

**Submission to the
Telecom Regulatory Authority of India
(TRAI):**

**Comments on
Consultation Paper on
Next Generation Public Protection and
Disaster Relief (PPDR) communication
networks**

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1. Executive Summary

Samsung Electronics Co., Ltd (hereinafter Samsung) is pleased to submit a response to the TRAI consultation paper on “Next Generation Public Protection and Disaster Relief (PPDR) communication networks”¹. Samsung is grateful for the opportunity to work with the TRAI relating to providing comprehensive communication infrastructure for PPDR agencies enabling better communications for public safety.

In section 2, Samsung provides comments and suggestions on the issue for questions listed in the consultation paper. Samsung fully supports the consultation by the TRAI to evolve existing legacy PPDR communication infrastructure (based on either analog systems or narrowband radios), which is fragmented and inadequate to meet the present day challenges. For Indian conditions we strongly believe that the next generation PPDR communication networks enhanced with broadband capabilities should be deployed over a single unified framework, and based on a shared network using RAN Sharing Model. At the same time to ensure that the rigorous requirements set out for public safety networks are not sacrificed, we recommend dedicated spectrum for PPDR communication services. With consideration of the increasing demand for critical communications in India, and the necessity for public safety communications to be supported on both on-network and off-network (D2D) modes, exclusive frequency band in Band 28 (APT700MHz), with a minimum of 10MHz downlink and 10MHz uplink is recommended to be earmarked in the National Frequency Allocation Plan (NFAP) inline with spectrum allocations in other regions of the world. We also believe that ownership of the management of the single unified PPDR solution should remain with the PSU on behalf of the government for efficient and effective public safety operations.

Samsung has demonstrated strong leadership in broadband PPDR technology through active participation in development of global PPDR standards and experience in successful implementation in Korea (please refer to Appendix 1 for more information) and active engagement with public safety agencies in nearly 30 countries around the world.

Finally, Samsung would like to thank the TRAI for the opportunity to comment on the consultation, and look forward to working closely with the TRAI in a continuous manner for evolution of PPDR communication networks aspects in India, including the possibility of establishing a mission program for PDDR e.g. “SURAKSHIT BHARAT”.

2. Comments and Suggestions

In this section, Samsung provides detailed comments and suggestions for questions listed in the consultation paper.

Q1. Do you consider the existing fragmented model of PPDR communication network in the country adequate to meet the present day challenges? If not, what are the deficiencies in the existing model of PPDR?

No, the current fragmented model of PPDR communication is not adequate to meet the present day challenges in India. There is a need to have a single unified framework with nationwide

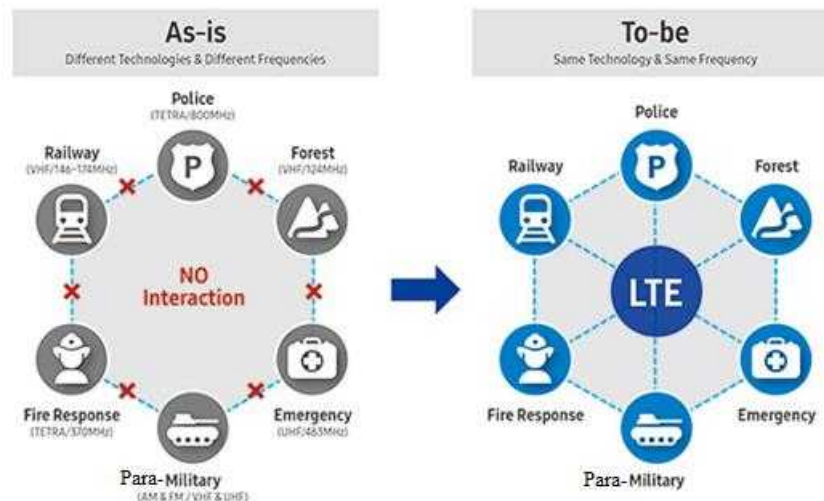
¹ http://www.trai.gov.in/sites/default/files/Consultation_Paper_PPDR%20_09102017.pdf

PPDR network coverage and enhanced broadband capabilities (based on 3GPP LTE solution, a.k.a. PS-LTE).

Below, we would like to elaborate on some of the key challenges with the current public safety systems, for your consideration.

1) Interoperability among various public safety agencies:

PPDR agencies – including police departments, fire departments, emergency medical professionals, para-military forces, air traffic control and many others – need to be able to maintain streamlined and reliable communications in the event of natural or man-made disasters. The first few hours of an emergency are the most critical time to save lives; however, lack of coordination and reliable communication can severely handicap those efforts. In India, the ability to communicate and share information between agencies is prevented due to individually adopted technologies, spectrum, equipment, standards and protocols by the respective agencies (i.e. existing **fragmented framework** as illustrated in Figure 1). Cross-agency communication and coordination remains hard to achieve because it is never part of the planning or procurement process due to each agency's internal decision. Lack of interoperability leads to multiple issues that are not immediately apparent: proprietary, custom designed and non-interoperable technology and equipment are more expensive and typically limit the array of equipment options. For example, Tsunami in 2004 was a major disaster in which several Indian states were involved together. There was substantial variation in the responses of these states' governments which was uncoordinated, and resulting in inadequate response to the overall situation. As we move into the increasing realm of unpredictable geo-climatic and human introduced calamities, there is a strong need for coordination between the central and state governments to address the present day challenges. **Therefore a single unified framework (both policy and technology) is the need of the hour to enable coordinated efforts across states and agencies.**



[Figure 1: Lack of Interoperability hampers Coordination]

2) Limitations of existing Narrowband PPDR networks:

Agencies currently use Land Mobile Radio (LMR) technologies such as TETRA/P25 for mission-critical communications. While LMR networks are designed to meet the unique needs and priority access requirements, they carry only voice and do not provide data capabilities such as enhanced messaging, images and video-based functionality that is becoming an essential requirement for the

first responders. Existing PPDR communication networks are outdated and cannot be enhanced for enriched content due to the inherent limitation of narrowband technologies, suffering significant productivity benefits. We are witnessing many agencies augment voice capabilities with data services and equipment from commercial carriers, however, this requires them to carry and maintain two devices e.g. a TETRA device and a smartphone or tablet. **In summary, existing narrowband-based PPDR networks are very limited and caters mainly to voice service needs.**

Adopting a standardized technology around LTE will lead to establishing a **single unified framework**, which can be **scalable and brings economies of scale**. While the requirements defined by each government vary slightly by local environment, jurisdiction, geography, history and threat assessment, the use of LTE as a common underlying technology for mission critical services will satisfy the rigorous requirements set out for public safety networks, and offers significant benefits of a large and sustainable ecosystem of infrastructure equipment, devices and a harmonized spectrum usage. This advantage has been the basis for regulatory agencies in many countries to adopt public safety solutions based on LTE. **Leveraging LTE-based broadband technology unifies existing disparate public safety agency requirements through a common platform.**

Q2. In the various models described in para 2.11-2.15, in your opinion which of the model (dedicated, commercial, hybrid) will be more suitable for Indian conditions? or Is there any other alternate model which would be more suitable for Indian telecom environment? Please provide rationale for the suggested model.

India, with its vast human population, and unique geo-political environment faces uncertainties from manmade disasters/hostile activities, and also prone to many natural disasters. In such environment, we highly recommend to earmark and utilize dedicated spectrum (as specified in section 2.13 of the consultation paper) in order to comply with the rigorous requirements set out for PPDR communications. In terms of network deployment strategy, our recommendation is to adopt Hybrid - RAN Sharing Model (as specified in section 2.15 of the consultation paper), to facilitate rapid deployment of nationwide PPDR infrastructure.

1) Spectrum based models

For emergency communications over a spectrum of commercial carriers, it is imperative that first responder communications receive priority over commercial voice and data traffic. The Quality-of-Service Control Index (QCI) of PS-LTE can enable the pre-emption and prioritization to the public safety service request relative to other commercial service requests. First responders cannot rely on spectrum allocated to commercial carrier networks, as public usage can overload networks (from capacity point of view) and make emergency communications unreliable. In a different argument it also not commercially viable option for Indian operator's to always provide priority to PPDR services on a limited low band premium spectrum, which is currently used for commercial services unless the agencies agree to pay a market driven price for the priority PPDR services. In Indian context, it is highly desirable to have dedicated spectrum, which allows PPDR agencies have better control of the resources and subscribers database to better manage the high demand for PPDR services (voice and multimedia data capabilities) during emergencies and other critical communication needs. Dedicated spectrum will also provide added benefit of smooth inter-agency communication, i.e. better coordination through a unified policy framework, e2e compliance, and as well as a highly secure network satisfying PPDR requirements. Both the US and South Korea have chosen to reserve dedicated spectrum in the 700 MHz Band for first responder communications. While dedicated

spectrum for PPDR services may be shared by a number of PPDR agencies (police, fire, emergency medical services etc.) and other critical communication user organizations (captive users), there may be challenges in economic justification. To address such concerns, US and other countries are exploring business models for monetization of unused capacity in the dedicated spectrum e.g. when it is underutilized by PPDR agencies.

2) Network deployment strategy based models

Any comprehensive public safety system must provide nationwide coverage whether it is dense urban areas or sparsely populated rural areas. So planning, building and operating a dedicated nationwide broadband PPDR network, as vast as India could be time consuming and expensive. In such cases, it is advantageous to explore leveraging existing network infrastructure deployed by commercial carriers.

Commercial carrier networks are generally designed and deployed in geographies (service circles) only with reasonable user density and traffic considerations, which makes economic sense for the commercial carriers. However, there is also a possibility of having coverage holes in geographies not covered by commercial carriers, which is not acceptable for PPDR communications. Therefore completely relying on commercial carrier network infrastructure, in the hour of need that can be shared between PPDR first responders and commercial carrier network subscribers may not meet the PPDR requirement on nationwide coverage, and additional infrastructure may be necessary. Nevertheless, sharing infrastructure in urban and rural areas covered by commercial carriers will help in identifying the coverage holes.

Government agencies need to explore appropriate models (e.g., CAPEX for deployments in coverage holes or providing other benefits) with commercial carriers for meeting this additional infrastructure meant to be used for PPDR usage. Network Availability is another key requirement for PPDR agencies during disasters, however maintaining the network availability is a big challenge (primarily, due to loss of electric supply, loss of backhaul etc.) and sufficient alternatives need to be planned in advance in order to achieve the public safety grade network availability.

In our perspective for Indian conditions, both from coverage and economic standpoint, to start with, it will be appropriate to have a shared infrastructure model based on existing commercial carrier networks supplemented by additional deployments mitigating coverage holes. This shared model is equivalent to the hybrid model discussed in section 2.15 of the consultation paper. Among the hybrid models, RAN Sharing Model is highly recommended which seems attractive to all the major operators for the PPDR services.

To enable such shared model, we outline a suggested framework:

- 1) Government to identify a dedicated spectrum (preferably APT700MHz – please see our response to Question 5).
- 2) Government select an operator who provides a commercially viable PPDR network through a tendering process and a service agreement to deliver PPDR services on the newly identified dedicated spectrum.
- 3) Operator will be contracted to build & manage the PPDR communications network to ensure the availability of PPDR network resources with given capacity at any point of time, and paid for by the government as per the business arrangement.

- 4) The operator may utilize the unused capacity for commercial services. For such usage, the operator may be required to pay to the Government.
(**Note:** During the period that PPDR agencies are active and utilizing the resources, commercial carrier users might be restricted/less prioritized to use the network resources).
- 5) Additionally, new mechanisms should be derived for the Government revenue generation based on further TRAI consultation. The mechanism combines the overall spectrum charge (combining spectrum acquisition charge + SUC) to be paid by operator to government for using PPDR spectrum.

Benefits of the proposed model:

- Government provides priority to mission critical communications platform for public safety services in a time bound manner.
- Government benefits from the additional revenue from the commercial usage of the PPDR spectrum.
- Operator benefits from the usage based payment mechanism for the PPDR spectrum which may be used for other than PPDR services.
- Offers significant benefits of a large and sustainable ecosystem development of devices in Band 28 for India market.

Q3. Should PSUs be earmarked for providing nationwide broadband PPDR communication network? Please justify your answer.

Yes, PSU earmarking will help establish a single coordination framework for communication across the first responders that belong to multiple agencies i.e. through common dispatch and notification process during disaster management. Further, we are of the opinion that ownership of the entire PPDR solution (proposed in response to Question 2) should remain with the PSU on behalf of the government.

In this approach, it will be possible to deploy a dedicated core network for PPDR services, which can be connected to the shared RAN infrastructure of a commercial operator, as proposed in our response to Question 2.

Q4. Will it be technically feasible and beneficial to permit PPDR trunking service roaming on public telecom networks? If yes, what challenges do you foresee in implementation of such an arrangement? Please justify your answer.

PPDR trunking service roaming on commercial carrier networks is technically feasible, and beneficial in scenarios where there are coverage holes.

With an assumption of good nationwide coverage PPDR trunking service, roaming on commercial carrier networks may be rare in occurrence. However, until the time the dedicated PPDR network is getting build there are chances of coverage holes which may require roaming to the commercial carrier network. In such scenarios, the commercial operators should allow PPDR roaming to their network on the spectrum band PPDR device supports. Agencies need to ensure necessary commercial & service level agreement with commercial carriers to provide priority for PPDR services over other commercial services during the necessary period. Technically, it is feasible to permit PPDR trunking

service roaming on commercial carrier networks with appropriate service agreements and network configurations such that PDN establishment is routed to the P-GW in Home PLMN over a VPN connection.

Q5. Can frequency bands be identified exclusively for public protection and disaster relief? What are the candidate bands for PPDR operations in India?

Yes, we strongly believe that an exclusive frequency band for PPDR operations is identified, in order to efficiently design the nationwide network for coverage and capacity. Based on the global trends, Band 28 is recommended to be earmarked in National Frequency Allocation Plan (NFAP) for PPDR communications.

As illustrated in the Table 1 below, Band 28 (APT700MHz) is the leading LTE band for PPDR communications.

Region	Countries	LTE Bands
Asia-Pacific	South Korea	Band 28
	Japan	Band 5, 8
	China	Band 39
	Australia	Band 7, 28
North America	USA	Band 14
	Canada	Band 14
Latin America	Mexico	Band 28
Europe	UK	Band 3, 7, 20
	France	Band 28, 68
	Germany	Band 28, 68
	Finland	Band 28
Middle East	Qatar	Band 20
	UAE	Band 68

[Table 1. LTE Frequency Band Usage by Country for Public Safety]

In the proposed model in response to Question 2, we recommended dedicated spectrum for PPDR service. This should be possible because Resolution 646 (rev WRC-15) has identified the 694-894MHz for broadband operations. Of 694-894MHz, APT700MHz (Uplink: 713-748MHz; Downlink: 768-803MHz) is best for fulfilling the Data service requirements of a PPDR network.

Other Benefits for APT 700MHz band:

- Better Radio Propagation Characteristics
- No concern of Interoperability
- Availability of broader device manufacturing base
- References available from countries like US, South Korea, UAE, Canada, France etc. where 700MHz is already being used for broadband PPDR (globally harmonized band providing economies of scale)

- Offers significant benefits of a large and sustainable ecosystem development of devices in Band 28 for India market.

NOTE: While we believe that any spectrum block from Band 28 is identified exclusively for PPDR operations, please refer to our response to Question 2, where other spectrum blocks from the same band may be made available for commercial services as well.

Q6. If wideband/broadband PPDR is to be implemented in India, what quantum of spectrum will be needed for such solution for PPDR?

Minimum of 10MHz downlink and 10MHz uplink is recommended to provide an efficient broadband PPDR solution.

Allocation of 10MHz (downlink/uplink) spectrum is in line with global practices being followed in early adoption countries such as US, South Korea etc., but also taking into account the multiple agencies in India, and multitude of device types (e.g. dash board units, drones, remote surveillance cameras) for emerging use cases, it seems natural to consider the same minimum requirements. In order to enable effective operation and achieve acceptable performance for PPDR services including the D2D support, it is necessary to assign a dedicated spectrum with atleast 10MHz bandwidth. Further, we envision higher data consumption with services based on data and video capabilities (e.g. live streaming), which will require higher data rates.

Q7. What is the cost and benefits tradeoff envisaged for public protection and disaster relief viz-a-viz commercial value of spectrum?

We do not provide specific comments, however please see our response in Question 2 for related information. Further, we are in the view that no cost comparison should be made in case of saving life of the citizens as the security and welfare of the society is the prime responsibility of the government.

Q8. Do you suggest any other workable option that can be adopted?

Please refer to our response to Question 2.

Q9. Please give your comments on any related matter not covered in this consultation paper.

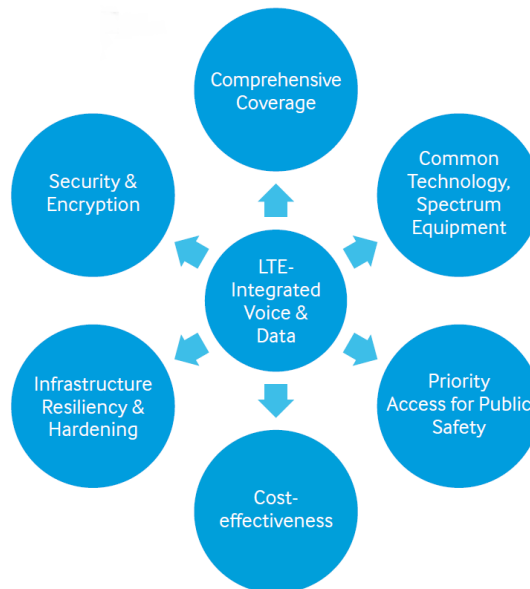
The PPDR solutions for India should be based on the global 3GPP standard². For India specific PPDR solution needs, a study may need to be organized in TSDSI (Indian Telecom SDO), to identify specific Indian requirements (if any) not already addressed by the 3GPP solution.

In this section, while we focus on presenting the evolution of global standards for PPDR services and to share our thoughts for developing India specific requirements, we would like to take the opportunity to suggest to the authority to recommend DoT to establish a mission programme for PPDR. The mission programme can be termed for example, as “SURAKSHIT BHARAT”. The

² http://www.3gpp.org/news-events/3gpp-news/1875-mc_services

creation of such mission programme would kick start the goal to achieve a single unified framework (both policy and technology) enabling coordinated efforts across states and agencies.

Demand for Mission Critical services over broadband drove the development of specifications for a standardized PPDR functionality in 3GPP based on key requirements illustrated in Figure 2 below.



[Figure 2: Key requirements of a PS-LTE System]

3GPP-based PPDR standard has strong support from all the major national public safety agencies, including the US Department of Commerce, UK Home Office, South Korea Ministry of Public Safety and Security, French Interior ministry, and TETRA Critical Communication Association (TCCA). 3GPP selected LTE as the mobile technology for public safety broadband communications. 3GPP Releases 12 and 13 were focused on defining the specifications for Mission Critical Push-to-Talk (MCPTT) over LTE to be used for broadband critical communications. Subsequently, member countries have rapidly adopted 3GPP based PS-LTE solution for their respective Public Safety communications systems.

In the event of a major disaster, if the LTE network collapses due to congestion or physical damage, first responders must be able to connect with each other. The Device-to-device (D2D) capabilities of the 3GPP PS-LTE system based on Release 12 ProSe allows first responders to maintain the critical lines of communication in such scenarios. ProSe enables direct discovery of peers in order to establish communication between the devices that are not under the coverage of the network. ProSe also allows the communication between devices under the network coverage and outside the network coverage using UE-to-network relay capability of the device. Hence D2D communication is one of the most essential features for first responders.

Besides attaining service parity for voice (both Network Mode Operation and Direct Mode Operation) with the existing PPDR systems, Public Safety community have requested multimedia services be adapted to their missions and way of working. As a result, 3GPP in Release 14 introduced additional Mission Critical (MC) Services and enhancements to its repertoire of standardized applications, specifically:

- Enhancements to MCPTT
- Mission Critical Data (MCData) for both on-network and off-network (D2D) modes
- Mission Critical Video (MCVideo) for both on-network and off-network (D2D) modes
- Common Functional Architecture to enable standardization of additional MC Services

In 3GPP Release 15 MC services are further evolved, in particular:

- Interconnection between 3GPP defined MC systems
- Interworking between the 3GPP defined MC system and legacy systems such as TETRA or P25, for voice and short data service
- MC Service requirements from railway industries
- MBMS APIs for MC Services
- MC Service requirements from maritime industries

Please refer to 3GPP website³ for detailed information on 3GPP efforts.

Considering PPDR is a global initiative, we highly recommend that standards developed by 3GPP should be adopted for Indian PPDR services as the baseline. For India specific PPDR services requirements, it is suggested that related studies and technical specifications are developed in Telecommunications Standards Development Society, India (TSDSI - India's Telecom SDO).

3. Acronyms and Abbreviation

3GPP	3rd Generation Partnership Project
APT	Asia-Pacific Telecommunity
CAPEX	Capital Expenditure
D2D	Device-to-device
E2E	End to End
LMR	Land Mobile Radio
LTE	Long-term evolution
MBMS	Multimedia Broadcast Multicast Service
MC	Mission Critical
MCPTT	Mission Critical Push-To-Talk
NFAP	National Frequency Allocation Plan
PDN	Packet Data Network
P-GW	PDN Gateway
PLMN	Public land mobile network

³ http://www.3gpp.org/news-events/3gpp-news/1875-mc_services

PPDR	Public Protection and Disaster Relief
ProSe	Proximity Services
PS-LTE	Public Safety-LTE
PSU	Public Sector Undertakings
QCI	Quality-of-Service Control Index
RAN	Radio Access Network
SUC	Spectrum Usage Charges
TCCA	TETRA Critical Communication Association
TETRA	Trans-European Trunked Radio
TRAI	Telecom Regulatory Authority of India
TSDSI	Telecommunications Standards Development Society, India
US	United States of America
VPN	Virtual Private Network

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Appendix: 1

Appendix 1

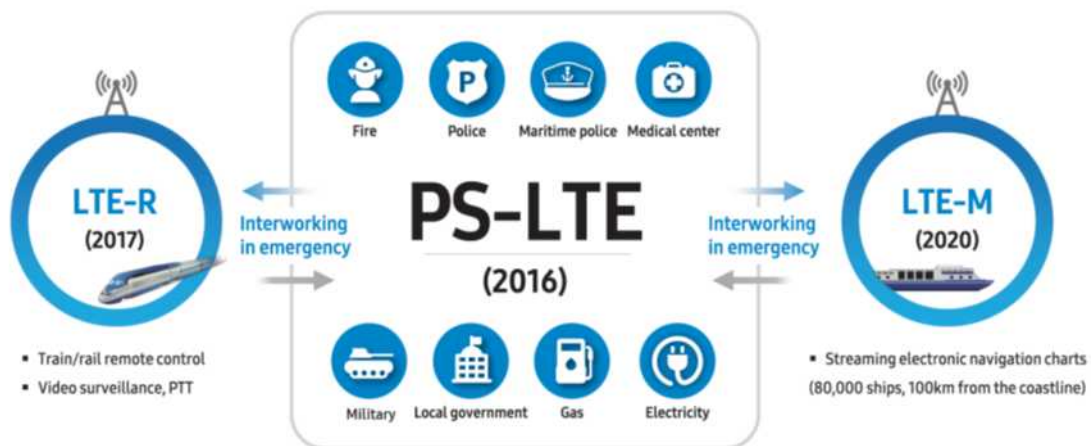
PS-LTE: A Successful Implementation in South Korea

The Korean government was early to recognize that in emergency situations, it is crucial that inter-organizational communication be both accessible and highly functional. This necessitated a converged communication network for public safety agencies. As a result, the Korean government decided to implement PS-LTE in an expedited timeframe.

The Korean government in partnership with Samsung is currently deploying the public safety LTE network. The network is being rolled out in three phases, culminating in a nationwide PS-LTE service by 2018. The Korean government is planning to invest around USD1.5billion for the PS-LTE network, which includes the pilot, deployment and operational costs.

The Korean government has been at the forefront of integrating its crucial transportation systems into the same LTE network over 700MHz Band 28 as PS-LTE.

Figure 3 shows the South Korean government’s vision for an integrated LTE network spanning the



entire country.

Figure 3: South Korea’s PS-LTE, LTE-R and LTE-M Networks

Samsung is also leading the deployment of LTE-Railroad (LTE-R), the world’s first LTE-based railroad and subway wireless network, and LTE-Maritime (LTE-M), the world’s first maritime wireless network.

Busan, Korea’s second largest city, has already deployed a commercial LTE-R network in 2015 and the government is planning to set up and install LTE-R base stations throughout the country’s entire rail network by 2025 – about 4,800km in length.

LTE-M, or “e-navigation,” will be a comprehensive safety system to assist the prevention of maritime accidents and will offer tailored safety measures based on past statistics. It will enable high-speed data communications for up to 80,000 ships as distant as 100km offshore.
