Activities of Scalability Working Group (WG)

Morio Toyoshima

Scalability WG Leader

National Institute of Information and Communications Technology (NICT)

October 25, 2022

Outline

- Scalability WG
  - Overview
  - Study Roadmap
  - Structure
- Current Status of Landscape Mapping for Non-Terrestrial Networks (NTN)
  - Technical Roadmap for NTN
  - Examples of Detailed Information for NTN
  - Summary of Landscape Mapping
- International Collaboration for NTN
- Concluding Remarks

Scalability WG Overview

- Objectives
  - Landscape mapping on NTN
  - Identification of potential domestic companies contributing NTN technologies
  - Activation of NTN area with international collaborations
  - Aiming for a role of NTN global consortium
- Current activities
  - FY2021
    - First trial of the landscape mapping on four areas (HAPS, HTS, Satellite IoT, and Maritime domain)
  - FY2022
    - Continuous discussion on NTN area
    - Exchanging the opinions among WG members
    - New use case study through cross-industrial association

Study Roadmap for Scalability WG

Working items / meeting dates		2022						2023	
		No. 1 July 29	No. 2 Sept. 2	No. 3 Sept. 30	No. 4 Oct. 28	No. 5 Nov. 25	No. 6 Dec. 23	No. 7 Jan. 27	No. 8 Feb. 24
Information exchange		K/O	X	X	X	X	X	X	
Landscape mapping	NTN technology	K/O	X	X	X				X
	Use case study				X	X			X
	Institution/ standardization						X	X	X
Cross-industrial association	Dissemination of WG activities							X	X
	Study session					X	X		X

Major discussion items:
- Technical information (priority No.1)
- Use case study
- Institution / standardization
- Cross-industrial association

K/O: Kick Off Meeting

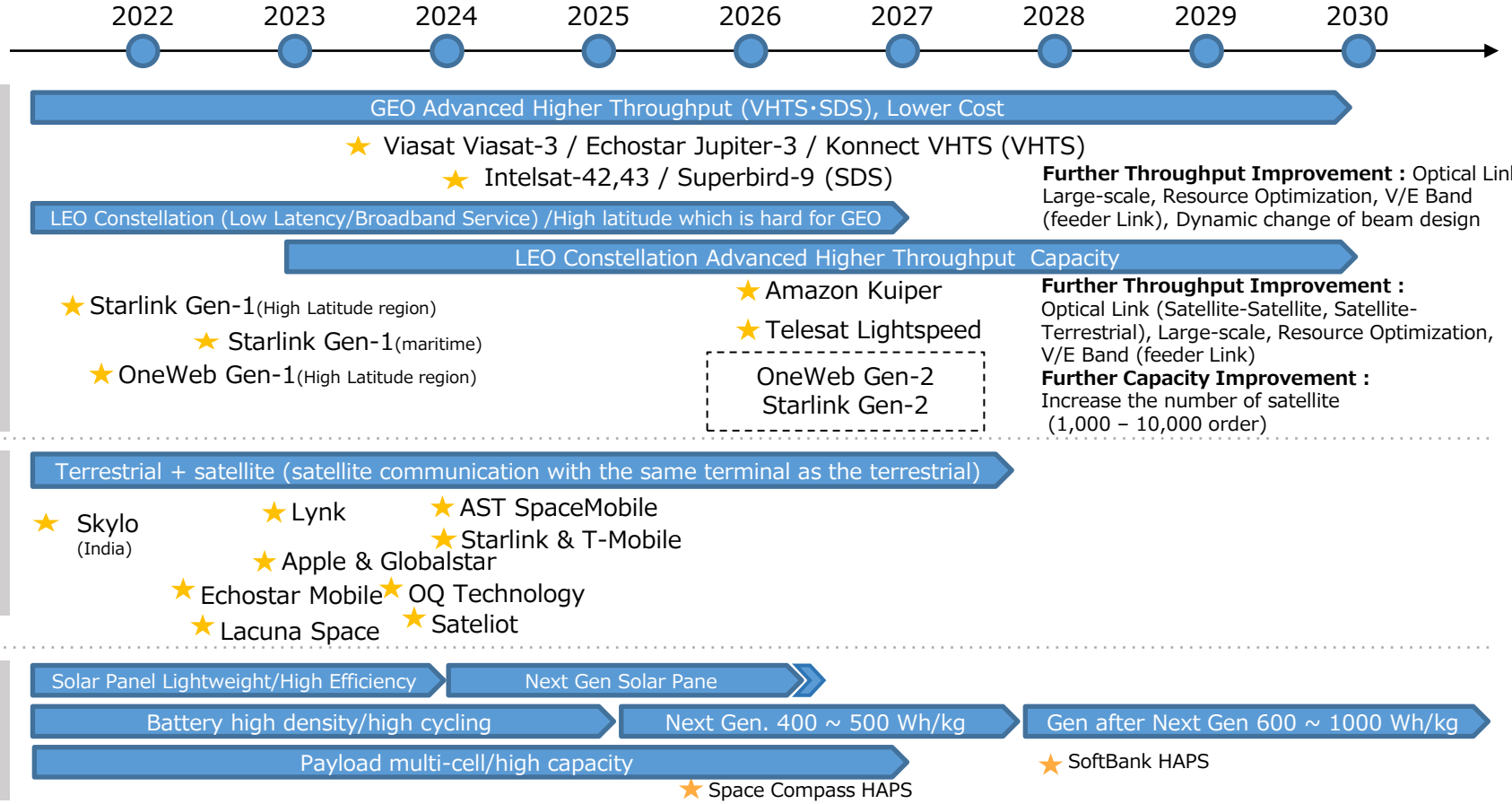
Scalability WG Structure

Working items		Coordinator	Participation member	Contents
Information exchange		**SoftBank**	Ericsson Japan VIAVI Huawei Rakuten Mobile	- Information exchange in WG
Landscape mapping	**NTN technology**	**Rakuten Mobile**	Ericsson Japan SoftBank VIAVI Huawei	- Investigation on NTN technologies - Report in the international committee meeting - Report in the general assembly in B5G Consortium
	Use case study	**Huawei**	Ericsson Japan SoftBank VIAVI Rakuten Mobile	- Study on NTN use cases for interdisciplinary stakeholders - Report in the international committee meeting - Report in the general assembly in B5G Consortium
	Institution/ standardization	**SoftBank**	Ericsson Japan VIAVI Huawei Rakuten Mobile	- Discussion on the institution/standardization for NTN and the use cases - Report in the international committee meeting - Report in the general assembly in B5G Consortium
Cross-industrial association	**Dissemination of WG activities**	**VIAVI**	Ericsson Japan SoftBank Huawei Rakuten Mobile	- Dissemination to the companies outside B5G Consortium
	Study session	**Ericsson Japan**	SoftBank VIAVI Huawei Rakuten Mobile	- Discussion on the future vision by utilizing NTN - Plan and execution of activities involving cross-industrial association

Observer	Tokyo Metropolitan University (Prof. Ishii), NTT DOCOMO

Welcome to join WG anytime!

Landscape Map: NTN Technology Roadmap



Landscape Map: NTN Technology Roadmap

Satellite BB	Currently, the service is mainly provided by geostationary satellites, but the service of the LEO constellation is also starting, and it is expected to improve performance (low latency, high speed), reduce cost, and use at high latitudes, which was difficult with geostationary satellites. In addition, with the advent of VHTS and Software Defined Satellites (SDS), capacity increase and cost decrease of geostationary satellites system are expected. Currently, the Ku band is the mainstream service link frequency, but in the future, the use of the Ka band will be further advanced, and the use of even higher frequency bands such as the V band and the E band is also planned for feeder link.
NTN IoT & Mobile Direct	Currently, satellite communication requires terminals dedicated to satellite communication, but a satellite communication system that can communicate directly with 3GPP mobile phone terminals, 3GPP IoT terminals, and LoRa IoT terminals is planned. Both terrestrial and satellite networks will be available at the same terminal, and coverage is expected to expand significantly.
Maritime	Currently, in addition to L-band services (Iridium, Inmarsat), the use of services using geostationary satellites in the Ku band and Ka-band where wideband is available is increasing. In the future, the availability of the LEO constellation is expected to further improve performance (low latency, high speed) and reduce costs. In addition, with the advent of VHTS and Software Defined Satellites (SDS), capacity increase and cost decrease of geostationary satellites system are expected. The satellite system is not planned to be dedicated to the marine area, and each company has separately designed services and terminals for the marine area.
HAPS	It is in the stage of development and testing. Methods using mobile direct communication and CPE are planned. It is expected to be used as a backup in the event of a disaster or as a super-wide area of mobile coverage. Compared to satellites, the coverage is narrower due to the lower altitude, but it is possible to provide lower latency and faster communication services with the rapid deployment.

NTN Technology Roadmap, Comparison Chart, Mobile Direct

	SpaceMobile	Lynk	Starlink	Apple & Globalstar
Satellite Type	LEO	LEO	LEO	LEO
Service Link Frequency Band	3GPP Frequency Band (Mid-band, Low-band) Utilize the frequencies of partner MNOs	3GPP Frequency Band (Low-band) Utilize the frequencies of partner MNOs	3GPP Frequency Band (Mid-band) Utilize the frequencies of partner MNOs	Specific frequencies designated to Global Star
End Device	3GPP Compliant UEs	3GPP Compliant UEs	3GPP Compliant UEs	iPhone14 model (Is the satellite communications department independently implemented?)
Service	Text, Voice, Data	Text (Planning to support Voice/Data in future)	Text (Planning to support Voice/Data in future)	Only Emergency notification
Coverage	Global, but within the range of the frequency of the partner MNO	Global, but within the range of the frequency of the partner MNO	Global, but within the range of the frequency of the partner MNO	United States, Canada (In the future, it may be used within the coverage range of Globalstar.)
Features	24m diameter phased array antenna Bentpipe method Doppler on the ground, correcting for delays	1 m ~ 1.5 m diameter phased array antenna eNodeB and EPC on satellites Even if you are away from the gateway, you can send and receive text messages via store & forward communication.	5 ~ 6 m diameter phased array antenna Doppler correction	Utilizing Globalstar's satellite communications capabilities
Related legal matters	Radio Communication Regulations 4.4	Radio Communication Regulations 4.4	Radio Communication Regulations 4.4	Used with an existing license?
Use Cases	Significant expansion of mobile network coverage Restoration of mobile networks in the event of a large-scale disaster, etc.	Message service outside of mobile coverage, emergency calls	Message service outside of mobile coverage, emergency calls	Emergency calls outside of mobile coverage

In addition, there is the following news
- Huawei's smartphone "Mate 50" supports sending text and location information in an emergency using the positioning satellite "Beidou" (transmission only)
* ZTE has succeeded in connecting ultra-long-distance direct connections between mobile phone terminals and communication satellites (GEO?) 36,000 km (kilometers) away.

NTN Technology Roadmap, Comparison Chart, Satellite Broad Band

	VHTS･SDS (GEO)	OneWeb	Starlink	Amazon Kuiper	Telesat Lightspeed
Satellite Type	GEO	LEO	LEO	LEO	LEO
Service Link Frequency Band	Ku-band, Ka-band	Ku-band	Ku-band, Ka-band (GEN2から)	Ka-band	Ka-band
End Device	Dedicated Terminal (e.g. VSAT) 60 cm ～ 1.2 m diameter Parabolic antenna	Dedicated Terminal ~1.2 m diameter Parabolic antenna 50x45 cm diameter Flat antenna	Dedicated Terminal 50 x 30 cm Flat antenna 57x51 cm Flat antenna	Dedicated Terminal 30 cm Flat antenna	Parabolic antenna Flat antenna
Througput	~150 Mbps (Downlink)	~195Mbps (Downlink)	~350Mbps (Downlink)	~400Mbps (Downlink)	~7.5 Gbps
Latency	~600 ms (Altitude 35,000 km)	~70 ms (Altitude 1,200 km)	20 ~ 40 ms (Altitude 500 km)	~50 ms? (Altitude 600 km)	~70 ms? (Altitude 1,015 km, 1,325 km)
Coverage	Depends on the position of the satellite. Polar coverage is difficult.	Global	Global	Global	Global
Features	Existing ground systems for geostationary satellites can be used. Reduced costs due to increased capacity and optimized coverage with flexible beams.	Inter-satellite optical link (from GEN2)	Inter-satellite optical link (not on board the initial constellation)		Regenerative payload Inter-satellite optical link
Related legal matters	Available under existing systems (VSAT, ESIM, etc.)	Regarding GEN1, the relevant ministerial ordinances, etc. have been revised.	Regarding GEN1, the relevant ministerial ordinances, etc. have been revised.		
Use Case	Rural areas, broadband for ships and aircraft, mobile backhaul, backup lines for disasters	The basic use case is the same as that of services using geostationary satellites (VHTS and SDS). Although latency, throughput, cost, and ease of terminal installation are considered advantageous, it is assumed that there are many cases where it is difficult to use because the visibility conditions are stricter than those of GEO satellites. In the case of services for ships and aircraft, the outlook conditions are not an issue, so it is expected that they will be actively used in the future.			

Technology Details

SpaceMobile

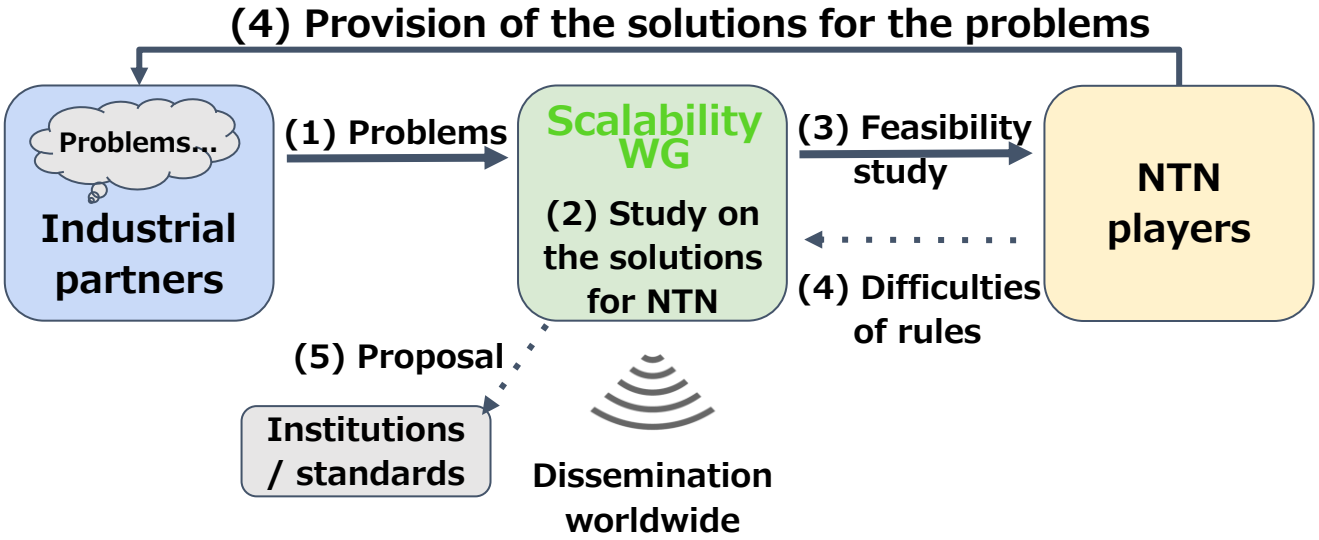
Satellite Overview	AST SpaceMobile's constellation of 168 satellites at an altitude of approximately 730 km Provide direct communication services to regular mobile phones (VoLTE, broadband communications) Uses the frequencies of MNO partners (3GPP frequency) The test satellite BlueWalker3 was launched in September 2022.
Technology	24m size phased array antenna Bent pipe method (eNB is located on the ground) Doppler shift and delay correction
Device	Terminal Regular mobile phone handsets (3GPP terminals)
Use Case	Significant expansion of mobile network coverage Restoration of mobile networks in the event of a large-scale disaster, etc.
Related legal matters	Institutional issues related to direct communication with satellites by mobile phone terminals (type of radio station, construction design certification, etc.) Use of unassigned frequencies for mobile satellite operations (Article 4.4 of the Radio Communications Regulations applies)
Other	Rakuten Mobile is developing eNodeB for use with SpaceMobile

International Collaboration for NTN

1. Collaborative technological area
   - Execution of hearing comments from communication operators and manufacturers
   - Identification of possible collaborative technological areas for NTN
2. Collaborative country
   - Communication with possible countries
   - Identification of collaborative countries
3. Discussion of Scalability WG activity
   - Dissemination of technologies and use cases for NTN
   - How to proceed the international collaborations
   - Aiming for a role of NTN global consortium

Aiming for a Role of NTN Global Consortium

- Establishment of the common solution and value with the international partners by forming and modeling the co-creation system for NTN issues in Scalability WG



Concluding Remarks

- Current activities of Scalability WG were introduced,
  - WG Study Roadmap,
  - WG Structure,
  - Landscape Mapping for NTN, and
  - Examples of Detailed Information for NTN.
- International collaboration is important to realize NTN applications, and the collaborative technologies and countries should be identified,
  - Examples: Global IoT, Integration of Satellite&5G, LEO constellations and NTN global consortium...
- Scalability WG aims for a role as NTN global consortium.
- Shall we discuss possible collaborations in Scalability WG together? Welcome to join Scalability WG anytime!