Monthly Progress Report for December 2003

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PROJECT TITLE: Unlicensed Band Routing and Spectrum Allocation
                  Throughput of Ad-Hoc Networks

BACKGROUND / PRIOR WORK: Interested in ad-hoc network problems as well as unlicensed band routing and spectrum management issues.

PROGRESS DURING DECEMBER 2003:
[Progress was slower in December 2003 because of the final examinations and a visit home during the Christmas vacation]

- Continued working on the problem of wireless node neighborhood estimation from signal power measurements. The model comprises a central node (called the Network Interference Server, or NIS) that records transmissions from all nodes that partake of this directory information service, and uses the received signal measurements from a single information-requesting-node to correlate signal strengths and estimate the relative radio-distances. The communication model invokes a BPSK scheme for transmission and reception, and all signal measurements are formulated in terms of signal power.
  - The problem was reformulated in matrix notation in terms of frames and a transmission activity factor that remained unchanged for the duration of each frame. Matched filter operation was still being performed at the bit-level, but the NIS and the subsequent channel estimation development was modified to the frame-level, thus reducing information overhead at the NIS.
  - An experiment was designed and successfully carried out to test the veracity of the algorithm in the context of ad-hoc 802.11 transmissions in the neighborhood of a single access point. Simulations were performed with ns2 to obtain a distribution of the node transmission activities under the influence of 802.11's CSMA/CA mechanism. The activity distribution was then used as the input to a MATLAB program that simulated a network with a single access point and several transmitting nodes. The NIS determined the channel coefficients and the node distances on the basis of the signal measurements received at the nodes to a very high degree of accuracy.
  - The distribution of estimation error was studied with different frame-sizes (in bits) and distance and graphs plotted.
  - Began rewriting the problem in terms of a general correlation receiver, instead of the matched filter implementation.
- Read papers on interference cancellation and error estimation for application in the correlation estimation aspect of the NIS problem.
- Prepared project proposal for the "Spectrum Management" class to characterize the optimum codeword configurations that lead to minimum transmitter power levels required for achieving a specified BER level in the case of correlated data.
- Attended talks by other members of the Network/RRM group to learn about different projects.
- Attended the ECE Colloquium (Distinguished Lecture Series).
- Updated personal and central WINLAB websites.

WORK PLANNED FOR JANUARY 2004:

- Reformulate a more general solution to the problem of designing a wireless Network Interference Server (NIS) using correlation receivers that would avoid the use of matched filters to resolve signals, thus allowing the NIS to operate on multiple systems that use the same spectrum.
- To continue ns2 simulations and writing MATLAB code for a distribution of nodes that may be classified as "near" and "far" nodes and compare the estimation errors.
- To read material on detection and estimation theory.
- To continue learning Network Simulator (ns2) for the simulation discussed above, and also prepare a simulation model to verify that the throughput of the ad-hoc network problem agrees with the theoretical results.
- To complete the final paper for the "Spectrum Management" class.
- To attend colloquia organized by WINLAB and weekly Network/RRM group meetings.
- To continue maintaining personal and central WINLAB websites.