NICT's Concept Toward 5G to Realize Micro Operators

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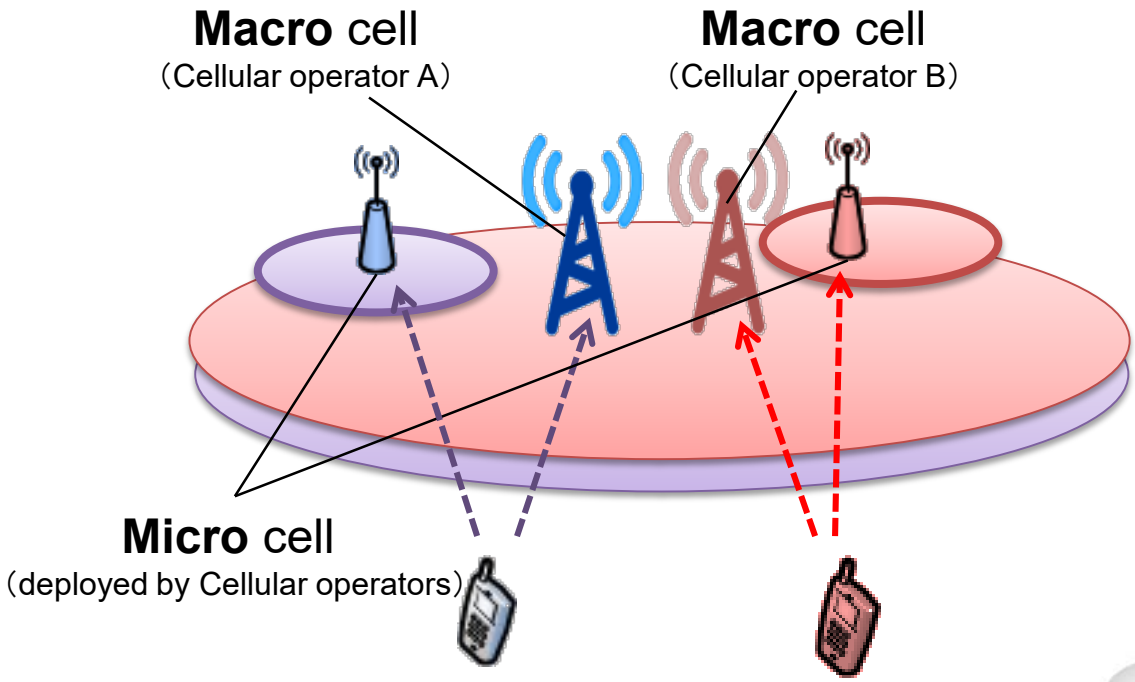
November 2018 @ ASEAN IVO forum

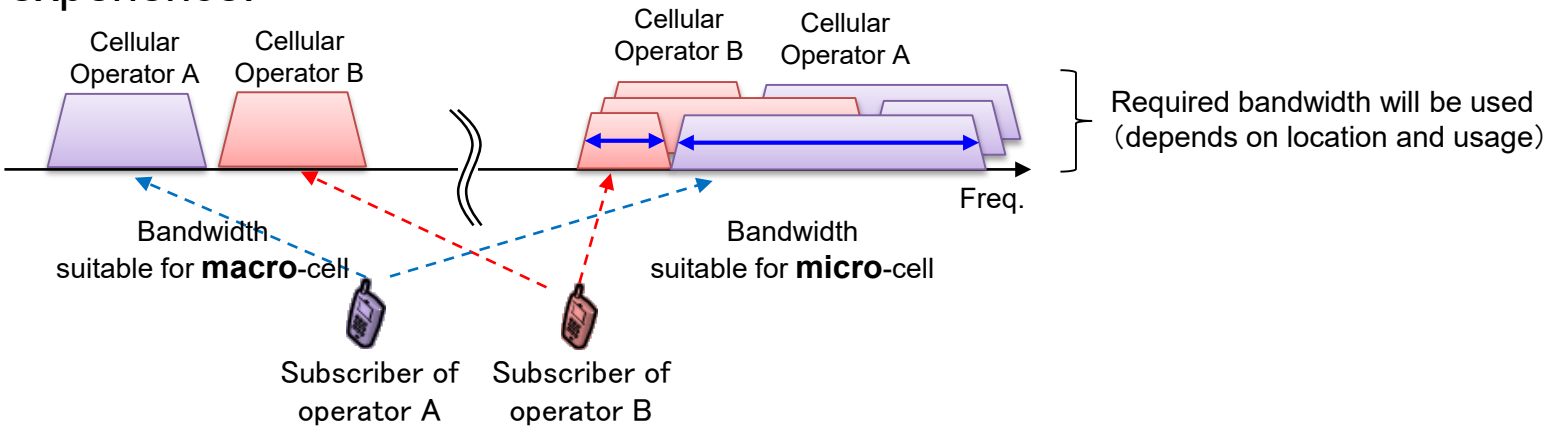
Micro-cell Base Stations in 5G

- Due to the small coverage of micro-cell BSs and propagation characteristic of using bands, cellular operators need to deploy more BSs in 5G era.
- It may difficult to cover wide area by micro-cell gNodeBs (gNBs) especially in the case of deployment indoors by the cost reason.
- 2 concepts are expected to mitigate the narrow coverage of micro-cell BSs.

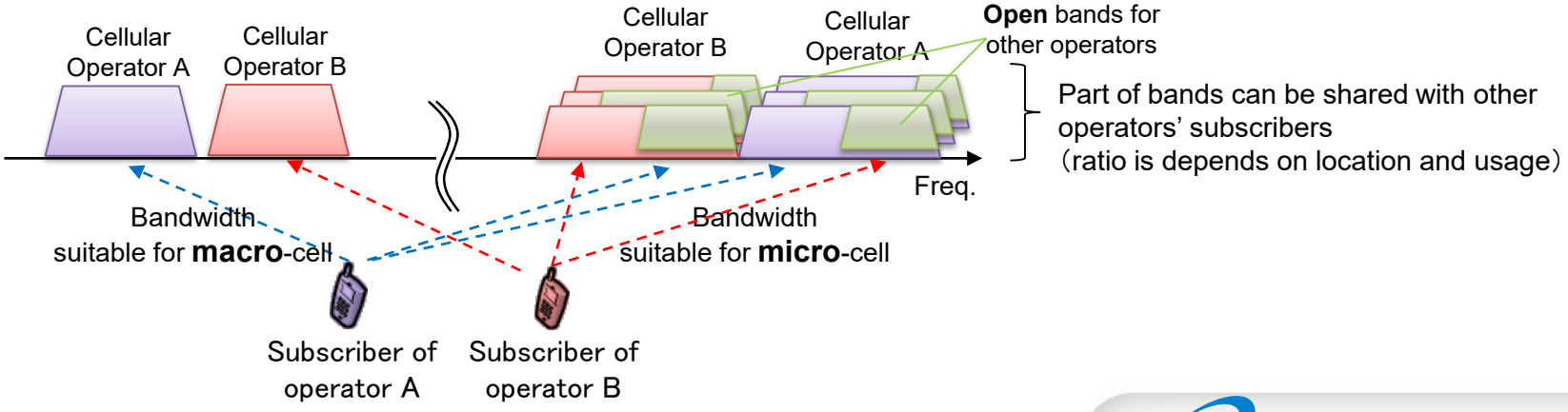


Concept 1 : spectrum sharing by operators

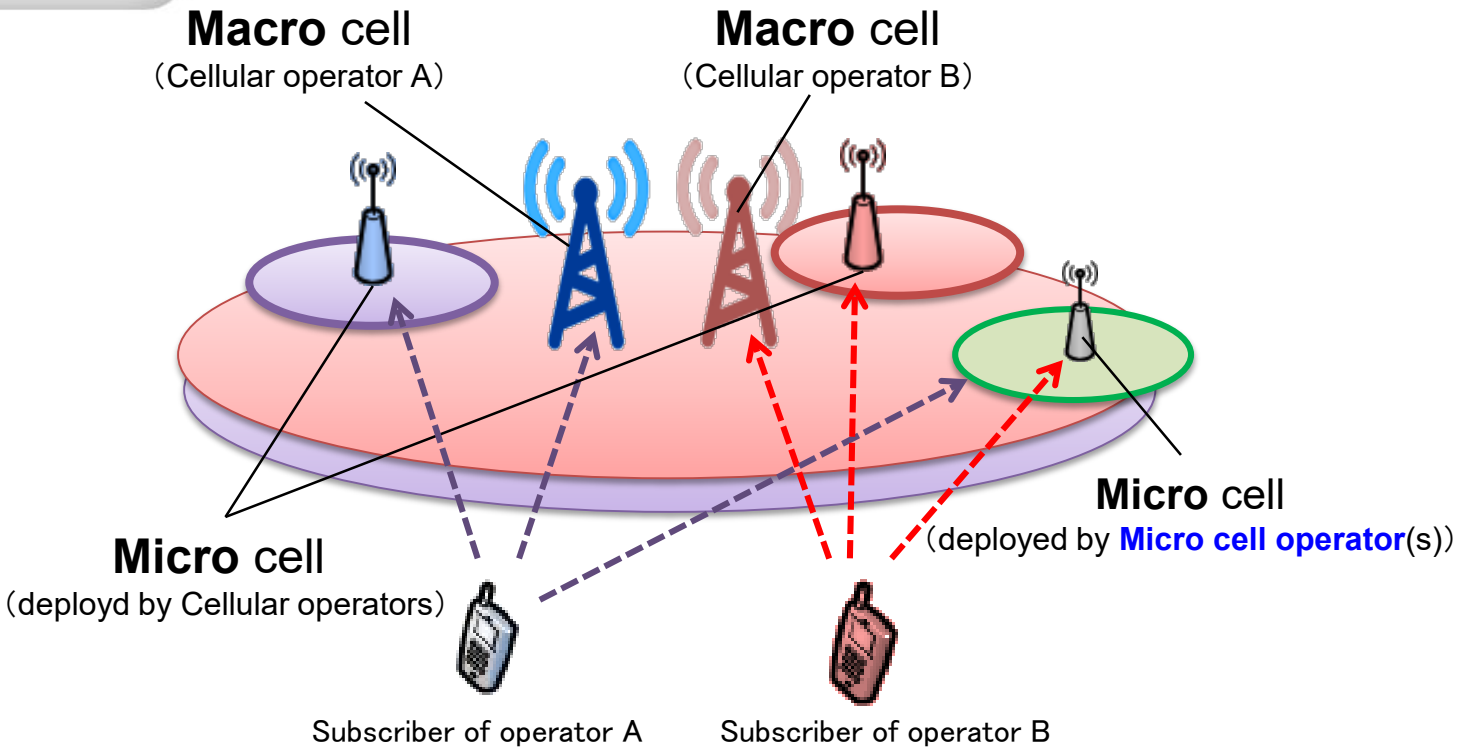
- Adaptive and dynamic usage is most suitable for efficient spectrum use and for user experience.



- Or, each operator has their bandwidth, Share a part of resources of BSs with other operators may also have a good performance.

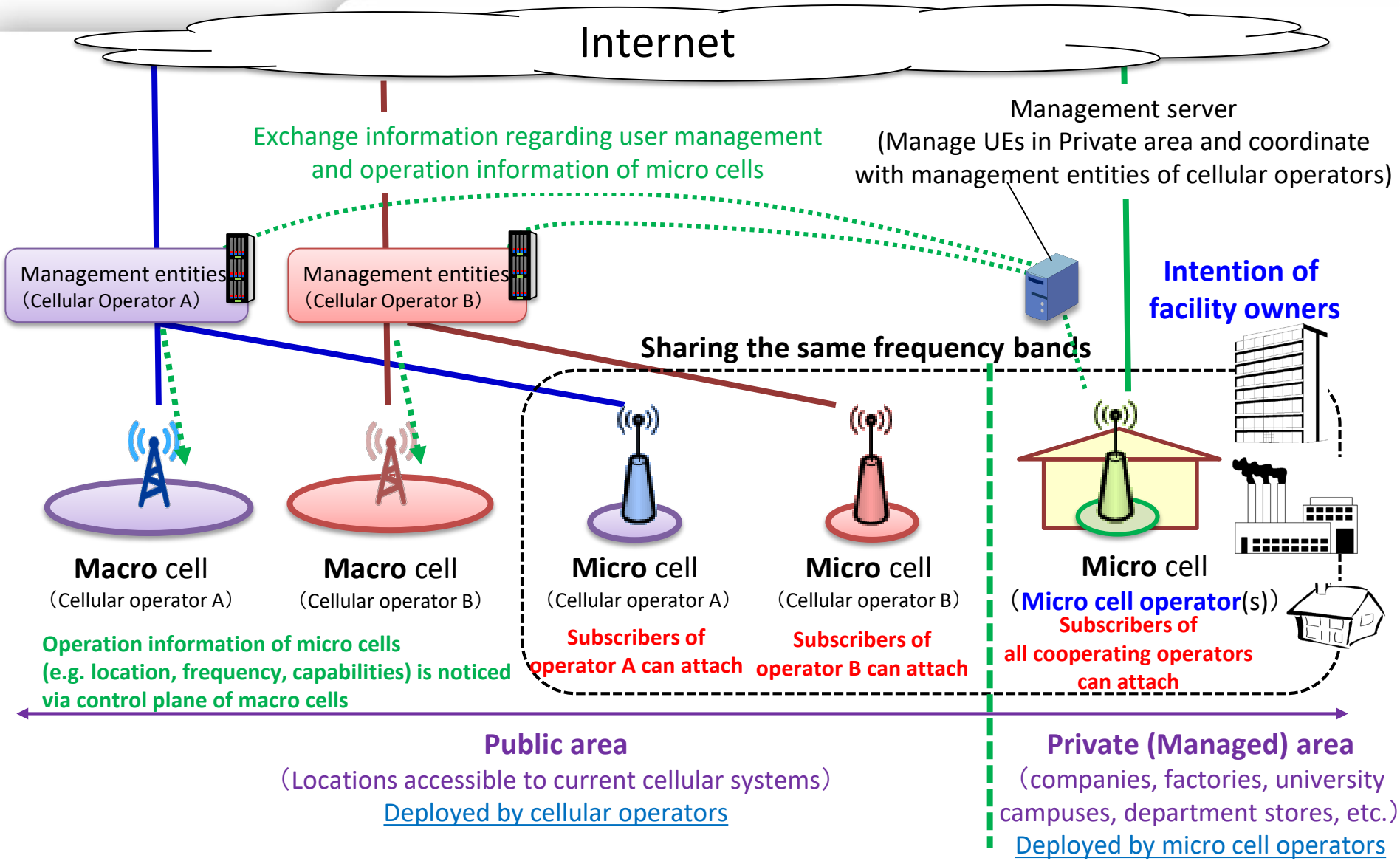


Concept 2: micro-cell operator



- The concept enables owners of private areas to deploy private gNodeBs by themselves.
  - In addition to using as a private network by the owner, the private gNodeB can also be opened for operators' customers.
  - The private gNodeBs can be use a specific bands assigned for the use cases, or the sharing bands, which is assigned for cellular operators but not used in a specific location.

Concept 2: micro-cell operator (cont'd)



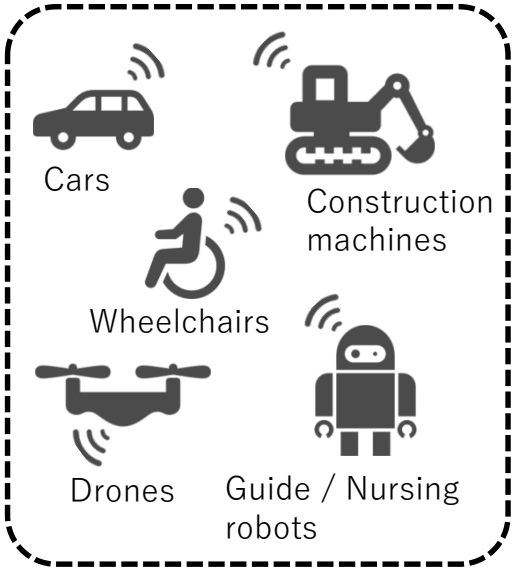
3GPP: Network sharing

- 5G phase 1 (3GPP Release 15) <Done in June 2018>
  - Fundamental specifications to be realized in 2020
- 5G phase 2 (3GPP Release 16) <On-going>
  - Full specification including support for low latency and IoT
- Concept of **Network sharing**
  - Spectrum bands and radio communication systems (including base stations)
  - Core networks (control system, storages, CPU resources, etc.)
- Inputs to Release 15 (June 2018) from NICT
  - Proposals accepted for RAN sharing
  - TS 23.501 "System Architecture for the 5G System" (section 5.18)
  - TS 23.502 "Procedures for the 5G System" (modification of handover procedure)

Case study 1 : ITS utilizing URLLC

- Ultra Reliable and Low Latency Communications (URLLC)

- Variety of mobilities capable of autonomous driving
  - To address lack of drivers
  - To support elder people
  - To reduce traffic accidents and traffic congestion

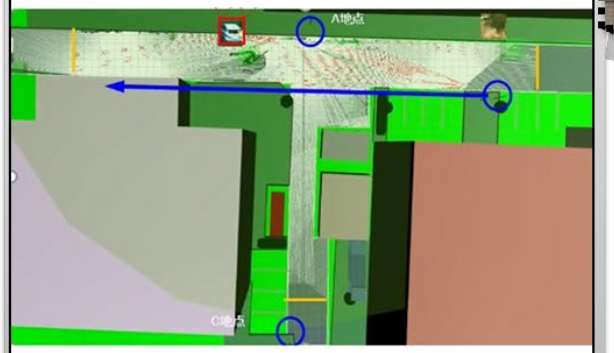


Examples of mobilities

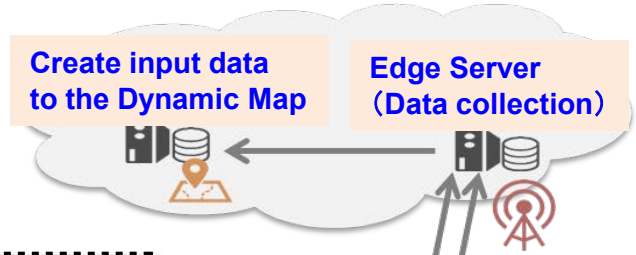
Case study 1 : Traffic E-Mirror

Compress information by extracting characteristics from streaming video taken from camera

Detection of obstacles

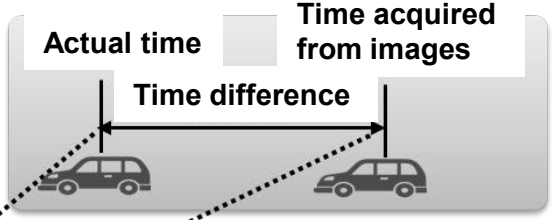


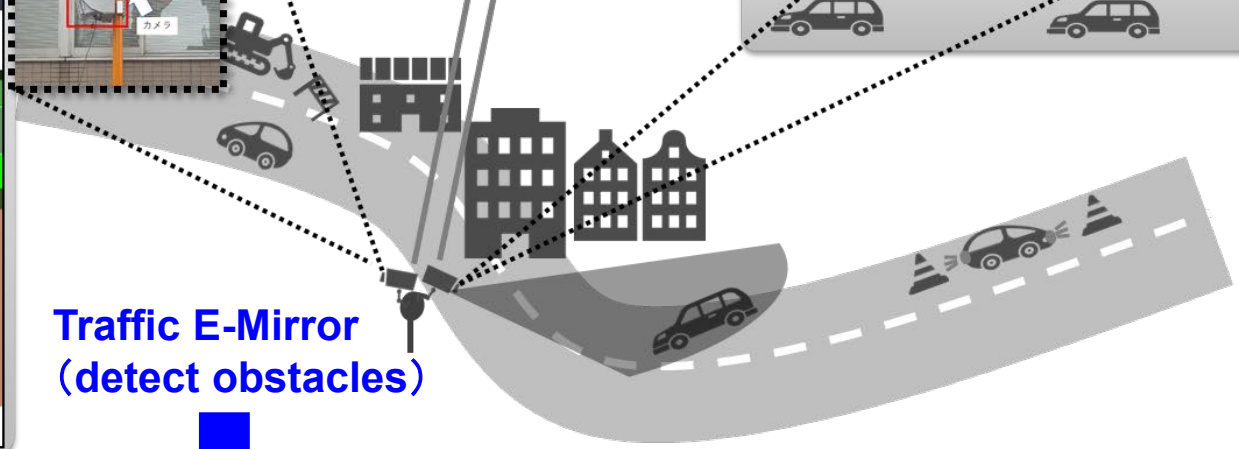
World view of intersection showing movement of obstacles



5G URLLC

Grouping information provided from multiple cameras and sensors by managing using synchronized time stamps

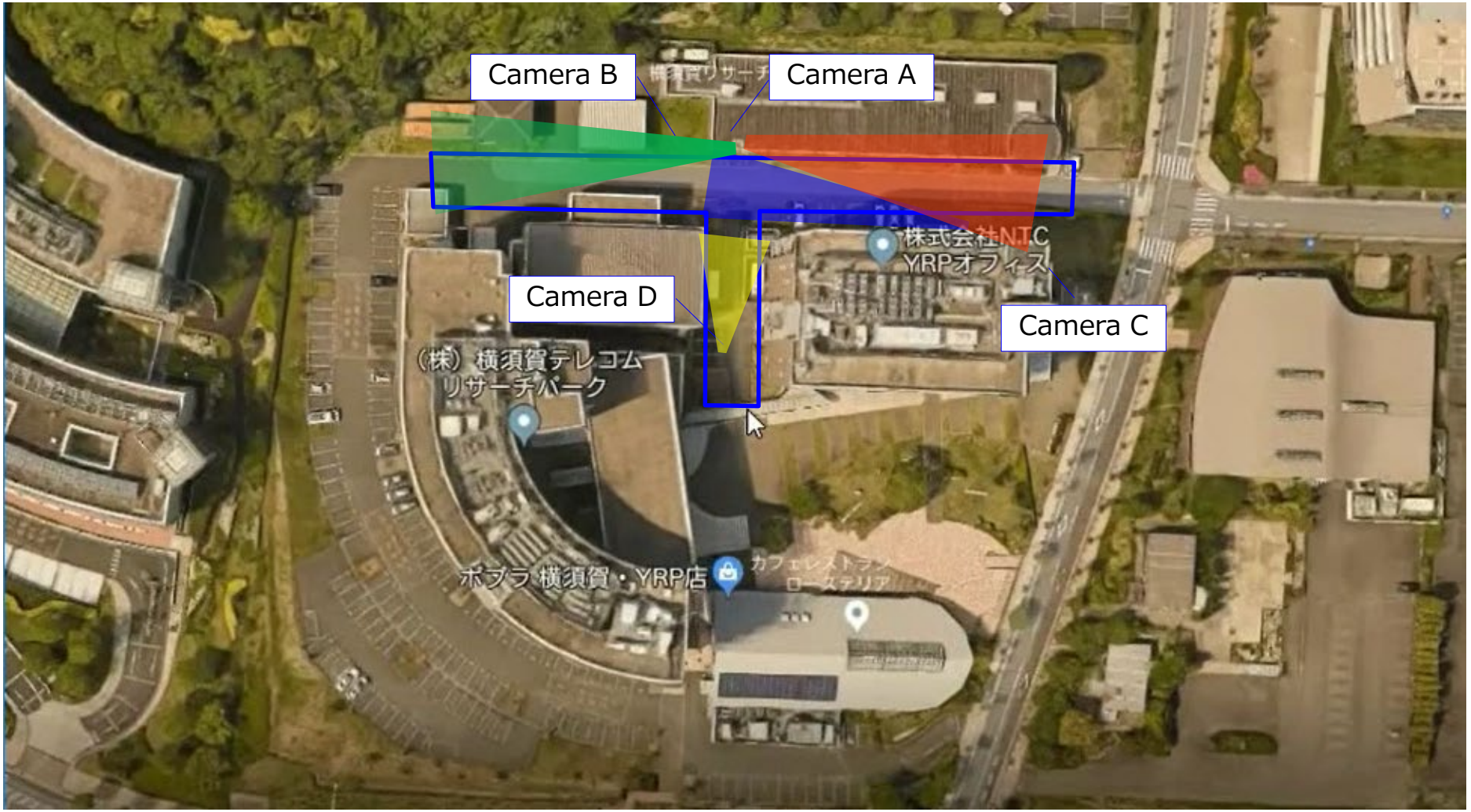




Traffic E-Mirror (detect obstacles)

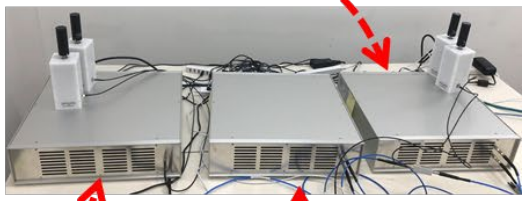
- Secure safety in non-line-of-sight spots such as between buildings and curving roads
- Road sensors including cameras recognize traffic environment in real-time
- Flexible deployment and operation using wireless systems

Case study 1 : Experimental field (Yokosuka, Japan)



Case study 2 : Functional evaluation system

- 5G : 20,000 UEs (Emulation in the air I/F level)
- 4G : 100 UEs (real off-the-shelf devices)



Cloud server

Browsing

2.6GHz

4.6GHz

EPC

5GC

4G eNB

5G (MUSA) eNB (Grant free)

LTE

Massive connections

Massive connections

LTE UEs (100 unites)

UE management PC

Management PC

5G UE (Grant free)

Emulation of massive UEs

Control function

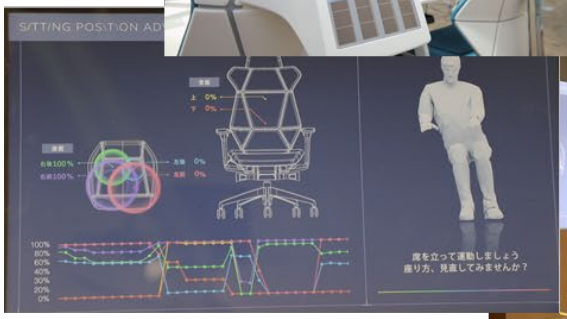
Radio function

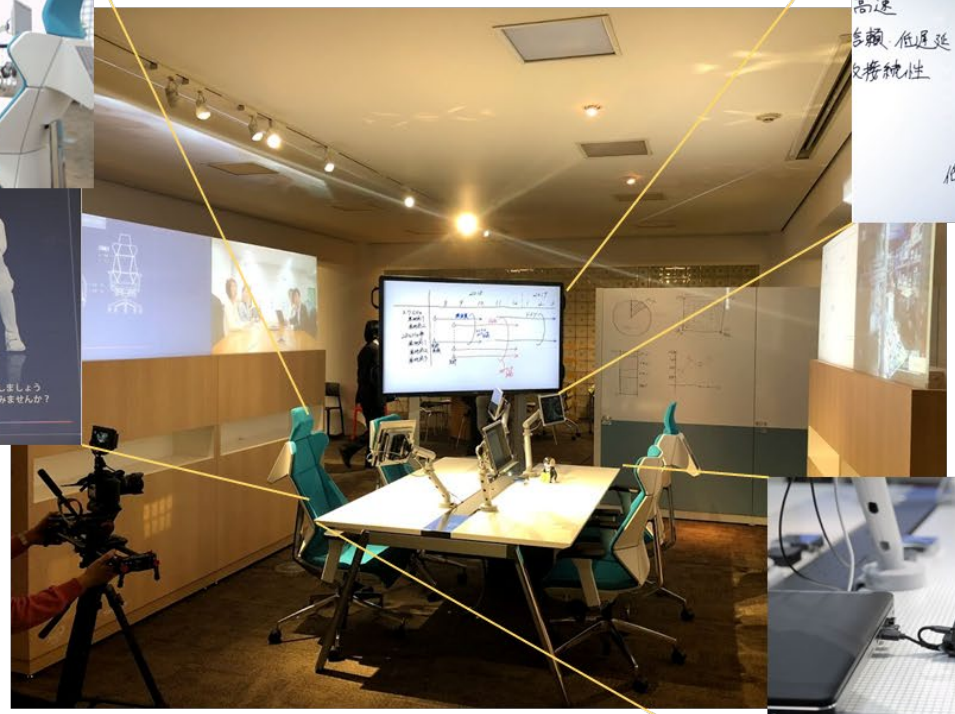
Legacy system (LTE)

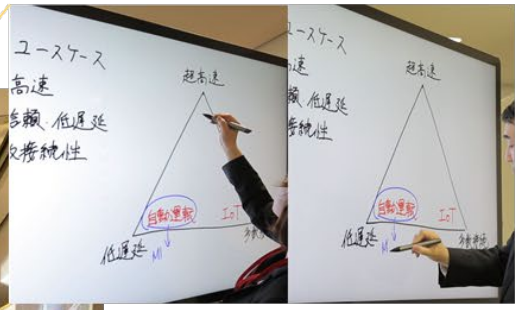
5G (Grant Free): MUSA

NICT National Institute of Information and Communications Technology

Case study 2 : Functions of smart office







mMTC 2.4GHz

Smart chair

Embed sensors for posture detection with high spec solar panel for battery less operation

※ Bluetooth Low Energy (BLE) is used for smart chair instead of standardized 5G system

URLLC 3.7GHz/28GHz

E-Whiteboard

Smooth communications with remote sites by sharing real-time drawings

eMBB 3.7GHz

Smart table

Allows devices just on the table to communicate Hence, enables wireless communications without interference from other tables

※ 5G systems for eMBB and URLLC are emulated with currently standardized specifications adapted for frequency bands assumed for 5G

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