New Technology Review

Navigation Radar Intercept Sensor (NRIS)

# Summary

At DTEC1 a presentation was provided to the Committee, WG2, on the use of Navigation Radar Intercept Systems to support vessel detection. The system is used in conjunction with external AIS receivers to:

* Correlate bearings to vessels with AIS to confirm active AIS
* Identify the presence of vessels not operating AIS

The technology is interferometric measurement of source of X-band navigation radar emissions.

## Purpose of the document

Based on the presentation provided at DTEC1, the purpose of this paper it to provide an initial review using the Guideline G1153 review template.

## Related documents

DTEC1-13.1 section 9.1 (report of presentation)

Reutech Presentation at DTEC01 (located on IALA fileshare)

# Anticipated Activity – DTEC02

The technology will be reviewed during DTEC2.

# Outcome of the review

The outcome of the review to be determined at DTEC.

Details on the review are contained in Annex A.

1. Emerging Technologies – Review Table

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|  | **Question** | **Technology Candidate Response** | | **Working Group Response** | |  |  |  | | --- | --- | --- | | **Green** | **Amber** | **Red** | |
| **Infrastructure** | **User** |  | **Status** |
|  | Where has the referral come from? | RRS was requested to submit our product for Technology Review following presentation to IALA DTEC WG2 in September 2023. | |  |  |
|  | Name of technology and product name? | Technology is interferometric measurement of source of X-band navigation radar emissions. Product is RIS 100X Navigation Radar Intercept Sensor. | |  |  |
|  | Functional description | RIS 100X measures bearing from location of the RIS 100X to vessels at sea that are operating X-band navigation radar. Bearing markers are colour-coded to differentiate one radar from the other on the basis of radar operating frequency. Bearing measurement accuracy is high enough to correlate with AIS emissions. “Dark” vessels may be detected as being present when a bearing marker is present without an AIS report along the bearing line. Where two or more RIS 100X sensors are deployed with coverage overlap, the location of the vessel may be fixed. Where an AIS report exists without correlated bearing from RIS 100X, possibility exists that vessel has disabled X-band radar. | |  |  |
|  | Proposed user group | 1. Coastguard/navy on patrol vessels. 2. Coast-watch organisations (eg light-house operators) using single or multiple fixed installations. 3. Ports authorities. 4. Maritime Search and Rescue agencies. 5. Border management agencies. | |  |  |
|  | What are its Key limitations? | The receiver detects the radar using the peak radiated power of the navigation radar. When the radar is too far away from the receiver, path losses reduce the power level at the RIS 100X to below the receiver’s sensitivity. Some X-band navigation radars that are solid-state with lower peak power levels than conventional navigation radar will result in restricted operating ranges.  Detection is at most limited to radar visibility range (due to earth’s curvature) and physical obstructions between receiver and vessel at sea will mask radar.  RIS 100X employs a tracker on the bearing lines to filter out reflections off structures. In an extremely high vessel density scenario (such as overlooking a crowed harbour) discrimination between targets may be compromised. | |  |  |
|  | Where is it currently used (geographic and/or industry)? | 1. A single RIS 100X is currently installed on Slangkop Lighthouse on the Western seaboard of the Cape Peninsula, Cape Town, South Africa. Coordinates: S 34°08’ 55.10” E18°19’09.33” 2. One RIS 100X located on Bongao Island, West Mindanao Philippines under UN contract. Coordinates N 5° 01’ 00” E 119°44’ 43”. See video under <https://www.youtube.com/watch?v=EMxeLJKTYXs&t=251>. 3. 2 systems in fixed coastal application in Middle East. | |  |  |
|  | How is it currently used? | The RIS 100X receiver is integrated with an AIS receiver for combined display of AIS and radar bearing lines. These two main components are linked to a GSM modem for transmission of the maritime situation, as well as the system control and monitoring, to remote Control Rooms.  Alternatively, where internet access points are available at the deployment site, the system data may be exchanged via direct internet connection.  Where multiple RIS 100X systems have geographic overlap, each system may communicate with the remote Control Rooms where biangulation or triangulation may take place. Alternatively, at remote sites with limited GSM bandwidth/connectivity, one site may act as master and receive the data from another site for biangulation at the master site. | |  |  |
|  | How could it be used within the maritime sector? | Situational awareness of the maritime domain may be provided, amongst others, by AIS (which is a co-operative technology in that the ship operator is able to switch it off) or active shore-based radar (which is non-co-operative in that the ship operator is unable to prevent disclosure of own vessel location).  The RIS 100X is reliant on active ship’s navigation radar and is thus also a co-operative means of location. Vessels at sea that are inclined to switch off their AIS, however, may be less likely to switch off their navigation radar as they run the risk of being unaware of an approaching patrol vessel, or they may fear collision or grounding.  There are three benefits of the application of this technology:   1. Under poor weather conditions, detection of vessels at sea by the active shore (or ship) based radars may be compromised by the high sea and weather radar clutter situation. Under these conditions, the RIS100X may validate the intermittent detections of the active radar as it is less affected by inclement weather. 2. The RIS 100X device is entirely passive so its presence cannot be detected, unlike patrol ship/shore based radar that can be detected by low cost radar warning receivers on offending vessels. 3. Since a vessel’s navigation radar is generally high up on a mast, a vessel approaching the coast will be detected by the RIS 100X before the hull is detected by the active shore based radar (since the mast is the first part of the vessel to appear over the radar horizon). | |  |  |
|  | Who developed it? | The system was developed and is currently only produced by Reutech Radar Systems Division of Reutech Ltd, a South African company based in Stellenbosch South Africa. | |  |  |
|  | Is it commercial, non-commercial or military? | It is an uncontrolled, ITAR-free product able to be used for commercial, para-military and military applications. | |  |  |
|  | Is there an existing technology that meets the same requirements?  If so, what make this different? | The closest products to the RIS 100X are military electronic intelligence systems which are excessively costly to apply in the role in which RIS 100X is applied. RIS 100X fulfils a subset of the military systems in that the latter covers all radar bands of operation whereas RIS 100X only covers the radar frequency band allocated to X-Band navigation radar by the ITU.  To the best of our knowledge, RIS 100X is unique in the marketplace at present. | |  |  |
|  | Ease of implementation? | A team of two within one day, travel time dependent, can achieve system installation and setting-to-work at each deployment site. System Site commissioning at remote Control and Monitoring location eg Maritime Domain Awareness Centres (MDACs) can also be achieved within one day.  Operator and Maintainer training is a two-day course.  Assuming a turnkey system incorporating own AIS and GSM functionality is supplied, installation is relatively simple. If the system makes use of external AIS sources, the complexity of linking into the system would first need to be established. | |  |  |
|  | What are the constraints for implementation? | 1. The system operates on a line of sight principle, so any obstructions between vessel radar and RIS 100X will hinder effective vessel detection. 2. The system is limited by either the radar horizon or, where very high sites are available, by the vessel radar transmit power, vessel radar antenna gain and the RIS100X sensitivity. 3. Emerging navigation radar technology using solid-state transmitters rather than magnetron transmitter will have relative short detection ranges due to lower peak power levels (100’s of Watts as opposed to the 10’s of kiloWatts of the magnetron radars). At present the bulk of lower cost navigation radars remain magnetron based, as the solid state radars remain relatively costly. 4. In extremely congested areas such as large ports, the multitude of operating navigation radars and the proximity of vessels relative to one another may degrade system performance. 5. Detection of vessels may not occur on every scan of the vessel radar, since the RIS 100X switches its receiver faces and tuning sub-bands over time. The bearing lines have a settable persistence which allows the bearing to be retained even during periods when no detection is achieved. Given the relatively slow movement of shipping, these delays do not materially affect system operation. 6. Adequate GSM and/or internet bandwidth is required to convey the system data to remote user sites. 7. Ambient temperatures outside of 0°C to +55°C may compromise system operation. | |  |  |
|  | what is the capability of the technology? (i.e. nominal range; data throughput; support for audio / video?) | In order to protect the RIS 100 receiver from close in navigation radar emissions (such as when the RIS 100X is installed onboard a patrol vessel which has its own navigation radar), front-end attenuation has been introduced. This protection circuitry reduces receiver sensitivity. In installations where there are no close-by active radars, this attenuation may be removed to increase receiver sensitivity.  With the protection (attenuation) in place, the detection range of a 25kW peak power/32dB antenna gain navigation radar is approximately 65km (35 nm). | |  |  |
|  | What is the scalability of the technology? | The RIS 100X covers the ITU-defined X-band navigation radar bandwidth. The same principle of operation may be applied to the ITU navigation S-band frequency domain using some common elements of the RIS 100X. The S-Band version of the receiver (RIS 100S) is presently only in concept form and is not currently available as a product.  The SensorView Display HMI provided as part of the system is able to incorporate digital radar inputs with the necessary protocol conversion. This allows 3 sources of information relating to the position of a vessel to be simultaneously displayed, notably primary radar, AIS and navigation radar bearing “strobes” (or triangulated reports). | |  |  |
|  | Is the technology backward compatible? | Not applicable as there is no precedent for the current systems. | |  |  |
|  | Is the technology dependant on another technology? | Only insofar as the limited emergence of solid-state navigation radars mentioned in para 13 sub 3) apply. | |  |  |
|  | Can the technology be demonstrated? | Yes. The Slangkop lighthouse installation (see para 6 sub 1) is operating and can be viewed either on-site or operator display via remote teams meeting. | |  |  |
|  | Are there any results and test bed? Please List | There are various recorded operator screens available, and deployment site as per para 6 sub 1) is available for evaluation. The other sites mentioned in para 6 are not easily accessible. | |  |  |
|  | Is there a compliance summary? | There is no operational standard associated with the RIS 100X system and thus compliance is not applicable. | |  |  |
|  | Are there legal issues associated with the implementation of the technology? | No. The system is not controlled technology in terms of the Wassenaar Arrangement. Since the receiver is passive, it is not subject to licencing requirements. | |  |  |
|  | Are there any intellectual property rights (essential patents) associated with the technology? | There are no patents, but the intellectual property associated with the product remains the property of Reutech Radar Systems. There is no additional fee to use the product by an entity that buys the product. Should another entity want to manufacture the RIS 100, there would be a negotiated royalty fee applicable. | |  |  |
|  | Is the technology safe to use *[note – safety could be understood in different ways]* | Yes. Since it is non-radiating there are no health risks associated with its implementation or use.  Mains power present in the mast box housing the AIS and associated equipment is indicated with appropriate warning signs. | |  |  |
|  | Does the use of the technology require extra training? | Yes, a short 2 day operator and maintainer course is required. The two courses are provided simultaneously as an operator needs to understand what the maintainer needs to know and vice versa.  Installation for the installer is included in the operator maintainer training. Assuming a turnkey system incorporating own AIS and GSM functionality is supplied, installation is relatively simple. If the system makes use of external AIS sources, the complexity of linking into the system would first need to be established. | |  |  |
|  | Are there environmental considerations with the technology? | The only environmental considerations relate to the ambient temperature environment limitations and degraded range performance under severe weather conditions.  The system is non-polluting in terms of effect on the environment.  The RIS 100X is passive, so the electromagnetic environment is unaffected by its operation. | |  |  |
|  | What are the financial considerations for implementation and use? | Costs are dependent on the installation. For shipborne application, the system consists of RIS 100X that interfaces to the ship’s Inertial Navigation System (INS) or may be supplied with independent vessel location and heading devices. For shore based application, costs depend on the site in terms of available infrastructure and available AIS data.  Running costs include the GSM data subscription and any maintenance and support contracts. | |  |  |
|  | Is the technology secure (i.e. protected against hacking; privacy of data)? | Connection between sensor sites is established via ZeroTier, a Virtual Private Network (VPN), which essentially creates a secure and private network infrastructure, mimicking a local network irrespective of the physical location of the sites.  • This secure network utilizes strong 256-bit end-to-end encryption on all traffic flowing within its virtual boundaries.  • To ensure authorized access only, a zero-trust security model is employed, requiring devices to undergo authentication before joining the network. | |  |  |
|  | Readiness (EU Technology Readiness level - TRL) (level of maturity of technology) | The RIS 100X is operational in the field in the Philippines (para 6 sub 2) and is commercially available. As such, it is a TRL9 system. | |  |  |
|  | Can you provide independent References | Yes- UN Buyer.  Captain Francis Lozano Philippines Navy (Rtd) email: [francis.lozano@un.org](mailto:francis.lozano@un.org).  National Programme Officer (Maritime Domain Awareness) Southeast Asia and the Pacific.  Global Maritime Crime Programme.  United Nations Office on Drugs and Crime  See video under <https://www.youtube.com/watch?v=EMxeLJKTYXs&t=251> | |  |  |