

A Quantum Leap in Wireless Communications for the Andrews Forest

Scientists and educators at the Andrews Forest are excited at the prospect of working with ADEC to enhance our wireless communications capabilities. The very tall trees, steep slopes and rugged terrain of the 6,400 ha Andrews Forest impose formidable challenges to research as well as to research communications. At the same time, we have a history of successful and innovative research and education programs that would be greatly enhanced by improved communications.

Our current capabilities and limitations. We have a foundation for wireless communications at Andrews. Residences and offices all have WiFi access. We are using telemetry to transmit data from climate stations and stream gauging stations and from a dense sensor network to the on-site Headquarters; data are transmitted from Headquarters to Oregon State University via a T1 line. However, the telemetry to the climate and gauging stations is by an outdated Campbell scientific radio telemetry system using VHF radios at a licensed frequency of 151.65 MHz. This equipment is no longer supported by Campbell Scientific, so if the radios fail we will be forced to change; adding equipment requires updating the FCC license. The equipment for the sensor network is by modern 900 MHz spread spectrum wireless modems with rs232 interfaces made by Maxstream. Our options for new sensors and sensor networks are seriously limited by limited transmission range and bandwidth. Voice communications across the site are limited to handheld radios, and even these do not work in many locations. Visual communications are not possible.

Our vision. We envision blanketing as much of our site as possible with a wireless communications network, prioritizing areas with climate stations (distributed throughout the site) a 96 ha small watershed in the SE corner of the site, (which we have designated as a “cyber watershed”) and a transect along an elevation gradient designated for new biodiversity/climate research. To avoid bottlenecks, we also need enhanced capability (beyond the current T1 line) for transmitting data from the site to Oregon State University, a distance of about 100 miles.

What this would mean for research and education. The wireless LAN would provide a quantum leap in capability for both teaching and research. Here are just a few examples of how we plan to use this capability: 1) The wLAN forest would create a virtual “distance learning” classroom. We want to provide real-time, two-way audiovisual communications between teachers in the field and students in remote locations. We also want to make video access available to parents of students who take part in field activities, examining the impacts of enhanced parental involvement on student learning. 2) Our biodiversity studies could be expanded to include animal tracking over extensive areas and addition of bioacoustics studies (which requires much higher bandwidth than our current system allows). 3) We aim to develop new technologies to measure CO₂ and H₂O fluxes and ecohydrological processes in the complex terrain of our “cyber watershed”. This will require installation of a dense network of environmental sensors, laser diode instrumentation to measure stable isotopes in air and water, and very high frequency measurements of trace gas concentrations and wind vectors. It is a new frontier in ecological studies to conduct such research in complex terrain, and it will require very high bandwidth, rapid communications – in addition to power.

Details. We look forward to working with the experts from ADEC to help us design and optimize a system that would be appropriate for our site. Our initial investigations suggest that the goals could be accomplished with the installation of two outdoor wireless Ethernet bridges and two dual radio outdoor wireless access points. Power is a critical consideration. There are sites with excellent solar potential for establishment of Ethernet bridges. We also think that the installation of line power to these or other locations, though expensive, should be seriously considered, as this would allow us to consider power-hungry sensors (e.g. laser diodes, trace gas analyzers, etc) and experiments (e.g., soil warming) that are currently impossible at our site. We would like to consult with ADEC to evaluate the costs and benefits of solar vs. line power at key locations.