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Goals, Accomplishments, Realities, and Future Directions for Network Operations Based on the Array Network Facility for the NSF EarthScope USArray Transportable Array.

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We present an overview of the evolution of the Array Network Facility (ANF), its functions and responsibilities, throughout the EarthScope USArray Transportable Array (TA) project. The Transportable Array was intended to initially deploy a 400 element array with nominal 70 km station spacing starting on the west coast of the continental US, followed by a rolling deployment by removing stations on the west side of the array and redeploying these instruments on the eastern margin with each station emplaced for approximately 2 years. Each of the station's three seismic channels are sampled at 40 sps and 1 sps, along with $\sim$30 state-of-health (SOH) channels sampled either at 1.0 sps or 0.1 sps. Since the original station design of the TA, the capabilities have been significantly improved by upgrading the dataloggers, adding meteorological sensors, additional station SOH channels, and replacing the original onsite storage (Quanterra Baler 14) with a new design (Quanterra Baler 44). The most recent design change is the current rollout of additional sensors to measure infrasound signals.

The foundation of the TA and the ANF was based on the combination of state-of-the-art sensors (Streckeisen STS2, Nanometrics Trillium 240, and Guralp CMG3T), Quanterra Q330 dataloggers, IP communication systems, BRTT Antelope Environmental Monitoring Software, Sun servers, and RAID storage. In 2004, we started building the ANF hardware and software architecture to receive streaming realtime seismic and SOH channel data from this dynamic array. Over time we have developed a series of flexible development protocols to solve several classes of problems associated with the day-to-day running of such a complex network while still providing high data return rates. One class of difficult problems faced in the USArray project is related to the dynamic nature of the moving array including maintaining accurate and up-to-date metadata, and developing a variety of web-based tools to support field operations based on the changing requirements of the field teams. A second class of problems are based on the scaling of the data bandwidth, server processing power, and storage requirements which are driven by the requirements of acquiring data in near-real-time, generating the most complete data set possible by creating the union of real-time data with the on-site storage, and by adding new channels of scientific and SOH data.

We will discuss our approaches to solving problems in this dynamic environment and provide our views of how the next generations of systems can be designed to mitigate these types of problems.