A USER-CENTRIC CONTROL PLANE IN 6G NETWORKS

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MOTIVATION

- Multi-connectivity is here but devices are unable to extract its benefits

- Devices and networks take decisions on link selection locally

- Control plane decisions are largely network operator centric

- User devices continue to select links based on static rules

  - Wi-Fi preferred over LTE, even though Wi-Fi could be badly congested

- Inputs from user devices and user preferences are not included in control plane decisions

GOAL: A USER CENTRIC CONTROL PLANE

- Allow user devices to influence network decisions

  - Enable user devices to specify their requirements from the network

  - Allow networks to advertise the offered services

- Allow user devices to use different links based on application characteristics and requirements

  - Bulk file transfers over high bandwidth link

  - Interactive and low latency applications over low latency link

- Enable user devices to seamlessly switch between available links
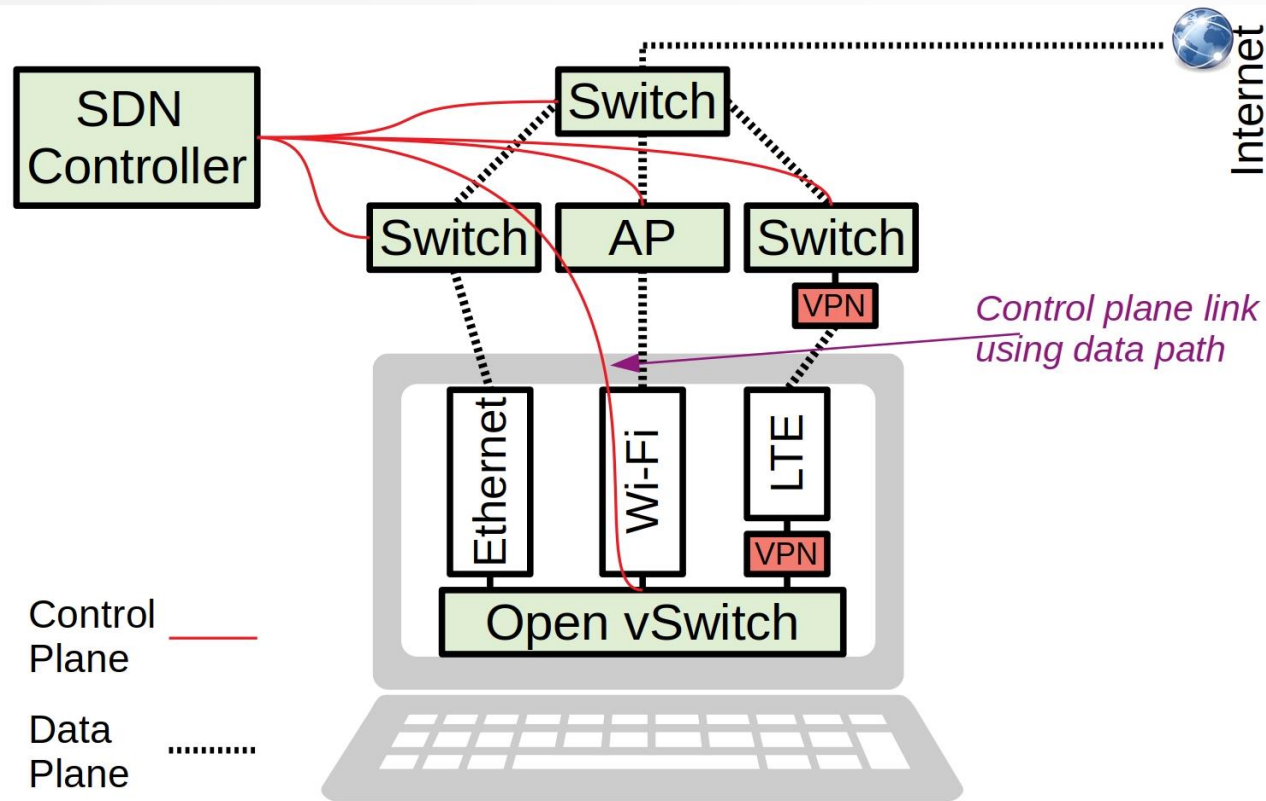
RESEARCH AGENDA

1. Enable a network controller to take control of the interface links

2. Implement an instance of the network controller in the user device

3. Allow the local instance negotiate with the network controller
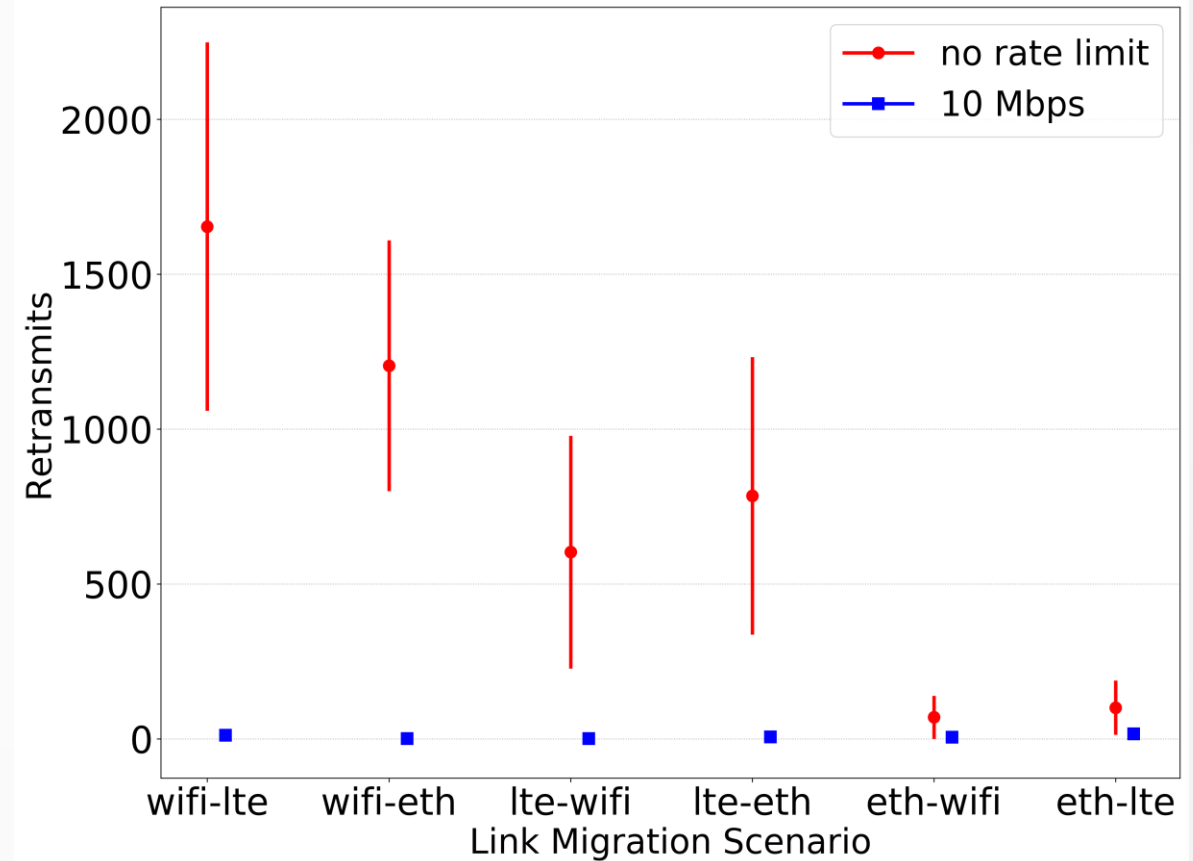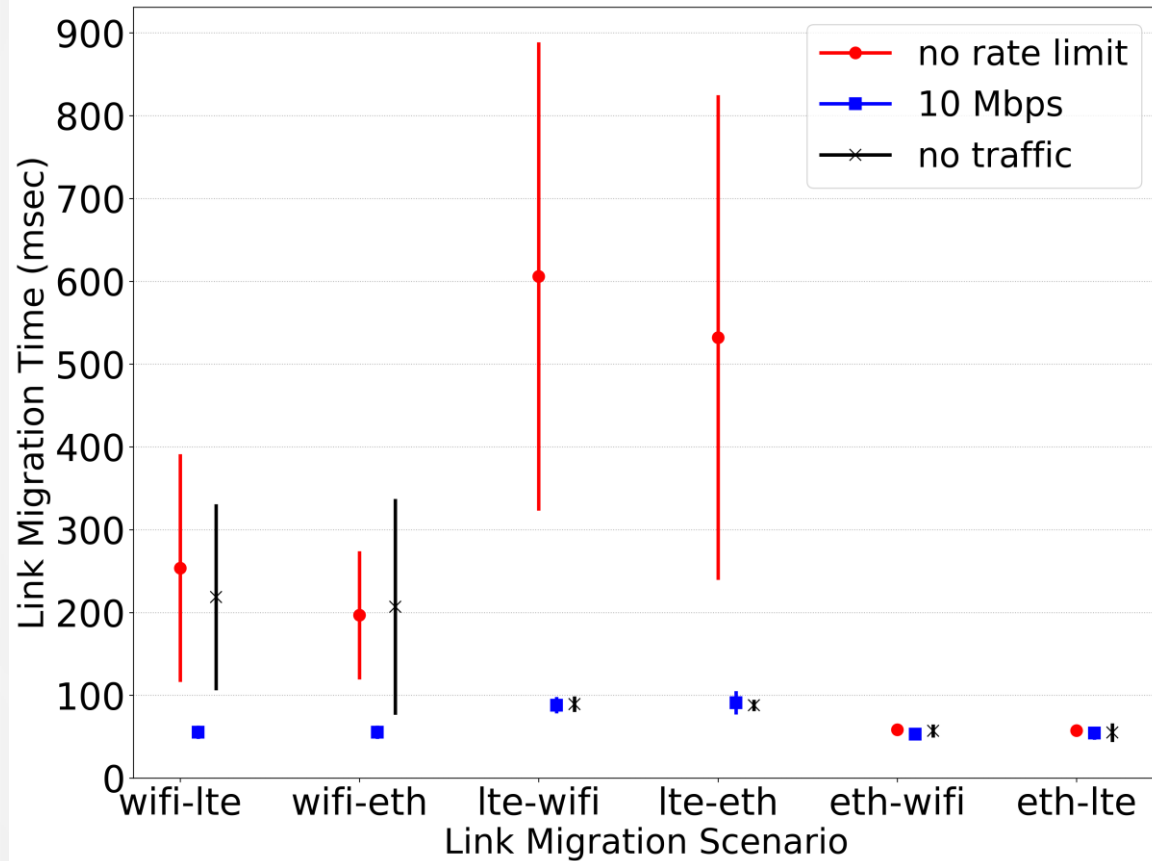
PROGRAMMABLE INTERFACE SELECTION

- Wi-Fi, Ethernet, and LTE interfaces plugged to Open vSwitch (OVS) on laptop

- VPN tunnel used to plug PPP interface of LTE modem to OVS

- SDN controller based on Ryu framework for managing SDN switches, APs, and OVS on the laptop

INITIAL RESULTS AND INSIGHTS

CHALLENGES AND INSIGHTS

- Lack of a dedicated control channel

- Varying characteristics of communication links

  - LTE bandwidth in our test network approximately 40 Mbps while Ethernet is 1 Gbps.

- Network inherently contains loops which must be addressed for serving broadcast and multicast packets

- Network discovery protocols not designed for multi-connectivity scenarios

  - LLDP broadcast address is dropped by WiFi
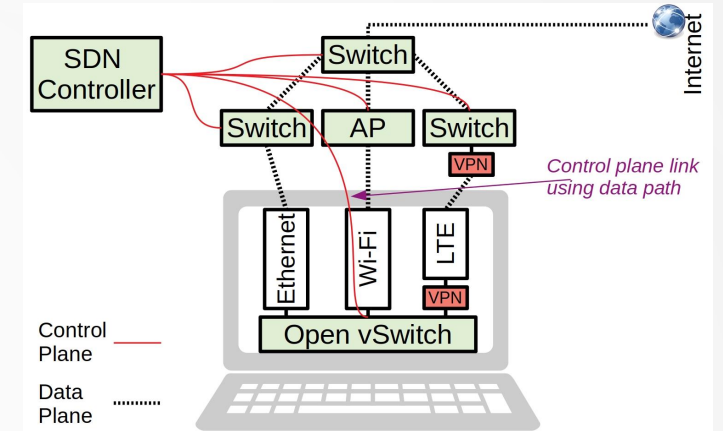
ON-GOING WORK (1):
LOCAL CONTROLLER ON LAPTOP
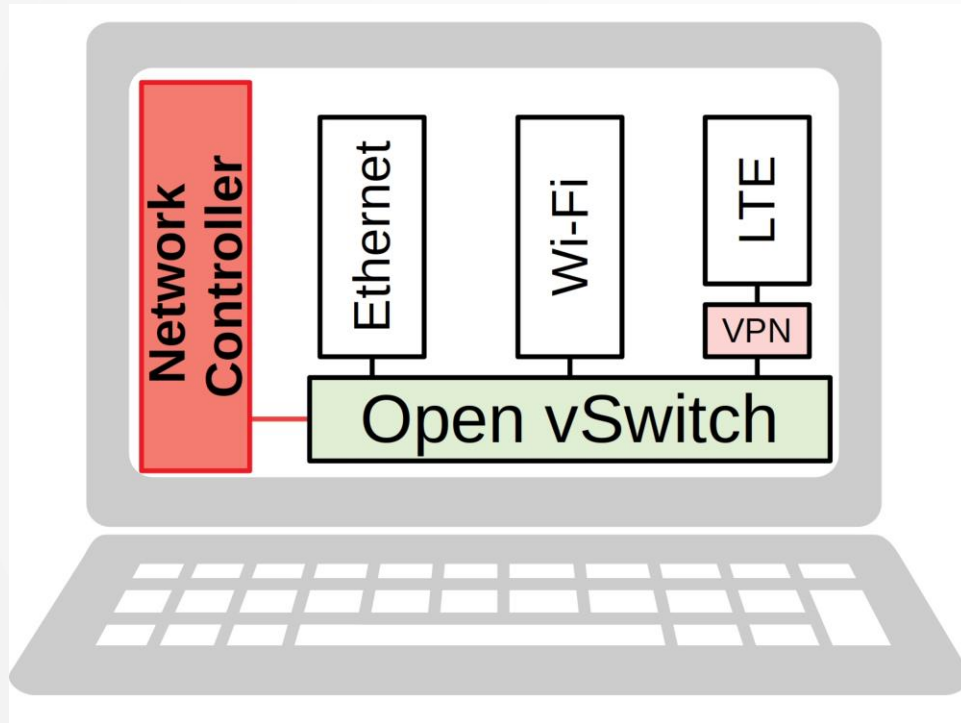
Local instance of Network Controller

- Ensure user preferences are met

- Manage the communication interfaces

- Bootstrap the network

- Negotiate with network controllers.

ON GOING WORK (2): NEGOTIATION BETWEEN CONTROLLERS

- Items to negotiate (in a secure and privacy preserving manner)
  - What services are available on a given link?
    – Security services offered by the network
    – Access to in-network devices such as printers, projectors, etc.
  - What are the QoS / QoE guarantees offered on a link?
    – Bandwidth, Latency, Jitter, etc.
- Mechanisms / protocols for performing the negotiation
  - Multiple Access Management Services (MAMS)
- Mathematical models for studying negotiations in a multi-connectivity environment

CONCLUDING REMARKS

- Need for revisiting multi-connectivity with a user-centric perspective

- Enablers have existed in different forms for a long time, however the best way to leverage these enablers is still an open research question

THANK YOU

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