
Practical

RADIO

TELEMETRY SYSTEMS

for Industry



YOU WILL LEARN HOW TO:

- Implement simple radio telemetry links for SCADA systems
- Understand the jargon, terminology and latest techniques
- Design and install an effective radio telemetry link
- Perform simple path loss calculations
- Troubleshoot radio telemetry communication problems
- Specify the main components of radio, satellite and microwave telemetry links
- Conduct a site survey
- Implement effective security on radio, wireless and Ethernet networks
- Explain the infrastructure requirements for effective systems
- Outline future trends in SCADA and telemetry systems

WHO SHOULD ATTEND:

- Instrumentation and control engineers
- Electrical engineers
- Process development engineers
- Control systems sales engineers
- Control systems applications engineers
- Instrumentation technicians
- Process control engineers
- Consulting engineers
- Design engineers
- Maintenance supervisors
- Project engineers
- Network system administrators



Technology Training that Works

THE WORKSHOP

This workshop has been designed in conjunction with radio telemetry experts from throughout the world (the SCADA list) and aims at providing you with all the critical information we can effectively transfer to you in two hard-hitting days.

The course commences with a discussion of radio and wireless fundamentals to ensure everyone is brought up to speed with the basics. Antennas are then discussed, followed by fixed systems. The essentials of data communications (and Ethernet) are then reviewed as they apply to radio telemetry systems. A review of Wireless LAN systems is undertaken and a comparison of radio modems is given. The fast growing topic of cellular radio data services is discussed. Protocols are a key part of all radio telemetry systems and the important ones outlined together with the challenges associated with radio.

A brief overview of satellite and microwave systems is given for completeness, followed by performance analysis. A discussion on radio telemetry systems would not be complete without sketching out the key issues of SCADA systems and alarm management. The overall network architecture of radio telemetry systems is then detailed. The course is concluded by an examination of troubleshooting techniques and the vital topic of security and encryption.

A thread throughout the workshop reflects today's emphasis on using open protocols and networking standards such as DNP3, TCP/IP and Ethernet off-the-shelf hardware and software to keep the costs down. A selection of case studies is used to illustrate the key concepts with examples of real-world radio telemetry systems in the water, electrical and processing industries. This workshop will also be an excellent opportunity to network with your peers as well as to gain significant new information and techniques for your next radio telemetry project.

Practical sessions throughout the two days of the course ensure that you can apply the course materials easily and effectively.

PRE-REQUISITES

Knowledge of basic electrical concepts.

PRACTICAL SESSIONS

- Construction of Wireless LAN network
- Signal strength site survey
- Extension of network with antennas and point-to-point links
- Microwave link path loss design exercise
- Performing an intermodulation products calculation
- Demonstrate use of encryption and authentication
- Protocol analysis of DNP3/Modbus and TCP/IP over wireless/radio network
- Design of an overall radio telemetry system

THE PROGRAM

DAY ONE

RADIO AND WIRELESS FUNDAMENTALS

- Basics of electromagnetic transmission
- Signal to noise ratio, frequencies and channels
- Radio block diagrams
- Radio propagation: attenuation, fading and multi-path
- System performance: coverage, error rates, availability, response times
- Quality of Service (QoS)
- Filtering and RF multicoupling
- Analog and digital modulation techniques
- Spread spectrum techniques
- Cellular concepts: cells, frequency re-use, hand-over and network components
- Interference/intermodulation
- Spectrum/frequency allocations
- Duplication and diversity
- Path loss calculations and multi-pathing (theoretical and actual)
- Environmental influences on transmissions
- Radio network diagnostics and path surveys

ANTENNAS

- Fundamentals
- Directionality and gain
- Path loss
- Distance calculations
- Diversity
- Specific types: omni, half wave dipole, Yagi, parabolic reflector and panel

FIXED SYSTEMS

- Wireless modems (serial and Ethernet)
- Simplex network comparison
- Repeater network comparison
- Critical features to specify
- Check sheet
- 802.16/WiMax

DATA COMMUNICATIONS AND RADIO TELEMETRY SYSTEMS

- RS-232/RS-485
- Industrial Ethernet
- Troubleshooting serial communication links
- Troubleshooting Ethernet

REVIEW OF WIRELESS LAN SYSTEMS (IEEE 802.11)

- Specifications: IEEE 802.11a, 802.11b, 802.11g, 802.11n
- IEEE 802.11i/WPA2
- Authentication: IEEE 802.1X
- Medium Access Control
- Components
- Antennas
- Topologies
- IP roaming

CELLULAR RADIO DATA SERVICES

- Cellular radio basics, CDMA, GSM
- FDMA/TDMA/CDMA
- Switched/Dedicated/Packet Switched GPRS
- Non-connectivity issues with GSM-GPRS
- CDMA 1X
- 1xEV-DO

PROTOCOLS

- Modbus
- TCP/IP protocol suite
- IP Addressing
- TCP
- UDP
- Routing
- TCP/IP utilities
- DNP3 SCADA protocols
- DNP3 over TCP/IP and UDP
- IEC 60870-5-10x
- IEC 61850
- Differences between these alternatives
- Protocol problems with radio data networks

DAY TWO

SATELLITE (BRIEF OVERVIEW)

- Background
- Classes of service
- Relevant organizations
- Frequency band allocation
- Theory of operation
- Downlinks and uplinks
- Practical implementation considerations
- Available satellite services
- VSat TM

LINE OF SIGHT MICROWAVE (BRIEF OVERVIEW)

- Background
- Point to point/point to multipoint
- Equipment - transmitter/receiver/multiplexer
- Data rates
- Dishes and antennas
- Cables and waveguides
- Multipathing
- Diversity and duplication

PERFORMANCE ANALYSIS

- Availability and reliability
- BER testing
- Complete system testing

SCADA SYSTEMS

- Terminology and overview
- Displays and HMI's
- Best practice configuration

INFRASTRUCTURE REQUIREMENTS

- Location selection
- Site works and access
- Mast selection
- Equipment shelters
- Power supplies - mains/solar/generators
- Back-up batteries
- Air conditioning

NETWORK ARCHITECTURE

- Design considerations
- Full duplex vs half duplex
- Continuously keyed repeaters
- Store and forward vs talk-through repeaters
- Network redundancy (secondary paths/PSTN)
- Wireless data integration
- Separate components versus integrated radio/modem
- Digital radios vs analog radios

TROUBLESHOOTING AND MAINTENANCE OF RADIO TELEMETRY SYSTEMS

- Using the LEDs on modems and RF units
- Use of a power/SWR meter
- Communications service monitor and sweep generator/spectrum analyzer
- Importance of correct terminations
- Surge and lightning protection
- Earthing/grounding
- Protocol analyzers
- Maintenance regimes of radio/telemetry systems

SECURITY & ENCRYPTION

- Introduction and terminology
- Firewalls
- Authentication
- Encryption: AES and DOS Encryption (draft IEC security standard)
- Remote access to SCADA and telemetry systems

FUTURE DIRECTIONS AND REVIEW