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MARS: Machine learning-based Adaptable and Robust network management for Software-defined networks

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

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RESEARCH DIALOGUES 2020

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Bio – Ilker Ozcelik, PhD

- M.S., *Syracuse University*, Thesis: Voice Activity Detection using Stochastic Resonance, 2010, Electrical Engineering
- Ph.D., *Clemson University*, Dissertation: ***Denial of Service Attack Detection and Mitigation***, 2015, Electrical Engineering
- *Recep Tayyip Erdogan University*, August 2016 – Present, Assistant Professor
- *Recep Tayyip Erdogan University*, 2017 – 2019, Department Chair of Information Systems Engineering
- *SimCenter, University of Tennessee at Chattanooga*, September 2019 -- Present, Visiting Scholar and Research Associate

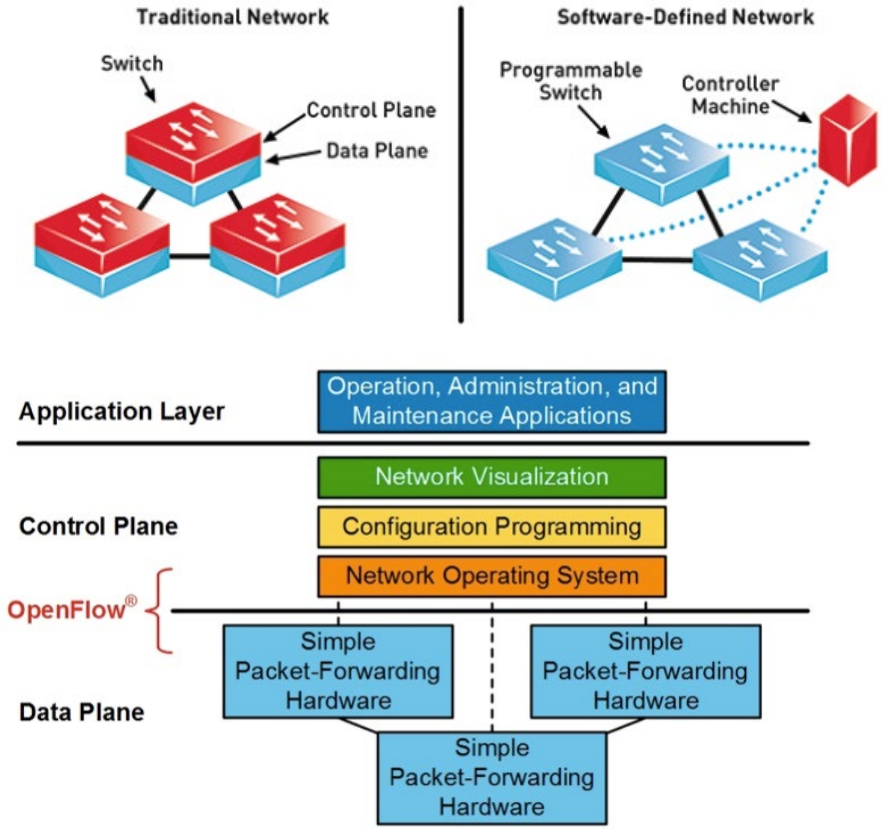
Outline

- 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

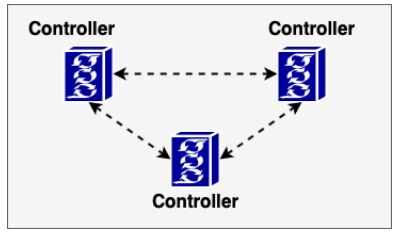


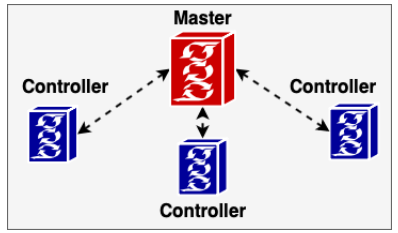
- Software Defined Networking (SDN) addresses network monitoring and management problems
  - It has scalability and single point of failure problems

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

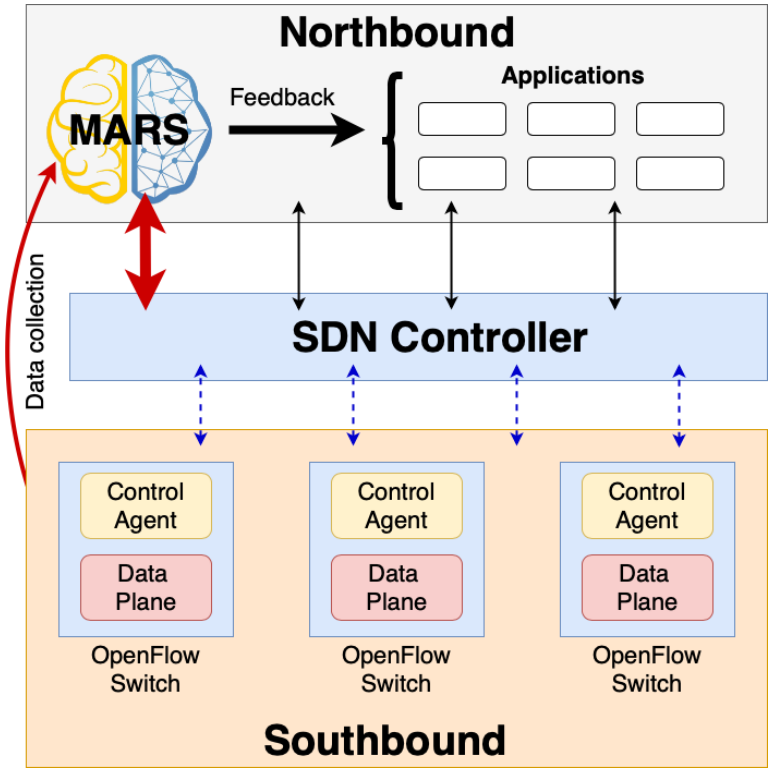
Literature

- 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



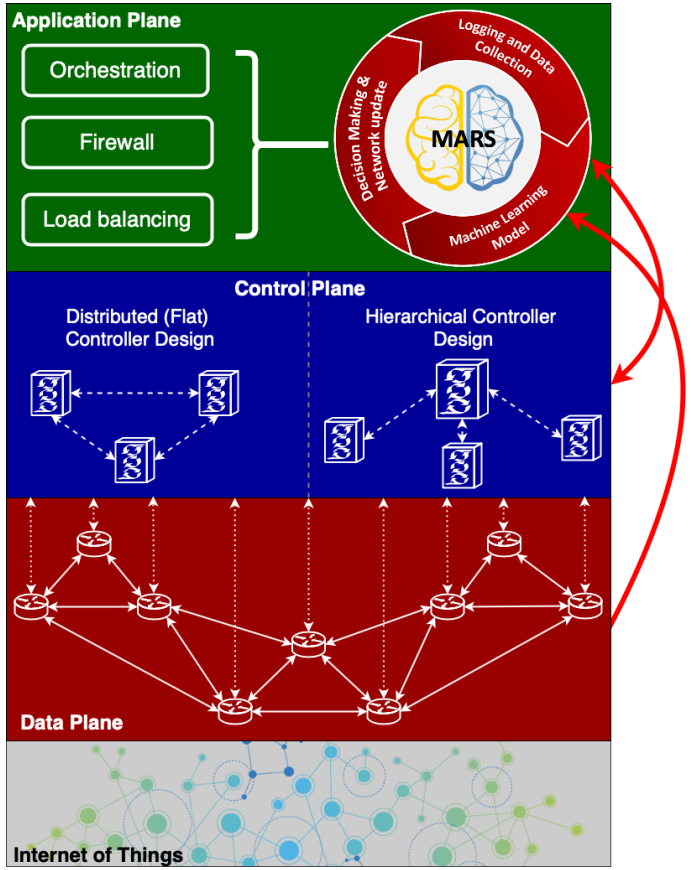


MARS Design



- 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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