Embracing the Connected Car with NI's Platform Based Approach

Ashish Naik
Automotive Business Development Manager
Diverging Automotive Test Challenges

- TPMS
- Radar
- XM, Sirius
- AM/FM/RDS, IBOC, DAB
- Garage Opener, Security
- Broadcast TV
- Keyless Entry, Remote Control
- Bluetooth, WiFi
- 802.11p, V2V
- GPS, Galileo, Glonass

Smart Washing Machine
- 100k Lines

Commercial Aircraft
- 6.5 Mil Lines

Luxury Automobile
- 10 Mil Lines

Challenges – Cost of Test
- Embedded Software Quality
- Passenger and Vehicle Safety
- Information and Entertainment
- Technology Convergence
Vehicles

Battery Management System
Brake Control Module
Telematics Control Unit
Speed Control Unit
Door Control Unit
Powertrain Control Module
Speed Control Unit
Electric Power Steering

802.11p, V2V
GPS, Galileo, Glonass
WiFi, Bluetooth
GSM/UMTS/LTE
AM/FM/RDS, IBOC, DAB
RADAR
DVB
TPMS
Keyless Entry, Remote Control
Sirius, XM
Approaches for Test and Measurement

Closed Approach
“Vendor knows best”
- Fixed-functionality box instruments
- Extend with vendor accessible customization
- Fixed software applications
- Monolithic instrument design
- Resulting closed vendor ecosystem

Platform Approach
“Customer knows best”
- Out of box measurement ready
- Extend with user accessible customization
- Productive, approachable software tools
- Modular instrument design with consistent APIs
- Resulting open partner, user, and IP ecosystem

ni.com
## Automotive Applications

### ADAS
- Short Distance Radar
- Long Distance Radar
- Camera
- LIDAR
- Ultrasonic sensors

### Communications
- 802.11p
- DSRC
- E-Call
- WiFi
- Future 5G Technologies

### Infotainment
- GPS, GLONASS
- AM, FM, RDS
- DVB, DAB
- Bluetooth
- NFC
- WPC

### PowerTrain
- Engine
- Transmission
- HEV/EV
- ...

### Chassis and Body
- Doors
- Light
- Steering
- ...

---

**Embedded Software**
Platform-Based Approach for Automated Test

NI TestStand

LabWindows/CVI

LabVIEW

NI VeriStand

Other Software
Measurement Studio, Visual Studio.NET™, …

Operating System and Drivers

PXI Chassis and Controllers
Switching
Reconfigurable Instruments
Modular Instruments
Bus Interfaces (GPIB/LXI/Serial)
Smarter Systems Require a Platform-Based Approach

“We improved test speeds by more than 200X compared to traditional rack-and-stack instruments while significantly improving test coverage.”

“The added flexibility and ease of use for test development has led to our teams using the same system in other phases outside of production…this helps reduce our time to market and increase our product quality.”

“The new system reduces cost per unit approximately 4X and offers customization capability to communication interfaces that have added test requirements.”
Trends in Advanced Driver Assistance Systems (ADAS)

• Focus on Safety
  - Object identification/distinction
  - Rear-end Crash Avoidance
  - CAR2X (Car 2 Car and Car 2 Infrastructure Communication)
  - 360 degrees vehicle surveillance

• Adoption of 77-81GHz
  - More reliable and more accurate
  - Greater capability to distinguish objects with high bandwidth
  - Smaller footprint (multi mode, multi range)
Virtual Object Simulation: Technique used to simulate different objects in the real-world to validate performance of a communication systems.

Channel Emulation/Sounding: Technique to build a model of the channel using hardware and software to mimic real-world behavior.
Real-World Behavior Can be Achieved at Different Levels

Realism

Complexity

Simulation

Emulation

Field Testing
Types of Real-World Scenarios

Mission Critical
- Adult Pedestrians
- Minor Pedestrians
- Animals
- Group/Individual

Static
- Buildings
- Road signs, infrastructure
- Traffic Regulators
- Trees
- Environmental effects

Mobile
- Doppler Effects
- Acceleration, Jerk
- Multi-car scenarios
- Various speed

ni.com
ADAS Test Cases – example Automotive RADAR
A closed loop system:
- Scene data passed to tester
- Image data taken from scene
- HIL system generates radar object data
- Synchronized camera and radar data sent to ECU
- ECU send command data to vehicle model
- Vehicle response captured in the scene generator
Automotive Radar Testing at 77 GHz

“The combination of the industry’s widest bandwidth and low latency software-designed instrument allowed us to discover our automotive radar sensors as never before, and even allowed us to identify problems very early in the design phase that were previously impossible to catch. With the VST and FPGA programmable by LabVIEW, we were able to rapidly emulate a wide range of diverse scenarios, thus influencing safety and reliability aspects in autonomous driving.”

-- Neils Koch, Component Owner

Radar Systems, Audi AG. “
Key Features

- RF Measurements for sensor performance verification
  - Signal Analysis: EIRP, noise, beam width, frequency
  - Chirp Analysis: linearity, overshoot, recording, tagging

- RADAR Target simulator
  - Single and multiple targets
  - Fixed and variable distance
  - Multiple object scenarios (distance, velocity, size and angle of arrival)

Example Audi: [https://www.youtube.com/watch?v=AJSpEq6U4Aw](https://www.youtube.com/watch?v=AJSpEq6U4Aw)
System Level Test for Sensor Fusion

• Sensors for next generation ADAS Functionality:
  • Radar
  • LIDAR
  • Vision
  • Ultrasonic sensors
  • V2X

• NI product platform offers high level of integration for multiple sensor technologies to reduce system cost.

https://theitmuseum.com/2015/09/04/car-to-car-communication-jack-s/

http://electronicdesign.com/iot/internet-things-stay