Major Challenge for Cellular Network Operators Worldwide

Exponential traffic growth
- fueled by rapid adoption of smartphones and tablets
- growing use of cloud based services and video traffic
- dominated by indoor use

Source: Signals Research Group

Source: Informa
Coping Strategies

Move towards heterogeneous network (HetNet) deployments with many small cells
- macrocells, relays, remote radio heads (RRHs), picocells, user deployed femtocells
- higher data rates by bringing network closer to end users
- increased spatial use
- cost reduction with RRHs and femtocells

Offloading traffic to co-located unlicensed WiFi networks

Opportunistic secondary use of other licensed spectrum (e.g., TV white spaces)
Problems with Current Cellular Networks [Li et al., EWSDN'12]
- Plagued by complex and inflexible architecture
- Most data plane related functionality centralized (e.g., traffic monitoring for billing, policy enforcement)
- Control plane too distributed (e.g., radio resource allocation)
- No clear separation between control and data planes
SDN for Cellular Networks

Offers a logically centralized control plane
- will lead to simpler and effective radio resource management (e.g., inter-cell interference management)

Enables common control protocol across diverse wireless technologies
- will ease seamless mobility support within and across technologies (e.g., 4G LTE, 3G UMTS, WiFi)

Allows distributing traffic monitoring at switches deep inside the core network and ease the burden on the packet gateway
Cellular network functions that could benefit from SDN

- Inter-cell interference coordination
- Seamless mobility support
- Adaptive and opportunistic spectrum use
- Distributed QoS and ACL enforcement
- Easing and reducing use of middleboxes
- Enable new services (e.g., in-network video caching, operator CDNs, usage based pricing)
- Etc.
Inter-Cell Interference Coordination in Heterogeneous Cellular Networks

Interference management in a HetNet deployment a major challenge
- unplanned deployment of user deployed cells
- significant power differences and coverage between cells (e.g., 46dBm and few Km for macrocells vs. <23dBm and <50m for femtocells) yet need to share same spectrum

Interference scenarios
- among overlapping small cells
- between macro cells and small cells
  - macrocell interfering with uplink of small cell
  - femtocell interfering with downlink of macrocell
Growing interest in industry and academia on SDN for cellular networks

Industry: Huawei SoftCOM, Ericsson Service Provider SDN, Tellabs ...

Academia: Princeton CellSDN, Stanford OpenRadio
Thank You