Co-creating 5G Solutions and Technical Challenges

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Profile

YANAHIRA, Yoshinori

2010 Joined DOCOMO as Network Engineer

Since Joining Network planning, network quality analyzing/optimization, and mobile network O&M

More than 5 years Instructor of training programs on routing, switching and SDN

2019 Senior Network Consultant, providing consultancy to peer operator to achieve DOCOMO-standard NW quality

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Agenda

1 Introduction ~ about NTT DOCOMO

2 Evolution from LTE to 5G

3 5G Key technologies

4 5G Use Case : VR, Festival Broadcast

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Introduction

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About NTT DOCOMO

- Japan's largest mobile carrier, serving more than 78 million customers.
- Nationwide LTE network and one of the world's most progressive LTE-Advanced networks.
- Contributing to international standardization activities toward 5G as an effort in providing comfortable, safe and secure mobile network and services.

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Evolution to 5G

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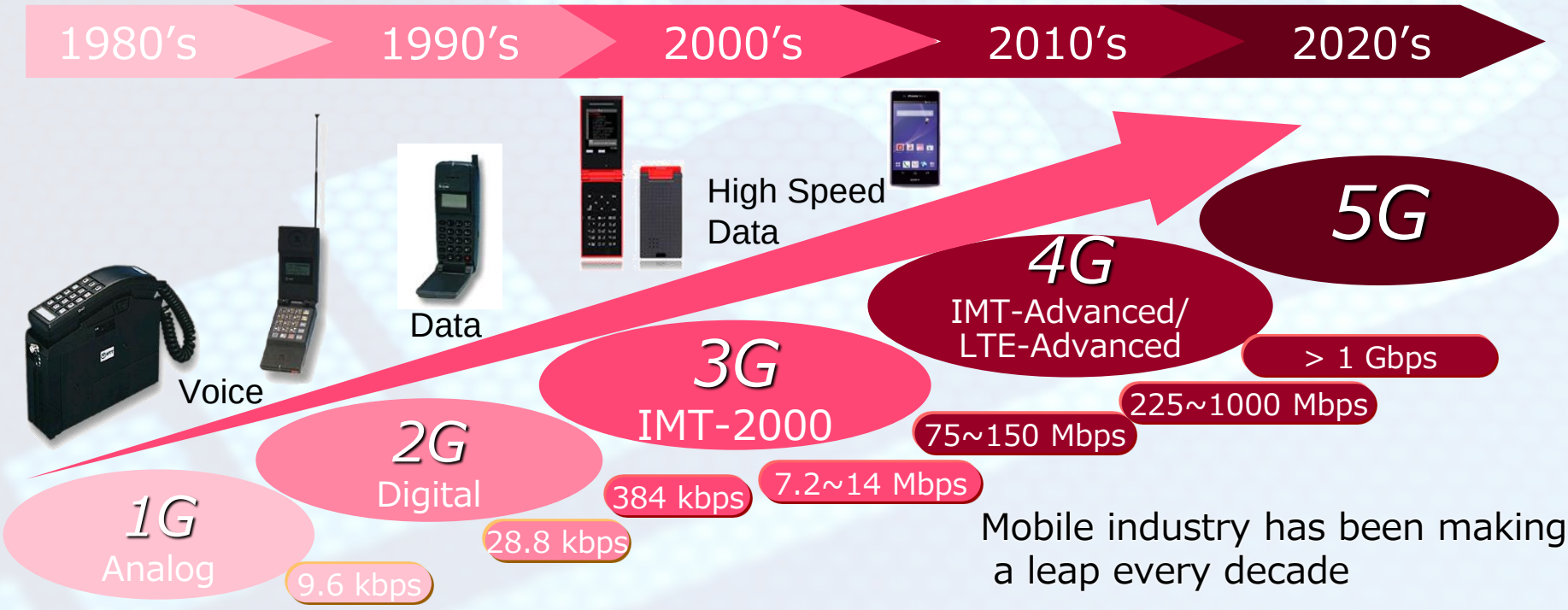
Evolution to 5G ~ Mobile Cellular Technology

- Steady evolution towards higher capacity and data rates.
- Evolution occurs every 10 years for radio access.
- Shifting from technology driven to solution driven evolution.



Mobile industry has been making a leap every decade

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Significance of Launching 5G

Creation of new values

Solving social issues

Fundamental Improvement of UI/UX	Creation of Innovative services	Enhancement of productivity

Digital Transformation

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Co-creating New Services of 5G Era with Partners

- Expanding value co-creation activities with partners to cultivate new use cases and potential commercial services for 5G.

»5G DOCOMO 5G Open Partner Program

- Participation in partner workshops
- Provision of 5G Technical verification environment
- Provision of latest 5G information

More than 2800* Participation from company and organization

docomo 5G Trial Site

5G Trial Site

5G×SPORTS
AR・multi-view

5G×GAME
VR game・VR Watch

Collaboration with 147 companies to create new service

5G new commercial service

*As per June 2019

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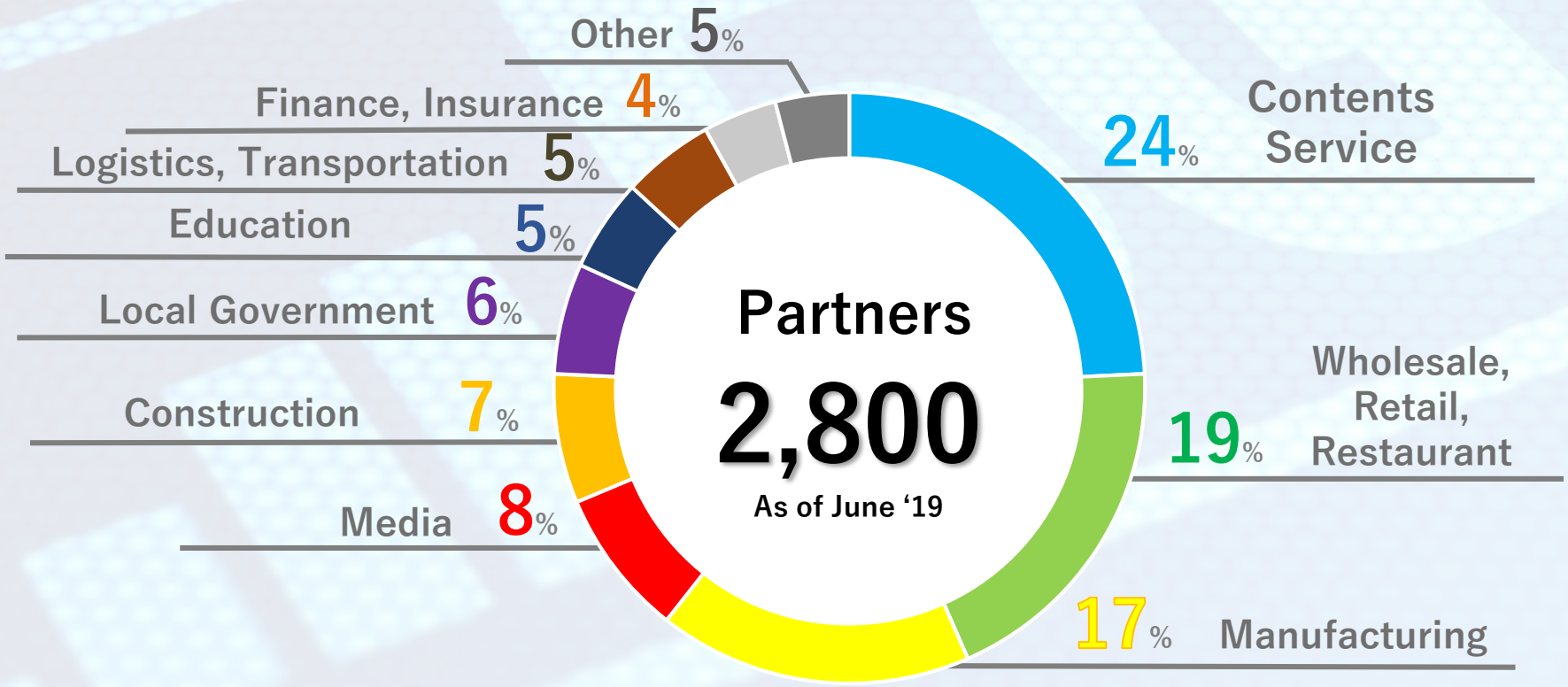
DOCOMO Open Partner Program

- Industry-wide partners gather together.
- DOCOMO co-create solutions to lead digital transformation together with increasing number of partners.



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Frequent Partner Communications

- Providing detailed key tech features to help understanding the facts.
- Set up industry wide meet ups for match making.
- Create touch point to experience 5G and open up innovative cloud PF

Info Sharing

- Technical Journal
- 5G White Paper
- Technical Reference

Communication (Matching)

2018

- Feb 21 WS
- May 24 WS (AR/VR)
- Sep 6 WS (Industrial reform/ creation)

5G Experience

Docomo 5G Open Lab®

- Tokyo
- Osaka
- Okinawa
- Guam

Docomo 5G Open Innovation Cloud®

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5G Key Technologies

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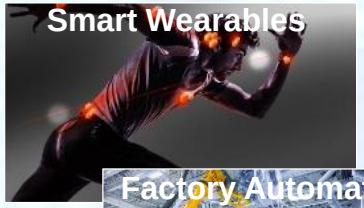
Use cases and 5G characteristics

High speed/large capacity

Peak rate **20Gbps**

eMBB



5G

URLLC

mMTC

Low latency

Transmission latency of radio access

1ms or less

Massive device access

Number of simultaneous access

10^6 devices/km^2

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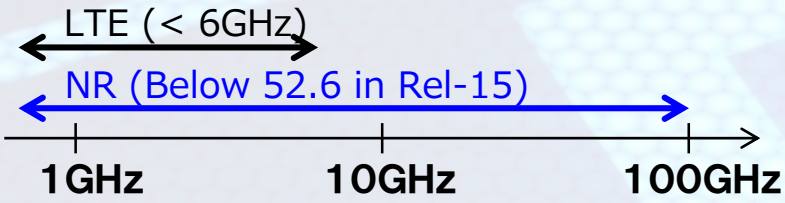
5G Key Technologies: New Radio wireless technologies

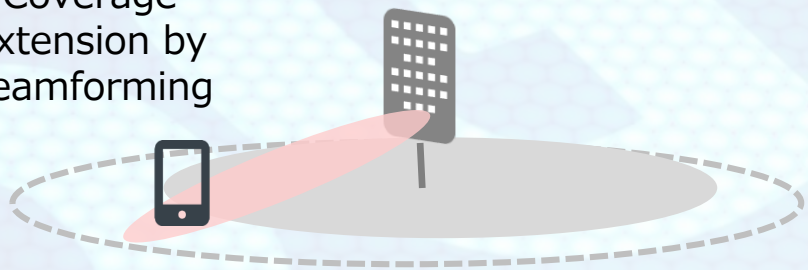
- New technologies to achieve high capacity, high data rates and low latency.

Wider Frequency Range



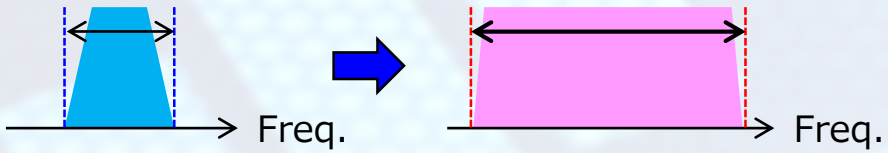
Massive MIMO

Coverage extension by beamforming

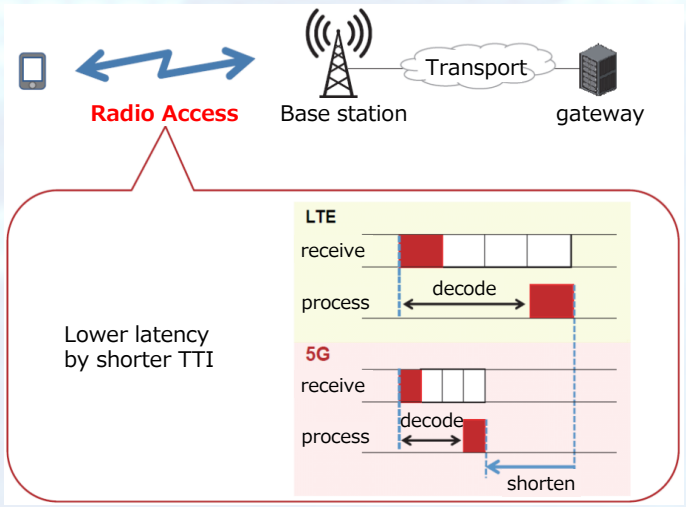


Wider Operating Bandwidth

LTE (Max. 20 MHz) NR (Max. 400 MHz)



Short TTI



TTI : Transmission Time Interval

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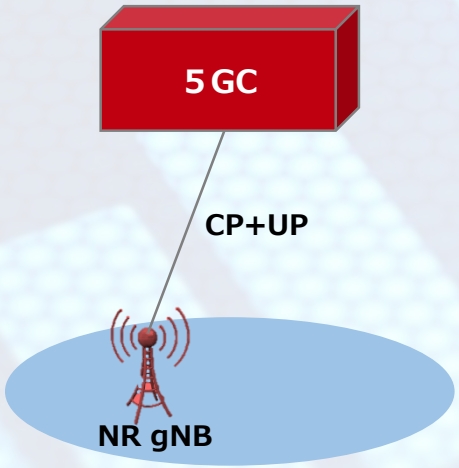
5G Key Technologies: NR Network Architecture

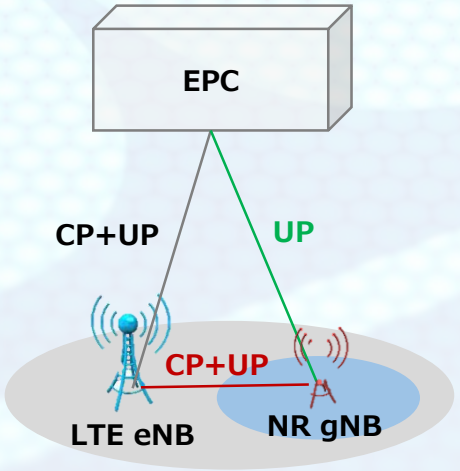
- Several network architecture options were defined in the standards.
- NSA and SA are two of the main options.

Stand Alone (Option 2)



NR gNB is connected to 5G CN

Non-Standalone (Option 3x)



NR gNB is connected to Enhanced EPC

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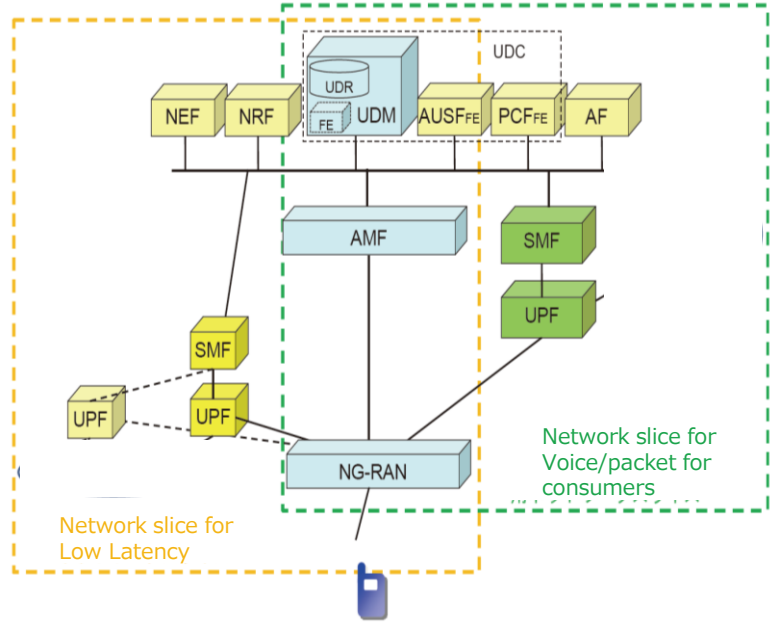
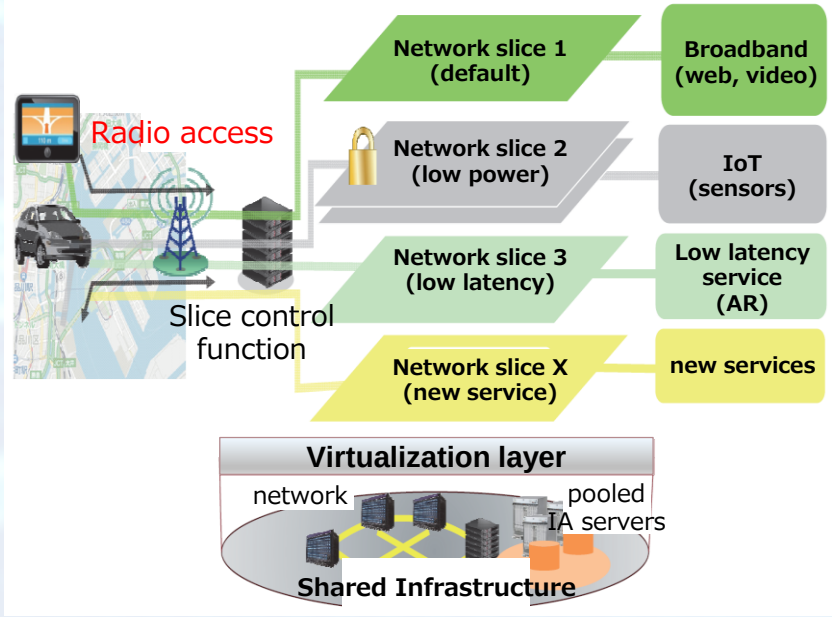
5G Key Technologies: 5G Core Network

- Separation of Control plane and User plane logical entity, made possible by re-usable Micro-services.
- 5GC supports network slicing which one UE can connect multiple network slices.

5GC Architecture



Network slicing



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5G Use Case: VR

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Expectations for VR

- VR is no longer pure entertainment. It is an enabler for creating a new business chances in 5G era.

Sports/ Music Live Entertainment

Sightseeing / Live Camera

Fitness
Rehabilitatation

Real Estate / Wedding/ Car Sales

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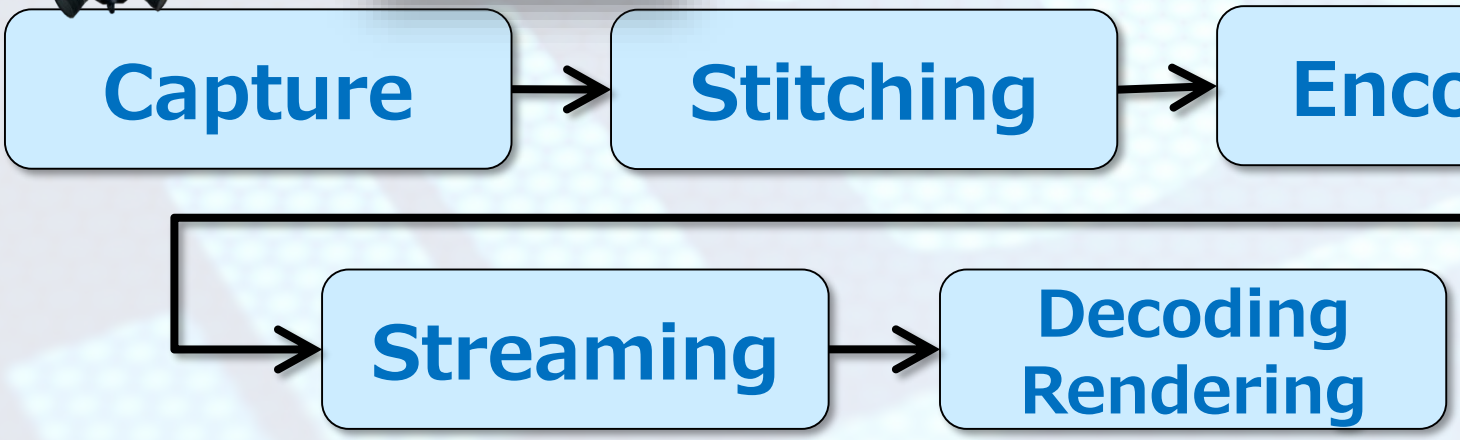
Requirements for VR

- 360 8K 60fps VR system is required for outstanding immersive experience.
- Back-to-back control and management from camera to HMD is the key to improve service quality.



System architecture of VR Live System

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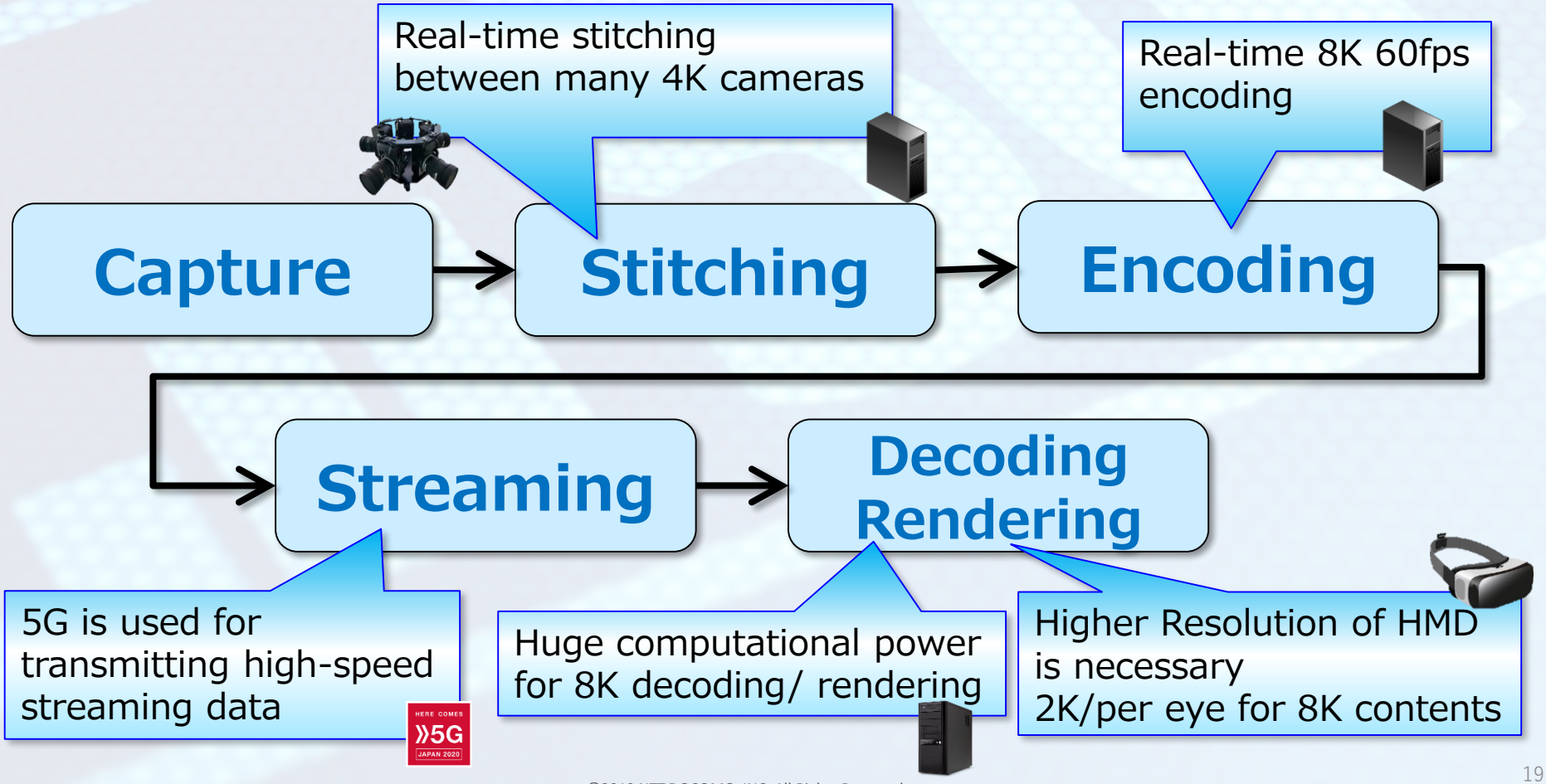
Challenges on 360 8K 60fps Live Streaming

- Identified challenges in each processing step.
- Improvement in each steps is a must in order to provide good service quality.



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360 8K 60fps 3D VR Live Streaming System

- NTTDOCOMO in-house development of most of the equipment necessary for the VR Live Streaming System.

8K 30fps 2D

4 K camera (Panasonic GH5S) x 5

Real-time Stitching*

Real-time 8K Encoder*

Distribution Server

Panorama “Cho” Engine Encoder*

VivePro+ **Windows player Application***

Android player application

Multi-projector (TBD)

8K 60fps 3D

3D Camera*

64ch mic （ViReal）

*** Developed by DOCOMO**

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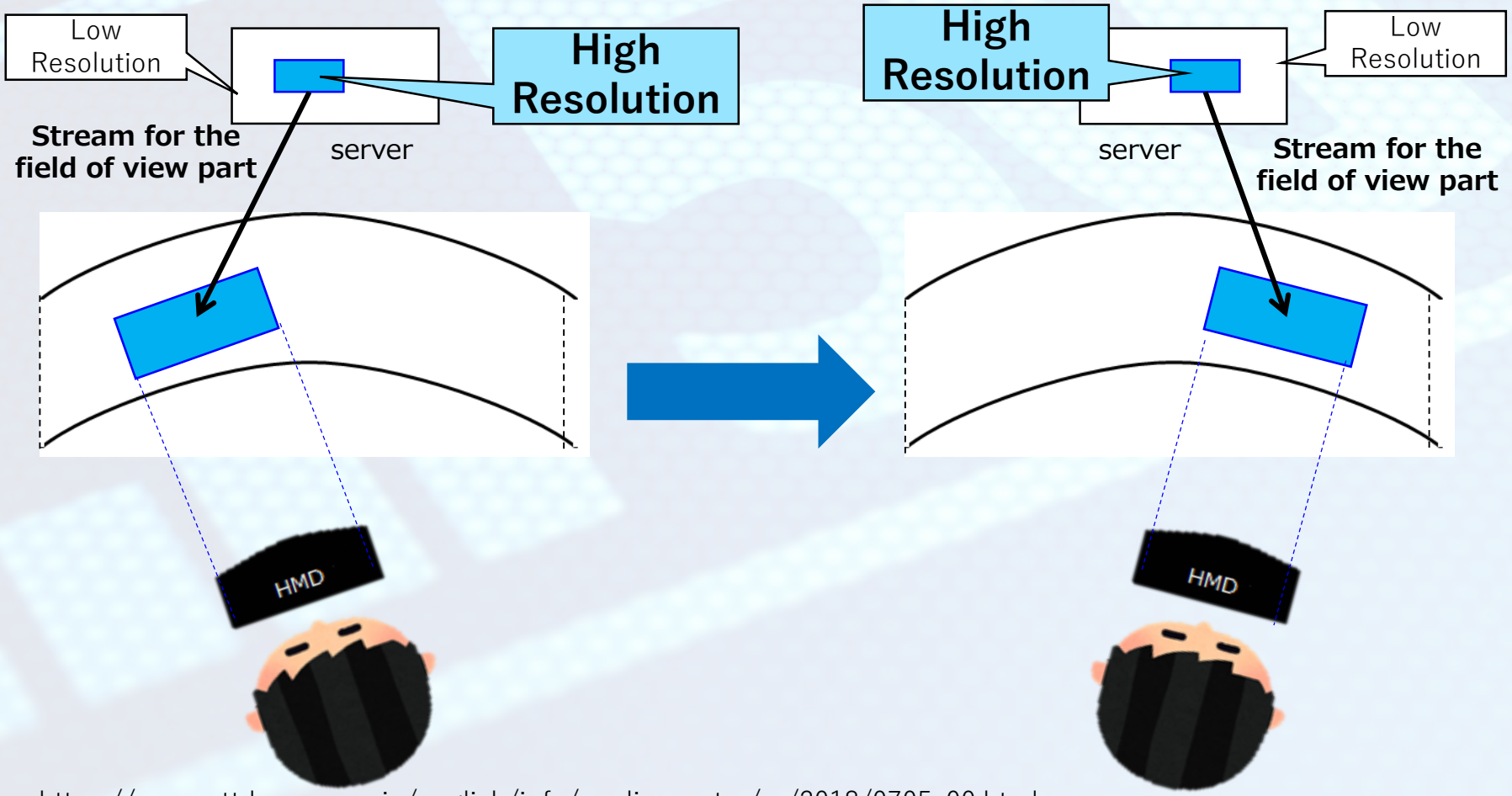
Panorama Video Streaming by Panorama "Cho" Engine™

- Transmit high resolution data stream for the field of view part, low resolution data stream for the other part, to reduce data rates.
- Dynamic of high resolution transmission for the field of view part taking into account the user bearing.



https://www.nttdocomo.co.jp/english/info/media_center/pr/2018/0705_00.html

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Video :
Niigata SOH-ODORI
(Dance festival)

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Summary

- **5G's Evolution: shift from technology-driven to solution-driven**
- **For VR live streaming system, E2E management/improvement is the key**
  - **High-efficient Panorama "Cho" Engine™ Encoder to maximum the user experience**
  - **Demo video of 360 8K VR live system**

We will continue cultivating the 5G transmission techniques to maximize the QoE with partners. And continually striving to drive digital transformation with 5G/AI.

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