

Title :

# Extending 5G Services in a Campus Area Network by Deploying 5G Micro-operators

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Institution : Chulalongkorn University

Background :

# Cellular Network Today

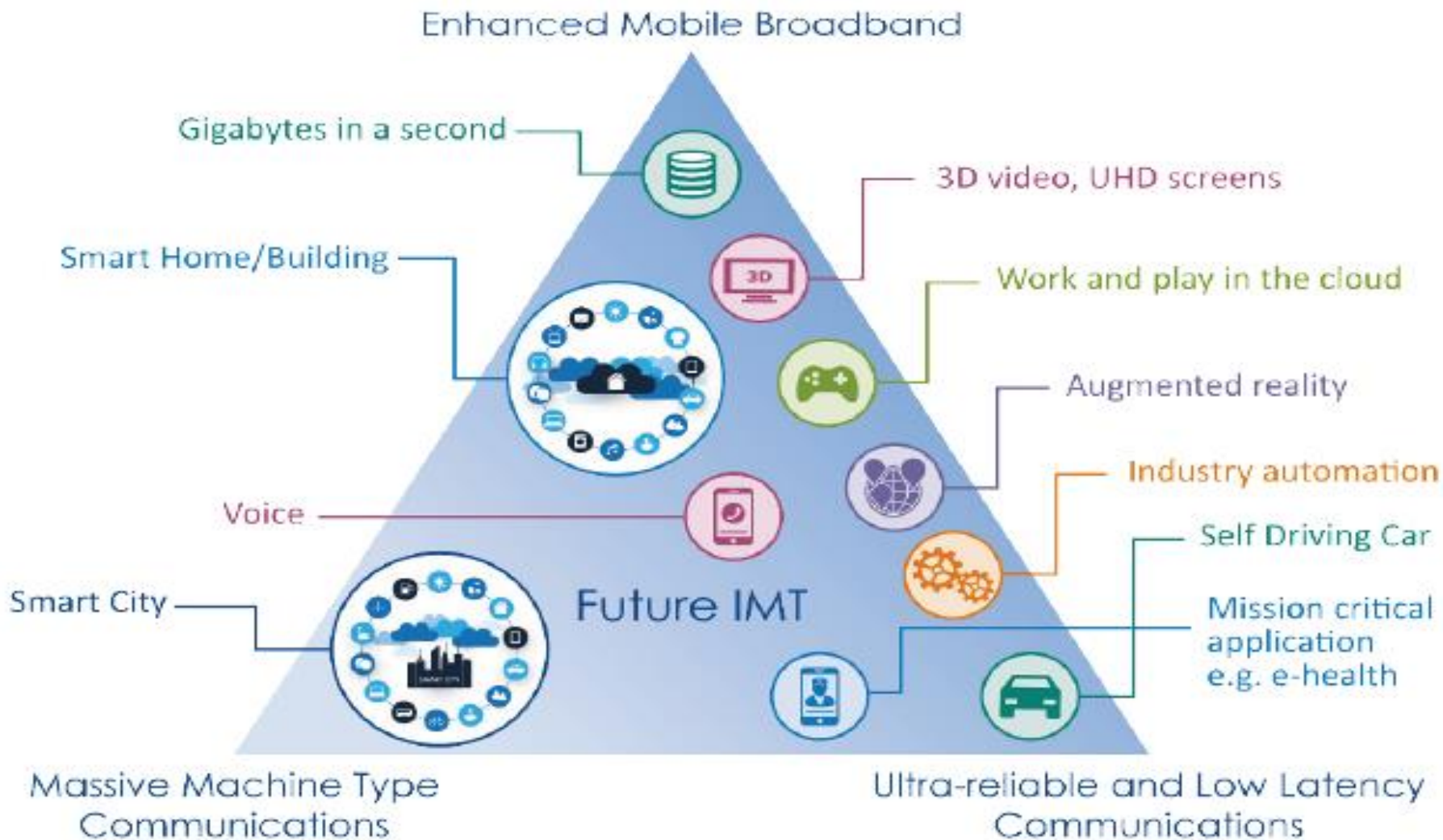


- A **few** Mobile Network Operators (MNOs) provides mobile services, e.g., voice, data and multimedia streaming, nationwide.
- Licenses to use frequency spectrum are made available through auctions for 10-15 years.
- New entrants to mobile markets are unlikely due to expensive investments and excessive time to deploy nationwide networks.
- MNOs earn their revenues by charging for the consumed minutes of talk and megabytes of data.
- OTT applications and services, e.g., fb, youtube and Netflix, benefit immensely from cellular networks without the need to have their own network infrastructure.



Background :

# 5G Will Transform the Way We Live and Work

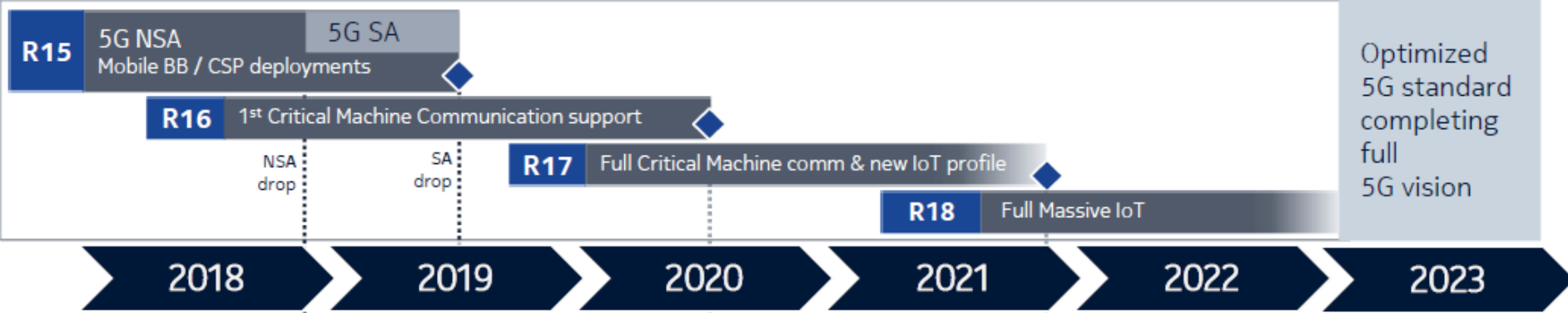


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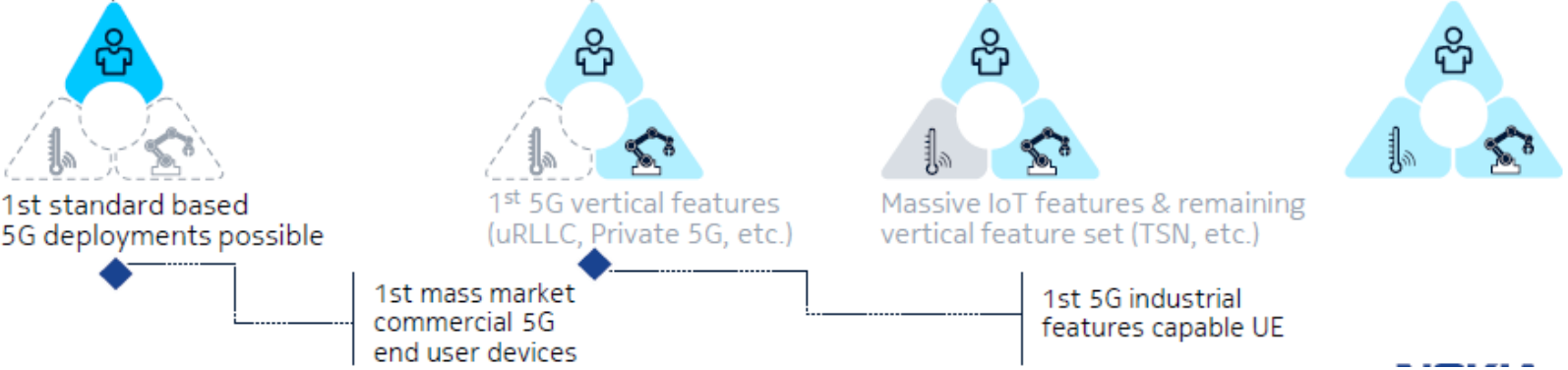
### 3GPP standardization timeline

Early CSP 5G deployments with R15, Vertical capabilities starting R16

### 5G standard releases roadmap



### 5G ecosystem roadmap



Source: 5G Update by David Banjo (Nokia)

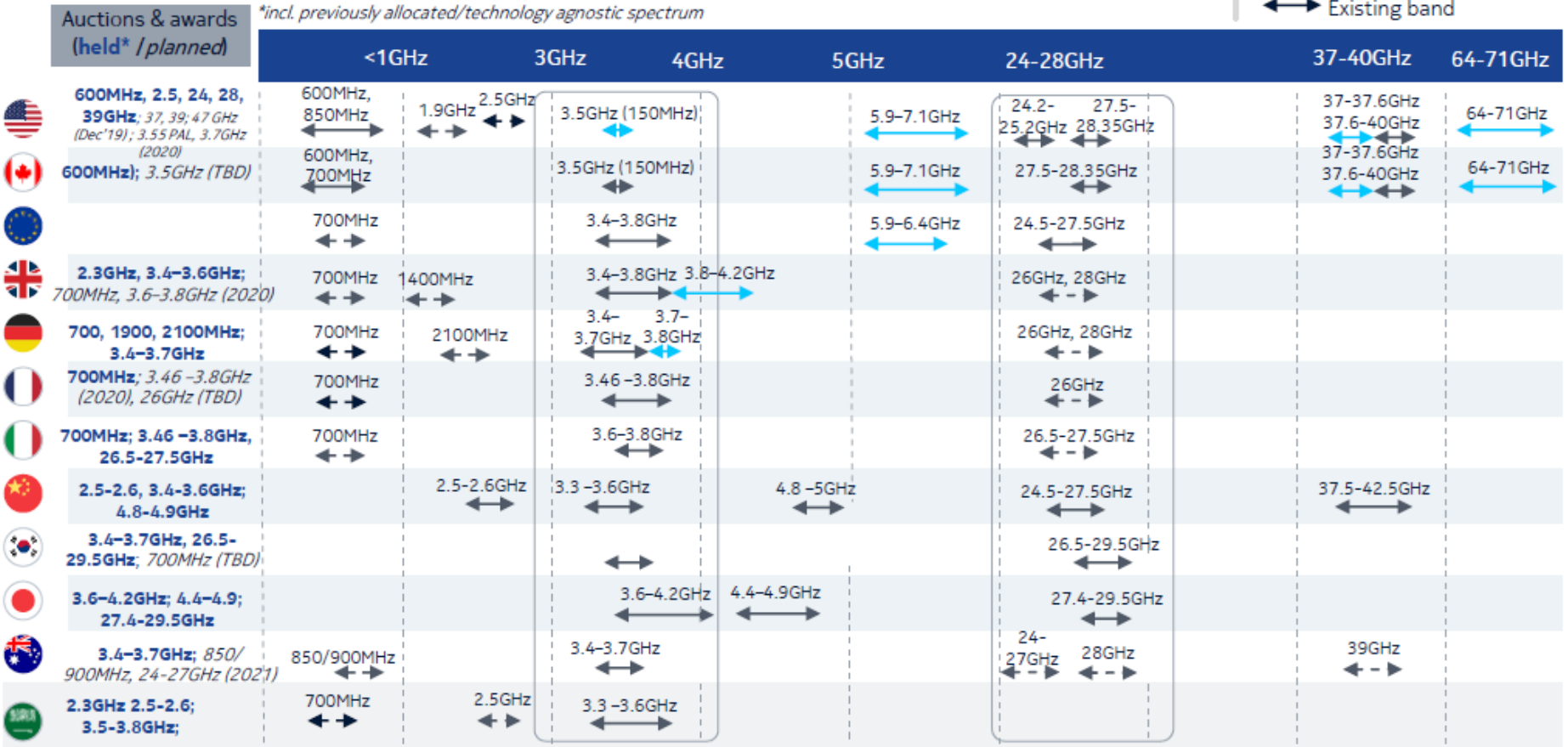
Background :

# Global snapshot of 5G spectrum

An emerging pattern of band allocation, with fragmented availability

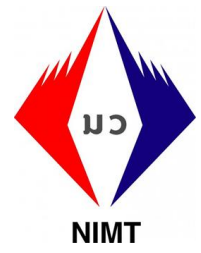
5G band

- ↔ Licensed
- ↔ Unlicensed / shared / private
- ↔ Existing band



Source: 5G Update by David Banjo (Nokia)

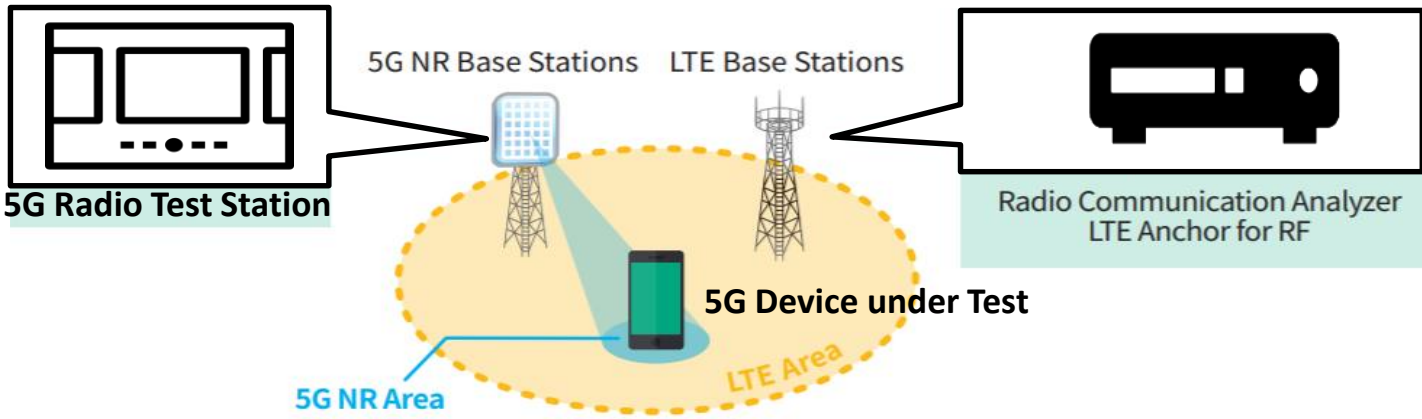
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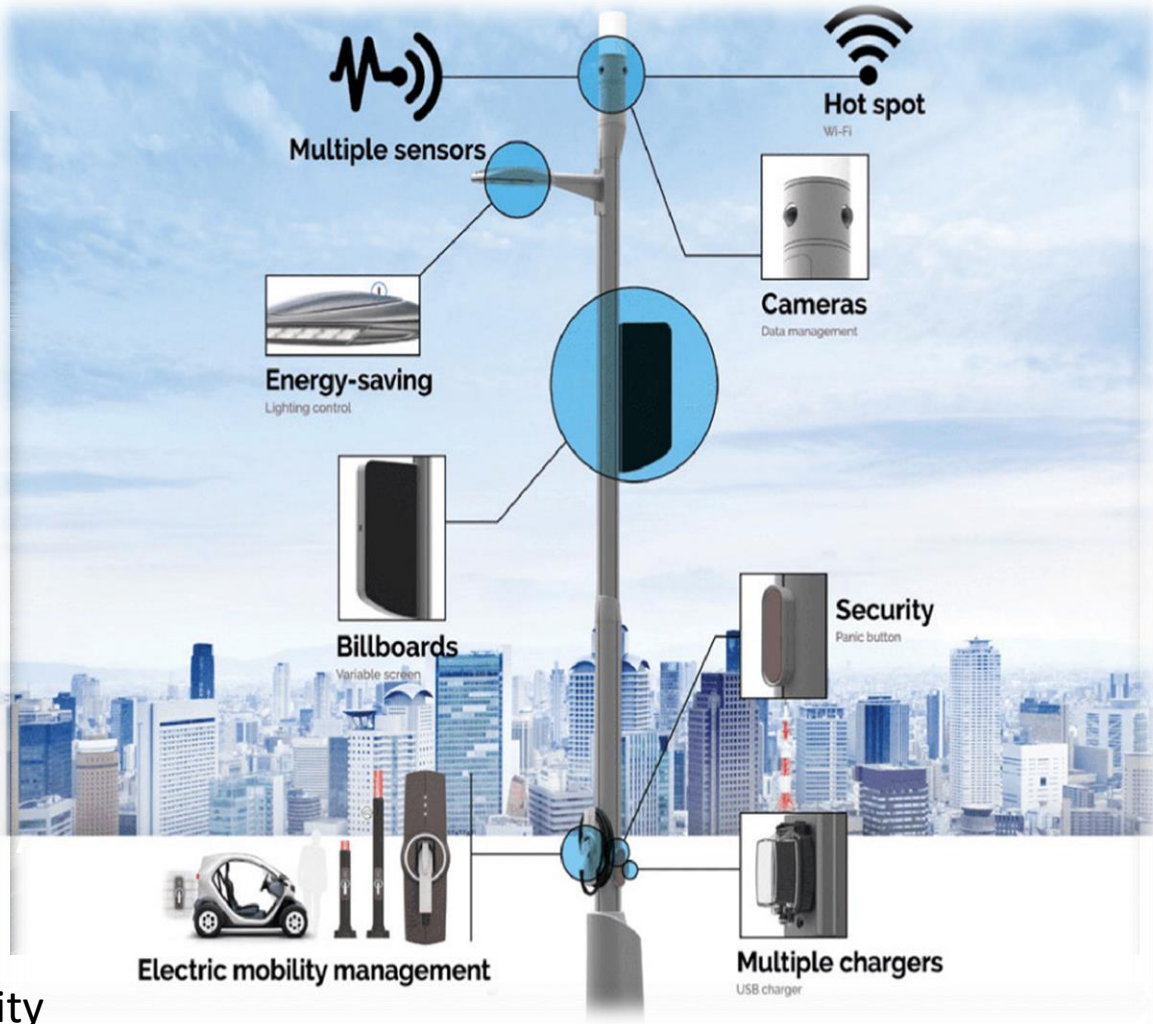
- To support research and development of 5G/IoT devices by researchers.
- To support verification test for vendors, operators, and regulator (NBTC).
- To serve the telecommunication laboratory course of EECU.



5G Test Equipment Set



5G Non-Standalone Test Equipment Block Diagram







## Telehealth / Smart Health

- Transmission of Multi-Parameter Vital Signs For Telemedicine
- Implementing 5G Wireless Picture Archiving And Communication System (PACS) in Dental Clinics
- Development of Data Collection and Transfer for Air Quality Monitoring in Hospitals

## Smart Environment

- Smart Pole based on 5G Technology
- Single-Phase Smart Meter based on NB-IoT, LoRa and 5G Technologies Project
- Smart Street Lighting Control System Project
- Project PolluSmartCell
- Video Analytics on Cloud Computing

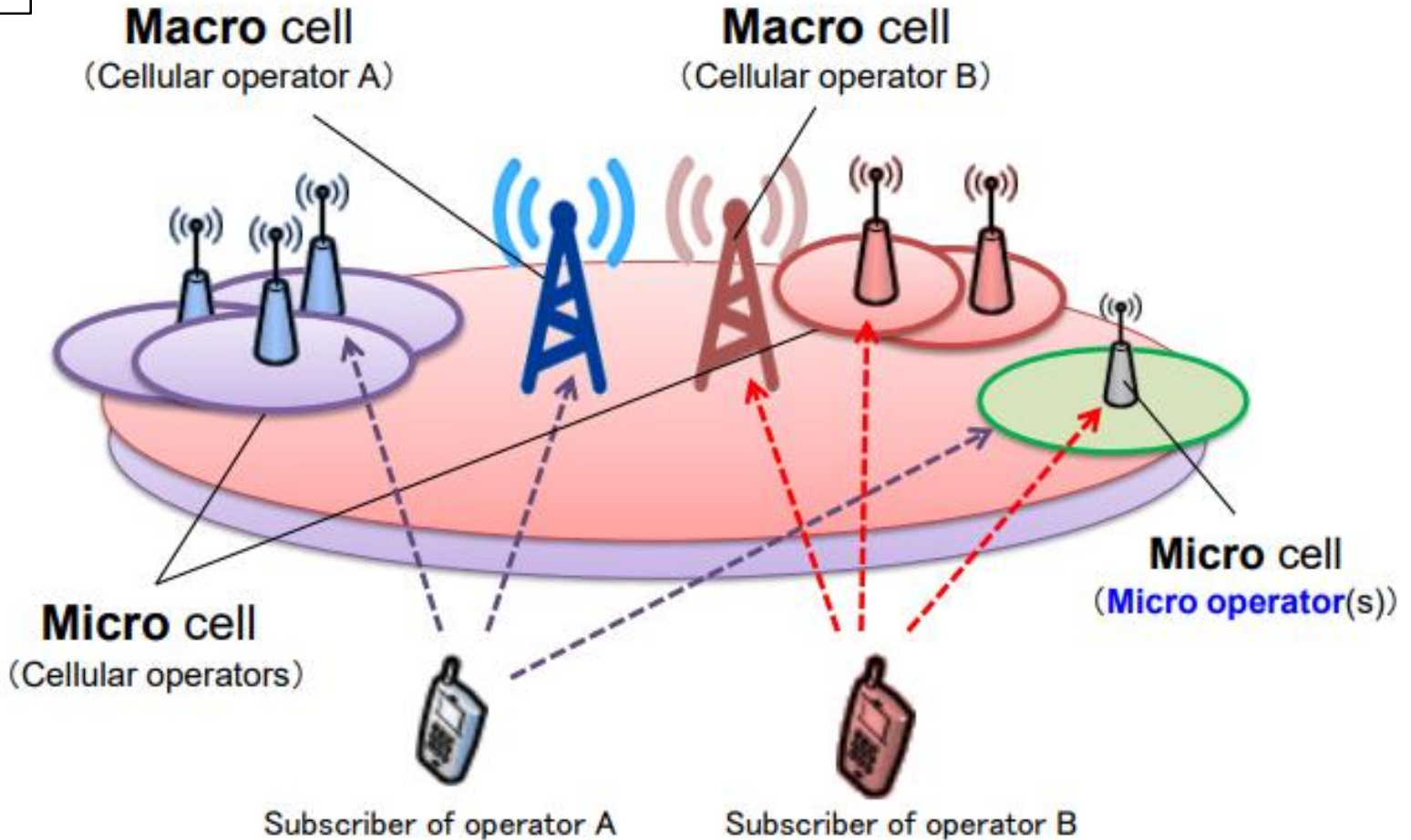
## Robotics / Smart Mobility / Smart Student Lives

- Control of Service Robots with 5G Network
- 5G-CU MegaSense and Video Analytics via CU Pop Buses and Smart Poles
- 5G Possibility in Drones and Robots
- Development of Autonomous Driving for Relocation of CU Toyota Ha:mo
- Development of Autonomous Driving for Shared EV (First-Last Mile Vehicle)
- VR 5G

# 5G/B5G Cellular Networks

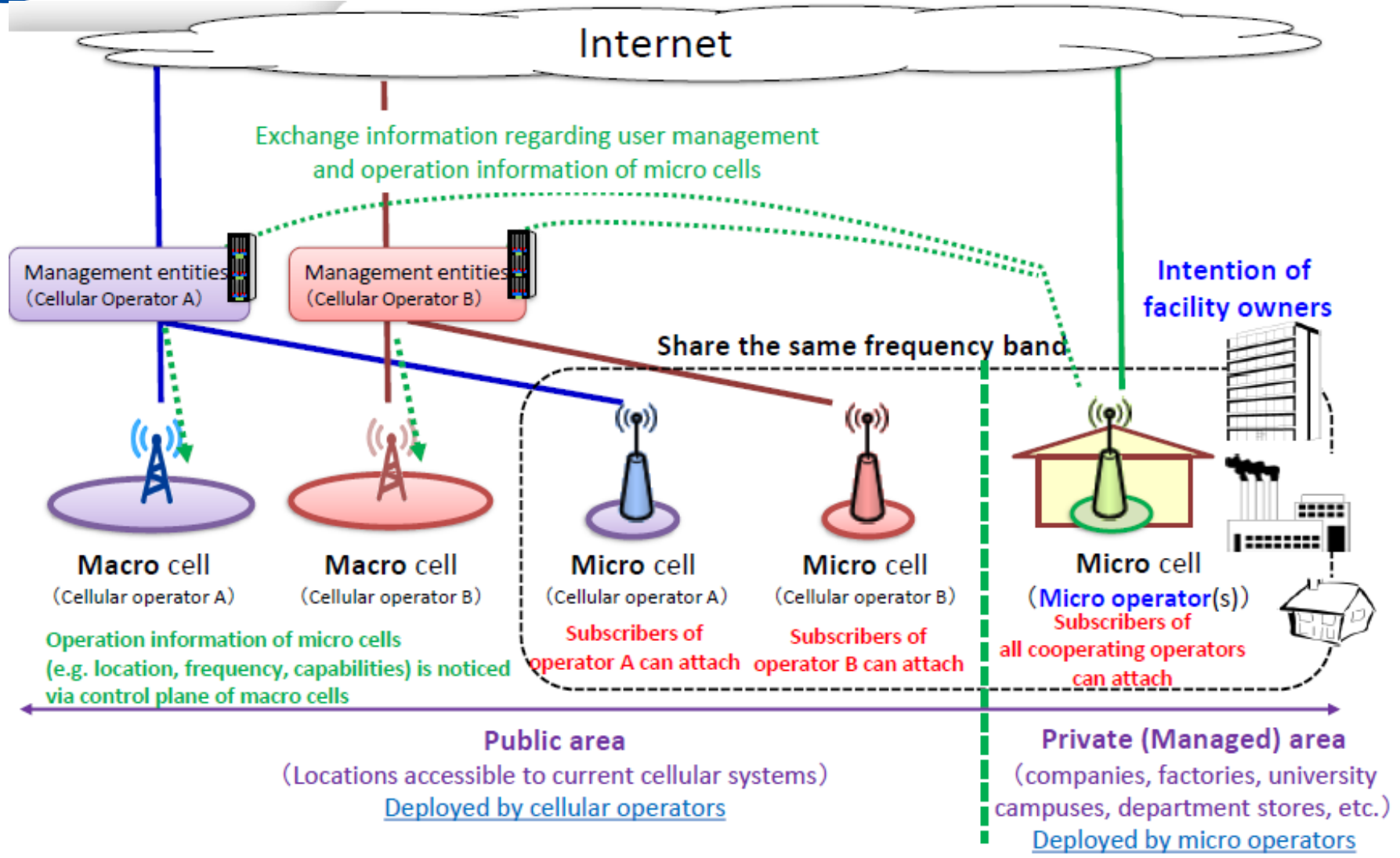
- High speed, low latency and reliability features of 5G technologies promise to bring new products and services such as self-driving cars, remote robotic surgery, smart health and much more.
- To satisfy diverse, specific and local demands of different sectors across the entire vertical industries, the deployment of 5G networks requires new mobile business ecosystem, where various vertical sectors must be coordinated.
- **5G Micro-operator** is an interesting way to provide localized services for vertical sectors' needs, increasing energy efficiency, strengthening security, minimizing radio wave interference and raising the quality of wireless communications.

Solution :

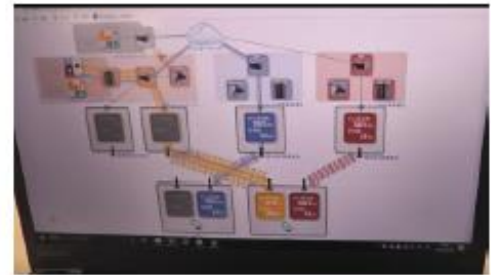
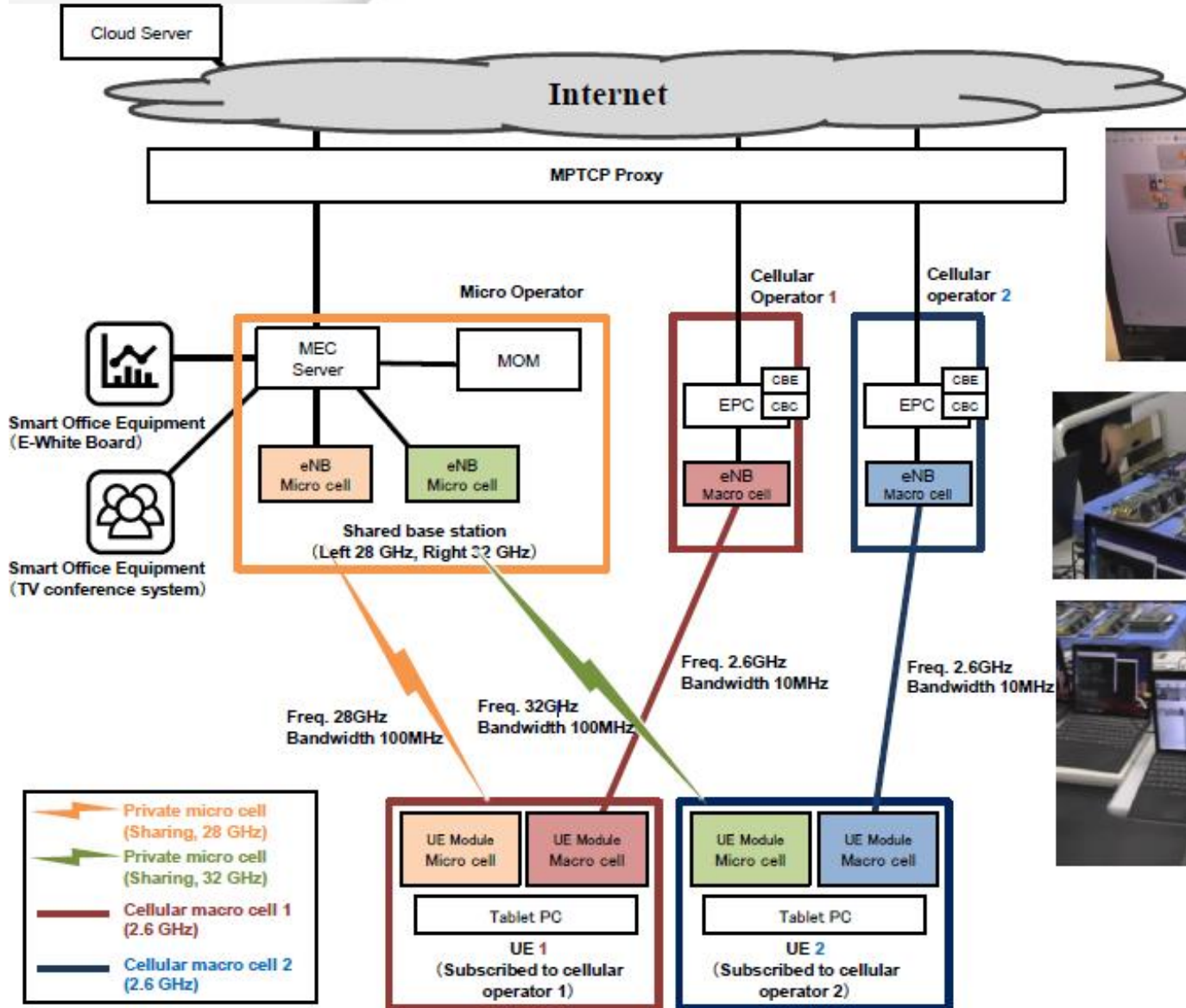


Source: 5G R&D Activities of NICT

# 5G Micro-cell Operator Model by NICT



# 5G Spectrum Sharing Prototype by NICT



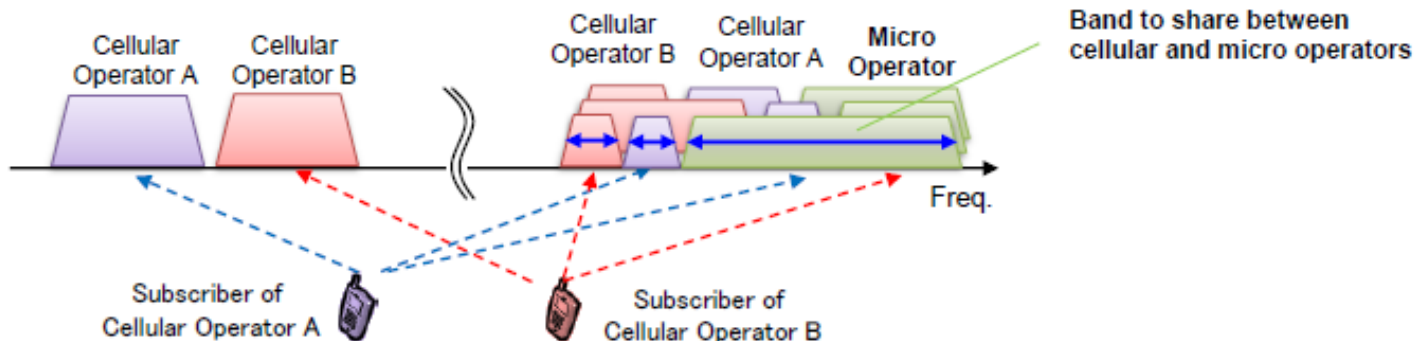
**MOM:** Microcell Operator Manger  
**MEC:** Mobile Edge Computing  
**CBE:** Cell Broadcast Entity  
**CBC:** Cell Broadcast Center

# Three Spectrum Sharing Scenarios by NICT

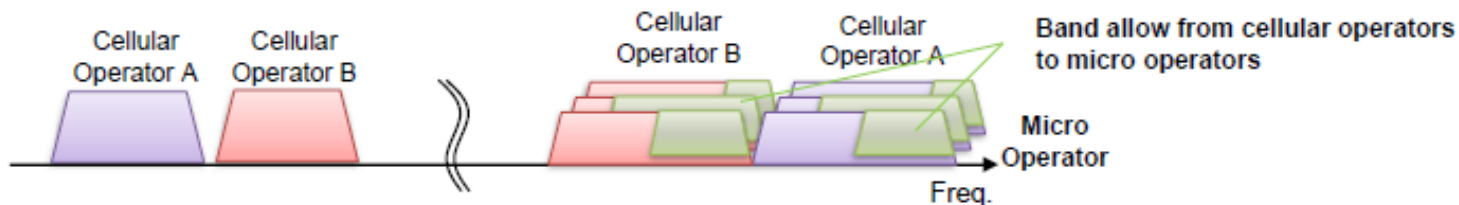
- Share spectrum between cellular operators and micro operators

- ▶ Share spectrum allocated to cellular operators

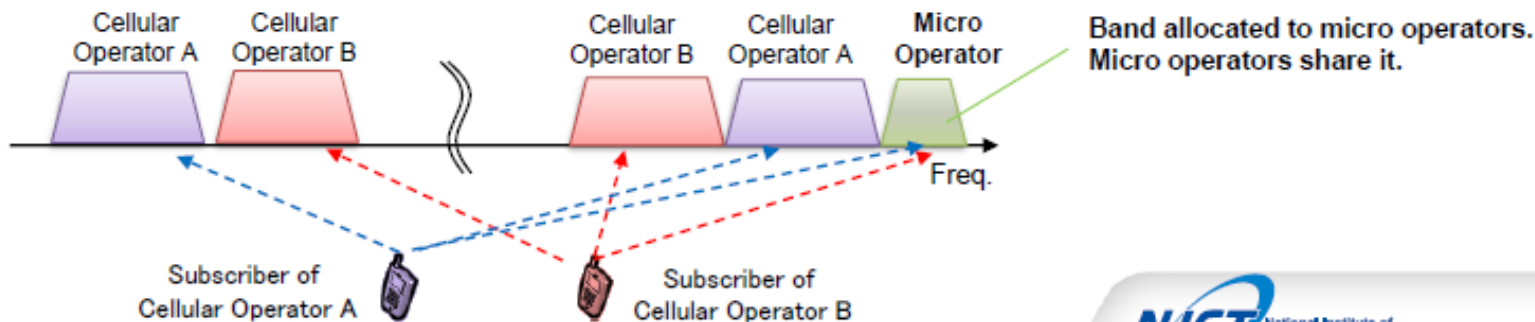
- ▷ According to user requirement, change operational bandwidth dynamically



- ▷ Cellular operators allow micro operators to use a part of allocated band



- ▶ Introduce a new freq. band for micro operators



Targets :

# 5G Micro Operator on Campus

- 📍 To deploy a fully functional 5G micro-operator network for C and/or millimeter bands by using existing infrastructure at Chulalongkorn University with strong technical support and equipment from NICT.
- 📍 To jointly develop and realize the 5G core network equipment among our university partners, creating and strengthening R&D research collaboration among ASEAN communities, accelerating the deployment of 5G micro-operator across ASEAN and laying a strong foundation for advancing mobile technology beyond 5G.

Targets :

# 5G Micro Operator on Campus

- 📍 To research and perform experiments on 10-12 different 5G use cases, for smart-health, robotics, smart mobility, smart student lives over the 5G campus-wide test network in collaboration with vertical industries and operators.
- 📍 To conduct research on network slicing using Network Function Virtualization (NFV) and Software Defined Networking (SDN) to allow spectrum sharing and automate seamless services by optimizing SLA based QoS.



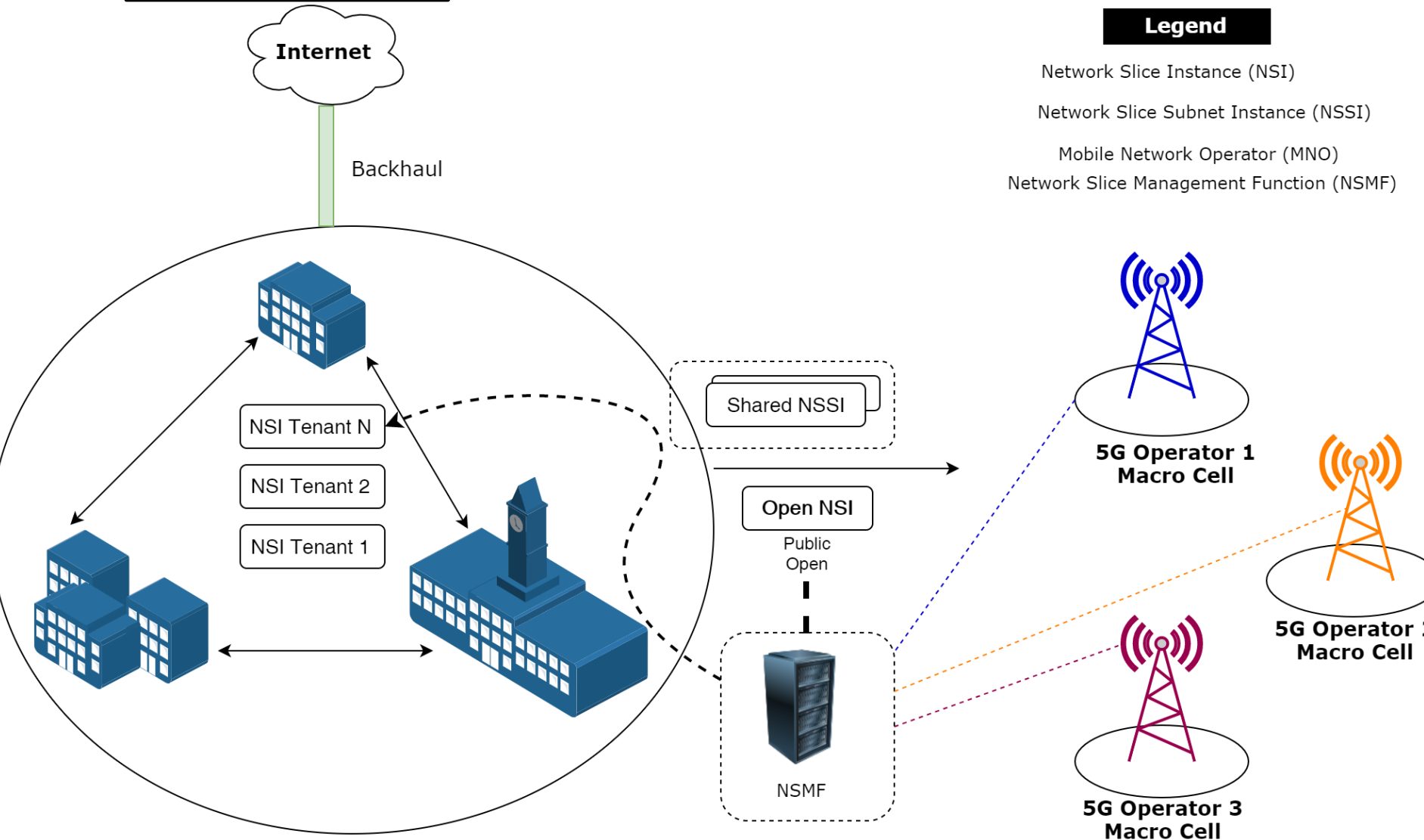
# Proposed Method:

## Deployment Scenario

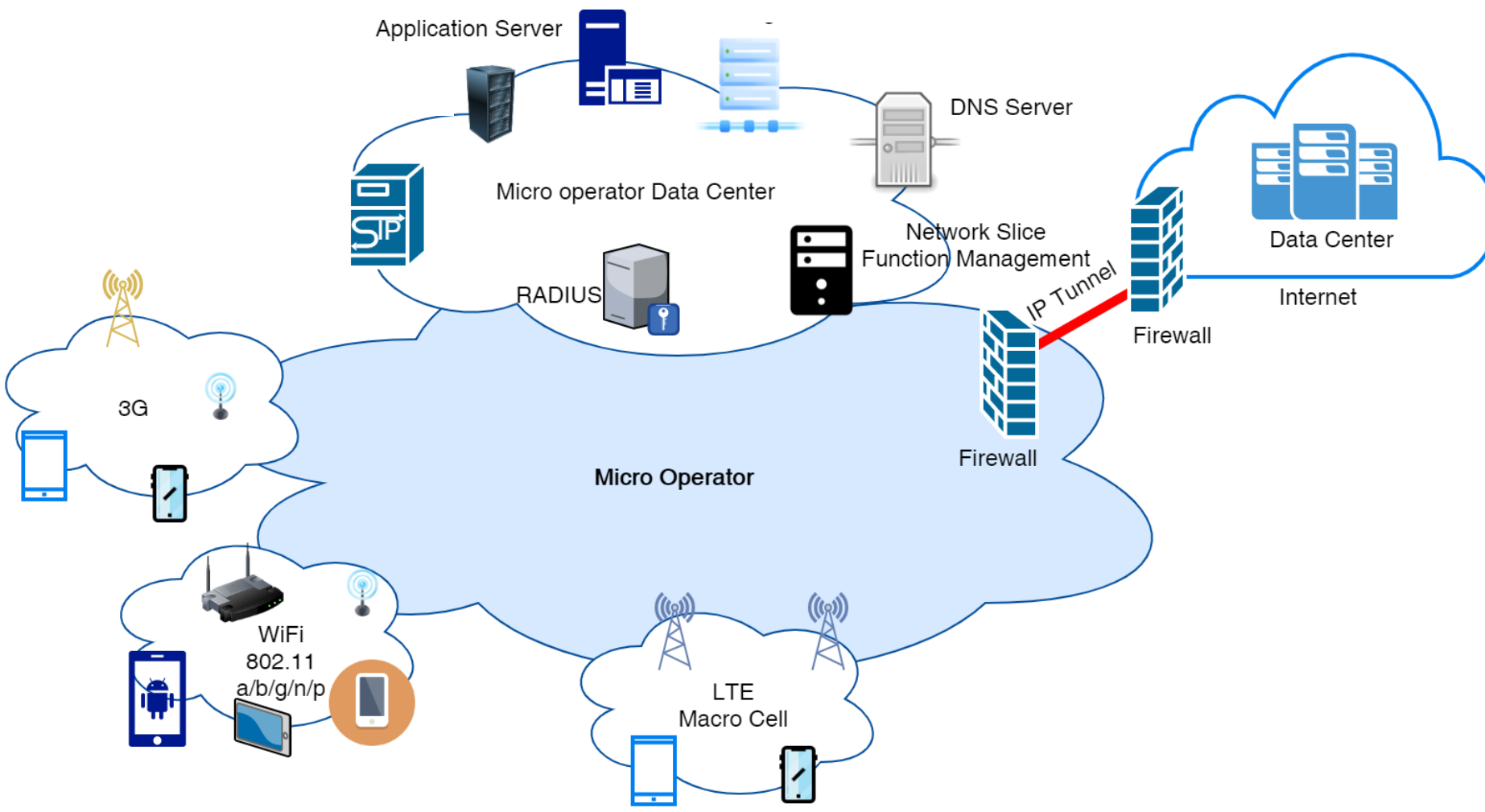
Single Site with multiple tenants at one-location

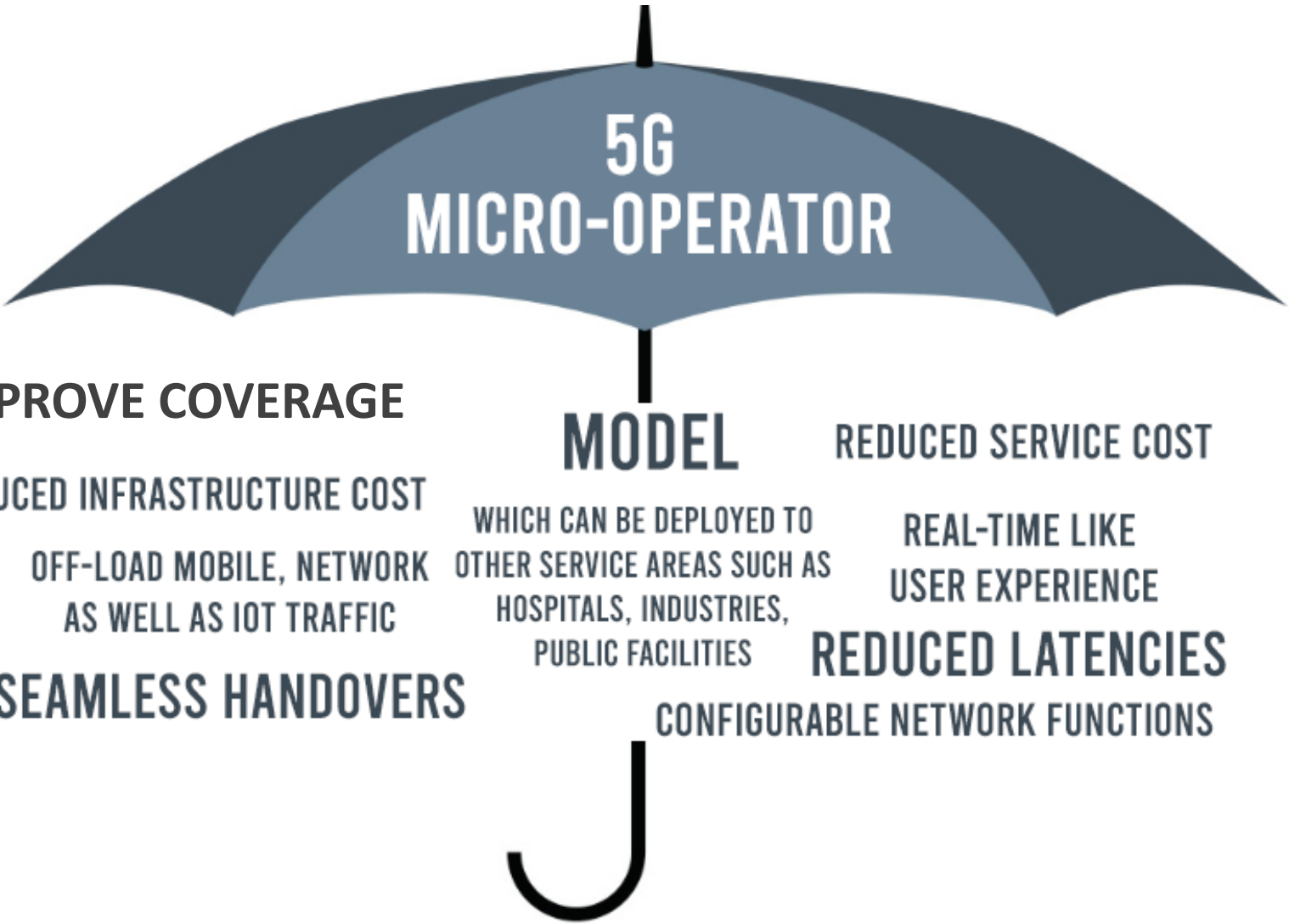
## Legend

- Network Slice Instance (NSI)
- Network Slice Subnet Instance (NSSI)
- Mobile Network Operator (MNO)
- Network Slice Management Function (NSMF)

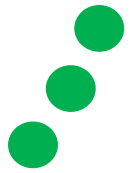


# Proposed Method:





## ASEAN Universities & NICT 5G Network Collaboration



# Output/Outcome:

## SCIENTIFIC

- 5G enabled micro-cell deployment, achieving extended 5G coverage by integration with existing infrastructure
- R&D on new 5G use cases
- Research on NFV ready scalable micro-operator gateway for SLA based flexible QoS settings per network slice
- Shared Spectrum sharing (Licenses/Unlicensed Spectrum)

## SOCIAL

- Improved coverage and improved end user experience
- Reduced service cost with additional bandwidth
- Real-time services with easy handovers with service connectivity
- Multi-MNO support providing equal support and coverage for all operators

# Output/Outcome:

## COLLABORATIVE

- Opportunities to connect campus wide research applications and use cases on to 5G network, potentially across ASEAN nations.
- Key collaborative possibilities in:
  - Micro Operator Architecture
  - Deployment and Optimization Strategies
  - Automated administration and network gateway design
  - Capabilities to monitor small cell sites thus opening room for business and further application
  - Radio optimization and coverage field tests
  - Network security design
  - Open standards-based orchestration templates to automate system wide processes

## Conclusion:

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- 📍 The ability to deploy micro-operators using unlicensed spectrum in ASEAN market, opens-up many interesting research and experimental cases which will not only extend services but will also help to standardize spectrum sharing and licensing in these regions.
- 📍 The ability to host multiple MNOs using shared network slice will provide a seamless connectivity and similar service across the board
- 📍 IoT based solutions and test-beds can be easily connected to 5G networks, facilitating smart city, smart farm, self-driving cars, smart health and etc.
- 📍 With flexible spectrum and service model, the new business models to consumer values can be realized.