‘Direct RF to Bits’ Testing

Introducing the Digital Signal Transceiver (DST)

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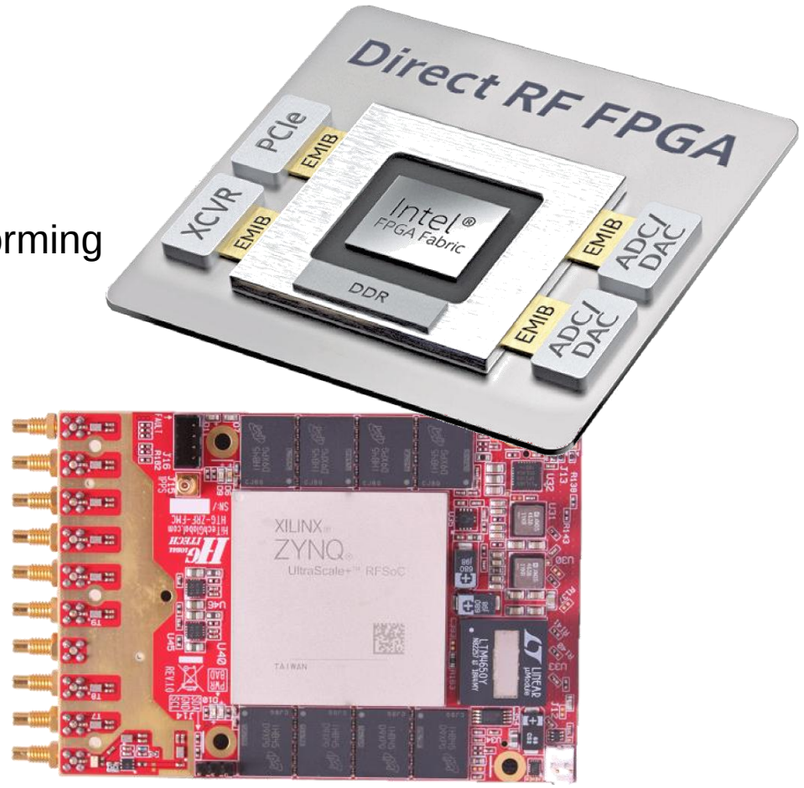
Define ‘RF to Bits’ Devices

RFSoC Enabled Devices Capable of Direct Sampling Wide-Band RF Signals

- Commonly sampling above 6GSa/sec to rates >64GSa/sec
- Significantly decreases component count to perform common operations like beamforming
- Digitally up/down converts signals and performs basic processing (gain, phase, eq)
- Requires digital bandwidths up to and beyond 100Gb/sec
- Flexible onboard FPGA with MGT streams to secondary processor
- Breaks common RF paradigm for using a VNA to test everything



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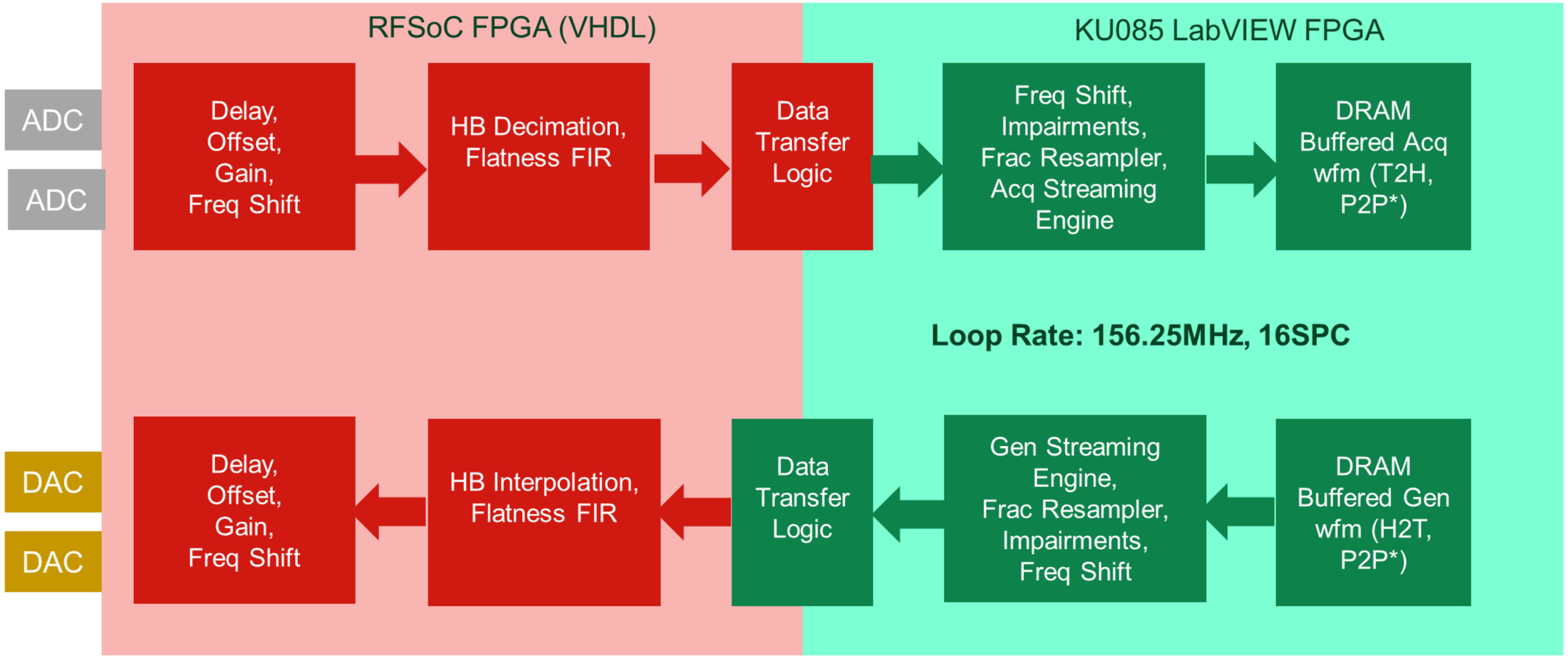
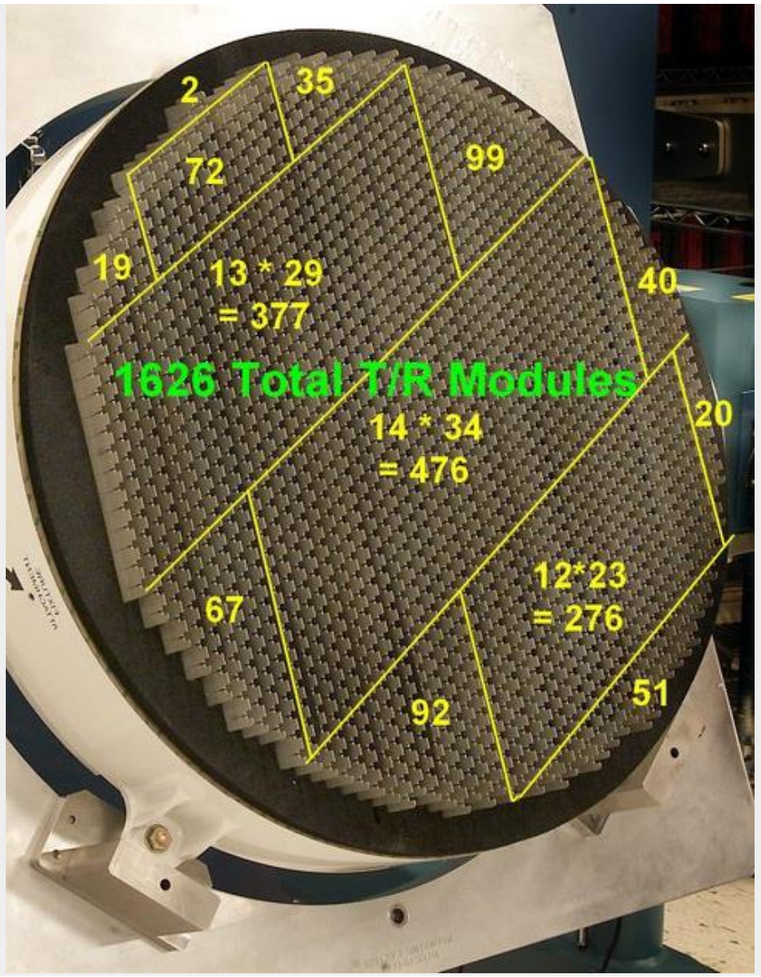
PXIe-5842 VST – 5GSa/s ‘RFSoC’ Device

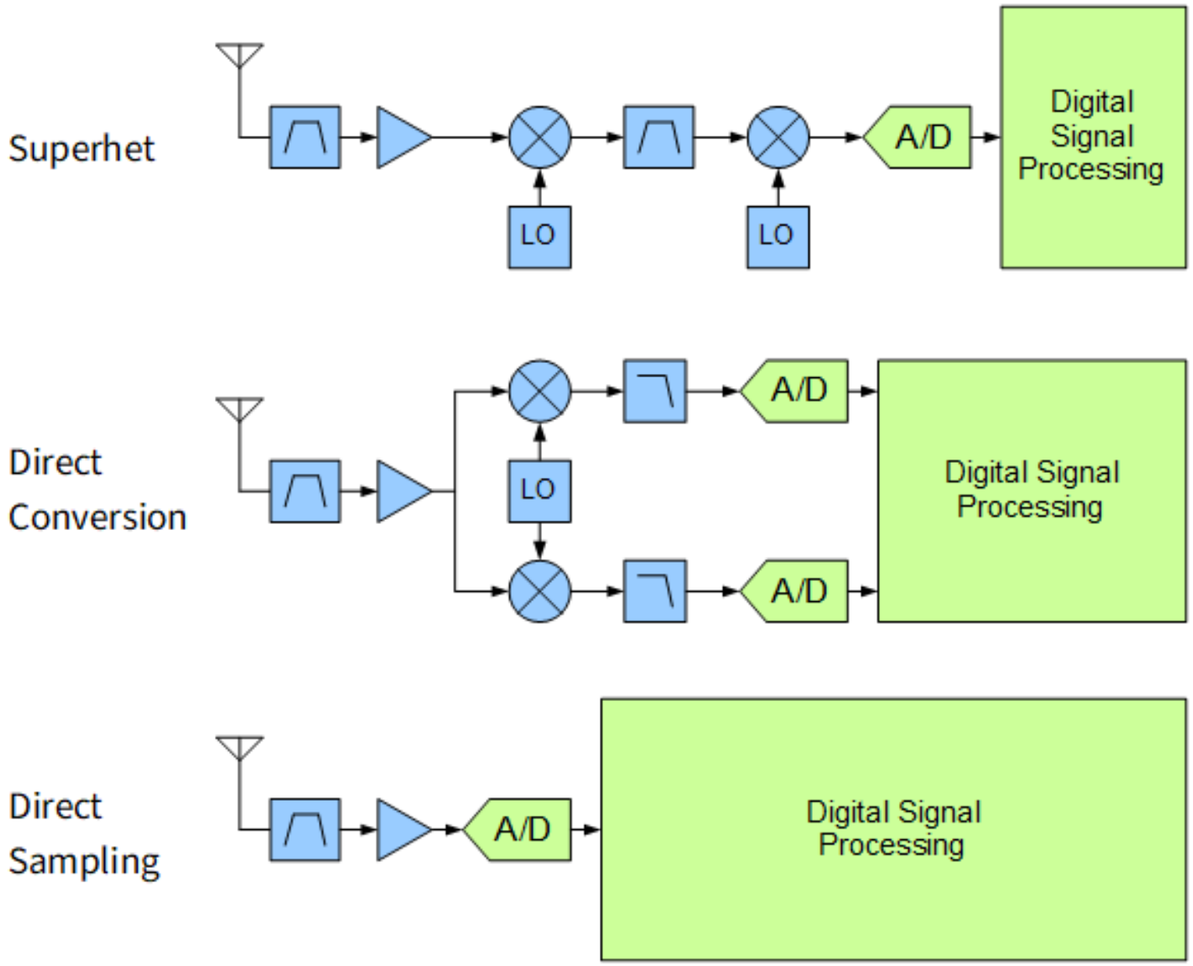


PXIe-5842 VST – 5GSa/s ‘RFSoC’ Device

Application:
‘RF to Bits’ Transmit Receive Systems



Human for Scale



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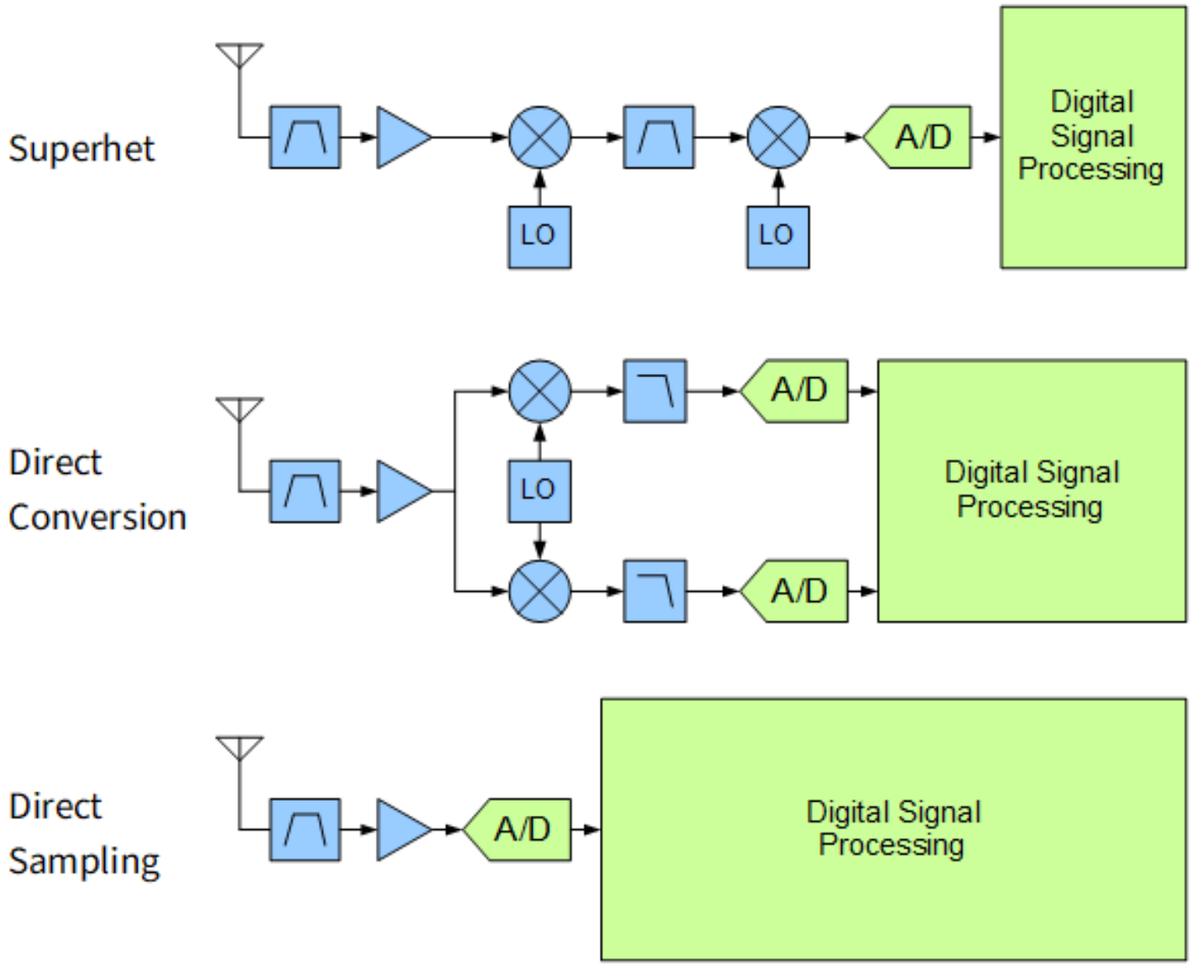
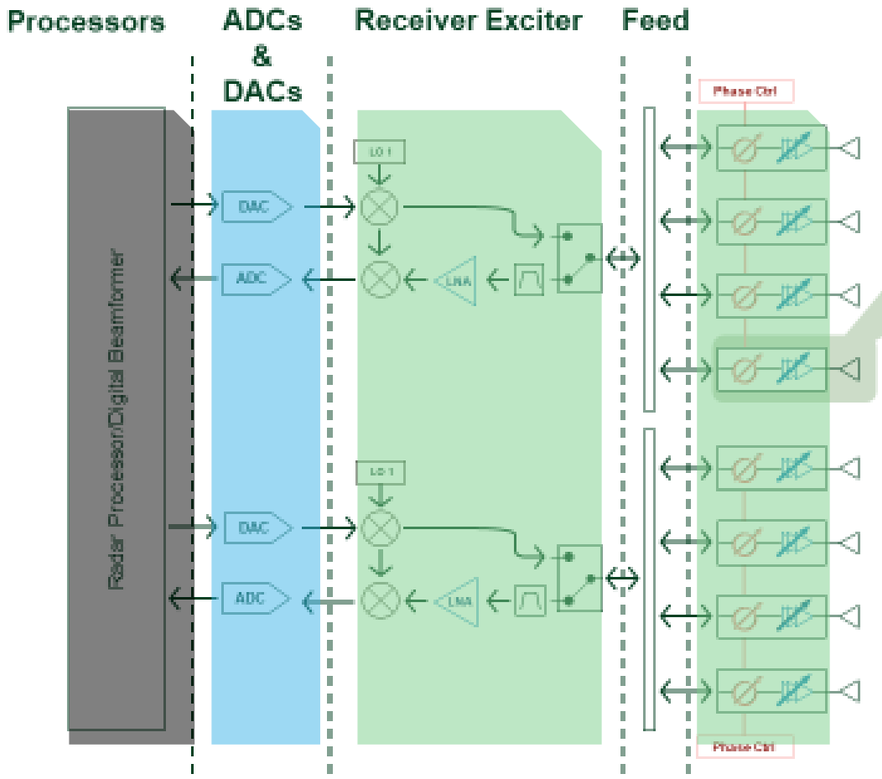
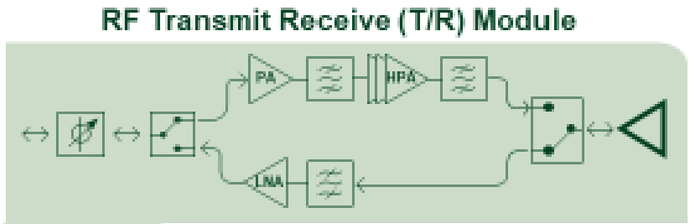


Industry Situation

Active Electronically Scanned Array (AESA) antenna systems & signal chains have evolved from multiple, discretely testable, analog modules into digitally dominated transceiver systems with directly integrated high speed converters (ADC/DAC).



Historical Test Boundaries Maintained – RF components and modules, Low frequency Data Converters, and Digital Processors



Testing of AESA components and modules largely consists of traditional RF parametric measurements due to distributed architecture, including:

Common:
- S-Parameters

T/R Modules
- Relative Phase (Phase Shifter)
- Noise Figure
- Compression

Receiver/Exciter
- Conversion Gain
- Phase Noise

ADCs & DACs
- SNR / SFDR
- Group Delay

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Industry Situation

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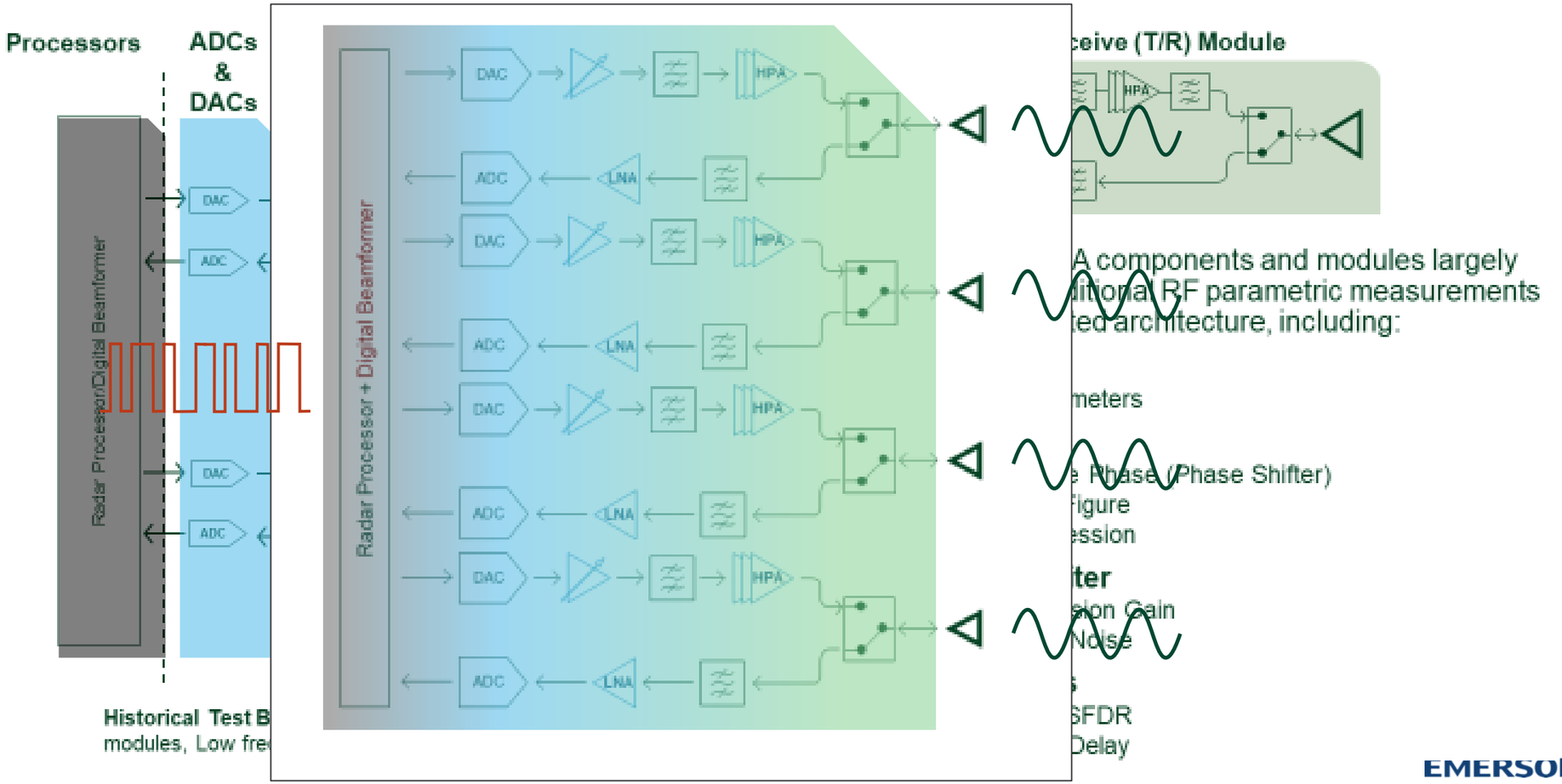

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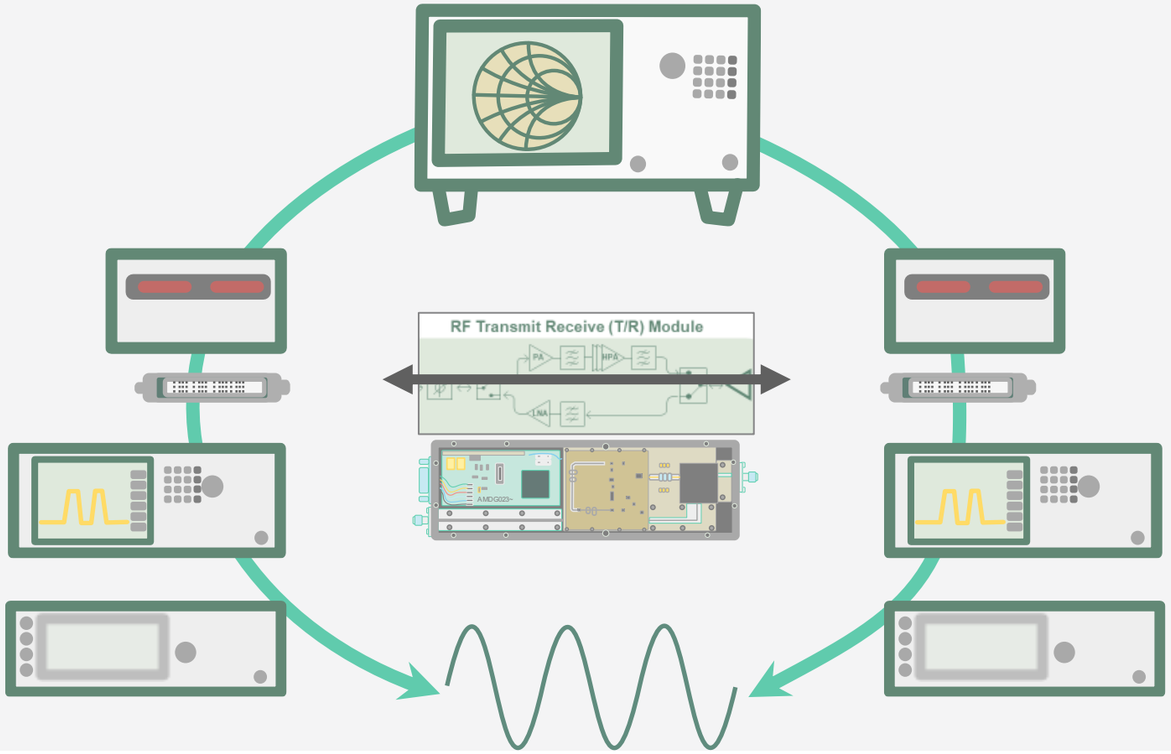
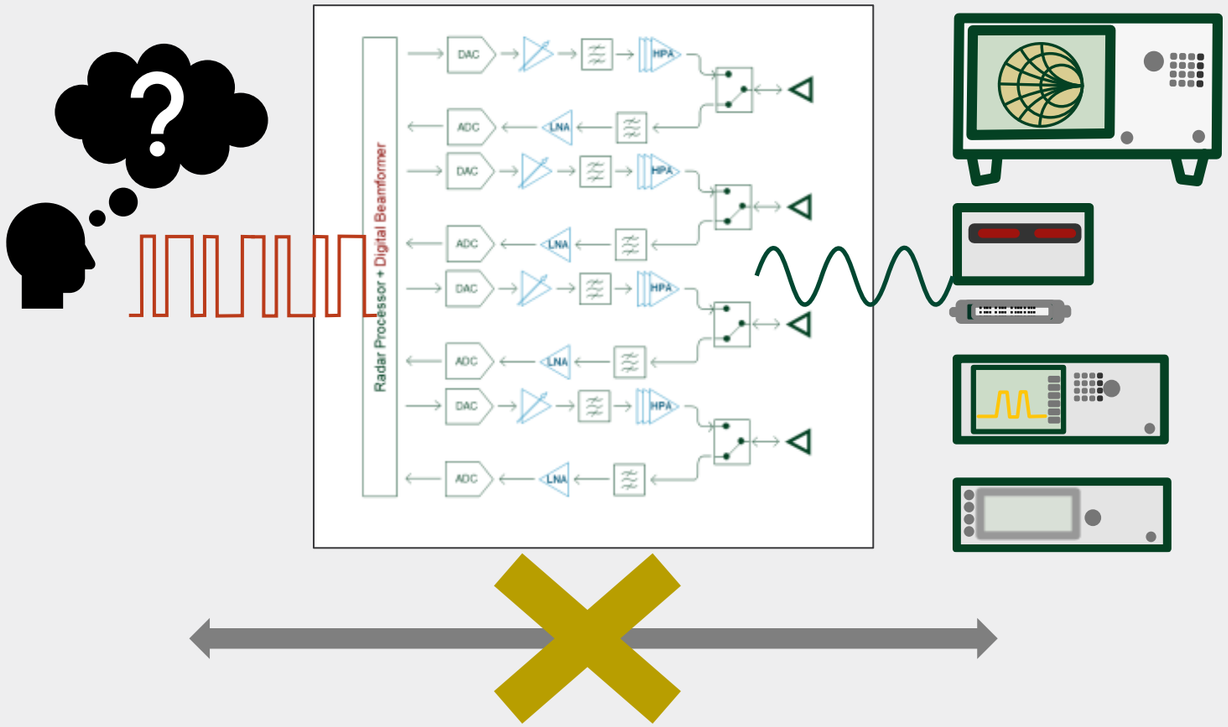
Industry Challenge

Traditional AESA measurement methodologies and instruments, commonly utilizing analog VNAs, are incapable of fully addressing the modern signal & demands of these newly digitally integrated transceiver modules (DTRM).

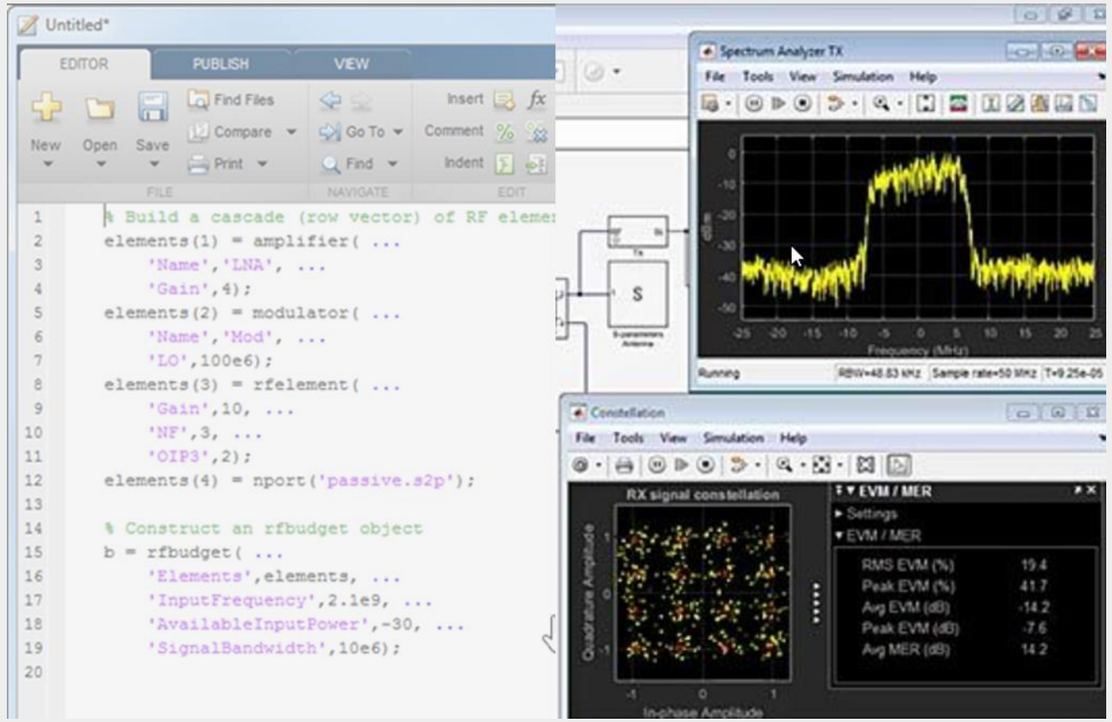




Problem Breakdown

Digital Connectivity Not Ready To Scale

Underperforming Measurement Science



What Connects to Your Digital?

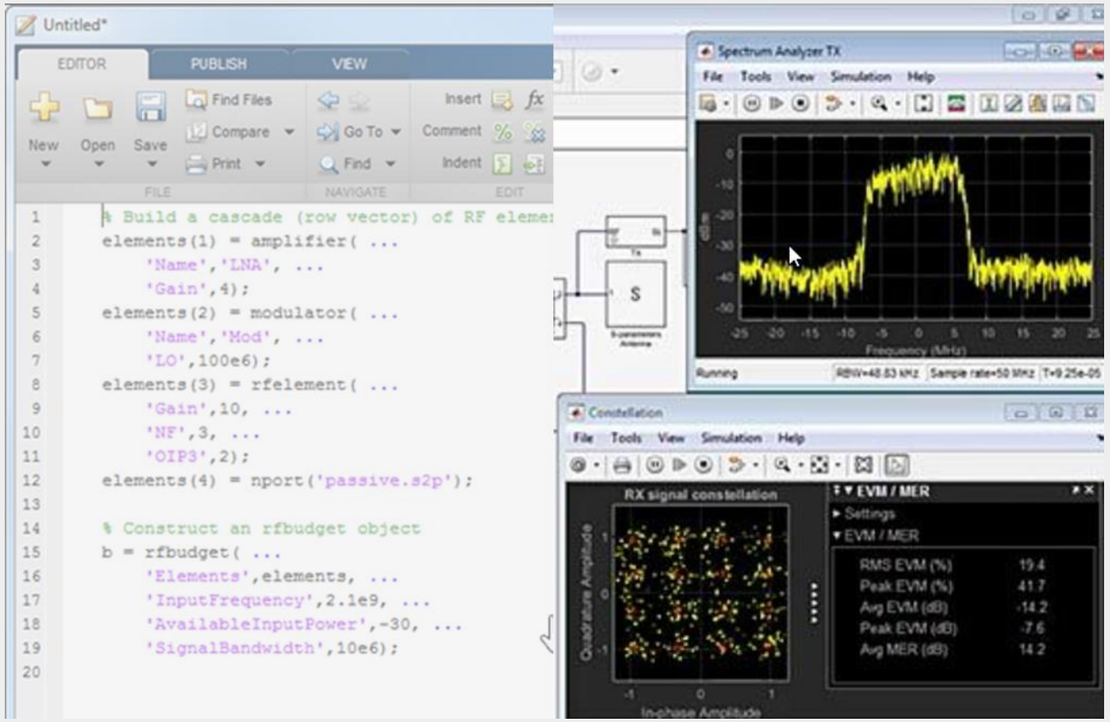
Evaluation / Home-Grown ‘Solutions’

- Test departments not equipped with High-Speed-Serial (HSS) interfaces
- Home-grown digital solutions costly and difficult to produce at scale, maintain and deploy over a program's lifecycle
- Evaluation boards not designed or manufactured to be long term scalable solutions
- Memory and data transfer size and rates limit test time performance
- Not suited for production or your SUT connectivity demands

Functional but Not Practical at Production

How Do You Calibrate and Correlate?

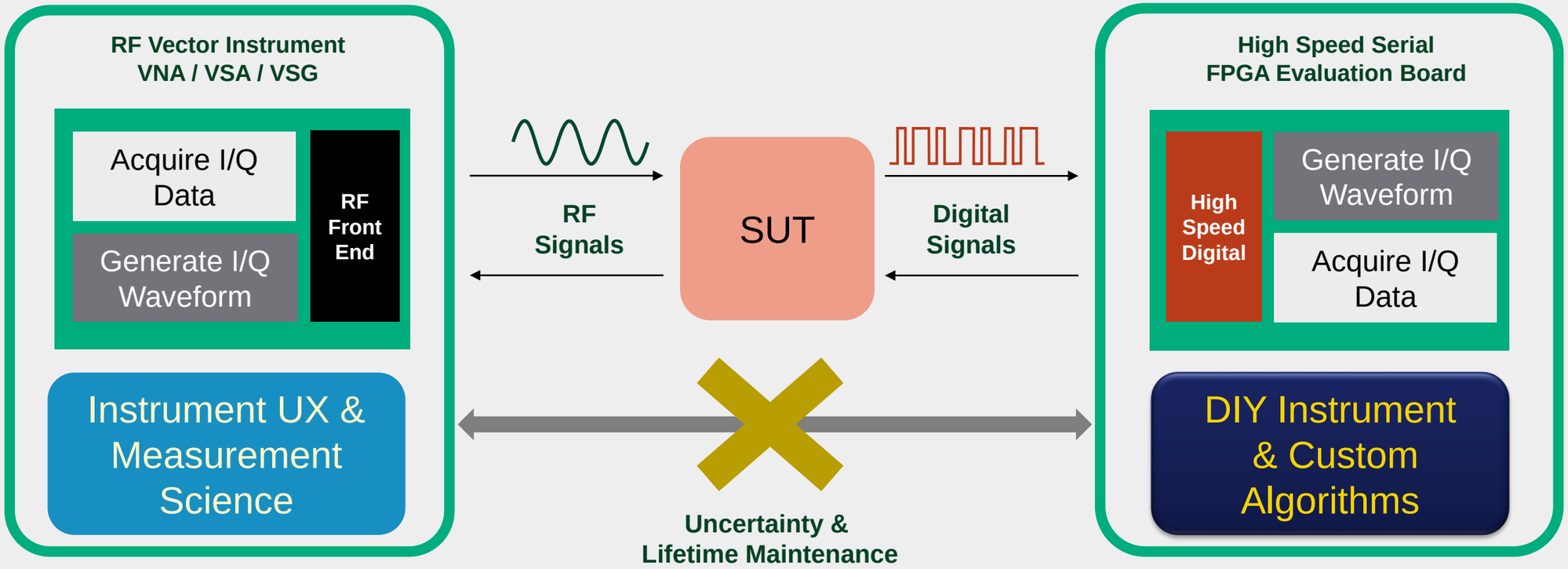
Slow Results on Custom Algorithms



Spend time measuring your device and not developing Instrumentation IP

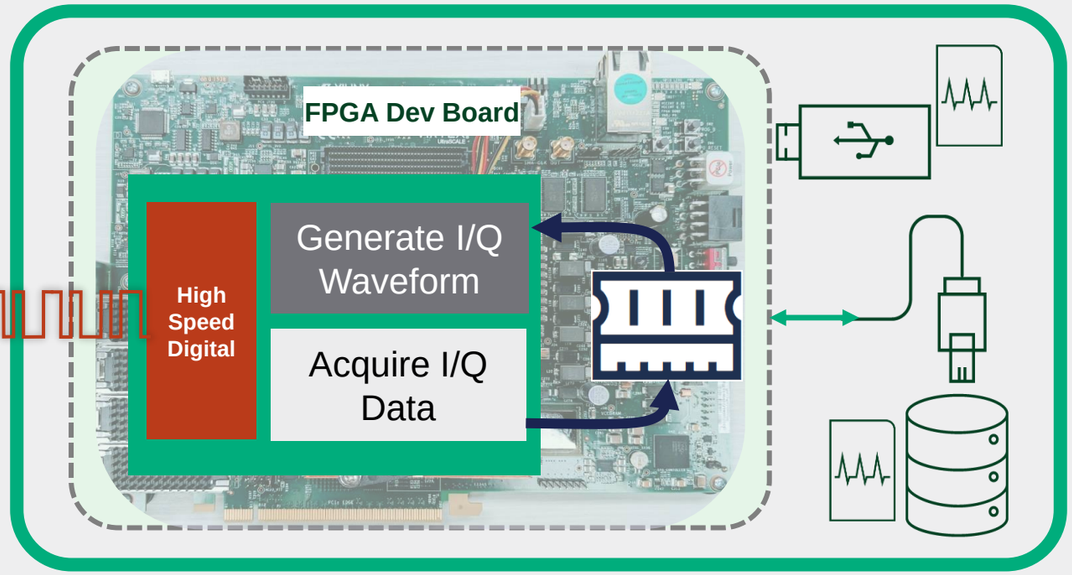
- Moving large data around memory or files is inherently slow
- Developing algorithms that display a result are easy, getting to good results you to correlate is hard
- Stimulus response measurements should have instrumentation on both stimulus and response
- Most custom algorithms and API are not developed for scalability, long term maintenance or speed
- Complex measurements like pulse profile analysis should be common regardless of domain (analog or digital)

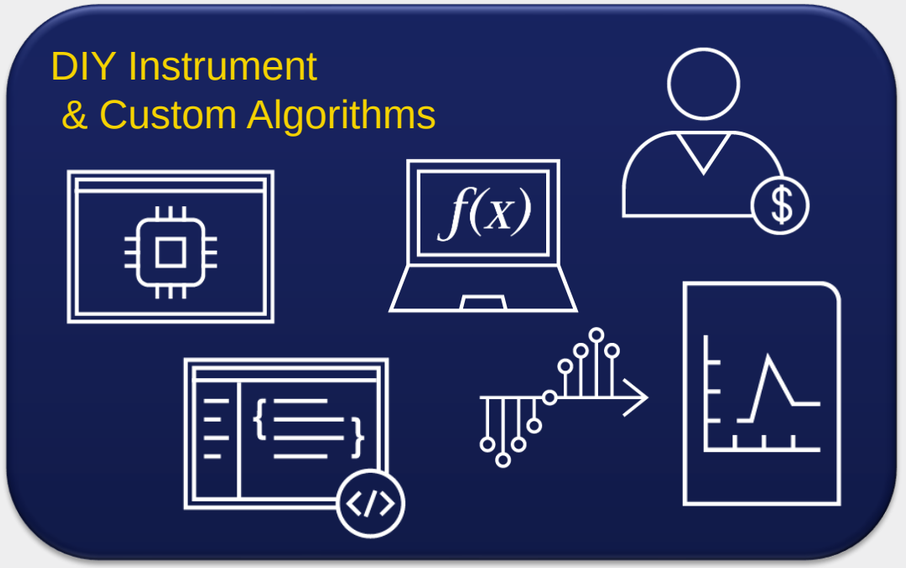
RF to Digital Workflows



RF to Digital Workflows

Save/Load Memory Model





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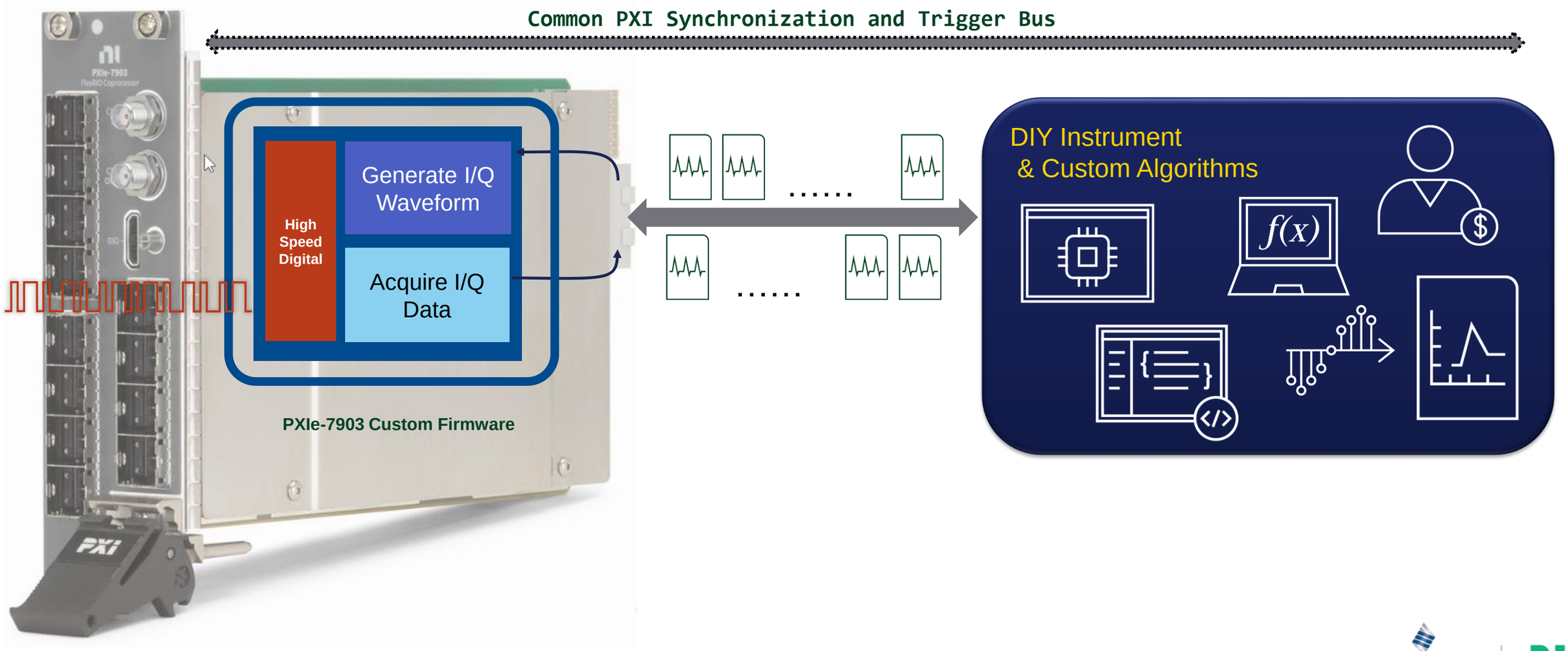
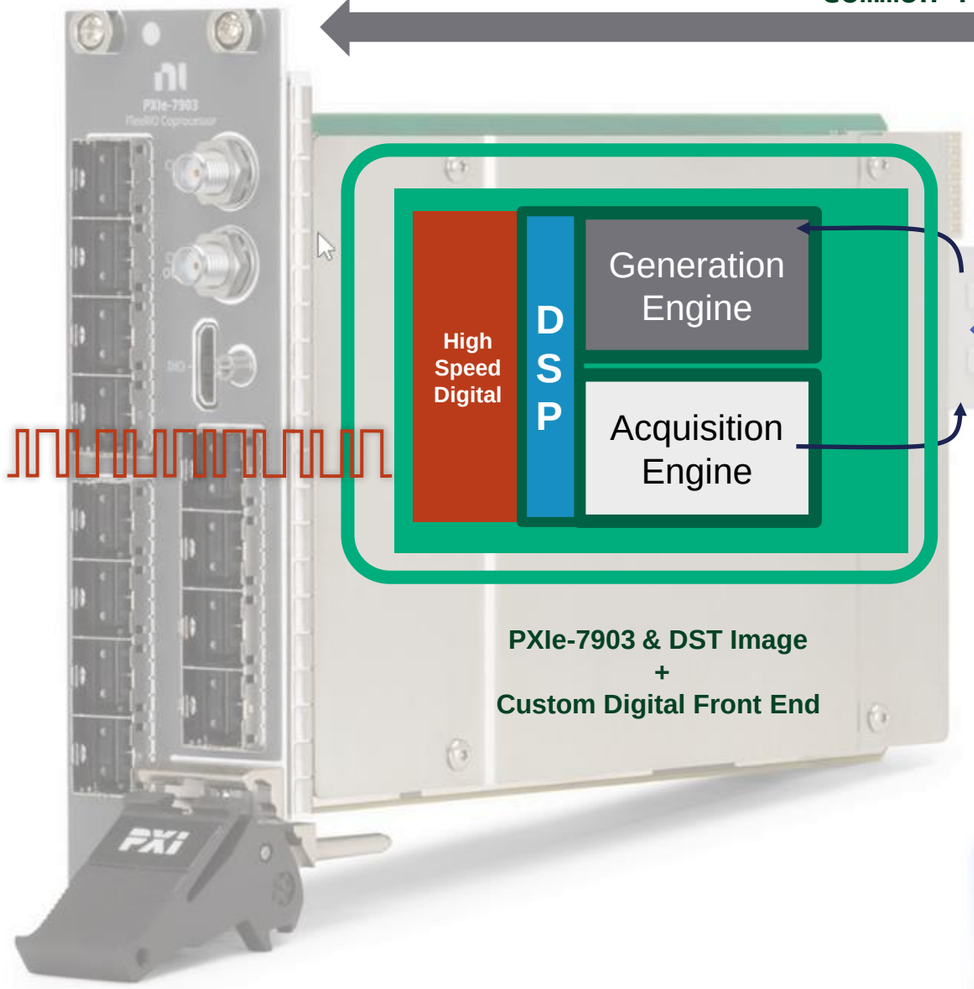
DIY Digital Instrument Model



DST - Digital Signal Transceiver

Common PXI Synchronization and Trigger Bus



PXIe-7903 & DST Image
+
Custom Digital Front End

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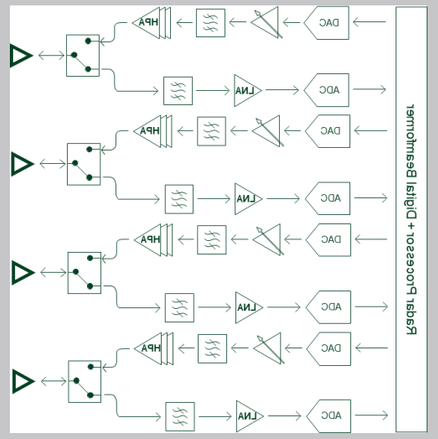
Re-establishing the Instrumentation Hug

Common PXI Synchronization and Trigger Bus

NI SYSTEM (HW+Driver)

VST Instrument (VSG, VSA, S-Param)

SUT



HSS Instrument 100GigE, JESD, etc

Digital Control LVDS, etc.

COMMON MEASUREMENT SCIENCE

- Signal Creation
- IQ Processing
- SpecAn

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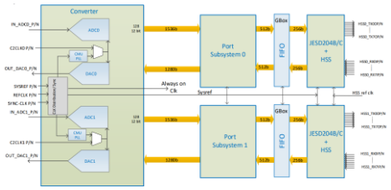
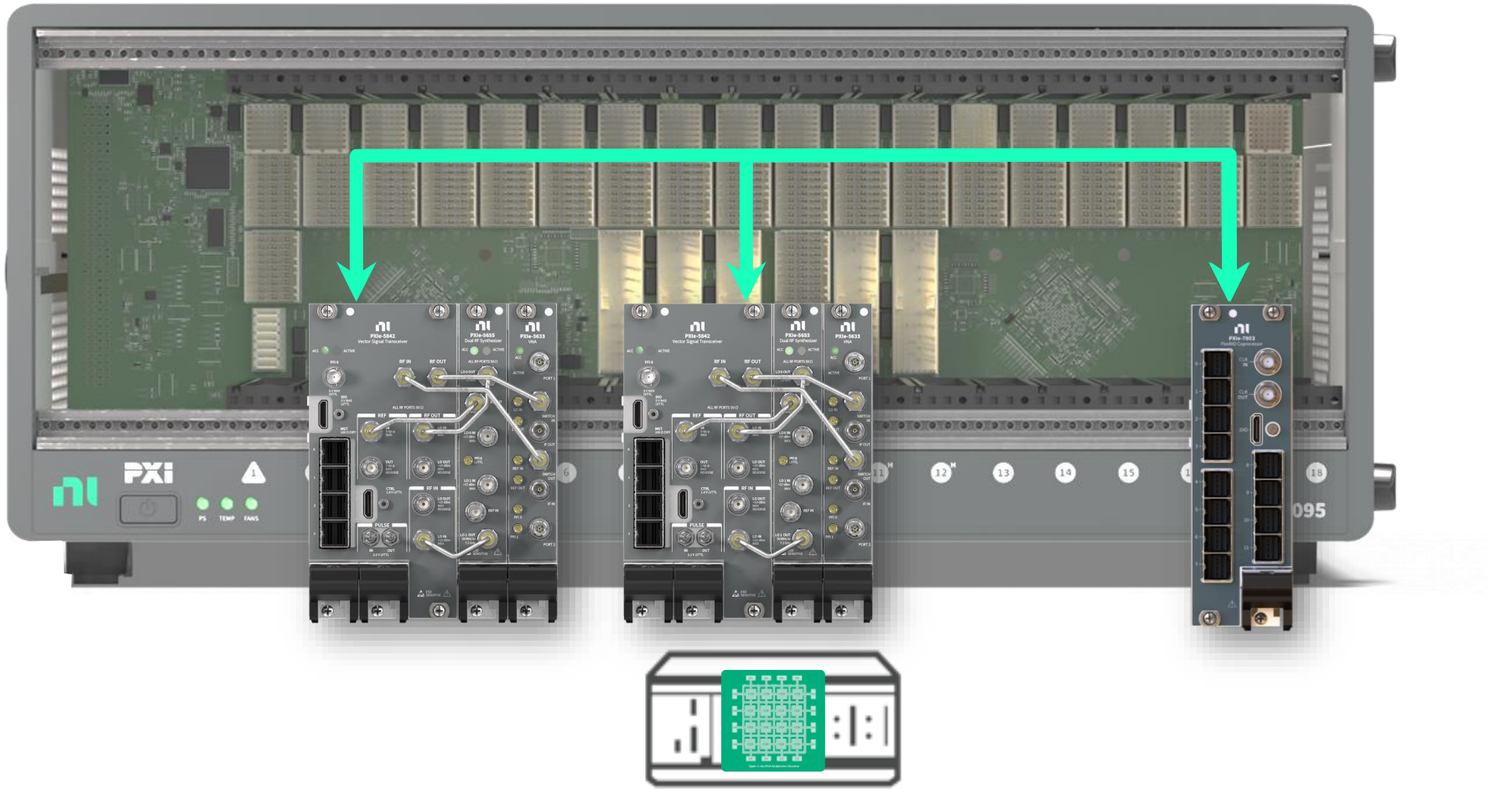
Instrument Coordination View



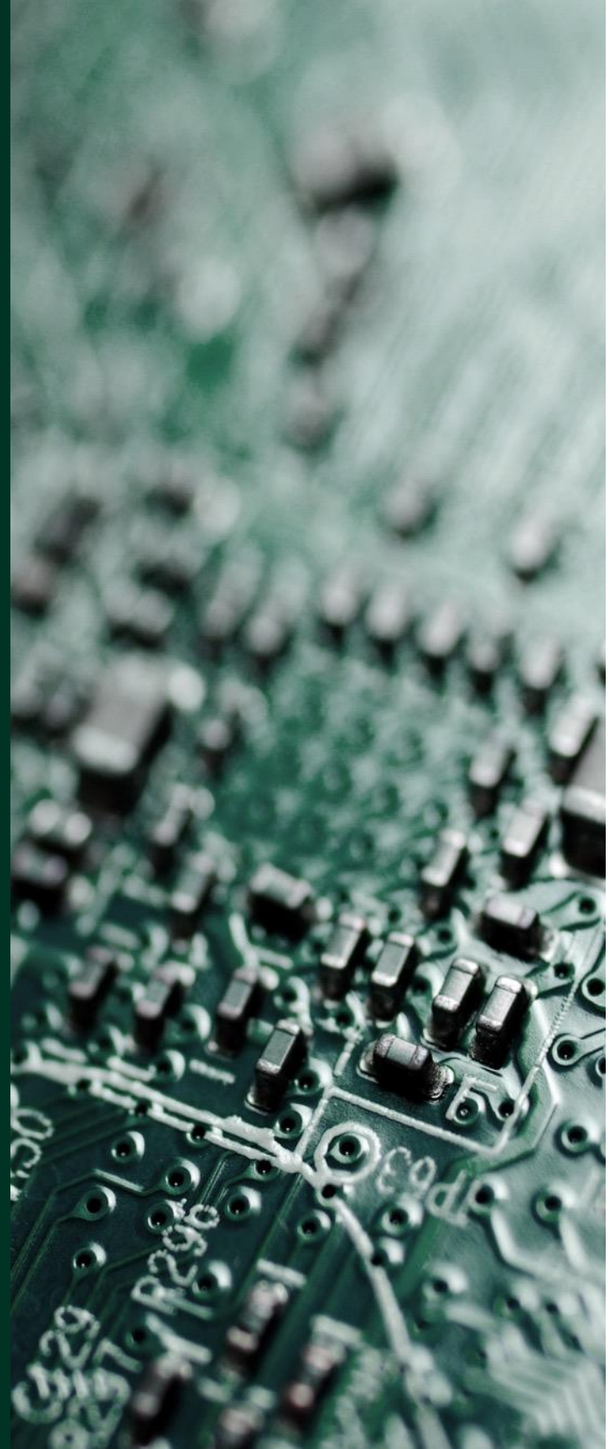


Common PXI Synchronization and Trigger Bus

System Under Test

Preview Demo

DST Instrument Workflow

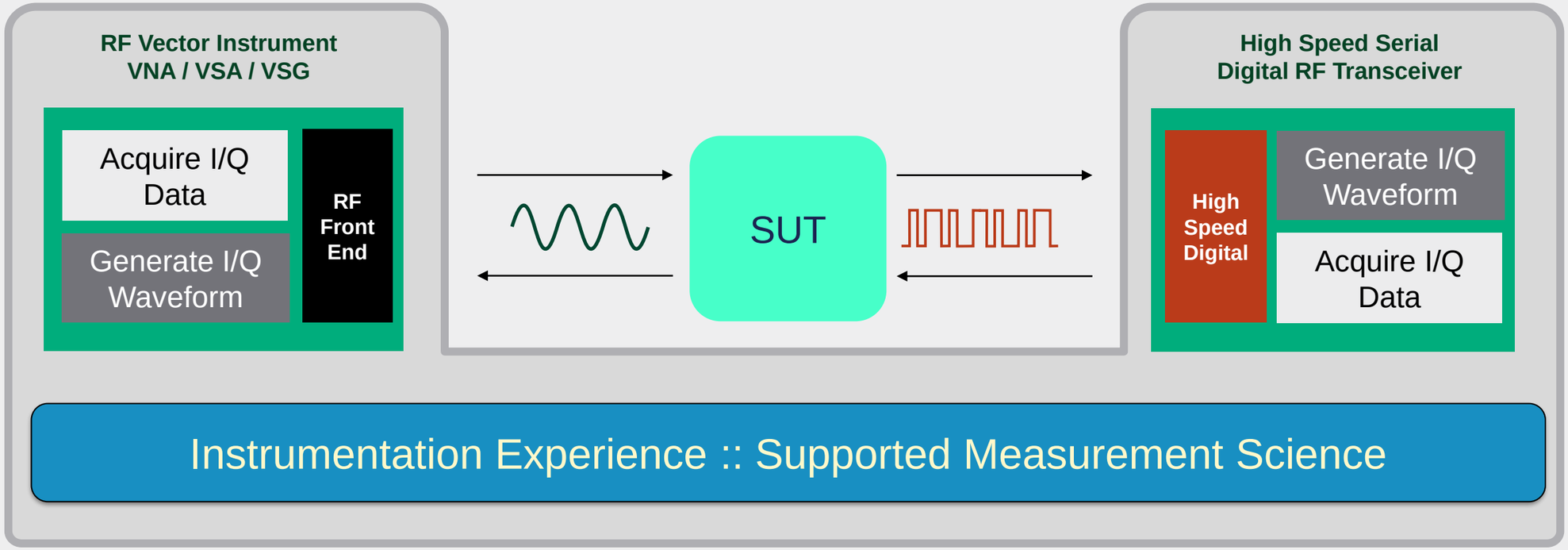


Design and Development Accelerators

- **Interactive** out of the box
  - No-code acquisition and visualization
  - Debug platform for designers
  - Extensible interface through Instrument Studio
- Instrument Grade **Automation API**
  - Features and interfaces mirrored from RFSA/G
  - Powerful trigger engines
  - Waveform scripting
  - Stream data or capture records

RF to Digital Workflows

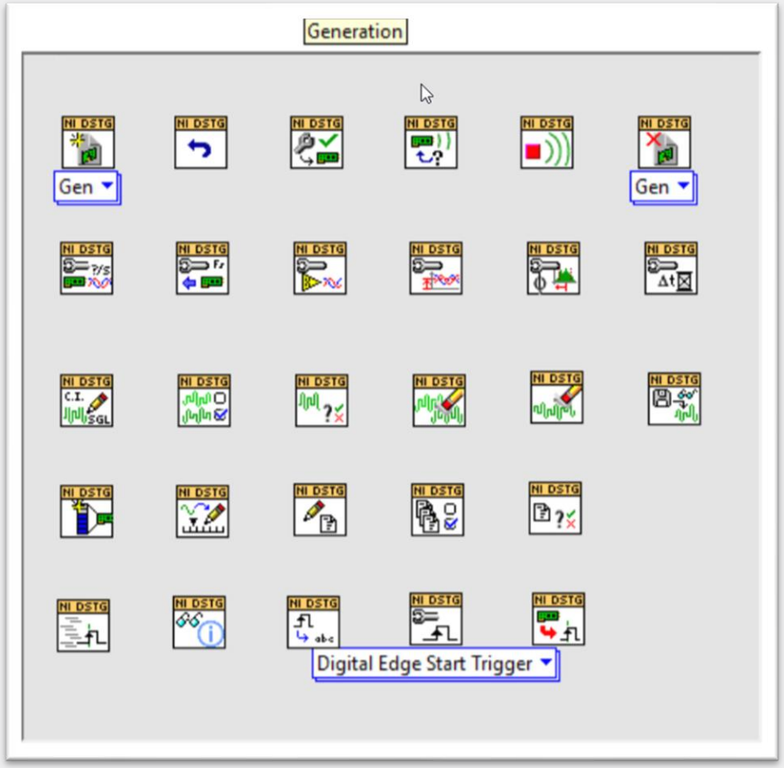
Digital RF Vector Instrument Model



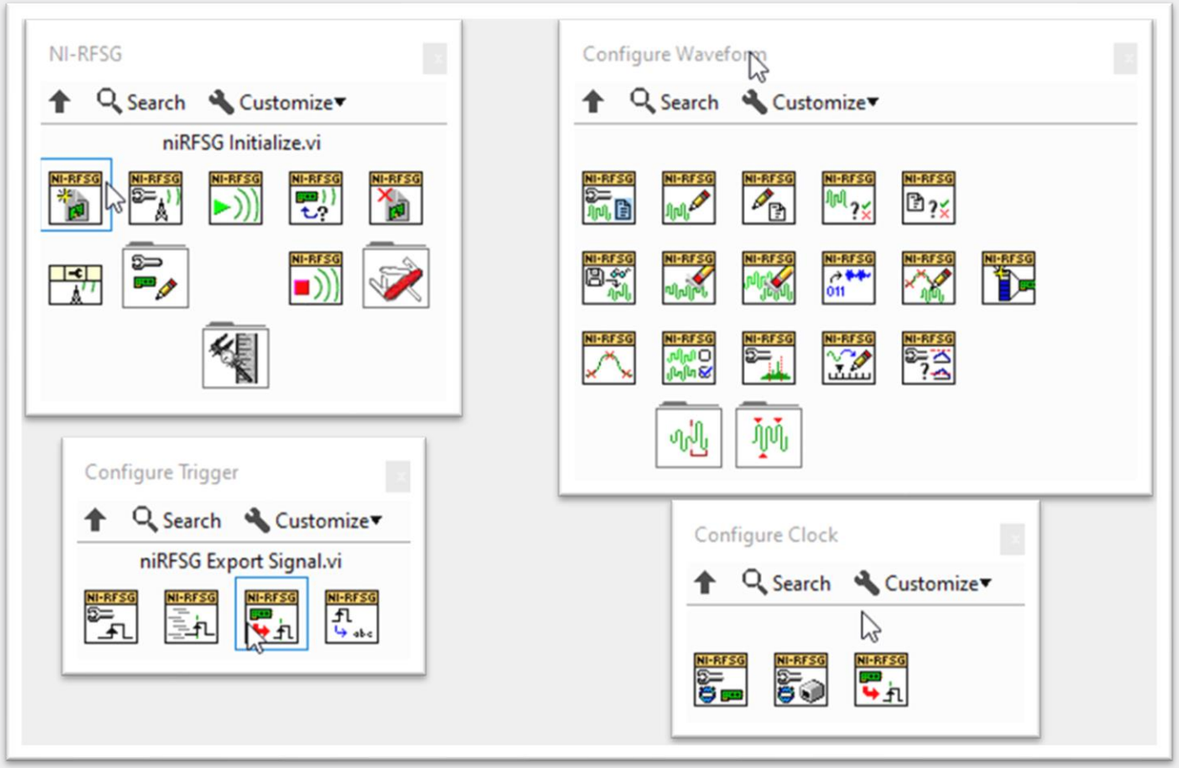
Desired Instrumentation – I/Q Stimulus and Response

Instrument Grade API – Generation Comparison

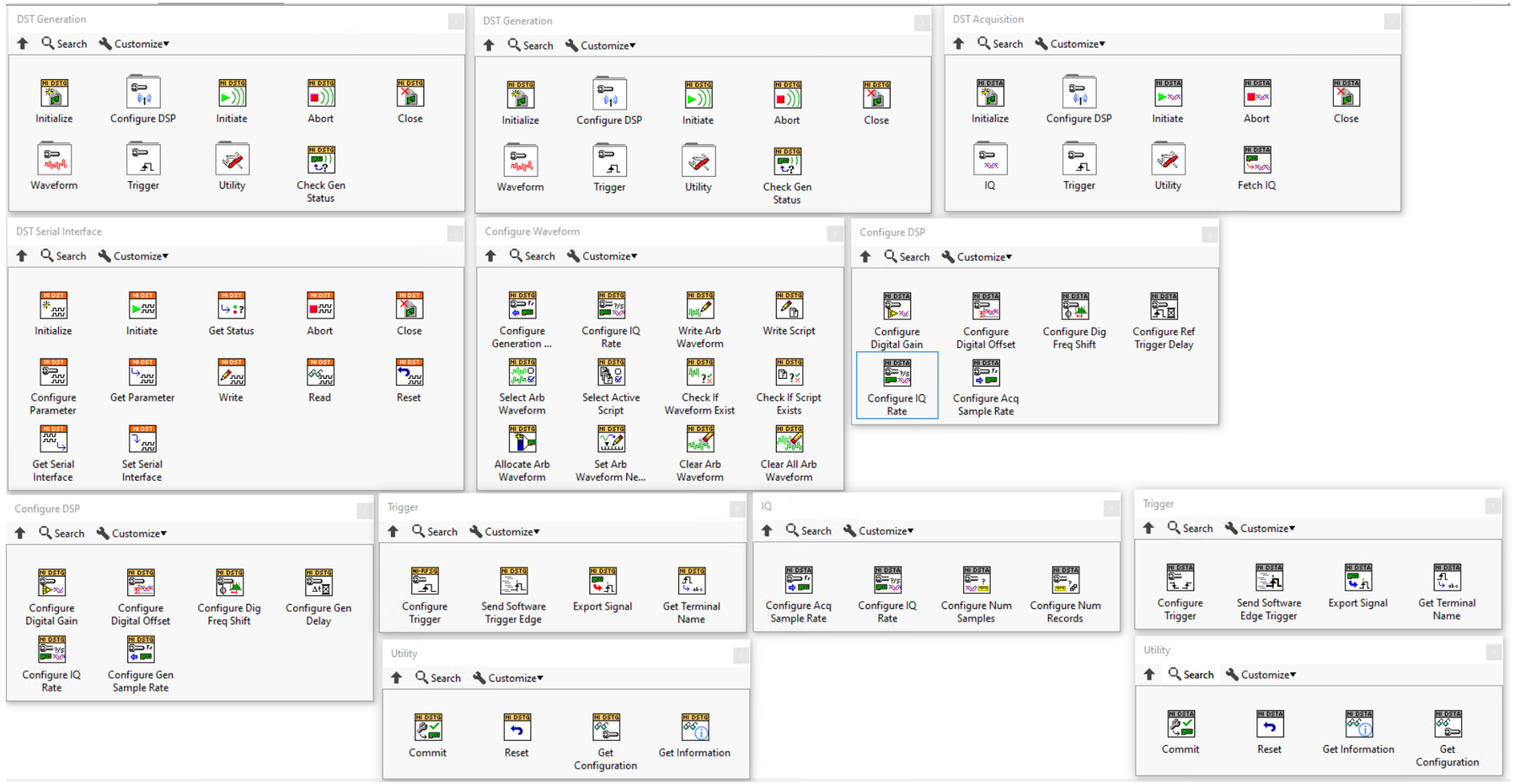
DST-G



NI-RFSG

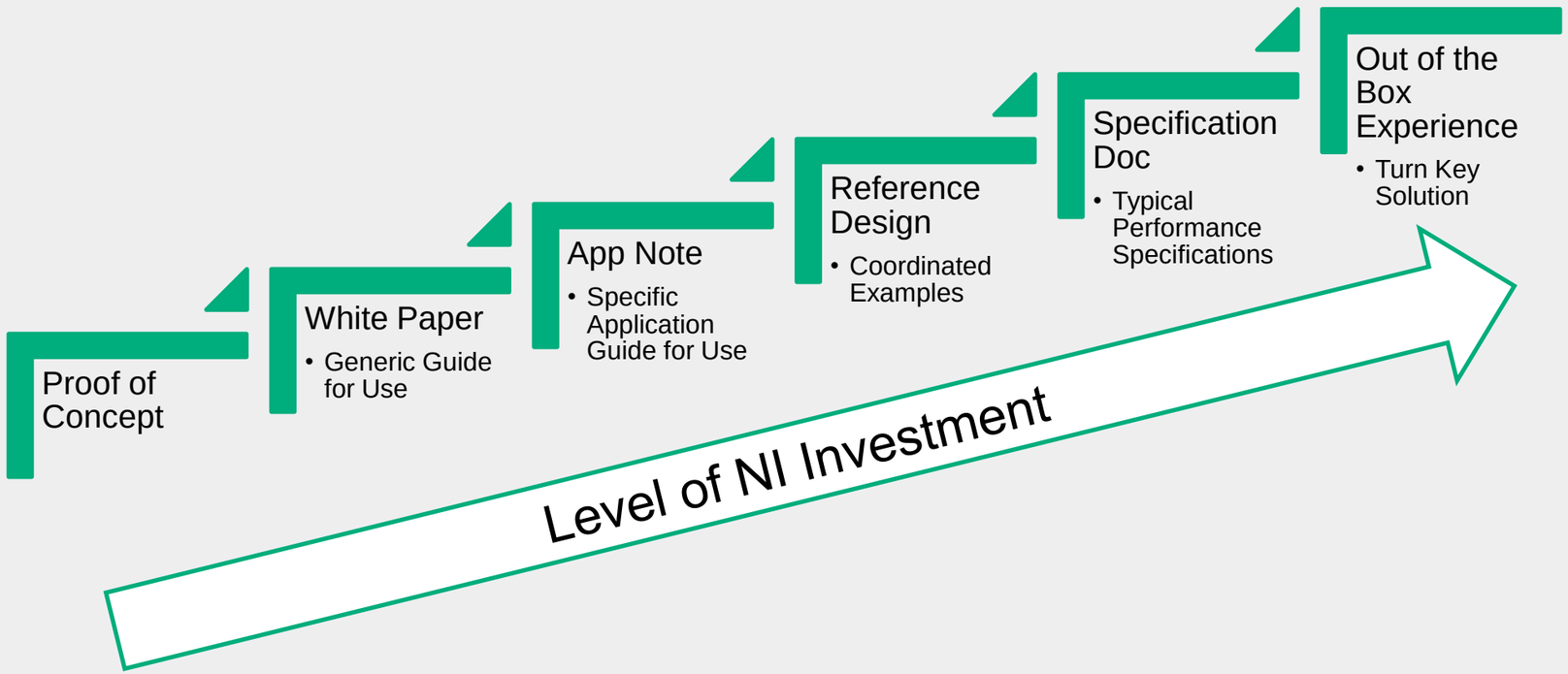


Full Pallet Overview



Easing the Struggle

NI Tiers of Service



Optimizing Support

- NI is able to provide Levels of Service that meet the needs of each customer
- Identifying the level of investment that is value added for YOU the customer is key to enabling and accelerating your success

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