5G for eHealth
- 5G Utilization in Telemedicine -

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Introduction

5G Features

High speed/large capacity

- Peak rate: Over 20Gbps *

AR/VR

4K/8K streaming

Stadium solution

Autonomous driving

5G

Smart city, smart home

Low latency

Transmission latency in Radio Access Network (RAN): 1ms or less *

Medical/Health care

Agriculture

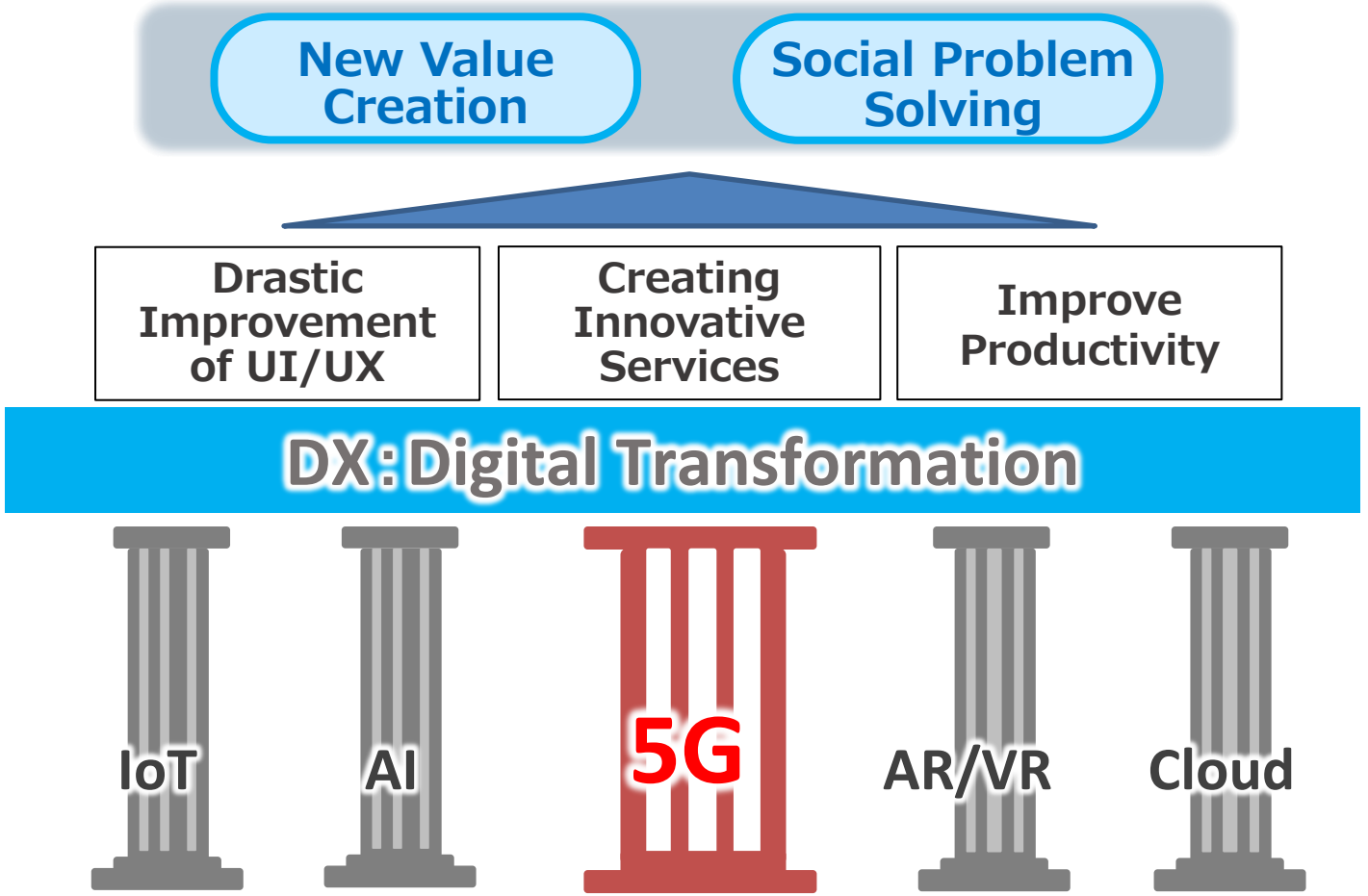
Massive device connectivity

No. of simultaneously connected devices: 10^6 devices / km^2 *

* Target requirement indicated in ITU-R M.2083-0

Significance of 5G Introduction

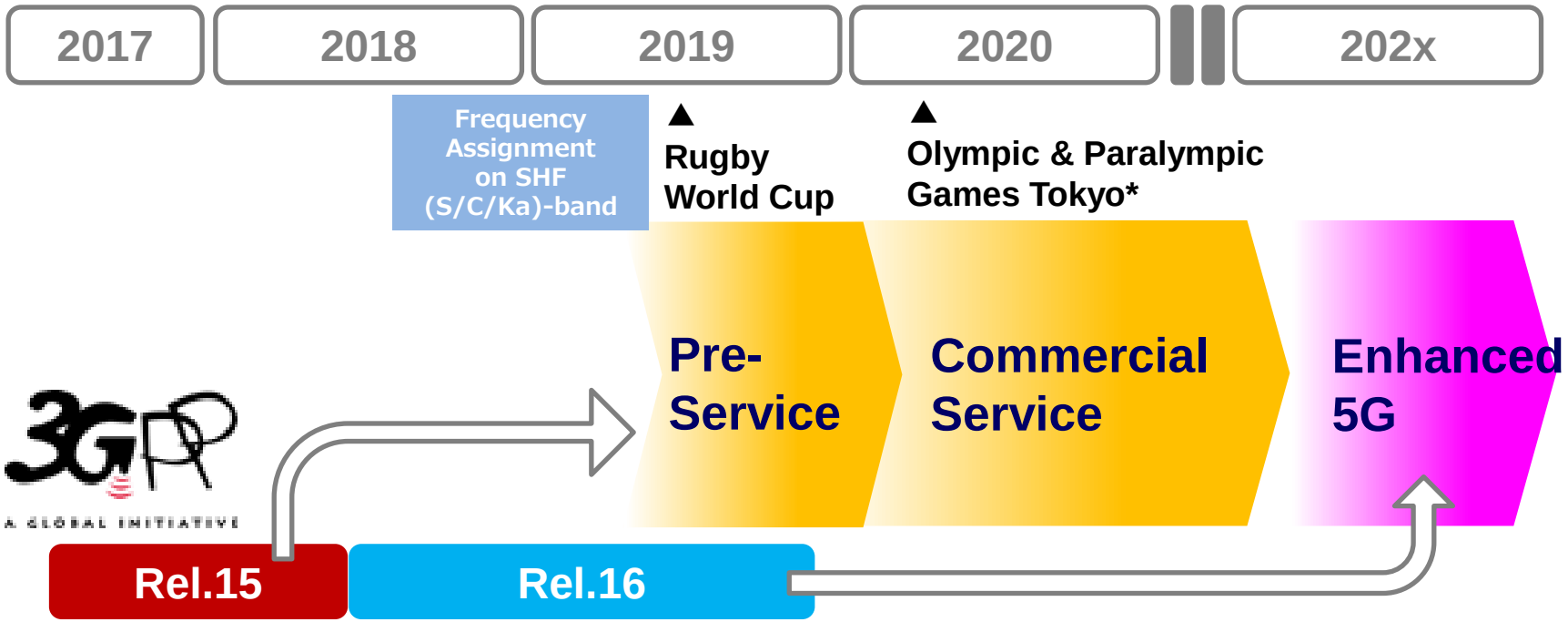
Promote “5G” as a pillar of digital transformation



5G Launch Schedule Assumed by NTT DOCOMO

Sept. 20th, 2019: Started ”Preliminary Service”

Spring, 2020: Starting “Commercial Service”



* NTT Group is a Gold Partner (Telecommunications Services) of Tokyo 2020 Olympic and Paralympic Games.

Field Trials on New Services by 5G

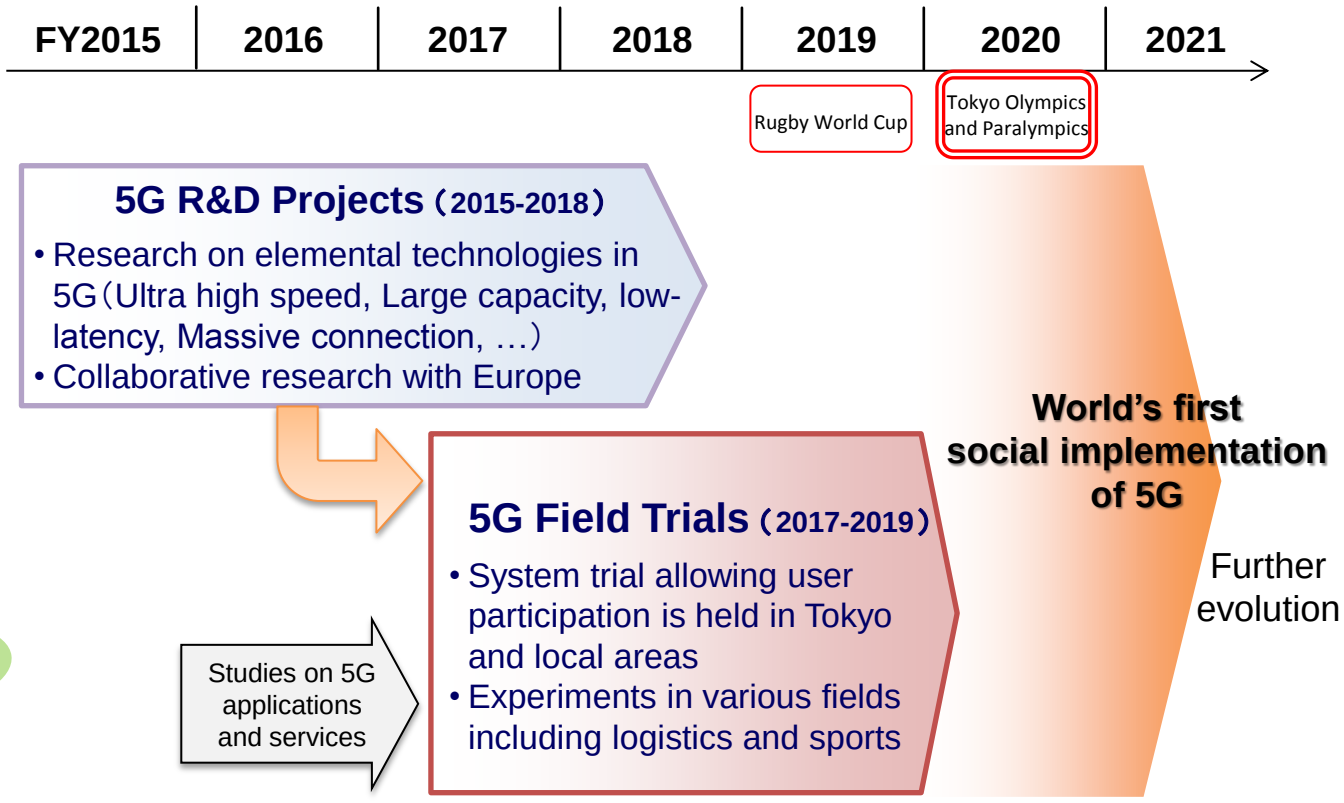
Japanese MIC's Projects toward 5G Realization

- **5G R&D projects on elemental technologies in 5G such as ultra high speed, large system capacity, low-latency, massive connection were led by MIC for 4 years**
- **5G field trials with 3 years have been held in all over Japan on various application-specific fields for social implementation of 5G**

Examples of 5G Field Trial

Outdoor experiment in open square with many people

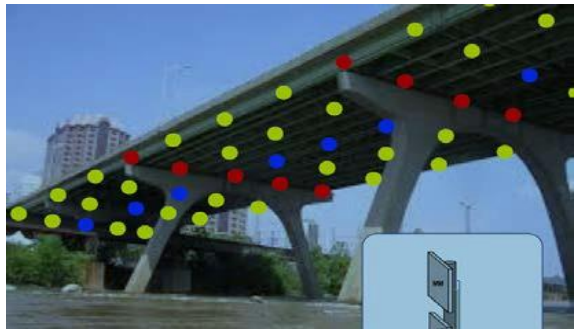
Coverage verification experiment in large site and outdoor driving experiment



Overview of 5G Field Trials in FY2018

massive Machine Type Communications (mMTC)

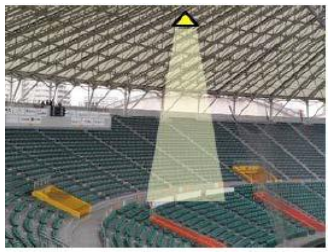
(Stock management)



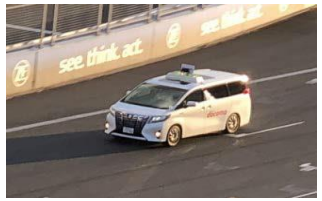
(Bridge inspection)

enhanced Mobile Broad Band (eMBB)

(Multi-transmission of 8K video)



(Sports)



(Transmission to car/train@over 60mph)

Ultra-Reliable Low Latency Communications (URLLC)

(Remote machinery control)

(Telemedicine)

(Truck platooning)

	Technology	Responsible Organization	Main Partners	Trial Overview	Main Trial Locations
G-I	**eMBB**	NTT DOCOMO	• TOBU TOWER SKYTREE • ALSOK (Security) • Fukui Pref. • Wakayama Pref. • Aizu-Wakamatsu City	• **AR/VR content** • **Monitoring and Security** • **Medical Services**	• Kyoto • Gunma • Tokushima • Wakayama
G-II	**eMBB**	NTT Communications	• Tobu Railway • West Japan Railway Company • Infocity (Contents Company)	• **Transport (High speed railway)**	• Ibaraki • Tokyo
G-IV	**eMBB**	ATR (Research Corporation)	• Kyushu Institute of Tech. • Keikyu Railways • Waseda Univ. • Maehara elementary school	• **Smart factory** • **Station** • **School education**	• Fukuoka • Haneda Airport International Terminal Station
G-V	**URLLC**	Softbank	• Advanced Smart Mobility Corp.	• **Transport** • **Car remote control**	• Yamaguchi • Shizuoka
G-III	**URLLC** × **eMBB**	KDDI	• Obayashi Corp. (Construction) • NEC (Appliance manufacturer) • The Univ. of Tokyo.	• **Remote Construction** • **Drone surveillance**	• Osaka • Nagano • Hiroshima
G-VI	**mMTC**	Wireless City Planning	• Pacific Consultants (Construction consultant) • NICT (National Institute) • Higashihiroshima City	• **Smart highway** • **Smart office**	• Aichi • Hiroshima

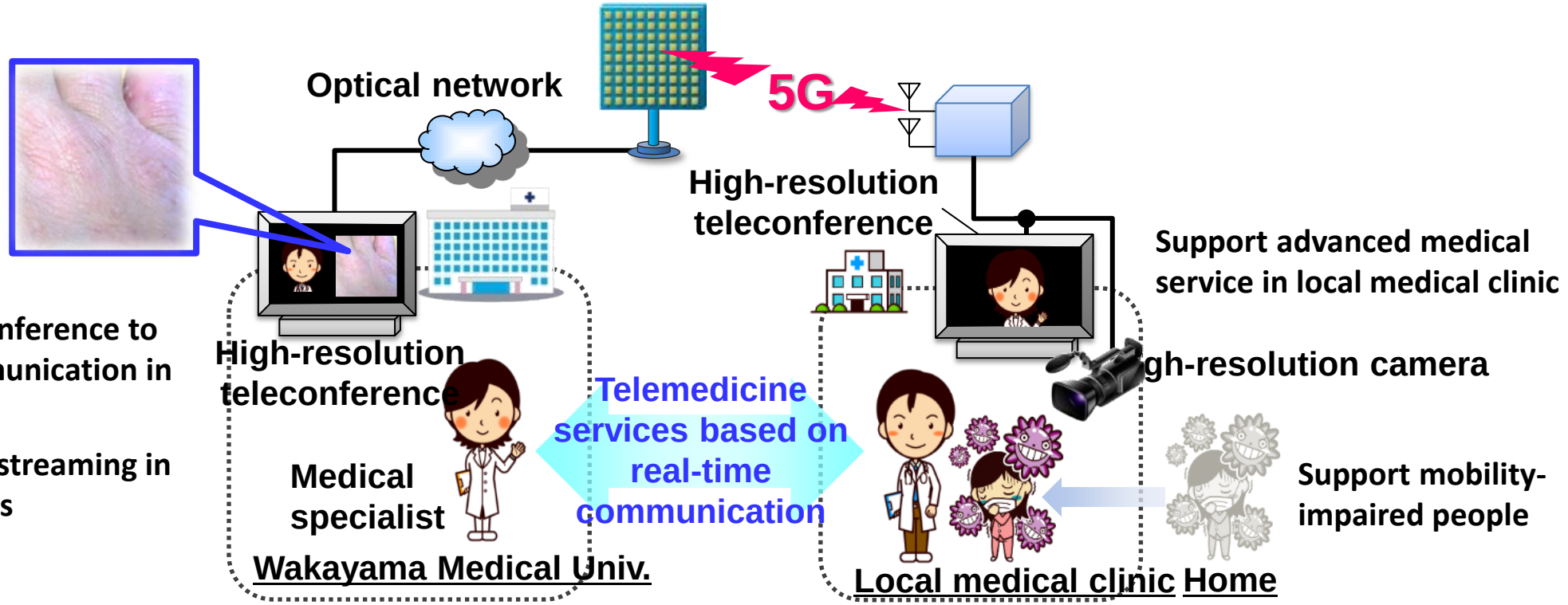
5G Field Trials on New Applications in Medical Field

From 2017, the system trials in the area of telemedicine using 5G was planned and started by Wakayama Prefecture, Wakayama Medical University and NTT DOCOMO.

System Demonstration

5G Field Trials on New Applications in Medical Field

In FY2017, first field trials on the advancement of telemedicine services using high-definition video transmission using ultra-high-speed communication of the fifth generation mobile communications system (5G) was conducted to provide advanced medical care of urban general hospitals in mountainous and depopulated areas.

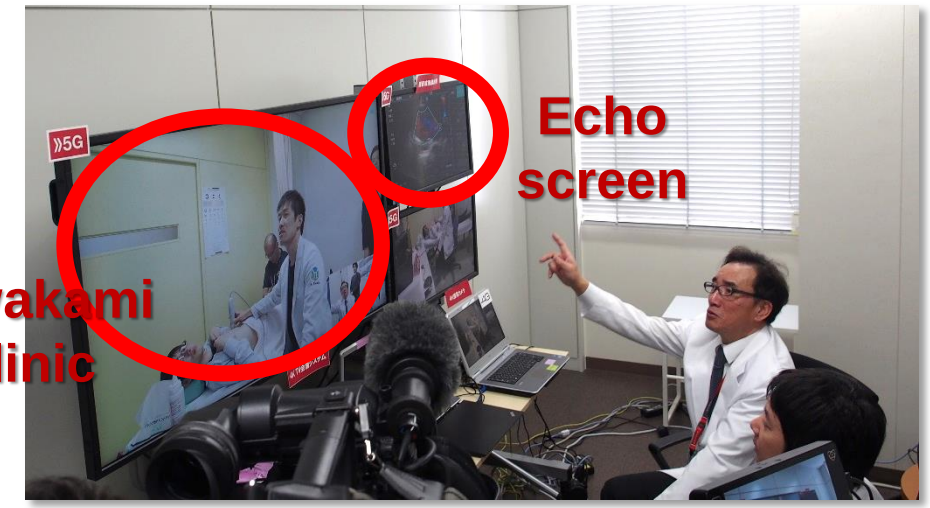


- High-resolution teleconference to support smooth communication in doctor's interview
- High-resolution video streaming in precise injury diagnosis

FY2017 5G Telemedicine Field Trials

Actual field trials of remote medical care were conducted using 5G & Optical link between Medical University and Hidakagawa National Health Insurance Kawakami Clinic for about 3 weeks from the end of February 2018

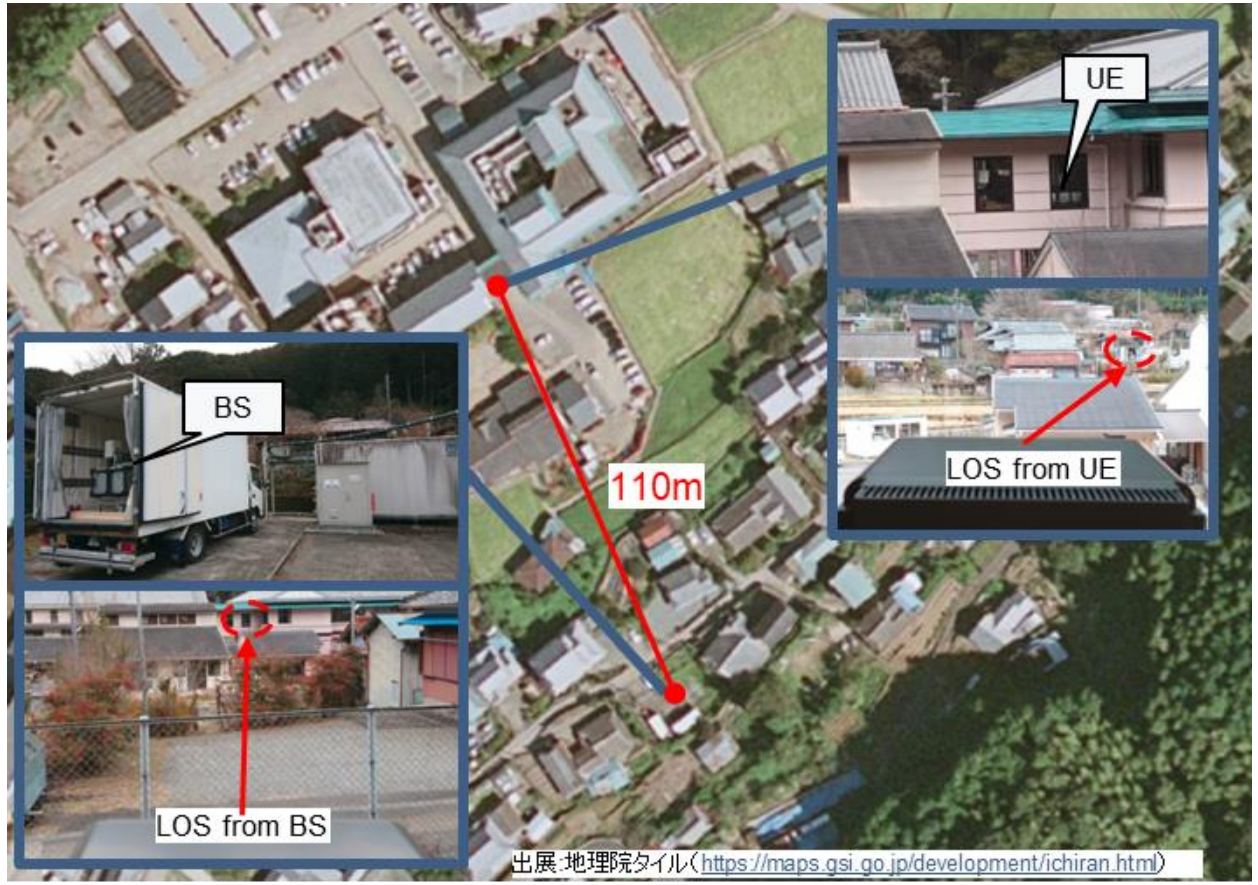
5G Radio Equipment at Clinic



Medical University Remote Outpatient Room

FY2017 5G Telemedicine Field Trials

Field trial environment



Used equipment for telemedicine

4K teleconference system

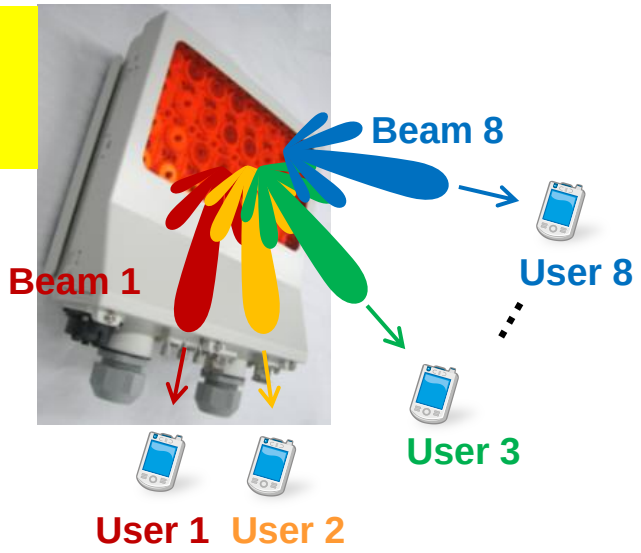
4K close-up camera

Tablet-type ultrasonic image diagnosis (echography)

5G Radio Transmission Equipment

High frequency utilization efficiency and high-speed communication are realized by full digital beam forming technology using a large number of antenna elements.

Active Antenna System for Base Station



Spatial Multiplexing of Maximum 8 users

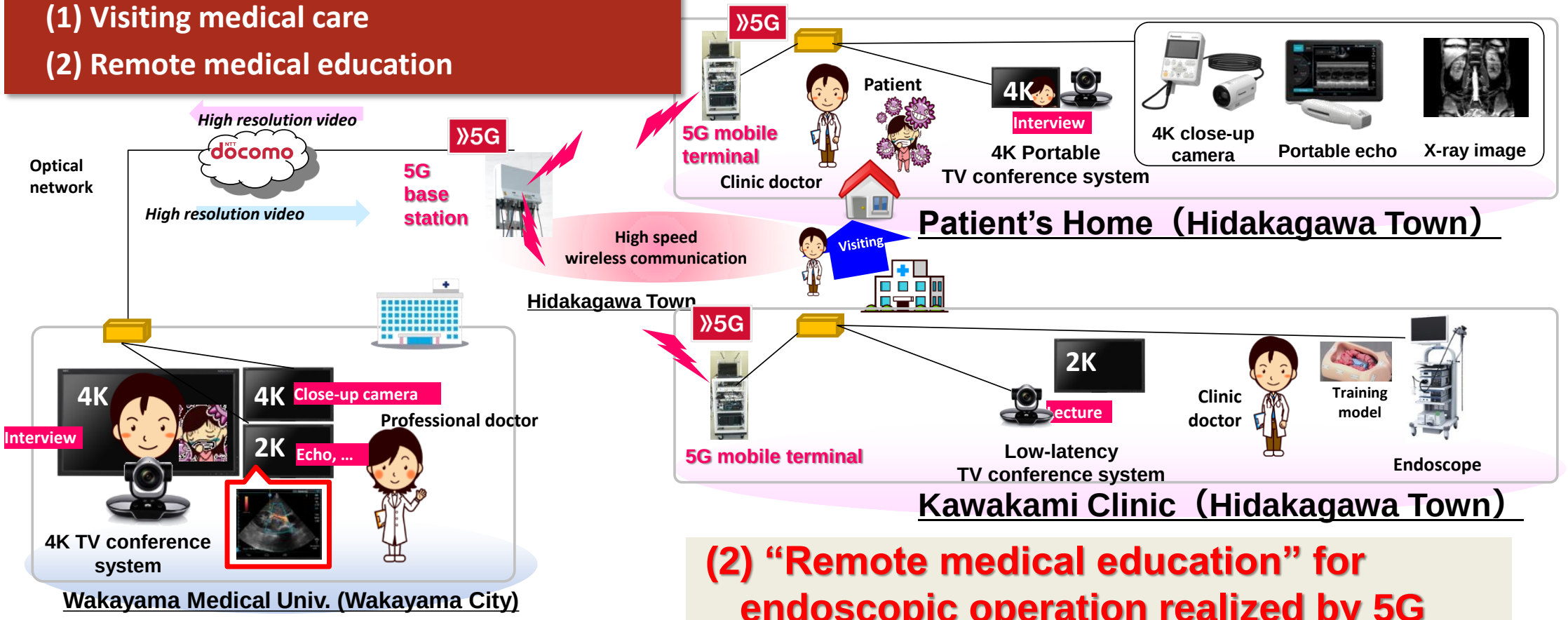
Specification of 5G Radio Transmission Equipment

Frequency	Band width	Anttena elements	Spatial MUX	Maximum throughput
C-band	100MHz	BS : 64 Mobile : 2	BS : 16 Mobile : 2	5.6Gbps

FY2018 5G Telemedicine Field Trials

- C-band 5G area is widely provided
- Field trials of 5G telemedicine for
  (1) Visiting medical care
  (2) Remote medical education

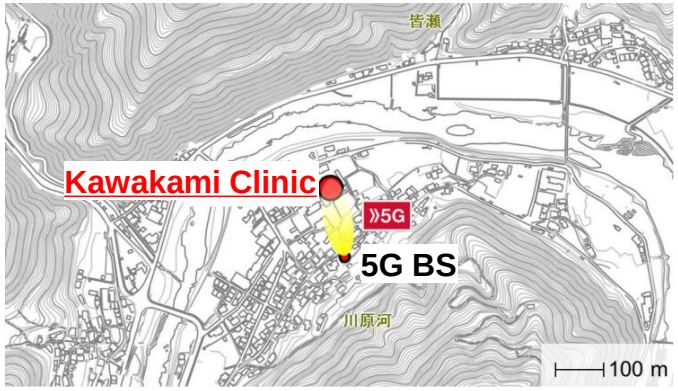
(1) Internal medical treatment for "visiting medical care" realized by 5G



(2) "Remote medical education" for endoscopic operation realized by 5G

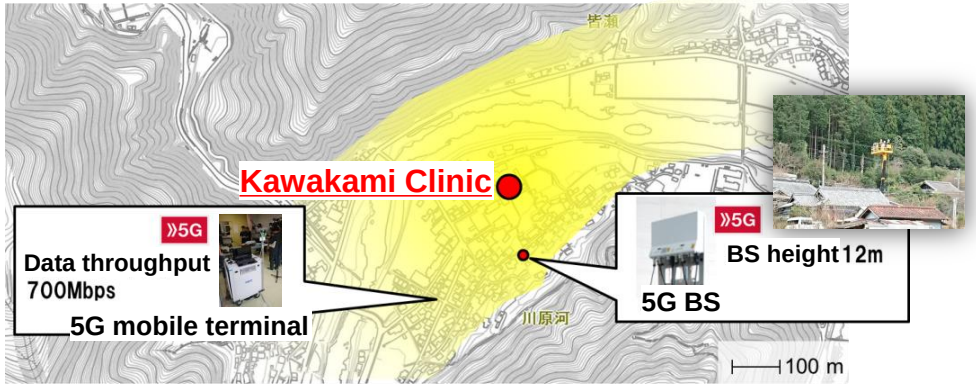
FY2018 5G Telemedicine Field Trials

- **In FY2018, a base station was installed at a height close to realistic station design, and the entire area of Miyama, Hidakagawa, Wakayama Prefecture was covered by 5G communication area**
- **A maximum throughput of 700Mbps was confirmed at the patient's home**



Field Trials Area in 2017

Expand 5G communication area (yellow area) from line to surface



Field Trials Area in 2018

(1) Results of Field Trials on “Visiting Medical Care” with Remote Support

A doctor of a rural clinic visits patient’s home and tries to do medical treatment by sharing “echo” images with a remote medical specialist and by getting help with the specialist

Wakayama Medical University Hospital
Department of Cardiovascular Image Dynamics
Associate Professor Hozumi

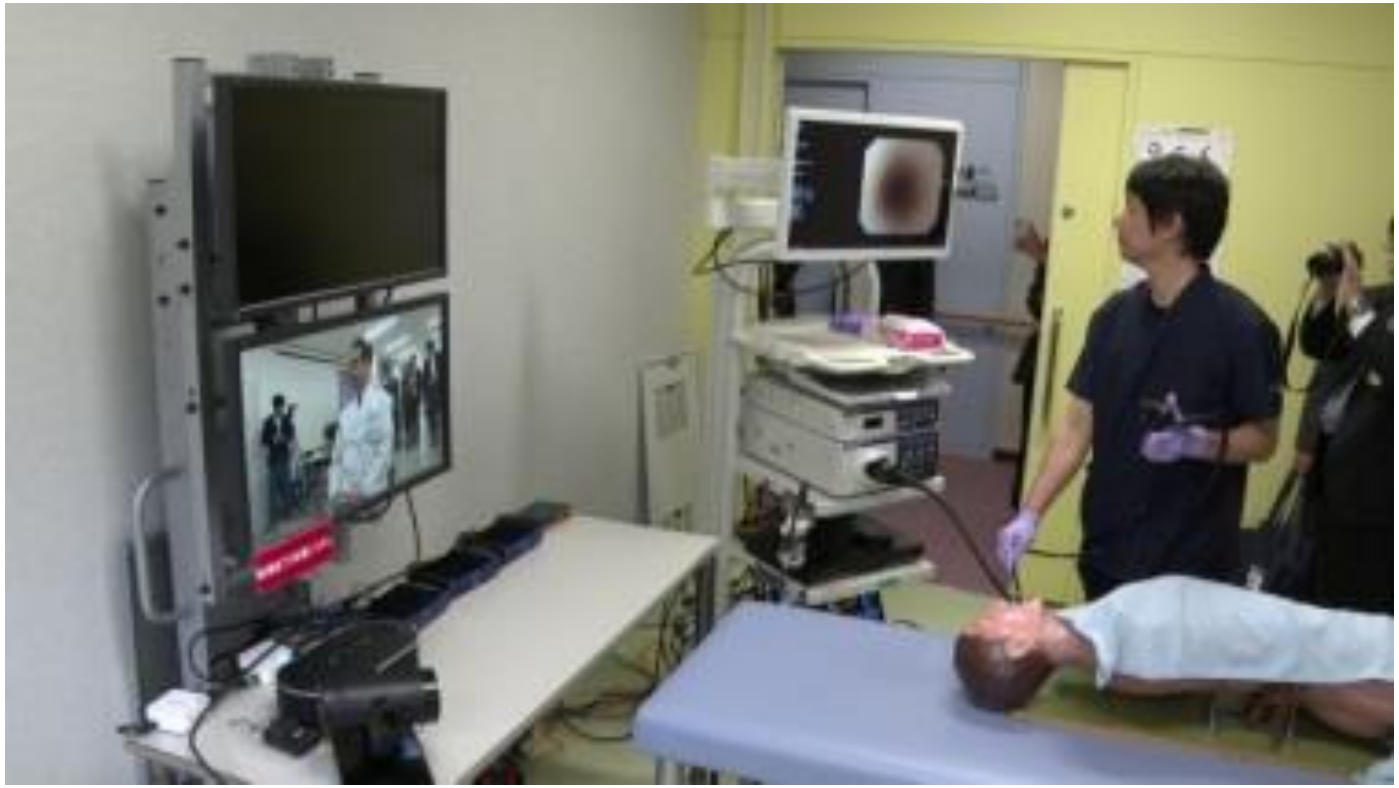
**By sharing high resolution echo images,
I can do medical treatment as same as I do on face–to-face. I’d like to use this system as soon as possible.**

(2) Results of Field Trials on “Medical Training” with Remote Support

A specialist watches real-time images of endoscope operated by young doctor through TV conference system and supports him

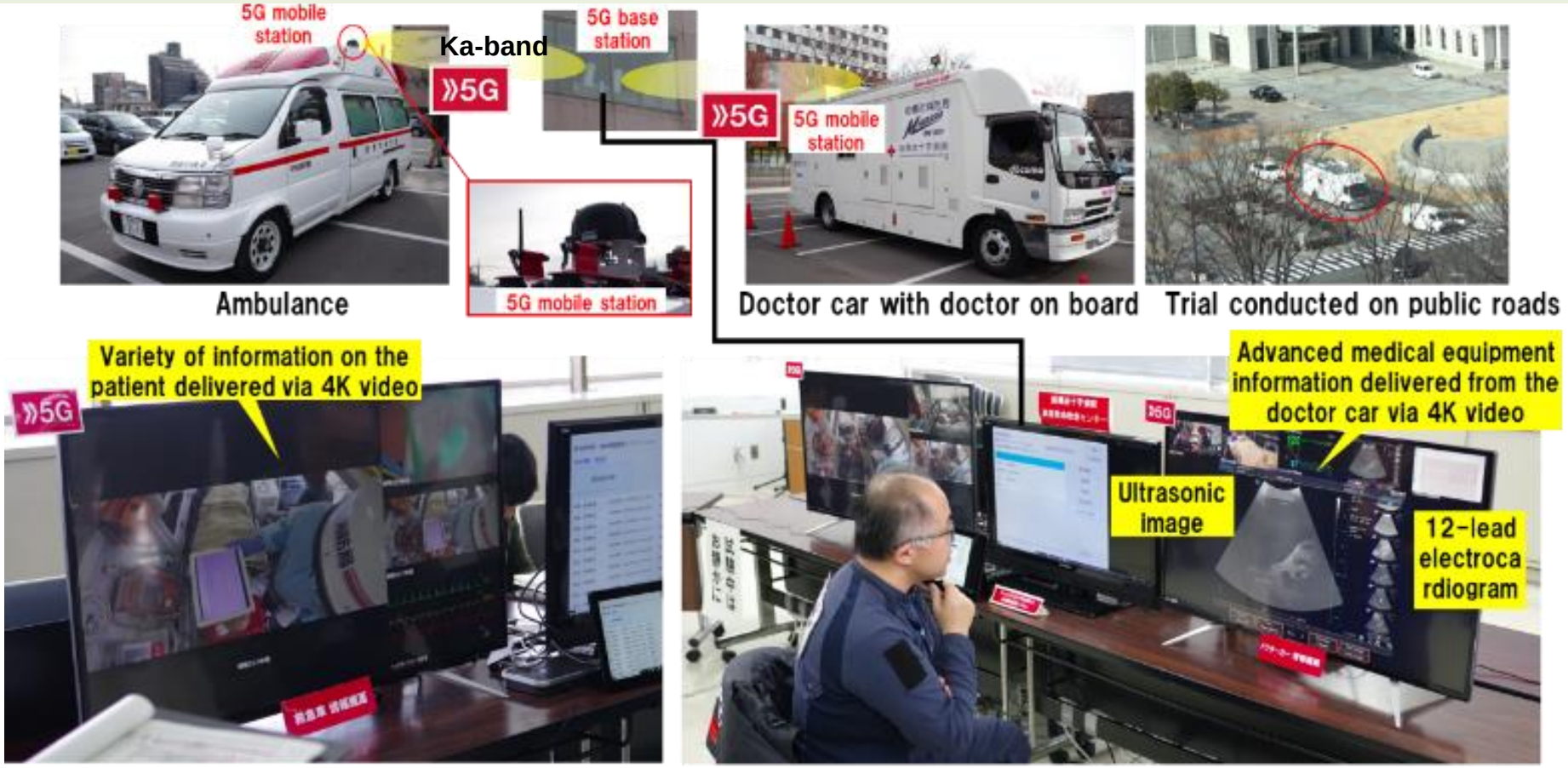
Wakayama Medical University Hospital
Second Course of Internal Medicine
Professor Kitano,

Despite the lecture for a doctor who does not get used to using endoscope, he allowed smooth operation. I felt endoscopic examination for actual patient will be also achievable.



Advanced Paramedical Service by 5G

Field Trial on Realizing Efficient Emergency Patient Transport



Possibility of advanced registration of a patient by exploiting information from the ambulance and doctor car shared via 5G with the accepting emergency hospital

Advanced Paramedical Service by 5G

Echo Image Transmitted by 5G from Doctor-car

4G Quality (reference)