Initial Review of 3GPP 4G Technology

# Summary

The ENAV 22nd committee has developed a staged process to conduct an initial assessment of new candidate technologies to ‘ENAV22-12.2.1 Initial Stage proposal IALA template.docx’.

The Republic of Korea has submitted the initial assessment document of LTE-Maritime to the ENAV 23rd committee in Singapore in April 2019 which include the response of template questionnaire for LTE-Maritime based on 3GPP 4G technologies, ENAV23-9.3. An updated review document was provided to ENAV24, ENAV24-6.1.21 (LTE); ENAV24-6.1.9 (4G). The Republic of Korea reported that the success of the initial trial has led to implementation of the technology, with implementation of 263 base stations, with availability of the system in 2021.

China reported on trials using LTE during ENAV23 and provided detailed input to ENAV24, ENAV24-6.1.20 and ENAV24-6.1.21.

Presentations on 3GPP highlighted that LTE is a component of 4G. The overall review has therefore been carried out based on 4G version 13 technology.

WG2 has evaluated 4G at a high level, identified advantages, limitations and applicability in consideration of user requirements and needs of IALA membership. This evaluation has concluded that 4G (version 13) could be considered a suitable technology for use by IALA membership.

Supporting documentation for this review is available on request.

# Discussion

[text in development]

# Actions Requested

[introductory text]

1. The IALA ENAV Working Group 3 consider the requirements for the integration of 3GPP services based on 3GPP release 13 within the maritime data communications domain
2. The IALA ENAV Working Group 3 provide technical guidance as to the integration of 3GPP on the ship and shore side

Digital Technologies – Initial Review Table

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Question** | **Technology Candidate Response** | | **Working Group Response** | |  |  |  | | --- | --- | --- | | **Green** | **Amber** | **Red** | |
| **Infrastructure** | **User** |  | **Status** |
|  | Where has the referral come from? | Technically, 3GPP 4G(LTE) standard is origin  SMART-Navigation project in the R.O.K has tested and is developing the LTE(4G) network in the Korean coastal area within 100km.  The brand name of this project is LTE-Maritime | Technically, 3GPP 4G(LTE) standard is origin  \* Use LTE-Maritime router(like AP) with high-gain antenna for 100km coverage |  | green |
|  | Name of technology and product name | 3GPP 4G (LTE) release 13 | 3GPP 4G (LTE) | Agreed – change name to 4G noting that LTE (long term evolution) is part of 4G | green |
|  | Functional description | 1. LTE mainly implements mobile data access. When the system bandwidth is 20MHz, the theoretical peak rate of LTE single cell uplink is 50Mbit/s, and the downlink theoretical peak rate is 100Mbit/s, and QoS provisions permitting a transfer latency of less than 50 ms in the radio access network.  2. LTE has the ability to manage fast-moving mobiles and supports multi-cast and broadcast streams. LTE supports scalable carrier bandwidths, from 1.4 MHz to 20 MHz. It supports both frequency division duplexing (FDD) and time-division duplexing (TDD), We're using TD-LTE technology.  Maritime Capability - Providing LTE coverage up to 100 km from the coastline in maximum depends on the LOS condition  Trials have resulted in confirmation that the communication quality, more than 3Mbps in downlink and 90% Tx/Rx success rate | Mobile phone\* is available within 30-40km range from the coastline.  With additional, dedicated equipment (i.e. router) on the vessel, coverage can be increased.  Digital data communication is available up to 100km from the coastline when base stations are in high locations (antennae height of 500m required for 100km).  \* It means the dedicated phone of public safety service | Include transmitter height (500m) and receiver height (2m) for range provides 100km.  Expected downlink 6 Mbps and uplink 3 Mbps. (section A – up to 30km)  Expected downlink 3 Mbps and uplink 1 Mbps (section B – 30km to 100 km)  Frequency range needs to be identified, noting the ‘roaming’ aspect.  For use of the system, requirement to register the equipment for use of the system. | green |
|  | Proposed user group | The 4G (release 13) public network is mainly for the public; private networks for designated persons can be implemented under license (national) | 1.The 4G public network has been widely used around the world.  2. The main users of 4G private network in the maritime field would include ships and shore. | Agree  Requirement to ensure maritime use is available on a global scale, noting ‘roaming’ aspect | green |
|  | What are its Key limitations | The altitude of base stations should be as much as high to assure the line of sight (LoS)  (bring in text from ENAV24-6.1.20 to cover note for WG3) | Mobile phone doesn’t work over 30-40km by weak signal strength, so Router is necessary for 100km coverage | Geography  Requirement for the sim card – the router purchased includes the sim card. eSIM and iSIM are now deployed to enable multi-network roaming.  Need to consider roaming aspect if to be used internationally. Marine use of LTE is standard, so roaming function would be linked to the provider of the sim card. | amber |
|  | Where is it currently used (geographic and/or industry)? | The LTE public network has been widely used in the world; The LTE private network is also widely used in public security, emergency protection, traffic supervision, and energy sector.  No dedicated 3GPP 4G infrastructure assuring maximum coverage for maritime use. | 3G/4G service may be available almost coastal country – global user base. | Global | green |
|  | How is it currently used? | The LTE public network has been widely used in the world; The LTE private network is also widely used in public security, emergency protection, traffic supervision, and energy sector. | Any user can 3G/4G service using universal SIM by roaming technology in the commercial base  4G used for voice, data and IoT. | Currently in use in Korea and trials in China  Further implementation planned. | green |
|  | How could it be used within the maritime sector? | As a base data network for high-rate communication way for any services and applications | As a maritime data network on mobile phone or through the Router with high gain antenna as a Access Point  Could be used for voice over internet, data transfer and IoT. | Use cases presented demonstrated viability of the system.  China has built about 20 LTE private network projects in the fields of port terminals and maritime safety supervision  Republic of Korea is implementing 263 base stations to have availability in 2021 | Green |
|  | Who developed it? | 3GPP (4G release 13) | Router(AP) in LTE-Maritime (Korea) project  Customer Premise Equipment (CPE) in China project | There will be a requirement for ship side equipment.  3GPP developments will continue (5G release 15 in 2019) | green |
|  | Is it commercial, non-commercial or military? | 4G can be commercial or Mission Critical (MCX)  MCX can be non-commercial, or military. | Use of 4G for maritime could be a commercial network or could be a non-commercial network. | Noted – 3GPP includes a maritime vertical and Marcom (Maritime Communications) element. | green |
|  | Is there an existing technology that meets the same requirements?  If so, what make this different? | Maritime SatComs (VSAT, INMARSAT) exist; proprietary digital mobile radio | SatComs in use broadly, global coverage | Use of 4G provides solution option that has economies of scale for the user group, reducing costs.  3GPP has access to significant bandwidth. | green |
|  | Ease of implementation? | 4G has mature technology and mature manufacturers support  For wide coverage, LOS is important depends on the height and number of base stations. | Commercially available  Require CPE | Ease of use – in common use  Infrastructure requirements | green |
|  | What are the constraints for implementation? | The LTE private network needs to apply for frequency to the radio management committees of various countries, require ‘roaming’ capability for CPE.  Base station locations – height and number. | Ships need CPE (Customer Premises Equipment).  For maximum coverage use, high-gain antenna of 1.2m length on the mobile phone power output | MarCom documentation in 3GPP includes maritime use cases, recognising roaming requirement.  Maritime requirements need to be highlighted to 3GPP MarCom working group. | green |
|  | what is the capability of the technology? | 4G mainly implements mobile data access.  75Mbps(Max.) (theoretical) available on 10MHz bandwidth  100 Mbps (Max) (theoretical) available on 20MHz bandwidth.  Theoretical peak rate of 4G single cell uplink is 50Mbit/s in 20MHz bandwidth. | Same situation on mobile phone use in the land | Noted | green |
|  | What is the scalability of the technology? | Network performance and speed is scalable to the dedicated bandwidth. | CPE use | Noted | green |
|  | Is the technology backward compatible? | 3GPP 4G has backward compatibility in 4G standard release | 3GPP backward compatible units. | Backward compatible 4G to 3G, not to 5G. | green |
|  | Is the technology dependant on another technology? | No. | No. | Noted | green |
|  | Can the technology be demonstrated? | Already demonstrated in 2017 as a test-bed project  LTE-Maritime will be available from the 2021 in Republic of Korea.  1.Shanghai Port  2. Qingdao Port;  3. Ningbo Port;  4. Taicang section and Nanjing section of the Yangtze River, Nanjing section;  5. Yangtze River Estuary E Navigation Construction Project | Positive trial results. | Note trials and implementation | green |
|  | Are there any results and test bed? Please List | Test-bed project in 2017 in the Republic of Korea  Test-bed project in 2018 in China.  Refer to ENAV23-9.4; ENAV24-6.1.9 ENAV24-6.1,20 and ENAV24-6.1.21 | Same to the left | Noted | green |
|  | Is there a compliance summary? | Comply with the standard 3GPP protocol and perform appropriate network optimization for specific projects. (release 13) | Same to the left | Noted  3GPP MarCom working group ongoing | Green |
|  | Are there legal issues associated with the implementation of the technology? | No legal issue for implementation  Only related to the frequency allocation for 4G use by regional rule through application to frequency management authority. | Same | Frequencies for international mobile telecommunications are allocated by the ITU-R Radio Regulations. | green |
|  | Are there any intellectual property rights (essential patents) associated with the technology? | IPR exist, embedded in the chip set and transparent to the consumer. This resides in both the shore infrastructure and the ship equipment. | IPR exist, embedded in the chip set and transparent to the consumer. This resides in both the shore infrastructure and the ship equipment. | Noted  Costs for access to the network needs to be taken into account. | green |
|  | Is the technology safe to use | Already proven  4G data is encrypted and transmitted, and the network terminals authenticate each other. |  | Some concern of possible cross channel interference between 4G and GMDSS terminals. (in discussion at IMO, ITU and CEPT) | green |
|  | Does the use of the technology require extra training? | No extra training, do need to operate the network. | May be requirement for some training. | There may be requirement to provide general overview training to seafarers on the capabilities provided. (i.e. need to know how connectivity exists) | green |
|  | Are there environmental considerations with the technology? | LOS is important so signal can be blocked by islands or big wave in bad weather  No | No | Some concern of possible cross channel interference between 4G and GMDSS terminals. (in discussion at IMO, ITU and CEPT) | green |
|  | What are the financial considerations for implementation and use? | If not using existing network infrastructure, initial capital investment required | Router(AP) / CPE costs | Require air time for 4G access.  May require additional antennae on existing infrastructure to ‘face the sea’ | green |
|  | Is the technology secure (i.e. protected against hacking; privacy of data)? | 4G system is secure itself with its unique protocol  4G private network is isolated from other networks, further enhancing network security. | Same | Note | Green |
|  | Readiness (EU Technology Readiness level - TRL) (level of maturity of technology) | 9 (already commercially available technology) | Same | Noted | green |
|  | Can you provide independent References | Yes, ENAV23-9.4; ENAV24-6.1.9  ENAV24-6.1.20, ENAV24-6.1.21 | Same |  | green |