

Advanced communication and wireless needs at the Central-Arizona Phoenix (CAP) LTER

Site description and communication needs

The Phoenix metropolis is situated in a broad, alluvial basin that once supported a vast expanse of lowland desert and riparian systems, but now houses the fifth-largest city in the USA. Encompassing the entire Phoenix metropolitan area, CAP is one of only two urban LTERs and has proven to be a stimulating environment for conducting ecological research. CAP LTER researchers have made great strides over the past decade addressing relationships and feedback loops between the city and surrounding environment. Data derived from monitoring and research programs are maintained at the CAP LTER data lab on the campus of Arizona State University, and made available to the public via the CAP LTER website. In addition to supporting a wide array of CAP LTER research programs, these data are used extensively in our outreach and K-12 education programs.

The multitude of CAP LTER research and monitoring programs, as well as our extensive outreach and K-12 educational programs, require state-of-the-art communication networks to facilitate near real-time data and video streams. However, CAP LTER researchers are generally limited in their ability to provide data streams from the field, regardless of whether study locations are in the heart of the city or at remote desert locations. The lack of data streaming is particularly challenging as emerging technologies provide researchers with more advanced tools but demand greater data and communication resources. To address these limitations, we request support from ADEC to establish wireless communication and data-transfer capabilities between the CAP LTER data lab and field locations within and outside the city. CAP LTER is particularly interested to establish wireless connectivity to tower-mounted sensor banks at seven locations distributed throughout the study area. Data collected by the tower-mounted sensors currently are stored by data loggers that are downloaded manually at regular, frequent intervals. Wireless data-transfer is critical to maintain data collection at these locations when field activities co-located near the towers are reduced in the future. Further, this technology will greatly reduce CAP LTER operating costs and carbon footprint by reducing technician hours and vehicle miles associated with manually downloading the data loggers (distance between the towers is > 160 km and driving time to each location is considerable). There are numerous challenges to establishing connectivity at these locations, including vast distances, high data-transfer rates (≥ 75 megabytes per day), limited or non-existent power, extreme topography, and tenuous access.

Proposed wireless communication network

The proposed system would employ Wi-Fi (802.11g) and frequency hopping spread spectrum (FHSS, 900 MHz) coverages to facilitate point-to-point wireless connectivity between the data lab and existing tower locations. A combination of wireless and land-line technologies may be employed at select locations within the city when feasible. Storage and processing upgrades, protocols, and the network of antennae established during this initial phase will provide ample flexibility to meet future communications needs as new study locations are identified and added to the network.

Budget

\$28,000	Field equipment (power systems, antennas, radios, associated hardware) (@ \$4,000 / location)
\$15,000	Signal receiving equipment, and storage and processing upgrades required to accommodate incoming data streams. Data storage (2 Terabytes; \$3,000 / Terabyte) and security are provided by the High Performance Computing Center at Arizona State University.
\$24,000	Personnel costs required for system development, including: quality control, data reduction, website development, and download interfaces. Cost reflects 1 year graduate-student stipend.
\$67,000	Total cost

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