

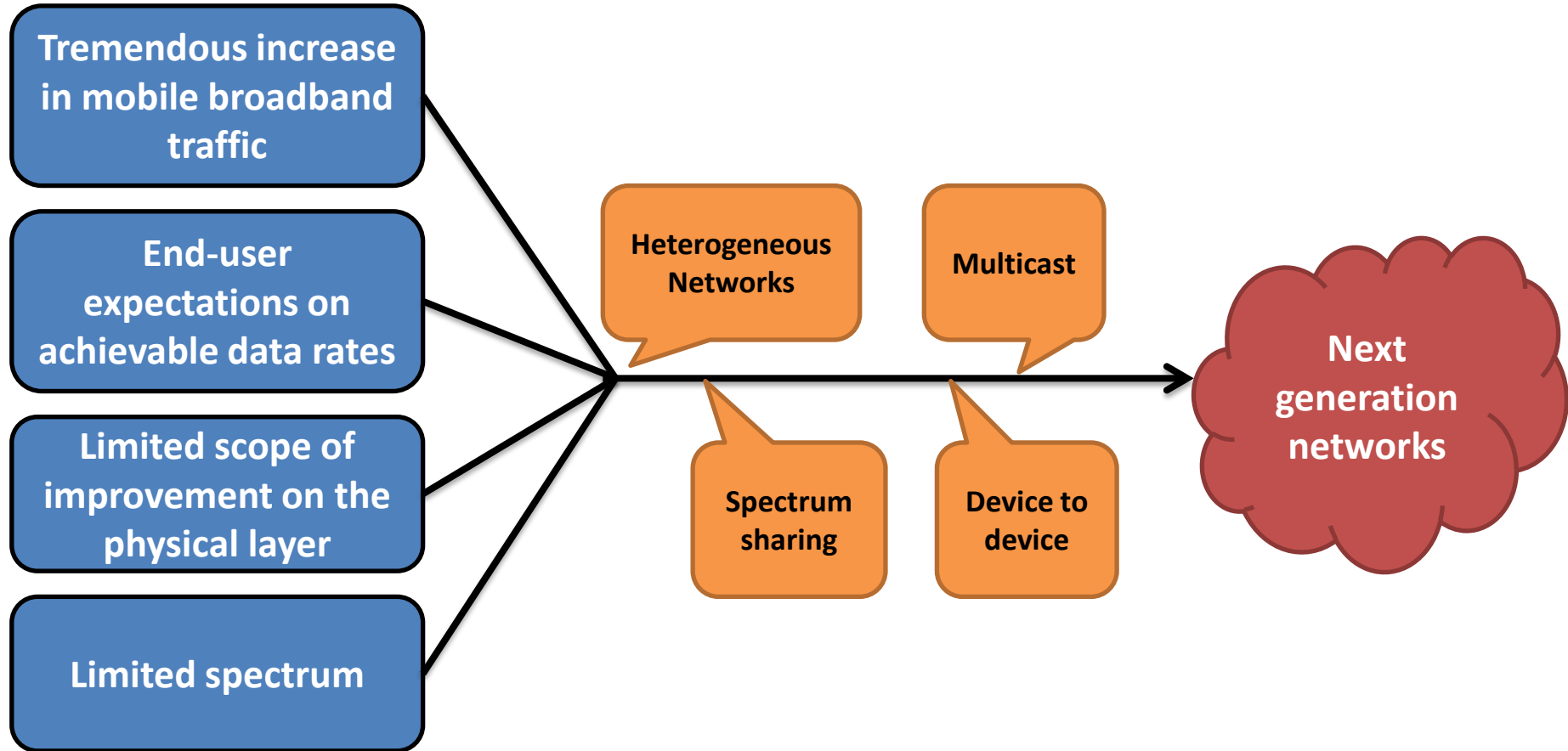
5G Wireless Networks

Resource Allocation for High Network Efficiency

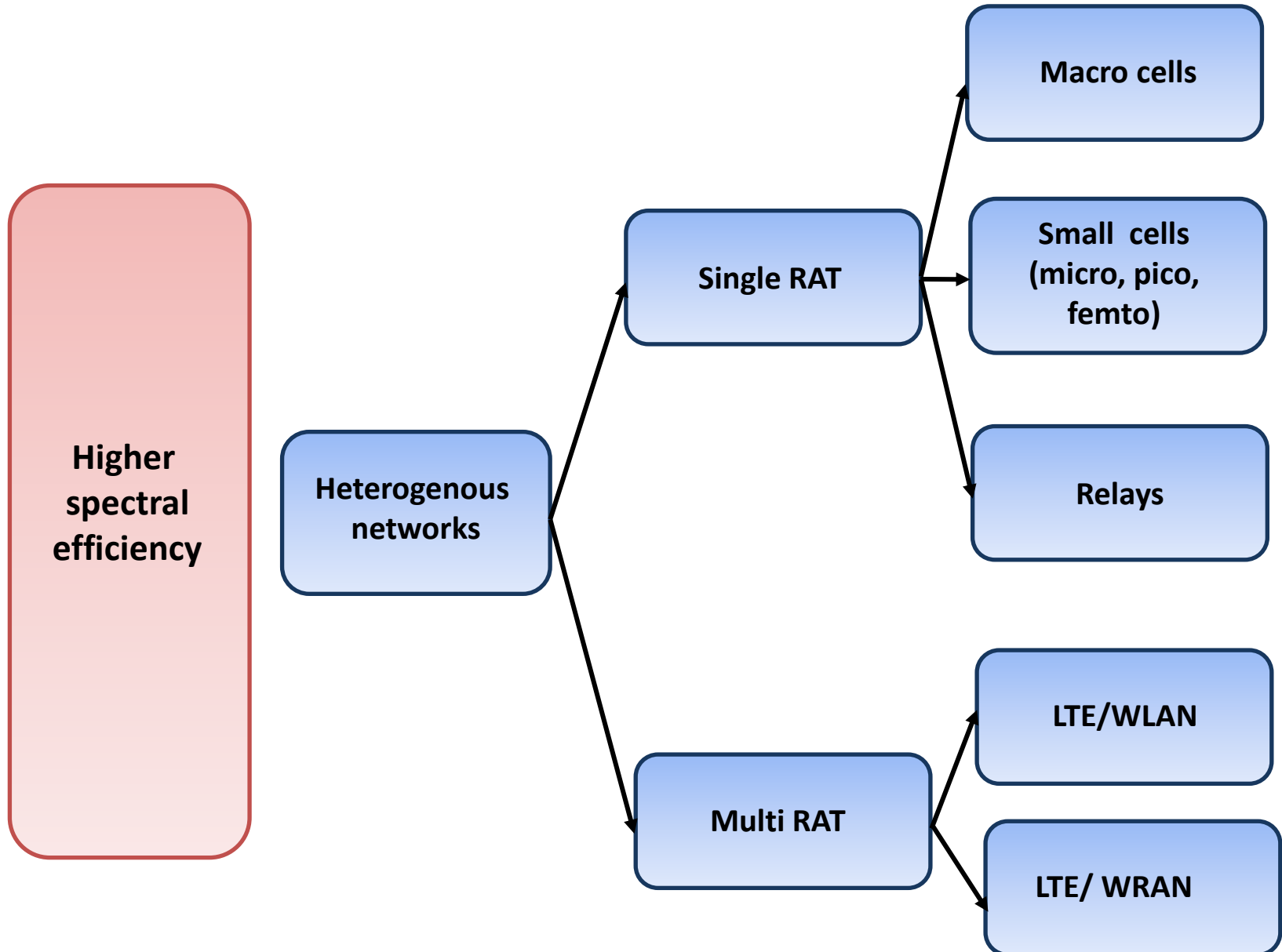
SDN, NFV and Fog/Edge Networking

5G Wireless Networks-Resource Allocation

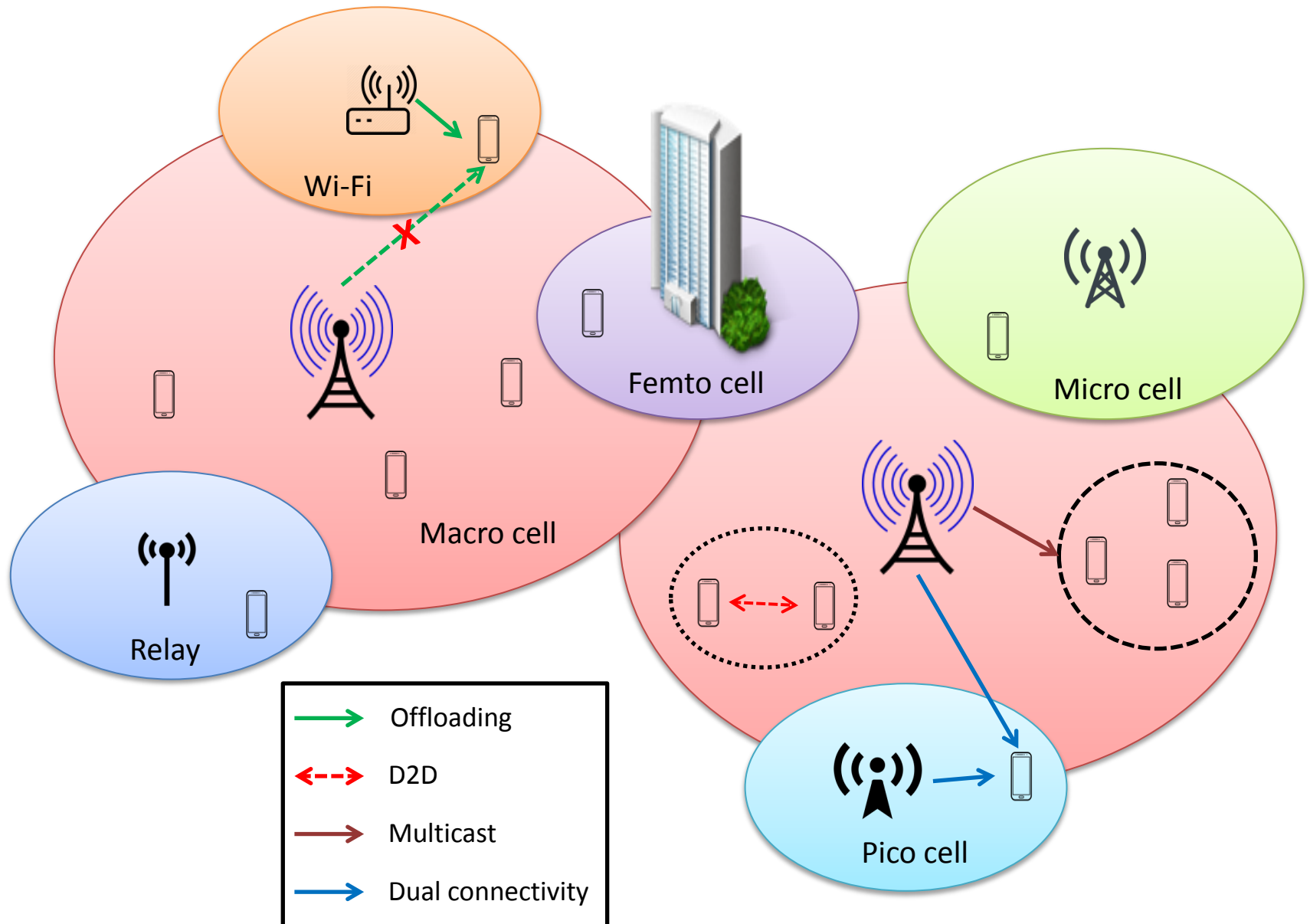
Introduction



Heterogeneous Networks

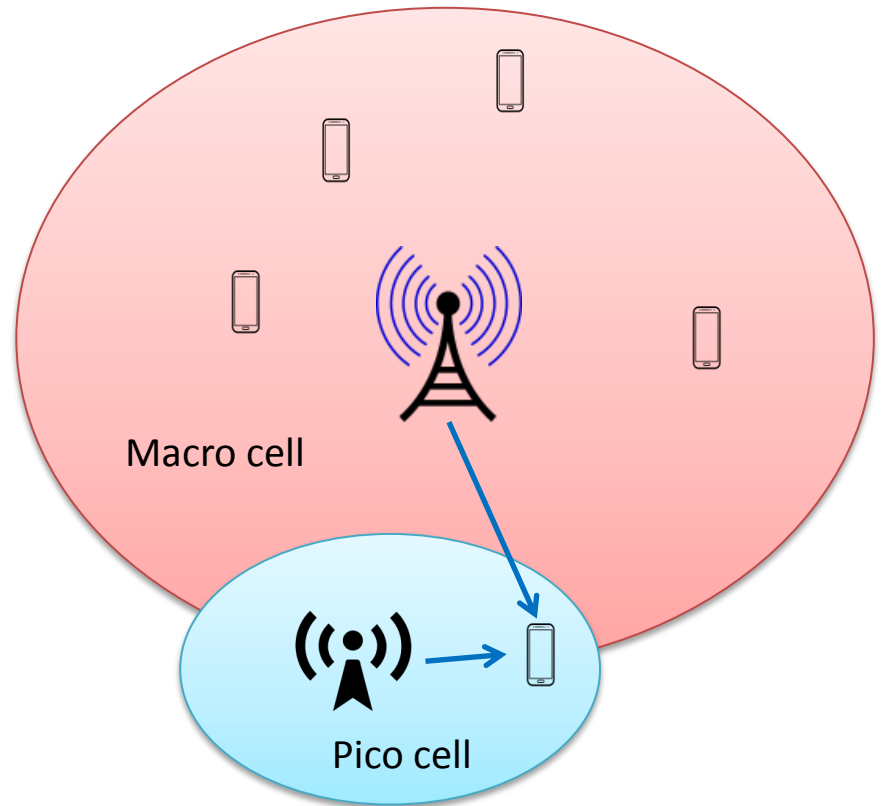


Heterogeneous Networks



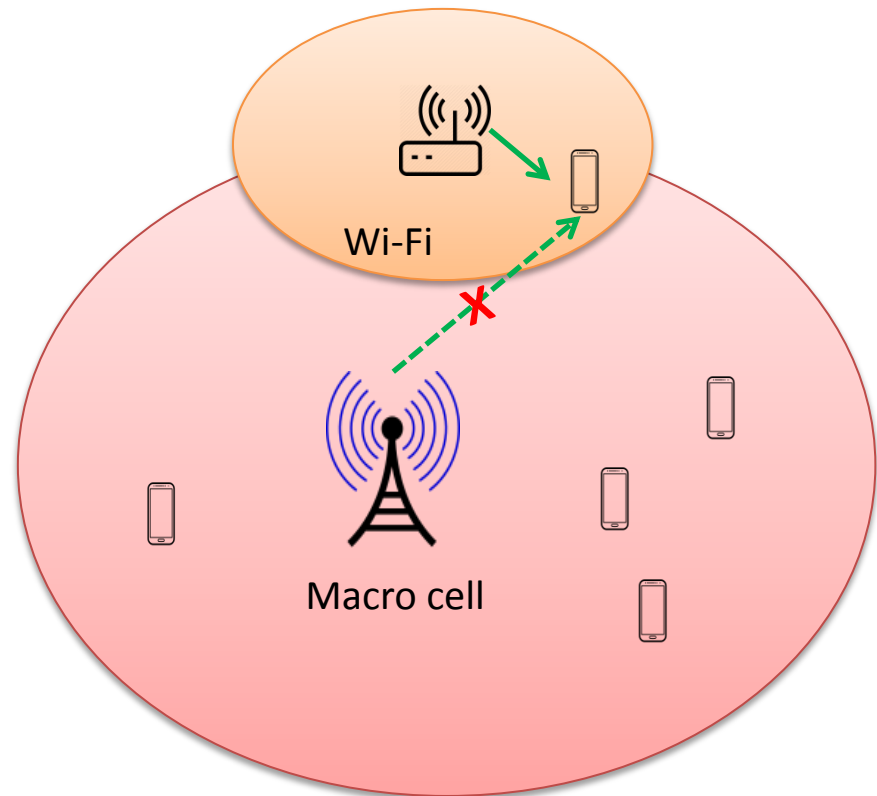
Dual Connectivity

- ❑ Introduced in 3GPP Release 12
- ❑ Architectures:
 - Split at Core Network
 - Bearer Split at Macro eNB
- ❑ Research challenges:
 - Selection of dual connected users
 - Routing and traffic splitting
 - Traffic aggregation at receiver
 - Multi-RAT dual connectivity



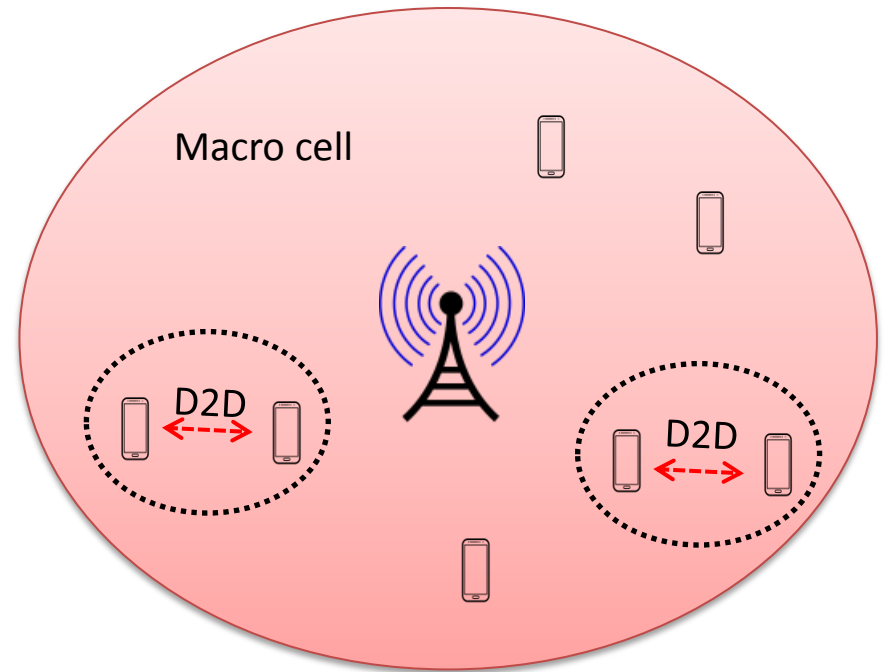
Mobile Data Offloading

- ❑ Proposed in 3GPP Release 12
- ❑ User-initiated offloading
 - Distributed approach: Greedy solution
 - Easy to implement
- ❑ Network-initiated offloading
 - System-wide view at centralized controller
 - In harmonization with SDN approach towards 5G
- ❑ Research challenges:
 - Optimal association and offloading decisions



Device-to-Device Communication

- ❑ Introduced in 3GPP Release 12
- ❑ Research interest:
 - Resource allocation
- ❑ Research challenges:
 - Resource and power allocation
 - Interference mitigation
 - Pricing schemes
 - Device relaying
 - D2D in unlicensed bands



Multicast Communication

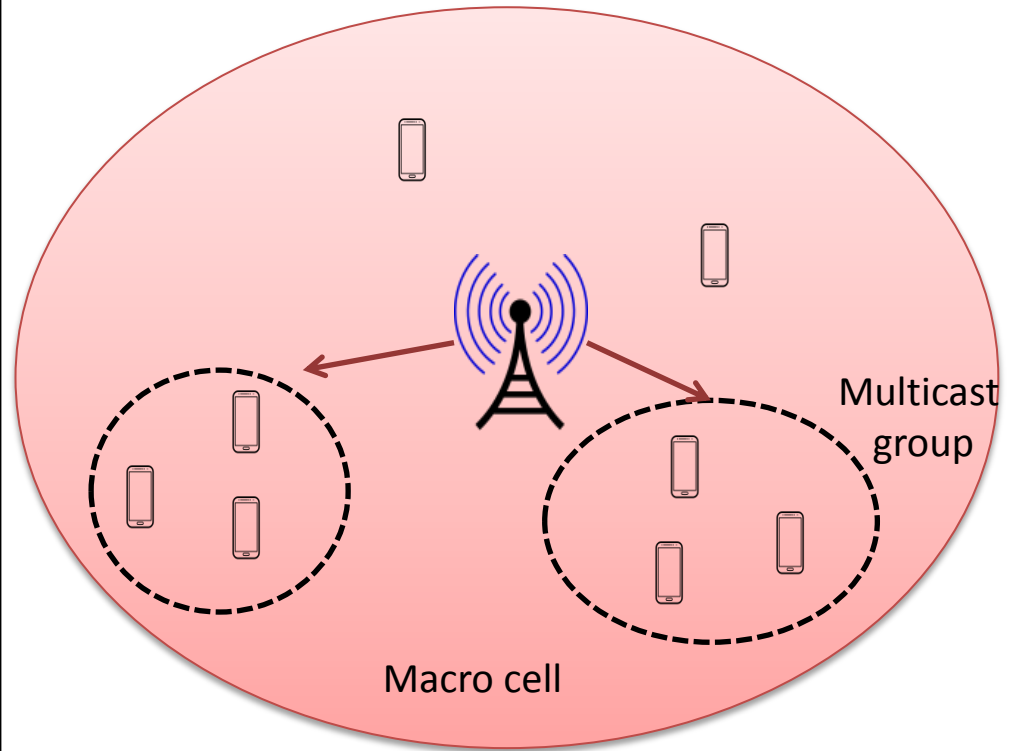
❑ Multicast introduced using MBMS in 3GPP Release 6

❑ Two main research challenges:

- Multicast group formation
- Resource allocation

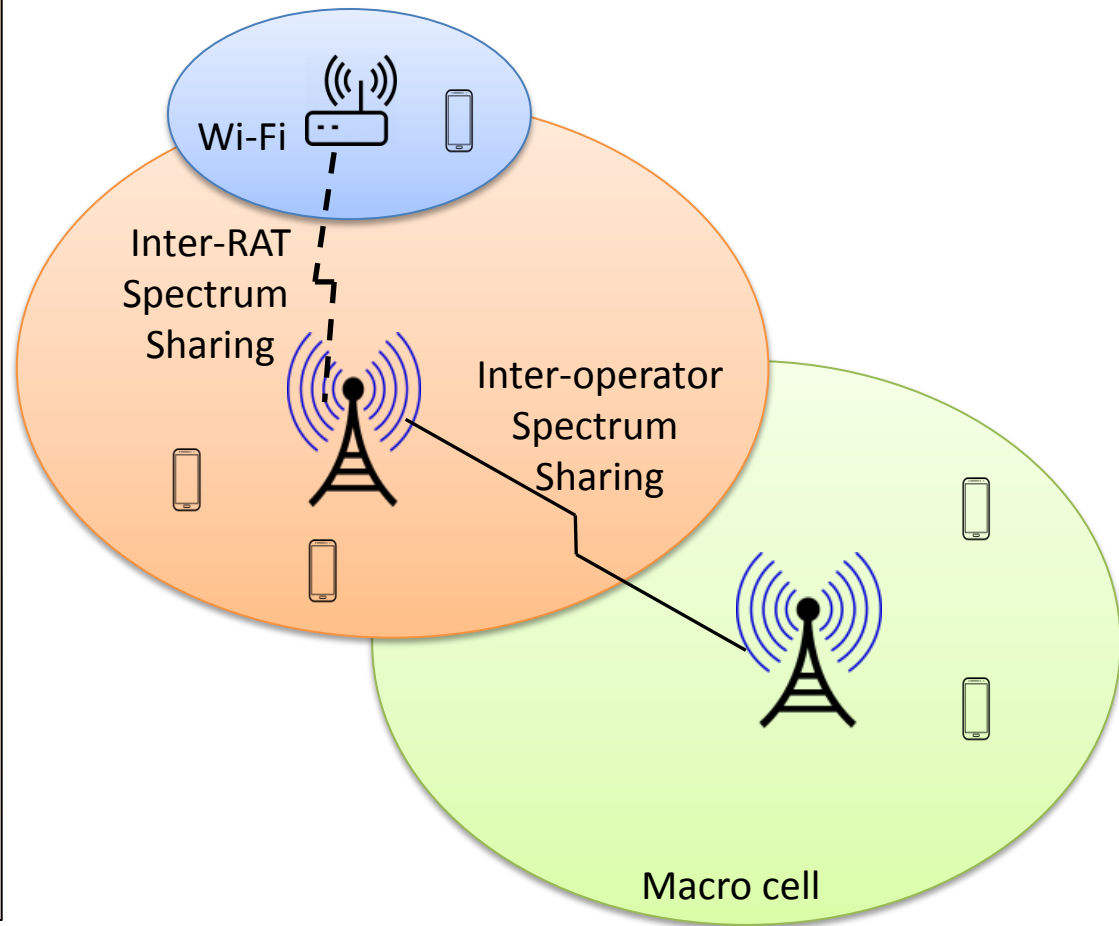
❑ Use cases:

- Video streaming from platforms like Netflix
- News alerts
- Streaming live events e.g. sports matches
- Mobile TV
- Software updates



Spectrum Sharing

- ❑ Licensed Spectrum sharing
- ❑ Unlicensed Spectrum sharing
 - Static sharing: Inefficient spectrum utilization
 - Dynamic sharing : Improves spectrum utilization
- ❑ Cooperative and non-cooperative approaches
- ❑ Challenges:
 - Interference management
 - Selfish behavior of operators



5G Wireless Networks- SDN, NFV and Fog/Edge Networking

Research Activities

- Evolution of Mobile Networks- Towards 5G
 - Software Defined Networking (SDN)
 - Network Function Virtualization (NFV)
 - Fog/Edge & Cloud Computing
 - Information Centric Networking

Evolution of Mobile Networks - Research @IITB

- Applying SDN/NFV principles to design future Mobile Networks
 - Develop and Evaluate an SDN/NFV based Architecture for Multi-RAT (Radio Access Technology) Mobile Networks
- Fog/Edge & Cloud Computing paradigm and Mobile Networks
 - Study and Analysis of Fog & Cloud Computing paradigm and their impact on the evolution of Mobile Networks
- Information Centric Networking and its application to Wireless Networks
- Standard Development activity for SDN/NFV based Wireless Networks

SDN/NFV based Architecture for Mobile Networks - Research @IITB

- Mobile Network divided into Control & Data Plane Functions
 - Control Plane Function
 - Multi-RAT Controller
 - Data (User) Plane Function
 - Base Stations and Gateways
 - Control & Data Planes - separated through open programmable interface
- Multi-RAT Controller
 - A single controller for different RAT based mobile networks
 - 3GPP-LTE/LTE-A, IEEE 802.11 WLAN, 3GPP-5G
 - User Admission Control, User Authentication, Session & Mobility Management, Load Balancing, Interference Management etc.
 - Configuration and Management of Data Plane entities
- Base Stations & Data Network Gateways
 - Responsible for data forwarding
 - Base Stations - RAT specific entities
 - Each Base Station handles one RAT
 - Common Data network Gateways for all RATs

SDN/NFV based Architecture for Mobile Networks

- Research @IITB

