Advanced Networking for Resilient Energy Delivery Systems (ANREDS)

PRESENTER: **Ashish Kashinath**

INTRO:

- Global view and configurability of SDNs allow can solve key issues in critical energy networks : **End-to-end QoS, Failure Tolerance & Isolation**
- Removes the need for custom standards & specialized equipment
  - Currently, 802.1Qav, 802.1Qbv : TSN standards
- Use Real-time task scheduling theory with SDN's

METHODS

- Developed a Real-time SDN framework
- Improving Efficiency
  - Multiplex RT flows onto the same queues
- Improving Resiliency
  - Backup paths for critical flows during link failure
- Bandwidth-Deadline formulated as **MCP problem**
- Evaluated on hardware SDN testbed with avionics specifications as well as software simulations, both with and without link failures

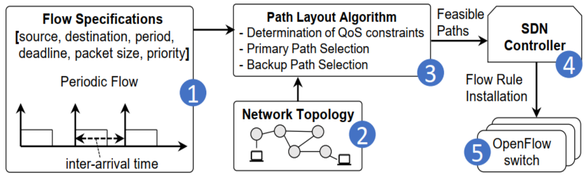
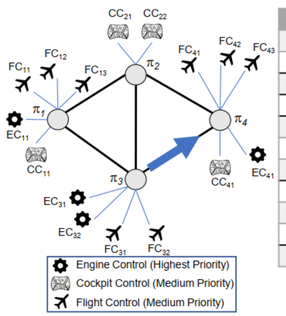


Figure : Real-time SDN Framework

RESULTS

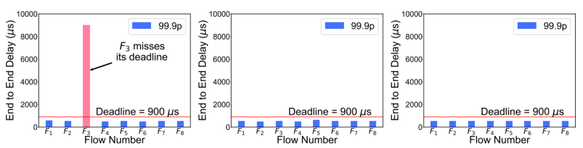
- SDNs shown to manage critical networks with commodity hardware platform & software stack



Flow ID	Source	Destination	Priority
Flight Control Flows			
F_1	FC_{11}	FC_{41}	Medium
F_2	FC_{12}	FC_{42}	Medium
F_3	FC_{13}	FC_{31}	Medium
F_4	FC_{32}	FC_{43}	Medium
Cockpit Control Flows			
F_5	CC_{11}	CC_{21}	Medium
F_6	CC_{41}	CC_{22}	Medium
Engine Control Flows			
F_7	EC_{11}	EC_{31}	High
F_8	EC_{32}	EC_{41}	High

Background Flow (Lowest Priority)

Figure : Hardware Evaluation with Avionics Specs



CREDC

Software-defined Networking (SDN) can enable the provisioning and management of critical networks in energy delivery systems better.

Take a picture to **download** the **poster**

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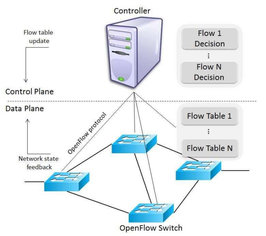
ADDITIONAL INFORMATION

SDN IN A NUTSHELL

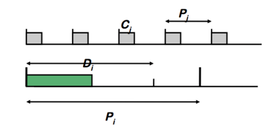


- Split the network into control plane (logic) and data plane (mechanism)
- Primarily used in data-center, enterprise, and corporate networks
- Aids better manageability, control over network & enables faster innovation

INSPIRATION FROM TASK SCHEDULING THEORY

- Worst case interference from a higher priority task, *j*?

Time required by a higher priority task in an interval of length that corresponds to the relative deadline of task *i*.



$$I_j = \lceil \frac{D_i}{P_j} \rceil C_j$$

Interference from higher priority task ⟶ $I_j + C_i \leq D_i$

Execution time of T_i

IMPLEMENTATION

Configuration	Details
Switch Model	Pica-8 P-3297 [4]
Switch OS	PicOS v2.8
Switch Software	Open vSwitch v2.3.0 [52]
OpenFlow	1.5
Host Model	Raspberry Pi [6]
Host OS	Linux Kernel v4.14
Switch-Switch Bandwidth	1 Gbps
Host-Switch Bandwidth	100 Mbps

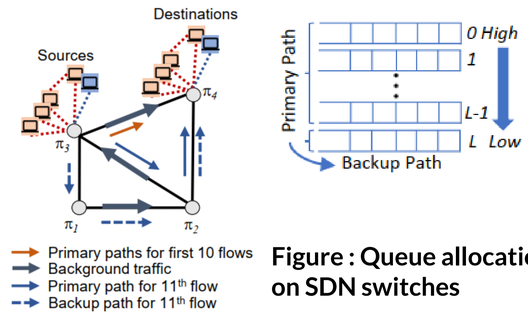


Figure : Queue allocation on SDN switches

CONTACT

University of Illinois at Urbana-Champaign
Ashish Kashinath, Monowar Hasan, Sibin Mohan
Oregon State University
Rakesh B Bobba