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MARS: Machine Learning Based Adaptable and Robust Network Management for Software-defined Networks

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- Ph.D., Clemson University, Dissertation: Denial of Service Attack Detection and Mitigation, 2015, Electrical Engineering
- Recep Tayyip Erdogan University, August 2016 – Present, Assistant Professor
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- SimCenter, University of Tennessee at Chattanooga, September 2019 -- Present, Visiting Scholar and Research Associate
Outline

- Motivation & Problem Statement
- Existing Solutions in the Literature
- MARS
- Road Map
- System Setup
- Q&A
Motivation & Problem Statement

- Traditional networks were designed to scale fast
  - They are harder to monitor and manage
- Internet of Things (IoT) has caused an increase in the number of nodes
- Mobile technologies caused constant topology changes on networks
Motivation & Problem Statement

Software Defined Networking (SDN) addresses network monitoring and management problems:
- It has scalability and single point of failure problems

We need networks that:
- Are easy to monitor and manage
- Can adapt topology changes to utilize resources efficiently and avoid failures autonomously
Literature

- **Scalable and fault tolerant SDN**
  - Elastic Distributed controller architecture
    - Pose as single controller
    - Dynamically grow and shrink
    - Migrate switches between controllers to loadbalance
  - Coordinating multiple control domains
    - Controllers exchange status information with each other
    - Each controller has global view
    - Aim to minimize flow setup time by adjusting number of controllers and delegating the switches
      - Utilize controller capacity efficiently
      - Determining and eliminating overloading controllers
  - Hierarchy-based network architecture
    - Domains are controlled by their controllers
    - Controllers rely on a broker (Higher level controller)
    - Local controller does not have global view
MARS Design

- Data mining and Machine Learning techniques to understand the network dynamics
- Network control plane that can autonomously adopt to network changes
- A control plane architecture that can utilize network resources efficiently and can scale
- An elastic control plane to prevent single point of failure
Road Map

- Data Collection
  - Controller Level
  - Network Level
    - Switch stats
    - Port Stats

- Pattern Recognition & Learning
- Decision Making & Update

- Controller Plane Topology
  - Distributed Flat
  - Hierarchical

- Performance Metric
  - Number of flow requests handled per second
  - Flow setup latency
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