A High-Performance CW Mobile Channel Sounder

Bob Johnk, Chriss Hammerschmidt, Irena Stange

ISART Workshop on Best Measurement Practices
July 26, 2018

Institute for Telecommunication Sciences (NTIA/ITS)
325 Broadway St
Boulder, Colorado USA 80305
Contact: rjohnk@ntia.doc.gov

Rationale for Measurement System

- Simple to deploy and operate
- Capture high-fidelity data that permits flexible post-processing and statistical analysis
- Accurate data to inform EMC analysis of interference scenarios and national policy

Propagation Parameters and Related Effects

Measure selected propagation parameters:

- Path Loss
- Fast-fading
- Power Spectrum
- Examine the local scattering environment
- Ratio signal power from the transmitter compared to local scattering (K-factor)

Mobile Channel Measurement System

- Simple fixed-to-mobile transmitter/receiver architecture
- Single-frequency (CW) transmitter at a fixed location
- Receiver located on a mobile platform that moves around on a prescribed route

Mobile Channel Measurements

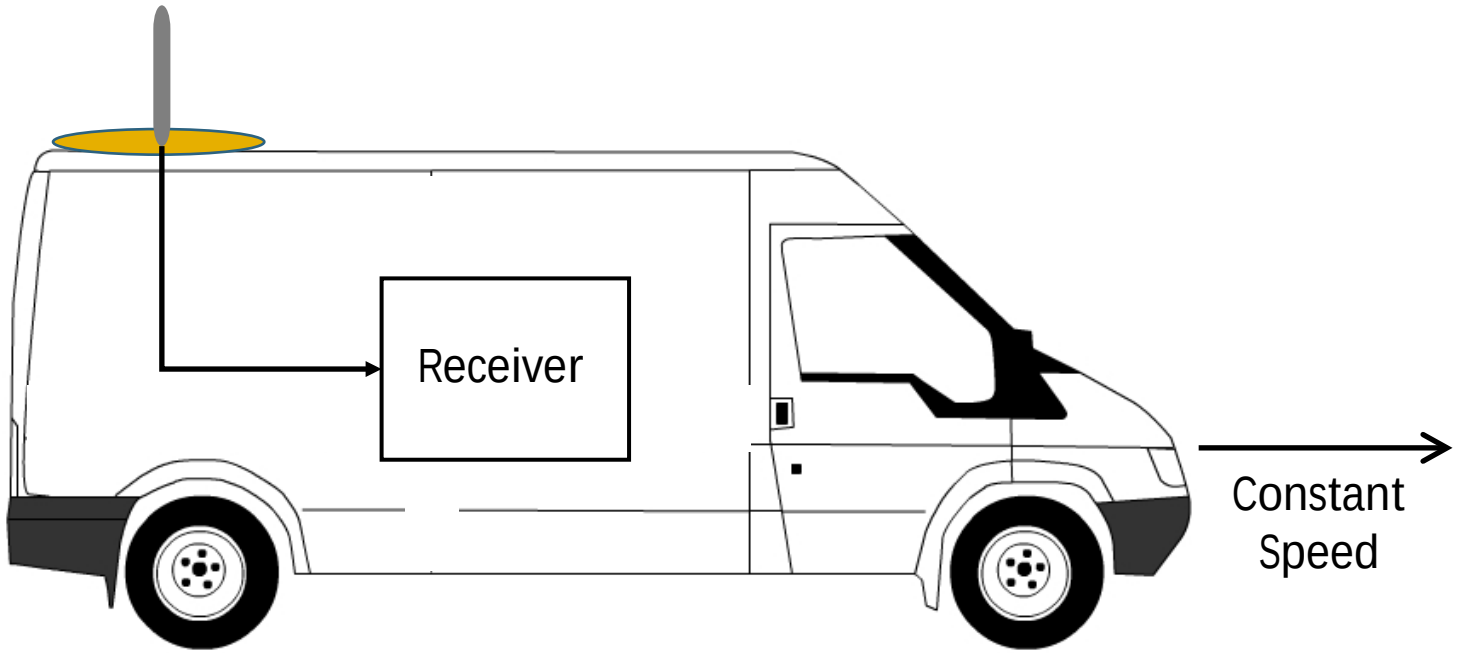
Fixed Transmitter on Building in Boulder, CO

Fixed Transmitter on ITS RSMS Truck in San Diego, CA

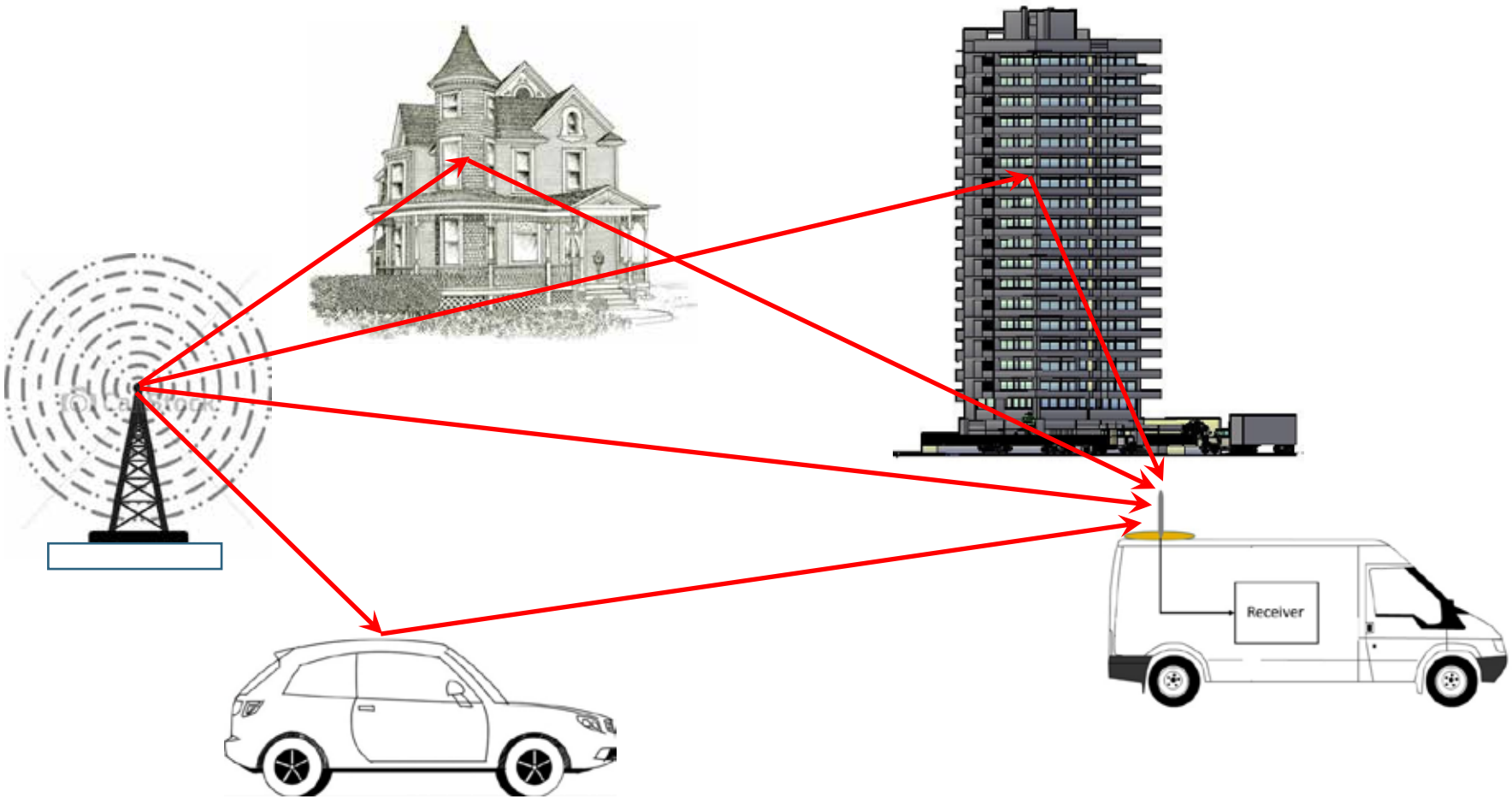
Receiving System in Van

This is a scanning-probe measurement system

20-70 l averaging interval—for path loss and de-trending



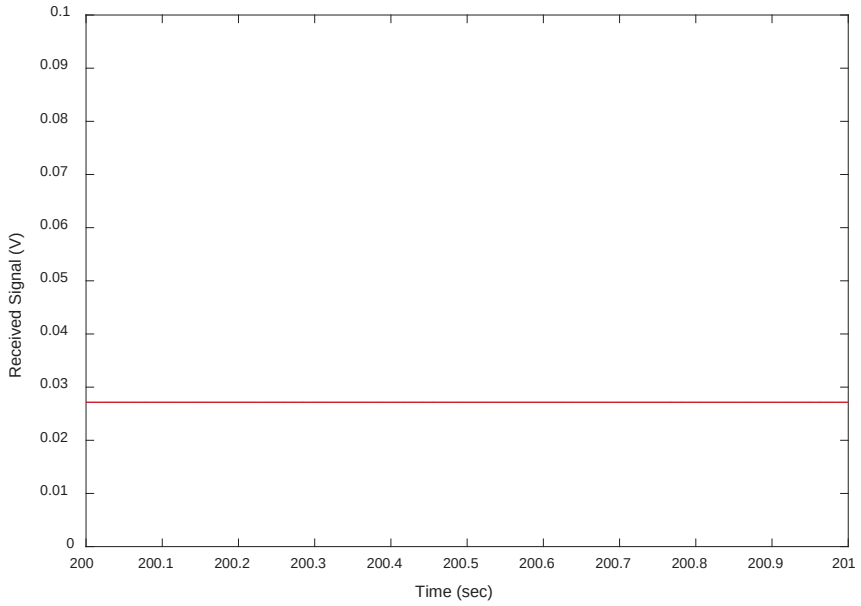
Complex Scattering Causes Rapid Signal Variations



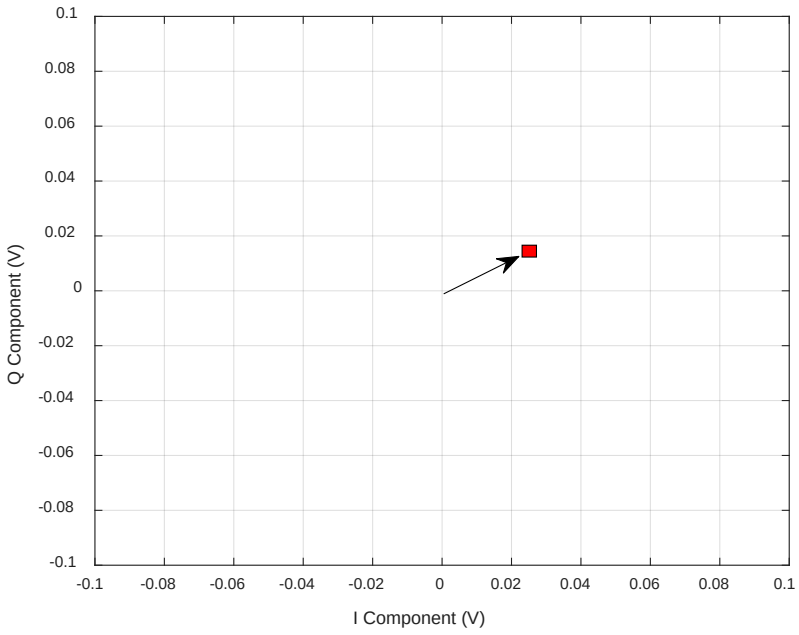
CW Signal Envelope and I-Q

- Single-tone sinusoidal CW signal at 3500 MHz, no channel variations, 1s record

Envelope



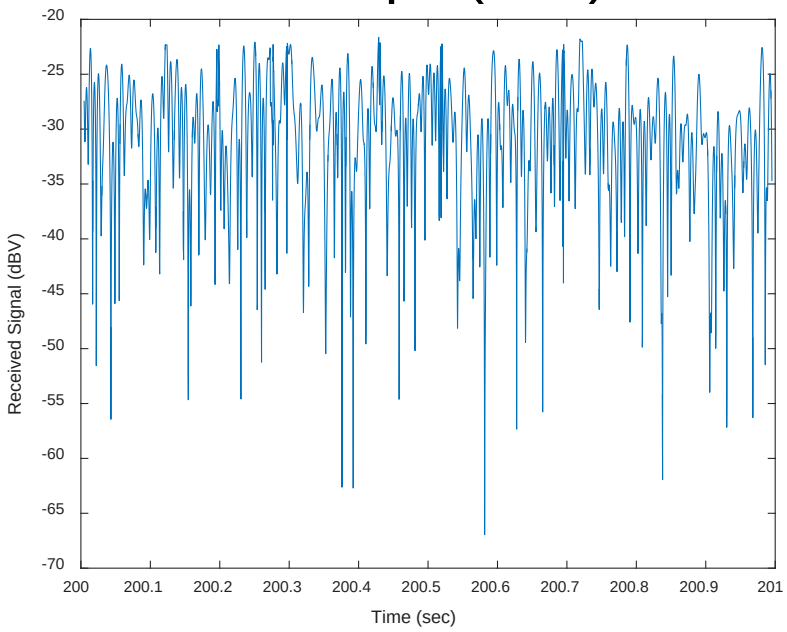
I-Q Components



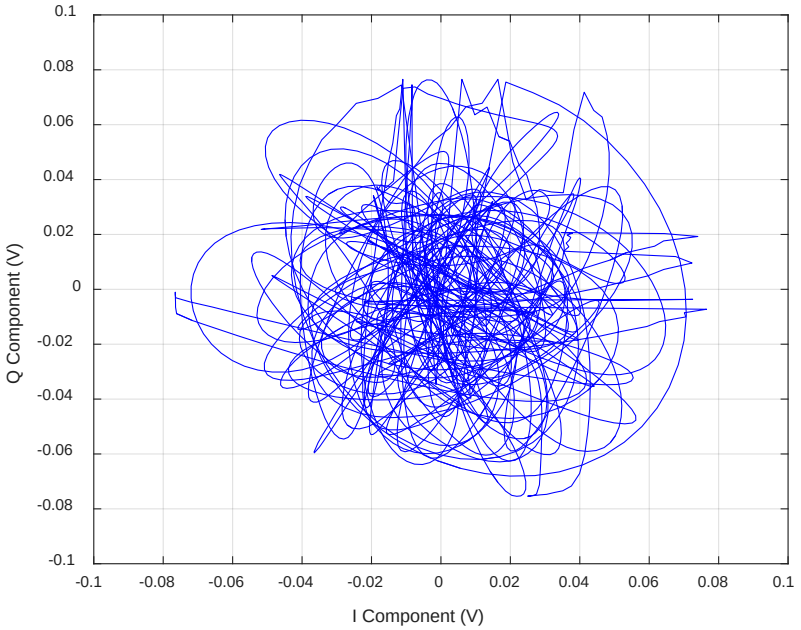
Result of motion

- Rayleigh fading at 20 mph

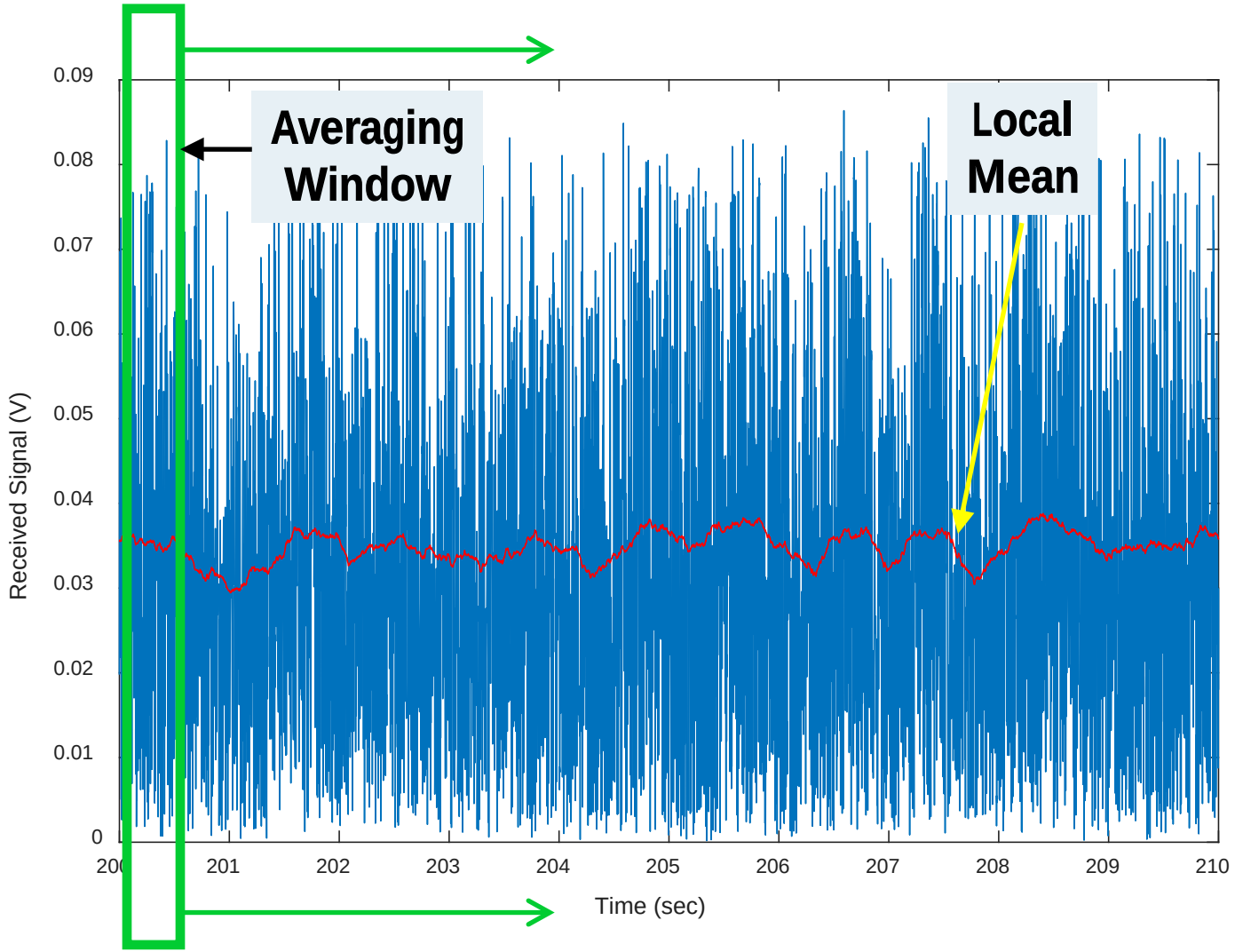
Envelope (dBV)



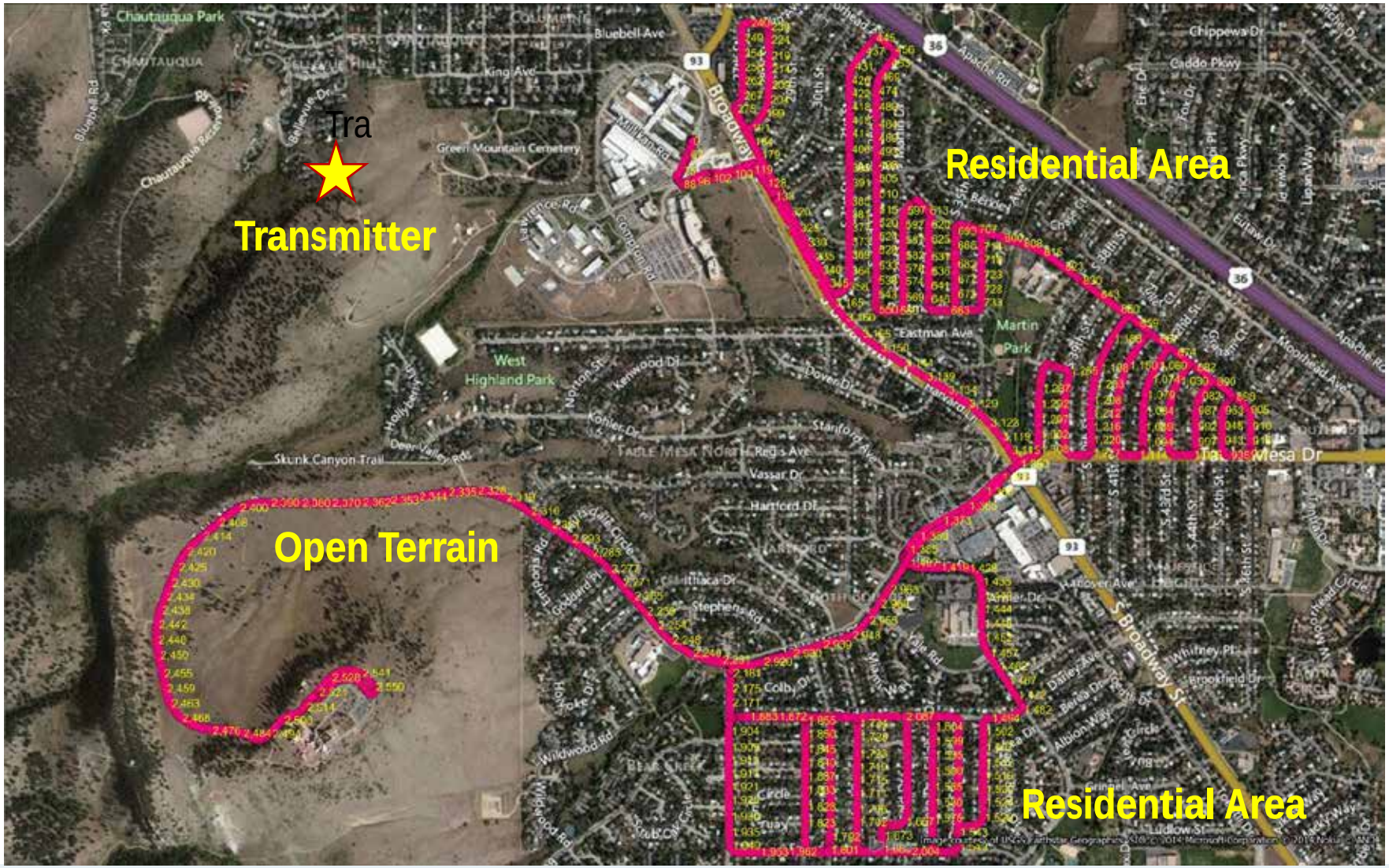
I-Q Components



Windowed Average 0.5s=52l , 3,500 MHz



Let's Look at Some Field Data



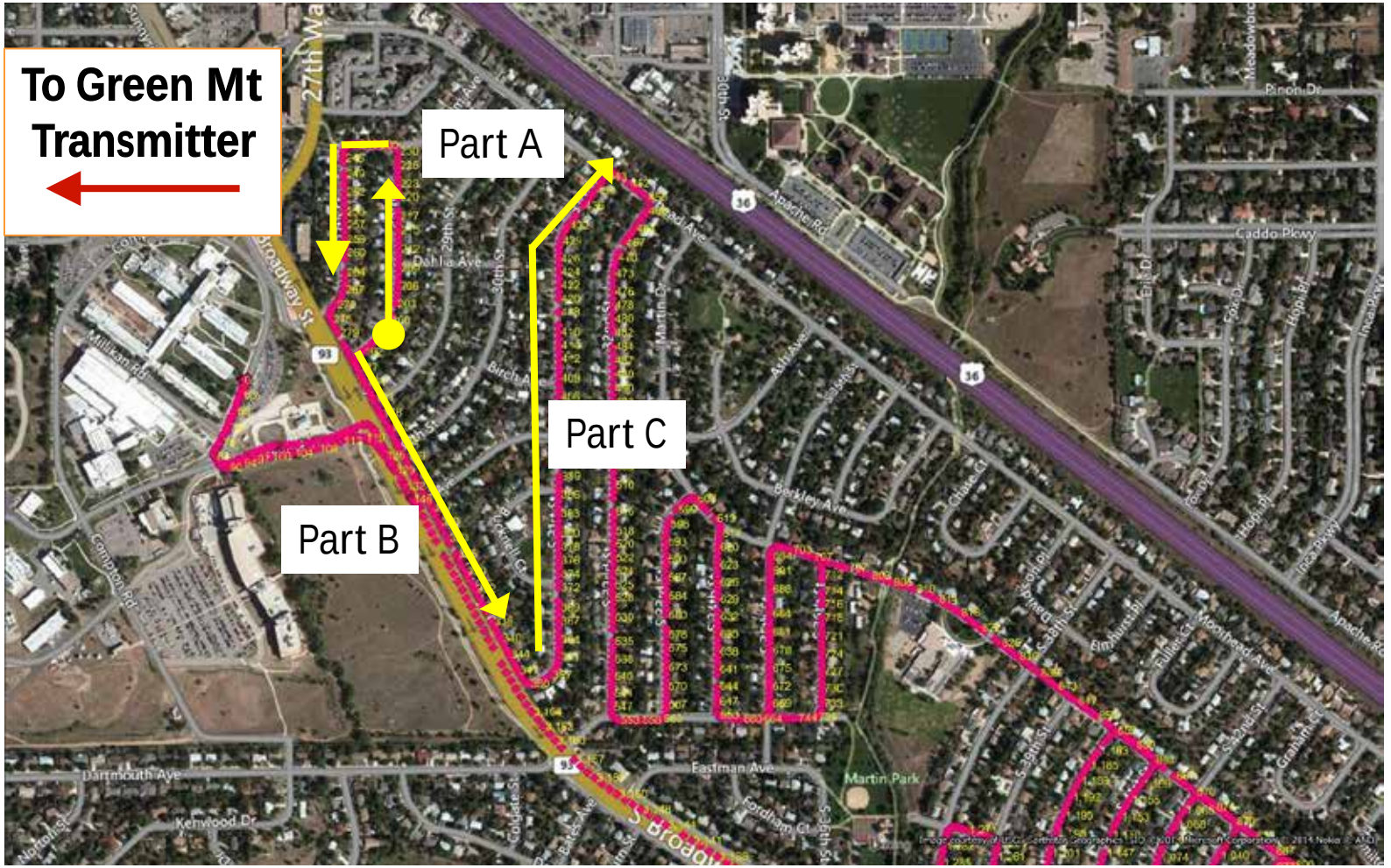
Boulder Drive Tests

(a) Define

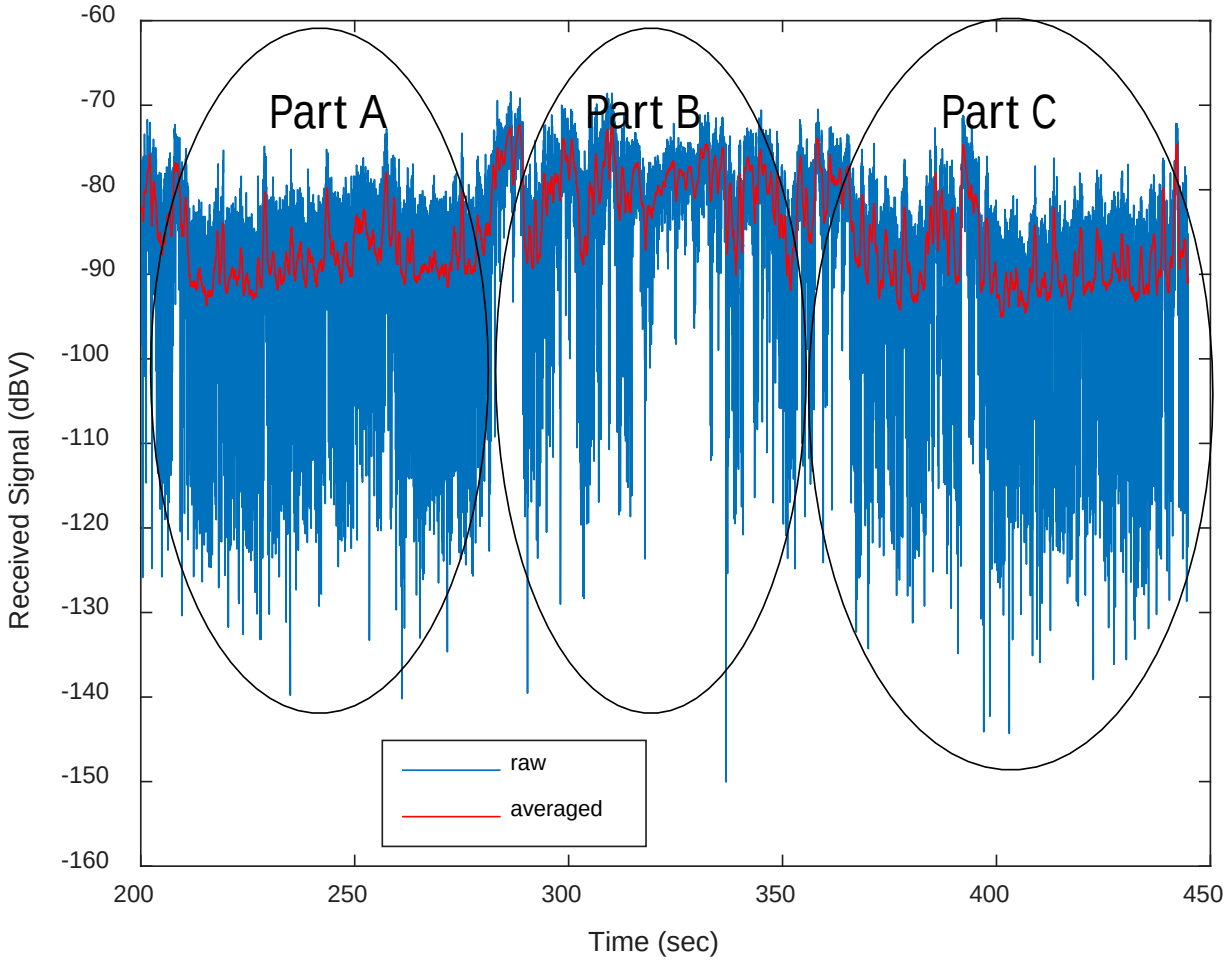
(b) TBD

(c) TBD

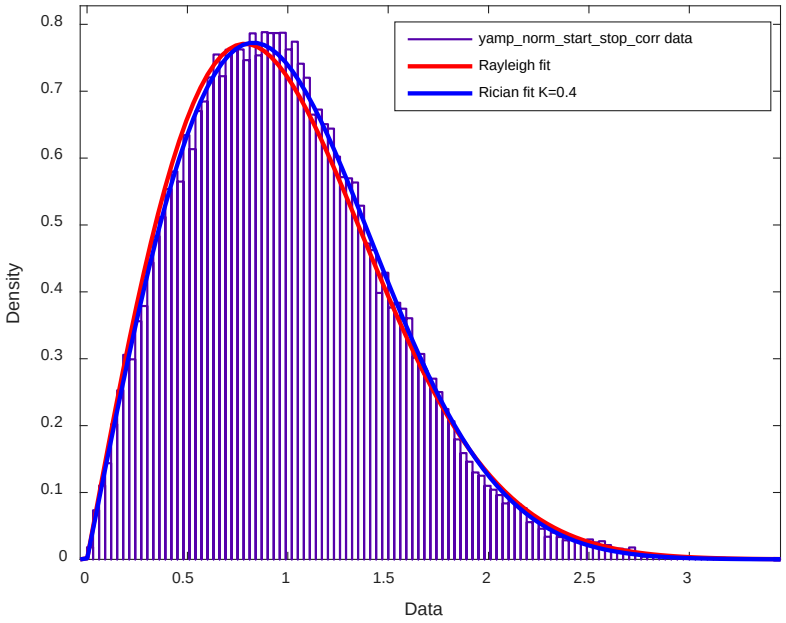
Residential Area in Boulder, CO

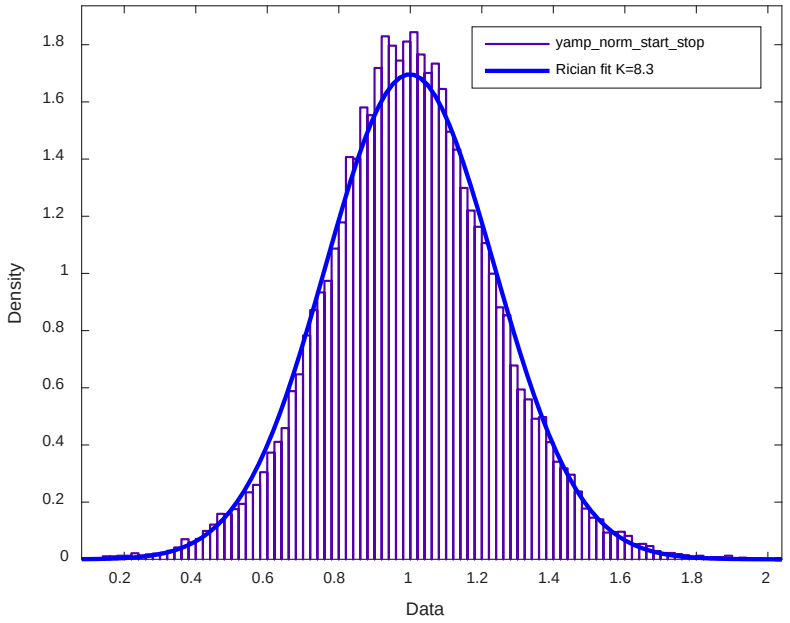


Raw Received Signal



Examine the Fast-Fading envelope distributions for the NLOS and LOS intervals of the time series

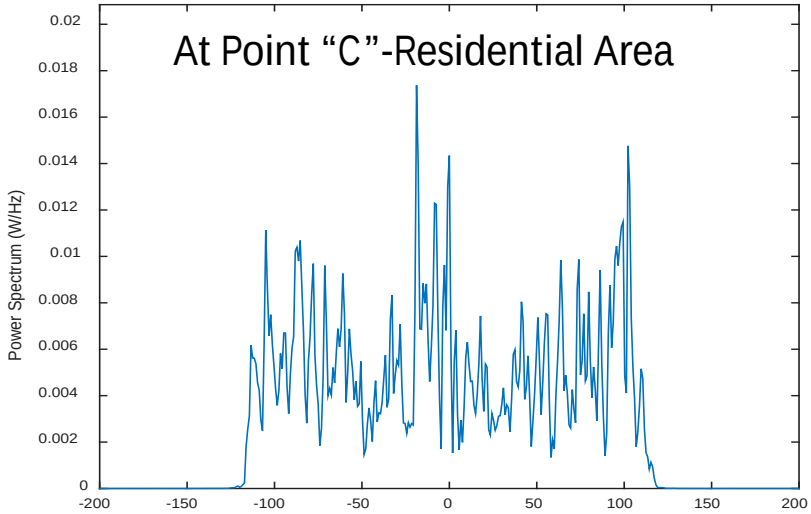


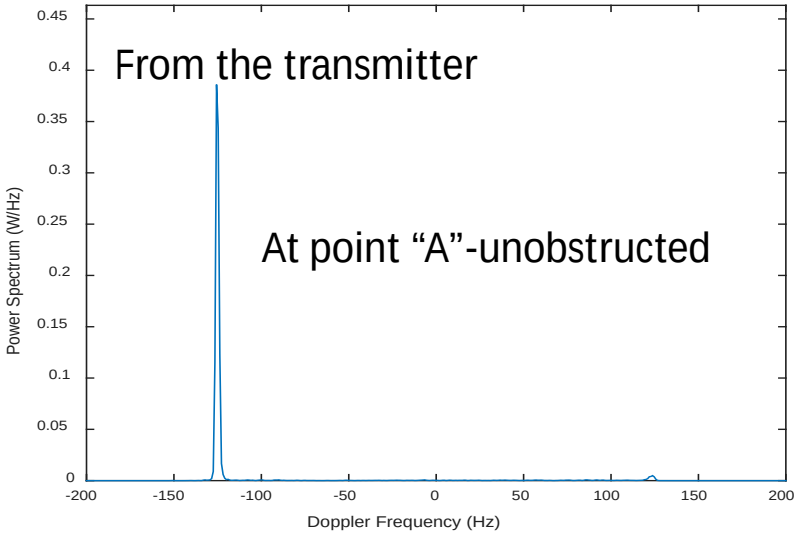


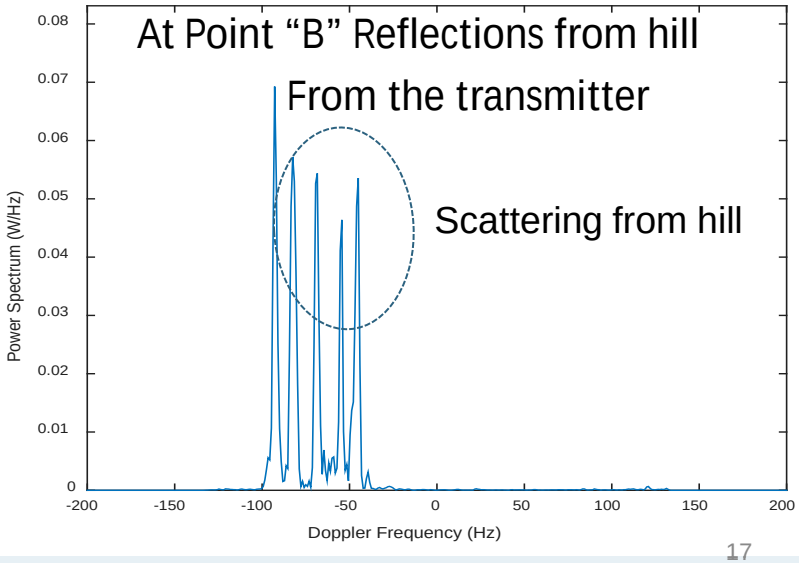
225-245 sec
K-Factor = 0.4
Weak LOS component!

318-332 sec
K-Factor = 8.3
Strong LOS Component!

Power Spectra on a Drive Test







Conclusions

- We have developed a powerful and robust propagation measurement tool
- Goal: develop best measurement practices
- Thanks!