SHORT-RANGE ULTRA-WIDEBAND SYSTEMS

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The focus of this research is on the novel problems and issues that are created when designing radios whose radiation has very large fractional bandwidth, i.e., ultra-wideband (UWB) radio systems. The changes in conceptual design approaches from narrowband to UWB radios are considerable, and apply to all aspects of radio design, from propagation characterization and modeling, to antenna design, circuit design, and system design and architecture.

We have assembled a team of well-qualified senior and junior researchers whose interests span this wide range of topics, and whose expertise is theoretical, experimental, and practical. The problems that we have singled out in this proposal have two characteristics: They are caused by the extreme fractional bandwidth of UWB radio, and they cannot be solved directly by conventional means. Major topics include modeling UWB channels (especially for short range mobile and dense multipath links), antenna design for UWB links, coexistence with interference, energy capture for highly time-spread UWB signals, rapid sync acquisition techniques, low-power implementation issues, and compliance with expected FCC regulations.

Because UWB systems must operate at the cutting edge in so many areas of technology, we believe that UWB research must be driven by efforts to gain experience with real problems and real environments. There are obvious military and commercial applications for UWB in identify-friend-or-foe (IFF) systems, covert communications, RF tagging for autonomous manifesting, status monitoring systems, battlefield asset tracking, position monitoring, medical tagging, etc. We will use short-range UWB radio applications in these environments as one key means of focusing our research, and will refer to them generically as RF tagging. These application scenarios provide a rich problem area that includes mobile radio effects, covertness requirements, a variety of network architectures, extreme reliability demands, extensive multiple access capabilities, low power requirements, etc. Most importantly, the majority of these applications have a need for either covert communications or accurate position location information (or both), which are the expected characteristics of "killer applications" for UWB technology.

This work is supported by good lab facilities at all three participating universities. It will result in the training of at least 16 graduate students and the development of new relationships between the participating faculty. The research participants and their labs are well connected to industry and will provide natural conduits for open

technology transfer. The application environments for this work were initially motivated by discussions with Steve Gunderson of NFESC, and these already have resulted in preliminary shipboard propagation measurements by this research team. We welcome further interaction with other interested parties in the Department of Defense. To promote this interaction and as a condition of this award, we will continue the tradition of the UltRa Lab at USC and the Berkeley Wireless Research Center by holding annual Ultrawideband Radio Workshops to review the state of UWB research and to develop relationships with government labs and industry.