R-Mode

IALA ENAV Committee
Working Document

Marine Beacon

technical

- design
  - R-mode network (3) — 3 month(s)
    - management
      - MOU?
      - Like NELS?
    - configuration
    - monitoring and control
    - status and health alerts
  - standard specification (2) — 1 month(s)
    - Validate results
    - Need to set the spec at some point in time
  - Simulation/Modelling of performance (3) — 5 month(s)
- development
  - Receiver development (2) — 12 month(s)
    - multi-system receiver
    - small craft (fishing/leisure)
    - PNT unit development
    - develop existing receiver to work with multiple R-mode transmissions and give position calculations
  - Transmitter site modification (design and build) (2) — 3 month(s)
  - Monitoring stations (2) — 3 month(s)
  - Joint procurement
    - reduce time
- Testing
  - Interference tests (2) — 3 month(s)
    - from R-mode
    - jamming tests
    - to R-mode
  - Test-beds
    - reduce time
    - Joint procurement
    - Suitable location — 1 month(s)
    - build on existing testbed (2) — 12 month(s)
      - grow existing
      - develop new testbed
      - worldwide consideration
      - longer terms stability and performance
      - far field monitoring
    - three tx to enable positioning tests — 12 month(s)
      - coverage maps to consider best geometry
    - use of multiple receivers at the same time to identify error sources
  - PNT tests (3) — 2 month(s)
    - Dynamic
    - Static
  - stability tests (3) — 12 month(s)
- Research
  - Atomics clocks
  - National UTC systems
  - time over DGPS
  - Two way satellite time transfer
  - Identification of timing solutions (3) — 2 month(s)
  - investigate the three proposed methods from ACCSEAS report. (1) — 3 month(s)
    - 1 CW signal
    - 2 CW signals
    - phase estimate on MSK
    - data on the CW?
  - interference — 2 month(s)
    - other R-mode users
    - legacy users
    - In-band interference
    - Out of band interference
  - propagation effects (2) — 12 month(s)
    - what is the maximum range for MF signal use for R-Mode
    - mitigation to skywave effects
    - skywave (2)
      - own-skywave
      - skywave from other stations
    - timing signal stability (2)
    - seasonal & weather effects
  - Security (2) — 3 month(s)
    - Jamming & Spoofing
    - Cyber threats
    - Physical threats
  - Hardware — 3 month(s)
    - impact to integrity monitors etc
    - Antenna system type and spec. (tx) (4)
  - R-Mode corrections (D-R-Mode) (4) — 12 month(s)
    - Timing corrections?
    - Messages within RTCM broadcast
    - (eLoran differential stations?)
    - Local area RTK type solution
    - local monitoring
  - Spectrum aspects
    - Future use of freq. band
    - 5.73 radio regs (RR)
    - ITU considerations (2) — 24 month(s)
  - data (3) — 6 month(s)
    - what's needed?
    - effect of different baud rates on R-mode?
    - baud rate
    - effect on time to alarm
    - Interleaving system messages
  - Other uses of infrastructure (5) — 3 month(s)
    - Inland
    - Other transport modes
    - timing uses
    - MSI
    - data channel (Msg16)
    - etc
- Implementation — 30 month(s)
  - Recommendation and Guidelines
    - transnational collaboration
    - Agreements with international partners
  - Operations
    - Familiarisation and training
      - (STCW)
  - Maintenance
    - Co-ordinating office?
      - coordinating maintenance
    - Notice to mariners
- standardisation (1) — 60 month(s)
  - IMO
    - Multi-system receiver PS
    - Backup requirements
    - Article to inform IMO of any Marine beacon status change (ref to be found)
  - IALA
    - RNP
  - ITU
    - ITU-R M823
  - RTCM
  - CIRM
  - IEC
  - Performance standards
    - Gap analysis
  - Operational (Functional) standards
    - Gap analysis
  - technical standards
    - Gap analysis
  - industrial standards
    - Gap analysis
  - Spectrum allocation/approval
    - R-mode only transmission (no DGPS)
    - new R-mode enabled DGPS site
- Business Case — 6 month(s)
  - Service provider point of view (4)
  - equipment provider point of view (4)
  - user point of view (4)
  - Financial consequences (4)
  - test bed development BC (2)
- Risks
  - Interference affects legacy users
  - Business case for some nations may not be the same for others
  - Risk analysis for global support
    - technical
    - political
    - e-Navigation - 5 operational areas
  - timely selection of approach is needed to ensure standardisation process is started sufficiently early
  - lack of coordinated development leading to interoperability issues

Roadmap

- IALA's Role
  - Coordinate development (2)
    - Roadmap
    - SMART?
      - Work programme
    - SMART?
      - Substantial activity plan
  - Manage R-mode station ID numbers (3)
    - Database of R-mode transmitting stations
  - testbed result collaboration (2)
  - Training (2)
    - model courses
      - WWA
- Legal issues
  - Investigation of any legal concerns regarding the use of data over system or international boundaries etc.
  - Liability
  - Patent issues
    - True Heading
- General questions
  - who owns R-mode
    - public information
  - who will manage the development and interactions?
    - IALA

AIS/VDES

- technical
  - Integration with other PNT systems (3)
    - Potential systems — 3 month(s)
      - eLoran
      - AIS/MF R-Mode
      - Radar positioning
      - GNSS (multiple or singular)
      - NAVTEXT/NAVDAT
      - VDES from space
    - time synchronisation — 12 month(s)
      - elaboration of requirements
        - time synchronisation
        - time stability
      - analysis of timing sources (Rb, CS, H-Maser, eLoran, NTP, PTP, TWSTFT etc)
    - Interoperability — 3 month(s)
    - Level of integration — 1 month(s)
      - different for location or application
    - Integrity — 3 month(s)
      - concerns with tight integration
      - different approach depending on requirements, trade accuracy v integrity
    - design — 3 month(s)
      - extend combined performance model to include different locations than in Feasibility study to include different configurations
    - research — 12 month(s)
    - development — 12 month(s)
    - testing — 30 month(s)
      - interference protection
      - establish testbed for combined solution
      - seamless switching of source
      - analyse possible test beds for combined use of R-Mode (AIS/MF) and other tech.
      - test one/multiple MF, AIS, + Other tech
        - static
        - dynamic
        - different configurations
      - Timing tests
        - independent timing scyn
          - static
          - dynamic
    - standardisation — 30 month(s)
  - Spectrum aspects (2) — 12 month(s)
    - ITU considerations
    - Impact on VDL
      - Is there space for R-Mode transmissions?
        - Location is key, lots of space in some areas
      - data prioritisation
    - Use of additional frequencies allocated at WRC
      - joined channels on VDES
  - data (4) — 6 month(s)
    - Interleaving system messages
      - effect on time to alarm
    - Geodetic reference frame
      - base station is not necessarily fixed.
  - Other uses of infrastructure (5) — 6 month(s)
    - Inland waterways
    - Other transport modes
      - agriculture
    - timing users
      - telecoms
- development (3)
  - Receiver development (3) — 18 month(s)
    - Work with existing equipment (interface box)
    - New receiver equipment for all systems other than class A
      - Class B existing equipment is limited to use of internal GPS and therefore wouldn't benefit of R-mode.
      - AIS AtoNs
      - AIS repeaters
      - AIS SAR
      - AIS MOBIS
      - AIS EPIRB
  - Transmitter site modification (2) — 1 month(s)
    - None - if standard message used
    - Timing input
  - Monitoring stations (ASF) (3) — 12 month(s)
    - via VDES receivers?
- Testing (2)
  - Interference tests (3) — 6 month(s)
    - interference to legacy users
    - impact to R-mode
      - of VDL loading
      - GPS jamming
    - impact to VDL
  - timing tests (2) — 12 month(s)
    - single site tests
      - Message 4, 8 and variable length tests
    - multiple tests
  - Test-beds (2) — 24 month(s)
    - Joint procurement
      - reduce time
    - suitable location based on geometry
      - best case
      - normal case
    - Grow existing R-mode testbed
    - Show benefit (hook) for VDES (1)
  - position tests (2) — 6 month(s)
    - static
    - dynamic
    - different conditions
    - maximum range permissible
  - stability tests (2) — 12 month(s)
- Implementation (4) — 12 month(s)
  - Recommendation and Guidelines
    - transnational collaboration
    - Agreements with international partners
  - Operations
  - Familiarisation and training
    - (STCW)
  - Maintenance
    - Co-ordinating office?
      - coordinating maintenance
    - Notice to mariners
- standardisation (2) — 36 month(s)
  - IMO
    - Multi-system receiver PS
    - eNav implementation
      - terrestrial backup
  - RTCM (Sc104)/NMEA/IEC
    - R-Mode talker ID
    - Resilient PNT talker ID
    - data sentences and structures
  - IALA
    - RNP
    - AIS/VDES Guidelines
  - ITU
    - ITU-R M1371
    - ITU-R M2092
  - CIRM
  - ETSI
    - MOB-AIS
  - Regional bodies
    - CCR
      - inland waterways
    - PIANC
  - IEC
    - R-mode Rx type approval
    - Base station type approval
  - Performance standards
    - Gap analysis
  - Operational (Functional) standards
    - Gap analysis
  - technical standards
    - Gap analysis
    - Interfacing (NMEA?)
  - industrial standards
    - Gap analysis
  - Spectrum allocation/approval
- Business Case
  - Service provider point of view
  - equipment provider point of view
  - user point of view
  - Financial consequences
- Risks
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  - Business case for some nations may not be the same for others
  - Risk analysis for global support
    - technical
    - political
    - e-Navigation - 5 operational areas
  - AIS or VDES and effect on loading
  - Use of allocated frequencies is not possible
  - timely selection of approach is needed to ensure standardisation process is started sufficiently early

IMO Role (2)

- Timely identification of IMO high level action plan (2) — 3 month(s)
- WWRNS
  - A1046
    - Recognition of systems
  - A915

Shipboard perspective (currently included in each technology but will be broken out in the future)

- AIS/VDE
- MF

User/system requirements (1) — 3 month(s)

- Requirements for back up systems
  - How long will a b/up system need to cover?
  - ship-side
    - INS etc
  - shore-side
  - timing requirements
- Common PNT processing box?
  - separate units
  - combined systems

international consideration — 60 month(s)

- communications (1) — 60 month(s)
  - early communication of intent
    - IMO INF Paper (1)
    - ITU INF paper
    - Other stakeholders
    - PR
  - regular updates
    - Status report for IALA members
    - Status report for others
  - allow other stakeholders to be part of the story
  - User & stakeholder feedback
  - Industry/manufacturer interest
- align with strategies where possible
- agreements across nations
- Regional/National Plans
  - ERNP
  - FRP