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)

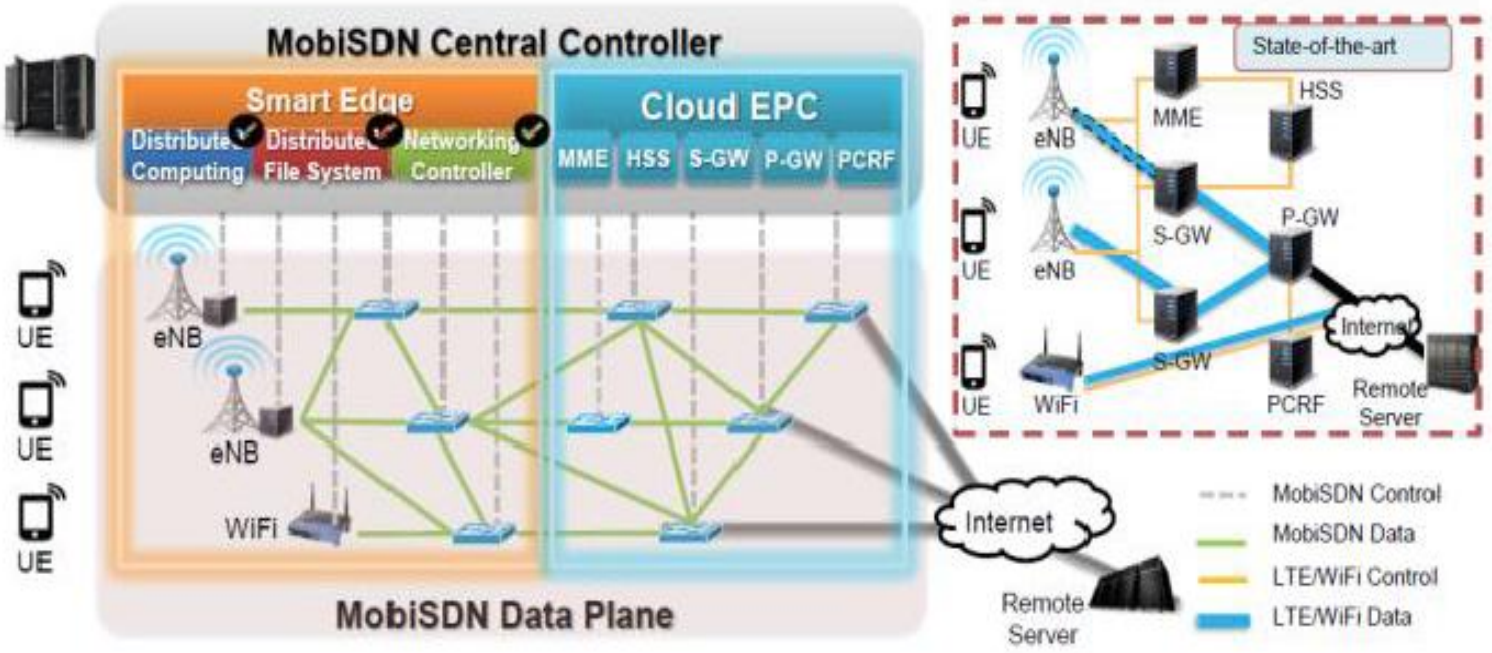
Mobile Extension of SDN

- 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*:

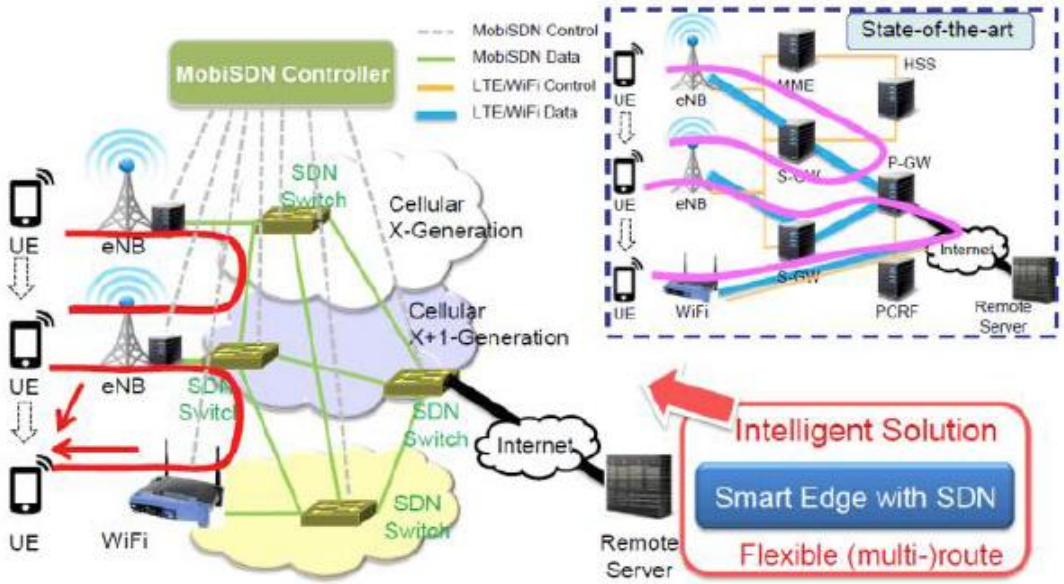
    Fast search (Hadoop MapReduce), distributed storage, cache sharing
  - *Network Controller*:

    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



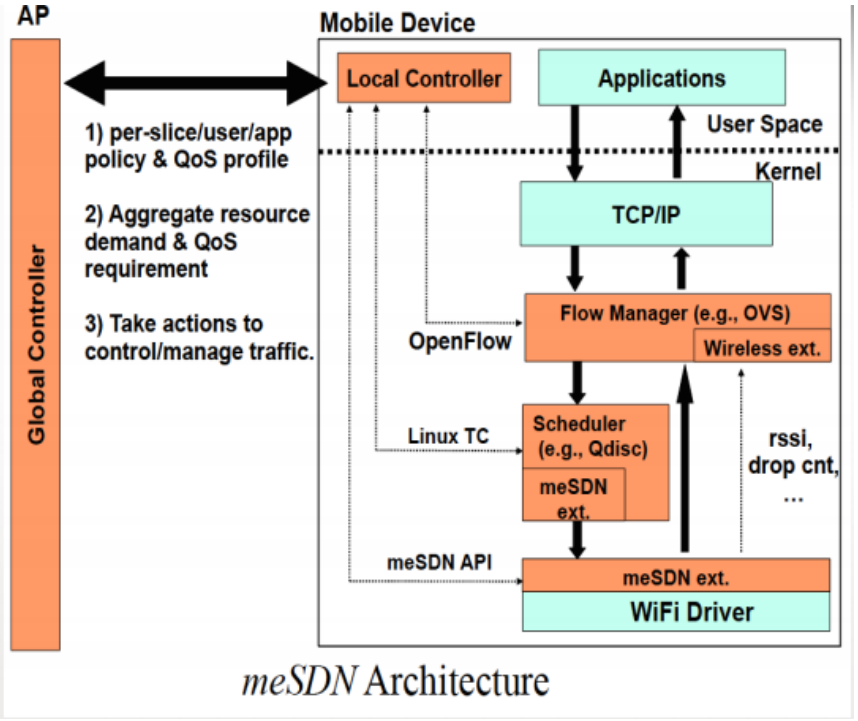
- *Low Latency mobility*:
  Short and flexible route using SDN
- *Efficient multi-route*:
  Multi-route support using SDN, different QoS traffic on different paths

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



meSDN Architecture

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

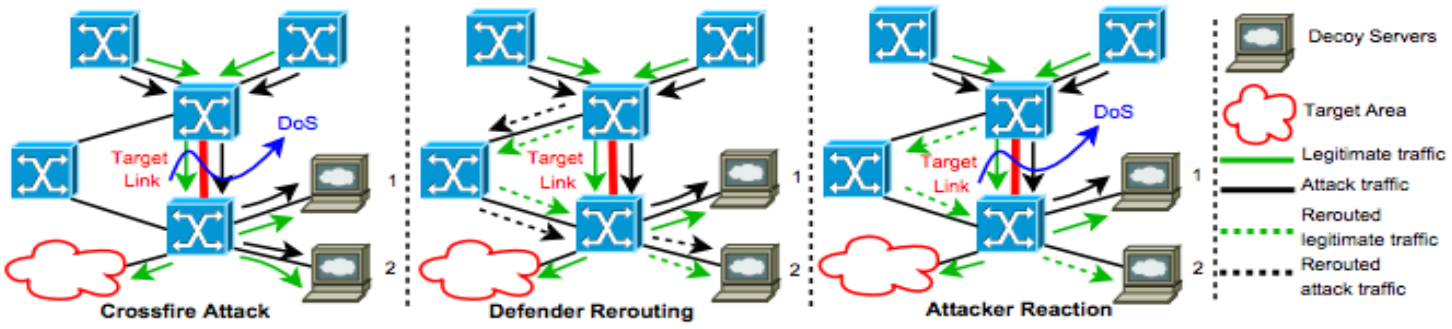
- Integrate meSDN client-side component to eight Google Nexus 4 Android phones
- Install OpenFlow switch and pTDMA kernel modules
- Re-build the kernel image

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

[1] Ying Li et al., *MobiSDN: Vision for Mobile Software Defined Networking for Future Cellular Networks*

[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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