R&D status on micro cell operator and spectrum sharing toward 5G and beyond

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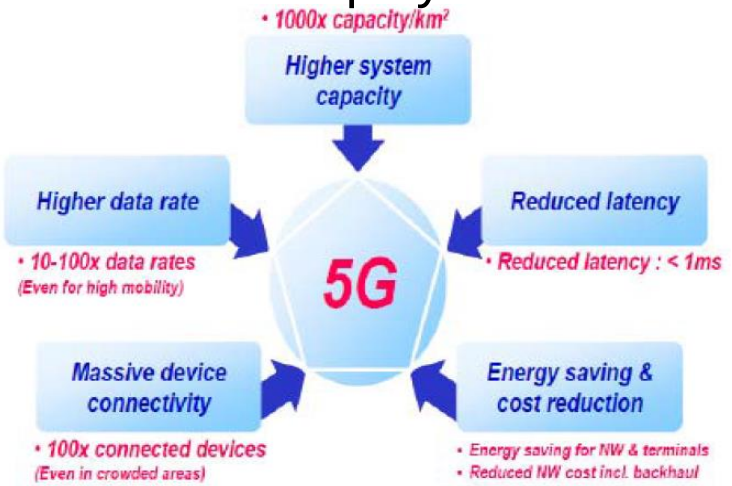
Future of Mobile Communication System

- Requirements for various performances of the 5th generation mobile communication system (5G)
  - Enhanced Mobile Broadband(eMBB)
  - massive Machine Type Communication (mMTC)
  - Ultra Reliable Low Latency Communication (URLLC)

- Era of Internet of Things (IoT) is coming
  - 5G is the key technology for the infrastructure of IoT
  - Various specialized wireless access systems will be deployed since a single system can not afford to satisfy requirements of variety of services

- Current cellular network architecture has come to its limitation

- Future wireless communication system including 5G should have a new way of functional improvement, not just an extension of 4G
  - Aggressive micro cells deployment



Ref. : Final report from Radio Policy Vision Council of Japan (Dec. 2014)

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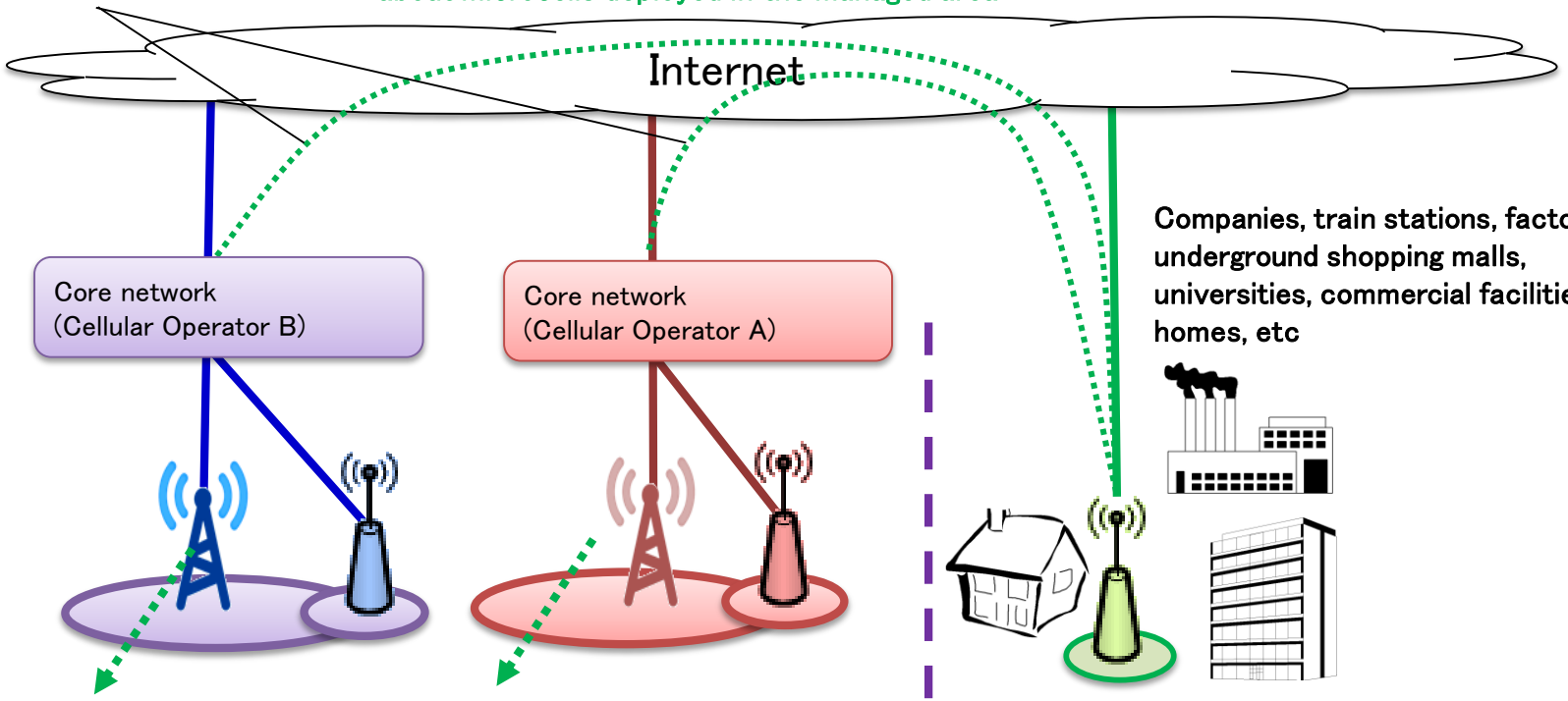
Cooperation of “public area” and “private area”

Minimum necessary interface for providing operational information (location, frequency, etc.) about microcells deployed in the managed area



Uses the macrocell control plane to inform the device of operational information (location, frequency, capabilities, etc.) about microcells

Cellular Operator B	Cellular Operator A	Microcell Operator
Subscribers of Operator B can connect	Subscribers of Operator A can connect	Subscribers of the partner cellular operator can connect

Public Area
(Areas where conventional cellular communications are deployed)

Installed by the cellular operator

Private Area
(Area in which the decision to install the cell was made by the owner/manager of the facility, etc.)

Installed by the facility manager / service provider

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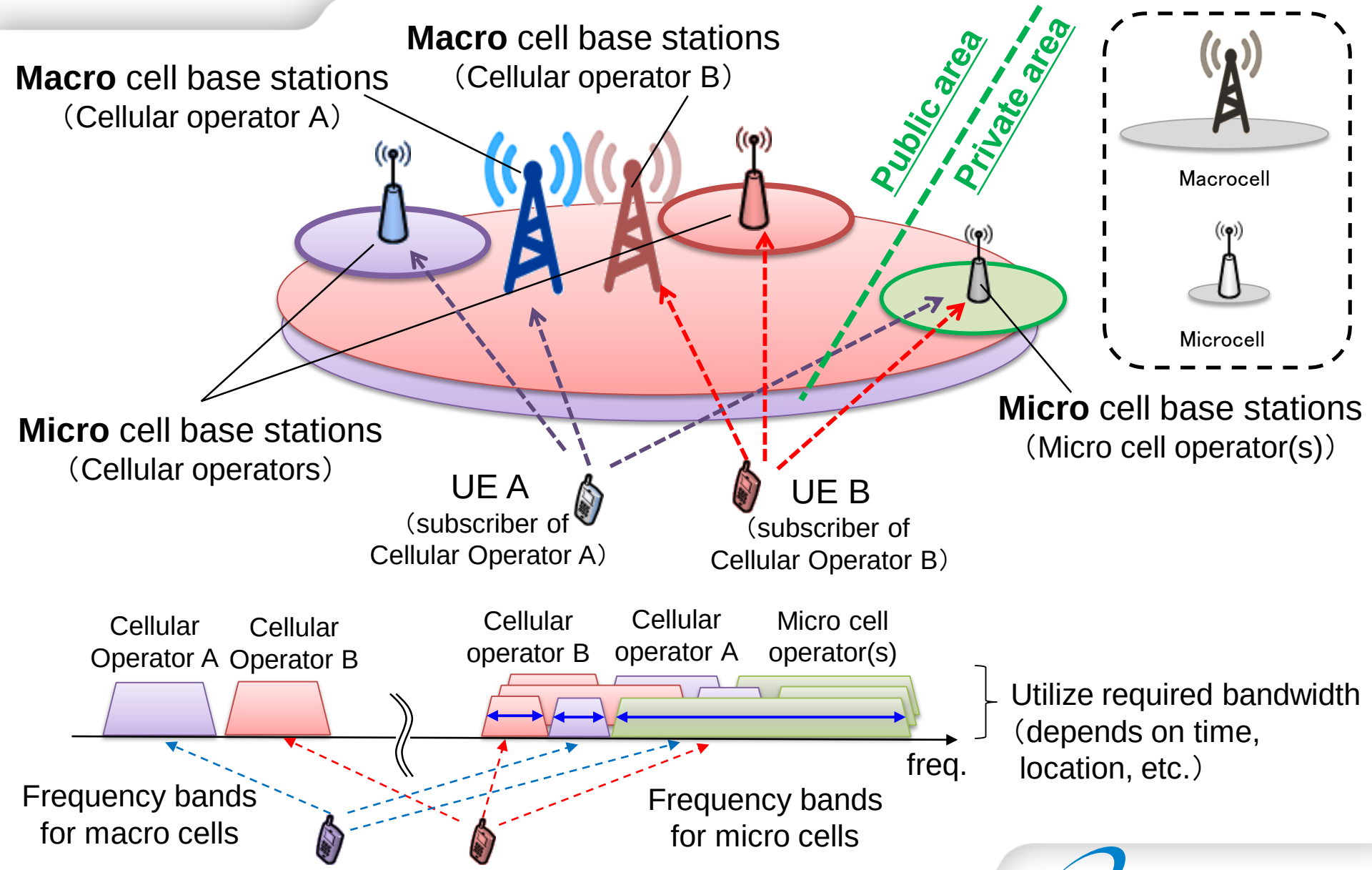
Introduction of “private area”

- To accommodate massive number of devices with different requirements
  - Classify operational area of micro cells
    - **Public area**:
      Area where cellular operators are operating
    - **Private area**:
      Area where specific individuals or organizations are operating (office, factory, university campus, shopping mall, etc.)

- Easy deployment like the wireless LAN,
  but also QoS guaranteed like 3GPP
  - Minimum interfaces to the cellular system

Accessibility of UEs and spectrum sharing

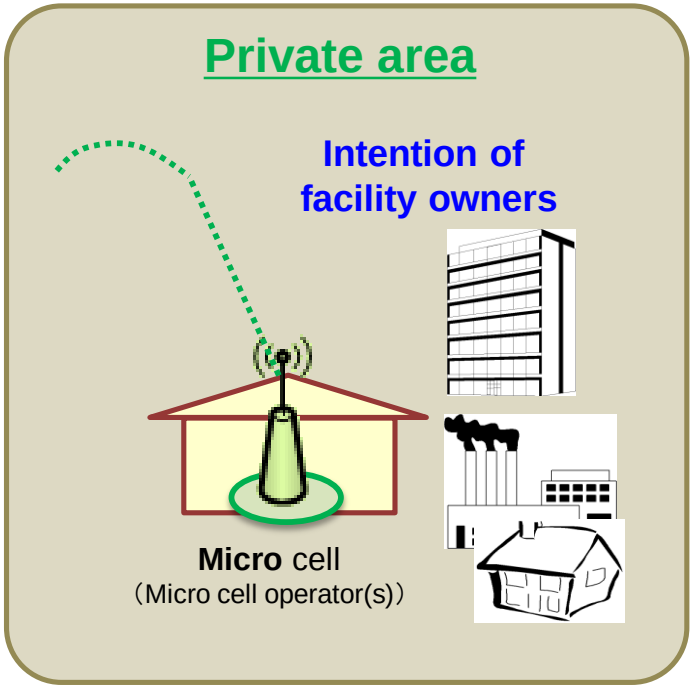


Business Opportunity

- Micro cell operators
  - Difficult for cellular operators to meet requirements of individual performance specific to each facility
  - Different business model required for a massive number of micro cells

- From cellular operators…
  - Area extension with various aspects of wireless communications without their own investment
  - Income for mobility management

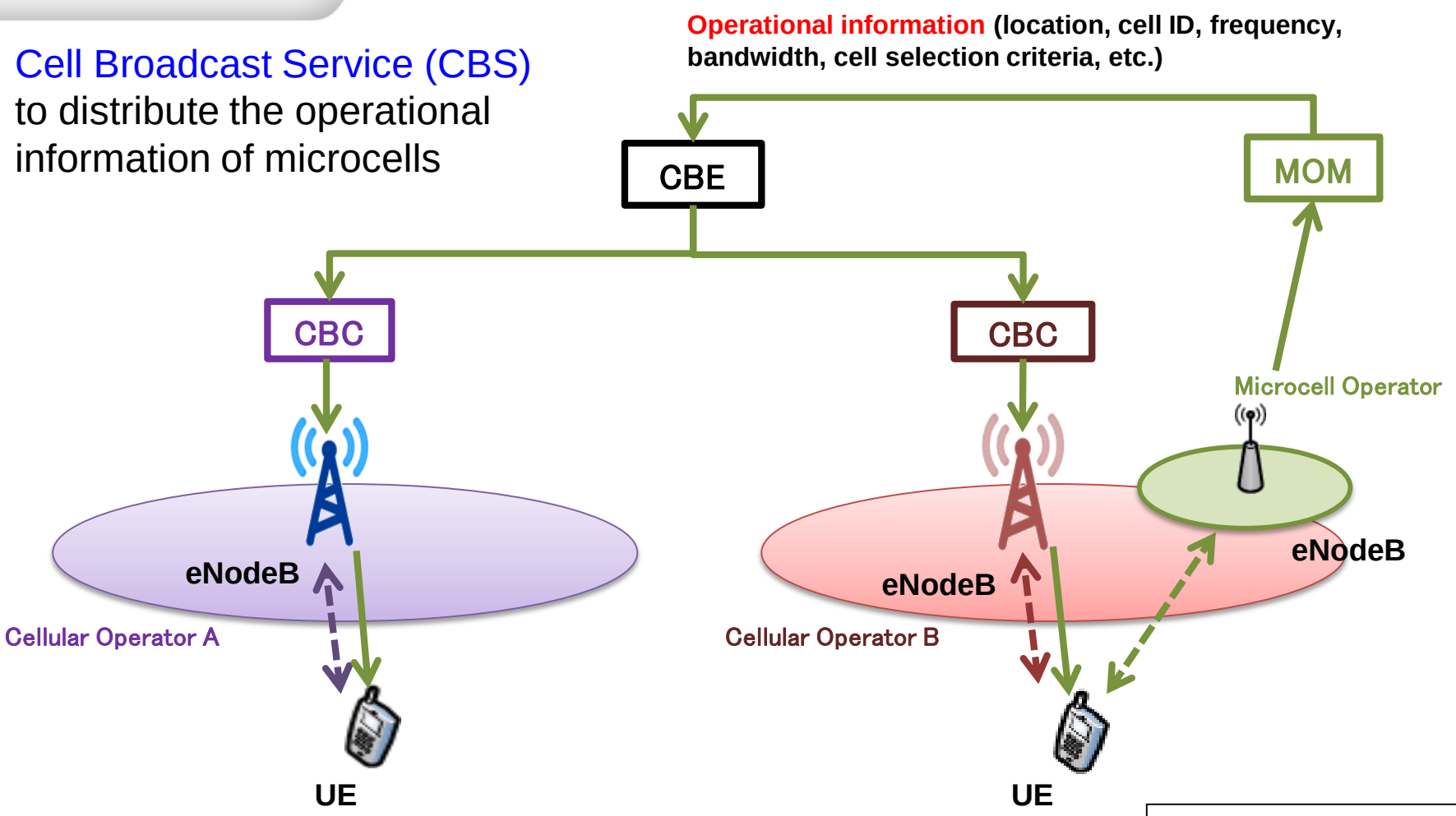
- From micro cell operators…
  - Small investment to satisfy performance requirement customized for each use cases
  - Integrate with the cellular system, not just a independent small system



- 5G as infrastructure of various IoT services will have drastically wide business, so there should be mutually profitable model for both the operators.

Distribution of Operational Information

Cell Broadcast Service (CBS)
to distribute the operational information of microcells



CBE: Cell Broadcast Enabler
CBC: Cell Broadcast Controller
MOM: Mobile Operator Manager

} Defined in 3GPP
} Original function

→ Transmission of operational information
<--> Device connection

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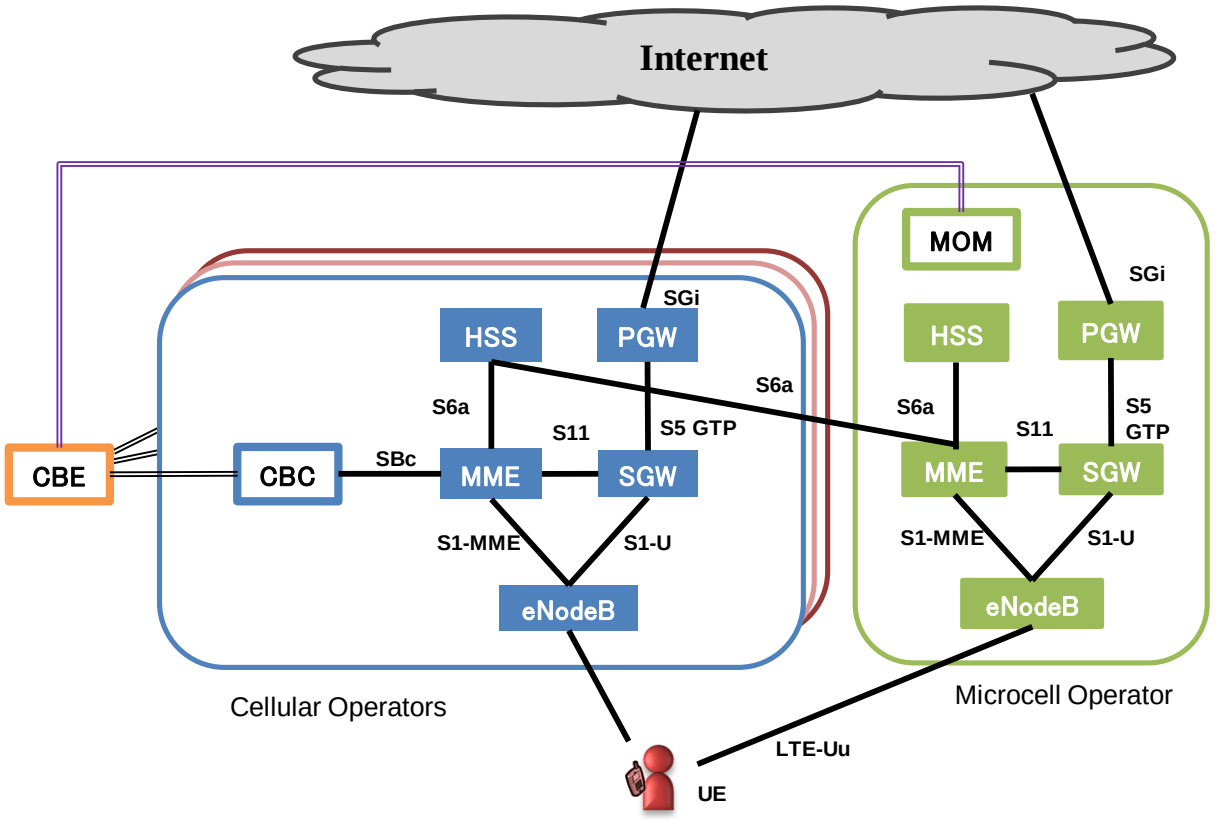
Proposed System Architecture (based on 3GPP Spec.)



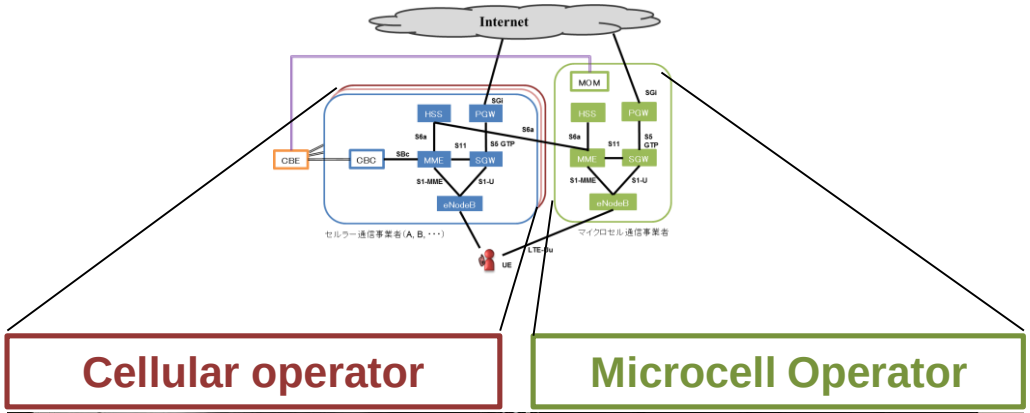
CBE : Cell Broadcast Entity

CBC : Cell Broadcast Centre

MOM : Microcell Operator Manager

Proof of Concept Experiments using Prototype

(1) UE connects to cell (cellular)
(2) Cell (cellular) provide operational information of cell (microcell)
(3) UE connects to cell (microcell)
→ On disconnection from cell (macrocell), UE reconnects to cell (cellular).



A device

Cellular operator

Microcell Operator

(1) Connection

(2) Operational information

(3) Connection

Module for cellular operator

Module for microcell operator

Commercial LTE Modules connected to a PC by USB I/F

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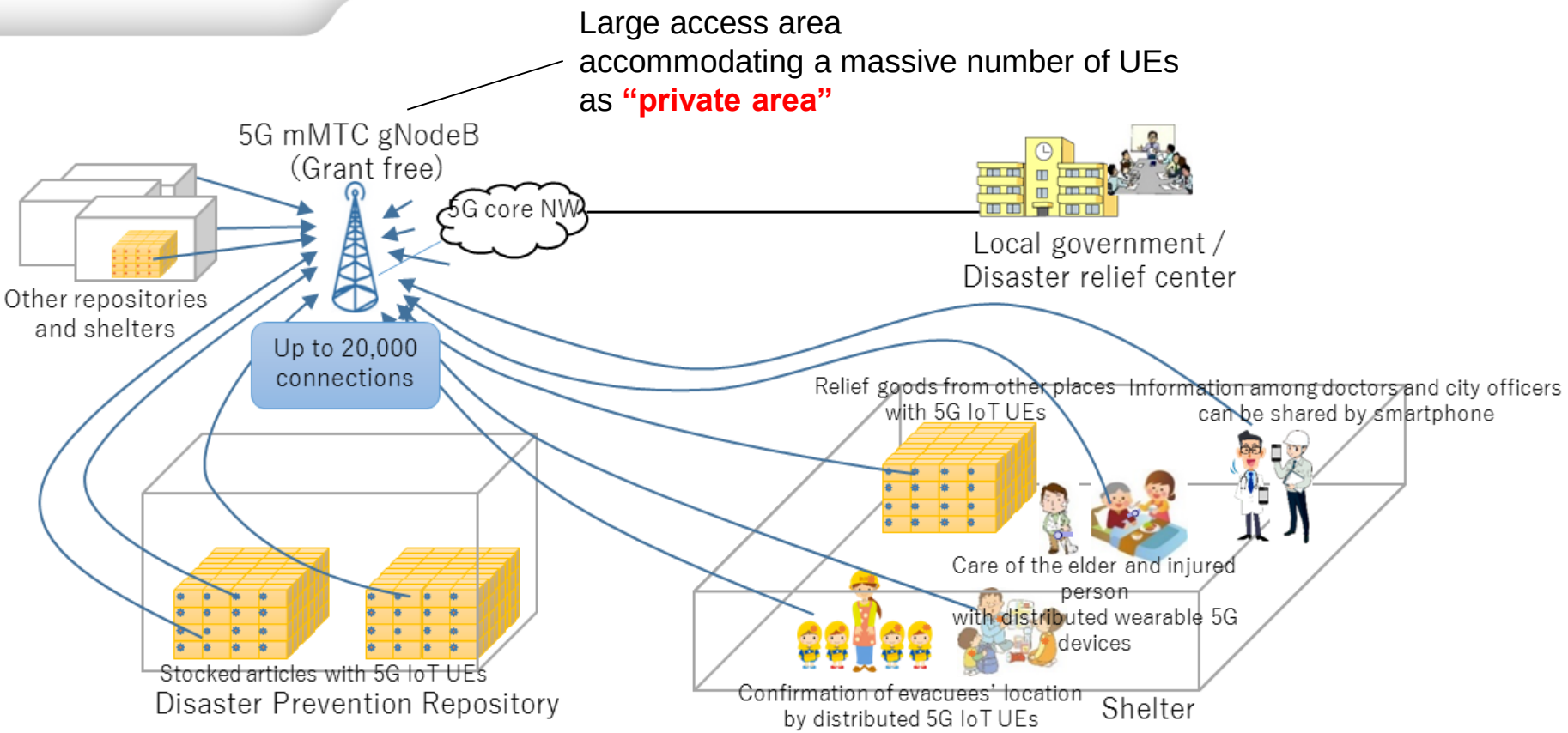
5G Application - Disaster Prevention Repository –



【Evaluation plan of massive MTC】

- Verify the performance of simultaneous massive connectivity to a 5G gNodeB (up to 20,000 UEs) , comparing with 4G
- Demonstrate the capability under a large-scale disaster scenario

【Use scenario】

- Manage the locations of articles and persons around shelters (doctors, volunteers, evacuees (with distinction of children / old people, male / female), etc.)
- Using 5G IoT devices and smartphone, integrated information can be provided to doctors, city officers and volunteers

5G Application – Smart Office –

Two dimensional (thin) access area on a table as **"private area"** for spectrum sharing

Displays
Sharing meeting documents/materials, showing remote attendees, and showing some suggestions from meeting assistance function

Meeting assistance robot
Taking meeting logs and support discussions working with servers/ edge computing resources

Smart desk with built-in 5G sheet antenna
Same frequency bands can use at adjacent smart desks

eMBB

Tablet PC
Showing faces of remote attendees

Smart chair
Sense position and movement of seated person

mMTC

URLLC

E-whiteboard
Drawing lines can be shared with another one at different locations

Conclusion

- 5G will play an important role
  - As an infrastructure for IoT
  - Concept of self-deployed micro cells in private area and spectrum sharing could be one of the keys

- **Collaboration** with variety of entities
  - Necessary for 5G R&D, not like until 4G
  - IoT/5G technologies are more business/service oriented