

**Course Description:                    UWB Radio Technology**

Based on their new book, *Ultra-wideband Radio Technology*, Wiley: UK, 2004, authors Siwiak and McKeown trace UWB technology through history, regulations, standards, system implementations and commercial applications. They strike a judicious balance between sufficient technical detail for the seasoned practitioner, and practical and strategic observations to benefit technology managers, marketers and potential investors in the technology. There has been a recent surge of invention and commercialization interest following the FCC's "Report and Order" which legalizes an unprecedented access to more than 7.5 GHz of unlicensed UWB spectrum in the US. Methods of generating and modulating UWB signals are described and set in the context of UWB proposals for IEEE802 Standards. Interesting UWB antenna, radiation, and propagation phenomena, including unique behavior in multipath, are presented in contrast with narrow band radio. Examples of UWB link margins including data throughput versus range and system data capacity (up to 2 Gb/s) are compared with conventional and much higher power 802.11a/b systems. The future of UWB is a judicious mix of wireless communications, precision positioning and radar. UWB can enable an accurate indoor adjunct to GPS with centimeter accuracy. Discussions of applications show that UWB capabilities make possible delivery of location-specific content and information, tracking of high value assets, security systems and various automotive and interesting home based "location awareness" systems.

**Benefits:**        Enhance your understanding of:

- Communications systems market drivers:
  - cost, size, data rates, capacity...
- UWB concepts:
  - promises made, promises delivered...
- Historical evolutionary path:
  - technology, funding, regulations, standards...
- UWB technology 'best fit':
  - commercial: 802.xx, 3G, 4G and beyond...
  - defense: portable radar systems, through the wall imaging...

**Who should attend:** This course presents an overview and introduction to the issues, regulations and technology of UWB, and is an invaluable resource for engineers and technical staff, managers and business development personnel who plan to pursue this technology, or compete with it.

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## Course Outline: UWB Radio Technology

1. **History of Wireless and UWB** - The earliest wireless was “UWB” but spectrum sharing technology evolved around narrow band techniques. The development of wireless shows a trend back towards UWB as new techniques make the technology more attractive.
2. **Regulatory Climate - Summary of Regulatory Activities** – By 2002 US FCC regulations are written to permit the deployment of UWB under the unlicensed provisions of the regulations. Both European and Asian regulators are considering permitting the technology along a path similar to what happened in the USA.
3. **Standards: UWB in IEEE802** - Ultra-high data rate standard is evolving under IEEE 802.15.3a, and a lower data rate version including positioning is growing in IEEE 802.15.4a. Standards for UWB deployment are under review in Europe.
4. **Generating and Modulating UWB Signals** - Methods of generating UWB signals are discussed: “time” signal designs and how they fill the spectrum; modulating UWB signals with data.
5. **Radiating UWB Signals** – UWB signal shapes change in the radiation and reception process. The process is followed from currents supplied to the antenna, to fields in space and finally to terminal voltages at the receiving antenna.
6. **Propagating UWB Signals** – Once launched as propagating wavelets, UWB signals are affected by multipath differently than conventional narrow band radio signals.
7. **Receiving UWB Signals** – UWB became practical with the advent of efficient recovery techniques for the UWB wavelet energy.
8. **UWB Link Budgets and System Capacity**– The link budget for UWB is constrained by regulations, bandwidth, and device technology. Samples of link designs are discussed. With 7.5 GHz of spectrum available (in the USA), UWB offers some unique challenges and capabilities in system design. Huge aggregate and shared capacities are available. Capacities in comparison to existing 802.11a/b systems will be seen.
9. **Location Awareness and Positioning in UWB-RT** - UWB bandwidth and some modulation techniques allow for a high degree of positioning accuracy making the concept of location awareness a part of future wireless systems. The value of knowing “where” a device is will take on an economic value on par with the value of the actual data transferred on UWB data links.
10. **Applications and Future Considerations** - Systems will begin to be deployed under the UWB standards; special applications systems will also begin to appear. The R&D trends and directions will find UWB appearing as a participant in late 3G and early 4G scenarios.

## Course Developer Biographies

**Kazimierz “Kai” Siwiak** is co-author of , *Ultra-wideband Radio Technology*, Wiley: UK, 2004, and an inventor, engineer and Founder of TimeDerivative, Inc., a wireless technology consulting venture. He was Vice President of Strategic Development at Time Domain Corp., and recently received the *Dan Noble Fellow* and the *Silver Quill Awards* from Motorola Corporation where was named *Master Innovator* and Member of the Technical Staff. He has lectured internationally on Ultra-wide Band radio technology, wireless systems, antennas and propagation. Kai received the B.S.E.E. and M.S.E.E. degrees from the Polytechnic Institute of Brooklyn, Brooklyn, NY, and his Ph.D. from Florida Atlantic University, Boca Raton, FL. He holds more than 70 patents world-wide and has published extensively, including the text book, *Radiowave Propagation and Antennas for Personal Communications*, Artech House, 1995 now in *Second Edition*, 1998. He was Technical editor for the IEEE 802.15.3 Study Group 3a, and is active in UWB standards development. Kai is also a contributing member to the FCC and ARRL RF Safety Committees and Electromagnetic Exposure committees. Kai is an Extra-class amateur radio operator and a commercial airplane pilot holding instrument and multi-engine ratings.

**Debra McKeown** is co-author of, *Ultra-wideband Radio Technology*, Wiley: UK, 2004, and a teacher who is devoted to supporting developing nations through education. She believes that technology will likely bring positive advancements for many people. Debra, previously Training Coordinator at Time Domain Corp., has an interest in UWB Technology and loves teaching and working with Engineers on the subject. Debra formerly designed and built web-based training, and computer assisted training. She worked with media departments to design, capture and deliver training related digital media. Debra received her M.A. degree in Varying Exceptionalities and Learning Skills from the University of South Florida, and her B.A. in Cultural, Biological and Archaeological Anthropology from the University of South Florida Honor’s Program. She holds Teacher Certifications in Florida and Alabama, and has co-authored several tutorials on UWB technology. Recently Director of Education and Curriculum at the Kenya Community Centre for Learning in Nairobi, Debra currently works in Kenya on various alternative education projects. She holds memberships in American Society for Training and Development (ASTD), Alabama Education Association, and the American Anthropological Association (AAA).