**CSE 534 – Course Project**

## Objective

Evaluate & Optimize packet forwarding strategies using the In-band Network Telemetry (INT) Framework with P4 Switches.

## Core Ideas

1. Create a Server-Client Topology with an elaborate BmV2 P4 Switch Backbone.
   1. One of the Servers will act as a controller, and P4 programs will be deployed using P4Runtime.
   2. One of the Servers will act as a Monitor collecting the Telemetry Information.
2. Implement & Use the In-band Network Telemetry framework optimally (minimize overheads) in its different modes (INT-XD, INT-MX, and INT-MD) using the BmV2 P4 Switch Backbone mentioned:
   1. Collect relevant information such as Hop Latency, Buffer Occupancy, Processing Delay Overheads, etc.
   2. Configure the INT Switch Topology accurately: clearly define the INT Source Switches, INT Sink Switches, etc.
3. Extension: Using the telemetry data collected, devise real-time configurations for the Routing Strategies. This will enable us to re-configure our Packet Forwarding Tables in the Switches in real-time using P4.
4. Optimization Metrics:
   1. minimize overall latency
   2. maximize overall throughput
5. The overall implementation can be completed on the FABRIC TestBed, specifically using:
   1. Configurable P4 BmV2 switches
   2. The Measurements Framework Library (MFLib API):
      1. This will help us monitor the overall metrics of the Network slices.
      2. Can be integrated with ElasticSearch to store metrics & LogStash to keep processing logs within the Switch Architecture.
      3. Can be integrated with Grafana to create Meaningful Data Visualizations.

## Experiments

Main Experiment:

1. Create, Monitor, and Evaluate a Slice without Routing Protocol Reconfigurations.
2. Create, Monitor, and Evaluate a Slice with our devised Routing Protocol Reconfigurations.

Possible Extensions:

1. The results can be extended and generalized for different and more complex topologies.
2. Implement basic load balancing techniques (ECMP & WCMP) in both Slices and evaluate the results.

## Primary Deliverables

1. Implement the INT Framework using P4 BmV2 Switches.
   1. Walk-through the tutorials on P4 Programming
   2. Using P4 Runtime for P4 Deployment
   3. Create the codebase for storing the Monitoring Information
   4. Fixate salient metrics for overall evaluation.
   5. Evaluate the different INT Modes of Operation (INT-XD, INT-MX, INT-MD)
2. Implement features of the FABRIC Measurements Framework to monitor overall Slice-level metrics.
3. Primary Objective: Implement real-time Re-configurations on the routing strategy based on the INT Architecture feedback.
   1. Reconfigure the Forwarding Tables of the P4 Switches.
   2. Simulate Scenarios (node failure, link failure or congestion, etc.) that will trigger the routing configurations.
4. Stretch Objectives:
   1. Implement a novel L2/L3 load balancing algorithm built on the reconfiguration strategies used.
   2. Create real-time defense mechanisms to DDoS attacks using a customized INT packet implementation.