The Fifth Generation Mobile Communications Promotion Forum

Strategy and Activities on 5G Development in Japan and 5GMF

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5GMF
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1. Introductory Remarks and 5G Roadmap in Japan

5G Activities in the World

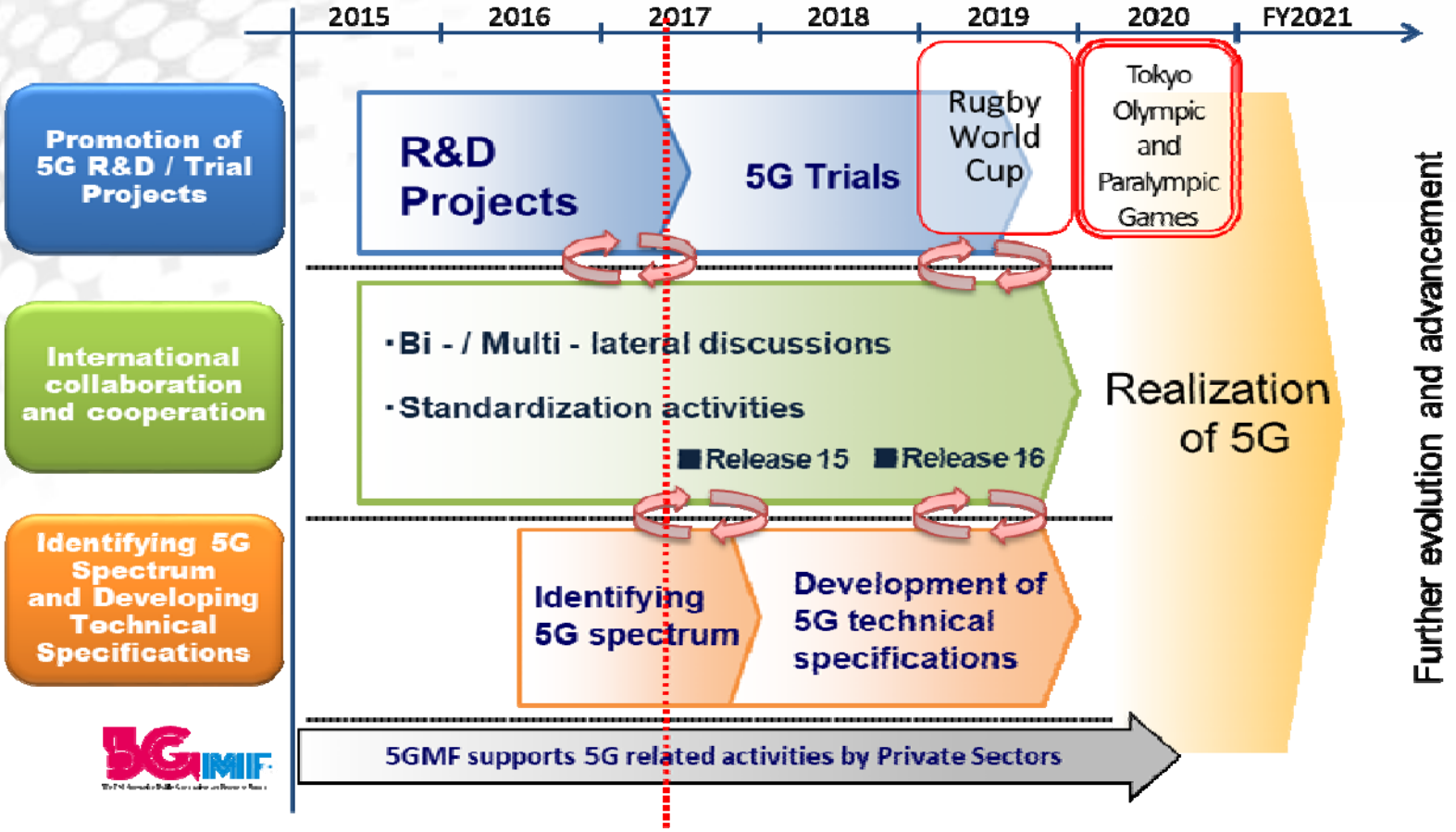
Future IMT Vision in ITU-R WP5D — **ITU-T Focus Group on IMT-2020**

5G Study Items

5G Initiative

Vision2020/ Network2020

5G Development Roadmap toward 2020 in Japan



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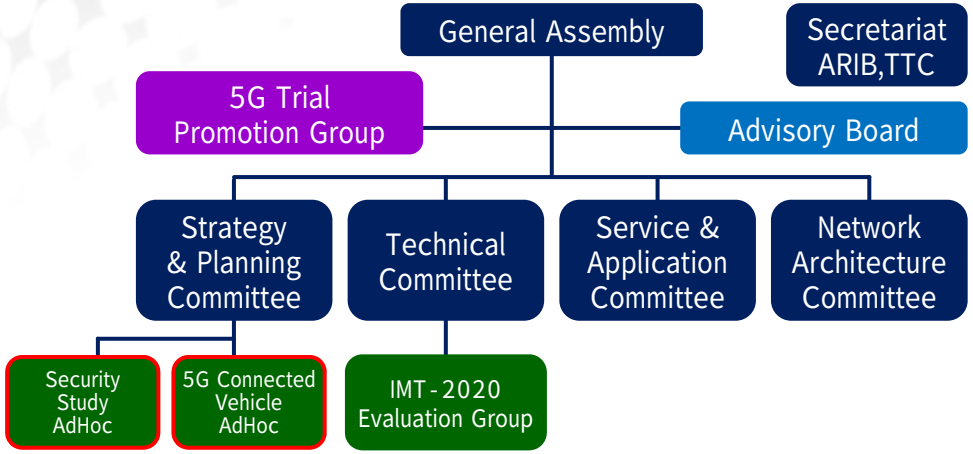
2. Overview of 5GMF Activities and Outcomes

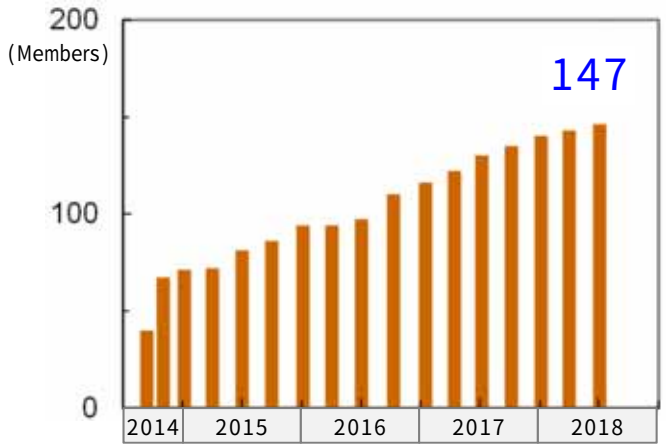
Overview of 5GMF

■ 5GMF (The Fifth Generation Mobile Communications Promotion Forum)

- Established : 30 September 2014 (taking over ARIB 2020 and Beyond AdHoc)
- Objectives : ・Innovative R&D through Industry - Academia - Government cooperation.
  ・International Standardization and Collaboration.
  ・Support and cooperate with 5G Field Trial in Japan.
- Members : 147 (Special:3, Individual:18, Ordinary:126 as of 7 August 2018)



Organizational Structure of 5GMF



Number of 5GMF Members

Activities of 5GMF

Committee Activities

- Over 50 meetings are regularly held every year.
- Publish Technical Reports & White Paper. https://5gmf.jp/whitepaper/
- Support and cooperate with 5G Field Trial.
- Established 5G Connected-Vehicle AH and Security Study AH.
- Organize 5GMF General Meeting and Advisory Board Meeting.

International Collaboration

- Collaborate with MIC、ITU-R WP5D、3GPP, et al.
- Collaborate with world's 5G related organizations. (MoU, LoI)
- Organize Asian Caravans.
- Introduce 5G related information through website. https://5gmf.jp/

Event & Congress

- CEATEC Japan 5G Workshop (every October)
- Global 5G Event (twice a year by 5G Promotion Organization)
- Organize meetings to report achievements of 5G Field Trial.
- Take part in the 5G related meetings and exhibitions.

Asian Caravan (February 20-21, Bangkok, Thailand)

The 16th ITS Asia-Pacific Forum FUKUOKA 2018
(May 8-10, Fukuoka International Congress Center)

White Paper & Trial Report

5GMF White Paper

- 5GMF published White Paper v1.0 in July 2016.
- White Paper was updated to v1.1 in September 2017.

5G Trial Report v1.0 (JPN) and English edition in September 2017

- Trial Concepts, Contents and Plans of “5G Utilization Projects” addressed in 5G Field Trials in Japan were described.
- More than 40 proposals were summarized into 6 Use Cases.

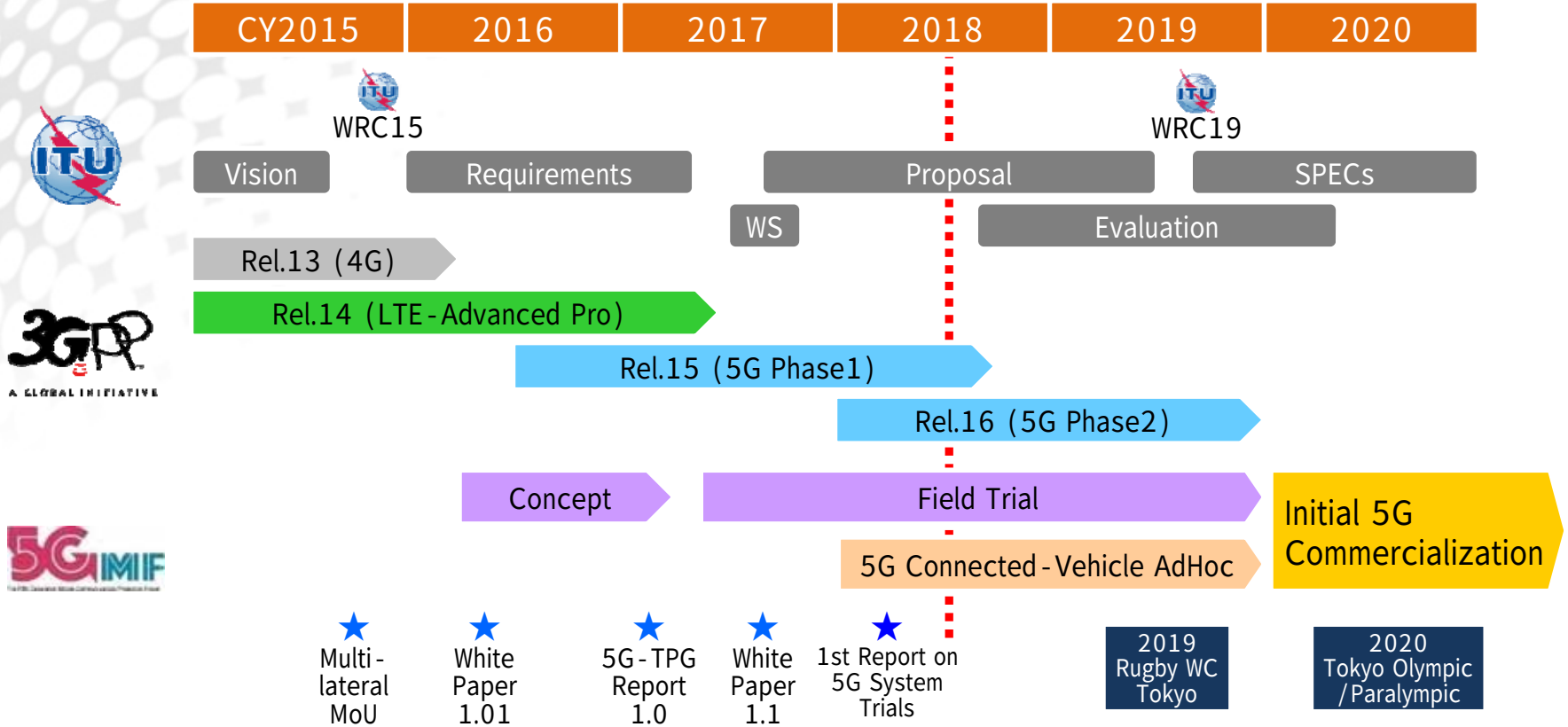
The First Report on 5G System Trials in Japan

- 5G-TPG published the Trial Report in March 2018.
- Progress and Results of 5G Field Trials in FY 2017 were described.

https://5gmf.jp/en/whitepaper/

Action Plan of 5GMF towards 2020

Accelerate practical implementations of 5G towards 2020



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3. 5G Field Trials in Japan

MIC started 5G Field Trial in Japan

- Ministry of Internal Affairs and Communications (MIC) started 5G Field Trial in 2017
- 5GMF supports and cooperates with MIC's activities

Period	FY2017 – FY2019 (3yeras)
Places	Tokyo and Local Areas
Test Environments	- Urban micro-cell or Urban macro-cell - Suburban macro-cell or Rural macro-cell - Indoor hotspot
Key Capabilities	- eMBB 10 Gbps peak data rate - mMTC 1 million connected devices/km^2 - URLLC 1 ms over-the-air latency
Radio Spectrum	- below 6GHz (3.7 & 4.5GHz) - 28GHz

eMBB: enhanced Mobile Broadband, mMTC: massive Machine Type Communications, URLLC: Ultra-Reliable and Low Latency Communications

Overview of 5G Field Trials in 2017

- 6 Projects are ongoing field trials in Tokyo and local areas in Japan.

	Responsible organization	Main partners	Field	Main locations	Technology
I	NTT DOCOMO	・TOBU TOWER SKYTREE ・ALSOK ・Wakayama Pref.	・Sightseeing ・Smart Cities ・Medical Services	・Tokyo ・Wakayama	eMBB
II	NTT Communications	・Tobu Railways ・Infocity	・Transport	・Tochigi ・Shizuoka	eMBB
III	KDDI	・Obayashi Corp. ・NEC	・Construction	・Saitama	URLLC
IV	ATR	・Naha City ・Keikyu Railways	・Entertainment	・Okinawa ・Tokyo/HND	eMBB
V	Softbank	・Advanced Smart Mobility Co., Ltd. ・SB Drive Corp.	・Transport	・Ibaraki	URLLC
VI	NICT	・Comm. carriers ・Local govt. ・Office sys. suppliers	・Logistics ・Smart office	・Kanagawa ・Osaka	mMTC

eMBB: enhanced Mobile Broadband, mMTC: massive Machine Type Communications, URLLC: Ultra-Reliable and Low Latency Communications

Field Trials on eMBB (enhanced Mobile Broadband)

■ 5G Transmission Characteristic Evaluation

@4.5GHz Ultra High Density Distributed Antenna
Radio propagation, 90km/h, urban or rural

@28GHz Long-Span (1.2km)
Ultra High Bit-Rate Communication
Radio propagation, 90km/h, urban or rural
Radio propagation indoor/closed environments

Long Span Transmission @28 GHz

8K-12ch Transmission @4.5 GHz

■ 5G System Performance Evaluation

Entertainment	8K Multi-Channel MMT Transmission
	4K 360-Degree Camera Video Transmission
	Real-Time Communication by MR
	Multiple simultaneous transmissions of Free-viewpoint video
Medicine	Telemedicine Services Exploiting 5G
High Mobility	28GHz, 90km/h, urban or rural
Smart City	Remote Monitoring by High-Res. Video

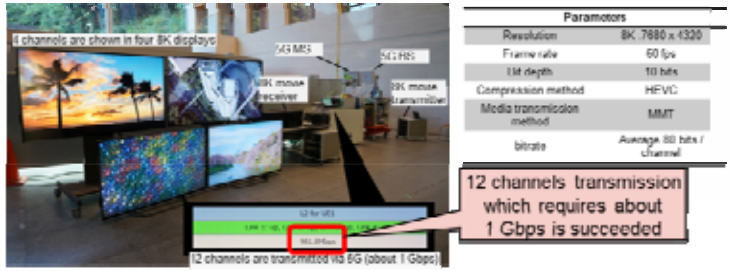

High Mobility : Automobile


High Mobility : Train

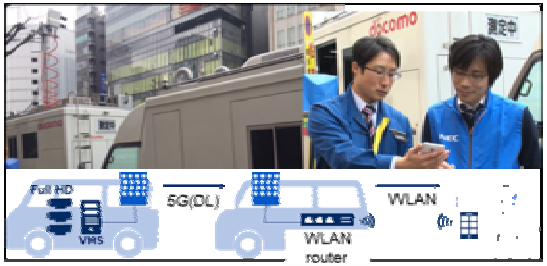
Results of 5G Field Trial FY2017 – Project I

- High-definition and High-realistic Video Streaming
- Smart City that Realizes Safety and Security
- Telemedicine

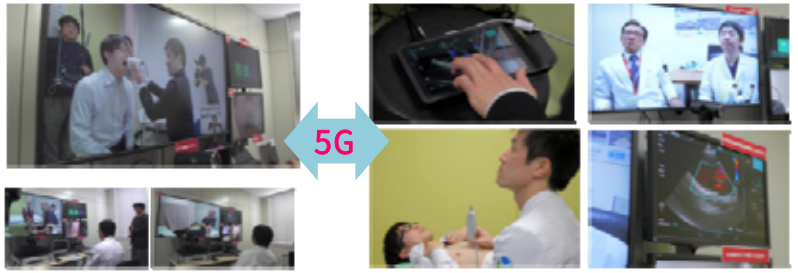
8K Multi channel transmission



Remote monitoring system with high-definition video



Telemedicine between Wakayama Medical Univ. and clinic.

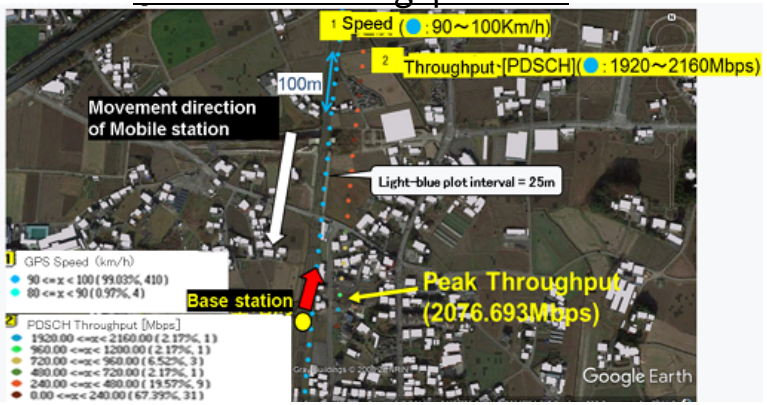


Results of 5G Field Trial FY2017 – Project II

・Entertainment System for High-speed Moving Objects. (Trains/Buses)

Test environment for the Train

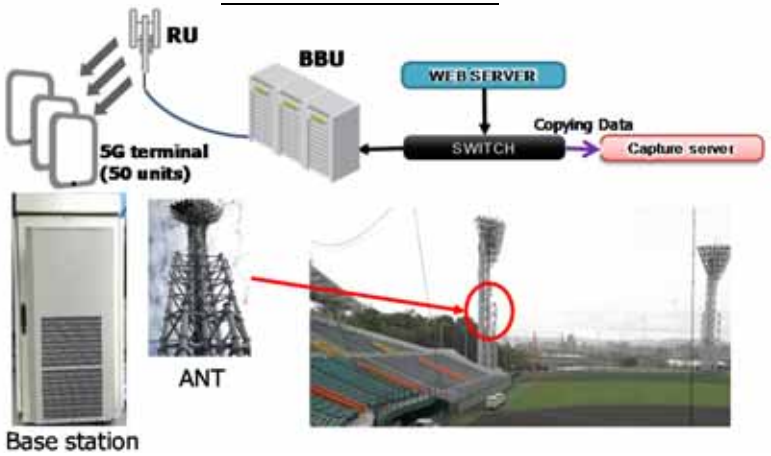
Measured Throughput Data



Results of 5G Field Trial FY2017 – Project IV

- Entertainment in the stadium
- High-definition Video Streaming
- Securing Safety on Station Premises

Test environment



Experimental equipments in the Station

Field Trials on URLLC (Ultra-Reliable and Low Latency Communications)

■ 5G Transmission Characteristic Evaluation

@4.5GHz Driving test route (Shinjuku/Ichinomiya)
Test Course (NILM, AIST)
@28GHz Driving test route (Shinjuku/Ichinomiya)
Test Course (NILM, AIST)

NILM: National Institute for Land and Infrastructure Management
AIST: National institute of Advanced Industrial and Science and Technology

■ 5G System Performance Evaluation

Connected Car	Data Streaming
ICT Construction	Remote control construction machinery
	4K Video streaming from Drone
Platooning	V2N, V2V Direct communication
	Ultra Low Latency

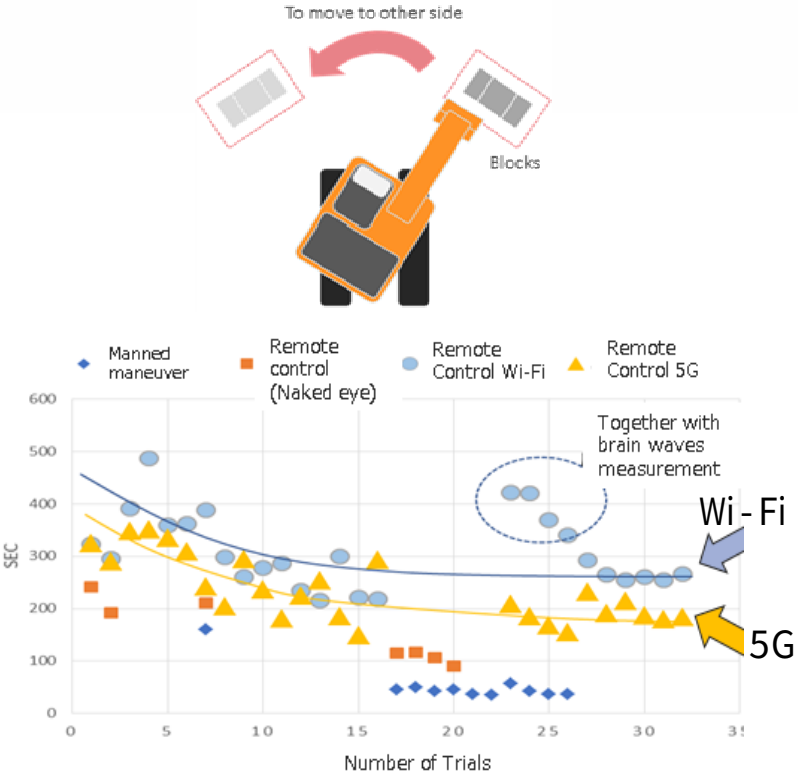
ICT Construction

Truck Platooning

Results of 5G Field Trial FY2017 – Project III

- Remote Control of Civil Engineering and Construction Equipment

Evaluated by the time required to move three blocks by construction machine.



Results of 5G Field Trial FY2017 – Project V

- Remote Control and Truck platooning

Test environment for V2N communication

Over the air Latency in 4.7GHz

Field Trials on mMTC (massive Machine Type Communications)

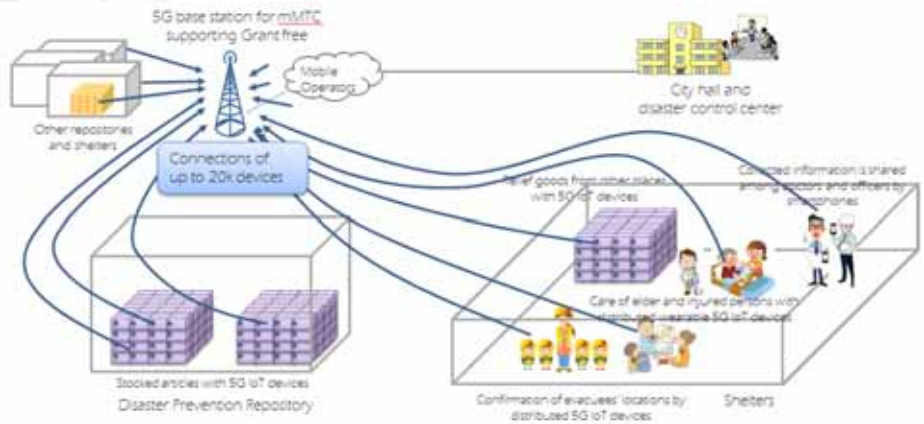
■ 5G Transmission Characteristic Evaluation

Clarification of radio propagation of 4.7GHz in different types of indoor environments

■ 5G System Performance Evaluation

Disaster　Capability of mMTC up to 20,000 simultaneous connections

Smart office　Verification & problem extraction of mixed use case with eMBB, URLLC & mMTC



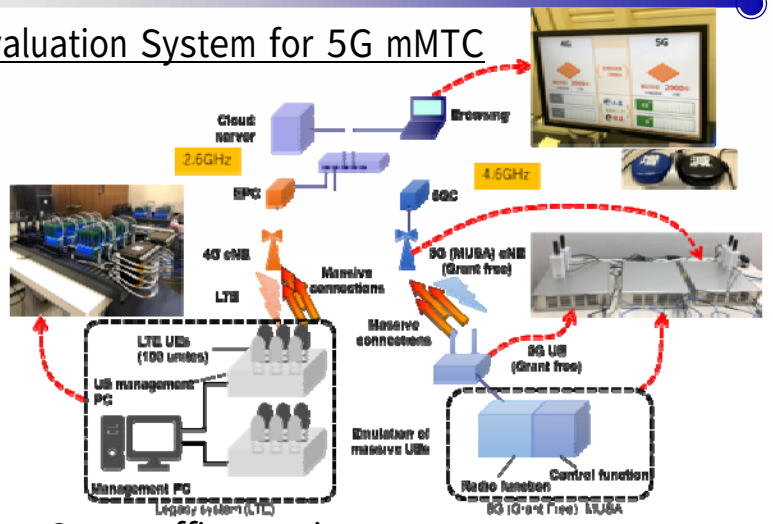
Disaster Use Scenario

Smart Office

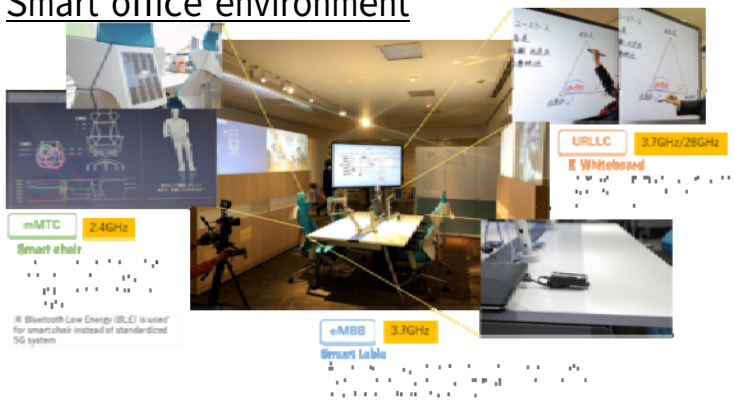
Results of 5G Field Trial FY2017 – Project VI

- Product Management and Logistics
- Smart Office

Evaluation System for 5G mMTC



Smart office environment



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4. Considerations on Spectrum for 5G in Japan and 5GMF

Frequency bands below 6GHz for 5G

The bands below 6GHz will play important roles for 5G as providing;

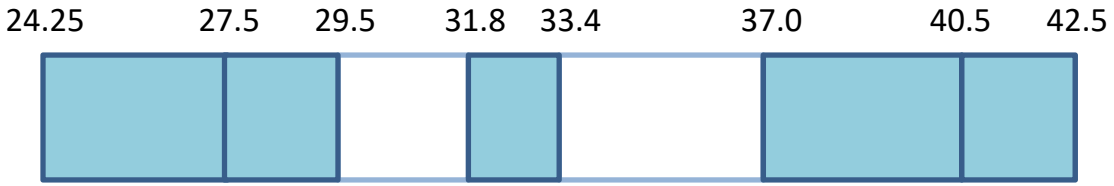
- Wide and contiguous coverage (e.g. below 2GHz) for;
  - IoT/M2M service with low bit rate and low power consumption,
  - conventional services, and
  - reliable C-plane in a C/U-split heterogeneous network
- Relatively large bandwidth for higher capacity (e.g. above 3GHz) for advanced mobile broadband services.

New candidate bands in Japan are 3.7 GHz band (3.6 – 4.2 GHz) and 4.5 GHz band (4.4 – 4.9 GHz). In these frequency ranges

- Global or regional harmonized frequency arrangement, and
- Sharing and compatibility with the incumbent radio systems should be considered.

Candidate Frequency bands above 6GHz for 5G

- Considering the information obtained at this point of time, a part of or whole of the following bands are preferred for initial use, from the view point of global/regional harmonization.
  - 24.25 – 27.5 GHz
  - 27.5 – 29.5 GHz
  - 31.8 – 33.4 GHz
  - 37.0 – 40.5 GHz
  - 40.5 – 42.5 GHz

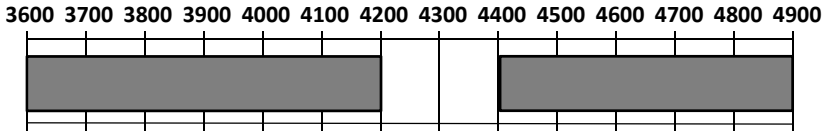


Candidate Frequency Bands for 5G in Japan

- **Below 6 GHz (<u>3.6 - 4.2 GHz & 4.4 - 4.9 GHz</u>)**

  Bandwidth： 500MHz (Maximum allocation)

  Allocation : By the end of FY2018



- **Above 6 GHz**

  <u>27.5 - 29.5GHz [& 27.0 – 27.5GHz]</u>

  Bandwidth : 2GHz (Maximum allocation)

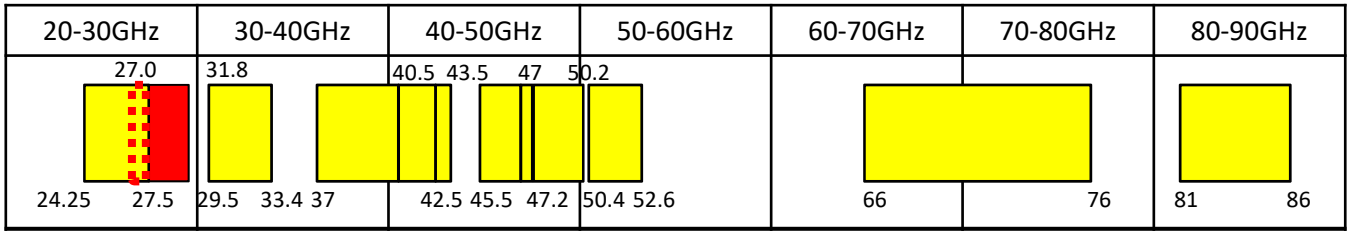
  Allocation : By the end of FY2018

  <u>24.25 GHz - 86GHz</u>

  Priority : Below 43.5 GHz

  Allocation : In the first half of 2020's

  (Candidate 11 Bands to be considered at the WRC-19)



(Quoted from MIC document)

How to license millimeter-waves for 5G?

Millimeter-wave band can be utilized for high speed and large capacity data communications; however, due to its high straight advancing property, it will be difficult to extend area coverage.

Currently, MIC puts on mobile operators obligations to implement certain coverage ratio (% of population in a certain period) when licensing.

Considering the millimeter-wave band's property, it might be difficult to maintain the above obligation and will be necessary to adopt a new license system or some other solutions...

(Quoted from MIC document)

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5. Closing Remarks

Towards the realization of 5G Eco-Society

- Lead R&D and international standardization to implement 5G mobile for 2020 and beyond.
- Support & Accelerate 5G Field Trials in Japan.
- Contribute actively through collaborations with international standardization organizations and cross-regional collaborations with other 5G-related organizations.
- Promote to create a new life style & business opportunities via 5G.

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Thank you for your kind attention.

https://5gmf.jp/en/