Mobile Edge Computing

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Outline

- 5G Communication Components
- Computation Offloading
- Mobility Management and Service Migration

5G Communication Components

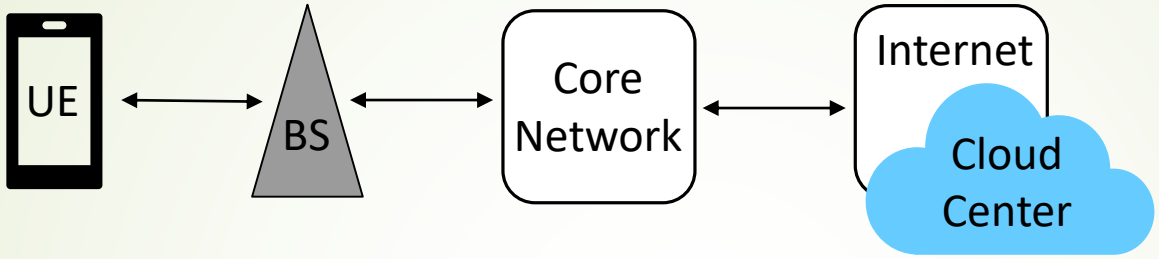
- Software Defined Network(SDN)
- Network Function Virtualization(NFV)
- Mobile Edge Computing(MEC)
- Centralized control, distributed service

Mobile Edge Computing

- Defined by ETSI(European Telecommunications Standards Institute)

"Mobile edge computing provides an IT service environment and cloud computing capabilities at the edge of the mobile network, within the radio access network (RAN) and in close proximity to mobile subscribers."

Mobile Cloud Computing

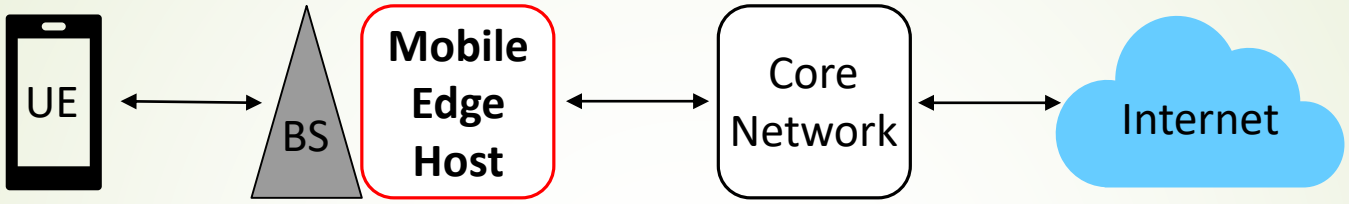


- Provide shared pool on resources
  - Compute, software, storage
  - Amazon EC2, Microsoft Azure
- Centralized
  - Long distance results in high latency

Mobile Edge Computing

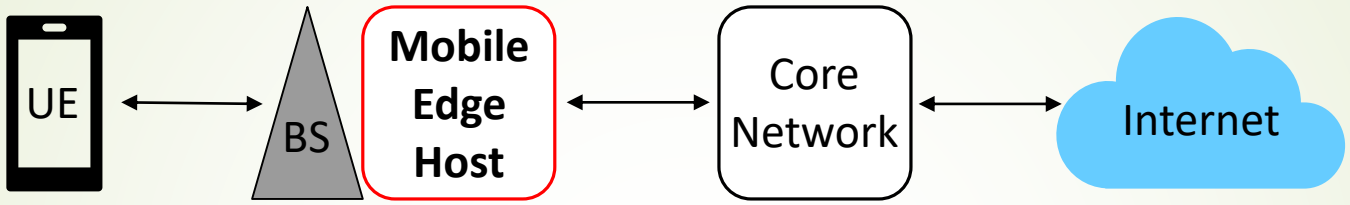
- Geo-Distributed Cloud System
  - Small local servers, small cells
  - Computing augmented Base Stations
  - Computing resources installed in RAN
- Fog Computing

Mobile Edge Host



- Computing equipment
  - Computation Offloading
- Proximity
  - Low latency
- Resource virtualization
  - Accessed by API on UE, based on SDN and NFV

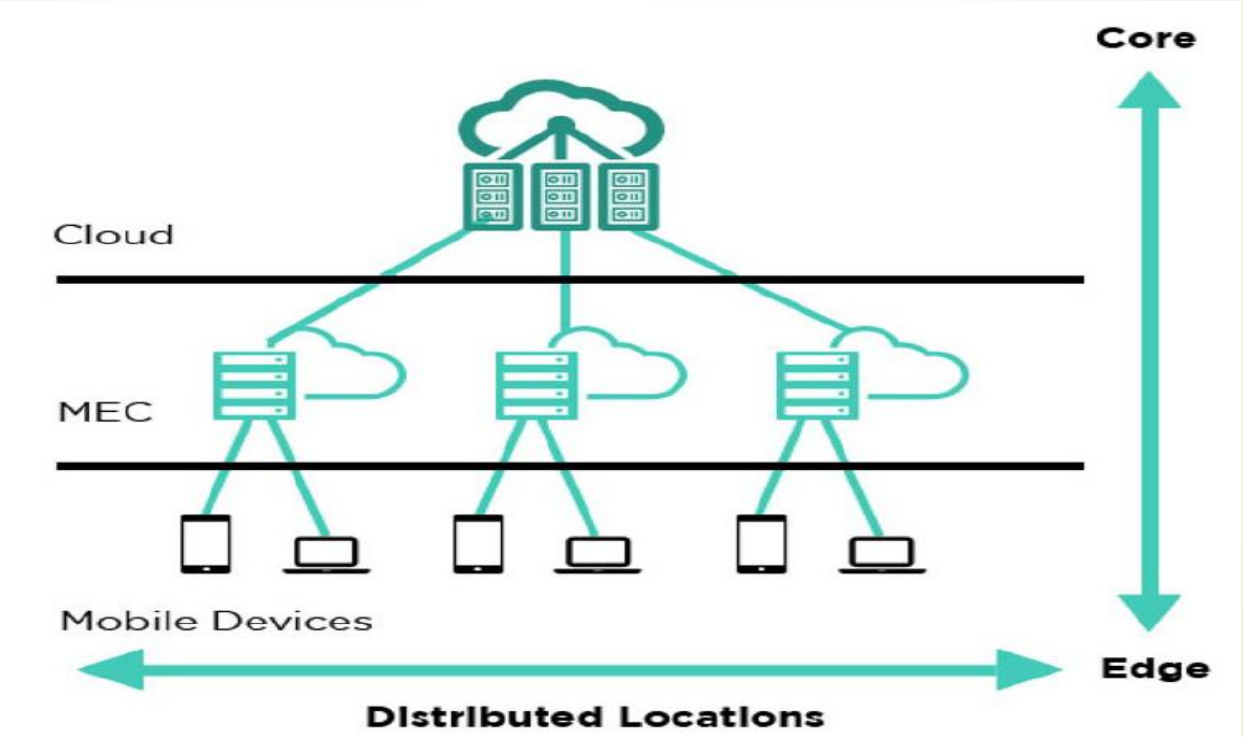
Mobile Edge Host



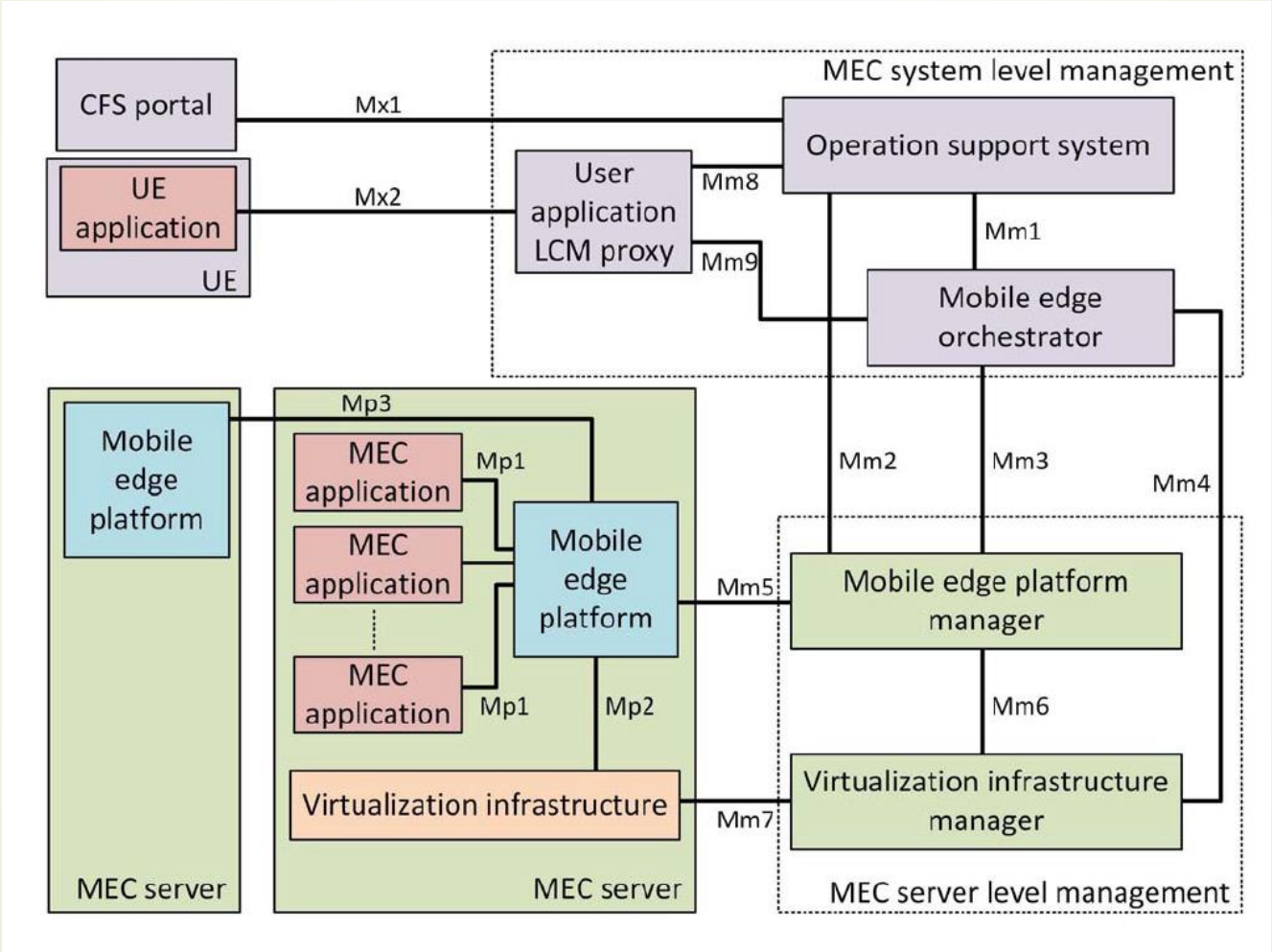
- Traffic monitoring
- Content caching
  - Caching proxy
- Local information aggregation
- User location services
  - Small cell, more precise

Three-layer Architecture

- MEC resides in the layer between the Cloud and the mobile device

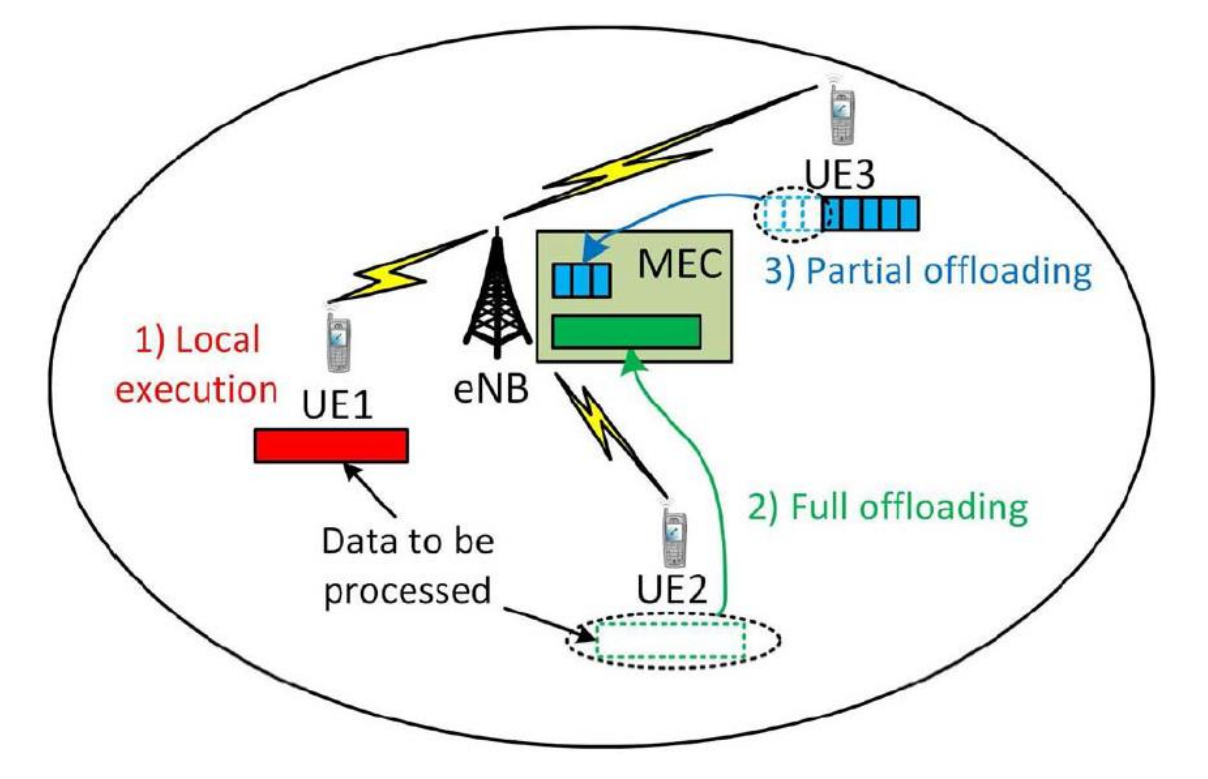


Reference Architecture



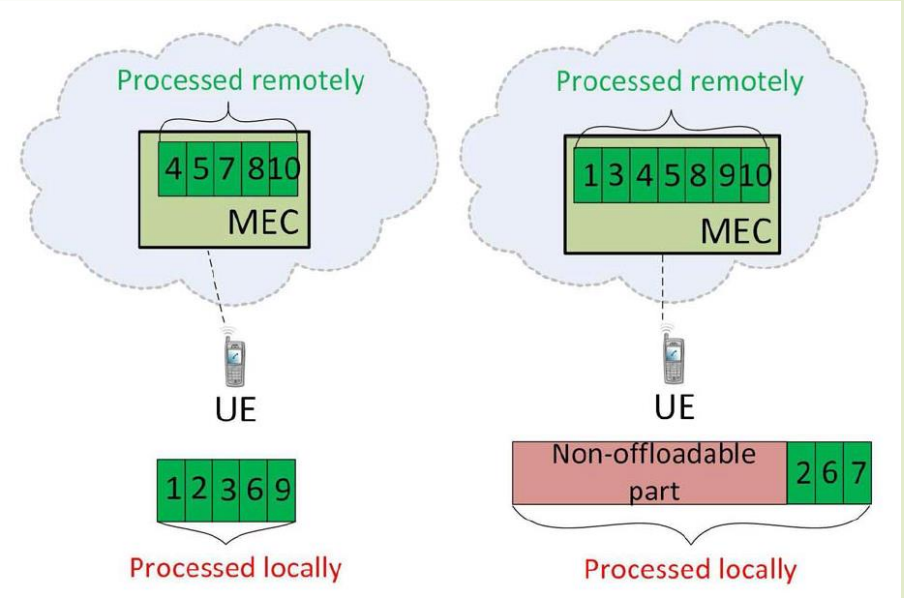
Computation Offloading

- None Offloading
  - Local Execution
- Partial Offloading
- Full Offloading



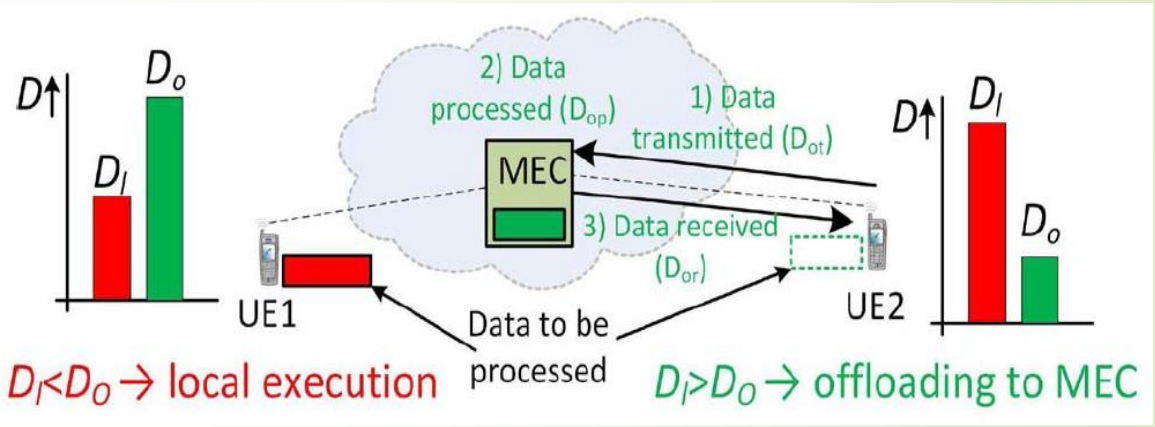
Computation Offloading

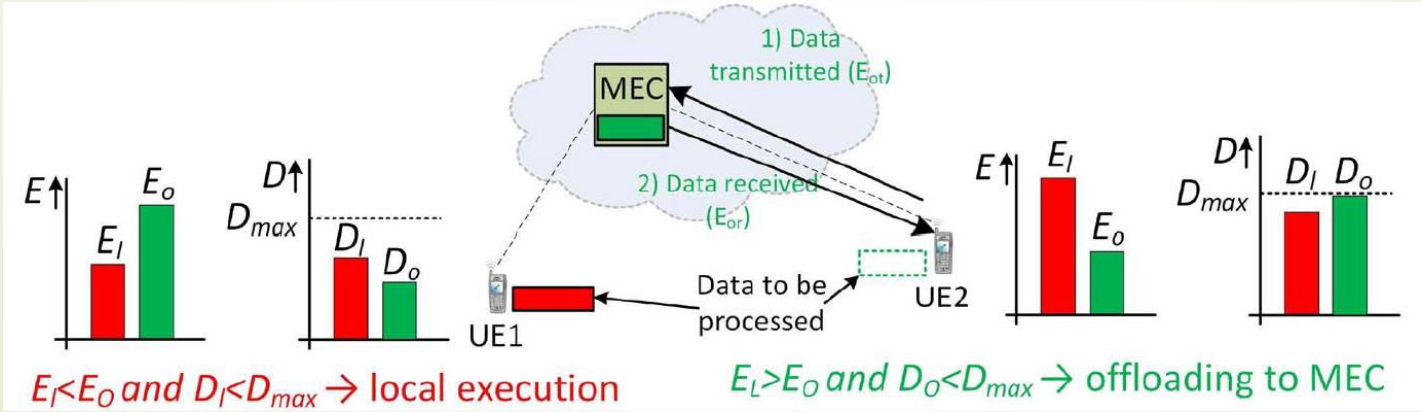
- Offloadability of application
- Knowledge on the amount of data
  - Video and image processing
  - Online interactive games
- Dependency of offloadable parts
  - Serial VS Parallel



Offloading Decision

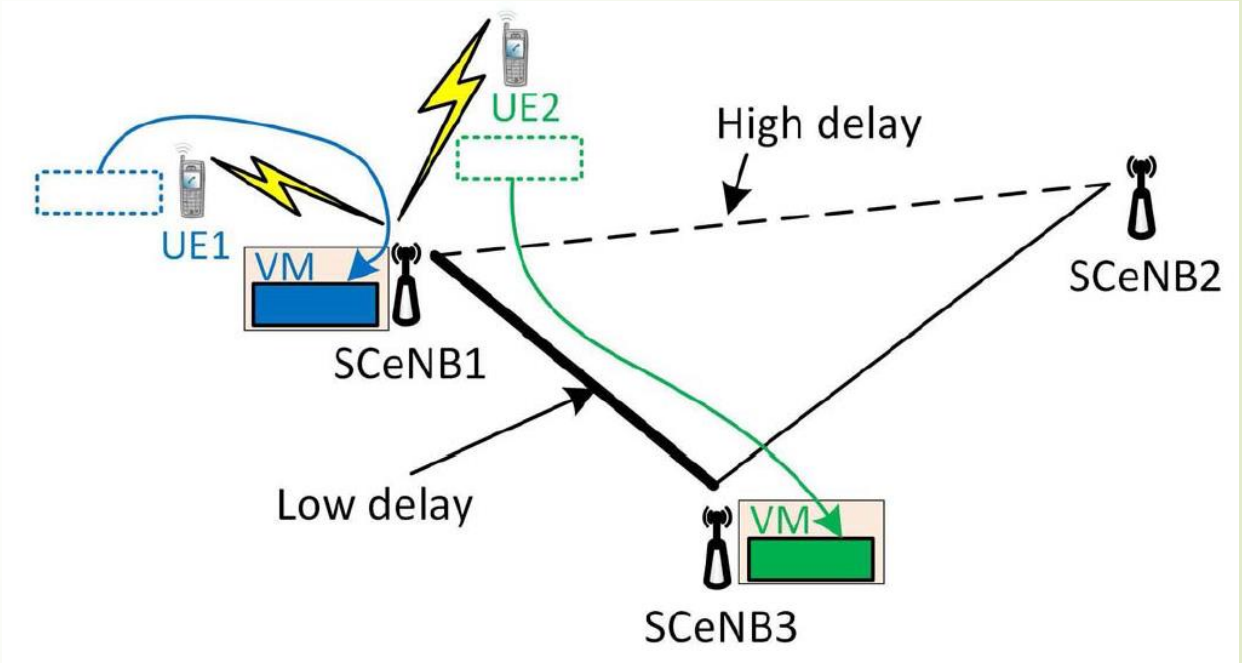
- Execution delay
- Energy consumption
  - With delay constraint
- Tradeoff





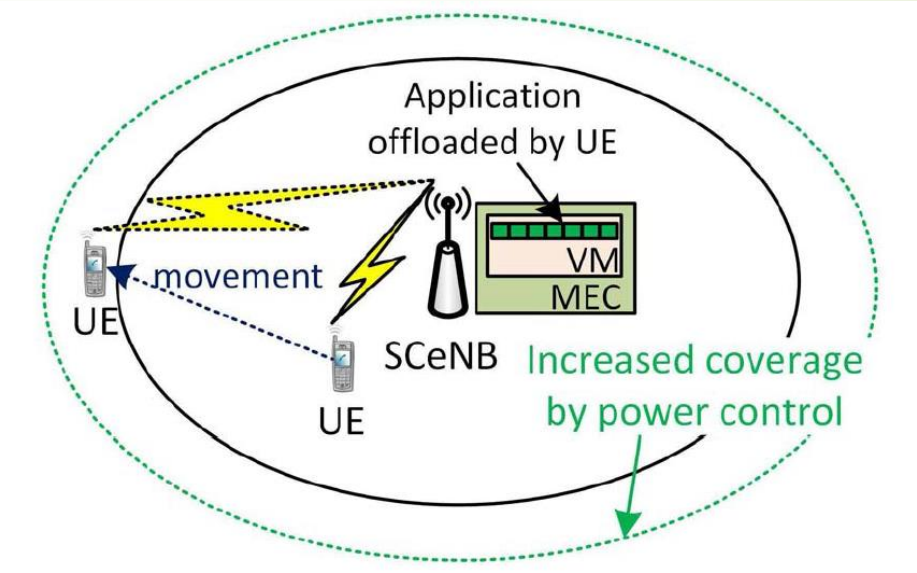
Allocation of Computing Resource

- Single MEC Node
- Multiple MEC Nodes



Mobility Management

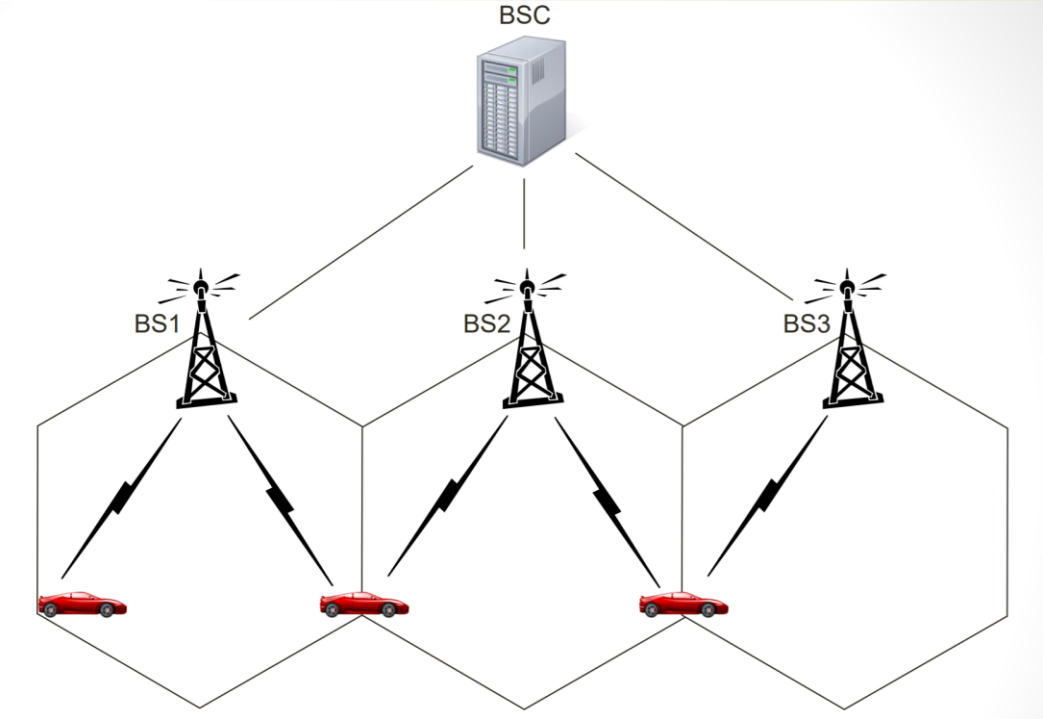
- Limited Mobility
  - Building
  - Stadium
  - Campus



- Signal Interference to Noise Ratio(SINR)

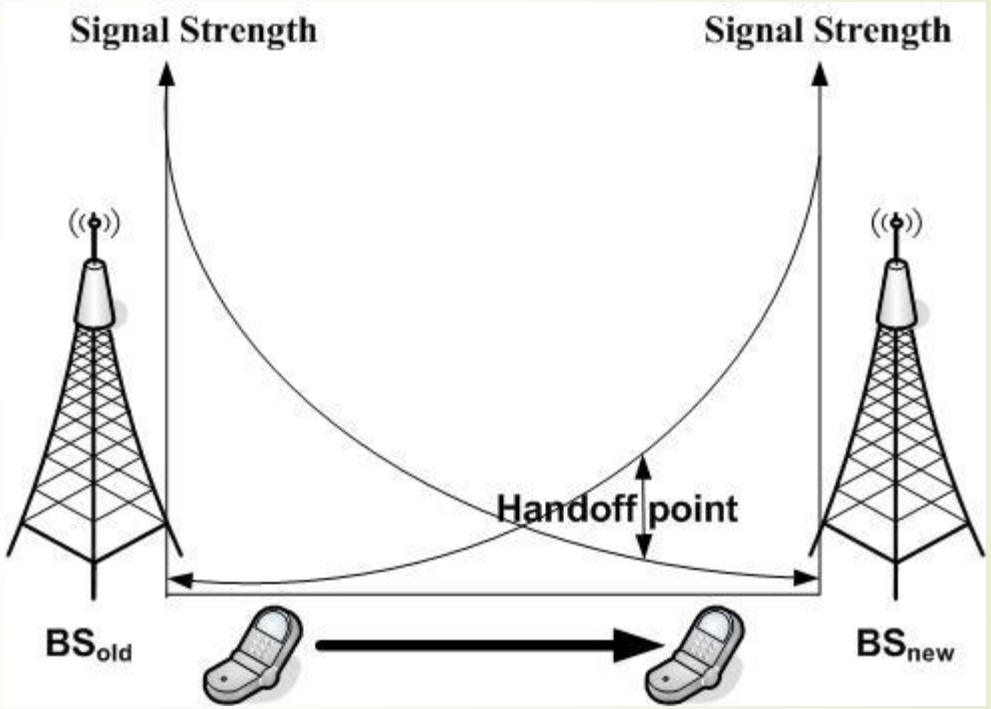
Handoff

- Changing connection from one BS to another
- Service continuity
- Guarantee QoS



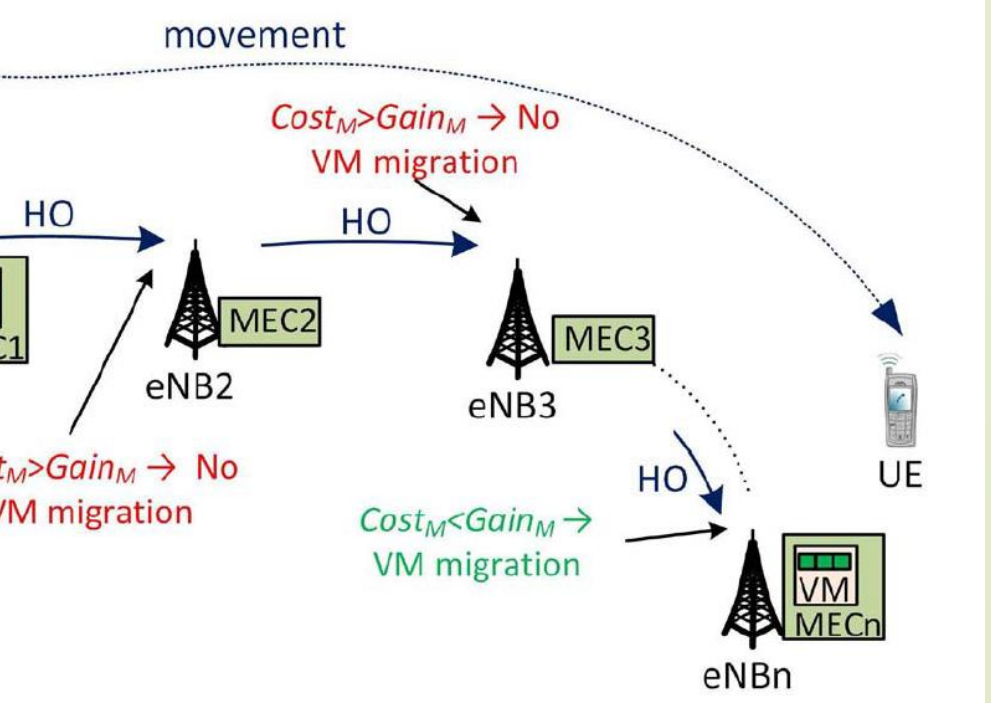
Handoff

- Hard Handoff
- Soft Handoff



Service Migration

- Applications run on VM
- Migration Cost
- Migration Gain



Aggregation Point

- Connection through various communication protocols
  - 3G, LTE, 5G, Wifi
- Multiple UEs via multiple channels
  - NP hard

Advantages

- Low latency
- Extending UE battery lifetime
- Enable sophisticated applications on UE
- Provide higher data storage capabilities

Improvements

- Optimization of mobile resources by hosting compute-intensive applications at the network edge.
- Pre-processing of large data before sending it to the cloud.
- Context-aware services with the help of RAN information such as cell load, user location, and allocated bandwidth.

Challenges

- **Resource management** – The computing and storage resources in individual MEC platform are expected to be limited.
- **Interoperability** – MEC infrastructures owned by different network providers should be able to each other as well.
- **Mobility support** – The coverage range of each individual cell is limited in a small cell network. Seamless handoff and migration are necessary.

Applications

- Health Care
  - Stroke Fall
- Augmented Reality
- Content Delivering and Caching
  - Video Streaming
- Video Analytics
  - Surveillance Camera(face recognition)
- IoT
  - Smart home
  - Smart City