Radio Modem Research at WINLAB (pre July 2001)

- **Radio Resource Management**
  - Adaptive Modulation/Integrated RRM
- **PHY**
  - Interference Cancellation, Channel Estimation, Channel Coding
- **RF Devices/Circuits?**
  - Radio waves anybody?
Radio Modem Research at WINLAB (post July 2001)

Radio Resource Management
Adaptive Modulation/Integrated RRM

PHY
Interference Cancellation, Channel Estimation, Channel Coding

RF Devices/Circuits
WINLAB is on to Radio Waves!

System On Chip
Software Radio & SSF Simulation Testbeds
For anytime anywhere cellular service
Multiuser Interference Cancellation at BS
Simulation Studies on WiPPET SSF simulator
Implementation Studies on Software Radio Testbed
WiPPET
Multicell
Mobility
Radio Resource Mgmt
Signal Processing
Propagation

MOBILITY/GEO
(long time-scale losses)

RAYLEIGH
(short time-scale losses)

FwdRCH

RevRCH

MS 1 → BS 1
MS 2 → BS j
MS x → BS j
MS N → BS 12

SWITCH

Scalable Simulation Framework
SDR Testbed based on FPGAs and DSPs

SDR Architecture for Interference Cancellation

SDR Testbed based on FPGAs and DSPs

SDR Architecture for Interference Cancellation

Linear MUD

Nonlinear SIC
Radio Modem Research (post 1999)

High rate data services
Interference Cancellation for the Downlink
Detection & Characterization of Impulsive interference
Space/Time Processing & Coding
Multicarrier/OFDM, Ultra Wideband (UWB)
Characterization of High Speed Short Range Channels
Infostations
A system of sweet spots for “free” bits

- Small, separated “cells”
- Low power (~100 mw)
- Brief connections (~1 sec)
- Very high bit rate (~1 G bps)
- Simple infrastructure (LAN on a pole, IP access)
- Unlicensed bands?
About 15 student projects in the RF/MODEM area

Investigators
Evans
Greenstein
Lin
Lu
Mandayam
Seskar
Spasojevic
Yates

Range of Systems
3G Cellular
Wireless LANs
Infostations
Ad hoc Data
Common Theme  
Efficient High Data Rate Transmission

- Propagation/Channel Modeling
  - Infostation & UWB channel models
    - Outdoor & indoor channel measurements for typical scenarios
      - Greenstein, Mandayam, Seskar
  
- Interference Cancellation
  - “Blind” receiver techniques for the handset
    - Exploit 2nd order statistics for mitigating unknown interferers
      - Mandayam, Seskar
  
  - Wippet multicell downlink simulations
    - Characterization of power profiles and performance evaluation
      - Spasojevic, Yates
  
  - Impulsive/Wideband interference cancellation
    - Robust detection under alpha-stable models for interferers
      - Spasojevic
Common Theme
Efficient High Rate Data Transmission

• **OFDM**
  - Peak power reduction
    - Heuristic iterative clipping algorithms
      - Evans
  - Synchronization for Infostation channels
    - Algorithms & implementation on Testbed
      - Mandayam, Seskar, Spasojevic

• **Space/Time Turbo Coding**
  - Performance on correlated fading channels
    - Impact of spatial & temporal correlations
      - Mandayam

• **UWB**
  - Analysis, cancellation, synchronization
    - Several new projects being initiated
      - Evans, Mandayam, Seskar, Spasojevic
Overlapping Research Areas

- Infostations
- Free Bits
- System on Chip
- Sensor Networks
- RF Modem