

Comité International Radio-Maritime

Ref: LN-ETSI-0320

Date: 2 April 2020

# LIAISON NOTE TO ETSI ERM TGMARINE

# Questionnaire concerning future Solid-State navigational radar systems

Dear Pete,

CIRM thanks ETSI ERM TGMARINE for the liaison statement ref. ERMTGMARINE(20)004035 requesting responses to the attached questionnaire concerning solid state navigational radar systems.

As agreed, CIRM has received and collated responses from the seven radar manufacturers that responded to the questionnaire; the results can be found in the annex to this note.

Best Wishes,

**Frances Baskerville**

**Secretary-General**



## ANNEX 1 – Questionnaire Responses

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | A | B | C | D | E | F | G |
| **Category A: General questions** | | | | | | | | | |
| 1 | **Are you a manufacturer of one of the following devices?** |  |  |  |  |  |  |  |
| MED approved S-band navigational radar equipment | X |  |  | X | X | X |  |
| MED approved X-band navigational radar equipment | X | X | X | X | X | X |  |
| non-SOLAS X-band navigational radar equipment | X |  | X | X | X | X |  |
| Inland waterway X-band navigational radar equipment (river radar) |  |  |  | X |  |  | X |
| No |  |  |  |  |  |  |  |
| 2 | **Do you plan to bring a MED approved X-band solid-state NT radar to market?** |  |  |  |  |  |  |  |
| Long-term, not before the next 5 years, depends on IMO | X |  | X |  |  |  |  |
| Medium-term, within the next 3-5 years |  |  |  |  |  |  |  |
| Short-term, in the near future |  |  |  | X |  | X |  |
| I have already such a device brought to market |  |  |  |  | X | X |  |
| No. |  | X |  |  |  |  | X |
| 3 | **Do you plan to bring a non-SOLAS X-band solid-state NT radar to market?** |  |  |  |  |  |  |  |
| Long-term, not before the next 5 years, depends on IMO | X |  |  | X |  |  |  |
| Medium-term, within the next 3-5 years |  | X | X |  |  |  |  |
| Short-term, in the near future |  |  |  |  |  | X |  |
| I have already such a device brought to market |  |  |  |  | X | X |  |
| No. |  |  |  |  |  |  | X |
| 4 | **Do you plan to bring an inland waterway X-band solid-state NT radar to market?** |  |  |  |  |  |  |  |
| Long-term, not before the next 5 years, depends on IMO |  |  |  | X |  |  |  |
| Medium-term, within the next 3-5 years |  |  | X |  |  |  |  |
| Short-term, in the near future |  |  |  |  |  |  |  |
| I have already such a device brought to market |  |  |  |  |  |  |  |
| No. | X | X |  |  | X | X | X |
| **Category B: Possible interference problems** | | | | | | | | | |
| **B1** | **General** |  |  |  |  |  |  |  |
| 1 | **Have you made any studies with respect to compatibility of conventional and Solid-State radar equipment?** |  |  |  |  |  |  |  |
| Yes. I can provide a test report. |  |  |  |  |  |  |  |
| Yes. I cannot provide a test report as it is confidential. But it seems to be a serious issue. |  |  |  |  |  | X (Given the growing field population of diverse NT radars) |  |
| Yes. I cannot provide a test report as it is confidential. It seems to be not a serious issue. |  |  |  | X | X |  |  |
| No. | X | X | X |  |  |  | X |
| **B2** | **Frequency band** |  |  |  |  |  |  |  |
| 1 | **Allocating a dedicated frequency band for NT radar equipment is difficult as it is a long formal process with open end. Do you think that coexistence of conventional and NT radar equipment is desirable within one frequency band, i.e. x-band from 9 300 to 9 500 MHz?** |  |  |  |  |  |  |  |
| Yes. |  | X | X | X | X (Interference affect radar performance and suffer navigation safety. The frequency allocation should be kept as it is) | X |  |
| No. | X |  |  |  |  |  | X |
| 2 | **Does it make sense to divide X-band (9 300 – 9 500 MHz) into sub-bands to achieve a minimum of frequency separation?** |  |  |  |  |  |  |  |
| Yes. |  |  |  |  |  | X |  |
| No. | X |  |  | X | X (Interference affect radar performance and suffer navigation safety. The frequency allocation should be kept as it is) |  | X |
| I don’t know. |  | X | X |  |  |  |  |
| 3 | **In case there would be more than one dedicated NT-frequency bands in the future, radars should support band switching. Is it difficult for technical or economic reasons to develop X-band solid-state transmitters that are capable to be tuned over a range of e.g. 800 MHz?** |  |  |  |  |  |  |  |
| No problem. |  |  | X |  |  | X |  |
| No, but as these transmitters are not very common, price would be higher. | X |  |  |  |  |  |  |
| Yes. |  |  |  | X | X |  | X |
| I don’t know. |  | X |  |  |  |  |  |
| 4 | **Is it difficult for technical or economic reasons to develop X-band antennas with a high bandwidth over a range of e.g. 800 MHz?** |  |  |  |  |  |  |  |
| No problem. Squint angle compensation is with state-of-the-art digital processing not a problem. |  |  |  |  |  | X |  |
| Yes. It is not easily possible for conventional slotted array antennas. |  |  | X | X |  |  | X |
| Yes. It requires new phased array antennas. |  |  |  |  |  |  |  |
| I don’t know. | X | X |  |  | X |  |  |
| 5 | **Any comments to this approach?** |  |  |  |  |  |  |  |
| Comments |  |  |  |  | Interference affect radar performance and suffer navigation safety. The frequency allocation should be kept as it is. | We already achieve the ability to tune the radar between 9300MHz and 9500MHz |  |
| **B3** | **Pulse length** |  |  |  |  |  |  |  |
| 1 | **Do you have any experiences with this approach?** |  |  |  |  |  |  |  |
| Yes, it was successful! |  |  |  |  |  |  |  |
| Yes, it was successful with the following restrictions: |  |  |  |  | Interference from conventional navigation radar can be suppressed well with those function. However, Interference from NT radars (ex. FMCW radar, meteorological radars) which has long pulse width cannot be suppressed enough and can introduce some problem. |  |  |
| Yes. This approach is not successful, because: |  |  |  |  |  |  |  |
| No. We have not made any investigation to this. | X | X | X | X |  | X | X |
| 2 | **What would be the maximum pulse length that would provide enough power for ranges to e.g. 4 000 m?** |  |  |  |  |  |  |  |
| µs |  |  |  |  | 14 | 1 | 0.15 |
| I don’t know. | X | X | X | X |  |  |  |
| 3 | **What would be the maximum pulse length that can be suppressed by conventional radar’s interference rejection function?** |  |  |  |  |  |  |  |
| µs |  |  |  |  | It varies depending on conditions, so it is quite difficult to assume those numbers. | 20 | 0.6 |
| I don’t know. | X | X | X | X |  |  |  |
| 4 | **Any comments to this approach?** |  |  |  |  |  |  |  |
| Comments |  |  |  | It depends on radar specifications. |  | this a typical value and depends on transmission power and clutter back scatter ranges |  |
| **B4** | **Pulse Repetition Frequency** |  |  |  |  |  |  |  |
| 1 | **Do you have any experiences with this approach?** |  |  |  |  |  |  |  |
| Yes, it was successful! |  |  | X |  | X |  |  |
| Yes, it was successful with the following restrictions: |  |  |  | not in congested water areas |  |  |  |
| Yes. This approach is not successful, because: |  |  |  |  |  |  |  |
| No. We have not made any investigation to this. | X | X |  |  |  | X | X |
| 2 | **Any comments to this approach?** |  |  |  |  |  |  |  |
|  | Comments |  |  |  |  |  | This method will degrade some performance measures. |  |
| **B5** | **Output Power** |  |  |  |  |  |  |  |
| 1 | **What is the maximum output power of any MED approved X-band NT radar system?** |  |  |  |  |  |  |  |
| W |  |  |  |  | 500W | 300W |  |
| 2 | **What is the maximum output power of any non-SOLAS X-band NT radar system?** |  |  |  |  |  |  |  |
| W |  |  |  |  | 600W | 80W |  |
| 3 | **What is the maximum output power of any inland waterways X-band NT radar system?** |  |  |  |  |  |  |  |
| W |  |  |  |  | 25W |  |  |
| 4 | **Any comments?** |  |  |  |  |  |  |  |
|  | Comments |  |  |  | It depends on radar specifications. |  | For current products and subject to change |  |
| **B6** | **Pulse modulation** |  |  |  |  |  |  |  |
| 1 | **Do you intent to utilize other than the mentioned modulation?** |  |  |  |  |  |  |  |
|  | No. I use up-CHIRP and / or down-CHIRP modulation. |  |  | X | X |  |  |  |
|  | Yes. I will use: |  |  |  |  |  | a mixture of up/down Chirp and non FM (gated CW) |  |
|  | I don’t know. | X | X |  |  | X |  | X |
| 2 | **Any comments?** |  |  |  |  |  |  |  |
|  | Comments |  |  |  |  |  | up Chirp v down Chirp provides limited isolation / suppression |  |
| **B7** | **Antenna** |  |  |  |  |  |  |  |
| 1 | **Which antenna do you intend to use with your X-band non-SOLAS NT radar system?** |  |  |  |  |  |  |  |
| Conventional slotted array antenna. |  | X | X | X |  | X |  |
| Passive antenna with pre-processed optimization. |  |  |  | X |  | X (If this means e.g. microstrip and patch antenna) |  |
| Phases array antenna. |  |  |  |  |  |  |  |
| I don’t know. | X |  |  |  | X |  | X |
| 2 | **Which antenna do you intend to use with your X-band inland waterways NT radar system?** |  |  |  |  |  |  |  |
| Conventional slotted array antenna. |  |  | X | X |  |  |  |
| Passive antenna with pre-processed optimization. |  |  |  |  |  |  |  |
| Phases array antenna. |  |  |  |  |  |  |  |
| I don’t know. | X | X |  |  | X |  | X |
| 3 | **Any comments?** |  |  |  |  |  |  |  |
| Comments |  |  |  |  |  |  |  |
| **Category C: Signal structure of NT radar** | | | | | | | | | |
| 1 | **Our NT radar intends to utilize:** |  |  |  |  |  |  |  |
| Only one pulse length at one range as conventional radars do. |  |  |  |  |  | X |  |
| Several pulses of different length, separated in time (only one pulse at a time) (pulses of different length share the same frequencies) |  |  |  |  |  | X |  |
| Several pulses of different length, separated in frequency (only one pulse at a time) |  |  | X | X |  | X |  |
| Several pulses of different length, separated in frequency (multiple pulses in parallel at a time) |  |  |  |  |  | X |  |
| I don’t know! | X | X |  |  |  |  | X |
|  | Comments |  |  |  |  | We don't disclose signal structure of our NT radar. |  |  |
| **Category D: Concepts of mutual compatibility** | | | | | | | | | |
| **D1** | **High sea radar equipment** |  |  |  |  |  |  |  |
| 1 | **How do you intend to overcome the possible compatibility problem between conventional and NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| I will not enter the market of NT radar equipment. I will stick to magnetron driven radars. |  |  |  |  |  |  | X |
| I will wait for dedicated frequency band. No further action until then. |  |  |  |  |  |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  |  | X |  |
| • Limited pulse length |  |  |  | X |  |  |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X | X |  |  |  |
| • Very low output power |  |  |  |  |  |  |  |
| • Simple up-chirp or down-chirp |  |  |  | X |  |  |  |
| • Consecutive transmission of pulses with different length (not at the same time) |  |  |  | X |  |  |  |
| • Reducing bandwidth by efficient pulse management |  |  |  | X |  | X |  |
| • Other: |  |  |  |  |  | default centre frequency is greatly offset from most common magnetron frequencies. |  |
| There is no problem at all. |  |  |  |  | X | X |  |
| <free text>: |  |  |  |  |  | our products already detect RACONS and SARTS |  |
| I don’t know. | X | X |  |  |  |  |  |
| 2 | **How do you intent to overcome the possible compatibility problem between different kind of NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| There is no problem as the signal is processed coherently. The radar is capable to identify his own signal and to drop signals from other radars. |  |  |  |  | X |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  |  | X |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X | X |  |  |  |
| • other: |  |  |  | utilized several pulses |  | We provide user/setup control of centre frequency |  |
| <free text>: |  |  |  |  |  | current population of NT radars is relatively low |  |
| I don’t know. | X | X |  |  |  |  | X |
| 3 | **How do you intent to overcome the possible compatibility problem between same kind of NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| There is no problem, because: |  |  |  |  | we have got MED certificate. |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  |  |  |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X | X |  |  |  |
| • other: |  |  |  |  |  |  |  |
| <free text>: |  |  |  |  |  | We provide user/setup control over centre frequencies. |  |
| I don’t know. | X | X |  |  |  |  | X |
| **D2** | **Inland waterway radar equipment** |  |  |  |  |  |  |  |
| 1 | **How do you intend to overcome the possible compatibility problem between conventional and NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| I will not enter the market of NT radar equipment. I will stick to magnetron driven radars. |  |  |  |  |  |  | X |
| I will wait for dedicated frequency band. No further action till then. |  |  |  |  |  |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  | X |  |  |
| • Limited pulse length |  |  |  |  |  |  |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X |  |  |  |  |
| • Very low output power |  |  |  |  |  |  |  |
| • Simple up-chirp or down-chirp |  |  |  |  |  |  |  |
| • Consecutive transmission of pulses with different length (not at the same time) |  |  |  |  |  |  |  |
| • Reducing bandwidth by efficient pulse management |  |  |  |  |  |  |  |
| • Other: |  |  |  |  |  |  |  |
| There is no problem at all. We will produce NT radar systems for this market soon. |  |  |  |  |  |  |  |
| <free text>: |  |  |  |  |  |  |  |
| I don’t know. | X | X |  | X |  |  |  |
| 2 | **How do you intend to overcome the possible compatibility problem between different kinds of NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| There is no problem as the signal is processed coherently. The radar is capable to identify his own signal and to drop signals from other radars. |  |  |  |  |  |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  | X |  |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X |  |  |  |  |
| • other: |  |  |  |  |  |  |  |
| <free text>: |  |  |  |  |  |  |  |
| I don’t know. | X | X |  | X |  |  | X |
| 3 | **How do you intent to overcome the possible compatibility problem between same kind of NT X-band radar equipment (multiple choice possible)?** |  |  |  |  |  |  |  |
| There is no problem, because: |  |  |  |  |  |  |  |
| Our radar NT radar system utilizes the following features to prevent interference: |  |  |  |  | X |  |  |
| • Arbitrary variation of Pulse Repetition Frequency (“staggering”) |  |  | X |  |  |  |  |
| • other: |  |  |  |  |  |  |  |
| <free text>: |  |  |  |  |  |  |  |
| I don’t know. | X | X |  | X |  |  | X |