Update on

Navigation Message Authentication (NMA) for NavIC SPS

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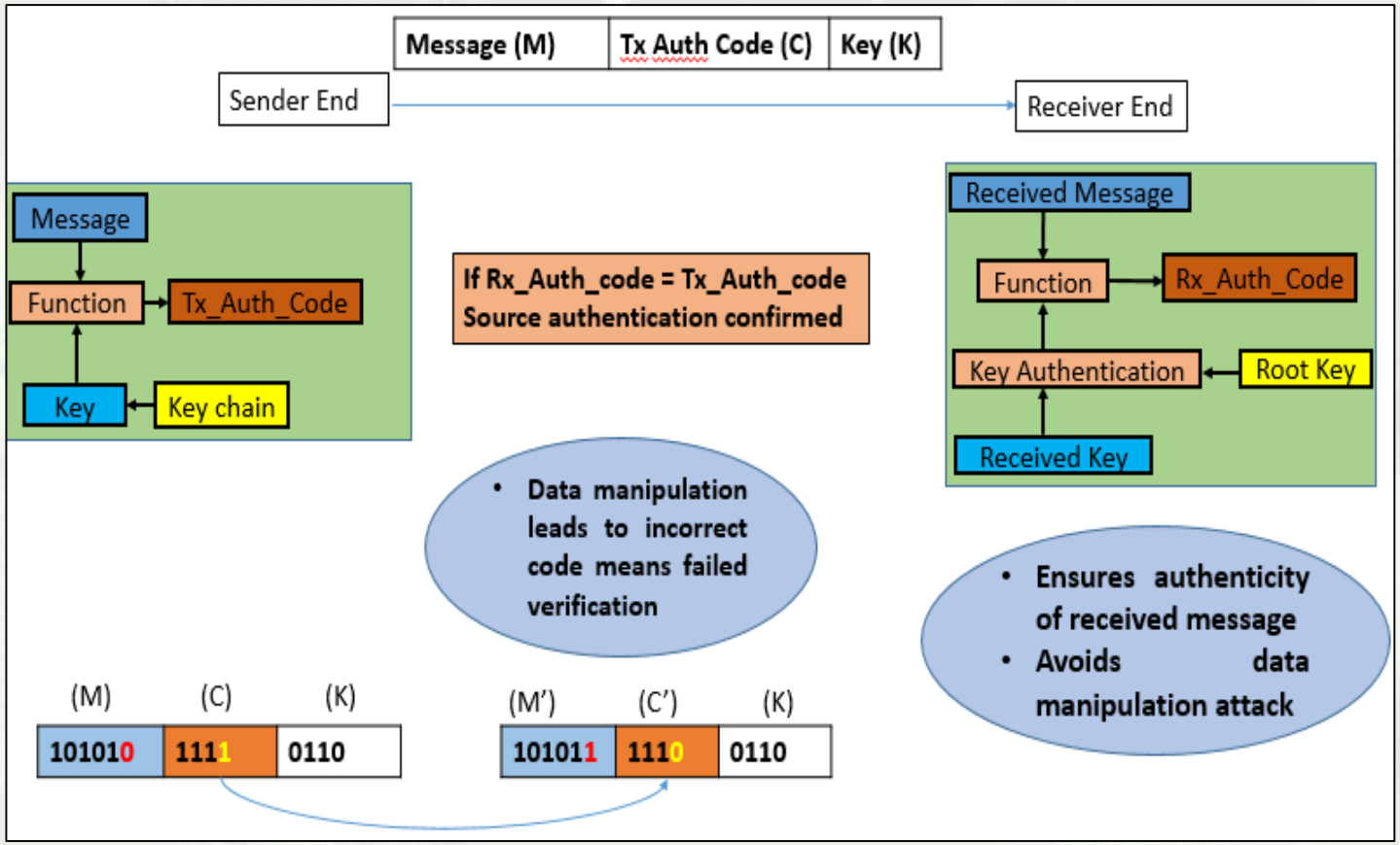
NMA as Anti-spoofing Measure

- The ***Navigation Message Authentication (NMA) in NavIC SPS*** proposes to provide data authentication as value added provision.

- The NMA shall provide NavIC receivers with the assurance that the received navigation message is coming from the system itself and has not been modified.

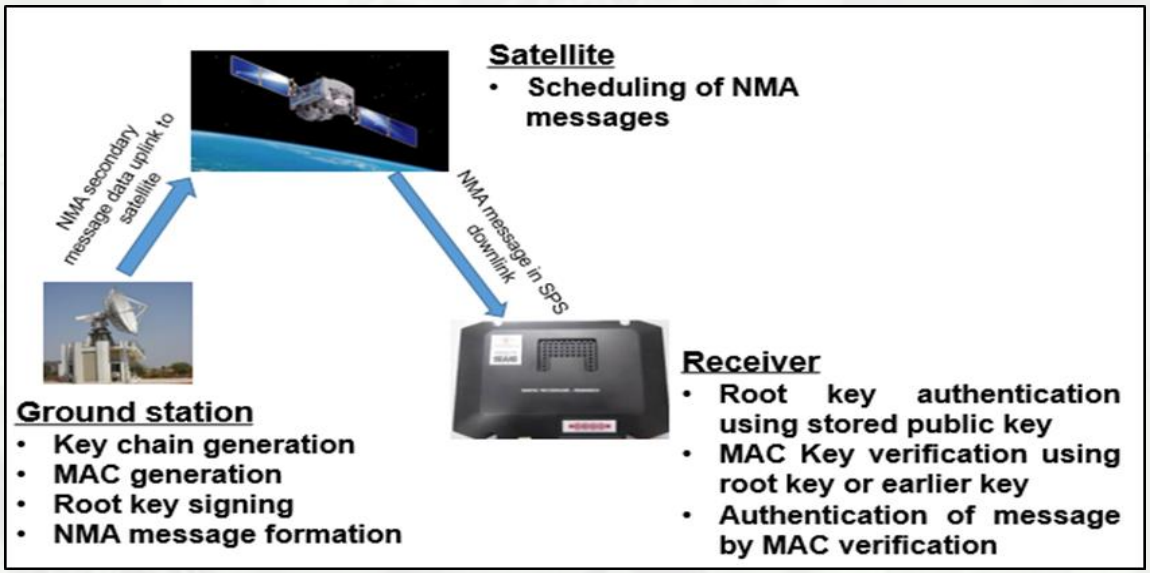
TESLA based NMA Concept



The receiver and sender should be in ***loose synchronization***.

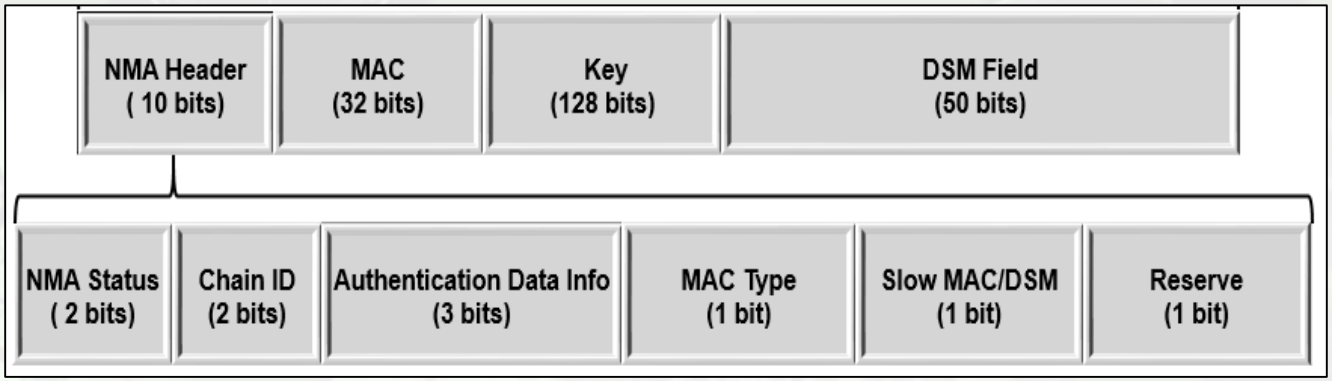
NMA for NavIC SPS

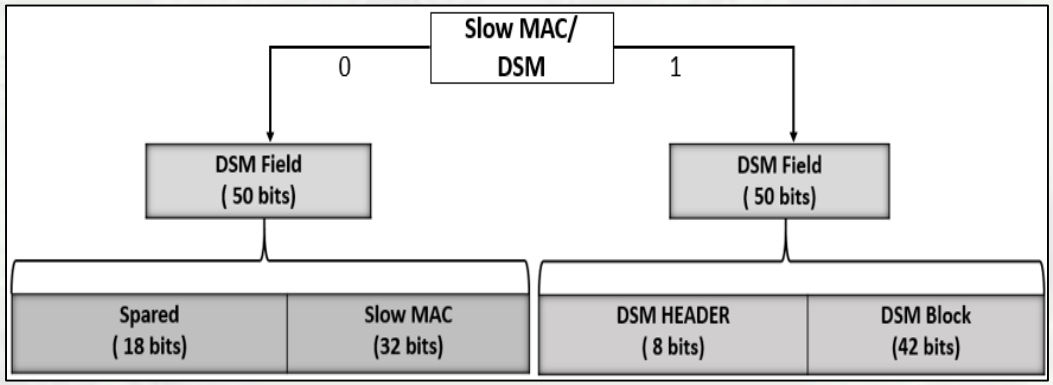
- The NMA in NavIC SPS (L5, S & L1) is proposed to be offered by defining a new secondary message.
  - Utilizing the flexibility of NavIC SPS data structure
- Two approaches for implementation:
  - For existing satellites: Ground based message generation and uplink
  - For future satellites: On-board message generation



Ground based Implementation

NavIC NMA Message





Root Key Distribution

- The root key distribution will be done through slow rate data embedded into the NMA message.
- For Root Key Distribution , the EdDSA digital signature algorithm has been chosen:
  - Approved in NIST document for Digital Signature Standard
    - FIPS 186-5, Ed25519 curve
  - Faster signature generation and verification and is easier to implement.
  - Better security against side channel attacks

NavIC NMA: Key Performance Parameters

Attribute	Separate Keychain for L5/S & L1	Shared Keychain for L5/S & L1
Minimum Key Disclosure Delay (KDD)	L5/S: 96 sec L1: 36 sec	144 sec
Typical Time To First Authenticated Fix (TTFAF)	L5/S: 144 sec L1: 54 sec	162-192 sec
Minimum Time between Authentication (TBA)	L5/S: 96 sec L1: 36 sec	144 sec
Size of MAC	32 bits	32 bits
Size of key	128 bits	128 bits
Typical Time Synchronisation Requirement	L5/S: <48 sec L1: <18 sec	<72 sec

NavIC NMA Testing

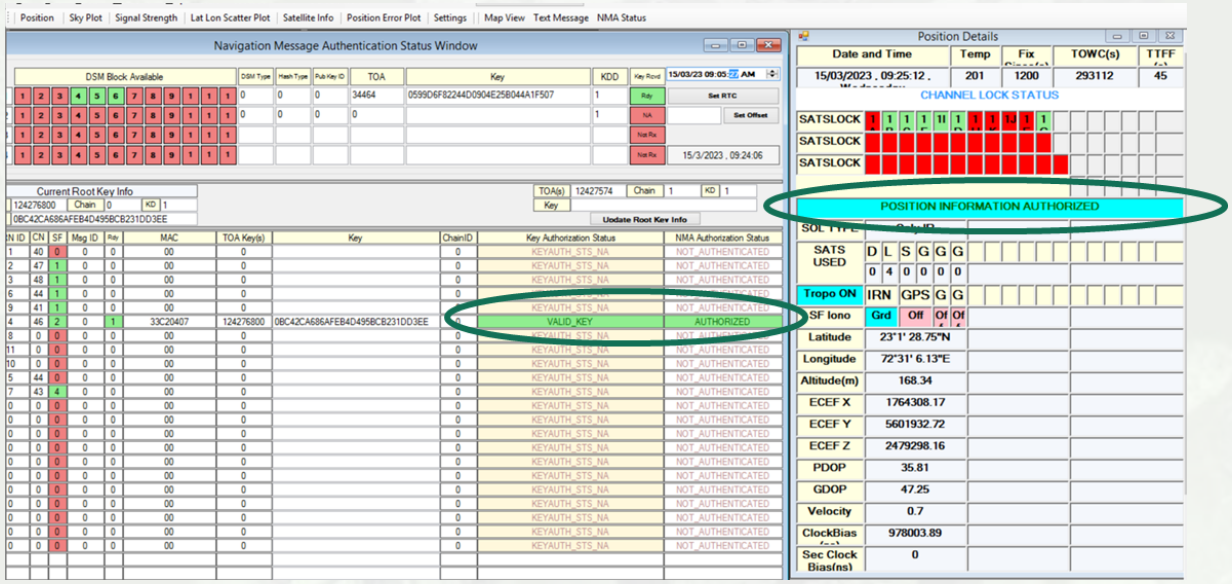
- NavIC NMA scheme is currently under test phase.

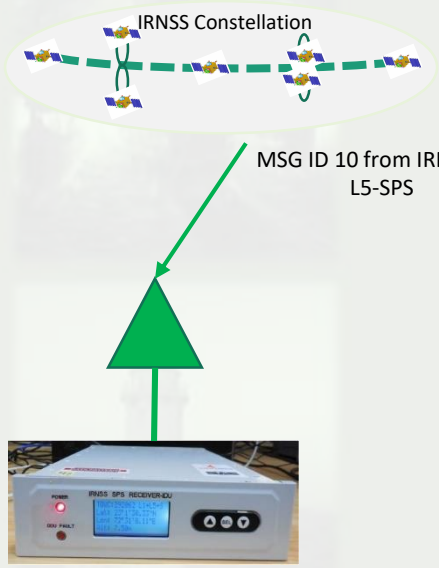
- Test transmission using *IRNSS-1D* and *IRNSS-1I* satellites carried out.

- Following test were done:
  - Functional Test
  - Test under spoofed scenario

NMA Functional Test

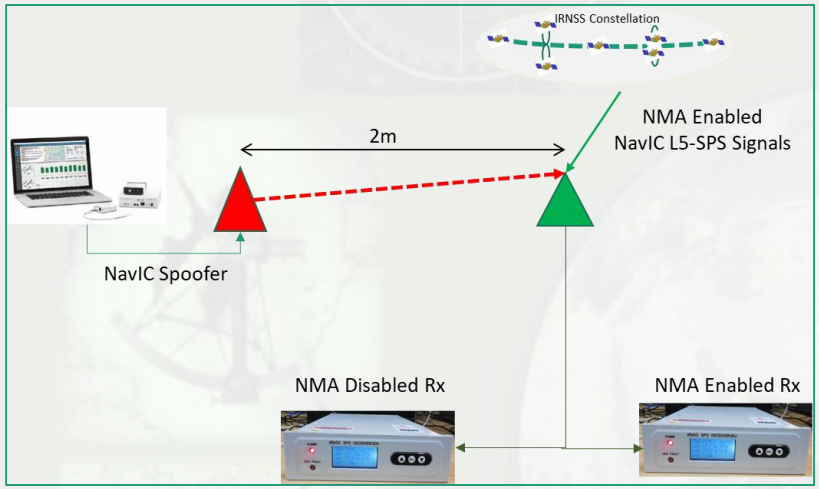
- NavIC receiver with NMA capability was tested using live NavIC signal from IRNSS-1D & 1I satellite.
- The NMA message is transmitted as secondary message in SF4 with message ID 10.
- Following functionalities were tested
  - The key and MAC extraction from secondary message
  - The key verification from Root key.
  - MAC authentication using the authenticated key.
  - Root key collection from DSM blocks.
  - Time synch error test



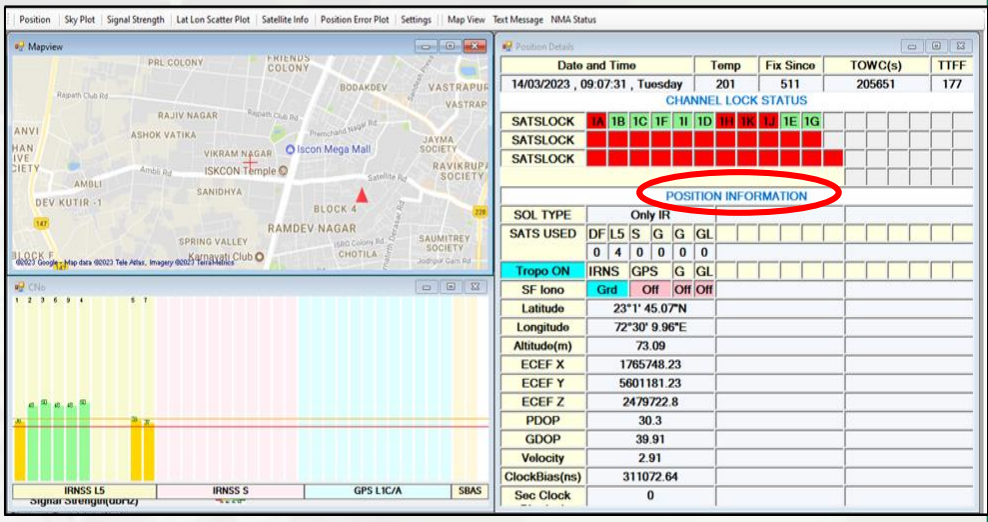


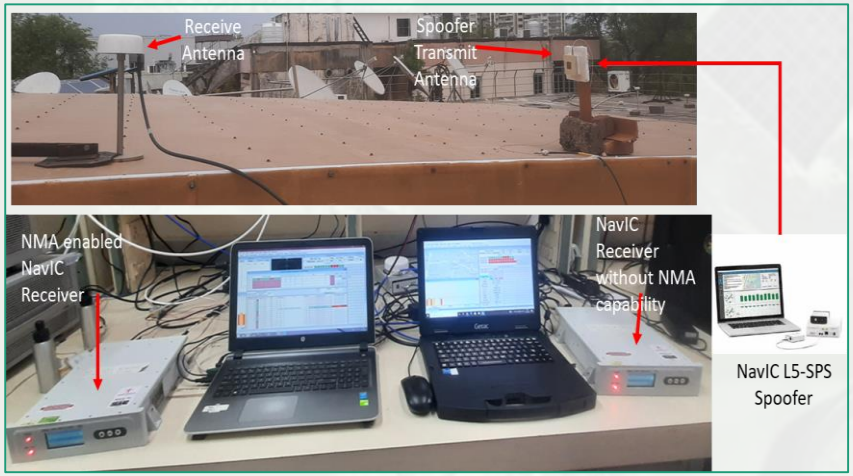
NMA Enabled Receiver

NMA test Under Spoofing scenario

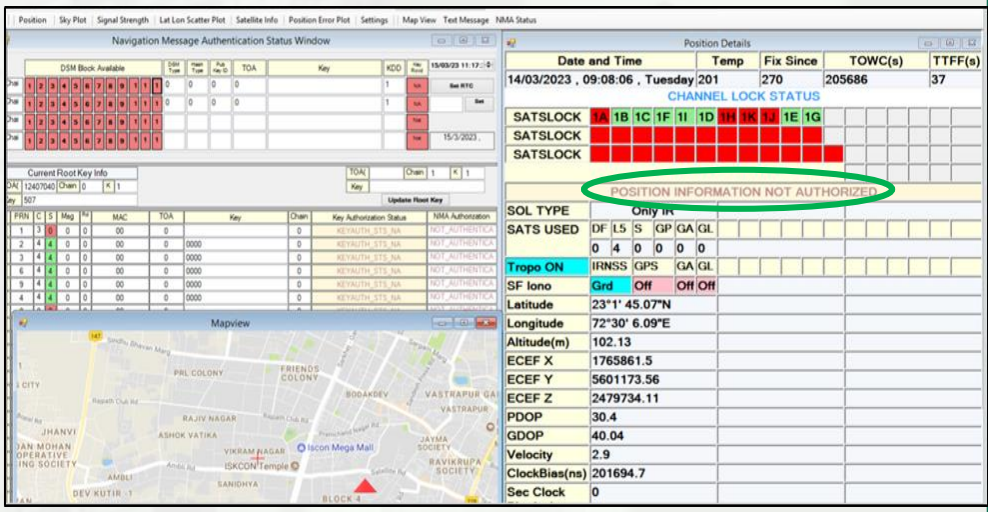


NavIC Receiver without NMA capability



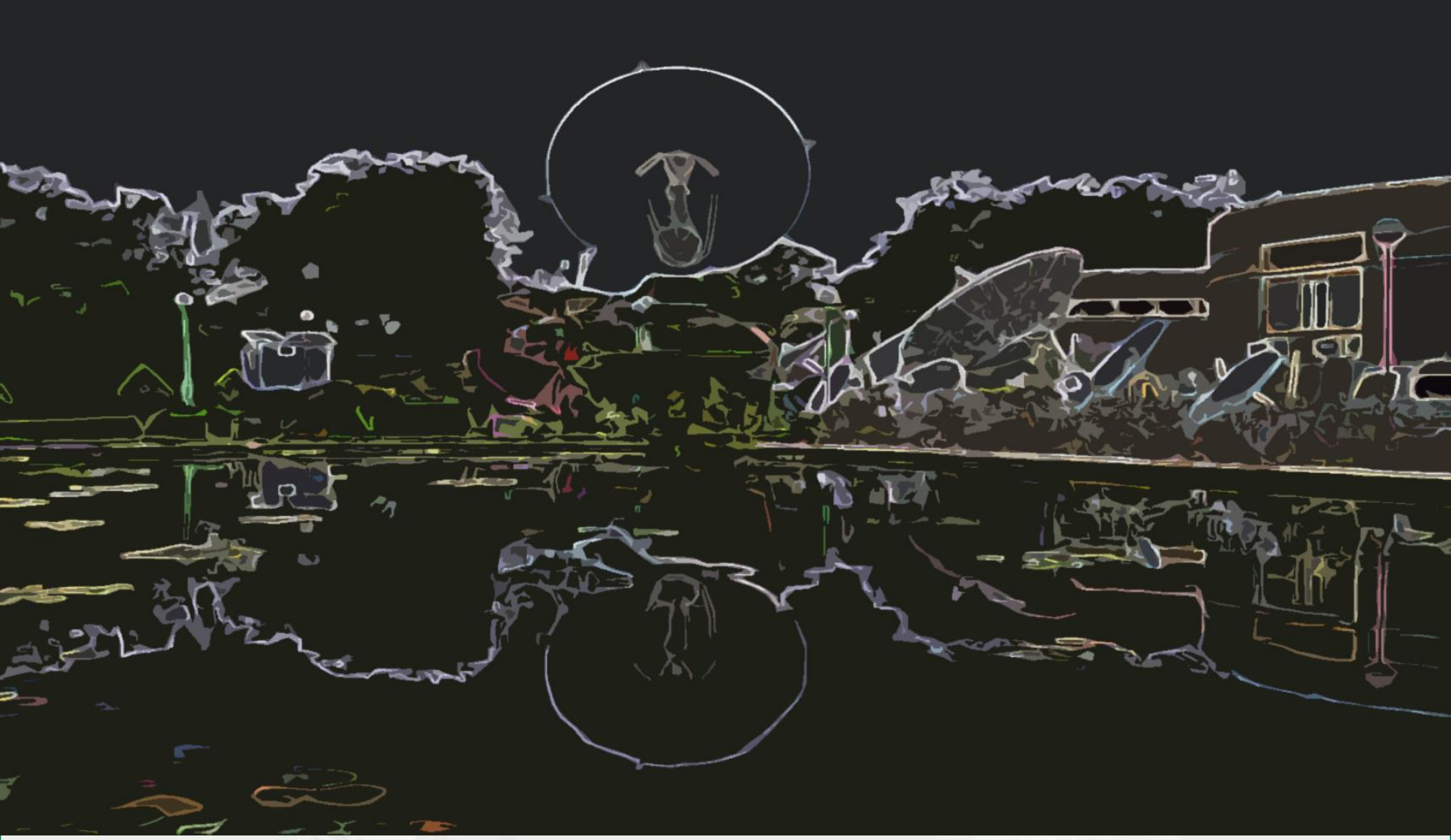


NMA enabled NavIC Receiver



Summary

- NMA for NavIC SPS users have been proposed as value added service.
- NavIC shall be able to support the civil signal authentication within the existing SPS signals and with existing satellites.
- The SIS experiments for NavIC SPS NMA are currently in progress.
  - Preliminary tests with IRNSS-1D and IRNSS-1I L5&S SPS signals carried out.
  - New NavIC L1-SPS shall also provide similar NMA provision.



Thank You for Your Kind Attention

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