INTERNATIONAL MARITIME ORGANIZATION

Ministry of Oceans and Fisheries

Maritime Communication Evolution

< *IMT-2030(6G): Building Block for Connected Ocean* >

14th May 2024

KOO, Hyounhee

SyncTechno Inc.

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Ministry of Oceans and Fisheries

CONTENTS

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Introduction of the Speaker

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Activities in progress – KOO, Hyounhee

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2002

Mobile Communication & Global Standardization

(2004 ~ 2008) (2008 ~) (2014~) (2023~)

2015

Public Safety & Collaboration with Relevant Stakeholders

- 2023 ~ Present: ***Chair of AWG TG PPDR*** for public safety over IMT in APAC region
- 2020 ~ 2022: ***Editor* of *AWG* work** related to public warning
- 2016 ~ 2020: ***Rapporteur of 3GPP ePWS*** for the enhancement of public warning

2016

Maritime Safety & Digitalization over IMT-2020(5G)/IMT-2030(6G)

- 2023 ~ Present: ***Leader of IALA DTEC Task Group*** on Marine AtoN over IMT-2030
- 2019 ~ Present: ***3GPP representative (liaison)*** for the collaboration with IALA for maritime sector over IMT
- 2023.01~09: ***Main contributor of ITU-R report M.2527*** introducing maritime usage over IMT-2020&beyond
- 2016~2018: ***Rapporteur of 3GPP MARCOM work*** introducing the maritime usage into 3GPP standardization

Present (May 2024)

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IMO Strategic Plan

for 2024 to 2029

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MISSION STATEMENT

The mission of the International Maritime Organization (IMO), as a United Nations specialized agency, is to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation. This will be accomplished by adopting the highest practicable standards of maritime safety and security, efficiency of navigation and prevention and control of pollution from ships, as well as through consideration of the related legal matters and effective implementation of IMO instruments, with a view to their universal and uniform application.

VISION STATEMENT

The vision of IMO for the period 2024 to 2029 is as follows:

1. IMO will uphold its leadership role as the global regulator of shipping, promote greater recognition of the sector's importance to world trade, and enable the advancement of shipping. In this regard, IMO will address the challenges and opportunities presented by ongoing developments in technology, the protection and preservation of the marine environment, tackling climate change, improving the well-being and competence of seafarers, and strengthening the resilience of the maritime industry and global supply chains.
2. To achieve this, IMO will focus on the review, development, implementation of and compliance with IMO instruments in its pursuit to proactively identify, analyse and address emerging issues. IMO will support Member States in achieving the goals of the 2030 Agenda for Sustainable Development, including through capacity development, taking into account the Organization's Capacity-Building Decade 2021-2030 Strategy.

Strategic Direction

SD 1: Ensure implementation of IMO instruments supported by capacity development

SD 2: Integrate new, emerging and advancing technologies in the regulatory framework

SD 3: Respond to climate change and reduce greenhouse gas emissions from international shipping

SD 4: Continue to engage in ocean governance

SD 5: Enhance global facilitation, supply chain resilience and security of international trade

SD 6: Address the human element

SD 7: Ensure the regulatory effectiveness of international shipping

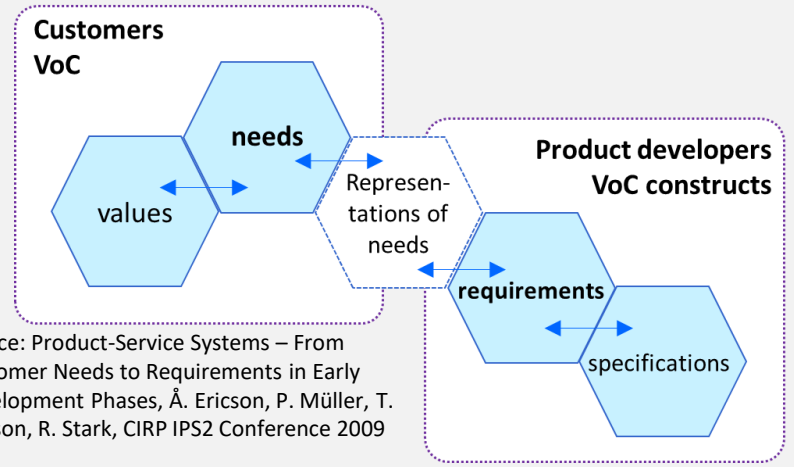
SD 8: Ensure organizational effectiveness

IMO regulatory framework affecting which phase of maritime communication technology?

New & Emerging & Advanced Technologies

Current approach

IMO Regulatory Framework



Source: Product-Service Systems – From Customer Needs to Requirements in Early Development Phases, Å. Ericson, P. Müller, T. Larsson, R. Stark, CIRP IPS2 Conference 2009

Phase in which error found	Cost relative to requirements phase
Requirements (Standardization)	1
Design	3-6
Coding	10
Development testing	15-40
Acceptance testing	30-70
Operation	40-1000

Source: Exploring requirements: quality before design, Donald C. Gause, Gerald M. Weinberg, Dorset House/Wiley, 1992

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Various Industries' Trends

towards IMT-2030 (6G) Standardization

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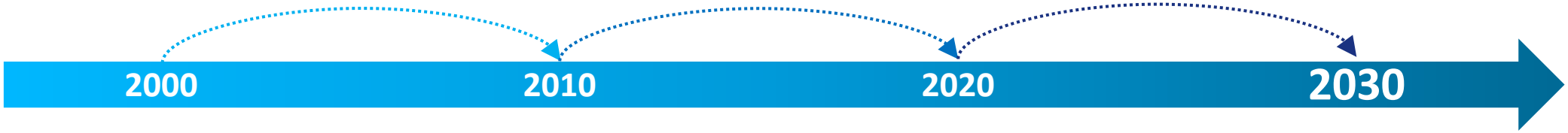
IMT families (1/2)



ITU	IMT-2000	IMT-Advanced	IMT-2020	**IMT-2030**
Commercial market	3G	4G	5G	**6G**
3GPP A GLOBAL INITIATIVE	UMTS	LTE	5G	6G

IMT families (2/2)

2024

10 years | 10 years | 10 years | 10 years

1990s | 1998 | 2000s | 2010s | 2020s | 2030s

2G GSM/GPRS/EDGE in ETSI — Evolution of GSM/GPRS/EDGE from 1998 to 2020* in 3GPP

GSM: Global System for Mobile communication
GPRS: General Packet Radio Service
EDGE: Enhanced Data for GSM Evolution

3G UMTS/WCDMA/HSPA/HSPA+ from 1998 to 2020* in 3GPP

UMTS: Universal Mobile Communication System
WCDMA: Wideband Code Division Multiple Access
HSPA: High Speed Downlink Packet Access

4G LTE / LTE Advanced / LTE Advanced Pro

5G 5G/5G-Advanced

6G

Global Standards Body for Mobile Communication based on IMT frameworks

5G ADVANCED

SMARTPHONE/TABLET | AUTONOMOUS VEHICLES | SMART FACTORY | SMART CITIES | SMART HOME





Diverse forms of 5G devices tightly coupled with societies anywhere anytime

Case studies

(within the framework of 3GPP standardization)

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Regulatory Policies Prior to 3GPP Standardization

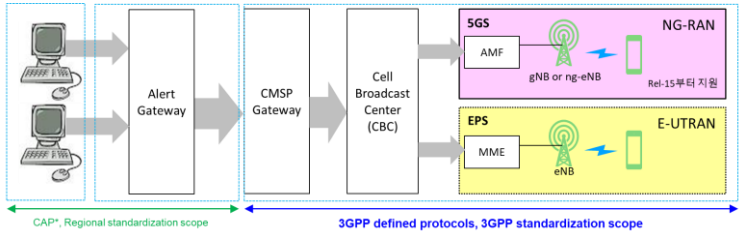
Inter-Authority communication

FirstNet
Home Office
Bundesministerium für Wirtschaft und Technologie
POLITIE
MINISTÈRE DE L'INTÉRIEUR
Liberté Égalité Fraternité
NTIA
DEPARTMENT OF COMMERCE

Authority-to-Public communication

European Commission
Kingdom of the Netherlands

Warning message on the phone



Emergency Call (eCall) communication

European Commission

Regulation (EU) 2015/758

eCall in-vehicle system based on the 112 service

GSM LTE 5G

Source of figure: transsec.eu

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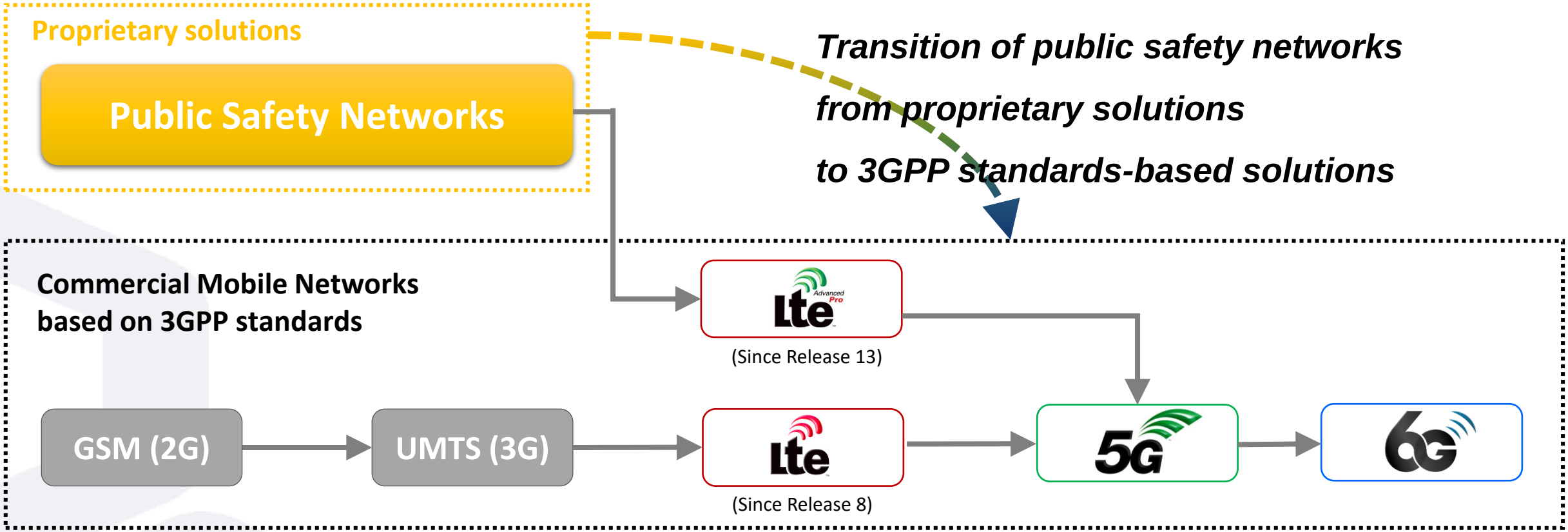
Inter-authority communication in 3GPP



Source of figure: SyncTechno Inc.

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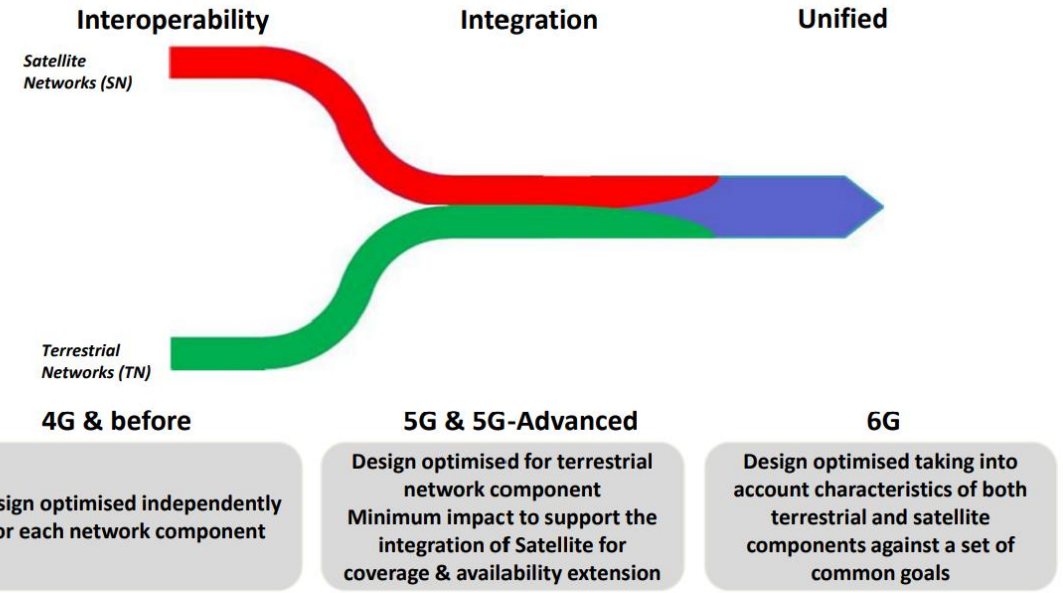
Satellite stakeholders participating in 3GPP since 5G started

to integrate satellite component into the framework of 3GPP standardization for 5G ADVANCED 6G

SES
INTELSAT
eutelsat ONEWEB eutelsat GROUP
Viasat
dish NETWORK
HUGHES
inmarsat
iridium
Terrestar solutions
SATELIOT Space · Connecting · 5G IoT

esa
AIRBUS
THALES
ligado NETWORKS
Gatehouse Satcom
Gilat
ESOA EMEA SATELLITE OPERATORS ASSOCIATION

NOTE: ESOA is the 3GPP MRP member.



Source: Thales Alenia Space, 'NTN requirements in Rel-18' at 3GPP MRP mini workshop, June 23rd 2021

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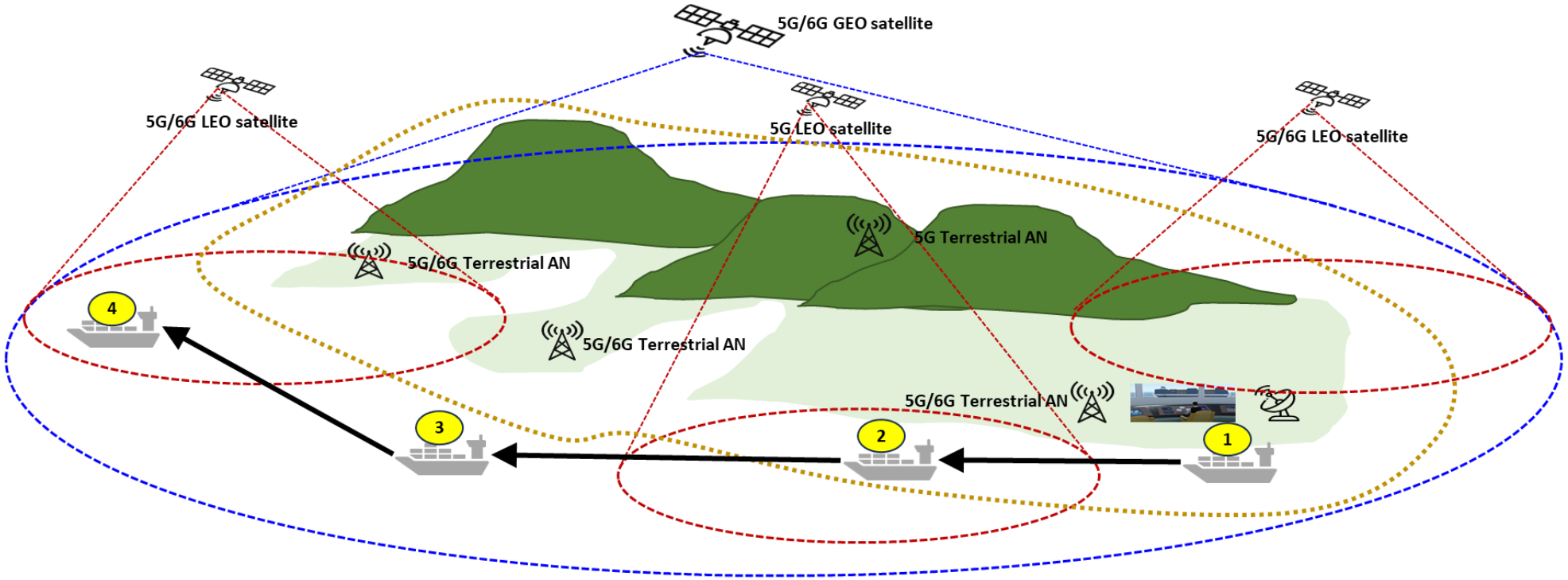
Towards Ubiquitous connectivity *based on* multiple RATs *over* 5G ADVANCED 6G

RATs: Radio Access Technologies



Navigation direction	1	2	3	4
Supported RAT connection	GEO : Connected LEO : Not available Terrestrial : Connected	GEO : Connected LEO : Connected Terrestrial : Connected	GEO : Connected LEO : Not available Terrestrial : Not available	GEO : Connected LEO : Connected Terrestrial : Not available

Coverage of 5G/6G terrestrial ANs
Coverage of 5G/6G GEO satellite ANs
Coverage of 5G/6G LEO satellite ANs

Source: Hyounhee KOO et al., 'Simultaneous utilization of multiple radio access networks in ubiquitous 6G connectivity for autonomous ships: opportunities and challenges,' Journal of Marine Science and Engineering, Nov. 2023, https://doi.org/10.3390/jmse11112106

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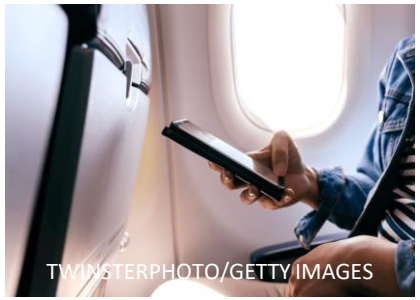
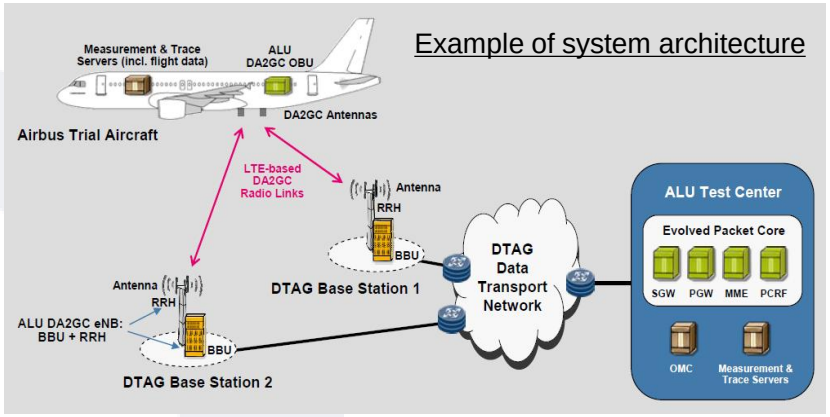
In-flight connectivity (AS IS)


TWINSTERPHOTO/GETTY IMAGES


YACOBCHUK/GETTY IMAGES



Source of figure: DA2GC-B4P_Trial_Flight_Presentation.ppt via The 3G4G Blog

Air-To Ground Communications

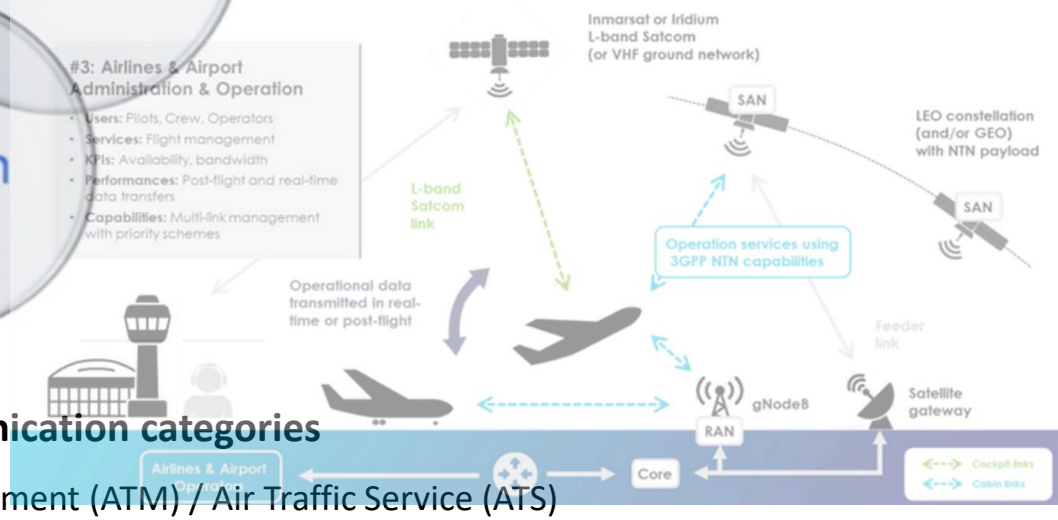
GSM LTE 5G

Aviation Connectivity (TO BE)

SEAMLESS AIR ALLIANCE

(Joined 3GPP MRP* in April 2024)

*MRP: Market Representative Partner



※ Aviation communication categories

- Air Traffic Management (ATM) / Air Traffic Service (ATS)
- Aeronautical/Airline/Aircraft Operational Communication (AOC)
- Aeronautical/Airline/Aircraft Information Services (AIS)
- Aeronautical Passenger Information and Entertainment Services (PIES)
- Aeronautical Public/Passenger Communication (APC)

Source: https://www.seamlessalliance.com/publications/

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*Stakeholders from various industries have **actively participated** in influencing the 3GPP standardization process of 5G ADVANCED 6G*

Railways

UIC INTERNATIONAL UNION OF RAILWAYS

LTE Advanced Pro → 5G ADVANCED → 6G

Automotives

GM General Motors · BOSCH · HYUNDAI · TOYOTA · 5GAA Automotive Association

(3GPP MRP)

5G ADVANCED → 6G

Smart factories

SIEMENS · ERICSSON · Deutsche Telekom · verizon · 5G IA INFRASTRUCTURE ASSOCIATION

(3GPP MRP)

5G ADVANCED → 6G

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Global Activities on IMT-2030 (6G)

for Maritime Domain in ITU-R, IALA and 3GPP

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Recommendation ITU-R M.2160「IMT-2030 Framework」

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ITUPublications
Recommendations

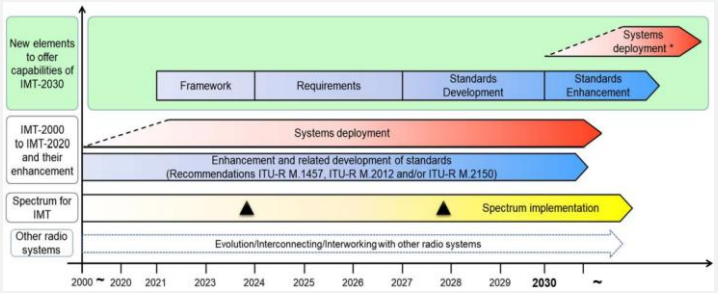
International Telecommunication Union
Radiocommunication Sector

Recommendation ITU-R M.2160-0
(11/2023)

M Series: Mobile, radiodetermination, amateur and related satellite services

Framework and overall objectives of the future development of IMT for 2030 and beyond

※ IMT-2030 related timelines



Source: https://www.itu.int/rec/R-REC-M.2160-0-202311-I/en

IMT-2030 (6G)

6 Usage scenarios

Extension from IMT-2020 (5G)

- eMBB ⇨ **Immersive** Communication
- mMTC ⇨ **Massive** Communication
- URLLC ⇨ **HRLLC** (HRLLC – Hyper Reliable & Low-Latency Communication)

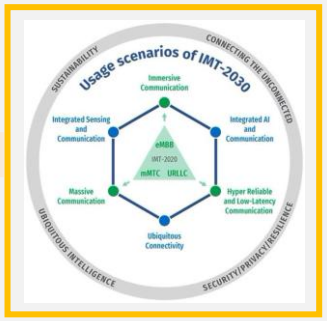
New

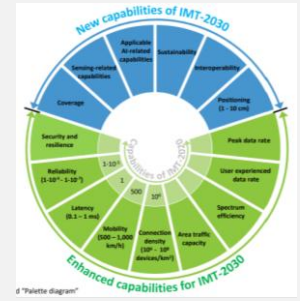
- **Ubiquitous Connectivity**
- **AI and Communication**
- **Integrated Sensing and Communication**

4 Overarching aspects

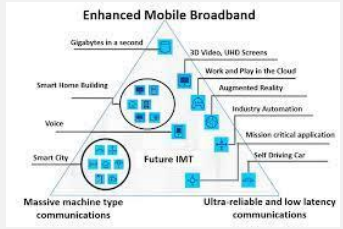
- Sustainability
- Connecting the unconnected
- Ubiquitous intelligence
- Security/resilience

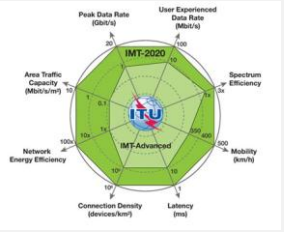
※ IMT-2030 (6G) usage scenarios & 15 KPIs



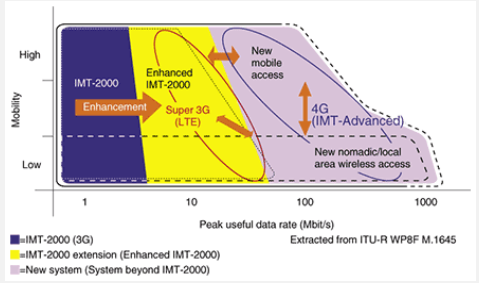


※ IMT-2020 (5G) usage scenarios & 8 KPIs





※ IMT-2000(3G) & IMT-Advanced(4G) 2 KPIs



Source: ITU-R

ITU-R Report M.2527 introducing maritime usage over IMT

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ITUPublications

International Telecommunication Union
Radiocommunication Sector

Report ITU-R M.2527-0
(09/2023)

M Series: Mobile, radiodetermination, amateur and related satellite services

Applications of the terrestrial component of International Mobile Telecommunications for specific societal, industrial and other usages

Source: https://www.itu.int/pub/R-REP-M.2527/en

REPORT ITU-R M.2527-0

Applications of the terrestrial component of International Mobile Telecommunications for specific societal, industrial and other usages

(Question ITU-R 262/5)

(2023)

TABLE OF CONTENTS

Task 6.2.1 for Marine AtoN over IMT-2030 (1/2)

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Task 6.2.1 for Marine AtoN over IMT-2030 approved at IALA DTEC#01 meeting held in September 2023.

IALA COMMITTEE WORK PROGRAMME 2023-2027	Reference to Standards	Title	Description	Expected outcome	Committee
	S1060 Digital communication technologies	Contribute to the development of IMT-2030 by formulating user requirements for Marine AtoN.	Contribute towards the development of 3GPP mobile communication standards, with a specific focus on the maritime industry vertical.	Revised Guideline, Reportage, input to 3GPP	DTEC

Task 6.2.1 for Marine AtoN over IMT-2030 (2/2)

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< Work Scope >

Development of *use cases and service requirements including regulatory aspects* for Marine Aids to Navigation (Marine AtoN)* over IMT-2030 (beyond 5G) *to formulate inputs* as served for incorporating demands of Marine AtoN related stakeholders *into 3GPP standardization* for IMT-2030 (beyond 5G).

< Categories (tentatively) considerable for use cases >

- Maritime Buoyage System (MBS)
- Positioning, Navigation and Timing (PNT)
- Vessel Traffic Services (VTS)
- Digital Maritime Services such as Single Window Reporting etc.

< Global collaboration with external bodies >

(Since 2018)

- *IALA contribution/liaison notes* to be *sent out to IMO, ITU-R and 3GPP TSGs* to inform them of IALA task 6.2.1 for Marine AtoN over IMT-2030 after the approval of IALA Council in June 2024

Maritime Communication over IMT-2020 and beyond

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Aug. 2016 ~ Dec. 2018: 3GPP Rel-16 MARCOM*

* MARCOM: Maritime Communication Services over 3GPP Systems

3GPP TR 22.819 V16.0.0 (2018-06)

3GPP TS 22.119 V16.0.0 (2018-12)

Maritime domain ***was included in the Scope of 3GPP standardization with the completion of Rel-16 MARCOM work.***

Rapporteur of FS_MARCOM study
- Hyounhee KOO (SyncTechno)

https://www.3gpp.org/ftp//Specs/archive/22_series/22.819/22819-g00.zip

Rapporteur of Rel-16 MARCOM work
- Hyounhee KOO (SyncTechno)

https://www.3gpp.org/ftp//Specs/archive/22_series/22.119/22119-g00.zip

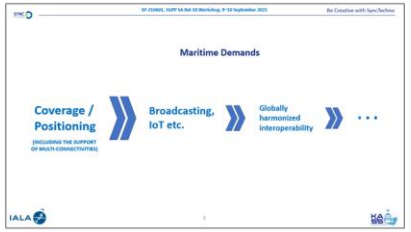
Sept. 2019 : 3GPP liaison with IALA

- 3GPP Liaoson Person
  - A contact between 3GPP and a dedicated external (standards) body, sometimes even only to a specific working group of an external body.
- External bodies that 3GPP Liaison Persons were appointed for at 3GPP TSG SA#85 in September 2019

ITU-R, IETF, MPEG, ITU-T, ngmn, ESOA, IALA

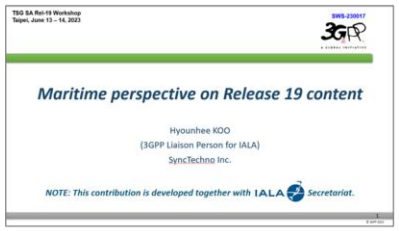
Hyounhee KOO (SyncTechno)

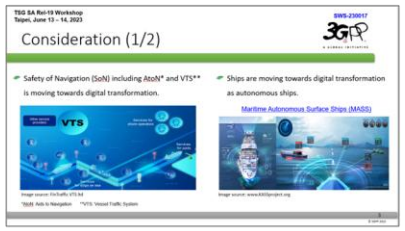
Sept. 2021 : Rel-18, maritime requirements prioritization based on the collaboration with IALA

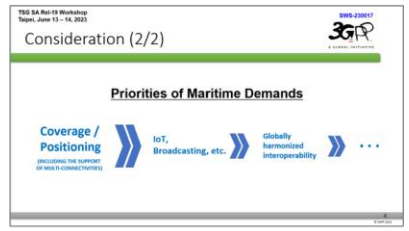


Source: SP-210601, 3GPP SA Rel-18 Workshop, 9~10 September 2021

Jun. 2023 : Rel-19, maritime requirements prioritization based on the collaboration with IALA







Source: SWS-230017, 3GPP SA Rel-19 Workshop, Taipei, June 13-14, 2023

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Moving Forward

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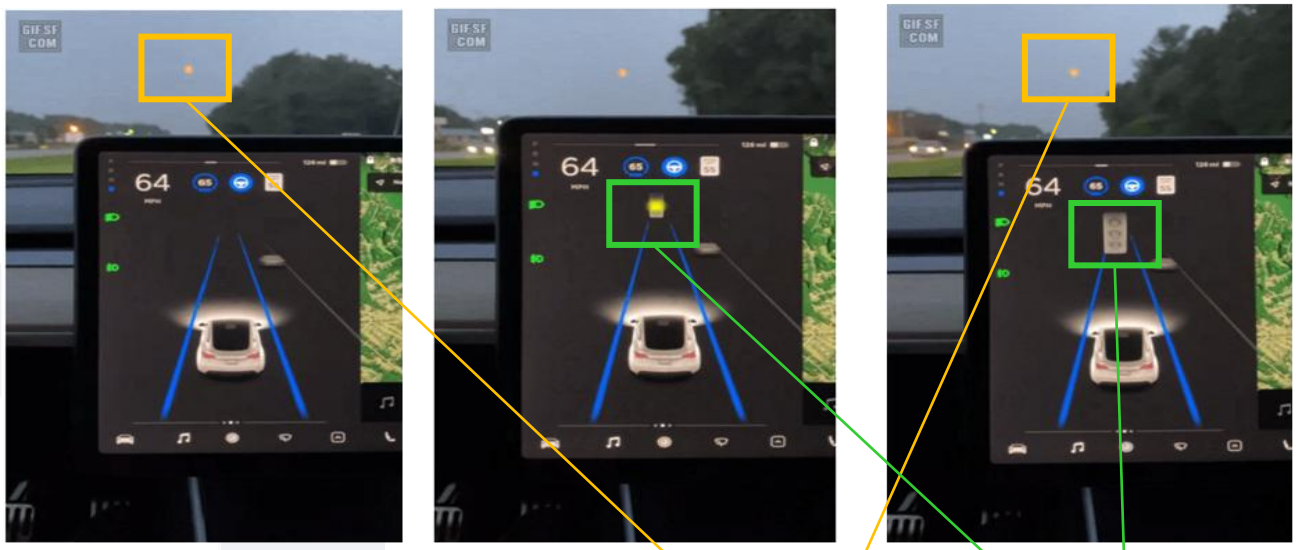
Utilizing **camera, sensors** but ***false operation likely to occur***
due to low accuracy depending on day/night or weather



Source: https://www.bobaedream.co.kr

The car's sensor identified the moon as a traffic light.

Dedicated lane of the expressway for
ambulance, fire engines, and police cars etc.
in case of emergency as well as bus

*For the **exchange of safety related information** throughout IMT-2030(6G)*

*For the **exchange of general (non-safety) information** throughout IMT-2030 (6G)*

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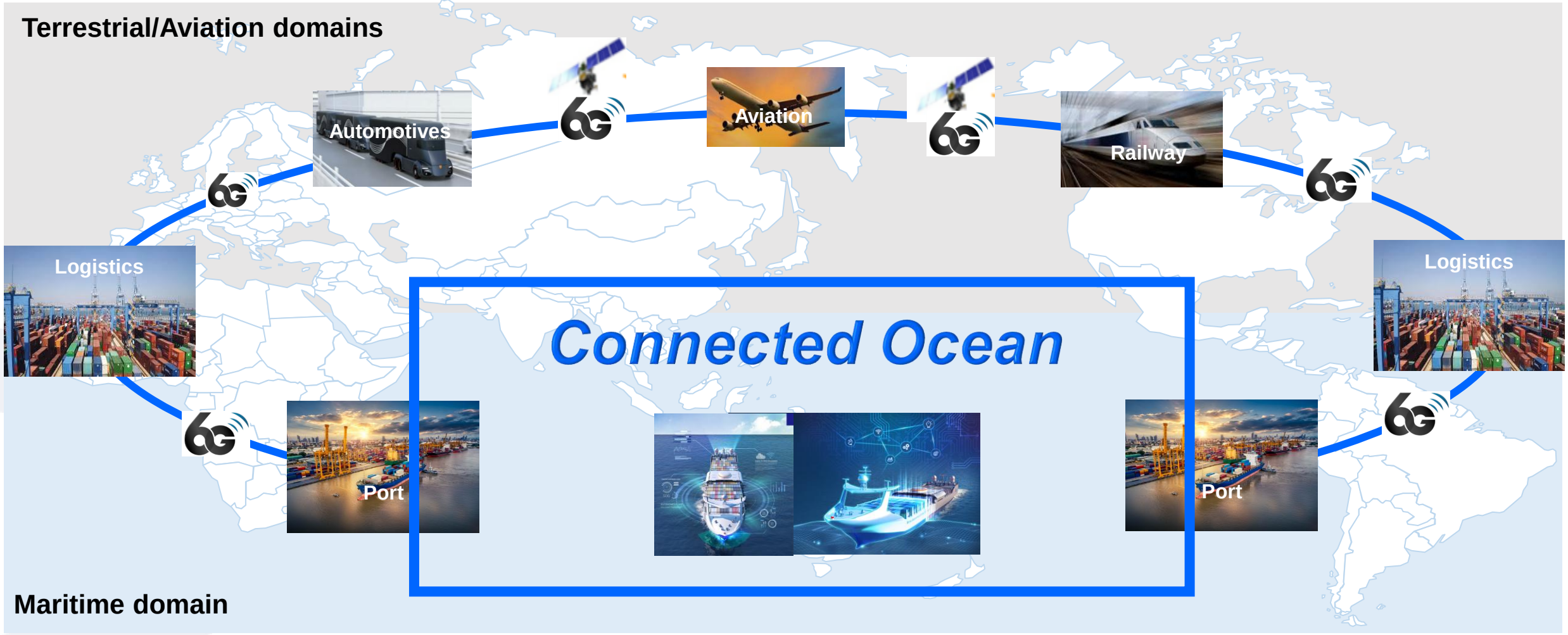

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IMT-2030(6G): Building Block for Connected Ocean

IMT-2030(6G) Standardization

New Approach

to integrate IMO regulatory aspects into the framework of the IMT-2030 (6G) for maritime communication & connectivity

IMO Regulatory Framework