WWRF Huddle 2025
Sep. 24, 2025 @ Brasilia

Updates of Beyond 5G/6G R&D activities in NICT and Japan

Dr. Kentaro Ishizu
Research Executive Director,
Beyond 5G Design Initiative, Beyond 5G R&D Promotion Unit
National Institute of Information and Communications Technology (NICT), Japan

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https://www.nippon.com/ja/ncommon/contents/guide-to-japan/2786817/2786817.jpg
https://cdn.4travel.jp/img/tcs/t/pict/src/85/82/61/src_85826183.jpg?1745508880

Expo 2025
Osaka, Kansai, Japan

https://www.expo2025.or.jp/en/officialblog/


Beyond 5G
ready showcase
SCROLL

Japan's only public research institute specialising in ICT

NICT Personnel and Budget

- Location: HQ in Koganei, Tokyo
- Personnel: ~ 1,427 (as of April 2024)
- Researchers: ~740
- Budget: ~30.01 Billion Yen + α (2024)
- 5th Mid-to-Long Term Plan: April 2021 – March 2026

Public Services:

- Japan Standard Time
- Space Weather Forecast
- Wireless Equipment Testing & Calibration
- Cybersecurity Training

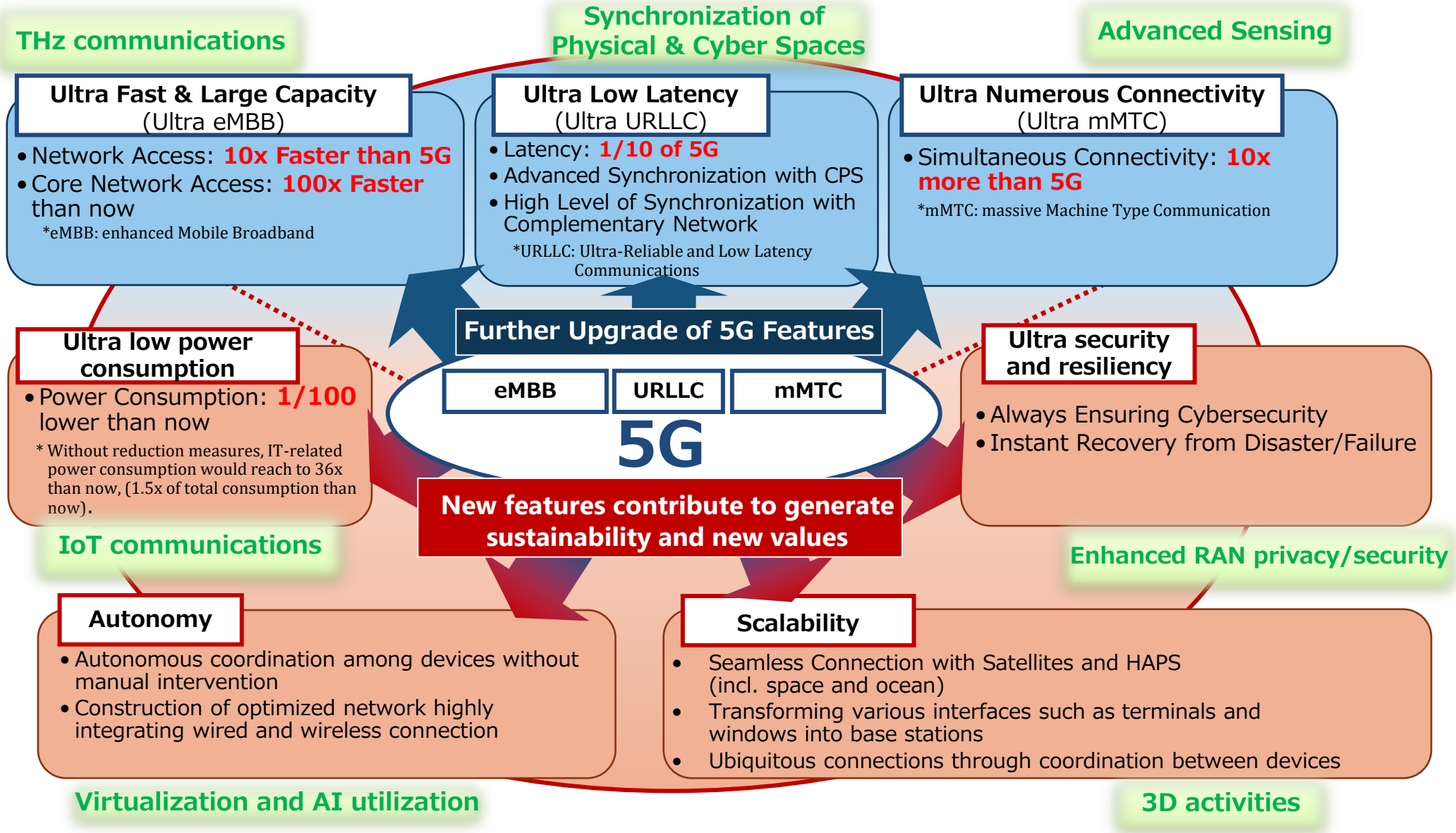
5 Main Research Areas

- Advanced Electromagnetic Wave Technology
- Innovative Networks
- Cybersecurity
- Universal Communication
- Frontier Science

Funding Agency:

- B5G/6G R&D Projects
- Domestic ICT Projects
- US-Japan Projects
- EU-Japan Projects
- Germany-Japan Projects
- ASEAN-IVO Projects
- Taiwan-Japan Projects

Beyond 5G Promotion Strategy (presented in 2020)

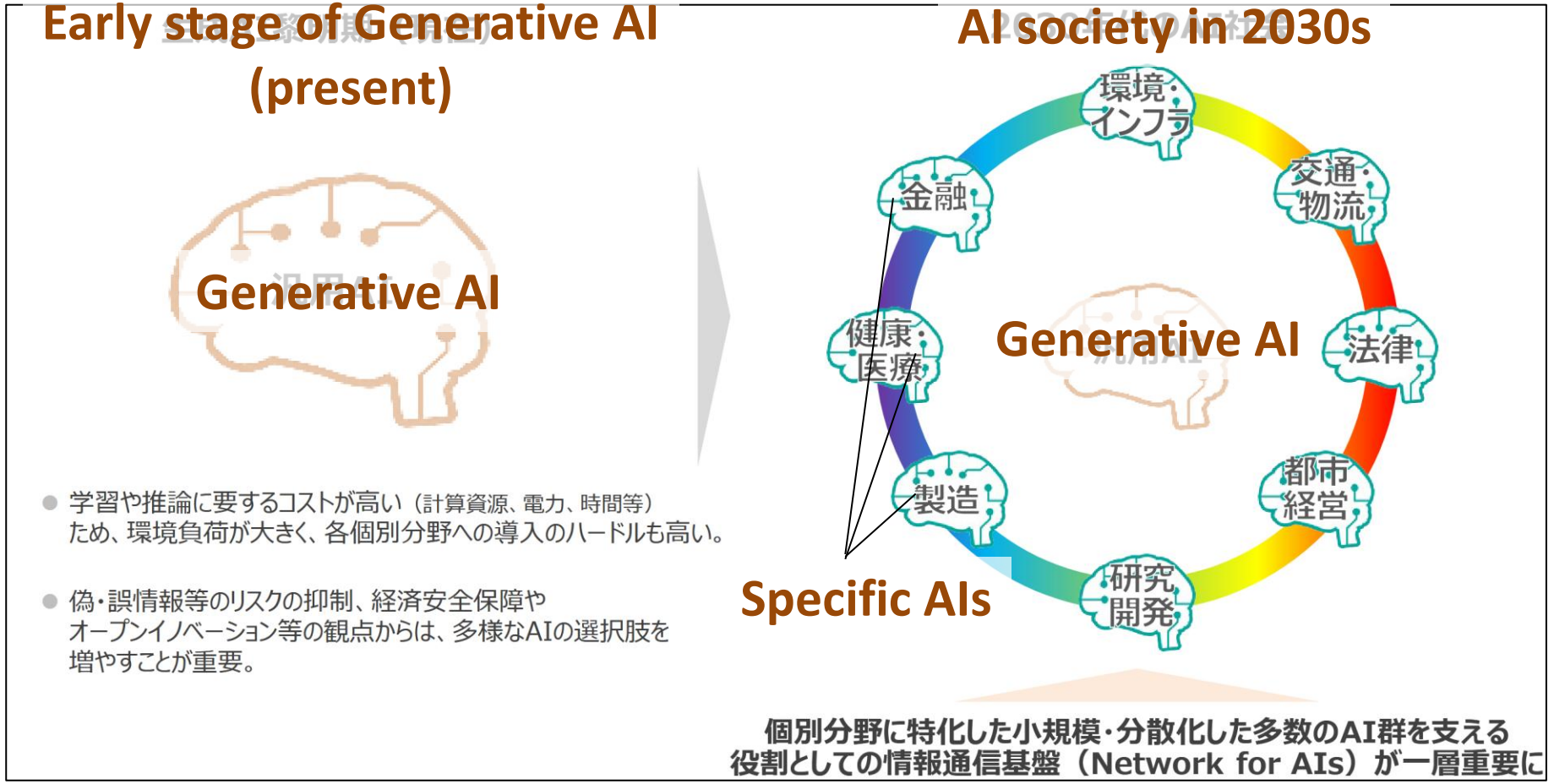


Ref.: Beyond 5G promotion strategy, Ministry of Internal Affairs and Communications, June 2020. (modified by presenter)

Beyond 5G Promotion Strategy 2.0 (presented in 2024)

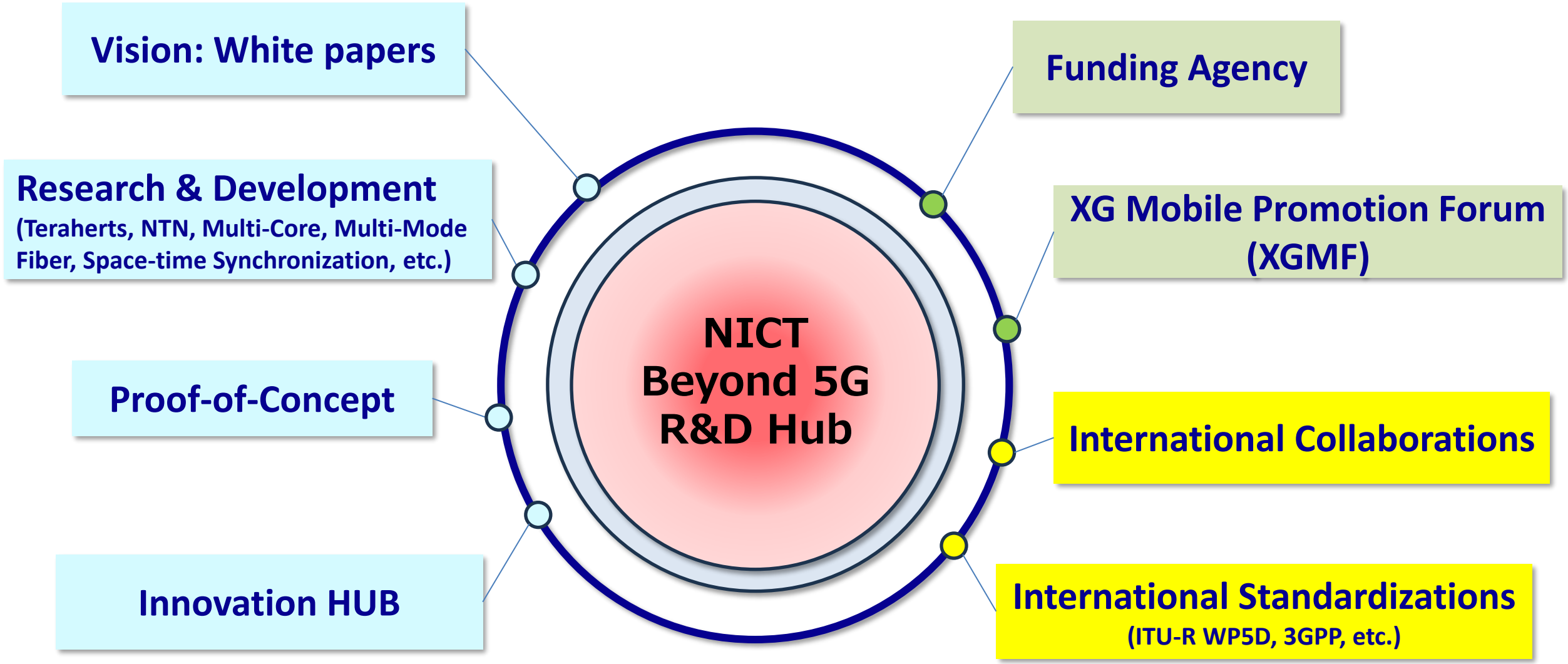
Beyond 5G =

"next generation communication infrastructure to support **AI society**"



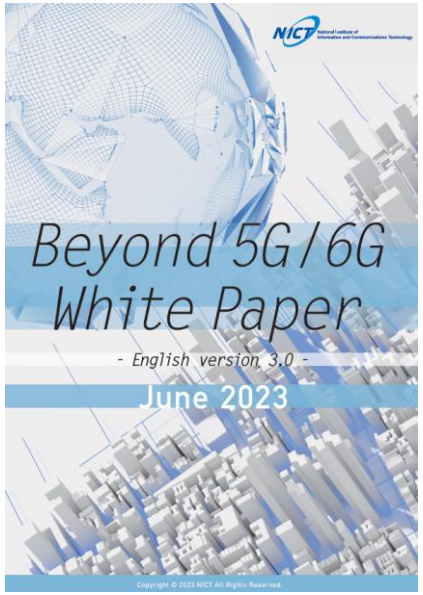
Press release from Ministry of Internal Affairs and Communications on Aug. 30, 2024.
"Beyond 5G Promotion Strategy 2.0 – Strategy toward realization of next generation communication infrastructure to support AI society"
https://www.soumu.go.jp/menu_news/s-news/01tsushin03_02000408.html

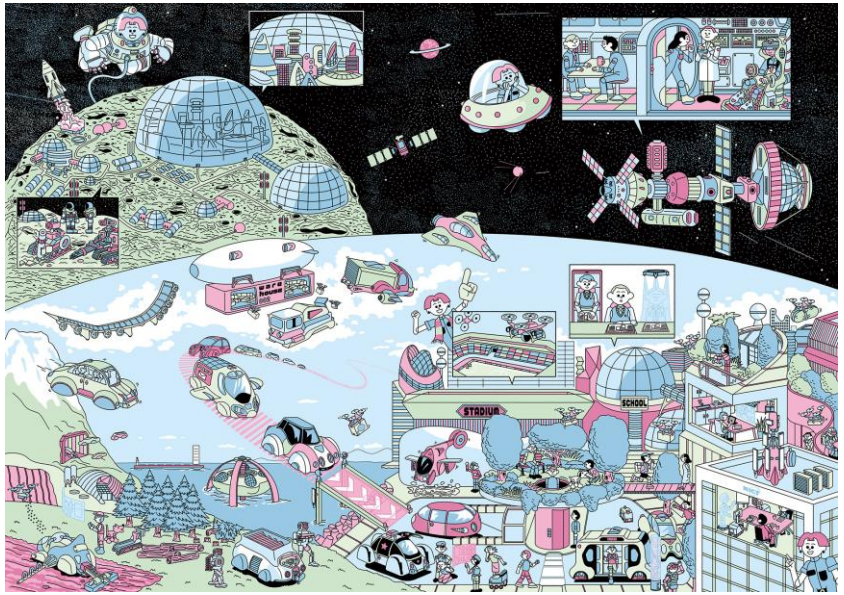
Overview of Beyond 5G / 6G Activities



White Paper: Future Life in 2030s

Society 5.0 is a human-centered, sustainable and inclusive society.
Through systems that achieve **advanced fusion of the physcial and cyber spaces**, we can solve both economic and social issues.





Scenario 1:
Cybernetic Avatar Society

Overcome limitations of BODY

Scenario 2:
City on the Moon

Overcome limitations of TIME

Scenario 3:
Vertical Flow of people, things and information

Overcome limitations of SPACE

Architecture: Cross-industry Orchestration

Service Operators

Users

Requests

Services

Orchestrator

Interface

Interface

Interface

Interface

Interface

System provider (Same industry)

Terrestrial mobile communication system

Non terrestrial network system

Power management system

Traffic management system

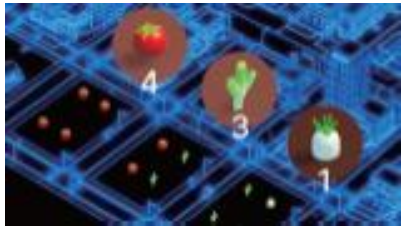
Construction, Distribution, Manufacturing, Finance, Medical, etc.

System provider (Different industry)

Discussion on Cross-Industry Orchestration

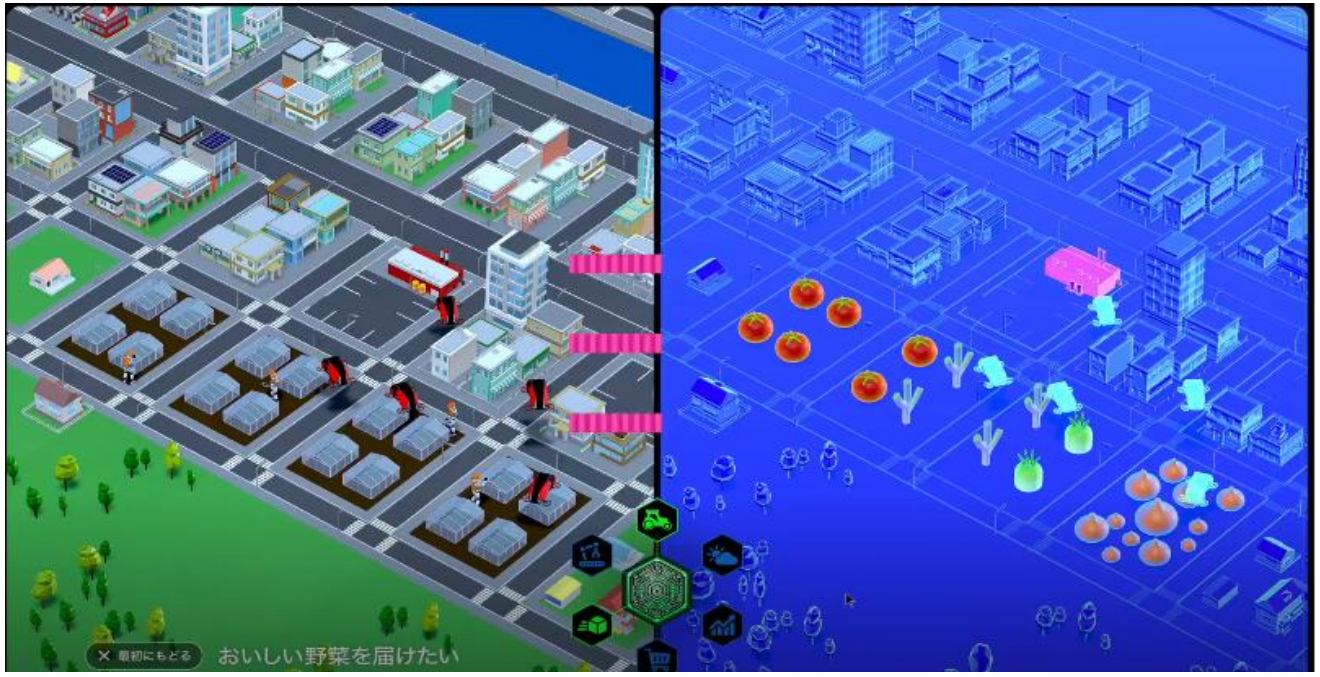
Three of orchestration stories

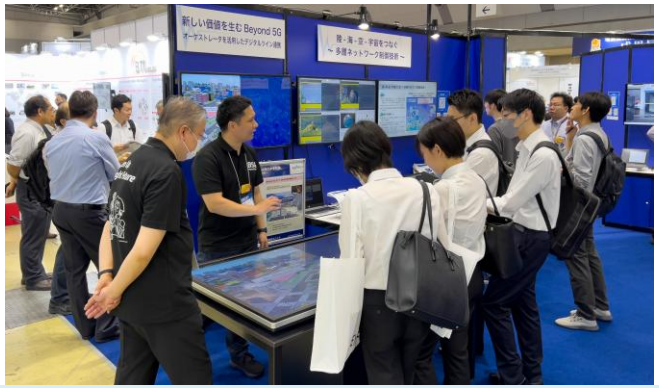
1 Productive agriculture



2 Reduction of CO2 emission

3 Reduction of disaster risks



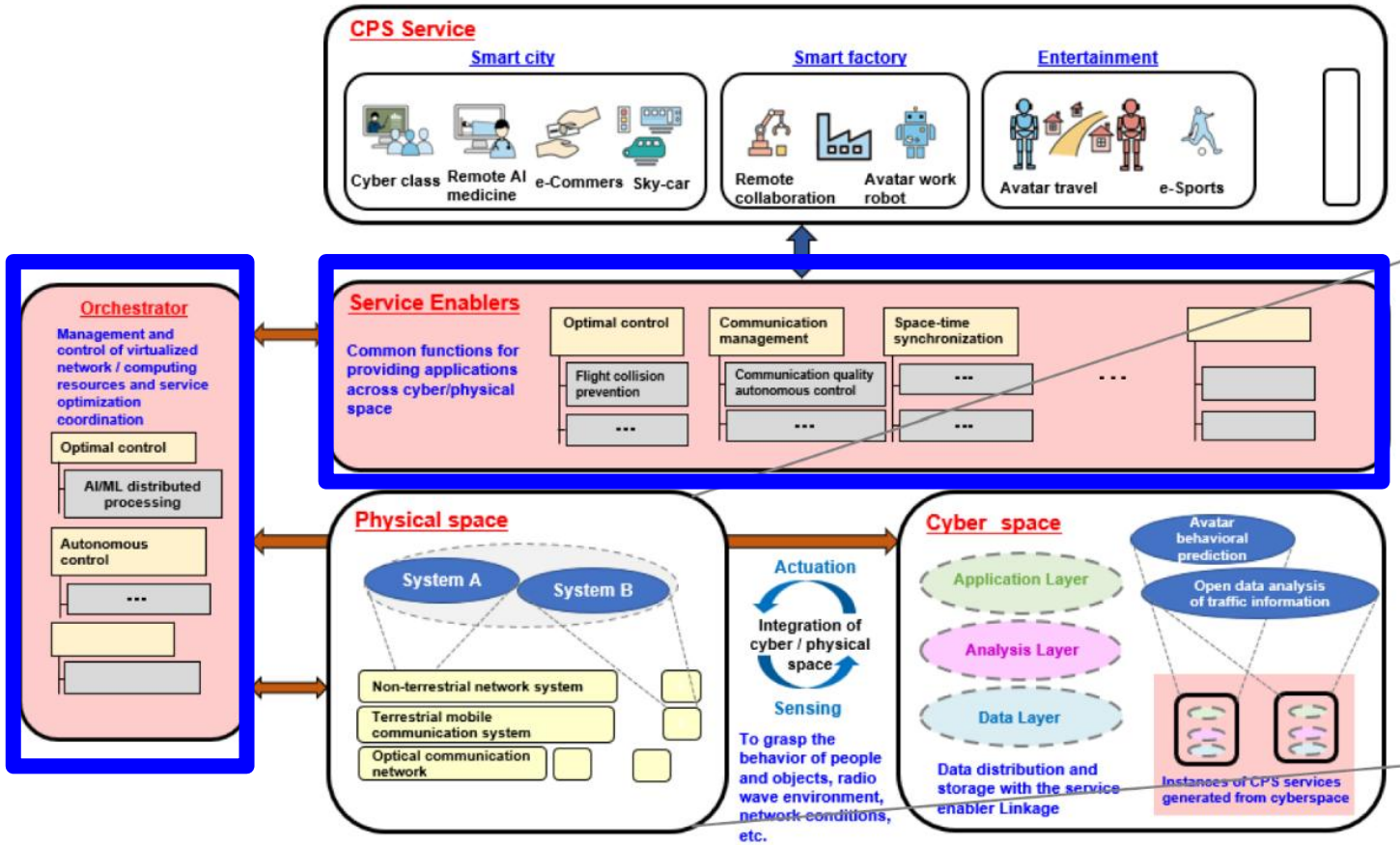


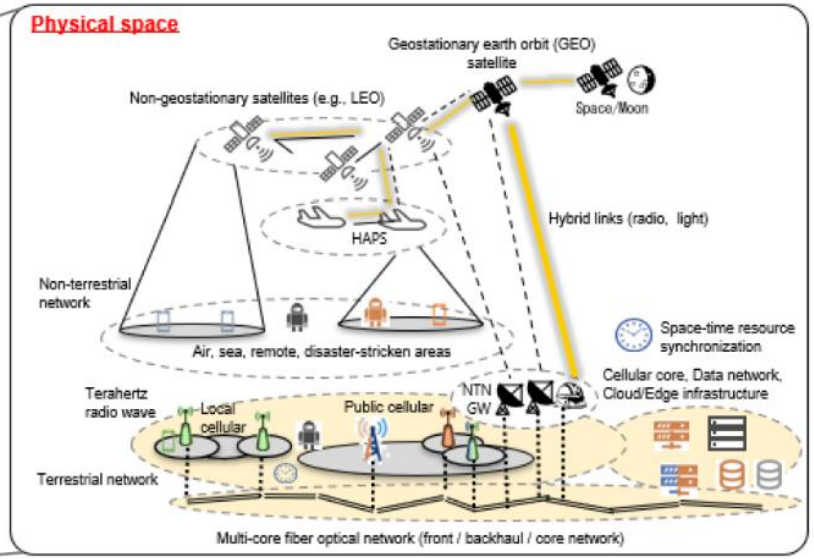
Here we are in the 2030s — the future city we live in. Let's use the orchestrator to take on various roles and solve the troubles.

B5G/6G Architecture for open service framework

The platform should be open, where the sub-systems are optimally combined.

Architecture of the Beyond 5G platform needs to be discussed on cross-industry basis.





Ref.: Beyond 5G/6G white paper ver. 2, NICT, Mar. 2022.

Key functions

- Orchestrator discovers adequate combinations of the systems and federates them to satisfy the requirements from services.
- Service enabler interacts with the services and the orchestrator to hide complexity of the CPS systems.

Key R&D activities at NICT

Teraherts Wireless Comm.:

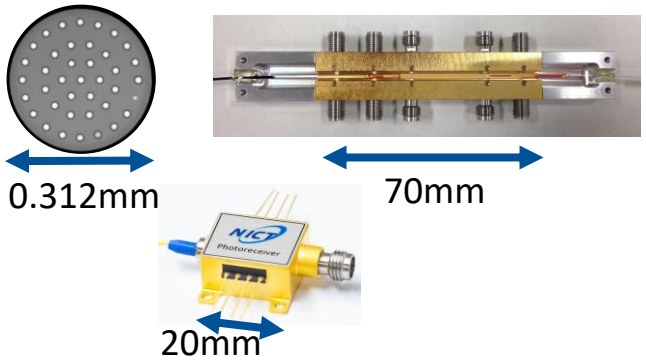
Increasing the capacity of wireless communications

THz Band Silicon Semiconductor

THz Band Compact antenna

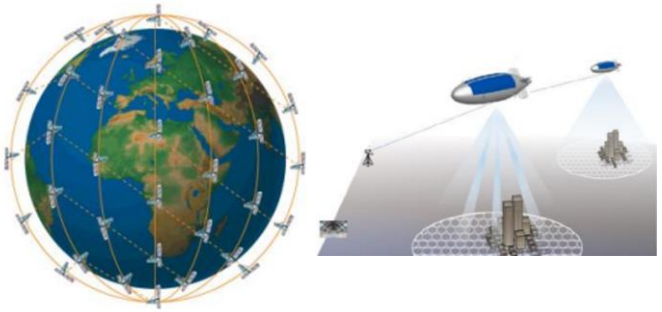
Multi-Core, Multi-Mode Fiber

Increasing the capacity of the core network
Multi-core fiber, multi-mode fiber, etc.



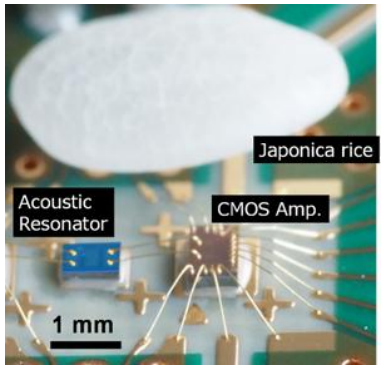
NTN: Coverage expansion

3D Networks Simulator/Emulator, Optical Comm. Terminals, HAPS, etc.



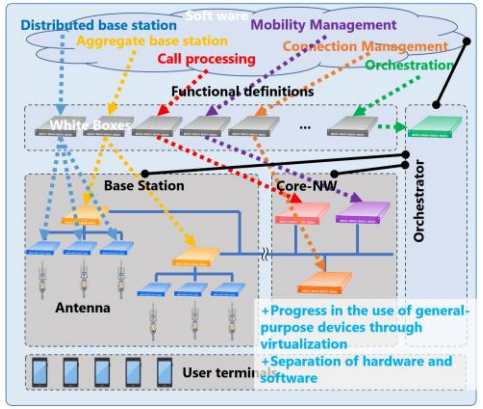
Space-time synchronization

+Inter terminal coordination
+Non-GPS location system with WiWi
(Wireless two-way interferometry)
+CLIFS: Chip Scale Atomic Clock



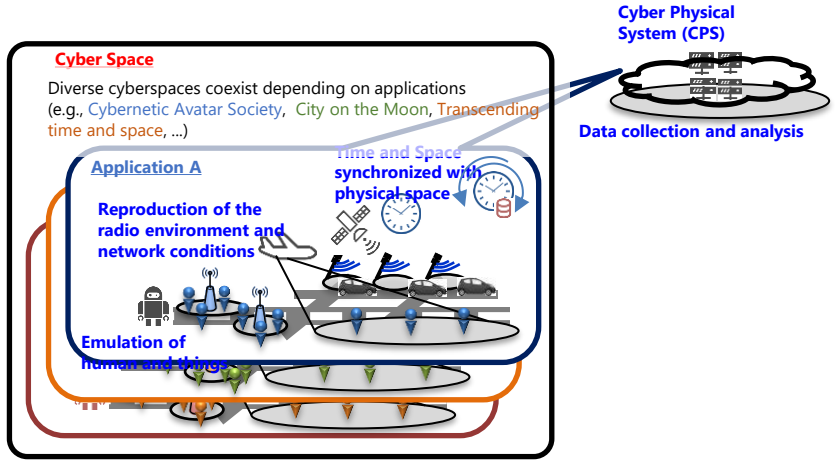
Virtualization and AI

+Cloud native
+Highly available resource allocation
+Network Control with AI
+Autonomic networks



Network slicing in 3D Networks

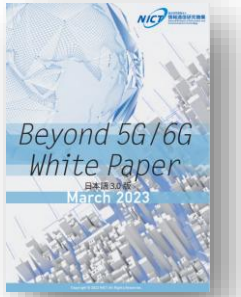
Network functions and resources can be dynamically managed and flexibly selected.



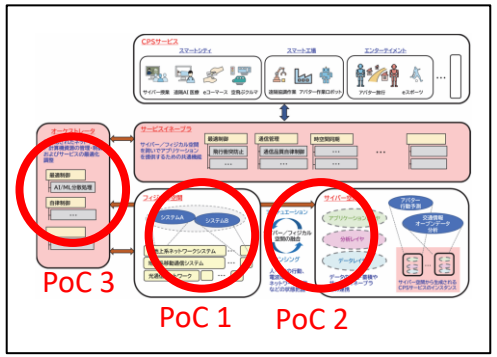
Vision to Reality

Vision

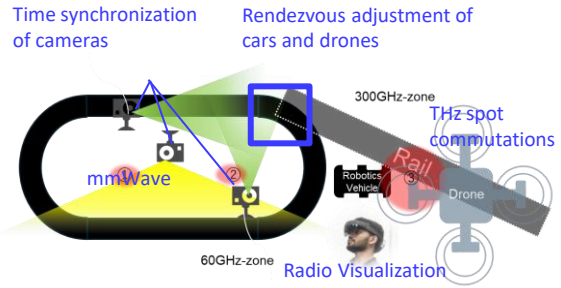
Technical break down



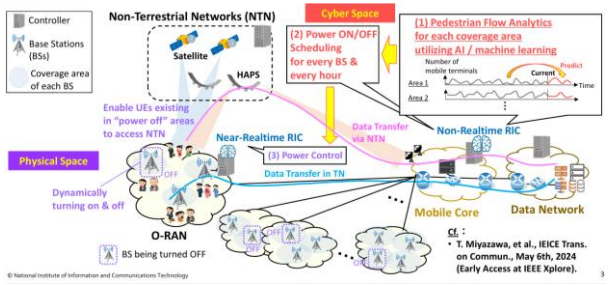
Key aspect extraction



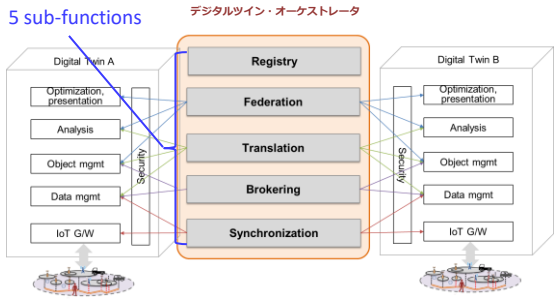
PoC



PoC 1 : THz, Time-Space Synchronization
Harmonization of multi-view high-resolution videos using THz/mmWave and time-space Synchronization technologies



PoC 2 : O-RAN with CPS, NTN, and AI
Network virtualization for QoS management and energy saving based on O-RAN and TN/NTN harmonization



PoC 3 : Digital Twin Orchestration
Cross-industry orchestration of Digital Twins based on newly defined 5 functional modules

Interdisciplinary harmonization

PoC 1	PoC 2	PoC 3
RWTH Aachen, Germany (Radio Visualization)	SUTD, Singapore (O-RAN Intelligence)	KDDI Labs (Digital Twin Cyber Security)
Univ. of Tokyo (Digital Twin Visualization)		

Information dissemination

PoC 1	PoC 2	PoC 3
MWC2025	MWC2025	
Osaka Expo		

International Standardizations

PoC 1	PoC 2	PoC 3
3GPP	ITU-T	IOWN GF
IEEE802		

PoC 1 : Spot Comm. with mmWave and THz

Robotic Vehicle w/ mmW device & camera

Display to play the recorded video after AI-based analyzation

Drone w/ mmW & THz devices

Ground station wi/ THz receiver

Research activities of Dr. Y. Shoji et al. from Social ICT Lab of NICT

PoC 2 : O-RAN for intelligent mobile comm.

【Objective】 To reduce the power consumption of O-RAN base stations (BSs) in terrestrial networks (TN) while maintaining the continuity of data communications, the QoS, etc.

Controller

Base Stations (BSs)

Coverage area of each BS

Non-Terrestrial Networks (NTN)

Satellite

HAPS

Cyber Space

(2) Power ON/OFF Scheduling for every BS & every hour

(1) Pedestrian Flow Analytics for each coverage area utilizing AI / machine learning

Number of mobile terminals

Predict

Current

Time

Area 1

Area 2

Enable UEs existing in "power off" areas to access NTN

Data Transfer via NTN

Non-Realtime RIC

Near-Realtime RIC

(3) Power Control

Data Transfer in TN

Physical Space

Dynamically turning on & off

OFF

O-RAN

Mobile Core

Data Network

BS being turned OFF

Cf. :

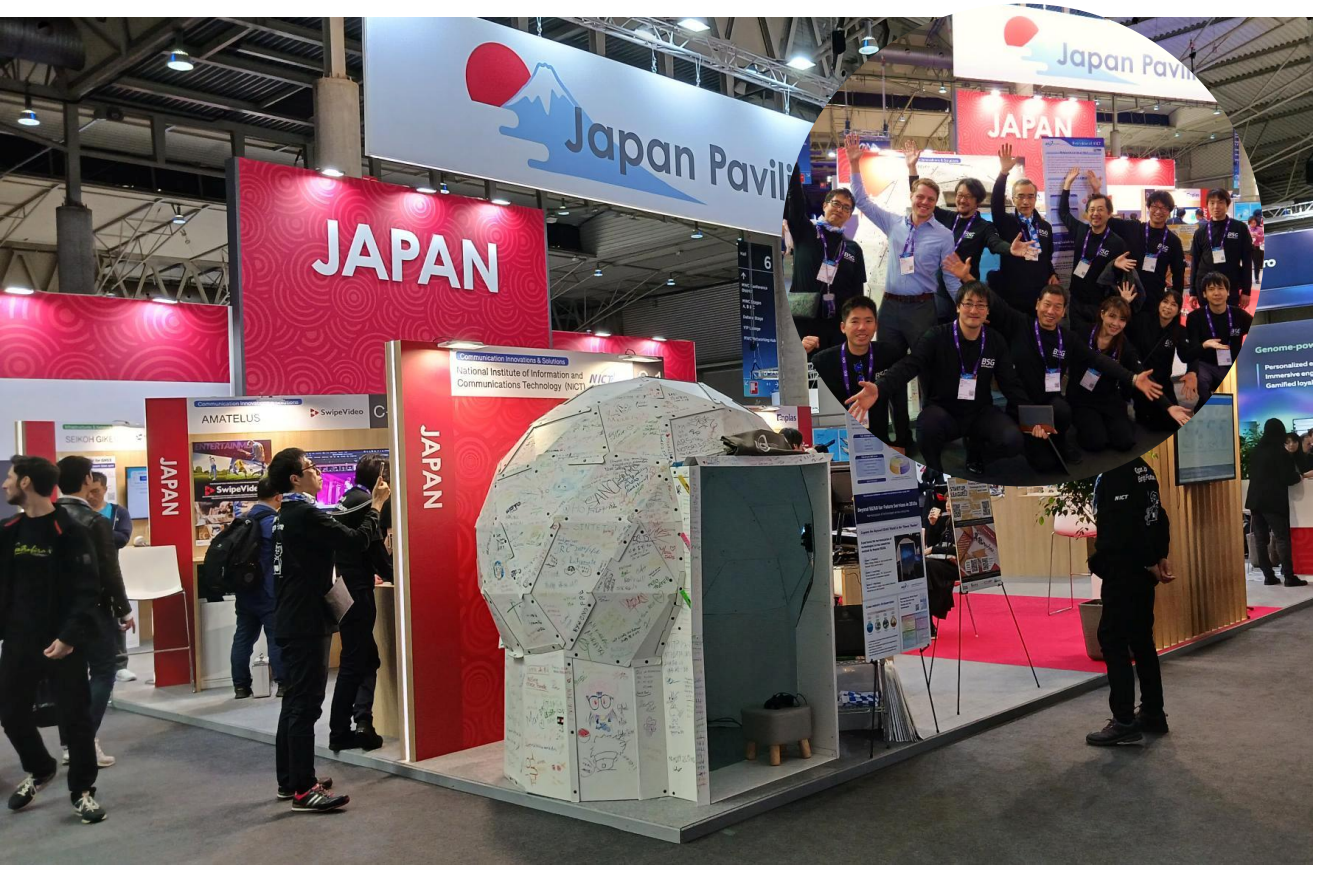
- T. Miyazawa, et al., IEICE Trans. on Commun., May 6th, 2024 (Early Access at IEEE Xplore).

3

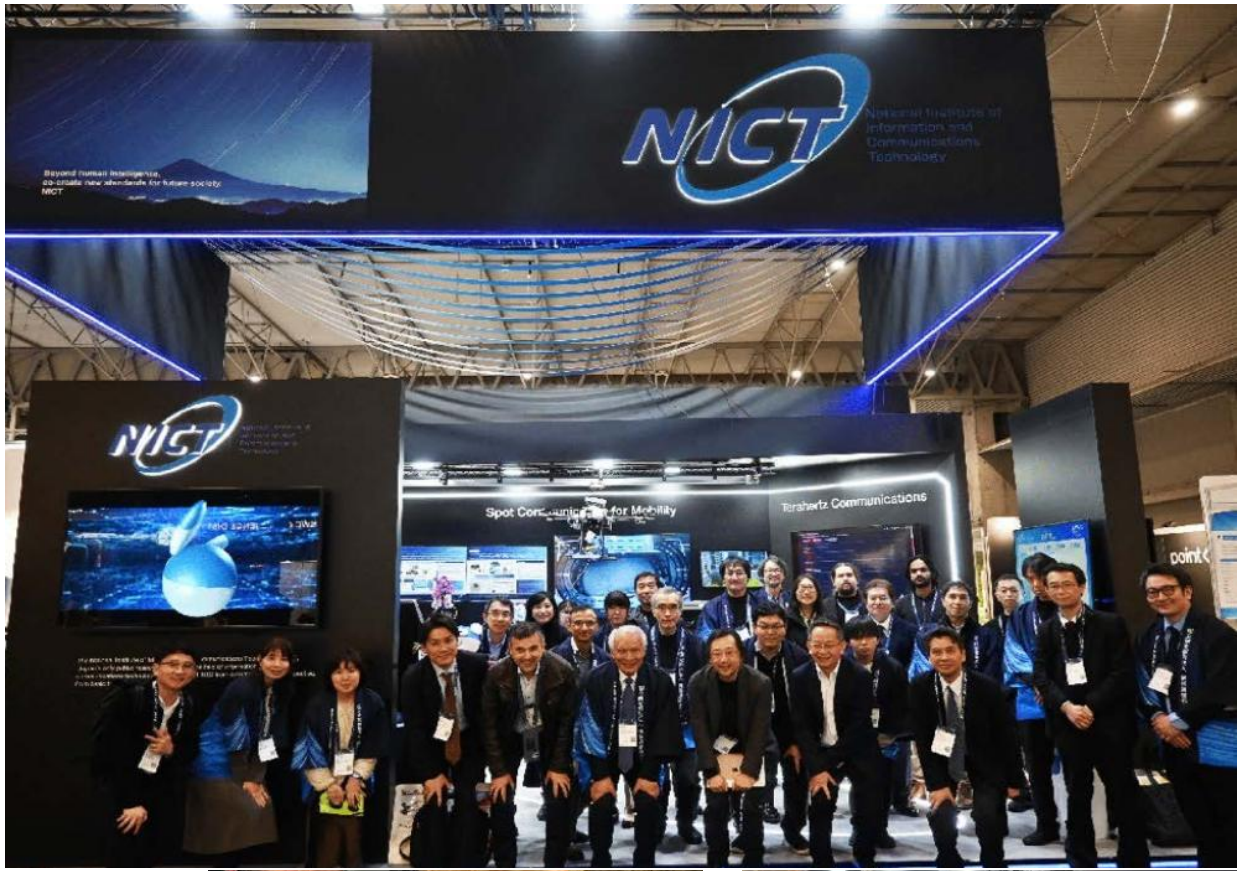
Research activities of Dr. T. Miyazawa et al. from Network Architecture Lab of NICT

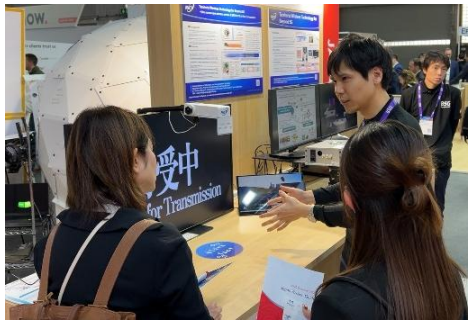
MWC Barcelona

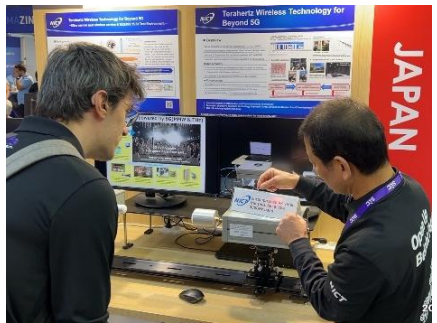
MWC2024

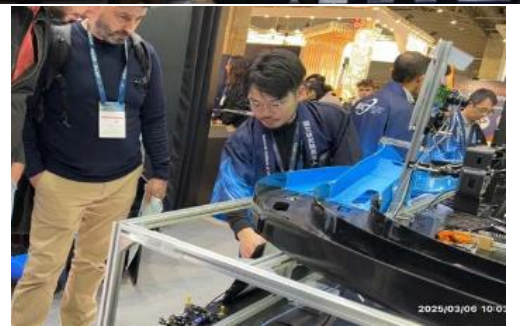


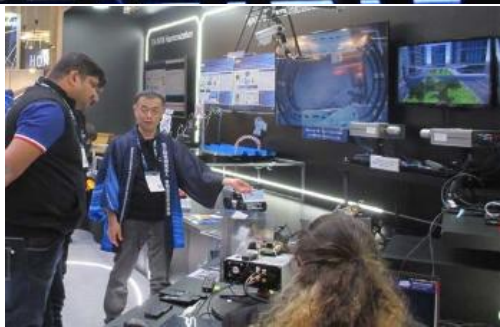
MWC2025





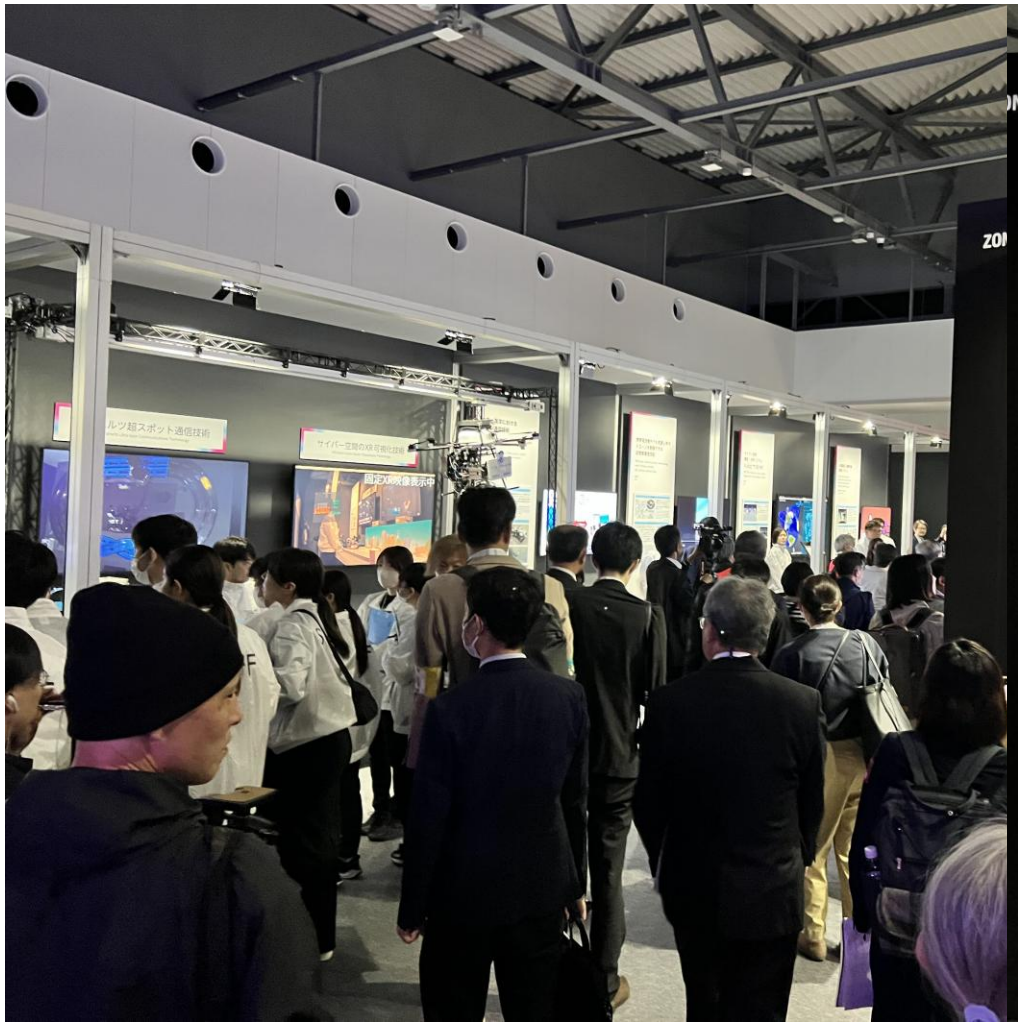


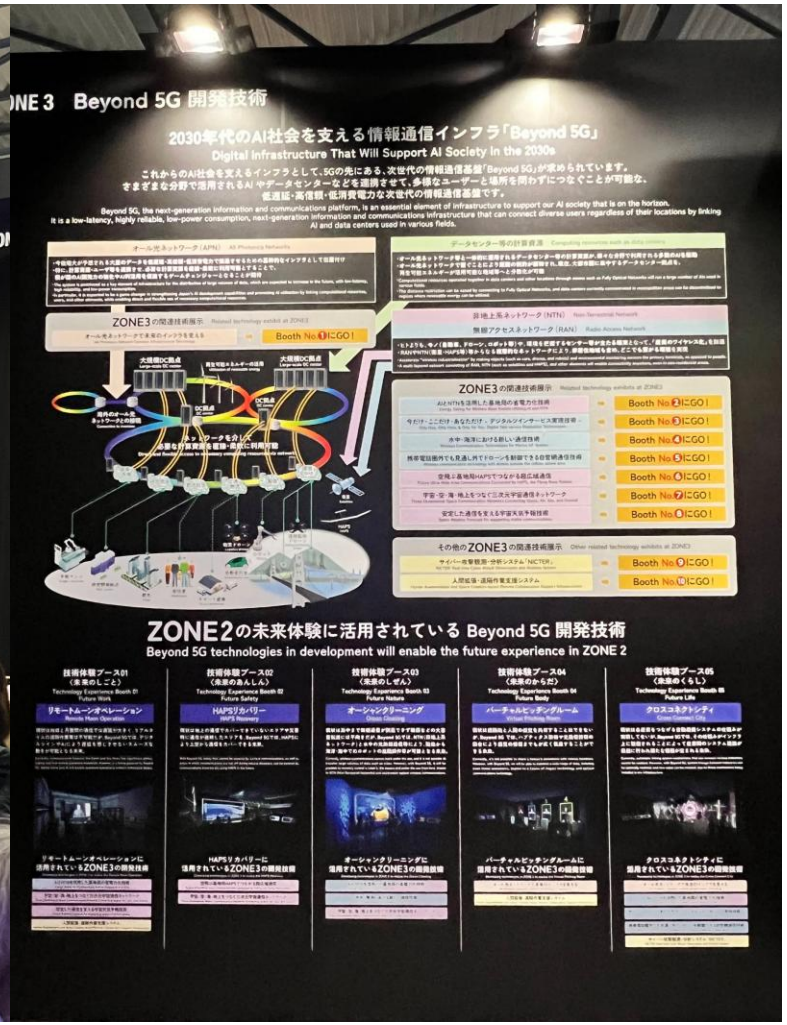


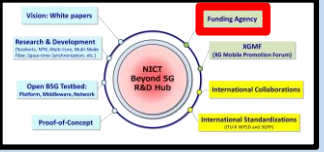


B5G Ready Showcase at Osaka EXPO 2025

- The next-generation communication technology, Beyond 5G, was demonstrated at Zone 3: video, experience, and exhibition to show how the future of society and life will change (May 26, 2025 - June 3, 2025)　URL: https://www.soumu.go.jp/b5g-readyshowcase/







Beyond 5G Funding Policy Updates (as of Apr. 2025)

MIC
Ministry of Internal Affairs and Communications

Funded in spring 2021

Funded in spring 2023

NICT National Institute of Information and Communications Technology

Initial Fund

<For FY2021–FY2022>

\30 billion (about €188 million)

(+\30 billion [about €188 million]: R&D)

(+\20 billion [about €125 million]: Test beds)

About 70 projects implemented

Commission /Grant

Additional budget

New Fund

Innovative Information and Communication Technology (B5G (6G)) Fund

<For FY2023～ >

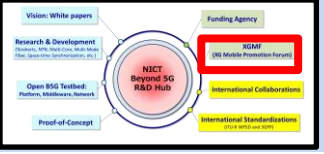
\166.8billion (about €1042 million)

About 35 projects implemented

Grant/ Commission

Research organizations In Japan (Private companies, universities, etc.)

EUR 1 = JPY 160



XGMF (XG Mobile Promotion Forum)

Launched in April 2024. Currently 24 projects are authorized.
Specialized activities are on-going crossing industries in a flat manner.

NTN Promotion Project
Leader: Morio Toyoshima NICT

6G Promotion PJ
Leader: NAKAMURA, Takehiro NTT DOCOMO

Space × Ground Use Case Study Project
Leader: FUJIMOTO, Koichirou NEC

Local 5G testbed for smart manufacturing
Leader: SAKAMOTO, Yosuke NEC

6G Network Architecture Project
Leader: IWASHINA, Shigeru NTT DOCOMO

6G Radio Technology Project
Leader: OHTSUKI, Tomoaki Keio University

Planning for a city-sized large-scale living laboratory
Leader: HIMONO, Takehiro NEC

Creation of 5G×OT business use cases for industry
Leader: ISHII, Takanori SOFTBANK Corp.

StarNet Earth
Leader: TAKAHASHI, Madoka NIPPON TELEGRAPH AND TELEPHONE CORPORATION

Agriculture × XG Project
Leader: KANO, Kayo ON BOARD Co., Ltd.

Terahertz Wave Wireless Technology Project
Leader: HOSAKO, Iwao NICT

XG-Supply Chain Management Project
Leader: NATSUME, Shinobu Gems Co.,Ltd.

Greedy Multi-Tasking Displays
Leader: SAKUMA, Morika incri Inc.

Social Ed-Tech for Individuality and Diversity
Leader: ONIZAWA, Miho incri Inc.

Local 5G Licensing Process Shortening Project
Leader: MASHIYAMA Daishi NTT East

Updating the Future of Manufacturing Manufacturing (factories, etc.) × XG
Leader: KAMATA, Naomi ON BOARD Co., Ltd.

Feasibility Study of a Multimodal Generative AI Service Using Multiple LLMs with ICT (XG for LLM)
Leader: OKANO, Yoshiki NTT DOCOMO

ODAIBA IX Core
Leader: IWANAMI, Gota INFOCITY, Inc., NAKAMURA, Takehiro NTT DOCOMO

Surveys on the communication environment in areas attracting customers
Leader: YOSHII, Daijiro Murata Manufacturing Co., Ltd.

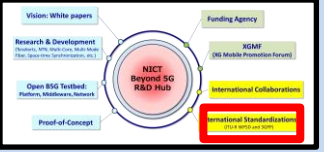
Space-Time Synchronization Project
Leader: IDO, Tetsuya NICT

The Expansion of Marine Utilization through the Evolution of ICT
Leader: HATAKAWA, Yasuyuki KDDI

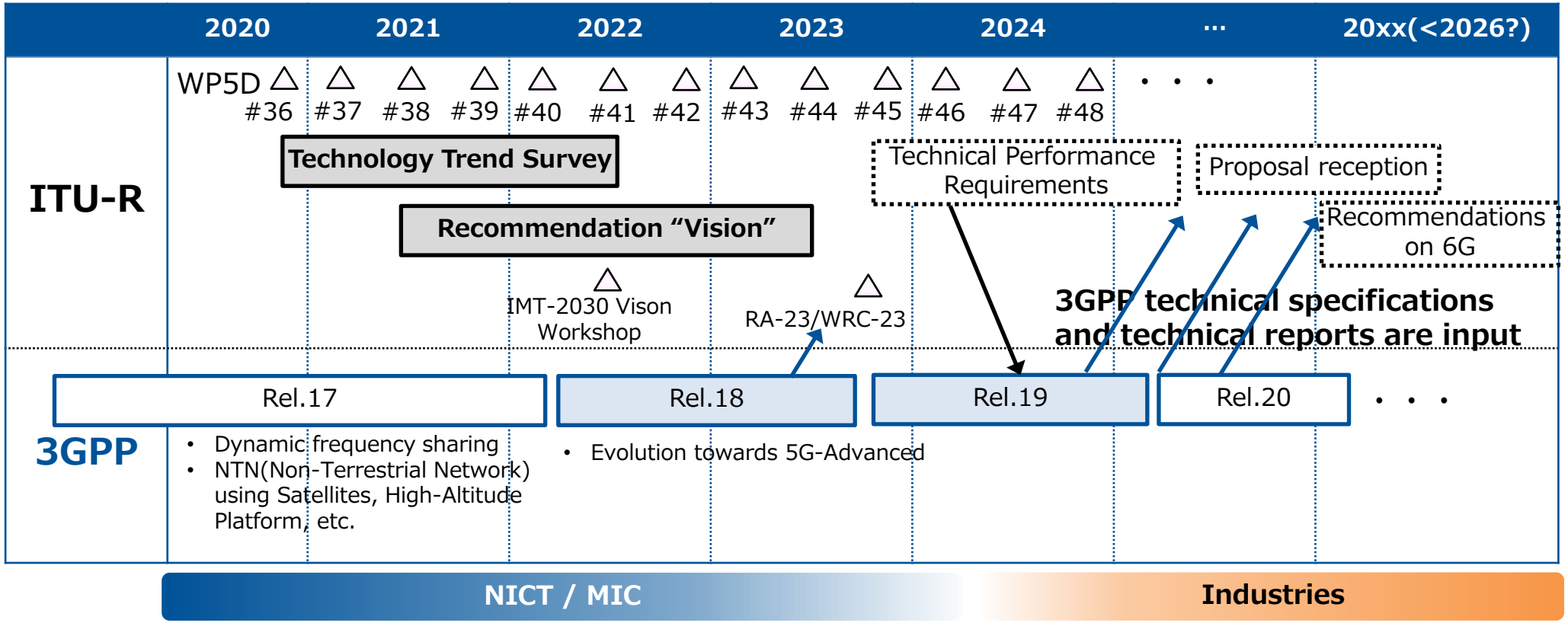
The Social Infrastructure in the Decreasing Population Era
Co-leader: HATAKAWA, Yasuyuk KDDI, NAGATA, Satoshi NTT DOCOMO, IIZUKA, Rumi Multimedia Promotion Center

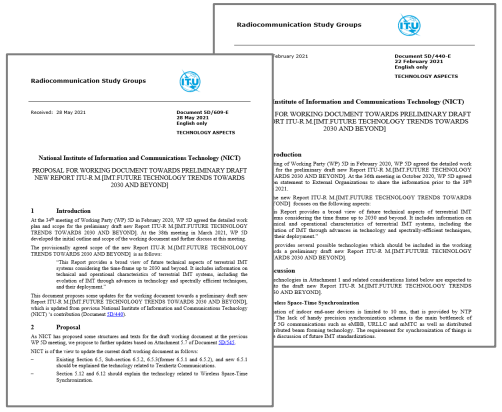
Project for realization of cross-industry orchestration
Leader: ISHIZU, Kentaro NICT

Project on creation of mechanisms for linking technology with social and economic value
Leader: HASEGAWA, Fumiki Mitsubishi Electric Corporation



Standardization Activities



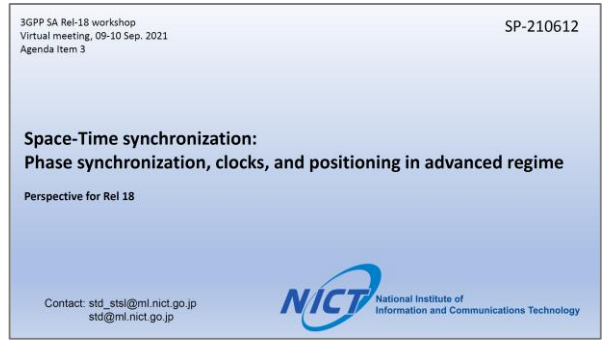


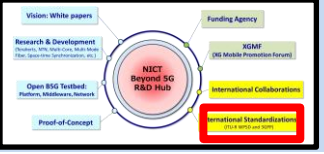
◀ **Contributions to ITU-R WP5D (5D/440, 5D/609)**

Proposals for the realization of Beyond 5G / 6G for Terahertz, Space-Time synchronization, and Non-Terrestrial Network (NTN).

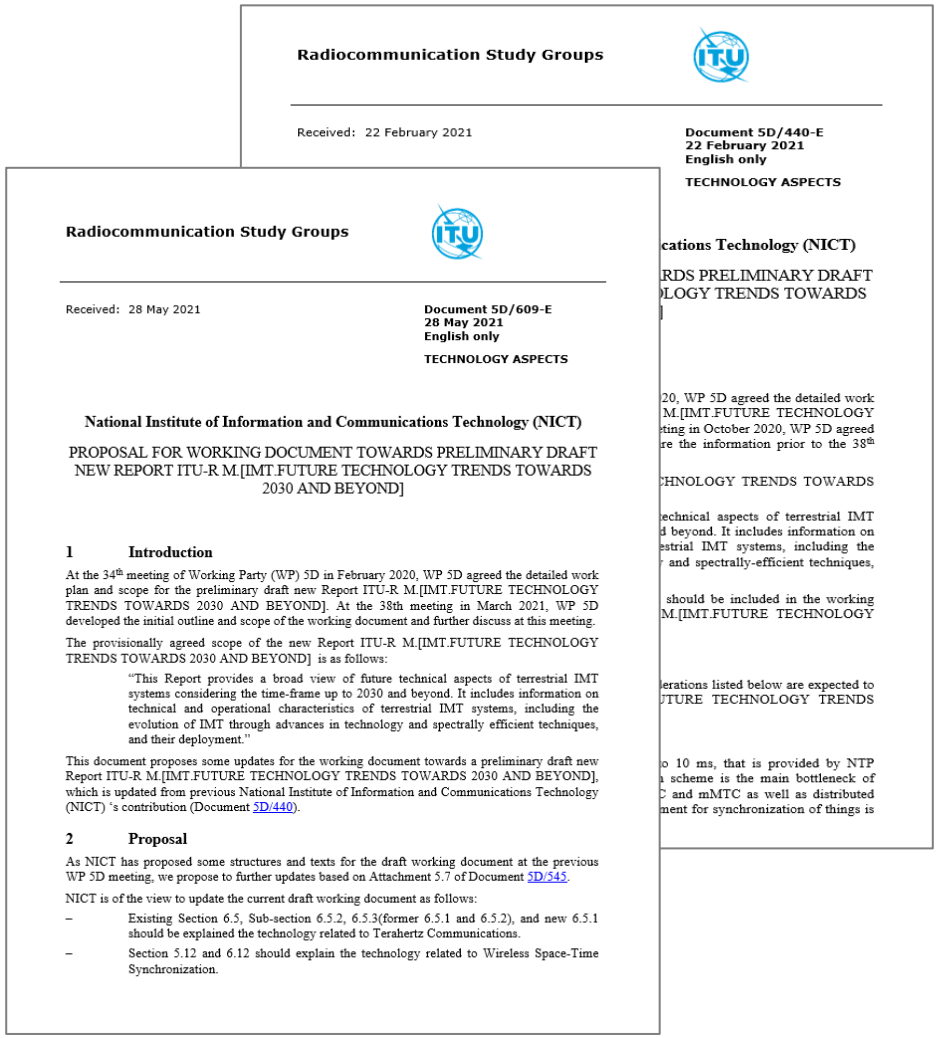
Contribution to 3GPP SA Rel.18 Workshop (SP-210612) ▶

Proposal of ultra-low latency and high-precision positioning technology by Space-Time synchronization technology.





International Standardization



Radiocommunication Study Groups

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Document 5D/440-E
22 February 2021
English only

TECHNOLOGY ASPECTS

...cations Technology (NICT)

...RDS PRELIMINARY DRAFT
...LOGY TRENDS TOWARDS

...20, WP 5D agreed the detailed work
...M.[IMT.FUTURE TECHNOLOGY
...ting in October 2020, WP 5D agreed
...re the information prior to the 38th

...CHNOLOGY TRENDS TOWARDS

...echnical aspects of terrestrial IMT
...d beyond. It includes information on
...strial IMT systems, including the
... and spectrally-efficient techniques,

... should be included in the working
...M.[IMT.FUTURE TECHNOLOGY

...erations listed below are expected to
...TURE TECHNOLOGY TRENDS

...o 10 ms, that is provided by NTP
... scheme is the main bottleneck of
...C and mMTC as well as distributed
...ment for synchronization of things is

Radiocommunication Study Groups

Received: 28 May 2021

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English only

TECHNOLOGY ASPECTS

National Institute of Information and Communications Technology (NICT)

PROPOSAL FOR WORKING DOCUMENT TOWARDS PRELIMINARY DRAFT NEW REPORT ITU-R M.[IMT.FUTURE TECHNOLOGY TRENDS TOWARDS 2030 AND BEYOND]

1 Introduction

At the 34th meeting of Working Party (WP) 5D in February 2020, WP 5D agreed the detailed work plan and scope for the preliminary draft new Report ITU-R M.[IMT.FUTURE TECHNOLOGY TRENDS TOWARDS 2030 AND BEYOND]. At the 38th meeting in March 2021, WP 5D developed the initial outline and scope of the working document and further discuss at this meeting.

The provisionally agreed scope of the new Report ITU-R M.[IMT.FUTURE TECHNOLOGY TRENDS TOWARDS 2030 AND BEYOND] is as follows:

"This Report provides a broad view of future technical aspects of terrestrial IMT systems considering the time-frame up to 2030 and beyond. It includes information on technical and operational characteristics of terrestrial IMT systems, including the evolution of IMT through advances in technology and spectrally efficient techniques, and their deployment."

This document proposes some updates for the working document towards a preliminary draft new Report ITU-R M.[IMT.FUTURE TECHNOLOGY TRENDS TOWARDS 2030 AND BEYOND], which is updated from previous National Institute of Information and Communications Technology (NICT) 's contribution (Document 5D/440).

2 Proposal

As NICT has proposed some structures and texts for the draft working document at the previous WP 5D meeting, we propose to further updates based on Attachment 5.7 of Document 5D/545.

NICT is of the view to update the current draft working document as follows:

– Existing Section 6.5, Sub-section 6.5.2, 6.5.3(former 6.5.1 and 6.5.2), and new 6.5.1 should be explained the technology related to Terahertz Communications.

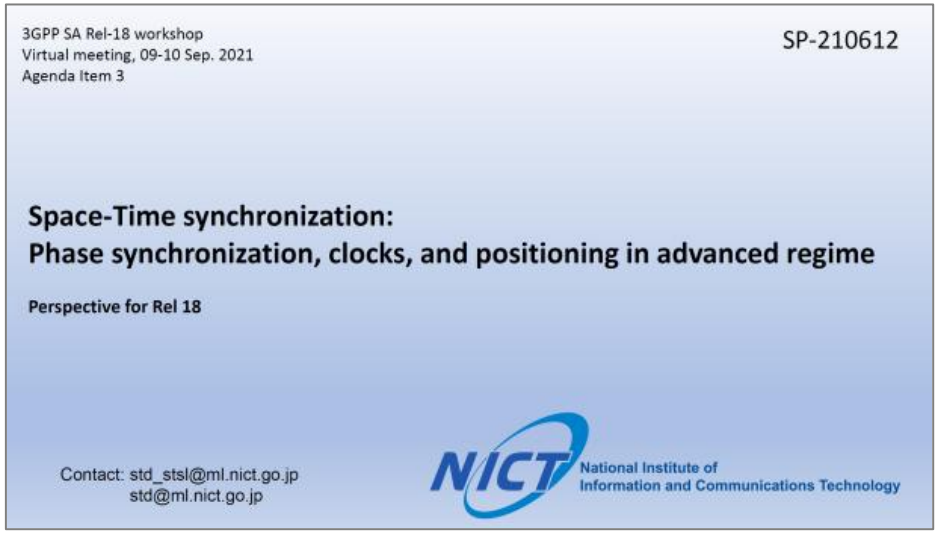
– Section 5.12 and 6.12 should explain the technology related to Wireless Space-Time Synchronization.

◀ Contributions to ITU-R WP5D (5D/440, 5D/609)

Proposals for the realization of Beyond 5G / 6G for Terahertz, Space-Time synchronization, and Non-Terrestrial Network (NTN).

▼ Contribution to 3GPP SA Rel.18 Workshop (SP-210612)

Proposal of ultra-low latency and high-precision positioning technology by Space-Time synchronization technology.



3GPP SA Rel-18 workshop
Virtual meeting, 09-10 Sep. 2021
Agenda Item 3

SP-210612

Space-Time synchronization:
Phase synchronization, clocks, and positioning in advanced regime

Perspective for Rel 18

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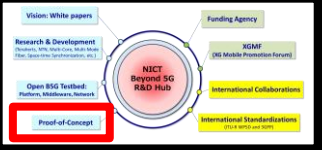
NICT National Institute of Information and Communications Technology



Zero Gravity Event

for innovative human matching across industry domains

1st: 2023/2/3

2nd: 2023/11/2

3rd: 2023/11/29

4th: 2024/1/22

5th: 2024/3/15-16

参加者募集！

好評につき今年度は複数回開催します！

Beyond 5G ゼログラビティイベント

「研究者×異業種」で新たな発想を。

新たなアイデアや発想を得るためには、様々な背景を持った人同士が交わり、一緒に議論することが重要です。このイベントでは、「研究者×異業種」がチームとなりBeyond 5Gをテーマに議論します。

PROGRAM ※各回10:00~17:00を予定しています。

第2回	2023年11月2日(木)	テーマ Cybernetic Avatar Societyが実現したら
第3回	2023年11月29日(水)	テーマ 月面都市のサービスとは？
第4回	2024年1月22日(月)	テーマ 時空を超えて実現したいこと
第5回	2024年3月15日(金) - 16日(土)	テーマ 未定（ご期待ください）

第１回は盛況のうちに終了しました！

会場

NICTイノベーションセンター（東京日本橋タワー）

※第5回のみ、機構外会場にて実施します。

詳細・お申込

右記QRコードを読み込むかURLにアクセスしてください

https://select-type.com/ev/?ev=8Gqk8GB5hhY

※募集締切：各回２週間前まで
※参加は1回から可能です。
※リピート参加大歓迎です。
※どなたでもご参加できます。
※会終了後、交流会も予定しています。

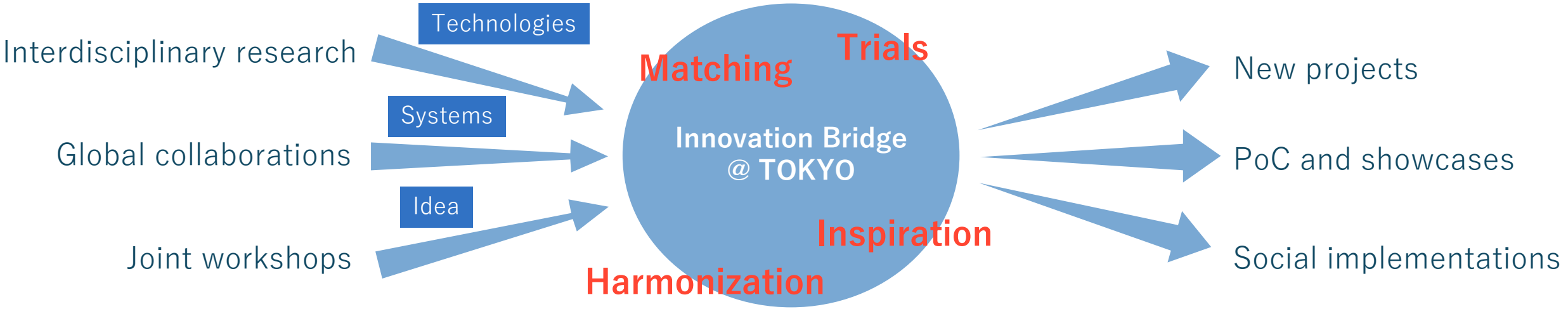
お申し込みはこちら→

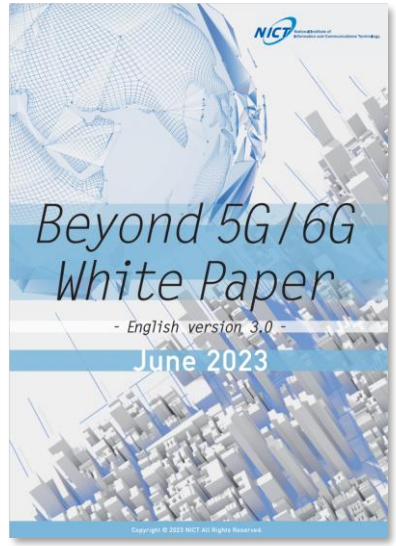
ご意見・ご質問はこちらへ
国立研究開発法人情報通信研究機構　Beyond 5G研究開発推進ユニット
B5G-event@ml.nict.go.jp

主催：国立研究開発法人情報通信研究機構 Beyond5G研究開発推進ユニット

Innovation Bridge @TOKYO

- Aiming at Beyond 5G / 6G R&D innovations
- Highly accessible building in central Tokyo
- Expected to be open early in 2026 (pre-opening in August 2025)
- Bringing together idea, systems, and technologies
- Agile technology harmonization for timely PoC and showcase





NICT
Beyond 5G R&D Promotion Unit

Looking forward to collaborations!