5G System Architecture to realize "Extreme Flexibility"

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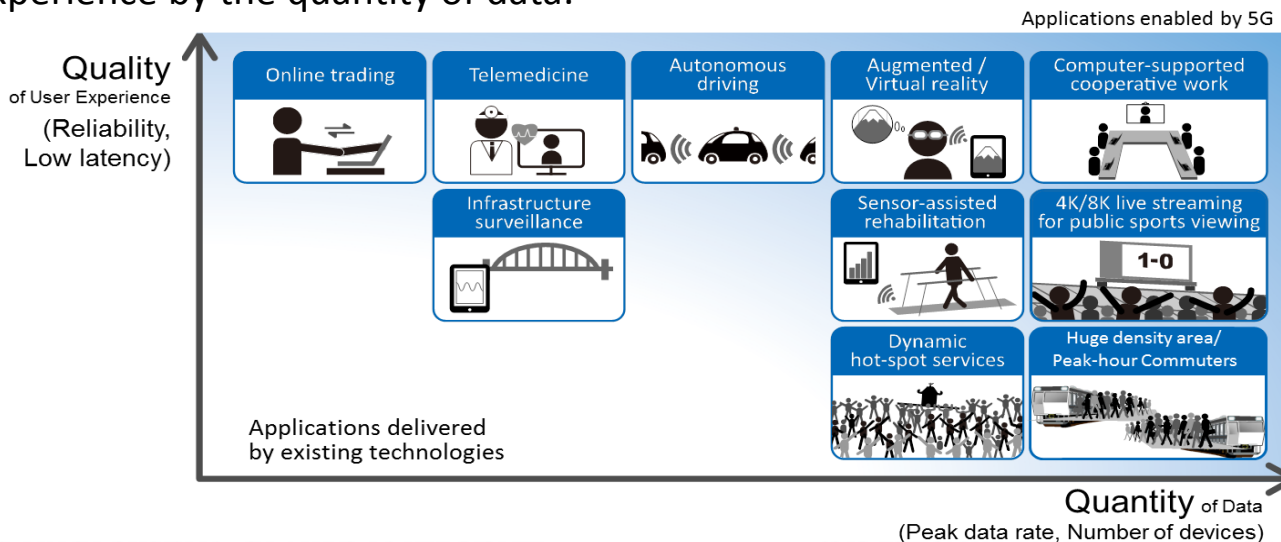# End-to-End Quality in the 5G era

- End-to-end (E2E) quality required by applications and/or users will be far more diversified in the 5G era than what we have seen in the preceding generations.

  For example, the ITU-R Vision recommendation [1] illustrates a number of usage scenarios in which the capabilities required are not identical but diversified depending on the expected E2E quality.

  [1] IMT Vision – "Framework and overall objectives of the future development of IMT for 2020 and beyond", ITU-R, Recommendation M.2083-0, Sep. 2015

- The following figure represents potential 5G applications mapped on a domain of the quality in user experience by the quantity of data.

Applications enabled by 5G

Quality of User Experience (Reliability, Low latency)

- Online trading
- Telemedicine
- Autonomous driving
- Augmented / Virtual reality
- Computer-supported cooperative work
- Infrastructure surveillance
- Sensor-assisted rehabilitation
- 4K/8K live streaming for public sports viewing
- Dynamic hot-spot services
- Huge density area/ Peak-hour Commuters

Applications delivered by existing technologies

Quantity of Data (Peak data rate, Number of devices)

Key Concepts of 5G

■ **Two Key Concepts of 5G**

1. Satisfaction of End-to-End Quality
   - 5G shall provide satisfactory **"End-to-End Quality"** required by any kind of application **anytime, anywhere and any use scenes**.

   - This conceptualization of **"Satisfaction of End-to-End Quality"** is very **different from previous generations** of mobile communication systems, for which best effort delivery was seen as sufficient.

2. Extreme Flexibility
   - 5G networks will be **required to provide "Extreme Flexibility"** In order **to produce this level of End-to-End Quality** for the many services 5G systems will be expected to support.

Key Technologies for Key Concepts

■ Key Technologies Needed to Realize Key Concepts

1. Advanced Heterogeneous Networks
   5G will **not** be made up of **a single network**, rather it will **use advanced heterogeneous networks**, where **5G radio access technologies (RAT), already existing 2G, 3G, LTE, WLAN networks** to **create an integrated system** that can provide support for a variety of services with flexibility.

2. Network Softwarization
   Network Softwarization is an overall transformation trend in this industry.
   With network softwarization, network devices and components can be designed, introduced, maintained and administered with easily updated programmable software as well as ensuring that network devices and components can easily and flexibly be used and maintained.

Advanced Heterogeneous Networks

In addition to 5G Radio Access Technologies (5G RAT), 5G will continue to use already existing 2G, 3G, LTE, WLAN to create an integrated system that can provide support for a variety of services with flexibility.
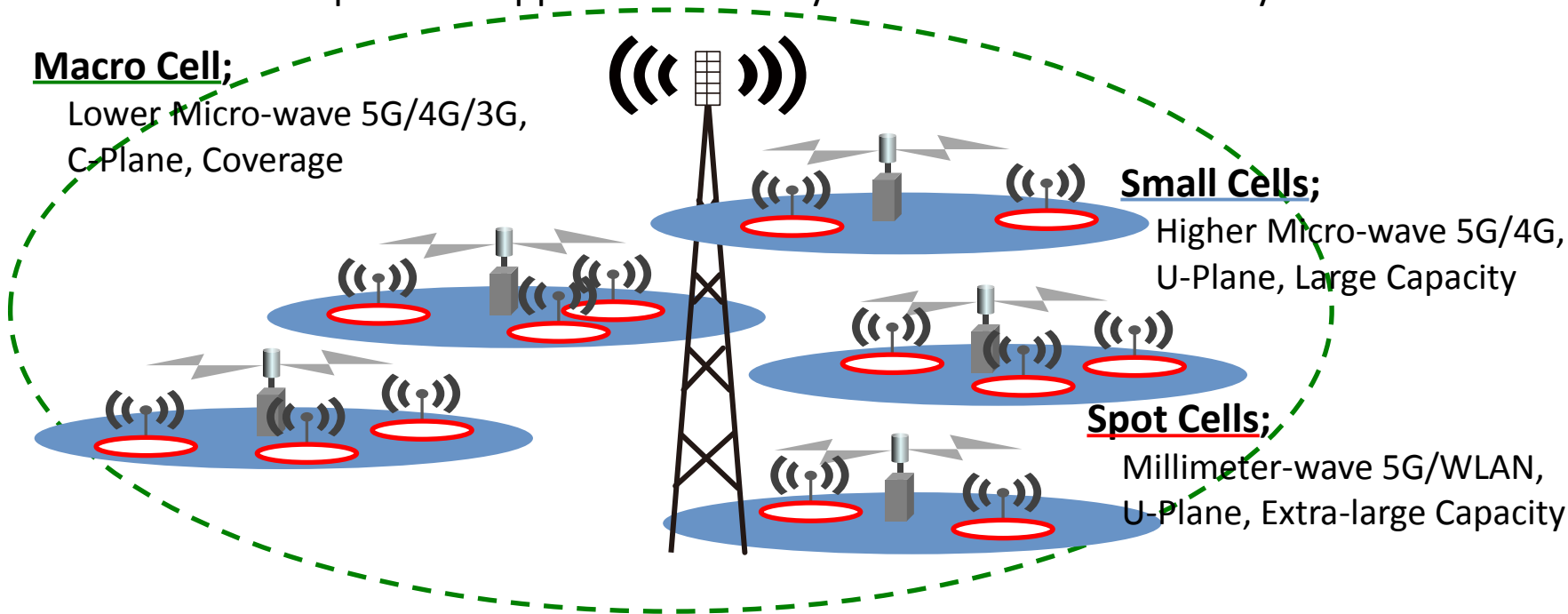
Macro Cell;
Lower Micro-wave 5G/4G/3G, C-Plane, Coverage

Small Cells;
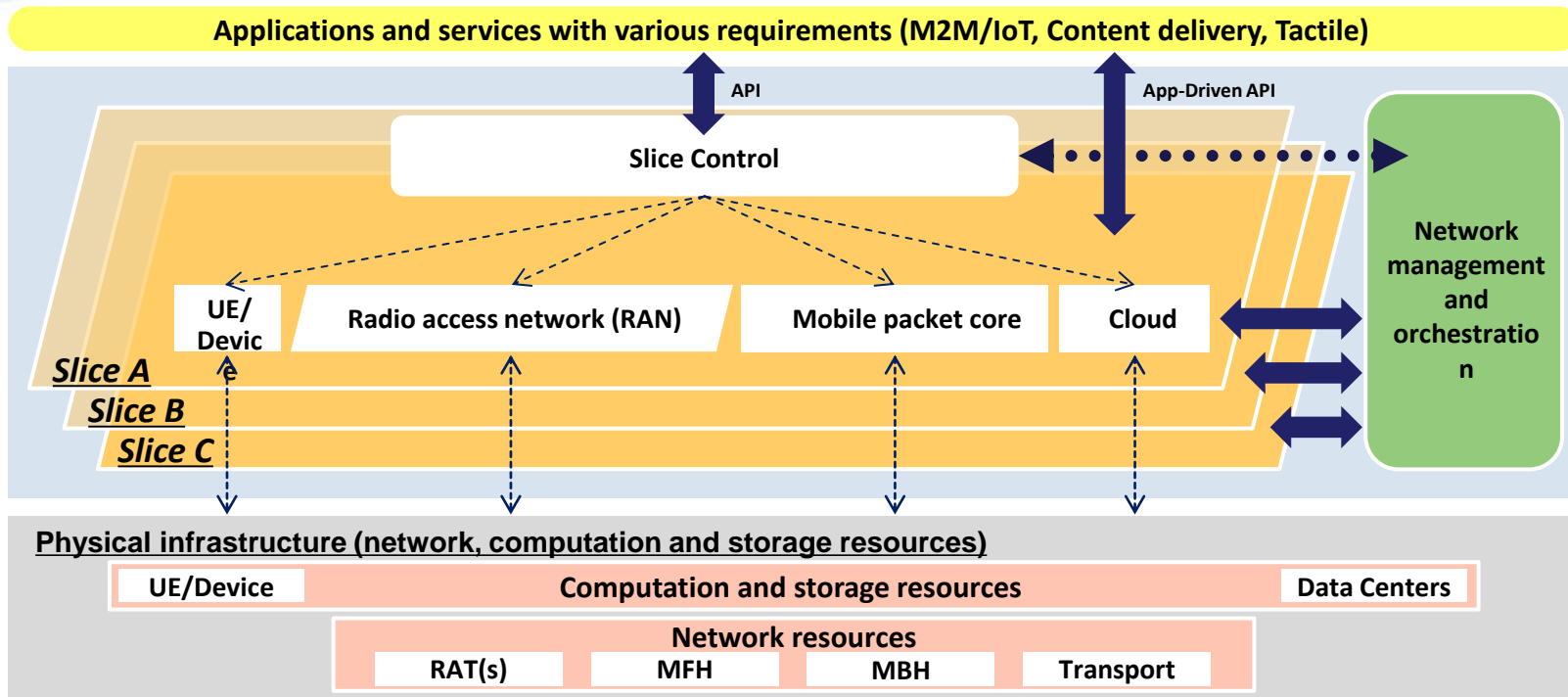Higher Micro-wave 5G/4G, U-Plane, Large Capacity

Spot Cells;
Millimeter-wave 5G/WLAN, U-Plane, Extra-large Capacity

Network Softwarizasion and Slicing

Network softwarization and slicing will allow network devices and components to support a variety of services in a extremely flexible manner.

Optimal data processing method should be selected depending on requirements.

Hierarchical structure of data processing in 5G

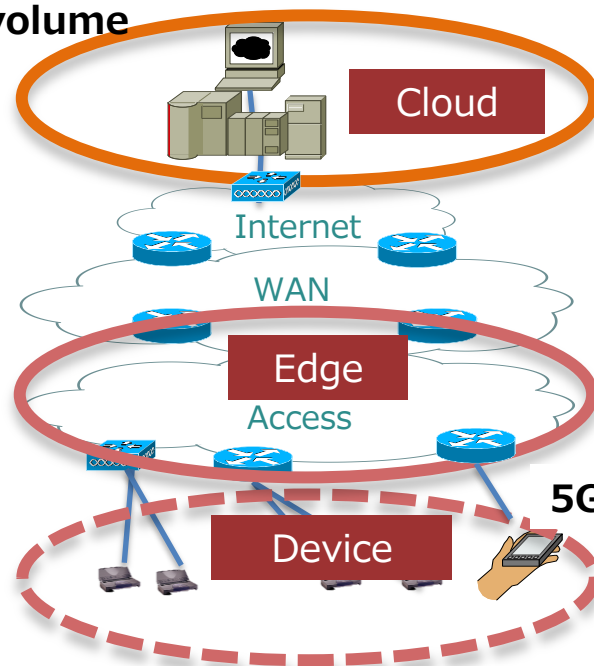**Tier 1: Cloud Computing**
Totally optimized, Concentrated, Integrated

Tier 2: Edge Computing
Partially optimized, Distributed, Cooperative
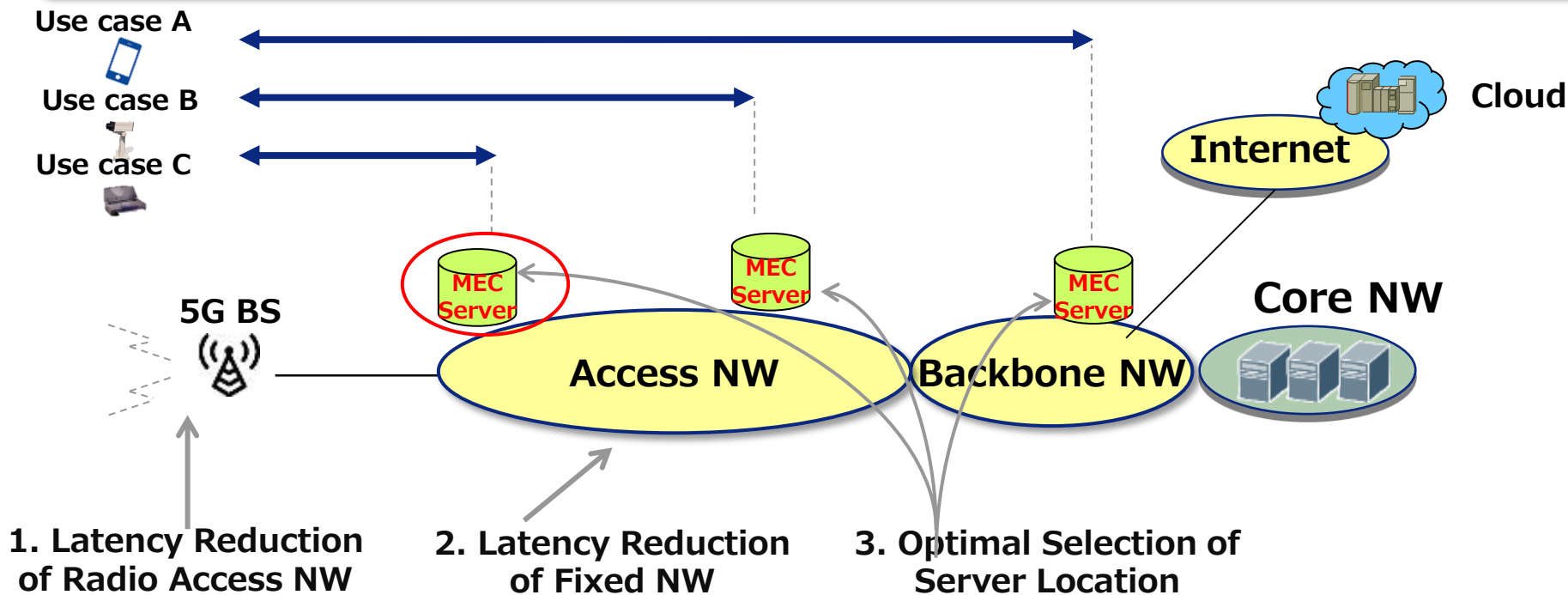
Tier 3: D2D
Locally optimized, Autonomous

Complexity, Data volume

Cloud
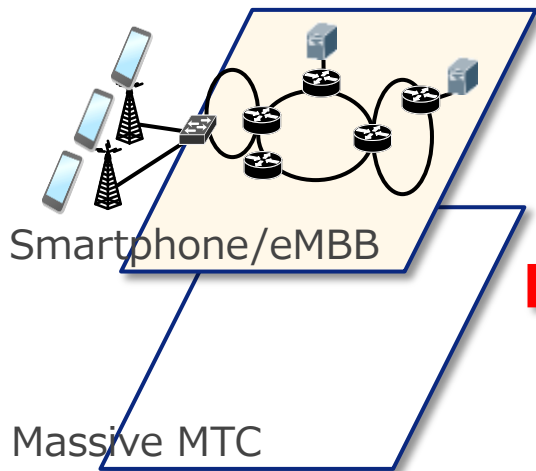
Internet

WAN

Edge

Access

5G Access

Device

Real timeliness

In order to meet low latency requirements, combined solution including selection of server location, latency reduction in RAN and Fixed NW should be sought.
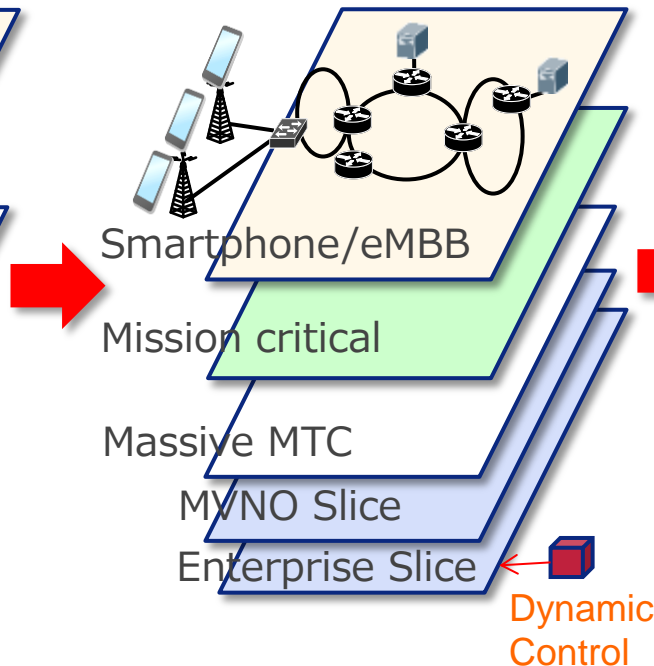

Use case A

Use case B

Use case C

Cloud

Internet

5G BS

MEC Server

MEC Server

MEC Server

Access NW

Backbone NW

Core NW

1. Latency Reduction of Radio Access NW

2. Latency Reduction of Fixed NW

3. Optimal Selection of Server Location

From Core NW slice towards dynamic, end-to-end slice.

Core NW Slice	Dynamic Slice	End-to-end slice

Smartphone/eMBB

Massive MTC

Smartphone/eMBB

Mission critical

Massive MTC

MVNO Slice

Enterprise Slice

Dynamic Control

Smartphone/eMBB

Mission critical

Massive MTC

MVNO Slice

Enterprise Slice

Dynamic Control

Designing The Future
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