Report on the ANSS NetOpsX Workshop
November 4-5, 2019 at University of Memphis

The tenth ANSS NetOps Workshop, NetOpsX, was held November 4-5, 2019 at the University of Memphis. Seventy-nine people from twenty-five organizations attended and included significant participation from the USGS volcano observatories. The program (Appendix A) was two full days with topics focused on field operations and their contributions to network performance and data quality. The organizing committee consisted of Mitch Withers (CERI), along with Marcos Alvarez (USGS Pasadena), Matt Gardine (UofA Fairbanks), Peggy Hellweg (UC Berkeley), and Brian Shiro (USGS HVO). The organizing committee wishes to thank the sessions leaders and participants for making the workshop a success. We also wish to thank Roberta Chavez at USGS Reston for her tireless assistance arranging travel for many participants.

Recommendations:

The NetOps workshop participants identified the following recommendations to ANSS management, in no particular order.

1. Seismic / GNSS hardware vendors should incorporate industry standards including SNMP/MIB/Oid into their instruments (see Definitions below). This would facilitate more robust / reliable RSN performance and maintenance planning.
2. The future of SeisNetWatch should be explored, including aggregating more information into it and/or folding it into more modern tools (that don't need Java).
3. It would be useful to have more developed QC standards. Not just what to measure, but how to make the measurement and how to calculate the metric. Would a centralized tool, not unlike SIS, be useful for generation of these metrics to allow for better ANSS performance standard monitoring?
4. It would be useful to hold 2-4 hour mini-NetOps workshops once or twice each year, perhaps through a webinar or conference call.
5. Given the potential for cell modems to slow during an earthquake sequence, do they meet EEW standards? What is the standard for reliability?
6. Currently, the metadata for GNSS is a huge unresolved problem, with the future of the BINEX format in question.
7. It would be useful to have a certification of equipment such as solar panels, radios, etc. not unlike what ASL currently does for sensors and digitizers. Canada has a non-profit that certifies solar panels for all govt. installations.
8. A shared drive for technical drawings, standards, sample agreements and templates, etc. would be useful. Document security would be an issue.
9. Federal inventory audits can be time consuming depending on the level of verification required—e.g. physically touching and photographing installed equipment. Can an acceptable procedure be developed to avoid a site visit for the sole purpose of inventory?

Summary:

We began the meeting with a presentation from IRIS on performance monitoring tools built on the MUSTANG platform. MUSTANG offers seismic data quality metrics, power spectral densities (PSD), and probability density functions (PDF) accessible through web services. Several browser interface tools are available including the MUSTANG Databrowser for metric plots, MUSTANGular for map-based metric views, and LASSO (Latest Assessment of Seismic Station Observations) for color-coded tabular summaries of quality. A preview was also given of a forthcoming tool, QuARG (Quality Assurance Report Generator), which will allow networks to generate their own reports from MUSTANG metrics and can also tie into a trouble ticket system for easier tracking of issues.

PNSN presented their forthcoming tool SQUAC (Seismic Quality Assessment Console), which uses JSON over http to monitor network state of health (SOH) and, perhaps more importantly, tell someone when something goes awry. There was discussion on the future of SeisNetWatch (SNW), whether it will continue to be supported or whether it should be folded into newer tools. Many networks present reported that they use SNW and that it is also being used in the CTBT community.

The discussion moved on to assessing operation of other hardware beyond the sensor and digitizer (e.g., radios, routers, batteries, and solar charge controller) using Nagios, SolarWinds, and other tools. It was noted that many IT hardware vendors provide Simple Network Management Protocol (SNMP) to assess SOH, but many seismology vendors do not (e.g., Nanometrics only has a JSON API). The group was in agreement that inclusion of SNMP into seismic hardware would aid greatly in monitoring and also cautioned that SNMP can be easily exploited if the device is incorrectly configured (e.g., not set to read-only with 128-bit AES encryption).

Several networks discussed custom-developed tools and practices they use for SOH monitoring. For example, UofO uses a site assessment rubric for each station to help prioritize maintenance. Caltech described a tool they developed which allows anyone to send a text message to their server and receive back a message with basic metrics; this generated a great deal of interest from the group. It was noted that a strength of SIS, as an example of a community resource, is its centralized standardization, though this comes at a cost of less customization.

Telemetry is a prime issue for siting and operations and often a source of poor performance (e.g., latency and data gaps). Given the potential for cell modems to slow during an earthquake sequence, do they meet EEW standards? What is the standard for reliability? Telemetry at many networks is evolved rather than planned. It may be useful to redesign telemetry for some networks (e.g., following UNRs mesh topology) rather than continue to shoehorn stations into the existing network. Proper grounding on radios is needed to help avoid hung connections.

A session on co-locating sensors (e.g., GNSS, magnetotelluric, infrasound, weather, camer, etc.) raised issues with power, telemetry, and metadata. Operators have to be aware that higher bandwidth needs can introduce periodic latencies due to “bursts” in some data types. When different agency partners co-locate sensors and share resources at a site, that brings another

level of complexity with regard to permitting, inventory, and quality assurance. Handling of the metadata can be a challenge, especially since SIS was not designed with non-seismic sensor types in mind. Currently, the metadata for GNSS is a huge unresolved problem, with the future of the BINEX format in question.

The second day began with engineering-focused discussions on power systems, highlighting issues related to solar charge controllers, grounding, and batteries meeting ANSS performance standards, especially in winter conditions. MPPT vs. PWM charge controllers were compared, and it was stressed that MPPT is superior. Perhaps most importantly, a problem with induced current noise at 110-115 seconds in the Centaur was described, along with an easy solution to avoid it using a DC-DC converter from vendors like CUI and Meanwell. Recurring problems with flooding of TA site vaults and retrofits to mitigate there were mentioned as well.

Patrick Bastien of ASL gave a very informative update on the ANSS Depot and offered specific tips for using SIS. Some of the next 5-year (2019-2023) vendor contracts are available (Kinemetrics and Nanometrics), while others are being worked on (Trimble/Reftek, Guralp). Silicon Audio's contract was not renewed due to a fundamental sensor noise issue. Patrick described the testing procedures done on all depot equipment and the forms that users must fill out to request equipment. He has recently finished creating standard templates for most items in SIS and recommends everyone migrate their configurations to the "USGS-ANSS-DEPOT" templates and be consistent in using them. Other SIS tips include do not include leading zeros in serial numbers, use ZXY naming for wiring templates in most cases, and always check sensitivities and responses, especially for accelerometer channels. Since SIS cannot handle integrated sensor/digitizer combination units (like the Etna2), one has to "fake it" by setting the logger as the primary piece of equipment and having the sensor adopt the serial number of the logger. Note also that ownership of both ANSS-owned and operator-owned equipment can be tracked in SIS by leveraging the "co-owner" field.

Philip Crotwell of USC led a session devoted to gathering SIS feedback. He made the case for updating SIS in the field, provided there is access to the internet, to ensure metadata is always up-to-date. Feedback gathered from the room included:

- Site level field actions in one window would be convenient.
- Every setting needs to be entered individually. Can this instead be done in batch mode?
- Need a better way to handle integrated sensor/digitizer equipment in SIS.
- A phone app for use in the field would be useful for entering field actions and checking site configurations. This would allow entry of updates offline in the field that can then be uploaded w/ feedback upon return to the office.
- A local mirror of the SIS database would be useful to some networks and would greatly improve robustness of SIS since it would not depend upon a network connection. Alternatively allow local editing/creation of extended station XML that can then be uploaded to SIS later. Networks could create their own local applications to create this input. An XML validator provided to networks would help facilitate this strategy.
- It was noted that a major factor limiting implementation of some of these suggestions is the fact that SIS uses the Oracle database, rather than a cheaper and more widely available open source database.

The 2019 NetOps concluded its second day with sessions on modernizing legacy equipment, focused mainly on analog-to-digital best practices at the PNSN, CERI, and AVO, and the extensive permit-tracking practices to meet regulatory requirements in California, which is the main limiting factor for Earthquake Early Warning (EEW) rollout. After a brief brainstorming session for messages to management, the workshop adjourned.

Presentations from the Workshop are available at
http://www.ceri.memphis.edu/people/mwithers/NetOpsX/Presentations/

Definitions:

- AES: Advanced Encryption Standard; a symmetric encryption algorithm
- JSON: JavaScript Object Notation; a common data-interchange format that is easy to read and write by humans and machines.
- MIB: Management Information Base; a collection of information organized hierarchically accessed using the SNMP protocol.
- MPPT: Maximum Power Point Tracking; a type of solar charge controller using newer technology
- OID: Object Identifiers used to uniquely identify objects in a MIB hierarchy.
- PWM: Pulse Width Modulation; a type of solar charge controller
- SNMP: Simple Network Management Protocol; an Internet Standard protocol for collecting and organizing information about managed devices on IP networks.

Appendix A

NetOpsX November 4-5, 2019 Memphis, TN			
	University Center, Room 304		
Monday Morning November 4, 2019 8:00-Noon			
8:30	Welcome	Chuck Langston, CERI	
8:40	Introductions	Mitch Withers, CERI	
9:00	Review of Performance Monitoring Tools, Mustang	Gillian Sharer, IRIS	
10:00	Break	-	
10:30	Review of Performance Monitoring Tools, cont'd.	Marc Biundo, PNSN	
11:15	Unmet Performance Monitoring Needs.	Jon Connolly, PNSN	
Noon	Lunch	-	
Monday Afternoon November 4, 2019 1-5pm			
13:00	Field SOP Changes to Improve Performance	Brian Shiro, HVO	
13:50	Siting issues Affecting Performance	Jonah Merritt, UC Berkeley	
14:40	Drobeck Salute	Greg Steiner, CERI (ret.)	
14:45	Break	-	
15:15	Colocating sensors (GPS, magnetotelluric, weather…) impacts on infrastructure, perfor	Brian Shiro, HVO and	
16:00	Adjourn	-	
Tuesday Morning November 5, 2019 8:00-Noon			
8:00	Monitoring and remote reset and recovery	Scott Dalton, AEC	
9:00	Power systems	Karl Hagel, UW Seattle	
10:00	Break	-	
10:30	Equipment Life Cycles, and replacement criteria and procedures	Patrick Basien, ASL	
11:00	SIS Q&A and Feedback for Development Team	Philip Crotwell, USC	
11:30	Lunch	-	
Tuesday Afternoon November 5, 2019 1-5pm			
12:30	Modernizing legacy equipment	Karl Hagel, UW Seattle and Mitch Withers, CERI	
13:15	Station Acceptance Criteria and Procedures	Glenn Biasi and Igor Stubailo, Caltech	
14:00	Break	-	
14:30	Permit Tracking and keeping Permissions Current (NEPA and other requirements).	Marcos Alvarez, USGS	
15:15	Telemetry/sensors/field access during the Ridgecrest events.	Marcos Alvarez, USGS	
16:00	System-wide needs and messages for management	Mitch Withers, CERI	
16:30	Adjourn	-	
	More info on NetOpsX http://www.ceri.memphis.edu/people/mwithers/NetOpsX/		
	NetOpsX Agenda Version 20191028		