A Software Defined Instrumentation Approach to

Automotive Infotainment Testing
Agenda

- Company Overview
- Automotive Infotainment System - Overview
- Test Requirements
- Software Defined Instrumentation
- Software Defined Approach vs Traditional Test Solution
- Infotainment Test Solution
- Case Studies
- Awards and Recognitions
- Testimonials
Company Overview

- **Company Incorporation**: August 2011

- **Location**: Bangalore

- **Team**
  - 10+ Engineers
  - 100+ years of industry experience.
  - Employee owned and Self funded Organization.

- **Specializes in providing system integration and turnkey solutions in**
  - RF Test and Measurement, Wireless Communication, Signal processing
  - DVB Test Solutions

- **National Instruments Alliance Partner**
Automotive Infotainment System
Automotive Infotainment System

- Due to the advancement in technology and consumer electronics, automotive infotainment system is growing rapidly.

- More and more new technologies and devices are integrated into the system.

- Today’s in-car infotainment systems provides information and services useful to drivers for safety, analog radio, digital video and audio broadcast services, GPS and communication systems such as WLAN, Bluetooth and DVD Video.

- Infotainment system is one of the key-focus area in the automotive design process. One of the major challenge in the automotive design is to test all the modules of the infotainment system and its interfaces.

- MaxEye Technologies provides the complete Vehicle Infotainment Test Solution using National Instruments Software Defined PXI hardware Platform, LabVIEW and MaxEye Digital Video and Audio test and measurement software.
Automotive Infotainment System Block Diagram

- BT/WLAN
- Analog and Digital Radio Tuner
- GPS/GLONASS
- HDMI/USB
- CAN Transceiver
- LIN Transceiver
- Ethernet Transceiver
- DSP or Microcontroller (Main Controller)
- Audio Codec
- DAC
- ADC
- Line In
- Line Out/Headphone
- Speakers
- Human Machine Interface / LCD Display
- Rear Seat Monitor
- Analog/Digital Camera
- Audio Amplifier
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<th>Module</th>
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<td>Delay between audio and video and lag between multiple screen</td>
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Software Defined Instrumentation
Software Defined Instrumentation

- There are many challenges in meeting the test requirements of an automotive infotainment system because of wireless standards evolution, support for multiple wireless standards in in-car infotainment system.

- Flexible and Software configurable instruments are essential for reducing the cost of the test system, testing multiple wireless modules functionalities with single hardware, time to market and test automation.

- Designing the test system or automating the infotainment test system with multiple hardware modules is very complicated and time consuming.

- Software defined instruments helps user to use same hardware module to test different wireless standards by configuring the functionality of the hardware through software.

- Reduced Time to Market, Complexity of the Test System and Scalable for future evolution in the wireless standards.
## Software Defined vs Traditional Instrumentation

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<td>Same Hardware to test multiple wireless standards</td>
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<td>Vendor defined Measurements</td>
<td>User Defined measurements and analysis in addition to standard specific measurements</td>
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![Diagram showing the comparison between traditional and software-defined approaches](image-url)
The NI RF Platform

Customizable in Software

- Customer Test Management Software
  - GSM/WCDMA
  - Bluetooth
  - RDS
  - GPS

Communications Toolkits
  - Spectrum and Modulation VIs

Long-Term Stability

- Driver Software
- PXI/PXIe Instrumentation

LabVIEW

TestStand

MAXEYE TECHNOLOGIES
Infotainment Test Solution
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Digital Video/Audio Test and Measurement Solutions

- Powered by National Instruments LabVIEW Software, NI RFSG (NI PXI 5673/5673E, NI PXI 5672), NI VST (NI PXIe-5644R/5645R) and NI RFSA (NI PXI 5663/5663E, NI PXI5661) Hardware.

- Enables testing of multiple digital video and audio standards testing using one NI PXI RF hardware. **Ideal solution for testing multimode Digital Video/Audio SDR.**

- Real time streaming of the generated waveform using NI RFSG streaming mode. (Typical DTG testing requires 5 minutes of video to be played in real-time)

- Generation of Multiple DVB carriers using single NI RFSG and supports various Transmitter measurements.

- The following are the digital video broadcasting toolkits currently being supported by MaxEye Technologies.
  - DVB-S
  - DVB-S2
  - DVB-T/H
  - DVB-T2
  - ISDB-T/Tb
  - CMMB
  - DTMB
  - ATSC and ATSC-M/H
  - DAB/DAB Plus/T-DMB
  - DRM/DRM Plus
MaxEye DVB-T/H/T2 Measurement Suite

**Generation**
- Bandwidth:
  - DVB-T2: 1.7Mhz, 5Mhz, 6Mhz, 7Mhz, 8Mhz and 10Mhz
  - DVB-T: 5.6, 7 and 8 MHz
- Modulation: QPSK, 16QAM, 64QAM and 256 QAM
- Coding:
  - DVB-T: ReedSolomon + Convolutional Code
  - DVB-T2: BCH + LDPC Encoder
- DVB-T2 Version 1.3.1 (Multiple PLP with MISO mode)
- MPEG2 TS Remultiplexing to adopt to the standard bitrates
- OFDM Windowing
- Real time Streaming of the Generated Waveform
- Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.

**Analysis**
- RMS and Peak EVM
- MER and Peak MER
- Average Power and Peak Power
- Frequency Offset, Clock Offset, IQ Offset
- Gain Imbalance and Quadrature Skew
- EVM Trace, Constellation Diagram, Decoded Bits, Spectral Flatness
- L1 Signal Decoding
- Magnitude Error and Phase Error Trace
- Spectral Measurements (Channel Power, ACLR, Spectral Emission Mask, Spectral Mask Margin)
MaxEye DAB/DAB Plus/T-DMB Measurement Suite

• **Generation**
  - Transmission Mode: I, II, III and IV
  - Modulation: QPSK
  - Coding:
    - ReedSolomon + Convolutional Code
    - Time and Frequency Interleaving
  - Guard Interval: All formats supported
  - All Standard Configurations Supported
  - MPEG2 TS Remultiplexing to adopt to the standard bitrates
  - OFDM Windowing
  - Real time Streaming of the Generated Waveform
  - Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.

• **Analysis**
  - RMS and Peak EVM
  - MER and Peak MER
  - Average Power and Peak Power
  - Frequency Offset, Clock Offset, IQ Offset
  - Gain Imbalance and Quadrature Skew
  - EVM Trace, Constellation Diagram
  - Magnitude Error and Phase Error Trace
  - Spectral Flatness
  - Spectral Measurements (Channel Power, ACLR, Spectral Emission Mask, Spectral Mask Margin)
MaxEye ISDB-T/Tb Signal Generation Toolkit

- **Generation**
  - Hierarchical layers: A, B, and C
  - Versions: Japan and Brazil Format
  - BW: 6 MHz/7 MHz/8 MHz (all bandwidths)
  - Mapping: DQPSK/QPSK/QAM16/QAM64
  - Support for all guard intervals
  - Support for full and partial reception mode service
  - MPEG-2 TS Remultiplexing
  - FEC: RS + Convolutional code (all code rates)
  - Payload configuration:
    - MPEG TS files
    - PN sequence
    - Test pattern
    - User-defined bits
  - LabVIEW API VIs, programming examples
  - All Standard Configurations Supported
  - Real time Streaming of the Generated Waveform
  - Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.
MaxEye DRM/DRM Plus Signal Generation Toolkit

- **Generation**
  - Robustness Mode: A, B, C, D and E
  - BW: 4.5, 5.9, 10, 8 and 20 KHz
  - Mapping: QPSK, 16QAM and 64QAM
    - Standard Mapping
    - Symmetrical Hierarchical Modulation
  - Number of Services: 4
  - Multilevel Coding: 1, 2 and 3
  - FEC: Convolutional code with all protection levels
  - Channels:
    - Main Service Channel
    - Service Description Channel
    - Fast Access Channel
  - Payload configuration:
    - Multiplexed Audio File
    - PN sequence
    - Test pattern
    - User-defined bits
  - LabVIEW API VIs, programming examples
  - Real time Streaming of the Generated Waveform
  - Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.
MaxEye ATSC/ATSC-MH Signal Generation Toolkit

- **Generation**
  - Support for main and multiplexed M/H service
  - Support for multiple M/H parades
  - 8 VSB modulation
  - FEC: SCCC $\frac{1}{4}$ and $\frac{1}{2}$
    - RS (235, 187),
    - RS (223, 187),
    - RS (211, 187)
  - Pulse shaping: RRC Filter with Roll off of 0.1152
  - M/H Signalling Channel: TPC
  - Payload configuration:
    - TS File
    - Multiplexed TS file
    - PN sequence
    - Test pattern
    - User-defined bits
  - LabVIEW API VIs, programming examples
  - Real time Streaming of the Generated Waveform
  - Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.
Test Methodology - Conceptual Flow Diagram

1. Design/Develop Test Code
2. Measure/Reporting
3. Transfer data
   PXI Bus
4. Generate Signal
5. Analyze Signal
6. Validation
7. Design Test Software
   (LabVIEW/TestStand)
8. Initiate Execution
   (PXI Controller)
9. Generate Test Signal
   (LabVIEW Toolkits)
10. DUT
11. Analyzer Test Signal
    (LabVIEW Toolkits)
12. Measure/Reporting
    Go to Next Test Sequence
13. Go to Next Test Sequence
Case Studies
Case Study – 1 (Confidential)

• Project Highlights
  
  • Complete automated test bench creation using NI LabVIEW and TestStand for Automotive Infotainment System.
  • Infotainment test system includes the following key features:
    • AM/FM/HD Radio
    • DAB/DAB+/DRM/DRM+
    • DVB-T/T2, ISDB-T/Tb, DTMB, CMMB, T-DMB and ATSC
    • SDARS
    • Navigation
    • Blu-Ray Player, DVD Player
    • Bluetooth
    • Camera etc.,

  • MaxEye Technologies and NI Proposed a PXI based test solution for testing the complete infotainment system using single PXI hardware

• Customer : Leading CAR manufacturer in Europe

• Hardware : NI PXI Chassis, Controller, VSG etc.,
• Software : MaxEye Digital Audio and Video Toolkits, LabVIEW, TestStand, NI Bluetooth Measurement suite, NI GPS etc.,
Case Study –2(Confidential)

- Project Highlights
  - DAB/DAB+/T-DMB Infotainment Receiver Testing
  - AM/FM-RDS Testing
  - Test Requirements: DAB Receiver performance, Channel Search, Tuning, Audio and Video Quality, subtitles, EPG etc.,
  - MaxEye Technologies and NI Proposed a PXI based test solution with MaxEye DAB/DAB+/T-DMB Signal generation toolkit. Complete tests can be automated using LabVIEW

- Customers: American audio and infotainment equipment company, Automotive infotainment device manufacturer in Europe etc.,

- Hardware: NI PXI Chassis, Controller, VSG

- Software: LabVIEW, MaxEye DAB/DAB+/T-DMB Signal generation toolkit, AM/FM-RDS measurement suite
Case Study –3(Confidential)

- Project Highlights
  - DVB-T Broadcast device testing and SFN Network monitoring, planning and performance optimization
  - SFN Measurements: Channel Impulse Response (Path Delay and Path Power)
  - Test Requirements: SFN network monitoring, maintenance and optimization
  - MaxEye Technologies and NI Proposed a USRP based low cost solution with MaxEye DVB-T Signal Analysis and SFN network monitoring solution.

- Customer: Public Digital Video Broadcasting company from Europe

- Hardware: USRP

- Software: LabVIEW, MaxEye DVB-T Signal Analysis and Network Monitoring Toolkit
MaxEye Technologies
Awards & Recognitions
Awards and Recognitions

• NI Week 2013 – LabVIEW Tools Network Awards
  – MaxEye Technologies Multi-Carrier Multi Standard DVB RF Test and Measurement product received 2013 LabVIEW Tools Network - Runner up for the test product of the year award at the NI Week 2013 Graphical System Design Conference held at Austin, Texas.

  – MaxEye Technologies is the Only Alliance Partner from India Company represented in the LabVIEW Tools Network Award.

• MaxEye DVB Products received compatible with LabVIEW Certification and available online in NI Website.

• NI Days 2013, Bangalore GSD Award Runner Up – Alliance Partner Category
Customer Testimonials (1/2)

• "We have worked with MaxEye Technologies for RF test and measurement solution in one of our business opportunities. MaxEye delivered the complete turnkey test solution, integrated with NI RF hardware, within the specified delivery time. We were happy with their professional approach to the development and testing of the system. We recommend their skills in the RF, Signal Processing and Communication domain and appreciate their commitment towards the deliverables and support after the delivery"

... Jayaram Pillai, Managing Director - IndRA (India, Russia and Arabia) at National Instruments, Bangalore (India)

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• "MaxEye delivers on its commitments and provides great after sales support. In retrospect, I am very pleased with our decision to work with them"

... Sujeeth Pai, Country Sales Manager, National Instruments, Bangalore (India)
Customer Testimonials (2/2)

- Simple and easy to use GUI.
- Easy to configure and generate DVB-T signal.
- Easy to convert from .ts to .bin file, through which the memory related issues are reduced.
- Good error handling by which the error are identified very easily and fast.
- Last but not least good support from the MaxEye Technologies has enabled us in completing the project on time.

  - Leading IT Services, consulting and Business Solutions Partner in India (More details can be shared on request)
Summary

- MaxEye Technologies Provides complete automotive infotainment test solution using NI Hardware, Software and MaxEye Digital Video and Audio test and measurement solutions.

- Proven solution used by leading CAR manufactures in the world.

- Software defined and scalable solution for future wireless standard evolution.

- LabVIEW and TestStand based powerful programming environment for test automation.
Thank You

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