MAXEYE TECHNOLOGIES

A Software Defined Instrumentation Approach to

Digital TV Testing

digital

NATIONAL INSTRUMENTS™ Alliance Partner

Agenda

- Company Overview

- DTV - Overview

- DTV Test Requirements and Challenges

- Software Defined Instrumentation

- Software Defined Approach vs Traditional Test Solution

- DTV Test Solution

- Awards and Recognitions

- Testimonials

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TECHNOLOGIES**

Company Overview

- **Company Incorporation**: August 2011

- **Location**: Bangalore

- **Team**
  - 10+ Engineers
  - 100+ years of industry experience.
  - Employee owned and Self funded Organization.
  - Several IP and Patents (includes approved and pending patents)

- **Specializes in providing system integration and turnkey solutions in**
  - RF Test and Measurement, Wireless Communication, Signal processing
  - Image Processing, Machine Vision
  - VLSI and Embedded Systems,
  - Industrial Automation and Control systems Engineering.

- National Instruments Alliance Partner

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**DTV Overview**

Test Requirements

Test Challenges

DTV Overview

- Digital Television (DTV) is an advanced broadcasting technology that has transformed the television viewing experience.

- DTV enables broadcasters to offer television with better picture and sound quality, and multiple channels of programming.

- A TV set with built-in digital TV tuner to receiver over the air digital television signals.

- Several regions of the world are in different stages of adaptation and are implementing different broadcasting standards.

- Transmission of audio and video by digitally processed and multiplexed signal.

- DTV signals are broadcasted to the end user via

  - Satellite (DVB-S/S2)

  - Terrestrial (DVB-T/DVB-T2/DAB/DABPlus/T-DMB/ATSC/ATSC-MH/DTMB/CMMB/ISDB-T/Tb)

  - Cable (DVB-C/C2)

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DTV Block Diagram
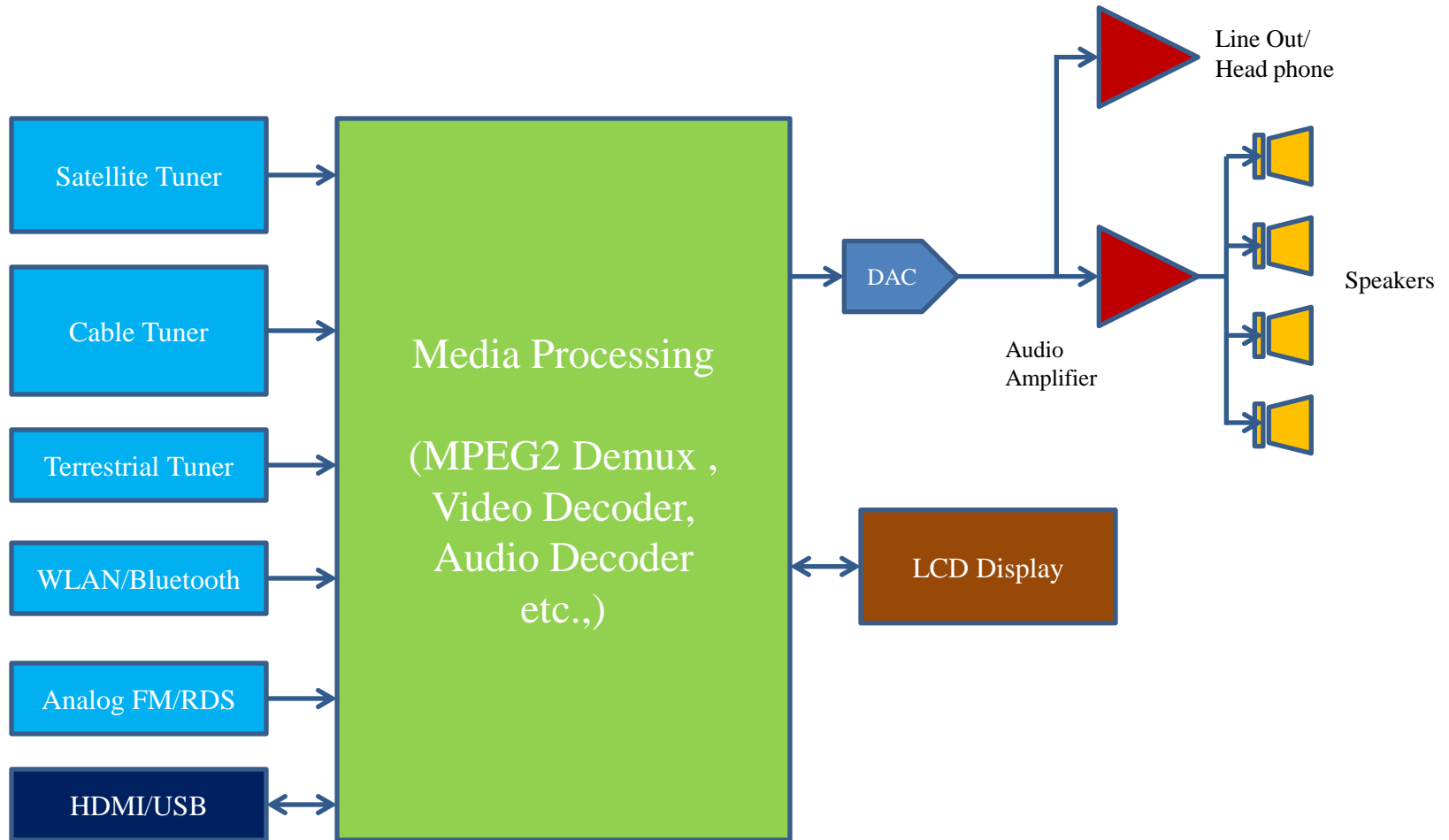
DTV Test Requirements

| Sl.no	Module	Test Requirement
1	Analog Radio FM/RDS	Signal Generation with different Standard Formats
2	Digital Video Broadcasting - Satellite (DVB-S/S2)	RF Signal Generation with different Standard Formats
3	Digital Video Broadcasting - Terrestrial (DVB-T/DVB-T2/T-DMB / DTMB /CMMB /ATSC /ATSC-M/H / ISDB-T/Tb	RF Signal Generation with different Standard Formats
4	Digital Video Broadcasting - Satellite (DVB-C/C2)	RF Signal Generation with different Standard Formats
5	Wireless Connectivity (WLAN/ Bluetooth / Zigbee)	RF Signal Generation with different Standard Formats
6	Audio Decoder	Audio Signal Generation Analog and Digital Audio Quality Tests
7	Video Decoder	Digital Video Functional and Performance Tests (Quality Analysis)

# Software Defined Instrumentation

Software Defined Instrumentation

- There are many challenges in meeting the test requirements of a 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
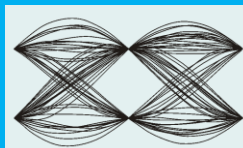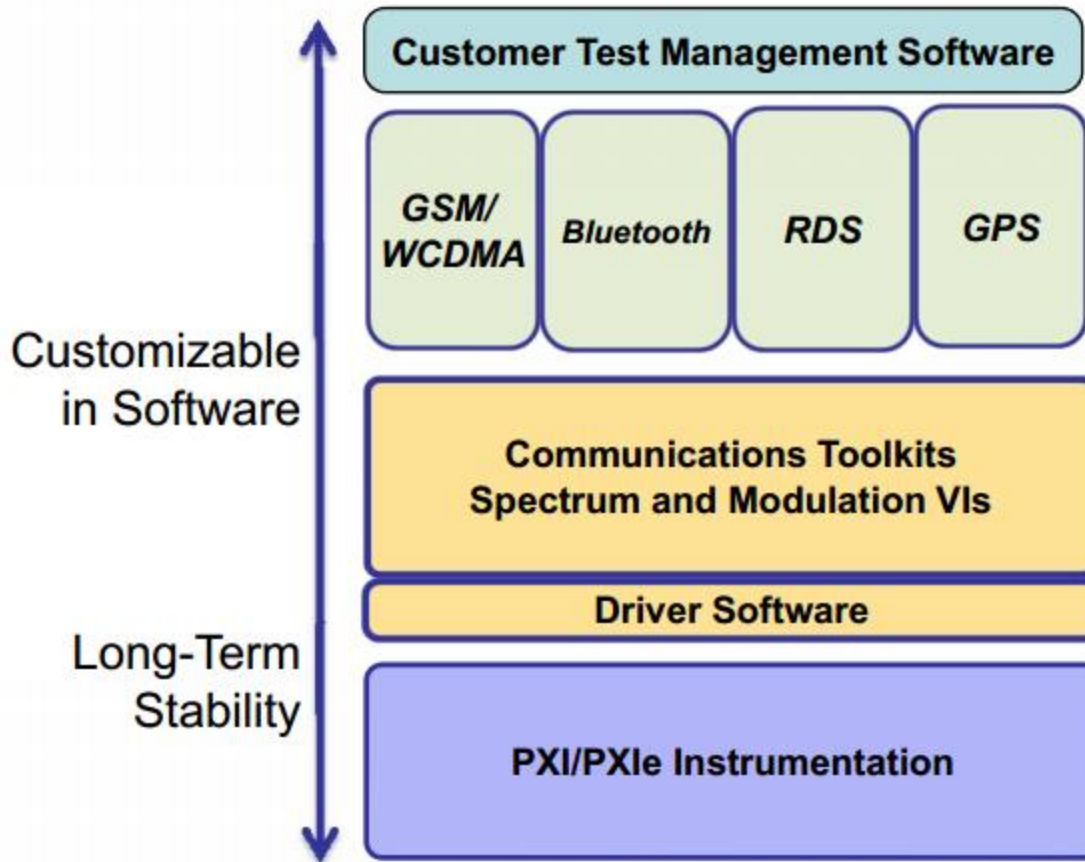

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Software Defined vs Traditional Instrumentation

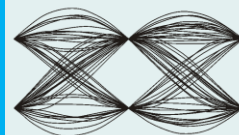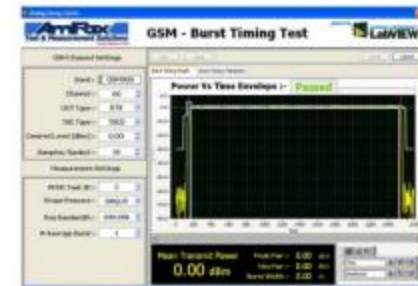| Traditional Instruments	Software Defined Instruments
Dedicated box instruments	Same Hardware to test multiple wireless standards
Vendor defined Measurements	User Defined measurements and analysis in addition to standard specific measurements
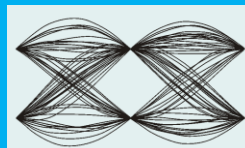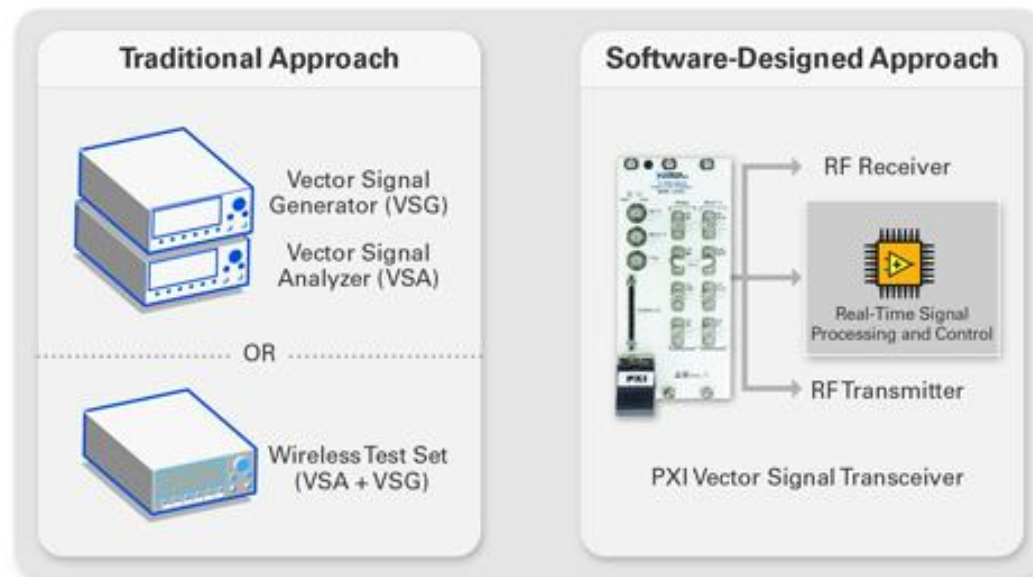
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DTV Test Solution

DTV Test Solution

Hardware

Powered by LabVIEW Toolkits

Test Requirement		Software Toolkits
Analog Radio	AM	NI Modulation Toolkit
	FM/RDS	NI FM/RDS Measurement Suite
Digital Video Broadcasting (Satellite)	DVB-S	MaxEye DVB-S Measurement Suite
	DVB-S2	MaxEye DVB-S2 Measurement Suite
Digital Video Broadcasting (Terrestrial)	DVB-T/H	MaxEye DVB-T Measurement Suite
	DVB-T2	MaxEye DVB-T2 Measurement Suite
	T-DMB	MaxEye T-DMB Measurement Suite
	ISDB-T/Tb	MaxEye ISDB-T/Tb Signal Generation
	DTMB	MaxEye DTMB Signal Generation
	ATSC/ATSC-M/H	MaxEye ATSC Signal Generation
Digital Video Broadcasting (Cable)	DVB-C	MaxEye DVB-C Measurement Suite
	DVB-C2	MaxEye DVB-C2 Measurement Suite
Navigation Test	GPS/GLONASS	NI GPS/GLONASS Signal Generation
Wireless Connectivity Test	WLAN	NI WLAN Measurement Suite
	Bluetooth	NI Bluetooth Measurement Suite
	Zigbee	MaxEye Zigbee Measurement Suite
Audio Test	Analog Audio	NI AudioMASTER for Analog Audio
	Digital Audio	NI AudioMASTER for Digital Audio
Video Test	Analog Video	NI Analog Video Analyzer
	Digital Video	NI Digital Video Analyzer

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

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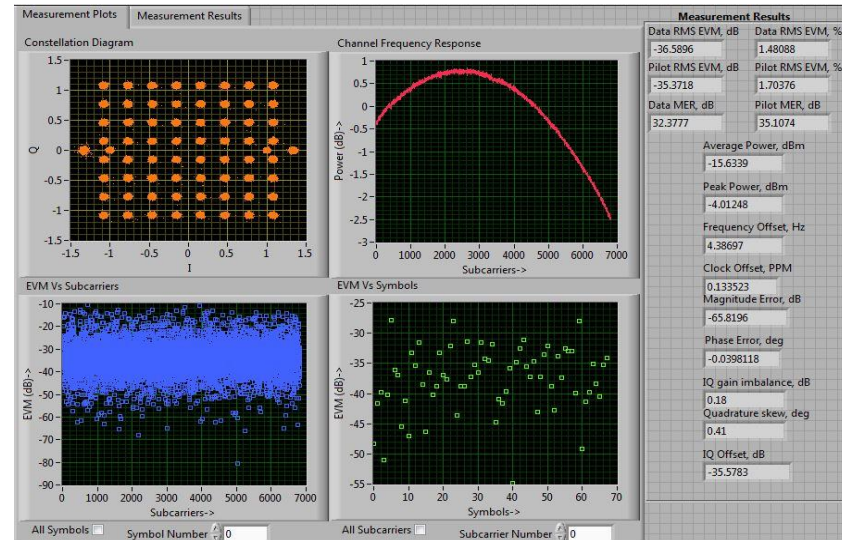
MaxEye DVB-S/S2 Measurement Suite

- **Generation**
  - Symbol Rate Upto 80MHz
  - Modulation: QPSK, 8PSK, 16APSK and 32APSK
  - Coding:
    - DVB-S   : ReedSolomon + Convolutional Code
    - DVB-S2 : BCH + LDPC Encoder
  - Pulse Shaping Filter as per standard
  - Support for Single and Multiple Streams
  - All Standard configurations are supported
  - MPEG2 TS Remultiplexing to adopt to the standard bitrates
  - 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
  - PL Header Decoding and Parameters Extraction
  - Magnitude Error and Phase Error Trace
  - Spectral Measurements (Channel Power, ACLR, Spectral Emission Mask, Spectral Mask Margin)


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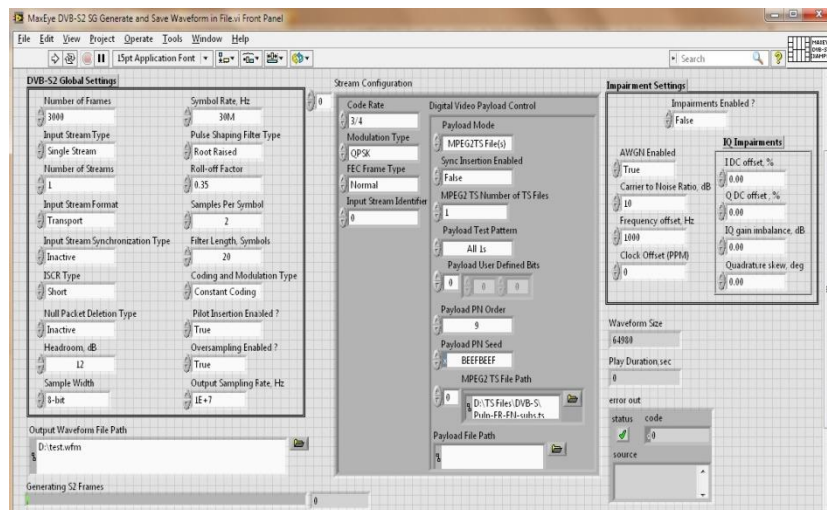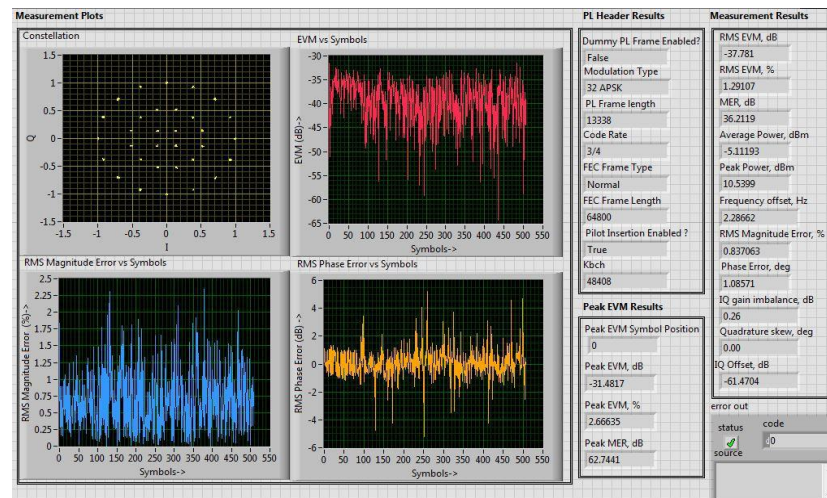
MaxEye DVB-T/H/T2 Measurement Suite

- **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)
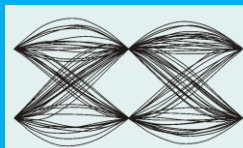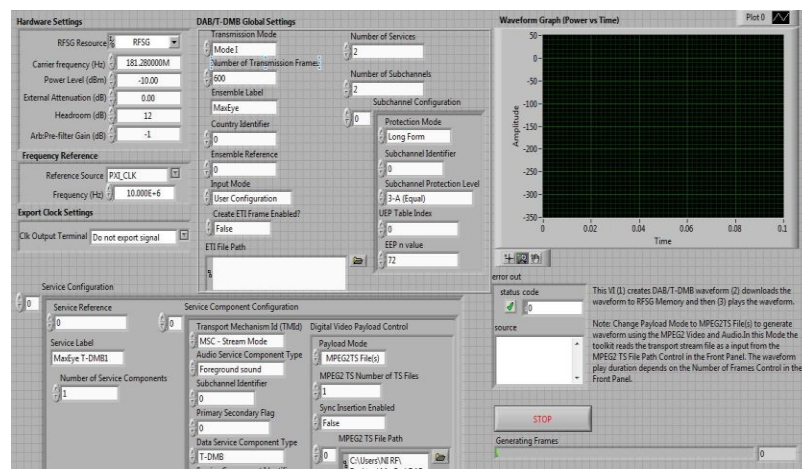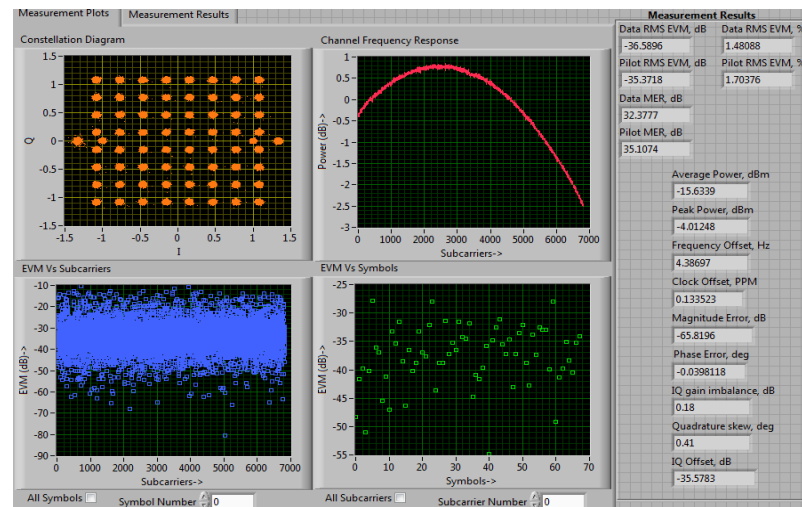

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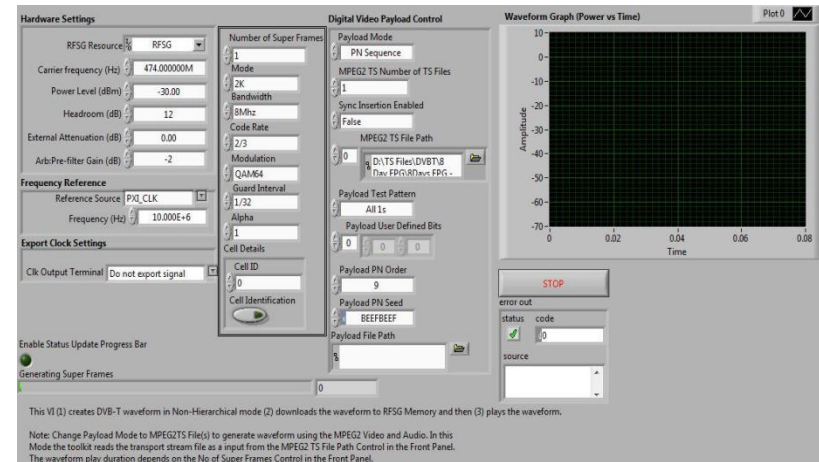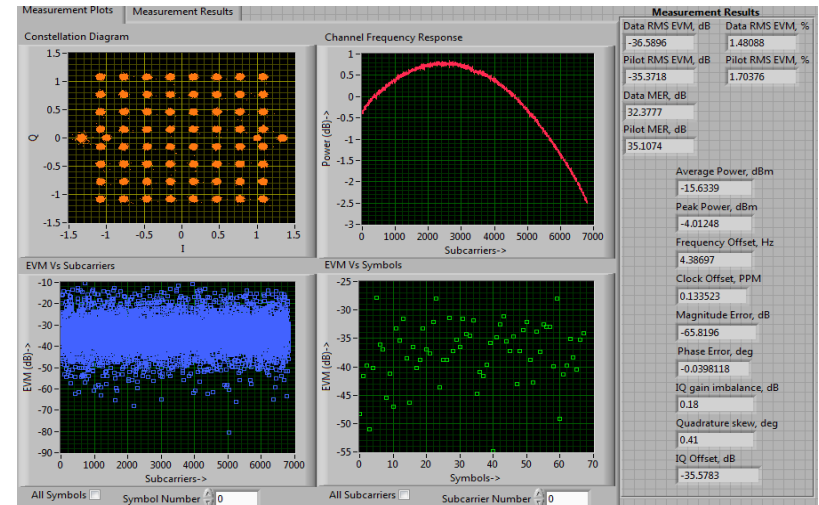
MaxEye DAB/DAB Plus/T-DMB Measurement Suite

- **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)

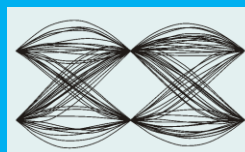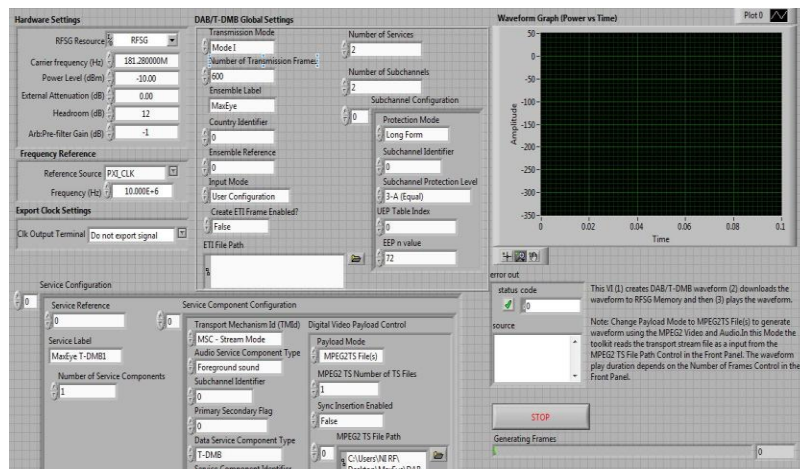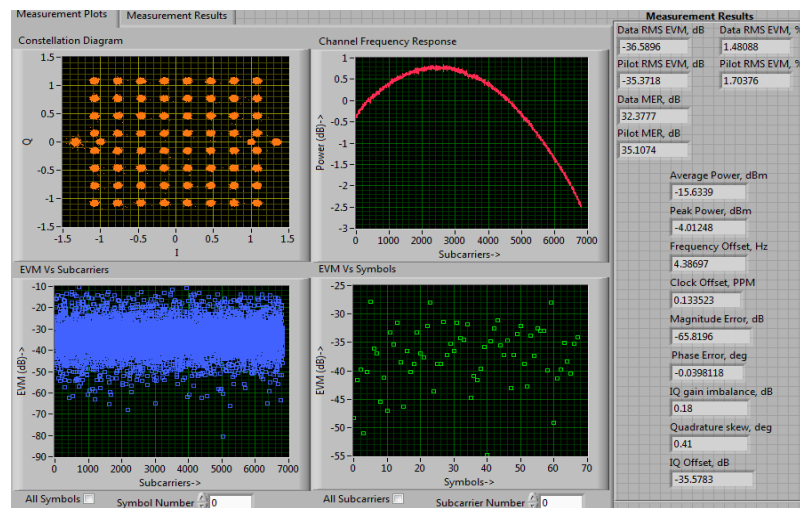**MAXEYE TECHNOLOGIES**

MaxEye DVB-C/C2 Measurement Suite*

- **Generation**
  - Symbol Rate : Upto 80MHz
  - Modulation: 16QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM
  - Coding:
    - ReedSolomon + Convolutional Interleaver
    - Differential Encoding and Mapping
  - All Standard Configurations Supported
  - MPEG2 TS Remultiplexing to adopt to the standard bitrates
  - 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 Measurements (Channel Power, ACLR, Spectral Emission Mask, Spectral Mask Margin)

Note: *DVB-C2 Under development

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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.
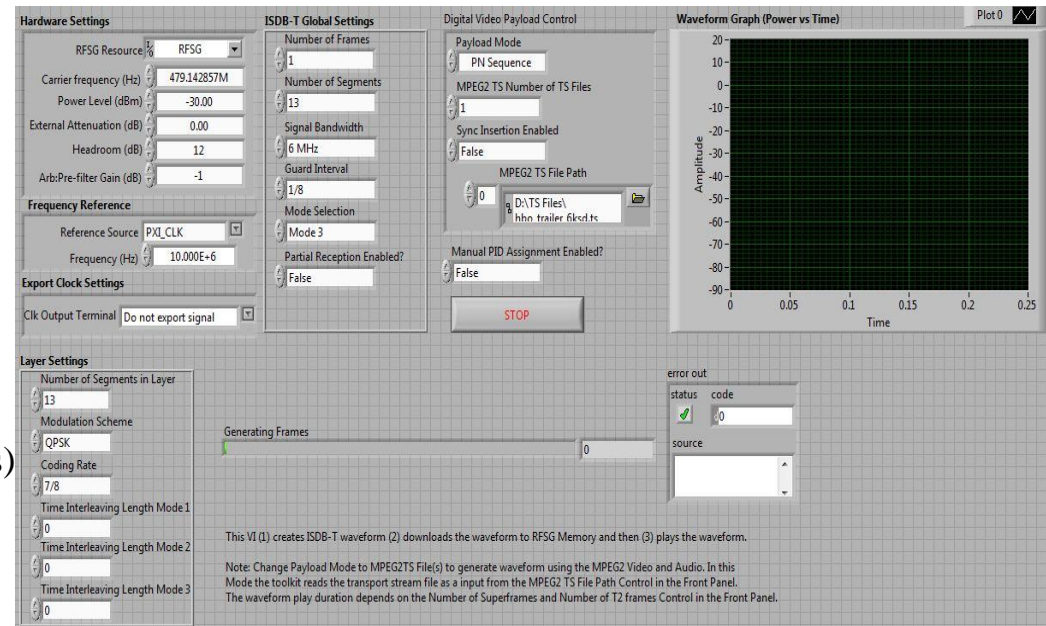
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MaxEye DRM/DRM Plus Signal Generation Toolkit

- **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
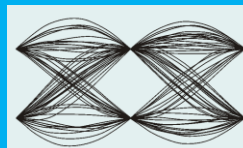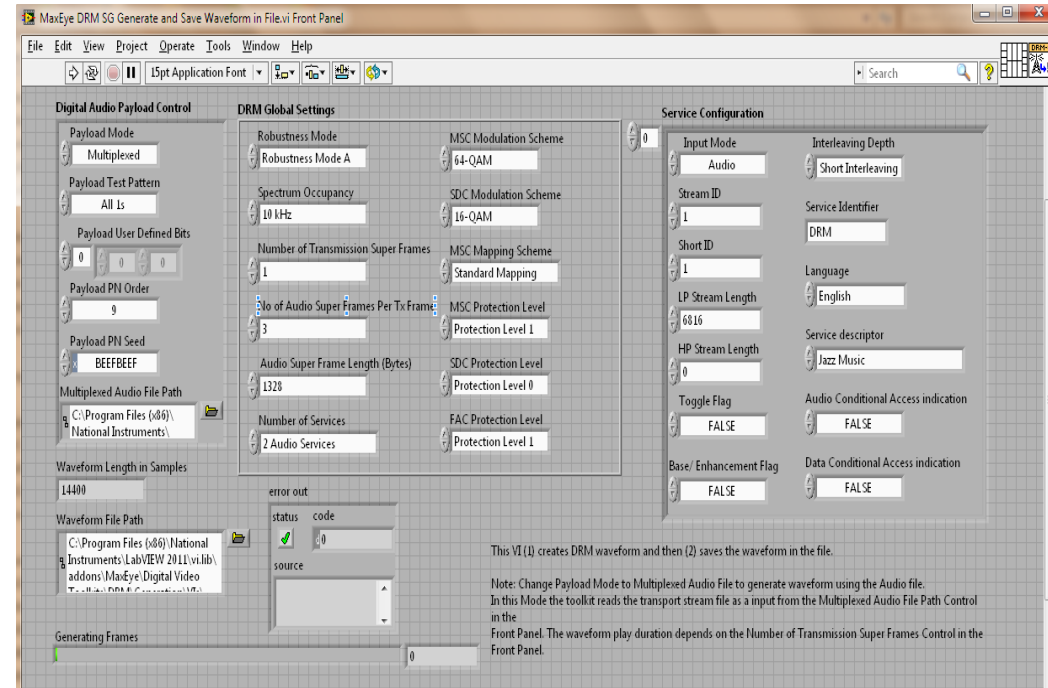 - Impairments: AWGN, Frequency and Clock Offset, IQ Offset, Gain Imbalance, Quadrature Skew.

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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 ¼ and ½
    - 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.
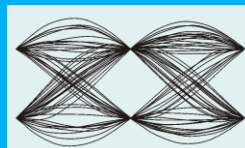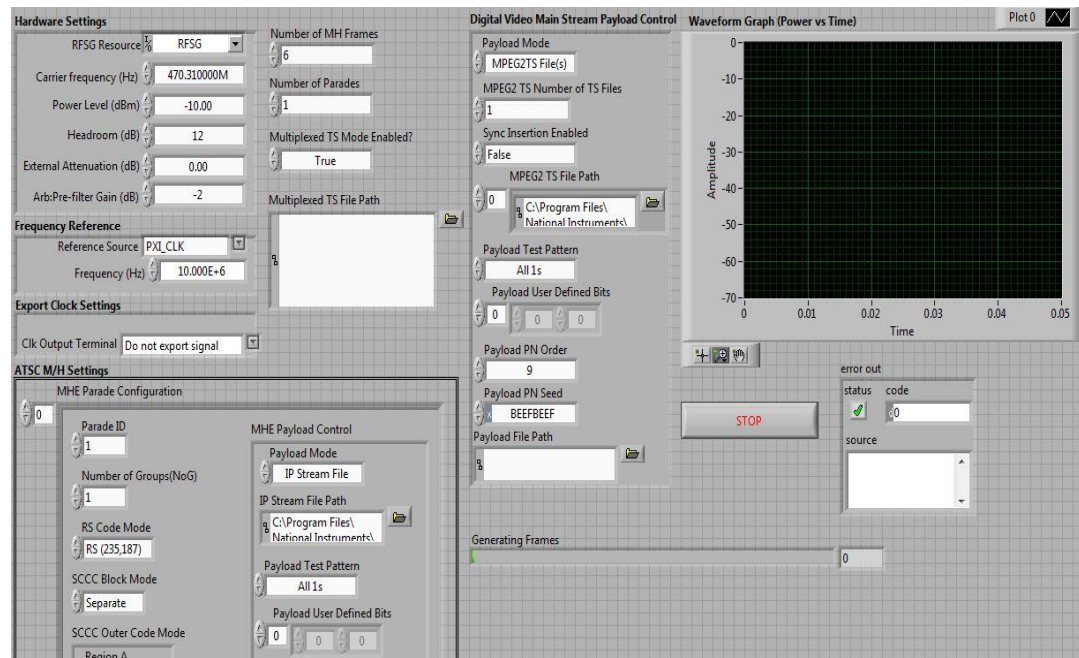
Test Methodology - Conceptual Flow Diagram

Design/Develop Test Code

Measure/Reporting

Transfer data PXI Bus

Generate Signal

Analyze Signal

Validation

DUT

| Design Test Software (LabVIEW/TestStand) |
| Initiate Execution (PXI Controller) |
| Generate Test Signal (LabVIEW Toolkits) |
| DUT |
| Analyzer Test Signal (LabVIEW Toolkits) |
| Measure/Reporting Go to Next Test Sequence |
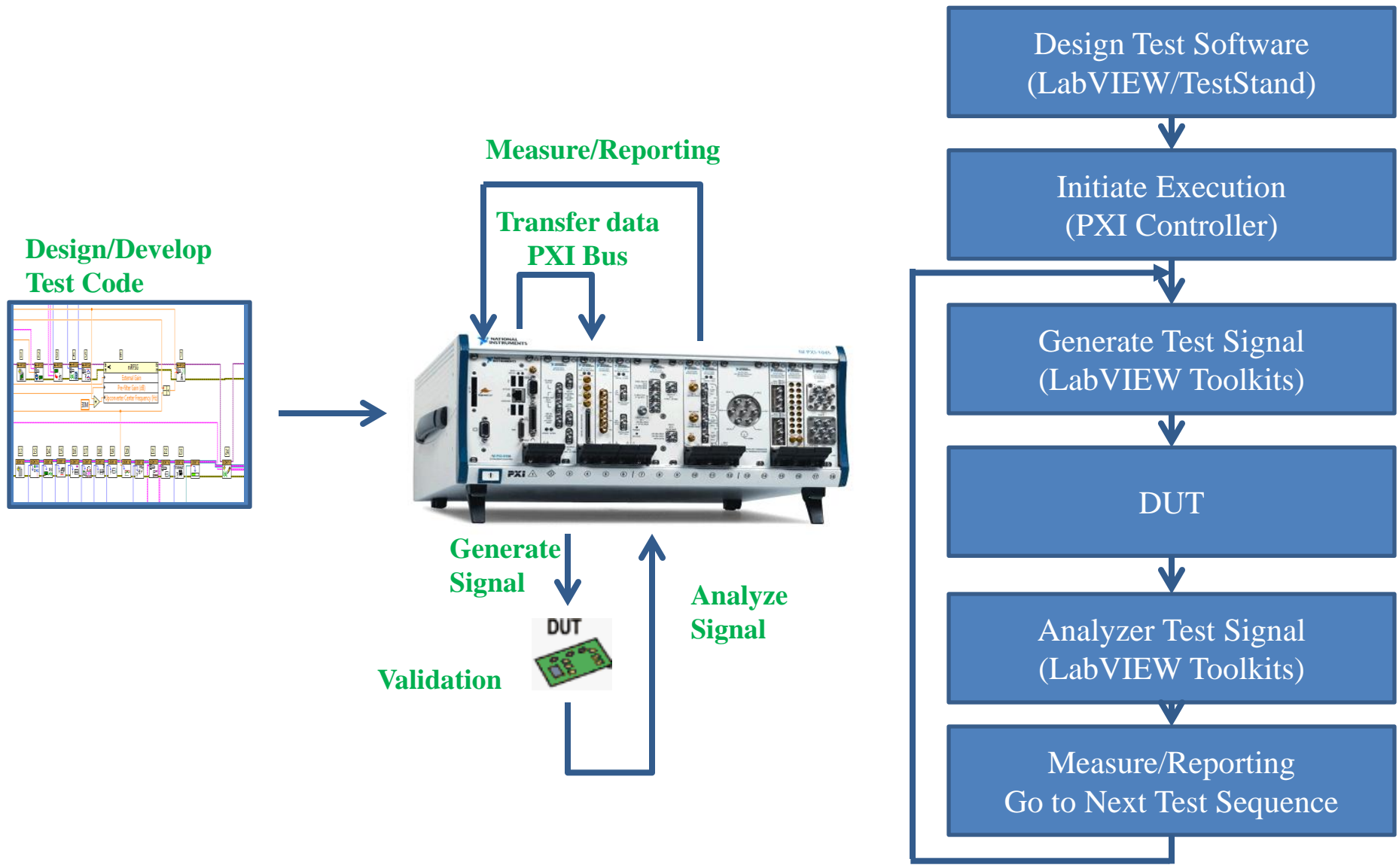
MaxEye Technologies

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.

http://search.ni.com/nisearch/app/main/p/bot/no/ap/global/lang/en/pg/1/q/maxeye/

- NI Days 2013, Bangalore GSD Award Runner Up – Alliance Partner Category

LabVIEW
TOOLS NETWORK

2013 LabVIEW Tools Network
Test Product
of the Year - Finalist
Digital Video Broadcasting Toolkits
MaxEye Technologies

LabVIEW
TOOLS NETWORK

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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)

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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)

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Summary

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

- Proven solution used by leading manufactures in the world.

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

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

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Thank You

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