REPORT
of
The Twenty-Eighth Session of the Council of the Far East Radionavigation Service (FERNS)

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1. Opening of the Session

The Twenty-Eighth Session of the Council (FERNS 28) was held at the Best Western Premier Seoul Garden Hotel in Seoul, the Republic of Korea (ROK), from 4 to 8 November 2019, convened by the Ministry of Oceans and Fisheries (MOF). A one-day meeting of the Technical Working Group (TWG) was conducted on 4th November 2019 and a technical tour to Samsung Innovation Museum, Incheon eLoran Testbed, Seoul N Tower was organised on 7th November 2019.

1.1. Chairman's opening remarks

The Chairman, KIM Min-jong, Assistant Minister of Maritime Affairs and Policy Bureau, MOF welcomed all participants to Seoul, looking forward to good discussions. He recalled that the 1st FERNS meeting was held in 1992 and many developments have happened since. Chayka and Loran-C have been the focus of FERNS. The chair added that IALA is recommending the development of R-Mode and emphasized the importance of the role of Aids to Navigation. The MOF proposed cooperation with China on R-Mode development. An agreement is proposed for this session. The chair added that e-navigation should now be added to the discussed topics of Chayka and Loran-C. Mr KIM declared the meeting officially open.

Then Mr KIM handed over the chairmanship of the meeting to Mr SONG Jong-joon, Director of Aids to Navigation Division of MOF.

1.2. Introductions

At the invitation of the Chairman, the Heads of each delegation introduced their delegates and expressed their thanks to the host and their wish for a fruitful meeting, for the benefit of enhanced maritime safety. Representatives of the following Members and Observers participated in the session:

Members:

- The People's Republic of China
- The Republic of Korea
- The Russian Federation

Observers:

- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)

Invited guests from:

- Ministry of Oceans and Fisheries (MOF)
- Korea Research Institute of Ships & Ocean Engineering (KRISO)
- Korea Institute of Aids of Navigation (KAtoN)

A complete list of participants is provided at Annex 1.

2. Adoption of the Agenda

The Chairman introduced the draft agenda, which was approved. The Agenda for the meeting is at Annex 2.

3. Presentation of reports by each country on the Loran-C/Chayka programmes

3.1. Operational Status of China Loran-C Chains in 2019

During the period from August 2018 to July 2019, the Loran-C system in China kept normal operation, and the signal availability of its chains meets the specified requirements.

The routine maintenance mechanism will be continued during August 2019 to July 2020, with a 96-hour off-air period in each quarter be arranged for equipment maintenance.

A full summary of the operational status of Loran-C chains in China is at input paper CS28-3-1-1

3.2. Operational status of Korea Loran-C Chain in 2019

The operation status of Korea Chain(GRI 9930), consisting of Pohang station(M), Gwangju station(W) and Ussuriysk station(Z), is as follows and the status includes the scheduled off-air time of the FERNS (August 2018-July 2019).

A full summary of the operational status of the Korean Loran-C is at input paper CS28-3-2-1.

3.3. The results of operational analysis of the Russian stations in chains B and C in 2018-2019

During the period from October 2018 to November 2019, there was no unscheduled off-air of stations Petropavlovsk-Kamchatsky, Ussuriisk, Alexander-Sakhalinsky and Okhotsk in chains B and C.

A presentation of the operational status of the Russian stations is provided at input paper CS28-3-3-1.

3.4. IALA Technical notes

Mr JEON Minsu from IALA gave a presentation. He updated the participants on the hierarchy of the IALA documents which was approved by its General Assembly in 2018, including Standards, Recommendations and Guidelines. He went over the Committee work programme and then introduced the concept of MRN. He concluded by giving an update on IALA events and the Inter Governmental Organization (IGO) project.

A presentation is at input paper CS28-3-4.

4. Operational matters for FERNS cooperating chains

4.1. Scheduled off-air for 2020

Planned off-air schedules for Loran-C stations were presented by China (CS28-4.1.1) and the Republic of Korea (CS28-4.1.2) and for Chayka stations by the Russian Federation (CS28-4.1.3). All scheduled off-air are for routine maintenance or improvement works.

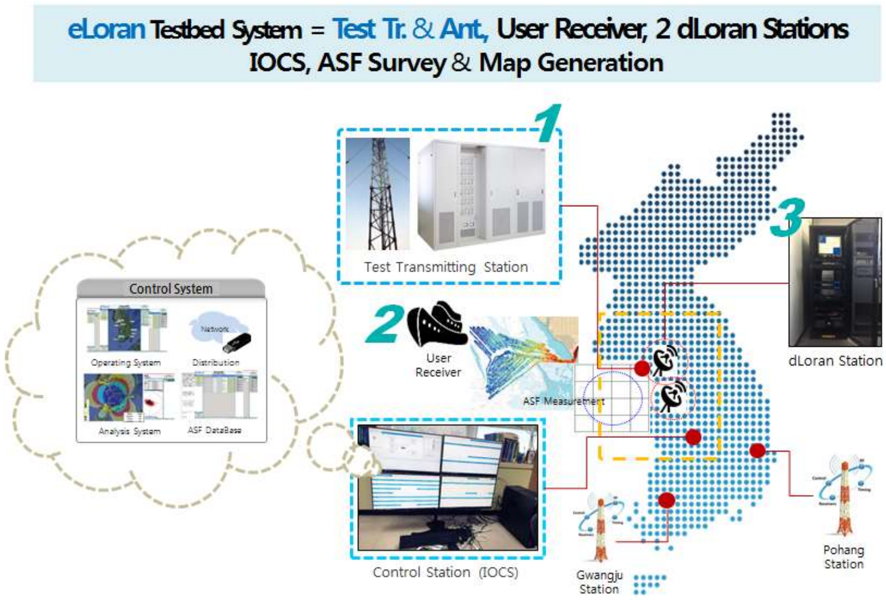
The off-air schedules were agreed.

4.2. Other operational matters

4.2.1 The development status of eLoran technologies in the R.O.K

Mr SEO Kiyeol from KRISO gave a presentation that can be found as Input CS28-4-1-2

The eLoran testbed system consists of a test transmitting station system with an antenna, dLoran stations in Incheon and Pyeongtaek, and an Integrated Operation Control system (IOCS), and is provided to users through ASF map of testbed ports. The following figure shows the overall configuration of the eLoran testbed system.



<Entire Configuration of eLoran Testbed System>

The delegates from Russia asked if the transmitter was their own design. The answer was yes. It was added that the power of the equipment could be 150 kW maximum. It is an eLoran signal shown in the presentation.

5. Technical matters for FERNS cooperation chains

5.1. Preliminary results of Loran-C differential test

Mr Wang Wei gave a presentation on preliminary results of Differential Loran Test. The presentation is available as input CS28-5-1-1.

In 2019, Navigation Guarantee Center of North China Sea commissioned Xi'an Research Institute of Navigation Technology to study the RBN-based eLoran technology. The performance of difference correction is verified by experiments. The feasibility of broadcasting differential Loran-C information on Radio Beacon (RBN) channel and its influence on differential GPS and differential BeiDou information broadcasting are analyzed. It will lay the technical foundation for building the national coastal eLoran system based on RBN.

The conclusion was that after Time Difference of Arrival (TDOA) difference correction, the positioning accuracy is better than 50m，and the positioning accuracy decreases with the increase of the distance from the reference receiver and the update period of the correction information.

The differential positioning accuracy has not reached the desired 8~20m. The measurement error may be caused by the difference of signal-to-noise ratio (SNR) from different transmitters, or it may be related to the calculation method of correction.

The follow-up work will be: Algorithm of the difference correction will be optimized to improve the accuracy, and the real-time difference test and the dynamic test onboard will be carried out to verify the dynamic difference performance by broadcasting the LORAN-C difference correction information on RBN.

5.2. Development of Output-Expandable eLoran Transmitter

Hanjin Electronic Industrial made a presentation on the development of output expandable eLoran Transmitter.

As part of the eLoran technology development project with the support of the Ministry of Oceans and Fisheries (MOF), Hanjin Electronic Industrial is developing an output-expandable eLoran transmitter system for amplification and transmission of eLoran signals.

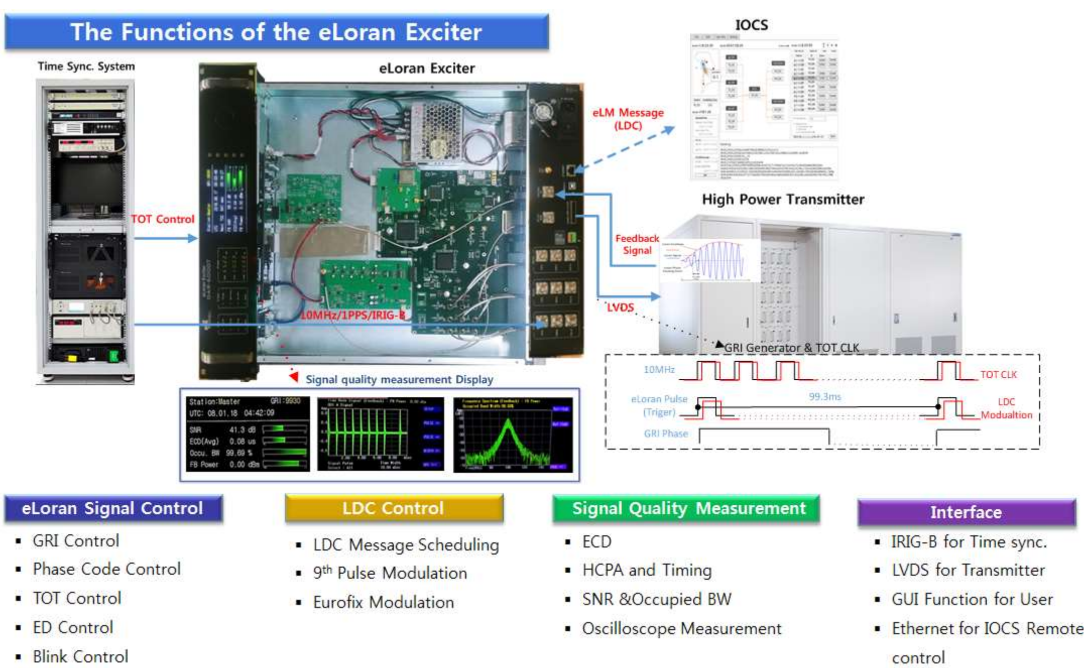
For the future, it is planned to install the developed transmitter in the eLoran test transmission station to improve the functions and stabilize performance through a pilot operation. Also, once the pilot operation is completed, it is expected to be used for upgrading transmitters in Pohang and Gwangju Loran transmission station systems.

5.3. Development of eLoran exciter

Mr SEO gave a presentation on eLoran exciter. The presentation is available as input CS28-5-2-2.

As part of the eLoran technology development project with the support of the Ministry of Oceans and Fisheries (MOF).

The eLoran exciter consists of the reference timing generation of eLoran signal to generate UTC synchronized eLoran signals and outgoing eLoran signal quality measurement. The following figure shows the function and interface of eLoran exciter.



The function and interface of eLoran exciter.

The reference timing generation function of eLoran signal receives the UTC information and the TOT control value from the time synchronization system as shown in Figure 1, provides the Loran generation reference timing to the Loran transmitter and performs the TOT correction function. In addition, it performs the function of processing Phase and Almanac correction information with LDC (Loran Data Channel) message, which is inherited from the IOCS.

The full presentation is available as input CS28-5-2-2

5.4. Development of integrated eLoran/GNSS receiver

Mr KIM Young-Baek gave a presentation on the integrated receiver. The presentation is available as input CS28-5-2-3.

As part of the eLoran technology development project with the support of the Ministry of Oceans and Fisheries (MOF).

Navcours Co., Ltd. has been developing an integrated navigation system using both eLoran and GNSS since 2016. GNSS represented by GPS has been increasing in its role and importance since the United States launched the service. However, as the dependency on GNSS is increasing, the vulnerability of GNSS to external influences such as intentional or unintentional interference has been a more serious problem. It has been emphasized that the backup system should be required to provide a more reliable position, velocity, and timing. eLoran system is less accurate and precise than GNSS, but it is robust to external influences due to the high signal power and long wavelength. Therefore, by complementary integration of eLoran and GNSS, more reasonable performance and robustness will be expected.

Navcours Co., Ltd is developing eLoran/GNSS integrated receiver with better performance and cost-effectiveness. And the first target application of it will be the time synchronization. Currently, eLoran signal reception and signal processing and interference mitigation algorithms are being improved by using the simulated signal and data with various conditions. When an eLoran testbed is constructed in the future, it is expected that the performance can be confirmed by receiving the actual eLoran signal.

The full presentation from Mr Young Baek Kim is available as input CS28-5-2-3

5.5. The Russian-Koran Radionavigation chain

Mr REDKOZUBOV gave a presentation as input CS28-5-3.

The first issue was discussed in 2012. The Russian-Korean meeting 2017 (16th meeting) was a way to implement beneficial cooperation for the Russian Korean radionavigation chain. The two countries agreed to develop their own map. But difficulties were encountered in coordinating the project in the government organizations of the Russian Federation and ROK, so the first draft was considered by the Parties only in October 2018.

The project of the Roadmap was agreed and a Roadmap was sent to ROK. The Roadmap was to be signed at ministry level in 2019. Agreement from ROK was only received in October 2019. The proposals for updating the Roadmap do not raise objections from the Ministry of Industry and Trade of the Russian Federation and the Ministry of Oceans and Fisheries of ROK, but need to be approved by the Ministry of Defence of the Russian Federation and the Ministry of Foreign Affairs of the Russian Federation. Russia then proposed to ROK a meeting to discuss proposals for adjusting the Roadmap and other operational issues of Russian and Korean radionavigation stations.

ROK took a few minutes to discuss the matter internally and agreed to a bilateral meeting after the afternoon session on 6 Nov 2019 (Bilateral Meeting Minutes are provided at Annex 5).

6. Coordination of other radionavigation services in the Far East

6.1. Providing Standardized Real-time Hydrological and Meteorological Information In Port Waters

Ms MA Min introduced presentation CS28-6-1-1

In China, the responsibility of providing meteorological and hydrological information services to ships is shared by the China Meteorological Administration (CMA), the State Oceanic Administration (SOA) and the China Maritime Safety Administration (CMSA). China MSA has developed "Harbor Environment Monitoring System" to provide real-time hydrometeorological information in port waters. The Harbor Environment Monitoring System is a monitoring service network in port, which is used to monitor the factors related to ship navigation safety, such as flow speed, flow direction, tide level, wave, wind speed, wind direction, visibility, etc., and distribute the data to ships entering and leaving ports and berthing. The system encounters limitations such as liabilities issues, data accuracy, the physical safety of the environment and the lack of unified technical standards.

Questions and comments:

It was asked how can the data be verified before release and the answer was that other means would be needed to provide accuracy and this is why it is announced to the users before providing. Also, with 3 different agencies have 3 different responsibilities, is there a system to integrate these 3 agencies? The answer is that there is a mechanism of exchange of information put in place between each agency at the moment.

IALA added that complementary use aids to navigation like monitoring systems and how to collaborate are topics included in the work to be developed and invited China to participate in these discussions.

6.2. Study on Technical Standards of AMRD

Ms Ma Min gave a presentation that can found as input paper CS28-6-1-2.

AMRD emerged in recent years and the number has increased year by year.

These mobile stations were defined by the ITU as Autonomous Maritime Radio Device (AMRD) and the ITU will develop a technical standard. But at the moment the lack of technical standards results in accidents. There are proposals of solutions such as indicators of fishnets and the use of a master-slave device. The benefit is to enhance the safety of navigation and improve work efficiency. There would also be a need for standardize AIS application and a wide range of application.

Questions and comments:

Answering questions from the floor the presenter answered for marking of wrecks and iceberg in China, normally use of conventional Aids to Navigation such as Emergency Wreck Marking Buoy (ERMB) and virtual Aids to Navigation are considered. But as part of technical standards study, AMRD could seldom use to mark wrecks or iceberg in the country.

6.3. Progress of IEC 61108-5(BDS)

Mr Wang Wei gave a presentation the progress of IEC 61108-5 BeiDou System (BDS) that can be found as input CS28-6-1-3

IEC 61108-5 cited and referenced more than 20 standards related to the BeiDou Open Service documents, IEC, IMO, ITU, RTCM and NEMA.

Standard research including:

- BeiDou open ICD, service documents and etc.
- IMO resolution of GPS, GLONASS, GALILEO and BDS receiver equipment
- IEC 61108 series standards
- Relevant standards developed by the IEC in recent years
- Research related ITU, IALA, RTCM, RTCA and NMEA standards, specify the related content which involves radio spectrum, as well as shipborne equipment interference, digital interfaces and equipment environment condition.

In order to test the standard; the following tests are made:

According to the requirements of IEC 61108-5, testing is executed in an indoor simulator environment and outdoor mobile platform.

The general testing items include:

BeiDou receiver equipment, position output, equipment output, accuracy, acquisition, protection, antenna design, sensitivity and dynamic range, effects of specific interference signals from other shipborne transmitters, position update, DBDS input, alert and status indication, self-testing, accuracy of Course over Ground (COG) and Speed over Ground (SOG), validity of COG and SOG information as well as output of UTC.

Associated standards are IEC 61162-1(Digital interfaces), IEC 61924(Integrated navigation system),

IEC 62288(Presentation) and IEC 62923(Bridge alert management)

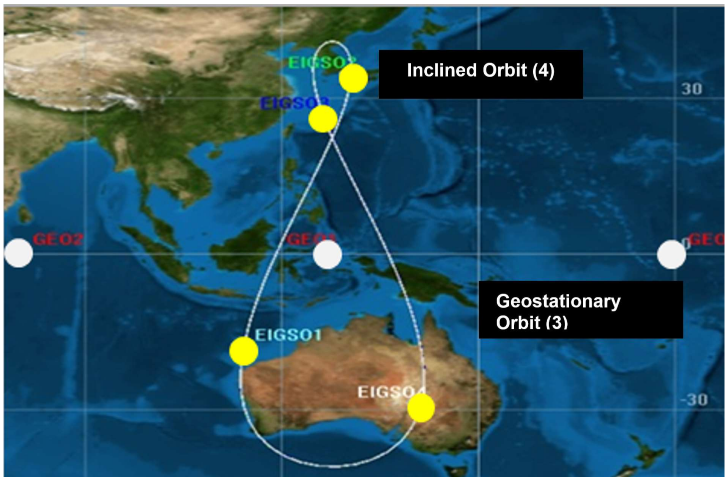
<u>Questions of comments:</u>

Answering questions from the floor, the presenter said that regarding IEC include differential BeiDou's function, it will be added to IEC61108-4 when the standard is amended but currently, it is not included in the existing version.

6.4. A plan update on the development of KPS (Korea Positioning System)

Mr PARK, Sang-Hyun introduced the presentation that can be found as input paper CS28-6.2.1

R.O.K. has recently enacted the plans to implement a Korean Navigation Satellite System, which is named by KPS, in 3rd Space Development Promotion Fundamental Plan (Feb. 2018). Meanwhile, the 'Task Force for Korean Navigation Satellite System' has been established and started its operation. Implementation of a navigation satellite system requires large-scale national investment, takes a long period of time, and needs to respond to a variety of variables such as securing state-of-the-art technologies and securing satellite orbit and frequency in the process. Therefore, it needs to gather and review the opinions of experts from various fields, for instance by FERNS members, and prepare efficient and sophisticated strategies. The task force consists of sub-committees for policy, utilization, international cooperation, and technology, and they are to review the system development, strategy, resources, and development schedule.



The KPS project, which ROK is promoting, requires close and sincere cooperation from FERNS members since FERNS member countries of Russia and China have already established or are currently in the process of their own navigation satellite system.

Questions and comments

Russia enquired if there was a plan for launching the satellite and if it would be just R.O.K of if other countries would be involved. The answer was that there are no plans at the moment and it has to be decided how to launch the satellite.

6.5. A plan on maritime precise positioning and navigation service in the Republic of Korea

Ms PARK Seul-gee introduced presentation CS28-6.2.2

R.O.K has carried out planning research of precise positioning service in 2015 and study demand of precise positioning service in maritime and need of maritime augmentation acceleration enhanced service. Based on this study, R.O.K has recently enacted the plans to implementation maritime precise positioning and navigation service. This project consists of 2 phases.

In the first phase, this project aims to develop the precise positioning service technology and pilot service and test in the testbed. In the second phase, the goal is to develop navigation integrity technology and verify precise navigation performance. The development is planned until 2024.

Maritime Precise Positioning and Navigation service in R.O.K requires close and sincere cooperation from FERNS members since FERNS member countries of Russia and China have a plan or are currently in the process of precise positioning service. Sharing the development status and plans regarding centimetre-level services of each member country, and designing and implementing effective service plans in the Far East should be considered as one of the key issues that FERNS needs to cooperate.

Plan on Maritime Precise Positioning and Navigation Service

6.6. The development status of R-Mode technologies in the ROK and the suggestions for its cooperation

Mr PARK Sanghyun introduced presentation CS28-6.2.3.

Nationwide DGNSS and Loran-C chain operations in the ROK have been introduced. Given a large number of MF beacons stations and AIS base stations already installed along the coastline. He introduced the predicted R-Mode performance of measurement using the MF beacons stations and eLoran stations.

The Field verification of R-Mode performance on the testbed project is targeting 10m positioning accuracy (Hor.,2drms) which meets the integrity monitoring service performance required by IMO and IALA.

In addition, from a deployment cost perspective, the cost-benefits of R-Mode infrastructure have proven to be economically superior to those of other terrestrial radio-navigation infrastructures. Through this comprehensive feasibility analysis, the ROK decided to carry out R-Mode technology development and actual sea area demonstration (2020~2022) and deployment (2023~2024).

During the presentation, ROK suggested 3 cooperation areas with China with regards to R-Mode development;

1. To hold a joint technical symposium on terrestrial radio-navigation systems including R-Mode
   - By holding a joint technical symposium once a year from 2020, it seeks to share various terrestrial radio-navigation system technologies under research and development in both countries and to enhance them.

- The two countries shall hold the joint technical symposium in turn, and the first ROK-PRC joint technical symposium in 2020 can be held in the ROK.
- It is proposed that the joint technical symposium be held in May or June, taking into account the timing of the FERNS hosting in November.

2. To build a joint testbed in the actual sea including waterways for R-Mode terrestrial radio-navigation system
   - The two countries shall build a joint sea area testbed in the Yellow Sea, where R-Mode signals of both sides are available, and use testbed jointly.
   - The two countries shall select two countries' MF beacons transmission stations needed for the joint testbed operation by 2020.
   - R-Mode technology is applied to the selected MF beacon transmission stations by 2021.

3. To co-operate a joint testbed for R-Mode terrestrial radio-navigation system
   - It shall operate the ROK-PRC joint testbed in the Yellow Sea starting in 2022.
   - The two countries will jointly verify securing a Resilient PNT environment and performance in the actual sea area due to the use of R-Mode and other terrestrial radio-navigation infrastructures in both countries.
   - The two countries will push for standardization of related technologies in international organizations based on the results of joint demonstration and jointly respond to them.

Questions and comments

China officially received this proposal before this meeting and discussed this possible cooperation. China is currently focusing on the development of BeiDou and its application on other areas; meanwhile China also recognizes the importance of land-based back-up systems and has carried out a series of researches on relevant technologies to complement the satellite systems. As far as R-Mode is concerned our research is focused on VDES R-Mode and we would also like to participate in the work on the development of related guidelines led by IALA together with Korean colleagues.

Mr JEON pointed out the potential benefits of this cooperation, the mariners could use the R-Mode service uninterrupted in this region. and IALA could act as a platform for this cooperation and welcome ROK and China to contribute to developing the guideline on MF and VDES R-Mode.

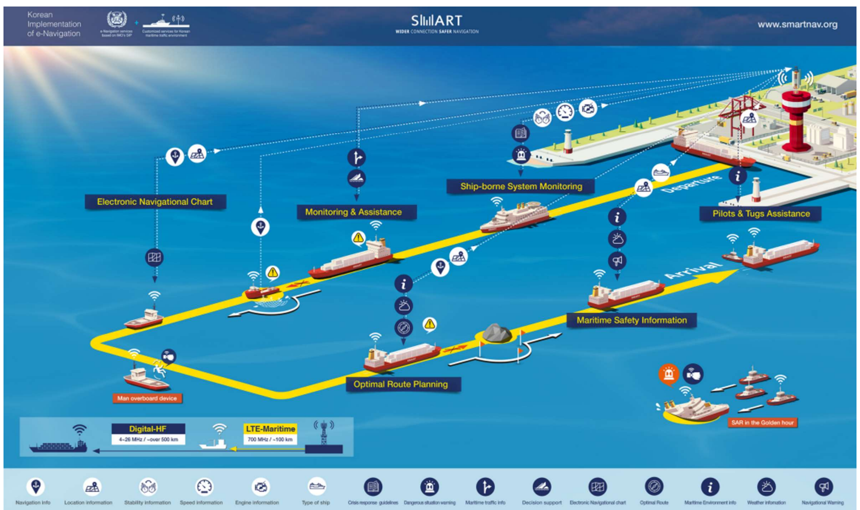
6.7. Smart-Navigation

The presentation is at input paper C67-6.2.4.

Mr Kim Sung-jae, MOF, introduced the SMART Navigation project in ROK with the Scope, timeline and outcomes. The project is focusing on Non-SOLAS ships as well as SOLAS, and it's been aligned with the IMO's overarching e-Navigation architecture.

It is anticipated that the project will provide ships with safety information, caution, alarm, emergency alarm and guidance according to the situation ships are encountering with.

ID	Service	Dedicated user/ship	Physical Link
Sv.1	Navigation Monitoring & Assistance Service (NAMAS)	• High risk ships	LTE-Maritime VDES
Sv.2	Ship-borne System Monitoring Service (SBSMS)	• Passenger ships with Korean Flag (International/Domestic) • Ships requiring the service	LTE-Maritime VDES, etc
Sv.3	Safe & Optimal Route Planning Service (SORPS)	• Passenger ships with Korean Flag (International/Domestic) • Ships requiring the service	LTE-Maritime VDES, etc
Sv.4	Real-time Electronic Navigational Chart Distribution & Streaming Service (REDSS)	• Non-SOLAS Ships	LTE-Maritime
Sv.5-1	Pilots/Tugs Assistance Service (PITAS)	• Pilot	LTE-Maritime
Sv.5-2	Maritime Environment and Safety Information Service (MESIS)	• Ships requiring the service	LTE-Maritime VDES, etc

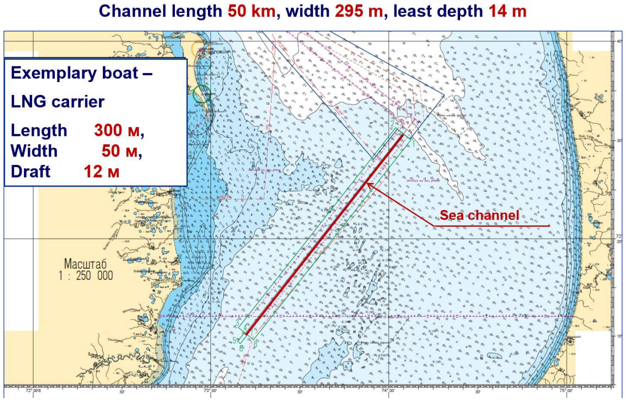


6.8. Navigation support in the Arctic, Sabetta port

Mr REDKOZUBOV Vasily gave a presentation in support of input paper C28-6.3.1.

The length of the sea channel is 50 km, width - 295 m, depth - 14 m. In 2020, sea trials are planned to determine the possibility of navigation support in the Gulf of Ob by the Chayka radionavigation system.

Kara Sea, Gulf of Ob
Sea channel approaching the port of Sabetta
Channel length 50 km, width 295 m, least depth 14 m



In polar latitudes, the likelihood of GNSS disruption and degradation of the parameters provided by them are growing. This is due to the instability of the ionospheric delays of signals from GNSS spacecraft, associated with auroras in the ionosphere.

In light of the increased requirements for the reliability and accuracy of coordinate-time support in the Arctic zone, these problems necessitate the independence of GNSS reservation, the need for special measures when working with GNSS signals, and the need for their integration with other radio navigation systems. The optimal addition to the GNSS and its independent reserve may be the Chayka and Loran long-range radionavigation system.

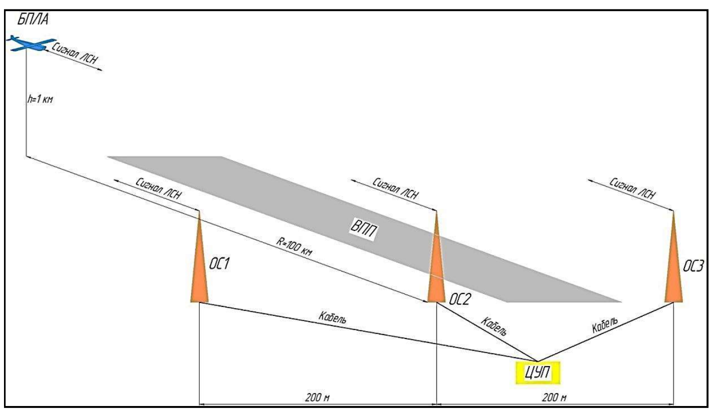
6.9. NIIMA Progress JSC experience in developing modules for satellite and local navigation systems

Mr REDKOZUBOV Vasily introduced presentation CS28-6.3.2.

He introduced the transceiver LMS module and the characteristics of the system which provides;

- optimal asynchronous reception of broadband signals;
- asynchronous determination of the coordinates of the transmitting / receiving subscriber;
- plane error doesn't exceed 1-10 cm;
- height error = 15 cm is vertically standing towers (h = 20 m) are available;
- accuracy of synchronization of reference stations generators = 0.2 ns

The network of ground-based reference stations emits a complex signal, which is received onboard the aircraft by LNS receivers and thus the navigation goal is achieved. The LNS signal is more powerful and complex and it is hidden, it lacks ephemeris and ionospheric errors. It is difficult to suppress and impossible to fake. In addition, the information about the location can be exchanged between aircraft and the control center using AZN-B transponders of 1090ES and VDL-4 types.



The developing modules for satellite and local navigation systems could provide accurate navigation operating in the open space and in the areas with poor SNGSS reception. It has been tested indoor and in the filed.

The advantages of the system compared to GNSS have been identified;

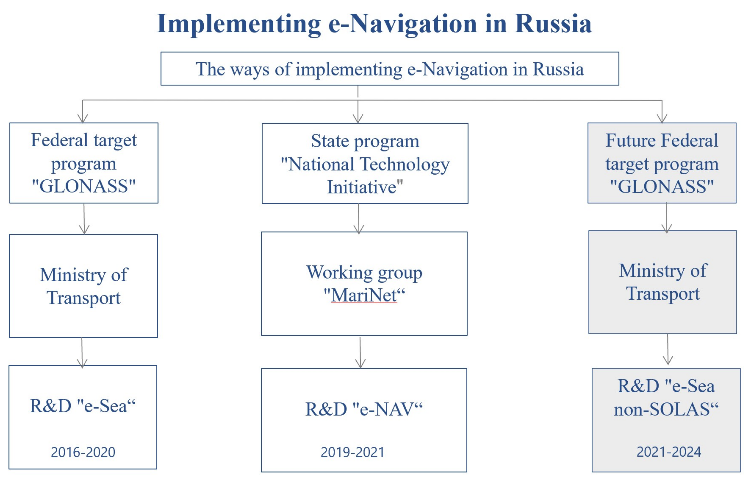
- the noise resistance of the proposed system will be much better
- proposed system ensures navigation in complex conditions such as urban areas and indoors
- low power consumption of LSN navigation terminals
- LSM can operate in two modes: navigation aid and object monitoring mode.

6.10. The introduction of e-Navigation in Russia

Mr REDKOZUBOV Vasily introduced presentation CS28-6.3.3

Kronshtadt Group (includes JSC "Kronshtadt Technology") is a Russian high-tech, IT and engineering company specializing in research, design, manufacturing and integration of advanced technology products and solutions for air, marine and ground vehicles and installations.

Kronshtadt is a contractor for developing business roadmap e-Navigation in MARINET of NTI of Russia, and the structure of the implementing e-Navigation is as following;



Regarding onshore marine and river segments (VTS), In 2016, the equipment of main Marine and River VTSs are installed in Coastal Vessel Traffic Services - VTS (Petrodvorets) and VTS on inland waterways (Shlisselburg) and in 2018, three additional VTS were deployed: one in the maritime segment (in the pilotage service in St. Petersburg) and two in the river segment (in the Dispatching offices of the Sviritsa and Otradnoe settlements).

The main tasks at this stage are identified as;

1. Implementation of the following functionalities into the deployed hardware and software systems of e-Navigation (ship, coastal and pilot segments).
2. Sending and receiving on-board additional layers of information:
    - border of the safe channel/ship;
    - data on depth measurements;
    - weather forecast;
    - water level.
3. Development of a prototype decision support system for a VTS operator:
    - collision avoidance systems;
    - detection potentially dangerous situations in terms of vessels collision avoidance and provide recommendations to the operator (responsible for safety operation) of his actions;
    - warning systems stranded, collisions with marine infrastructure;
    - optimization of traffic in order to reduce waiting time for entering the port.
4. Decision support onboard the vessel through VTS -ship exchange information.

Other e-Navigation related projects were introduced such as VDES, GNSS differential subsystem in the Far East region, use of unmanned aerial vehicles, and interaction with STM.

<u>Questions and comments:</u>

Mr JEON had a question on the standard of data modelling for sending and receiving on-board additional layers of information, and REDKOZUBOV will bring it back and respond in due course.

6.11. Standardization in the Arctic region

Ms AFANASYEVA Margarita introduced presentation CS28-6.3.4.

The aim of the Arctic Council is the development of standards for research in polar areas contributes to large-scale political, social, scientific, environmental activities.

One of the most important problems in this area is the lack of unified approaches to activities in the Arctic region, as well as common rules and standards on which both regional and international players could rely.

The presence of such standards will not only contribute to improving the competitiveness and quality of high-tech products used in polar research but also, in general, have a positive impact on the development of these areas.

The importance of standardisation of the Arctic region is proved by the fact that within the framework of the IEC General session, held in October 2017 in Vladivostok, one of the central topics was declared standardisation of increased requirements for climate resistance of electrical products on the basis of the Russian experience of standardisation.

The need of Arctic standards development was confirmed by the creation of TC 187 Research practice in the polar regions. The existing documents of TC 187 Research practice in Polar regions are;

Type	Title	Status
GOST R	Research practice in polar regions. Declaration of polar research participants activities in the Arctic. General principles.	Public discussion
GOST R	Research practice in polar regions. Information signs and symbols of polar regions.	Public discussion
GOST R	Research practice in polar regions. Information signs of infrastructure objects.	Public discussion
GOST R	Research practice in polar regions. Requirements to the quality of staff training and training centers.	Public discussion

6.12. Radionavigation service and R-Mode development

Mr JEON Minsu (IALA) introduced presentation CS28-6.4.

He started his presentation with recent and further works in IALA with regards to positioning services

- R-Mode Baltic project
- R-Mode workshop in IALA
- G1129 on the Retransmission of SBAS Corrections using MF Radiobeacons and AIS
- Preparation for ITU WRC-19 in November 2019 - Secure the satellite downlink frequency allocations for VDES

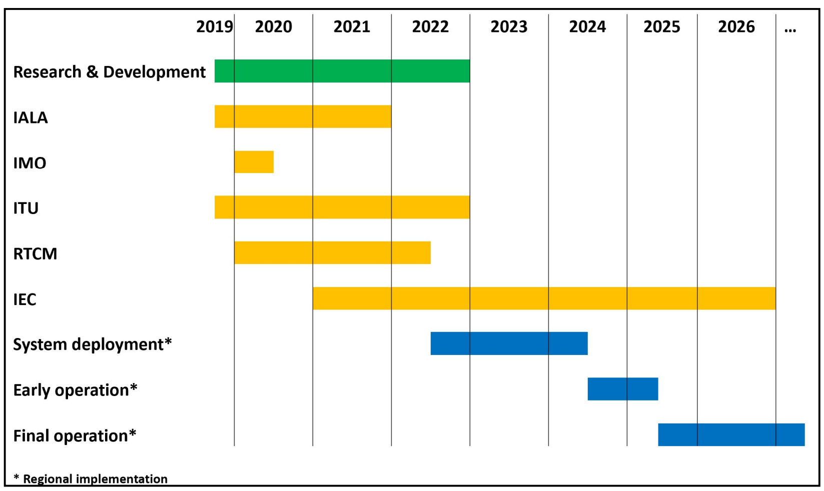
- Requirements of stakeholders on the R-mode system
- Guideline 1139 Annex VDES R-Mode
- Guidelines on Implementation of R-Mode on MF and VHF
- Guideline on SBAS performance for maritime

The Role of IALA on R-Mode development are;

- Promoting R-Mode on regional and worldwide level
- Standardization, harmonization of R-Mode service provided by synchronized R-Mode transmitter is necessary that mariners can use R-Mode service uninterrupted and all stations in view
- IALA is a platform for coordination of developments and exchange of information

He described VHF Data Exchange System (VDES) as a communication system which is considered as the third component of the e-Navigation Concept and provides all Automatic Identification System functions, transmission/reception of Application Specific Messages and exchange information of various Maritime Services.

Mr JEON invited all the participants to the workshop on the future of marine radiobeacon DGPS/DGNSS which will be held in Northern Lighthouse Board, Edinburgh, UK on 27-31 January 2020.



The result of IALA workshop on R-Mode was introduced with the conclusion;

- There is international recognition that the GNSS alone is insufficient for critical applications.
- There is a strong interest in R-Mode with world-wide R&D activities.
- IMO Resolution MSC.401(95) on the performance standards for multi-system shipborne radionavigation receivers enables the use of radionavigation systems including R-Mode.
- The work programmes of international organisations such as the IMO and ITU has to be harmonized with the IALA work programme to achieve standardisation and world-wide implementation of R-Mode.
- Standardisation of R-Mode will be continued in ENG and ENAV committee.

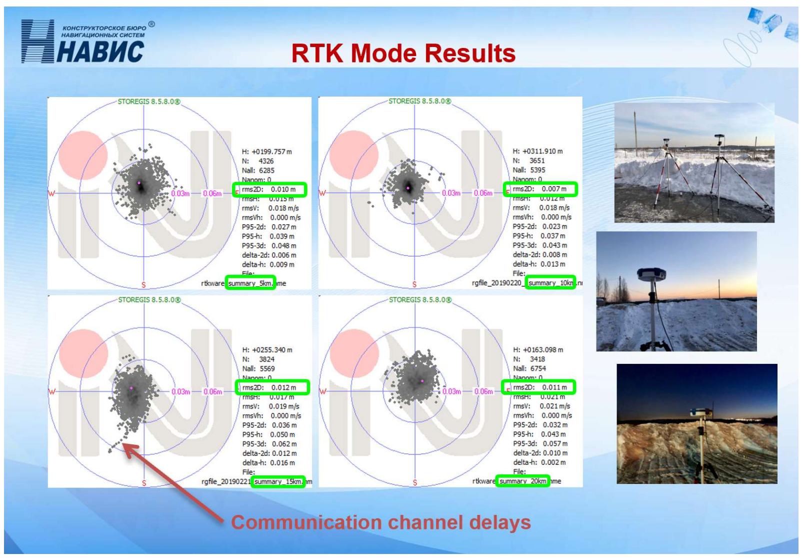
7. Other Business

7.1. The new generation of high-precision and anti-jamming GLONASS equipment

Mr REDKOZUBOV Vasily introduced presentation CS28-7.3.1.

JSC is a company in the business of development, production and servicing of mass-market navigation equipment for GNSS: GLONASS, GPS, GALILEO, BEIDOU, SBAS, SDCM established in 1996.

Receiver modules and navigation signal processor were introduced. And their new generation equipment which has been tested on various conditions and combined algorithm. This algorithm has enhanced the dependability and precision of the navigation data. The velocity measuring and orientation angles precision were improved. Maximum data output rate was raised up to 500 Hz.



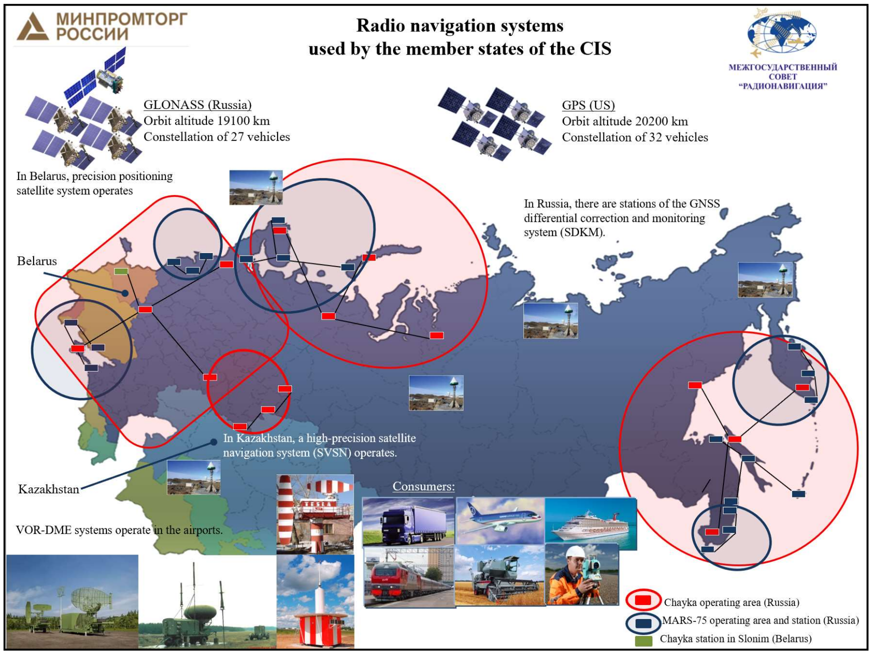
7.2. The main directions of radionavigation development in the CIS countries in 2019-2024

Mr REDKOZUBOV Vasily introduced presentation CS28-7.3.2.

On May 26, 2017, in Kazan, the Council of Heads of Government of the Commonwealth of Independent States (CIS) approved the Interstate Radio Navigation Program of the Member States of the Commonwealth of Independent States for the period until 2020.

The purpose of the program is on development of high-precision radio navigation fields in the CIS member states' territories and creation of interfacing elements for navigation systems and their augmenting systems created (or to be created) by the CIS member states.

Within the Program, the formulation of updated main directions (plan) for the development of the radio navigation in the CIS member states for the period up to 2024 has been implemented.



Heads of Commonwealth of Independent States Council, October 25, 2019, Moscow, Russian Federation approved the updated version of the main directions (plan) for the development of radio navigation in the CIS member states for the period until 2025 by the decision of the Heads of Commonwealth of Independent States Council.

The contents of the plan are

- General provisions
- Consumers' requirements for radio navigation systems
- general characteristics of existing radio navigation systems and systems under development
- perspective directions of development and improvement of radio navigation systems
- reducing vulnerability in radio navigation systems
- international cooperation in the field of radio navigation support

The main directions (plan) for the development of radio navigation of the CIS member states in 2019–2024 (hereinafter referred to as the "Main Directions") determine the directions for the implementation of the policies of the CIS member states in this area. The main directions take into account the relevant requirements of international organizations (ICAO, IMO, ITU), the recommendations of the International Committee on GNSS, the provisions of the radio navigation plans of the CIS member states, as well as the obligations of the CIS member states under international treaties.

The main directions are aimed at ensuring effort coordination and interaction between executive authorities, industrial enterprises, scientific organizations and institutions in the CIS member states engaged in the development, production of radio navigation systems and facilities, their operation and the provision of radio navigation services, as well as services based on PNT information.

International cooperation of the CIS member states in the field of radio navigation support is defined by interstate treaties and agreements within the framework of the activities of the CIS member states and by international treaties with non-CIS countries.

The main objectives of international cooperation are:

- coordination of the technical policies of the CIS member states in the field of radio navigation, taking into account national interests;
- development of the international market for navigation services and the creation of favourable conditions for the adoption of navigation services in the territories of the CIS member states;
- mutually beneficial information exchange for the sake of improving and developing navigation systems and tools.

8 Report of the 14th Technical Working Group Meeting

The report of the Technical Working Group meeting is at Annex 4.

9 Date and venue of the 29th Session

The People's Republic of China will be hosting the 29th Session of the FERNS Council in October or November 2020, more details about the dates and the venue will be communicated by 30 June 2020.

10 Session Report

The Council then reviewed the draft report of the 28th session and approved it.

Annex 1. List of Participants

Member Countries			
China (6)	Maritime Safety Administration (MSA)	LI Wenhua	Deputy Director
	Maritime Safety Administration (MSA)	XIA Tao	Senior Engineer
	Navigation Guarantee Center of North China Sea (NGCN)	MA Min	Section Chief
	Xi'an Research Institute of Navigation Technology	WANG Wei	Senior Engineer
	Xi'an Research Institute of Navigation Technology	REN Xiaowei	Senior Engineer
	National Time Service Center	LIU Yinhua	Associate Researcher
Korea (6)	Ministry of Oceans and Fisheries (MOF)	KIM Min-jong	Assistant Minister, Maritime Affairs and Safety Policy Bureau
		SONG Jong-joon	Director, Aids to Navigation Division
		CHAE jong-guk	Deputy Director, Aids to Navigation Division
		KIM Kang-on	Deputy Director, Aids to Navigation Division
	Nation Maritime PNT Office	JEONG Kyeong-gyu	Deputy Director
	Korea Maritime and Ocean University	GUG Seung-gi	Professor
Russia (5)	Ministry of Industry and Trade	Dmitrii Kan	Deputy Head of Section

	Internavigation Research and Technical Centre (IRTC)	Vasily Redkozubov	Deputy Director General
		Margarita Afanasyeva	Head of the service
	Ministry of Defence	Aleksandr Gritsov	Deputy Head of the Section of Management and Control
	Russian Embassy	Valery Fedorkov	3rd Secretary

Technical Working Group			
Korea	Korea Maritime and Ocean University	GUG Seung-Gi	Head of Department of Coast Guard Studies

Observers			
IALA		JEON Min-su	Technical Operations Manager
		Audrey Guinault	Communication Officer

Invited guest			
Korea	Ministry of Oceans and Fisheries	LEE Byeong-gon	Senior Deputy Director, Aids to Navigation Division
		KIM Jeong-sik	Deputy Director, Aids to Navigation Division
		KIM Hyung-jun	Deputy Director, Aids to Navigation Division
	Korea Research Institute of Ships & Ocean Engineering	PARK sang-hyun	Director/Principal Research Engineer
		SEO Ki-yeol	Principal Research Engineer
		PARK Sul-gee	Research Engineer

Annex 2. Agenda

1. Opening of the session
2. Adoption of the agenda
3. Presentation of reports by each country on the Loran-C/Chayka programme
4. Operational matters for FERNS cooperating chains

4.1 Scheduled off-air for 2020

4.2 Other operational matters

5. Technical matters for FERNS cooperation chains
6. Coordination of other radio navigation services in the Far East
7. Other business
8. Report of the 14th TWG meetings
9. Date and venue of the 29th session
10. Report of the 28th session of the FERNS council
11. Closing of the session

Annex 3. List of Documents

Doc. No.		Description	Contributor
CS28/1		3. **Opening the 28th FERNS Council session**	
	1	4. List of Participants	**Korea**
	2	5. List of Documents	**Korea**
	3	6. Program of the 28th FERNS Council session	**Korea**
CS28/2		**7. Adoption of the Agenda**	
	1	Draft Agenda	**Korea**
CS28/3		**8. Presentation of reports by each country on the LORAN-C/Chayka programs**	
	1	Operational Status of China Loran-C Chains in 2019	**China**
	2	Operation status of Korea Loran-C chain	**Korea**
	3	The results of operational analysis of the Russian stations in chains B and C	**Russia**
	4	IALA technical notes	**IALA**
CS28/4		**Operational matters for FERNS cooperating chains**	
CS28/4.1		**Scheduled off-air for 2020**	
	1	Scheduled OFF-AIR for China Loran-C System in 2020	**China**
	2	Scheduled OFF-AIR for Loran-C station in 2020	**Korea**
	3	Scheduled OFF-AIR for 2020	**Russia**
CS28/4.2		**Other operational matters**	
	1	The development status of eLoran technologies in the R.O.K	**Korea**
CS28/5		**Technical matters for FERNS cooperating chains**	
	1-1	Preliminary results of Loran-C differential test	**China**
	2-1	Development of Output-Expandable eLoran Transmitter	**Korea**
	2-2	Development of eLoran Exciter and Control System	**Korea**
	2-3	Development of Integrated eLoran/GNSS Receiver	**Korea**
	3	Russian-Korean Radionavigation Chain	**Russia**
CS28/6		**Coordination of other radionavigation services in the Far East**	
	1-1	Providing Standardized Real-time Hydrological and Meteorological Information In Port Waters	**China**
	1-2	Study on Technical Standards of AMRD	**China**
	1-3	Progress of IEC 61108-5(BDS)	**China**

	2-1	A plan update on development of KPS (Korea positioning System	**Korea**
	2-2	A plan on maritime precise positioning and navigation service in the Republic of Korea	**Korea**
	2-3	The development status of R-Mode technologies in the R.O.K. and the suggestions for its cooperation	**Korea**
	2-4	Smart-Navigation	**Korea**
	3-1	Navigation support in the Arctic, Sabetta port	**Russia**
	3-2	NIIMA Progress JSC experience in developing modules for satellite and local navigation systems	**Russia**
	3-3	The Introduction of E-navigation in Russia	**Russia**
	3-4	Standardization in the Arctic region	**Russia**
	4	Radionavigation service and R-mode development	**IALA**
CS28/7		**Other business**	
	3-1	The new generation of high-precision and anti-jamming GLONASS equipment	**Russia**
	3-2	The main directions of radionavigation development in the CIS countries in 2019-2024	**Russia**
CS28/8		**Report of the 14th Technical Working Group meeting**	
	1	Report of the 14th TWG meeting to the 28th FERNS council session	**TWG**
CS28/9		**Date and venue of the 29th session**	
	1	Date and venue of the 29th session	**China**
CS28/10		**Session report**	
	1	Report of the 28th session of the FERNS council	**IALA**

Annex 4. – Report of the 14th Meeting of the Technical Working Group.

4th November 2019, Seoul, Republic of Korea

1. Opening of the session

1.1 The 14th session of the Far East Radio-navigation Service (FERNS) Technical Working Group (TWG) was held at the Best Western Premier Seoul Garden Hotel, Seoul, the Republic of Korea on the 4th of November 2019.

1.2 The chairman, Professor Dr Seung-Gi Gug, Korea Maritime & Ocean University, made a safety briefing about the building and indicated that simultaneous translation was available from Korean to English and English to Korean. He thanked all participants for being present and opened the working group session. He added that he hoped for a fruitful meeting, good cooperation and friendship between members. He thanked the Ministry of Oceans and Fisheries (MOF) for accepting to hold this session and in Seoul and making all of the arrangements.

1.3 At the invitation of the chair, each participant was introduced to the meeting. The following Members and Observers participated in the session:

Members:

People's Republic of China
Republic of Korea
Russian Federation

Observers:

IALA

1.5 A full list of participants is given in **Annex 1**.

2. Approval of the Agenda

2.1 The Agenda was accepted for the conduct of the meeting. The Agenda and the list of documents submitted for discussions are given at **Annexes 2 and 3** respectively.

3. Technical matters

3.1 Maritime World related Megatrends.

The presentation is available as input TWG14-3-1.

The Chair gave a presentation on the description of the different trends and gave examples of the Netherlands, USA and England. He then introduced the strategy workshop that will be held at the IALA council meeting with different topics addressed such as autonomous vessels, digitalisation, amongst others.

He explained that the 4th marine industrial revolution included: Digitalization, connectivity and artificial intelligence. ROK will start research on autonomous ships. IMO has a system of classification for levels of autonomy for Maritime Autonomous Surface Ships (MASS).

The Lloyds Register's Autonomous levels go from 0 to 6 and are similar to IMO. IALA is also including MASS on the strategy developments.

Concerning the next generation marine aids to navigation in the 4th industrial revolution, the example of the Use of Electric Pilotage Service System (EPS) is given, with the supporting example of Busan port sea view.

Mr JEON added that the strategy workshop was a good chance to create a joint picture of possible future Maritime Trends and global development which are most likely to have an impact on IALA and how these may affect the association's priorities, organization and activities. And he informed that the Chair of the Strategy Group supported by IALA secretariat has been preparing a document called "IALA Strategy White Paper" and it will be an input to IALA Council in December 2019.

3.2 Progress of Chinese High Accuracy Ground-based Time Service System (HAGTS)(China)

The presentation is available as input document TWG14-3-2.

Ms Yinhua Liu gave a presentation with the following outline:

- General Introduction of Chinese HAGTS
- Outline of eLoran section contained in HAGTS
- Prospect of time service technologies in China

The chairman thanked Ms Liu for an excellent presentation about new eLoran station and integration and asked if there was a plan for a new receiver by 2022. The answer was yes.

Mr Vasily Redkozubov asked clarification about the accuracy of Loran-C and if the stations planed in Dunhuang, Korla, Naqu had a Loran transmitter and the answer was yes. The plan is to install more than 100 reference stations. Mr Redkozubov asked how can differential corrections be provided and Ms Liu answered that the broadcast will have differential data on eLoran transmitters. Each transmitter will have a service area.

The chairman asked the reason why eLoran system was preferred to another. Ms Liu replied that the advantage is that this system can also be used for other purposes.

3.3 Requirement for eLoran Time Synchronization and its Service Plan (Korea).

The presentation is available as input TWG14-3-3.

Mr. PARK Sang-Hyun introduced KRISO and gave a presentation with the following outline:

- Requirement for Time Sync System

- eLoran Time Sync System in R.O.K
- eLoran Time Sync Service Plan
- Conclusion & Cooperation

The conclusion was ‘that the Loran-C/Chayka infrastructure, operated by Korea-China-Russia FERNS member countries, is evolving into eLoran/e-Chayka. For this evolution, UTC synchronization for the Loran-C/eLoran transmitting station is essential. In order to expand the eLoran PNT service area, it is necessary to have technical and policy consultations on the utilization of the FERNS chain. Therefore, it is needed to discuss the required performance for UTC time synchronization of the Loran-C/eLoran transmitting station with sharing of the implementation status of FERNS member countries and the future plans.’

Ms Liu asked about the time synchronization and Mr Park replied that a GPS common view was used. About accuracy, the major result is 5 ns.

3.4 Implementation Status of eLoran Reference Time Synchronized with UTC (Korea)

The presentation is available as input TWG14-3-4.
Mr Lee Young-kyu, KRISS, gave a presentation with the following outline:

- Introduction of Time Transfer at KRISS
- Time synchronization methods of an eLoran reference clocks
- Implementation of eLoran Reference Time System Synchronized with UTC(KRIS) (2/2)
- Conclusion and Plans

The conclusion was as follows: ‘In this work, a time-synchronization system [was constructed] for eLoran reference time-synchronized with UTC (KRIS) and got a preliminary result before its utilization. The synchronization performance can get worse slightly from this result due to the influence of temperature variance of the testbed environment. However, the error can be predicted and handled by control algorithms. After the construction of the eLoran transmitter station is completed, the developed time-synchronization system will be installed on them and the control algorithm will be improved by reflecting the practical operating environments.’

Ms Liu asked if Loran technology was used. The answer was no but maybe would need to plan for.

The chair had some questions about the method and the efficiency and Mr Lee replied that eLoran should be implemented and that currently, Two Way Satellite Time and Frequency Transfer (TWSTFT) is the most common. The chair concluded that China and Korea are doing experimental research. Hopefully, they can cooperate in this research to have successful results.

3.5 Prediction of eLoran Positioning Performance Using FERNS Multi-Chain (Korea)

The presentation is available as input TWG14-3-5.
The outline of the presentation by Mr SEO Ki-yeol, KRISO, is as follows:

- Introduction to eLoran testbed
- Analysis of Harbour Entrances Approach (HEA) requirement
- Performance prediction in eLoran testbed
- Conclusion & future work

And the conclusions were:

'Based on the eLoran testbed environment, the prediction performance of the position accuracy was analysed through simulation and confirmed that can achieve the performance within 20m of the position accuracy with the three transmitting station signals. In the case of using FERNS multi-chain signals, it was possible to predict the possibility for not only the expansion of performance coverage but also the achievement of HEA performance within 10m required by IMO and IALA. Therefore, a time synchronization system should be built within the transmitting stations of Korea-China-Russia, and it is necessary to have technical cooperation to expand the coverage of PNT services.'

3.6 Time coordination system in the electric power industry (Russia)

The presentation is available as input TWG14-3-6.

Mr Vasily Redkozubov introduced the topic of his presentation as part of the main item of the day for this meeting which is synchronization. These issues are very important and of interest in many countries. In Russia, it is taken with more and more interest. As a result, requests from companies arose.

The key objective of digital transformation in the electrical energy industry are:

- It is necessary to solve the very difficult task of constructing a system not only of high accuracy but also of high reliability.
- In solving this problem, Chayka system could help, as a backup GNSS system.
- Digital transformation will not be possible without a reliable time coordination system.

However, the work area is not for all the country.

Korea inquired, in case of a broadcast, what is the accuracy. Mr Redkozubov confirmed it was 120 meters without corrections and the time was 52109 seconds.

The chair asked if other industries can use time synchronization. The answer was that yes, several organisations made a request to use the signal. For example, television is using it. Also, as it is the case for each country, they use their stations for their defence system.

According to the declaration, Chayka station is open, so anyone can use it.

3.7 Synchronization with Chayka standard time signals (Russia)

The presentation is available as input TWG14-03-07.

There were requests received from companies in Russia to develop the network. In 2018, the construction was completed for all network. The current system is the most efficient but the company asked to use Chayka for improving accuracy and to synchronize the broadcasting. According to the result of the experiment, it is possible to use the signal from existing stations.

There is a roadmap developed to implement the system. Russian Television and Radio Broadcasting Network (RTRS) provides terrestrial broadcasting in the regions of Russia through 78 national and regional radio and television broadcasting centres.

The RTRS broadcast network has over 20,000 television transmitting devices (including digital) and about 2,700 radio transmitters.

Through digital broadcast television RTRS provides a number of free services, including synchronization of time and date with digital broadcasting.

To note in the report:

Despite the fact that global satellites are using to this day, but they do not meet the requirements.

Proposal to be noted in the report to the FERNS Council: Proposal to use GNSS and Alternative System to avoid critical situations in the Critical Infrastructures.

4. Any Other Business

FERNS resolution 25.1 is dated from October 2016. It determines if the council should expand its activities. The chair opened a discussion about the future of FERNS and asked participants for their opinions.

Mr Li Wenhua from China MSA said he would like the introduction of principal policies about PNT in China. Currently, the priority in China is to promote the development and application of BDS. Application for the maritime user is important. It is capital to recognize the importance of the land-based backup system, with the development of new technology, China would like to emphasize the importance of such systems. Following the resolution of 2016, China is currently expanding its scope with radio navigation systems. A few years ago it was about positioning issues but now as this year's discussions show, it has expended to timing related issues. The prospect is to continue in the future.

Mr Chae from MOF said that PNT is currently addressing issues. At this Technical Working Group, from the perspective of Korea, discussions can improve things. Stations such as Loran/eLoran/Chayka can be used for improvement. But it should be kept in mind that it is also important to address the mutual cooperation beyond the local limitations. R-mode and time-synchronized data can be well utilized. It would be good if the Technical Working Group could have further discussions and information exchange on timing.

Mr Vasily Redkosubov from IRTC accepted the proposition of the resolution of 2016. He underlined that it was also important to talk about other systems that support navigation (not only Chayka, eLoran, etc.) and that integrated systems should be discussed. Attention should be brought to the duplication of systems. The task should be about using technologies about timing, data exchanging through other channels; type of data is various, in case of emergency, detailed information is needed. Nowadays there is less communication with European partners, and it would be good to involve them more in the future. It could be considered to think about inviting European countries, or countries like India for instance which would be interested to know how FERNS members work. It is proposed to think more clearly about regulatory documents like memorandums or roadmaps about the application of the systems. Regulatory documents in the framework of FERNS council could be produced. It would take more time and detail work, but it could then be applied at the government level.

Mr JEON from IALA indicated that discussions about PNT are recurrent in IALA's work as well as R-mode. Guidelines are being developed on these topics. R-mode could help provide resilient PNT, and best solution can be expected when being combined with other positioning systems. Even though R-mode will not be the answer in all areas. IALA supports the idea of inviting actors around this area to FERNS.

The Chair thanked everyone for expressing their opinions and added that this open discussion will lead to summary and how to proceed. It will be taken further.

Mr JEON added a brief note of the planed IALA workshop on the future of Marine Radio beacon DGNSS to be held in Edinburgh at the end of January 2020 and invited all the participants to join this event.

5. Date and venue of the 15th session of the FERNS TWG

It was agreed that the meeting will be held the day before the 29th session of the FERNS Council meeting. It will be held in China in October or November 2020. More details will be provided by June 2020.

6. Closing remarks

The chair thanked everyone for a successful session. He emphasized the great support received from MOF.

***

Annex 1

List of Participants

Member Countries			
China (6)	Maritime Safety Administration (CMSA)	LI Wenhua	Deputy Director
	Maritime Safety Administration (CMSA)	XIA Tao	Senior Engineer
	Navigation Guarantee Center of North China Sea (NGCN)	MA Min	Section Chief
	Xi'an Research Institute of Navigation Technology	WANG Wei	Senior Engineer
	Xi'an Research Institute of Navigation Technology	REN Xiaowei	Senior Engineer
	National Time Service Center	LIU Yinhua	Associate Researcher
Korea (6)	Ministry of Oceans and Fisheries (MOF)	KIM Min-jong	Assistant Minister, Maritime Affairs and Safety Policy Bureau
		SONG Jong-joon	Director, Aids to Navigation Division
		CHAE jong-guk	Deputy Director, Aids to Navigation Division
		KIM Kang-on	Deputy Director, Aids to Navigation Division

	Nation Maritime PNT Office	JEONG Kyeong-gyu	Deputy Director
	Korea Maritime and Ocean University	GUG Seung-gi	Professor
Russia (5)	Ministry of Industry and Trade	Dmitrii Kan	Deputy Head of Section
	Internavigation Research and Technical Centre (IRTC)	Vasily Redkozubov	Deputy Director General
		Margarita Afanasyeva	Head of the service
	Ministry of Defence	Aleksandr Gritsov	Deputy Head of the Section of Management and Control
	Russian Embassy	Valery Fedorkov	3rd Secretary
Observer	IALA	Minsu Jeon	Technical Operations Manager
	IALA	Audrey Guinalt	Documents and events coordinator
Invited guest	Ministry of Oceans and Fishiries	LEE Byeong-gon	Senior Deputy Director, Aids to Navigation Division
		KIM Jeong-sik	Deputy Director, Aids to Navigation Division
		KIM Hyung-jun	Deputy Director, Aids to Navigation Division
	Korea Research Institute of Ships & Ocean Engineering	PARK sang-hyun	Director/Principal Research Engineer
		SEO Ki-yeol	Principal Research Engineer
		PARK Sul-gee	Research Engineer

Annex 2

Agenda

1. Opening remarks

2. Approval of the agenda

3. Technical Matters
   - 3.1 Maritime World Related Megatrends (Chairman)
   - 3.2 Progress of Chines High Accuracy Ground-based Time Service System (China)
   - 3.3 Requirement for eLoran Time Synchronization and its Service Plan (Korea)
   - 3.4 Implementation Status of eLoran Reference Time synchronized with UTC (Korea)
   - 3.5 Prediction of eLoran Positioning Performance using FERNS Multi-Chain (Korea)
   - 3.6 Time coordination system in electric power industry (Russia)
   - 3.7 Synchronization with Chayka standard time signals (Russia)
4. Any other business
5. Date and venue of the 15th session of FERNS TWG
6. Closing remarks

Annex 5. – Report of the Bilateral Meeting between Republic of Korea and Russian Federation

6th November 2019, Seoul, Republic of Korea

MINUTES

1. Opening of the meeting

1.1 The Bilateral Meeting between Republic of Korea and Russian Federation was held at the Best Western Premier Seoul Garden Hotel, Seoul, the Republic of Korea, on 6th of November 2019, in order to solve the pending issues for operating the existing Korean–Russian Radio Navigation Chain and to get an agreement on a Roadmap for the creation of new Russian-Korean Radio Navigation Chain.

Participants:

The Republic of Korea (led by Mr CHAE Jong-guk, Deputy Director of Aids to Navigation Division, Ministry of Oceans and Fisheries, Republic of Korea)
Russian Federation (led by Mr Dmitrii KAN, Deputy Head of Section, Ministry of Industry and Trade, Russian Federation)

2. Approval of the Agenda

2.1 The following Agenda was accepted for the conduct of the meeting.

1) Consideration of proposals for updating the draft Roadmap "Creation of the Russian-Korean Radio Navigation Chain" submitted by the Korean and Russian parties.

2) Consideration of the digital code table implementation for radio exchange.

3) Consideration of the implementation of the UTC timeline synchronization mode of Ussuriysk and Pohang radionavigation stations.

3. Results of the Meeting

Following a bilateral meeting, the delegations of the Russian Federation and the Republic of Korea agreed:

3.1 Complete the approval of the Roadmap by the end of May 2020. To sign the Roadmap, the parties proposed to use diplomatic channels, unless one of the parties offers another option for the signing procedure.

To implement the Roadmap Activities, the Russian and Korean delegations came to a common opinion on the need for technical experts to carry out a series of research and estimate work aimed at developing interaction algorithms for duty shifts of Russian and Korean stations, taking into account the technical features of the Ussuriysk and Pohang radionavigation stations, while ensuring reliable and high-quality functioning international Russian-Korean radionavigation chain

In the implementation of Roadmap Activities, the parties agreed on close cooperation and coordination of the work direction. The parties exchanged contact information to ensure interaction.

3.2 To carry out Activities for the implementation of the time scale synchronization mode by UTC of the Ussuriysk and Pohang radionavigation stations until 2020. The parties took into account that for the implementation of these modes it is necessary to carry out technical works at the Ussuriysk and Pohang radionavigation stations.

3.3 To implement the Roadmap Activities, the Russian and Korean delegations came to a common opinion on the need for technical experts to carry out a series of research and estimate work aimed at developing interaction algorithms for duty shifts of Russian and Korean stations, taking into account the technical features of the Ussuriysk and Pohang radionavigation stations, while ensuring reliable and high-quality functioning international Russian-Korean radionavigation chain.

3.4 To approve, the radio frequency for the operational information exchange between the duty shifts of the Ussuriysk and Pohang radionavigation stations until the end of 2019, put in force the digital code table of radio exchange by the end of May 2020.

From the Russian Federation Delegation	From the Republic of Korea Delegation
Dmitrii KAN	CHAE jongguk