NavIC and MSS based Messaging and Surveillance Applications

G J Doshi
Indian Space Research Organization (ISRO)
9-12-2019
ICG-14, Bengaluru
NavIC Messaging Service

- NavIC Satellites have a message “Type 18” in secondary navigation data for broadcasting text message.
- NavIC 1A satellite has been dedicated to messaging service.
- NavIC 1A messaging services are provided in L5(1176.45 MHz) and S(2492.028 MHz) frequencies. User receiver can be operated in single and/or dual frequency operation mode.
- The signal is BPSK(1) modulated on L5 and S bands. The navigation data rate is 50 sps (1/2 rate FEC encoded) and PRN code chipping rate is 1.023M cps.
- NavIC 1A data is transmitted in sub-frame. Sub-frame is 600 symbols (16 bit Sync word followed by 584 bits of interleaved data) transmitted at 50 sps. The 584 symbols of interleaved data is obtained from FEC encoding 292 sub frame bits.
- Each sub-frame of 292 bits contains 220 bits of message data.
- Message data length can be ranging from 220 bits to 2220 bits. For messages exceeding the 220 bits, the longer message is fragmented and sent in the subsequent frames.
- **Different types of services can be given different priorities since messages are scheduled based on priority.**
# NavIC Message Definition

## Example of a typical warning message with Message ID 21

<table>
<thead>
<tr>
<th>Service ID</th>
<th>Seg.Count</th>
<th>Seg.ID</th>
<th>HWA1 Clear</th>
<th>HWA2 Clear</th>
<th>Spare</th>
<th>Port name 1</th>
<th>Port name 2</th>
<th>HWA message 1</th>
<th>HWA message 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 bits</td>
<td>4 bits</td>
<td>4 bits</td>
<td>1 bit</td>
<td>1 bit</td>
<td>34 bit</td>
<td>8 bits</td>
<td>8 bits</td>
<td>78 bits</td>
<td>78 bits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TLM</th>
<th>TOWC</th>
<th>ALERT</th>
<th>RESERVED</th>
<th>RESERVED</th>
<th>RESERVED</th>
<th>MESSAGE ID</th>
<th>DATA</th>
<th>PRN ID</th>
<th>CRC</th>
<th>Tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 BITS</td>
<td>17 BITS</td>
<td>1 BIT</td>
<td>1 BIT</td>
<td>2 BIT</td>
<td>1 BIT</td>
<td>6 BITS</td>
<td>220 BITS</td>
<td>6 BITS</td>
<td>24 BITS</td>
<td>6 BITS</td>
</tr>
</tbody>
</table>

12/16/2019

ISRO
NavIC Message Definition

- The sub frame is tailored to support messaging
- It contains 6 bit message ID, so 64 different types of messages can be transmitted
- Definition of 220 bits is left to user
- One such user is INCOIS (Indian National Centre for Ocean Information Services)
- Message Id 20 and 21 are allocated to INCOIS
  - Potential Fishing Zones (PFZ) – Msg 20
    - One sub frame can send 9 PFZs and will be repeated for more numbers
  - Emergency messages– Msg21 which further divided with service IDs
    - High Wave Alert Service ID 0111
    - Cyclone Alert Service ID 1111
    - Tsunami Alert Service ID 0011
IRNSS-1A messaging service overall flow

- Users need to register in WIMS or via SFTP
- User will load Messages to WIMS Server or to SFTP

After successful registration message will be received by INC

Navigation software at INC generates desired message and forward for uplink
INCOIS msg IDs are 20 and 21

Message transmission to the IRNSS-1A satellite from MCF
NavIC Messaging Receiver

- NavIC based Messaging Receiver has been designed at ISRO
- It has Bluetooth connectivity with user Cell phone and audio alarm with 5 days battery capacity
- Technology of the design has been transferred to many Indian vendors for manufacturing of units
- Mobile app supporting audio/visuals alerts for Fisherman in 13 different regional languages
Distress Alert Transmitter

- For Emergency Reporting by Fishermen using DRT transponder of INSAT (402.65-402.67 MHz)
- Six types of messages based on Manual Activation
- Sends its position along with distress type
- It is one way in nature
- DATs are in use since quite a long time
- Being upgraded by combining with NavIC Messaging service
- Message Acknowledgement using NavIC Messaging
- PFZ, Cyclone, Tsunami Warning using NavIC Messaging Channel
- Low Cost battery operated terminal
- Limited Short Messaging Possible from fisherman to HUB
DAT-2G Network Diagram

Display at Web Server
MSS NETWORK FOR TRACKING OF Sub-20m BOATS

MSS Network designed for

- Satellite based automatic periodic tracking of boats/ships
- Emergency Messaging (SoS) from Boat/Ship to Control Station
- Emergency Broadcast from Control Station to Boats/Ships
- Mobile App for Connectivity to MSS Terminal using Bluetooth/ Wi-Fi
- Technology developed and available through multiple vendors.

Salient Features of terminal

- Forward Link: 9.6kbps
- Return Link: 2.4kbps
- Channel Access: Dynamic TDMA
- In built GAGAN/NavIC for position
- Bluetooth/Wi-Fi Interface
- IP 65 compatible package
- Battery back up and light weight
Position Reporting from Boats

Each boat report its position once in every 15 minutes

Satcom

Internet

Satcom

Position Reporting at allocated time

Coast Guard, Fisheries, Boat Owners will be able to view the boat location in real-time
Messaging Service between Boat Owners & Fishermen

Messaging from Fisherman with acknowledgment

Satcom

Boat Owner’s Mobile & App

User Interface

I AM FINE

Bluetooth

Satcom

At Hub or Control Centre

Internet
Emergency Warning Broadcast to Fishermen

Emergency Warning Broadcast

Satcom

Satcom

HUB/Control Centre

Internet/LAN

Warning Message

INCOIS/IMD/ISRO/
Identified state agencies

Cyclone

Emergency Warning Broadcast

Bluetooth

Bluetooth
MSS TERMINAL & ANDROID APPLICATION
SNAPSHOT
MSS HUB FOR TRACKING OF SMALL BOATS

Feature of MSS HUB for tracking of small boats:
• 11m C-band earth station at SAC, Ahmedabad used for pilot project
• 11m HUB at Delhi Earth Station to be used for operational phase
• Network Control Processor and Network Management System developed.

Salient Features of NMS:
• Dynamic Slot Management ,
• User Agency Based Terminal Management
• Emergency Messaging ( Unicast, Broadcast, Multicast / Vendor wise etc)
• Unique Numbering Scheme & terminal management

The HUB / Control centre is at ISRO, Ahmedabad & 960+ terminals are fitted in Tamilnadu, Gujarat states and Puducherry UT