Rapid expansion of a multi-hazard monitoring network: lessons learned, challenges, and opportunities presented by the 2019 ALERTWildfire camera network buildout.

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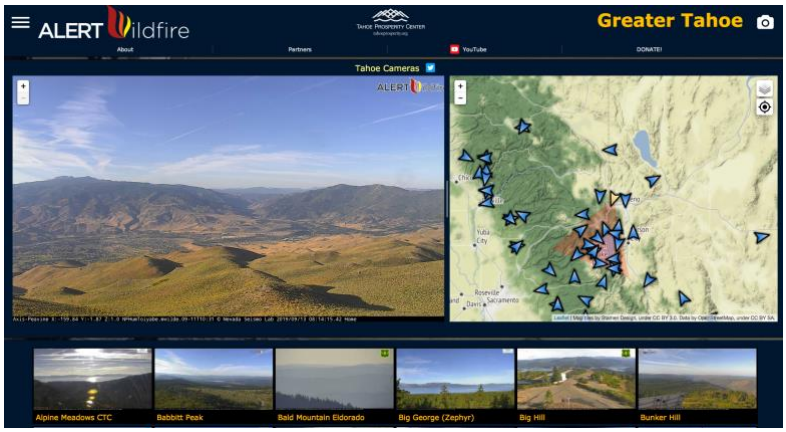
ALERTWildfire is a consortium of three universities – University of Nevada, Reno (UNR), University of California San Diego (UCSD), and the University of Oregon (UO) – that operates a real-time network of wildfire and hazard monitoring cameras in Nevada, California, Oregon, Washington, and Idaho. ALERTWildfire is an expansion of UNR's initial fire camera project, ALERTTahoe - funded the Tahoe Prosperity Center, the Eldorado National Forest, and the USFS Lake Tahoe Basin Management Unit, which was a 10-station pilot program deploying pan-tilt-zoom cameras and microwave networks in the Lake Tahoe region during 2014-2015. Following the success of this project, support from the Nevada Bureau of Land Management funded the expansion of the camera network eastward into northern Nevada, where the BLM Wildland Fire Camera Project was born. Through continued public and private partnerships and major investment by California public utilities, the network has grown to over 300 cameras, with plans to install ~100 additional cameras before the end of 2019. Key ALERTWildfire partners include the Nevada BLM, Washington-Oregon BLM, and Idaho BLM, USFS, San Diego Gas and Electric, Southern California Edison, Pacific Gas and Electric, Sonoma Water, and many California counties, including Marin, Sonoma, Napa, Lake and Mendocino.



The ALERTWildfire project currently uses Pan-Tilt-Zoom IP-based cameras with near-infrared capabilities to capture HD video from remote mountain top locations. These data were initially streamed back to NSL datacenters primarily along the core university's private microwave networks (supported by drops to fiber and cellular modems to increase path diversity), however the rapid expansion of the network in California during 2018-2019 required a new "tower of opportunity" strategy where existing third-part towers (e.g., utilities, state and county services, and other private point-to-point communications infrastructure) are outfitted with fire cameras and associated equipment allowing the network to grow at a rate of >100 cameras/year. We stream 15 frames per second video back to our datacenters, where fire camera users access the video feeds through a private proxy server, and from this stream, we pull one-second frame-rate imagery to build high quality MPEG videos on an hourly basis, and ten-second frame-rate imagery is uploaded to Amazon Web Services (AWS) S3 Bucket, where the ALERTWildfire website (www.alertwildfire.com) is supported to allow auto-scaling in response to traffic demands. On the website, users can view real-time imagery and camera time lapses at 15-minute, 1, 3, 6, and 12-hour intervals. We currently archive the one-second frame-rate images for 30 days, the ten-second frame-rate images permanently, and our archive is growing at rate of 1 petabyte of imagery per year.

The rapid expansion of the ALERTWildfire network has been driven by the need for real-time multi-hazard monitoring, support through public and private partnerships, and willingness to work with wireless internet service providers when advantageous. We are working to confederate existing microwave networks and increase our use of fiber and cellular communications to increase network bandwidth, lower data latency, and build greater path diversity. The ALERTWildfire network present opportunities for collaboration through co-locating additional sensors and wider access to the imagery archive that we look forward to exploring with the SAGE/GAGE community.