Field Research Vehicles

The University of Notre Dame owns and operates two field research vehicles acquired on a grant from the Office of Naval Research that are used for wireless signal research. These vehicles are equipped with interior dedicated desk space and computers for four people, a shared data network among the computers, a large screen monitor, equipment racks, a 42' telescoping mast, interior/exterior antenna patch panel, solar and wind power generators, rooftop antenna mounting locations, a 12 KW gas generator, stabilizer jacks, HAM equipment for local communications, and other features to enable long term field experimentation.

Mechanical Systems

- Ford F550 chassis with dual rear wheels and spare tire
- Stabilizer jacks
- Front Bumper Winch System
- Retractable awning
- RF I/O connection arrays on roof and side of vehicle bay
- Mounting rail for antennas on top of roof
- Wind generator mast can double as a secondary fixed mast system
- Winch to lift equipment to rooftop

Mast

- 42 foot locking telescoping mast (compressor system used to raise mast)
- Connectivity from vehicle to mast
    - 36 fibers (24 multi-mode, 12 single mode) with optical I/O panel above equipment rack in vehicle bay
    - 2 RF cables
    - CAT6A Ethernet
    - Various Power / Discrete signal
- Electronic pan / tilt control for masthead (controller in the vehicle bay)
- Light on mast

Power

- Operating modes
    - Battery / Solar / Wind
        - 24V / 12V Batteries
        - 2kW Inverter provides 120VAC from 24VDC
        - 4 Solar panels (up to 1kW)
        - Wind generator (up to 600W)
    - 12 kW gas-powered generator
    - 220VAC shore power
- Control / Monitoring
    - Electrical panel with switches controlling vehicle power usage
    - Voltage level displays
    - AC / DC current consumption
    - Battery capacity remaining (%)
    - 12V, 24V, 120VAC outlets throughout vehicle

Field Research Vehicles

Audio / Visual Systems

- Large screen TV / monitor
  - Mirror display of any workstation / server
  - TV antenna for broadcast TV reception
- Two internal and two external speakers

Computers / Networking

- 4 Windows workstations
- 1 Linux server with 4 SSD (RAID)
- Internal Gigabit LAN
- Mobile internet (planned)

Additional

- Bathroom
- Refrigerator (planned)
- Microwave
- Sink with instant hot water
- Bed
- A/C & Heater

Equipment

- Camera (Ethernet controlled from vehicle bay) to show antenna pointing direction
- GPS receiver for 10MHz reference and pulse-per-second (PPS) timing
- Vehicle-to-vehicle two way radio
- Two broadband antennas (0.4-6.0 GHz)
- Narrowband antennas (0.4, 0.9, 2.4, 5.8 GHz)
- Power amplifiers (0.9, 2.4 GHz)
- CP-Cases Equipment rack systems for rack-mounted equipment and associated tie-down tracks to stabilize the cases (two cases per vehicle)
- RF-to-fiber interface (1 km fiber)
- Wireless systems (see below)

Field Research Vehicles

Wireless research capability

2 x 4 Coherent Signal Dispersion Analyzer

- 0.1 – 6.0 GHz operating range
- 160 MHz instantaneous bandwidth
- Four channel coherent receive (continuous calibration)
- Two channel coherent transmit (arbitrary waveform)
- Transmitter / receiver equipment mounted at top of mast
    - Short RF cables (~2m) from antenna to receivers / transmitters
    - 10 Gb Ethernet connection over fiber to computers in vehicle
- Simultaneous Characterization of full scattering matrix using separable waveforms
- Software: control / display from MATLAB
- Displays: spectral, time, polarization, other user content
- Continuous stream to file capability
    - 40 minutes at 100 MS/s to SSD array
    - 45 seconds at 200 MS/s to RAM-based file

2 x 2 Radar

- Operating range: 0.05-6.00 GHz
- 20 MHz instantaneous bandwidth (expansion to 160 MHz is anticipated)
- Two transmit / two receive system permits full polarization control / analysis
- Design based on inexpensive Software Defined Radio (SDR) products

4 x 4 Channel sounding

- Operating range: 0.0-3.0 GHz
- Instantaneous bandwidth: 80 MHz
- 4 x 4 baseband channel emulator (Keysight N5106A PXB)
- Four RF vector signal generators (Keysight N5182A)
- Four channel digital oscilloscope (Keysight DSO9404A) including use of segmented capture mode
- RF-over-fiber link for transmitter / receiver synchronization and RF phase compensation
- Signal Generator for RF Carrier
- Distributed 10 MHz reference
- Ethernet control via Matlab scripts
- RF phase shifters

Other Collection Capability

- 4-Channel DSO with 16 GHz Instantaneous bandwidth and 10 MSa buffer per channel (for short-duration wideband collection)
- 4-channel digital scope with 4 GHz instantaneous bandwidth at 1 GSa buffer per channel