Course 602 – Wireless BDA/DAS
Application and Design Principles

Scope
This two-day seminar introduces the varieties of Bi-Directional Amplifier and Distributed Antenna Systems, the Services, Frequencies and Technologies they support, and the basic design and deployment principles involved in establishing successful systems.

Target Audience
Designers of BDA/DAS systems, system and test equipment, as well as system design engineers, operating engineers and technicians, consultants, and allied professionals.

Course Presentation Setting and Methods
Presented in a classroom setting using computer projection with student workbooks.

Topical Outline

Classes of BDA/DAS Devices and Systems
- Repeaters, Boosters, Cell Enhancers
- Slots, Frames, Resource Elements
- Distributed Antenna Systems
  - Cable-distributed
  - Fiber-distributed
  - HVAC ducting “waveguide” distributed
  - Over-the-air Donors
  - Microcell and On-Site Donors
  - Community and Multi-Operator/Multi-Technology systems

Wireless Services and Frequencies
- Public Cellular and PCS
  - 800, 850, 1900, 1700-2100, 700, 900, 1800, 2500, 3600 MHz.
- Law Enforcement, Public Safety – 150, 450, 800-900 trunked
- SCADA telemetry – 150, 450, 900 MHz.
- Public Unlicensed Mobile Data and Incidental Communications (phones, radio control, WIFI and Bluetooth)

Wireless Technologies: Signal Types carried by BDA/DAS Systems
- Basic Modulation Types
- AM, FM, PM, ASK, PSK, FSK types, combinations, pros and cons
- Public Cellular and PCS
  - GSM, GPRS, EDGE, IDEN, CDMA2000, 1xRTT, WCDMA, HSPDA
  - WIMAX, LTE
• Law Enforcement, Public Safety – FM, QPSK
• SCADA telemetry – FM, QPSK, others
• Public Unlicensed Mobile Data and Incidental Communications
• WVOIP, Mobile Video

Quality Criteria For BDA/DAS Systems
• Signal Quality Criteria for BDA/DAS systems
• C/I, Linearity, Dynamic Range, Headroom, Noise Performance
• Amplitude “tilt” over DAS Passband
• Interference – External sources, internal sources generated in-system
• Principles of generation and Detection/Mediation techniques

RF Propagation in BDA/DAS Systems
• Basic BDA/DAS Coverage Requirements
• Basic Propagation modes
  • Free-Space
  • Reflection-mode in cluttered environment
  • Obstructions and Diffraction
• In-Building Propagation
  • Free-space in rooms, hallways
  • Calculating Attenuation through walls, floors, ceilings, doors, windows
  • Commercial Propagation Tools
  • In-building measurement techniques
  • Frequency variability (“tilt”) of losses
  • Loss, Tilt, and coupling in the use of HVAC ducts as waveguide
• Outdoor Propagation Software Tools

Antennas for BDA/DAS Systems
• Matching needed Pattern Shape, gain, size, mounting, and aesthetics
  • Panels, dipoles, array and reflector techniques in BDA/DAS antennas
  • Slot antennas: a natural when using HVAC ducting as waveguides
  • Reflection characteristics of antenna surroundings
• Intermodulation and long-term electrical integrity
• FCC OET 65 issues, meeting/exceeding standards for public RF protection

BDA/DAS System Link Budgets
• What is a Link Budget? What does it provide?
  • Gains and Losses of DAS system components
  • Establishing Link Budgets for “Unloaded” and “Loaded” conditions
  • Special Link Budget considerations for TDMA, CDMA, OFDMA
  • System design to satisfy link budget requirements

BDA/DAS Equipment Manufacturers and Product Offerings
• SOLiD Technologies
• Andrew/Commscope
• IW
• Power Wave
• Others

BDA/DAS Installation Techniques and Practices
• Physical Installation
• Setup and Initial Performance Measurement
  • Level Setting for signals of different peak-avg ratios and loading effects
  • Identifying unexpected holes and hot spots, leveraging remedies

BDA/DAS Example Case Studies
• Basic Design, Operational, and Troubleshooting discussions

Prerequisites
Basic experience with electronics and wireless/RF communication systems. Ability to work in decibels (refresher provided).

Course Documentation and Materials
Student guide
CD with various individual resources

Facilities and Hardware Requirements
Classroom suitable for student note-taking and a screen or other light surface for projection.