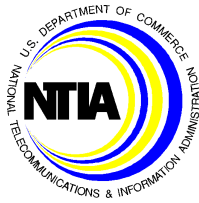


INSTITUTE FOR TELECOMMUNICATION SCIENCES
Advanced Radio Technologies 1998

ITS ADVANCED ANTENNA TEST BED

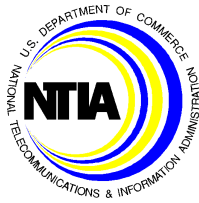
Peter B.Papazian, Michael G. Cotton, Perry Wilson
National Telecommunications and Information Administration
Institute for Telecommunication Sciences
(303) 497-5369 papazian@its.bldrdoc.gov

September 1998



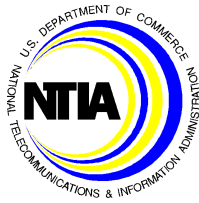
Problem/Motivation

- **No Common Methods/Environments for Testing Adaptive Antenna Technology**
- **Spectrum Efficiency (Increased Service Capacity)**
- **Increased Performance/Cost Ratio**
- **Test Communication Systems (not antenna metrology)**
 - Algorithms
 - Antenna Systems



ITS Approach

- Utilize a common area where propagation parameters are well known
 - BITB
- Characterize radio channel when testing
 - Impulse Response
- Record raw data
 - post process using different algorithms



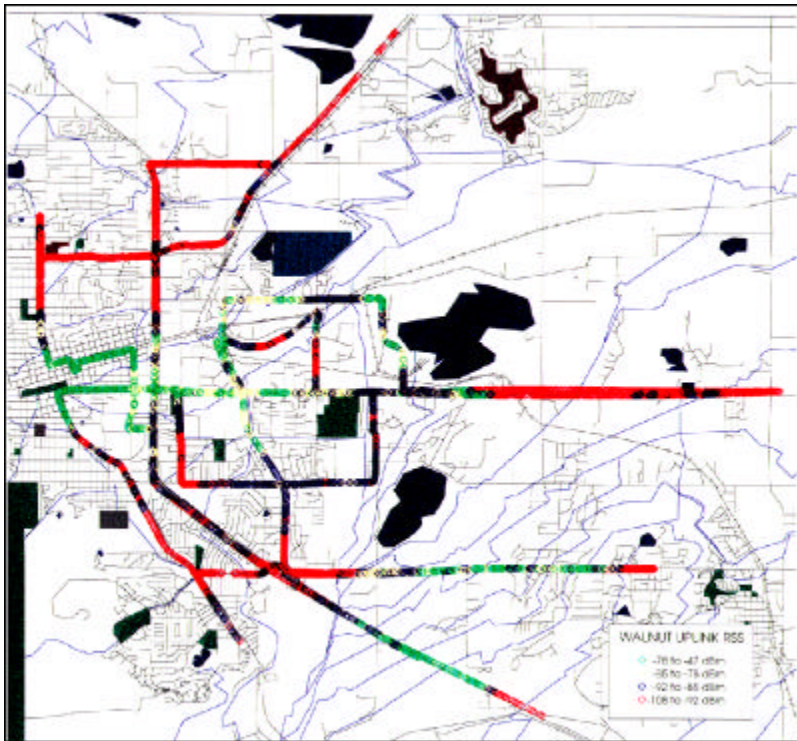
Methodology

- Transmitter
 - Multiple mobiles using gold codes
 - wideband, interference, polarization
- Receiver
 - Multiple channels
 - digitize IF signal for each antenna element
 - Calibrate channels
 - relative amplitude and phase

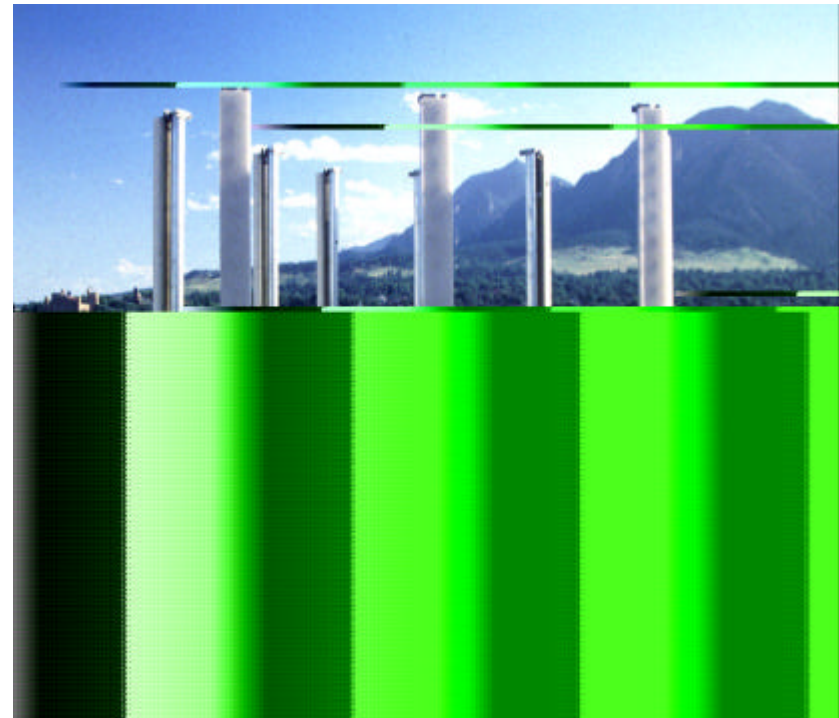


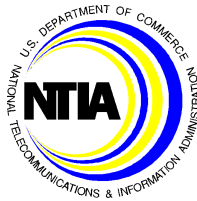
Boulder Industry Test Bed (BITB)

Uplink RSS - GSM 1900

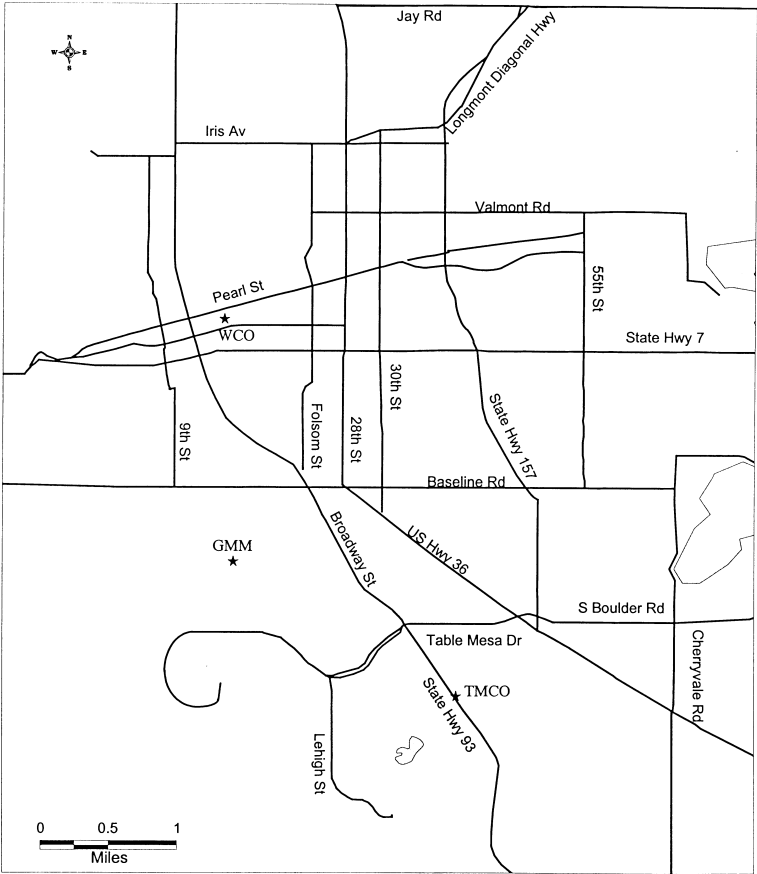


Walnut CO Antenna Site

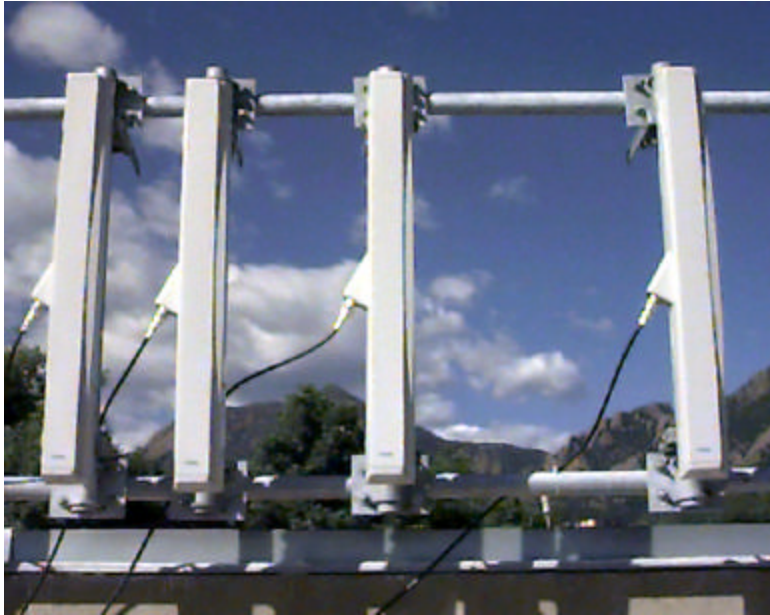


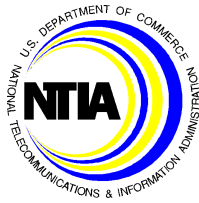


ITS Antenna Site



GMM cell site
PCS Antenna Array





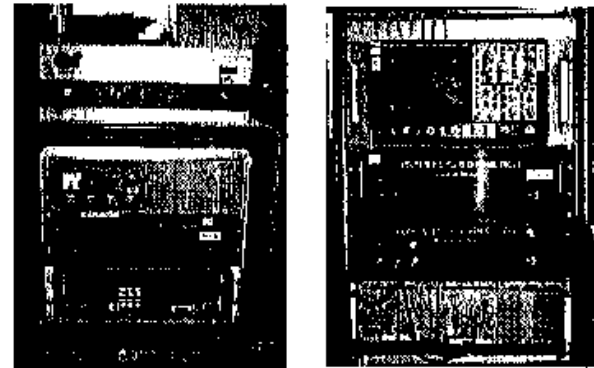
Measurement Capabilities

- **Transmitter**
 - .1 to 100 mc/s
 - maximal length PN code
 - multiple codes
 - multiple frequency
- **Receiver**
 - 1-8 channel A/D
 - AGC
 - impulse rep rate (51us)
 - burst rate (1-10 s)
 - real time processing
 - continuous acquisition
- **Typical Values**
 - 10 Mb/s (100 ns resolution)
 - 511 bit
 - 2
 - .915, 1.92 GHz
 - 4 channel, 40 Ms/s
 - 4-8 channels
 - 1-3 ms
 - 5 sec
 - 4 DSP's
 - 2 ms/impulse

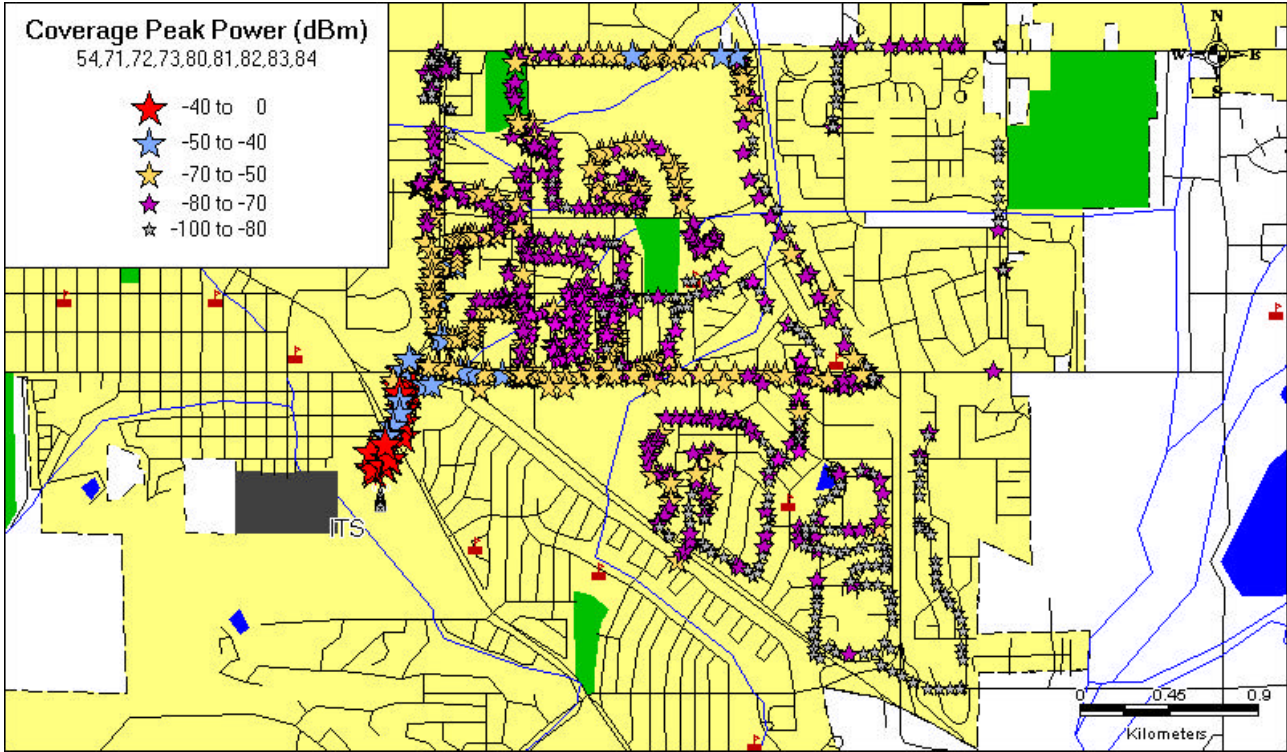
First Experiment - Diversity Gain

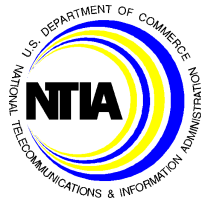
- **Characterize Test Bed**
 - PCS frequency
 - Gain vs ant separation
 - Simultaneous measurements
 - Wideband
 - Gain vs BW
 - Narrowband
 - Combining Algorithms
 - Selection, MRC, ORC

ITS Advanced Antenna Test Bed Tx, Rx
and Data Acquisition System



ATB RSS(dBm) North Sector





ATB Cell Coverage

Tx Antenna: Omni

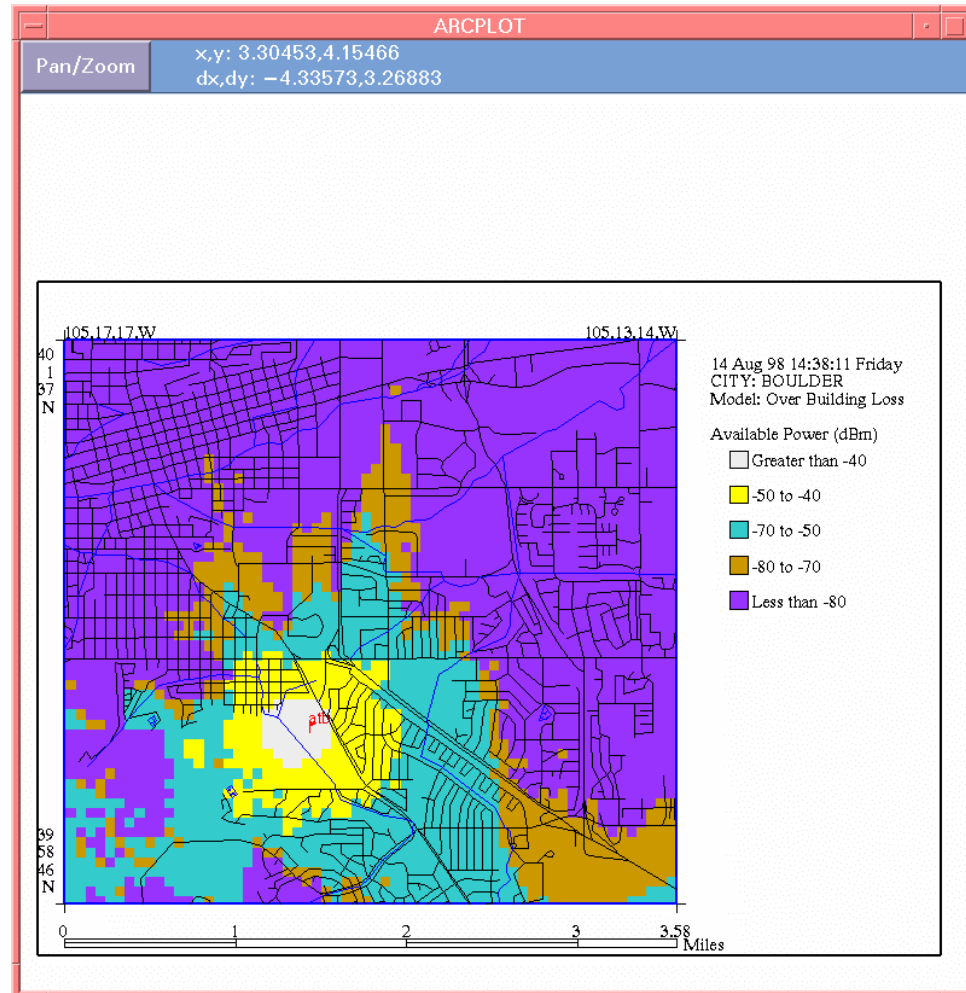
H=22 ft.

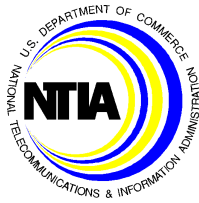
EIRP=40 dBm

Model: ITS PCS

Rx Antenna: Omni

H=8 ft.





Conclusions

- **Facility**
 - well characterized environment
 - suitable for PCS, cellular, WLAN
 - multichannel wideband system
- **Benefits**
 - measurement of propagation conditions
 - simultaneous impulse response
 - multiple processing algorithms evaluated
 - complete systems tested