Connected Vehicle DSRC Certification Test System
Agenda

1) System Architecture Diagram
2) System Components
   I. Mx-Suite
   II. NI WLAN Measurement Suite
   III. DSRC Modem
   IV. GPS Simulator
3) Mx-Suite Demonstration
4) Questions
System Architecture

Legend:
- Ethernet
- 5.9 GHz
- Satellite RF
- USB
System Architecture

**NATIONAL INSTRUMENTS PXI CHASSIS**

- PC
- VECTOR SIGNAL TRANSCEIVER
- ATTENUATOR
- SWITCH

**UDP Control Interface**

- Instrument Under Test (IUT)
- GPS SIM
- DSRC TRANSCEIVER

**MX SUITE**

[Diagram showing the system architecture]
System Components
Mx-Suite

- Embedded software test environment
- Danlaw’s Mx-Suite is a software for verification and validation (V&V) that runs on a Windows PC
- Used to test simulation models, software code (developer written or auto-generated) and vehicle electronics
- Includes powerful behavior diagrams, test cases are specified in terms of inputs, expected outputs, and tolerances
- Extensible via C# code snippets
Mx-Suite Embedded Software Test Environment

- One Test tool for **automatic validation during full development lifecycle** with test case portability across various phases
  - Model-in-the-Loop (MIL)
  - Software-in-the-Loop (SIL)
  - Processor-in-the-Loop (PIL)
  - Hardware-in-the-Loop (HIL)

- Supports Continuous Integration

- Integrates with ALM tools

- **Seamless** support for development within AUTOSAR and ISO-26262

- Graphical Test Environment with **easy and intuitive** GUI for quick implementation of test cases

- Supports test coverage with RapiCover integration

- Connectivity to a myriad of HW and SW used for automotive embedded testing
Mx-DSRC Protocol Testing

Testing for Compliance

DSRC Message Communication Layer Protocols

- Physical (IEEE 802.11)
- Link (IEEE 1609.4)
- Transport (IEEE 1609.3 WSMP & WSA)
- Security (IEEE 1609.2), uses Security Innovation Aerolink library
- Encoding (ISO ASN.1 UPER, OER and COER)
- Process Information (SAE J2735, BSM)
System Components
NI WLAN Measurement System

• Runs on Windows7, Modular PXI Chassis

• Support for 802.11(p)

• Support for common measurements such as EVM, spectrum mask, carrier leakage, and frequency offset

• Can generate 802.11 DSRC RF frames, also can Analyze received 802.11 DSRC frames

• Programming API in LabVIEW, LabWindows™/CVI, C/C++, and .NET
Mx-DSRC RF Quality Testing

RF Quality Testing using NI based WLAN test system

- Data Rate
- Adjacent / non-adjacent channel rejection
- Transmit Spectral Mask
- Center Frequency Tolerance
- Symbol Clock Frequency Tolerance
- Constellation Error
- Spectral Flatness
- Transmit center Frequency Leakage
- Transmit Power
- Receiver Input Sensitivity
Demonstration Time