Mobile SDN
Current Technologies for Mobile Software Defined Networks - Security and Performance Issues

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Introduction to SDN

- Networks are very complex to manage and evolve
- SDN introduce separation of control and data plane

Data Plane:
- Forwarding decision based on packet header
- Local Procedure

Control Plane:
- Routing procedure
- Traffic engineering (optimal traffic flow distribution)
- Achieve end-to-end QoS guarantees (delay, throughput, etc.)
Mobile Networks and SDN

• SDN was initially designed for wired networks
• Current work investigates extension of SDN for mobile wireless networks
• Challenges:
  – Existing SDN framework stops at network edge
  – Cannot control the QoS performance of the client device
  – New techniques to push SDN to the clients (edge)
Mobile Extension of SDN

- Two architectures that extend SDN to the edge:
  - MobiSDN from Samsung Research [1]:
    Propose a new architecture to enable smart edge, which enables extension of SDN to the client
  - meSDN from HP Labs and Networking Group [2]:
    Extend SDN framework to the end device and the control-plane of wireless network to the mobile device
MobiSDN: Prototype Architecture

Central Controller and Data Plane:
  • SDN, OpenFlow switches, eNB, servers

Smart Edge:
  • eNB: SDN capable, Edge controller: SDN and edge servers

Cloud EPC:
  • SDN capable, OpenFlow switches, servers
Smart Edge Functionalities

• Smart Edge needs to:
  – Handle big mobile data and huge mobile video traffic demand
  – Meet the E2E performance requirements

• Three core supported functionalities in MobiSDN:
  – *Distributed Processing/Computing*:
    Computing at the edge and load balancing
  – *Distributed file system*:
    Fast search (Hadoop MapReduce), distributed storage, cache sharing
  – *Network Controller*:
    SDN-based programmable routing, distributed policy checking and middle-box friendly
MobiSDN Application Support

• Content-Delivery Networks (CDNs) with MobiSDN
  – High QoE (Quality of Experience)
  – Cache Server interacts with SDN controller to find best routes for content distribution

• Low latency
  – Augmented reality server interacts with SDN controller to find the best routes
  – QoE management system provides inputs for QoE boosting and low latency

• Virtualization for value-adding services
Mobility Support with MobiSDN

- **Low Latency mobility:**
  Short and flexible route using SDN
- **Efficient multi-route:**
  Multi-route support using SDN, different QoS traffic on different paths
meSDN: Mobile Extension of SDN

• meSDN allows the SDN framework to be extended to the end device

• meSDN introduces smartness in end devices
  – Real-time monitoring and management of mobile application’s traffic flows
  – Ground-truth about client application information
  – Guaranteed end-to-end QoS service for clients
meSDN Architecture

- **Flow Manager (e.g., OpenFlow switch)**
  - Collects flow statistics
  - Enables SDN policies

- **Scheduler (e.g., Wi-Fi Driver)**
  - Receives time window from local controller for scheduling of packets

- **Local Controller**
  - Generates flow rules for OpenFlow switch per-application
  - Controls the scheduler

- **Global Controller**
  - Interacts with local controller
  - Collects airtime demand of applications and QoS requirements
  - Applies proper actions to local controller to manage traffic
pTDMA: WLAN Virtualization

• pTDMA is a simple prototype of meSDN for WLAN virtualization service

• WLAN virtualization enables effective sharing of wireless resources by different users with diverse requirements
  – Manage airtime share between clients that coexist in space and channel
pTDMA Scheduling Principles

• Allocate large time window to transmit and receive multiple packets
• Schedule multiple clients in a common slot to maximize channel utilization
• Configure interval between consecutive time windows based on traffic demand of different applications
pTDMA: Prototype Implementation

- Integrate meSDN client-side component to eight Google Nexus 4 Android phones
- Install OpenFlow switch and pTDMA kernel modules
- Re-build the kernel image
Security Concerns for Mobile SDN

- Applications and Controller have control of the network and need to be trusted
- DoS attacks
- Traffic to compromised nodes
- “Man in the middle” attacks
- Eavesdropping traffic
- Modifying data traffic
Defeat Crossfire Attack with SDN [3]

- DoS link-flooding attack
- Mitigation of the attack using SDN paradigm
- Dynamic traffic engineering to detect and mitigate the Crossfire attack
- Repeatedly modifying how traffic is routed and monitoring sources that react to re-routing
Issues to be Investigated

• Extension of capabilities of mobile devices using MobiSDN architecture
• Investigation of improvements on Mobile SDN architecture
• Lack of extensive research on Mobile SDN security issues
References


[2] Jeongkeun Lee et al., *meSDN: Mobile Extension of SDN*

[3] Dimitrios Gkounis et al., *Towards Defeating the Crossfire Attack using SDN*
Thank you!!

Questions?

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