SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Progress on the modernization of the IDC seismic, hydroacoustic and infrasound data processing systems

Thibault Arnal[1], Balazs Zachar[1], Pavel Strachota[1], Markiyan Sheremeta[1], Alexander Sudakov[1], Marjan Bugarinovic[2], Alexander Bruckner[2], Jozef Greznar[3], Andrej Tetak[3], Richard Sabol[3]

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INTRODUCTION AND MAIN RESULTS

To modernize its ageing software, the International Data Centre (IDC) initiated a programme ten years ago called the IDC Seismic, Hydroacoustic and Infrasound (SHI) Reengineering with the goal of creating a robust, open-source software for SHI data processing and improving maintainability and extensibility to the system.

This poster highlights recent achievements, ongoing efforts and challenges in the modernization of the IDC SHI software ecosystem.

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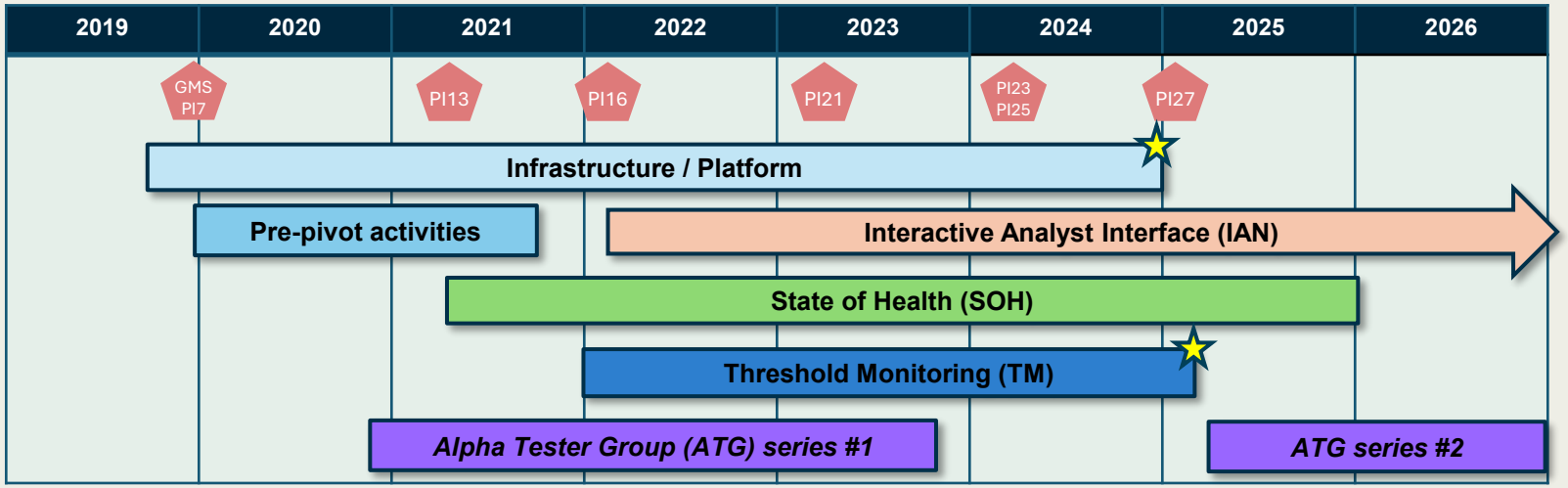
Software modernization programme of the IDC SHI data processing ecosystem

Why?

- Over the last 20+ years the SHI processing code and infrastructure has become **brittle**, **expensive to maintain**, and increasingly **difficult to update**.
- Improve verification capabilities - higher quality and more efficient analysis of International Monitoring System (IMS) data
- To align IDC operations and NDC-in-a-Box (NIAB)

Project timeline



GMS Geophysical Monitoring System open-source delivery. PI refers to Product Increment (3-months development cycle)

Key Objectives

- Modern
- Maintainable
- Open Source
- Secure
- Modular / Extendable
- Traceable (Provenance)
- Aligned with NDC-in-a-Box

Highlights in 2025

- Threshold Monitoring in Production
- First production environment on the new Kubernetes Platform
- New GMS received, integrated and tested during the ATG #5 (11 June – 11 July 2027)
- First SOH metrics being validated by users
- Initiation work on the validation of the new event location algorithm LocOO3D

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Threshold Monitoring

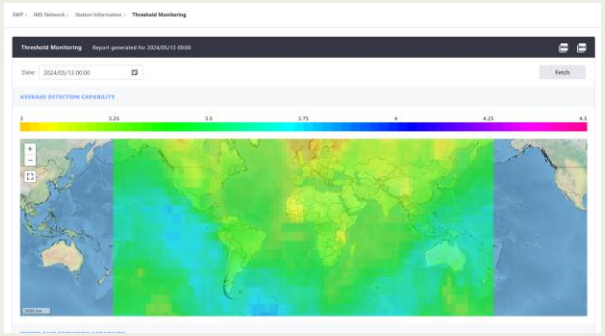
Threshold Monitoring (TM) was developed in the 1990's using a mix of Fortran code, shell scripts and external libraries.
It has proven to be rather difficult to maintain.

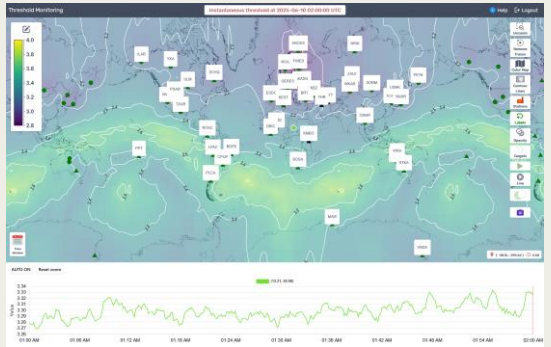
- Modernized version of TM improves data displays and user experience
- Prototype shared by NORSAR for evaluation in December 2021
- Official donation in January 2025
- Promoted to operations (internally) in January 2025

Upcoming activities

- Reprocessing archived data for Threshold Monitoring.
- DFX Threshold Monitoring data not generated for HILR, LZDM and PDYAR. Tuning and configuration required.
- Extend usage of S3 buckets to access and store data
- A Globe vue
- Make Threshold Monitoring production environment externally available
- Implement fixes and improvements suggested during ATG#5

	TM results (via SWP)	New TM web
Time resolution	Hourly averaged data	10 sec
Interface	No map interaction (zoom only) Fixed color scale	Highly customizable
Interval and method selection	Only a single interval can be selected Average and Max threshold displayed	Customizable time selection Instant, average, min and max threshold available
Spot-check analysis	✗	✓
Live & Play mode	✗	✓
Comparison mode	✗	✓





Dedicated poster by Tormod Kvaerna: P4.1-519

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State of Health Monitoring System (SOHMS)

SOH system should perform real-time monitoring of seismic, hydroacoustic, infrasound and radionuclide stations, along with the communication infrastructure.

SOH is a critical system for the daily work of Operations officers, also available to external users

Current system was mostly developed between 2008 and 2011.
A modernization effort in 2017-2018 brought improvements but with high additional complexity

The difficulty and cost of maintenance are a challenge for the organization

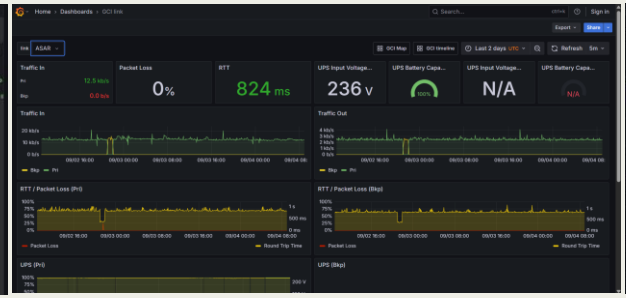
SOHMS aims to replace the current SOH system in operations at the IDC.
It is as much a technical upgrade than the opportunity to review our monitoring practices and provide traceability from definition of requirement through implementation and documentation.

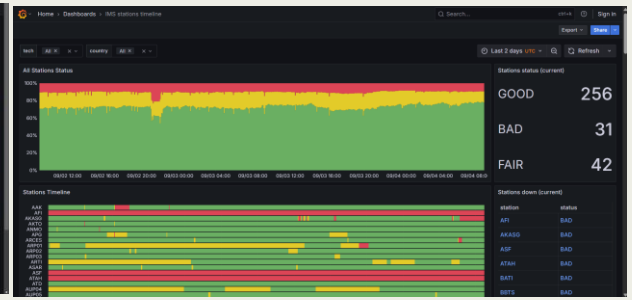
What's new since last presentation at SnT 2023?

Based on the open-source release GMS SOH PI23 (March 2024), the IDC is implementing its specific required monitoring features

Recent enhancements:

- Radionuclide station monitoring
- Auxiliary station monitoring
- Additional SHI metrics (Mission Capability, Data Availability…)
- Improvements to GCI monitoring
- CD status bits monitoring
- Alerting integration with IMS Reporting System (IRS)
- Performance monitoring and tuning





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Interactive Analyst Interface (IAN)

The Interactive Analysis Interface (IAN) is the new software to load data and processing results and to provide the functionality needed to support the typical analyst workflow.
It is under development and it the replacement of the Analyst Review Station (ARS), currently in operations.

Why is this a priority?
ARS is based on technologies which are deprecated on modern OS and is proving increasingly difficult to maintain.

The IDC work relies on the integration of the open-source releases of the GMS system which is adapted to fit IDC data and processing requirements.
https://github.com/SNL-GMS

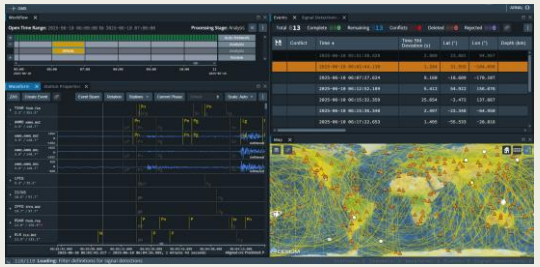
The current baseline is GMS PI27 received in January 2025.

This version was part of the scope of ATG#5 (11 June – 11 July 2025)

The development is currently planned to continue until 2028.

Current functionalities

- Analysis Interval selection
- Station Properties
- Waveforms w/ QC masks
- Signal Detection list
- Event List
- Map w/ stations, events, signal detections
- Waveform Filtering
- Signal Detection editing (create, edit, delete)
- Event editing (create, associate, delete)
- FK display
- Beamforming
- Waveform rotation
- Undo/Redo



LocOO3D / SALSA3D

LocOO3D is a seismic event location application capable of basing travel time predictions on the Salsa3D velocity model.
It is an open-source project available at:
https://github.com/sandialabs/Salsa3DSoftware/

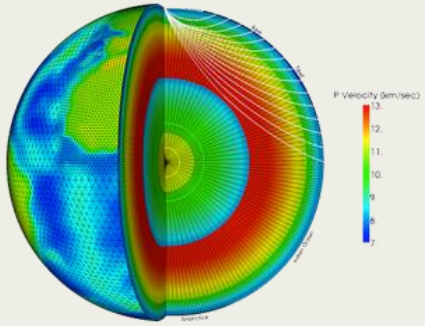
LocOO3D will be part of GMS/IAN release

➔ The IDC needs to evaluate the performance of the algorithm and model

➔ Location results between automatic and interactive processing should be consistent

Introducing new/modern algorithms is an objective of the Reengineering

The design of a validation plan started in May 2025



SALSA3D P-wave velocity model

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