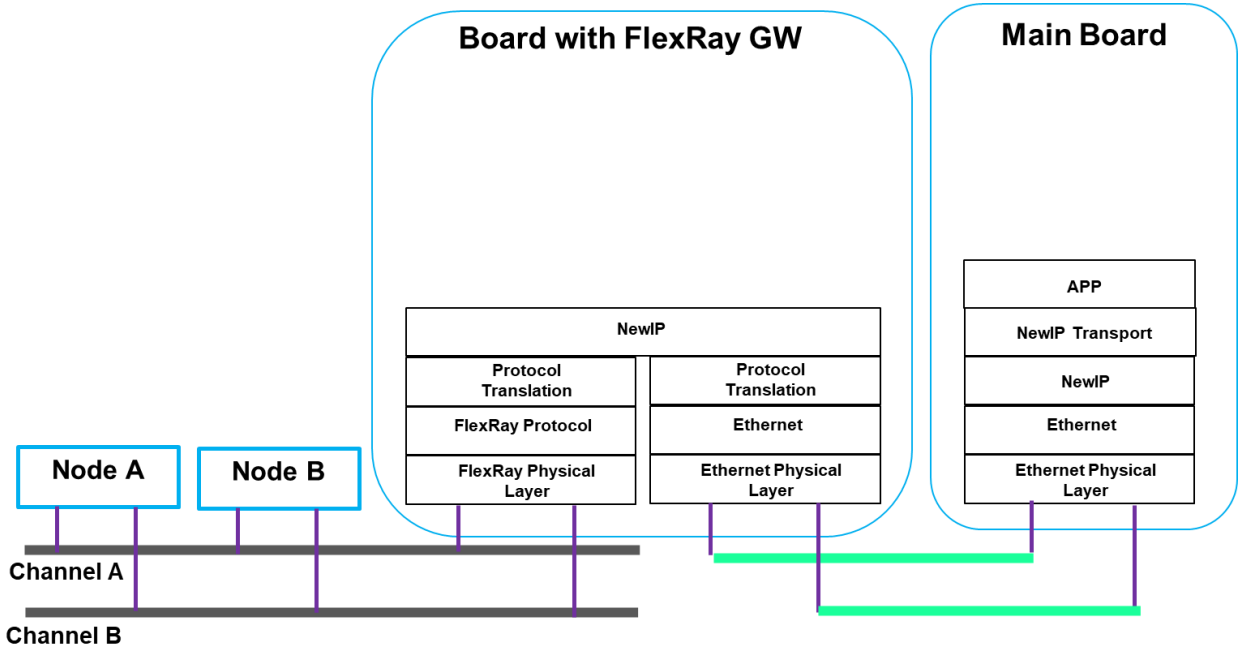
New IVN architecture and backward compatibility







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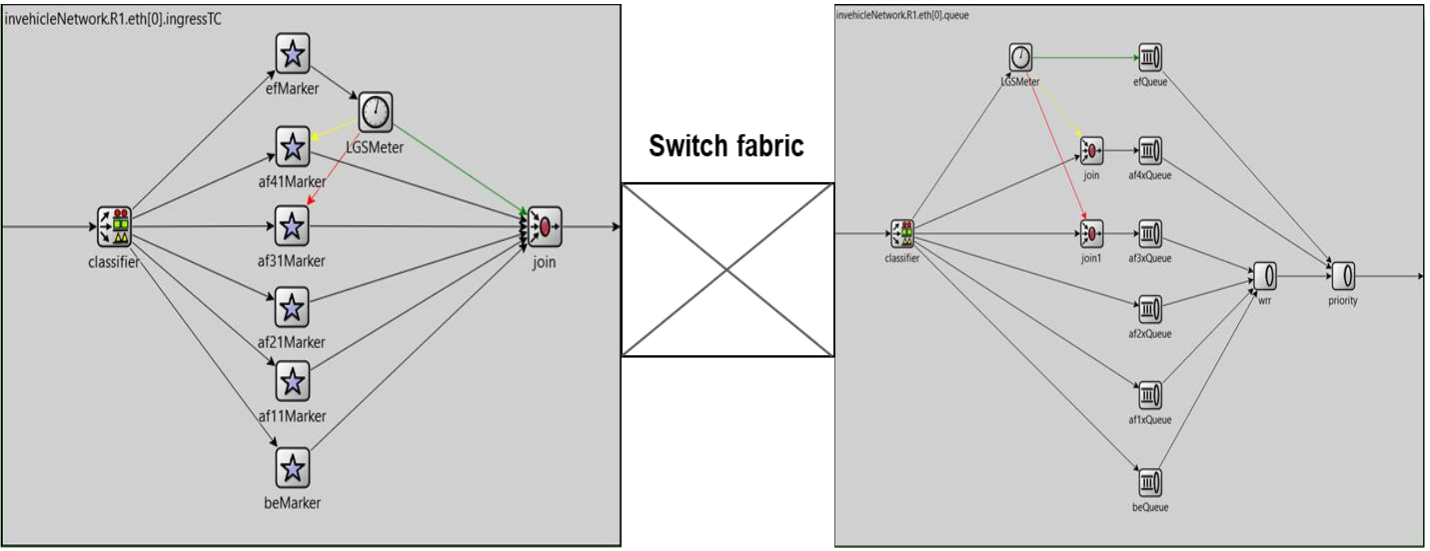
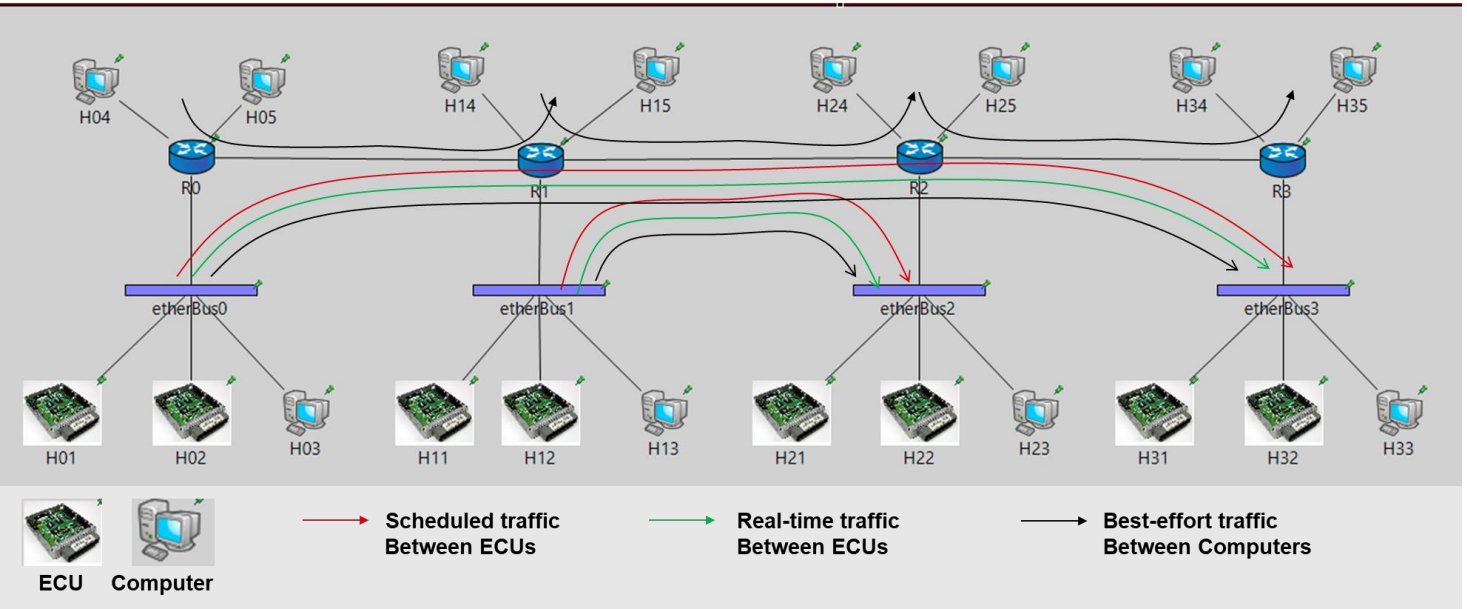
Modeling by INET and Oment++

- Modeling test architecture
- In-band Signaling process
- Traffic classification
- Queuing and Scheduling

Modelling network topology, traffic and service





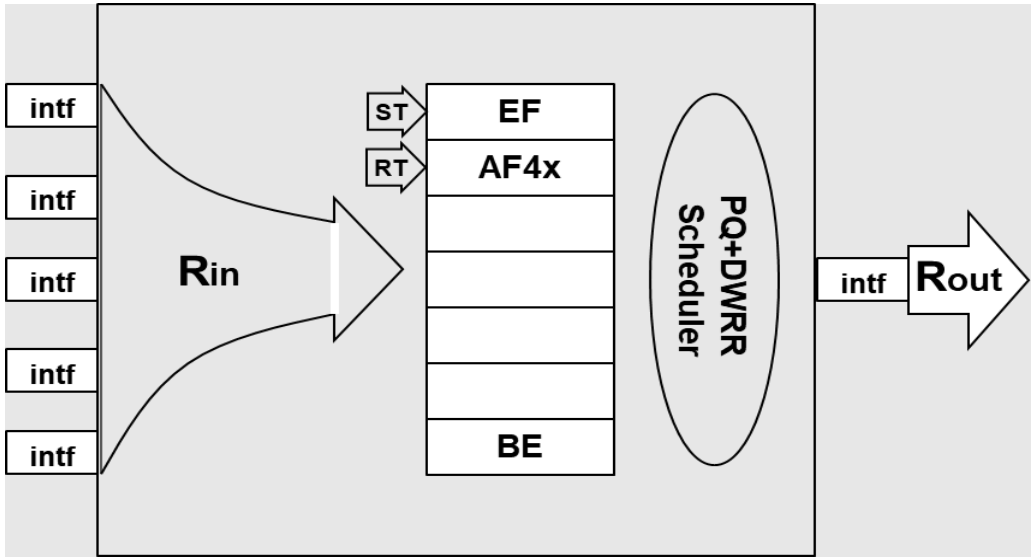
Service Type	QoS Characters	Use Case
LGS for Scheduled Traffic	**Bandwidth**: Network guarantees the bandwidth is within (CIR, PIR) **Latency**: Most precise. Network guarantees E2E bounded latency **Jitter**: Approximately zero **Packet Loss**: Almost Zero • Congestion-free • Lossless queuing • Multi-path to prevent drop from physical failure	Asynchronous or Synchronous communication: Critical sensor and control data
LGS for Real Time Traffic	**Bandwidth**: Network guarantees the bandwidth is within (CIR, PIR) **Latency**: Minimized. Network guarantees E2E bounded latency **Jitter**: ½ of E2E bounded latency **Packet Loss**: Minimized • Congestion-free • Lossless queuing • Only drop when physical failure	Asynchronous communication: Critical sensor and control data
BGS for bandwidth sensitive traffic	**Bandwidth**: Network guarantees the bandwidth is within (CIR, PIR) **Latency**: Less important **Jitter**: Less important **Packet Loss**: Don't care	Un-critical data
BES for other type of traffic	Don't care	Other data

In-band Signaling and Traffic Classification

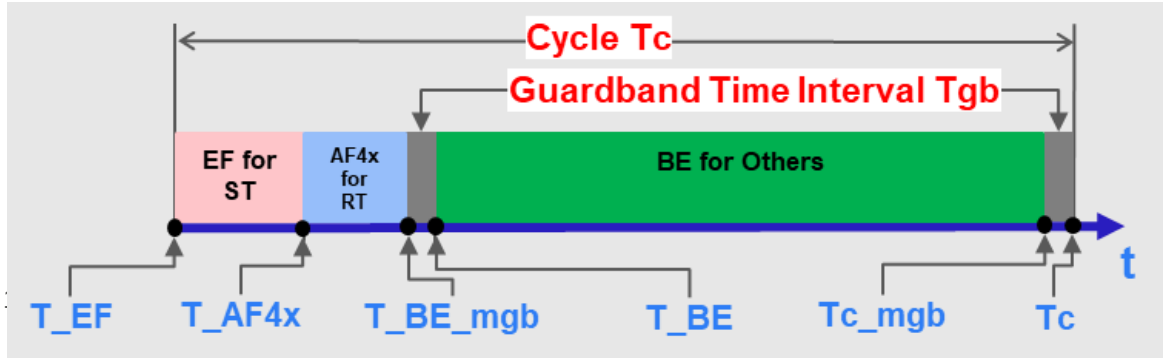
- In-band Signaling Process
  - At host
    - Add time-stamp, CIR/PIR, Reservation-status, etc to packet's parameter
    - TCP/UDP app modify the packet sent out
    - At the receiver,
      - Does the delay measuring and comparing with the Delay estimation (see paper)
      - Does the reservation-status process and send back
  - At routers
    - At each router, check packet's parameter and process it
      - Reserve the resource based on CIR/PIR and update Reservation-status
      - Add new entry (5 tuples) to the routing table if reservation is success
    - Prefix as key -> Prefix as key, and, 5 tuples as key for the reserved flow
- Classification
  - At host, packet is classified after sending out the interface

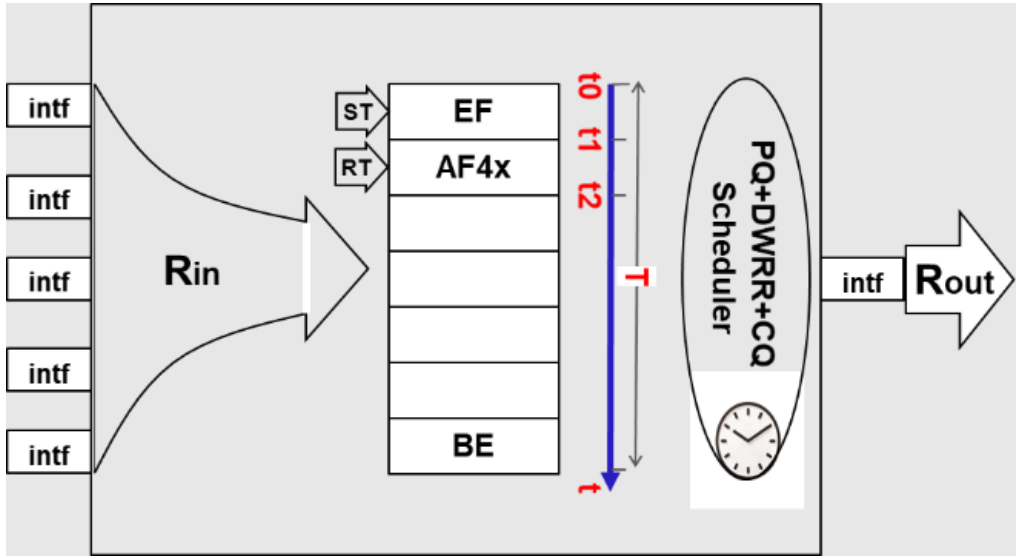
Queueing and Scheduling

- Algo1:
- Asynchronous
- PQ+DWDR



- Algo2:
- Synchronous
- Cyclic+PQ+DWDR





Thank You.