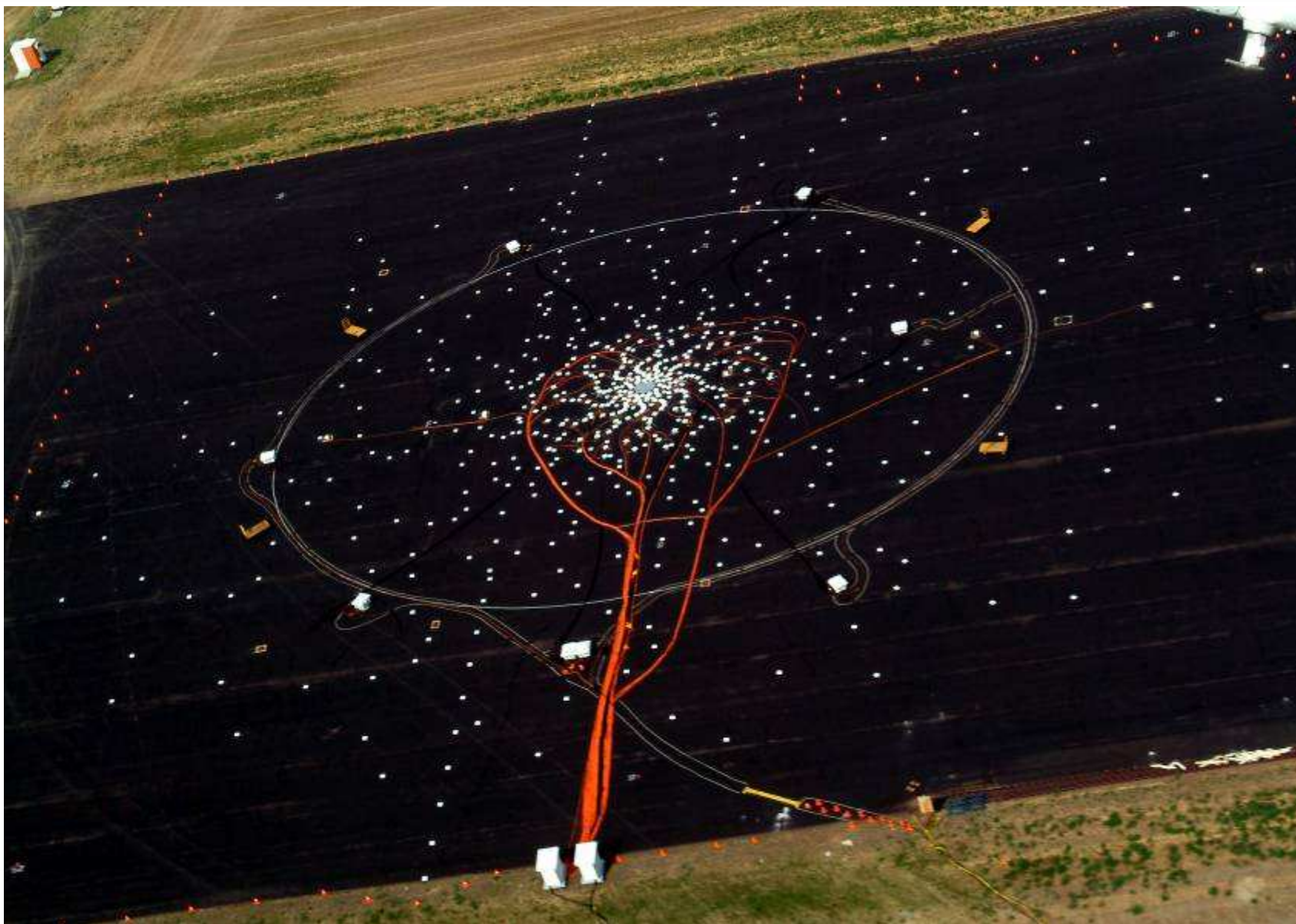


PXI and PXIe for Real-Time Applications

Murali Ravindran
PXI Product Manager
National Instruments



What is PXI?

- PXI = PCI eXtensions for Instrumentation
- Open specification governed by the PXI Systems Alliance (PXISA) and introduced in 1997
- PC-based platform optimized for test, measurement, and control
- PCI electrical-bus with the rugged, modular, Eurocard mechanical packaging of CompactPCI
- Advanced timing and synchronization features

PXI Combines Standard Technologies

Controller

- Embedded PC or remote PC / laptop interface
- Runs all standard software

Chassis

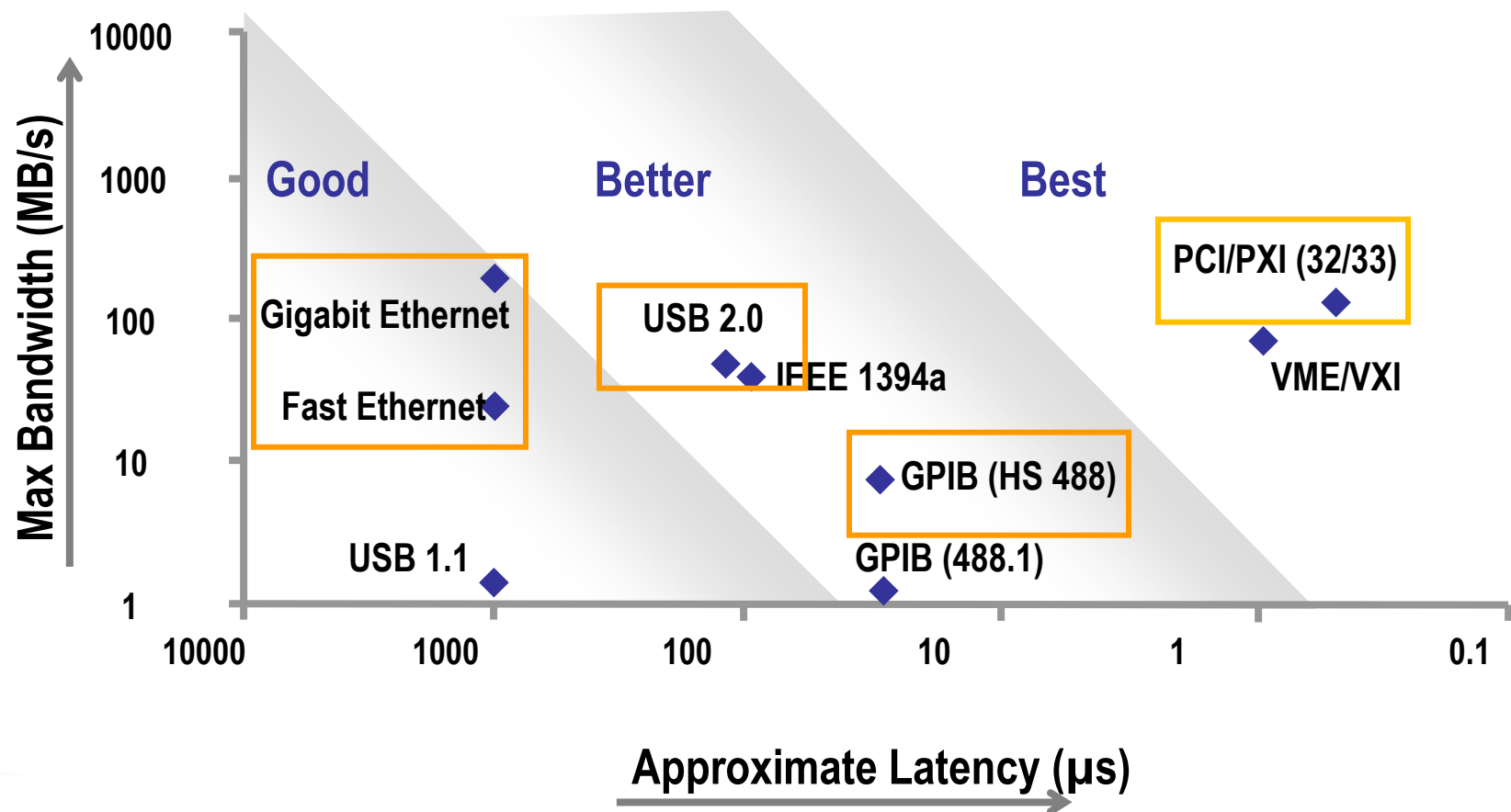
PXI Backplane

- PCI bus
- Timing and Synchronization



Peripheral Modules

Industry Bus Performance



Leveraging PCI Express

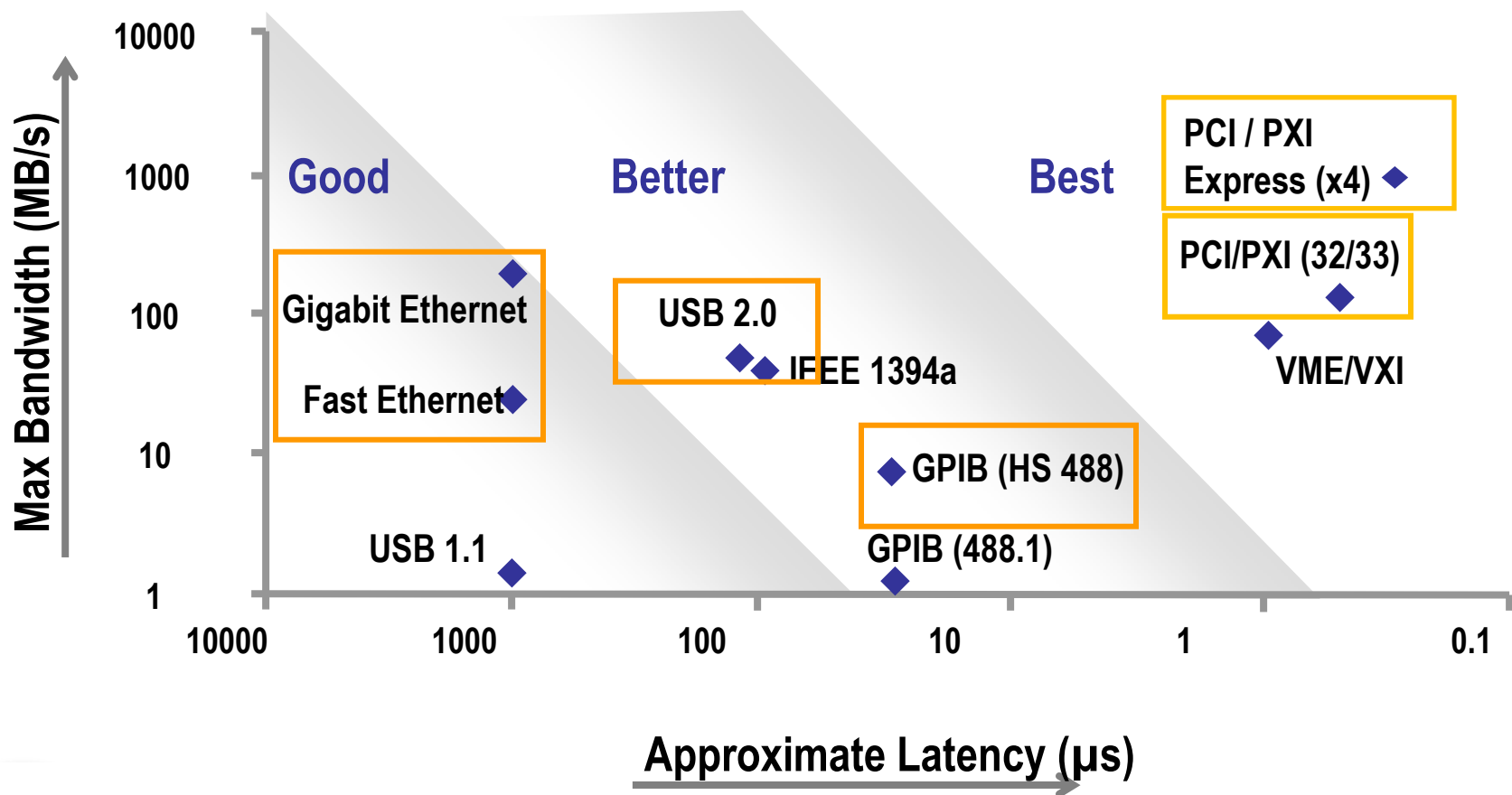
Data bus for PXI

- PCI
 - 132 MB/s
 - Shared Parallel Bus

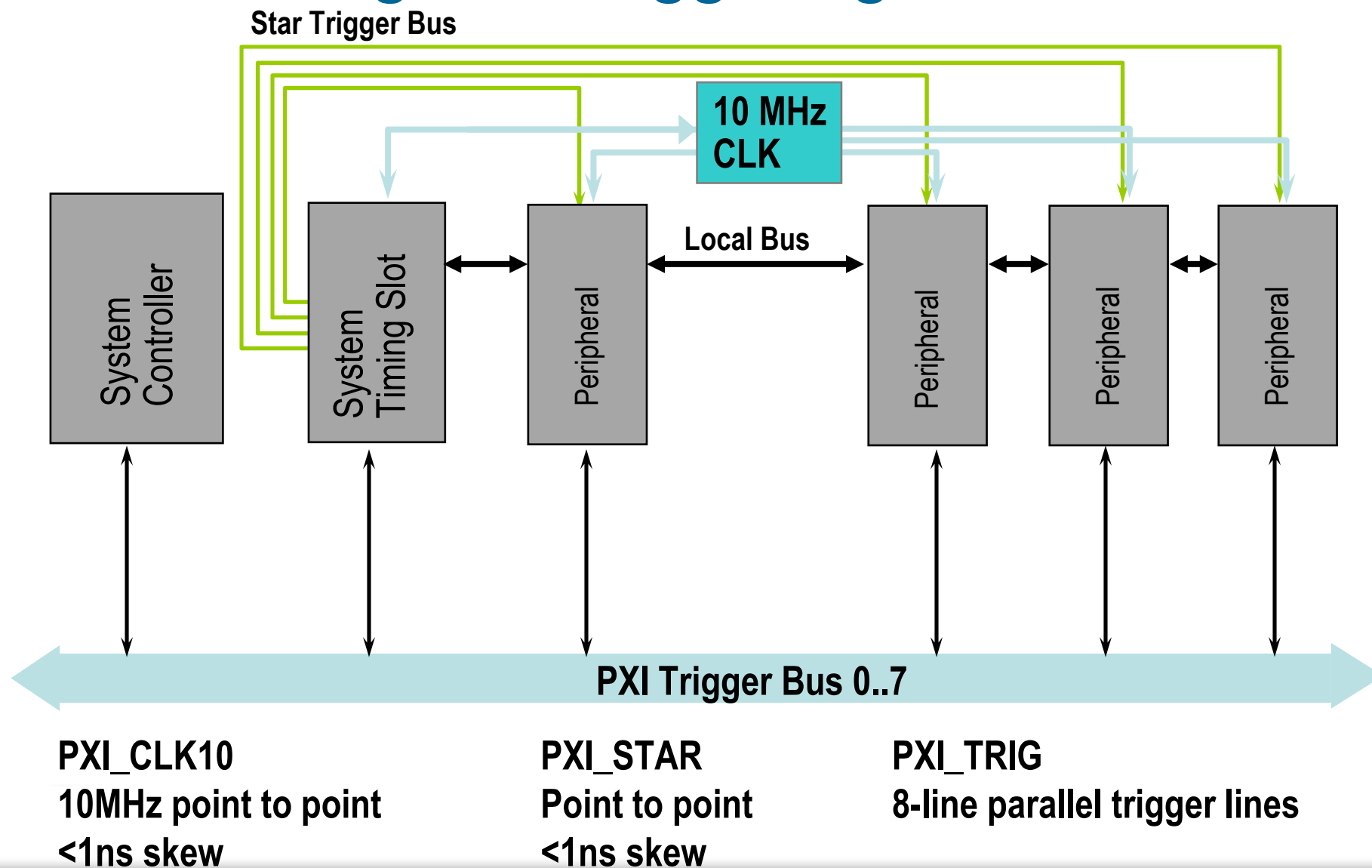
Data bus for PXI Express

- PCI Express
 - 250 MB/s to 4 GB/s
 - Independent Serial Bus
- Modules up to 1 GB/s
- Host up to 6 GB/s (2-link)
4 GB/s (4-link)

Industry Bus Performance

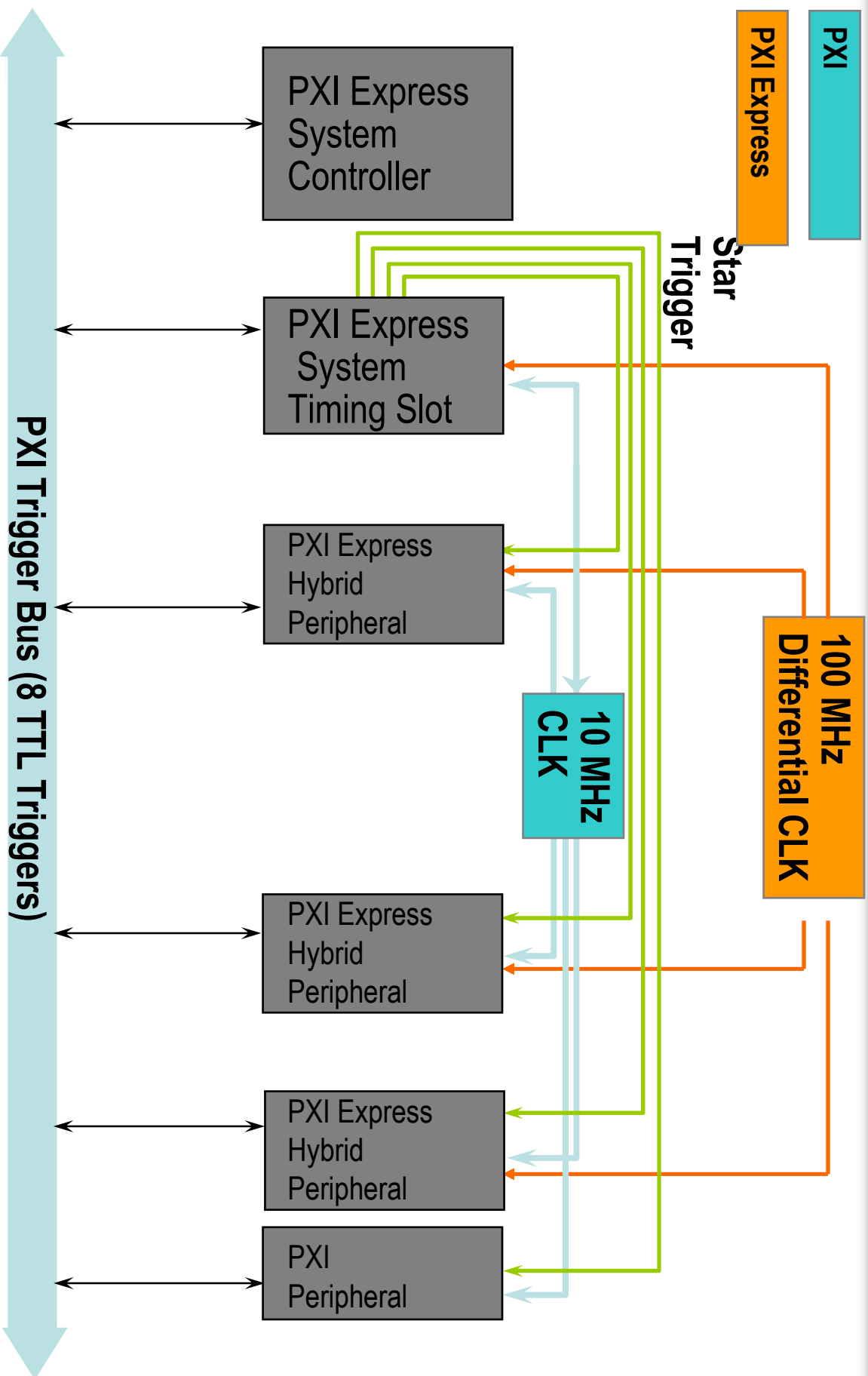


PXI Timing and Triggering



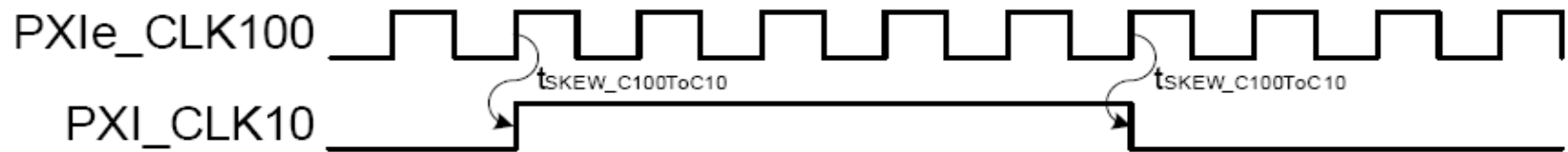
Additional Features in PXle

- Supplied Power and Cooling Increase
- Geographical Addressing
- Timing and Synchronization
 - 100 MHz differential clock
 - Differential Star Triggers



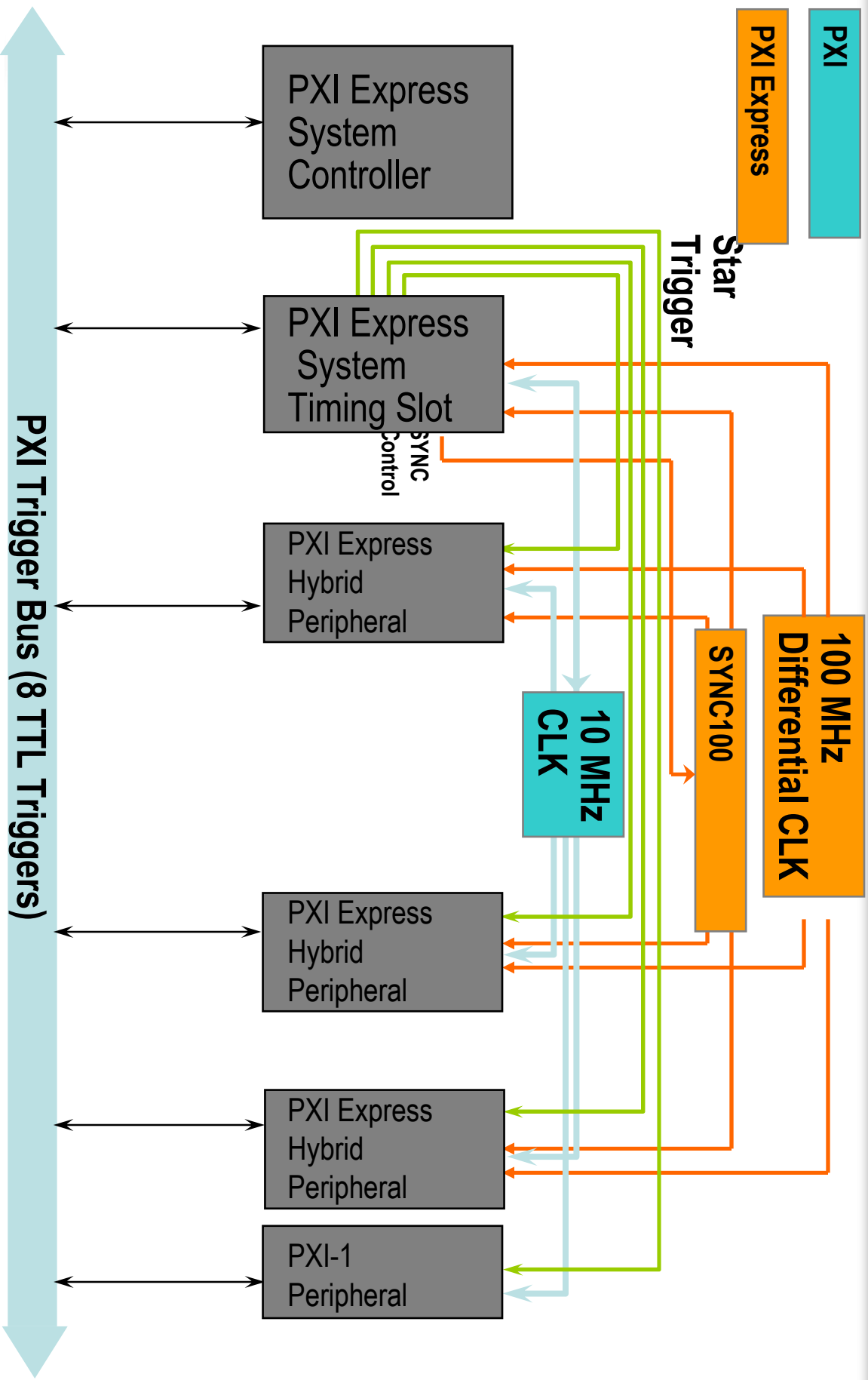
Comparing PXIe_CLK100 and PXI_CLK10

- PXI_CLK10 preserves compatibility with PXI modules
- PXI_CLK10 is synchronous to PXIe_CLK100



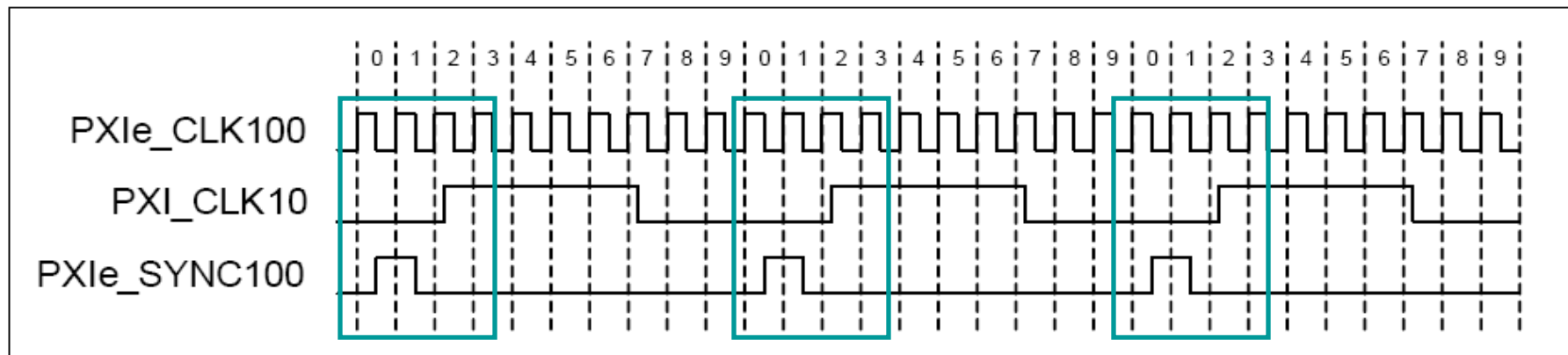
Specifications comparison

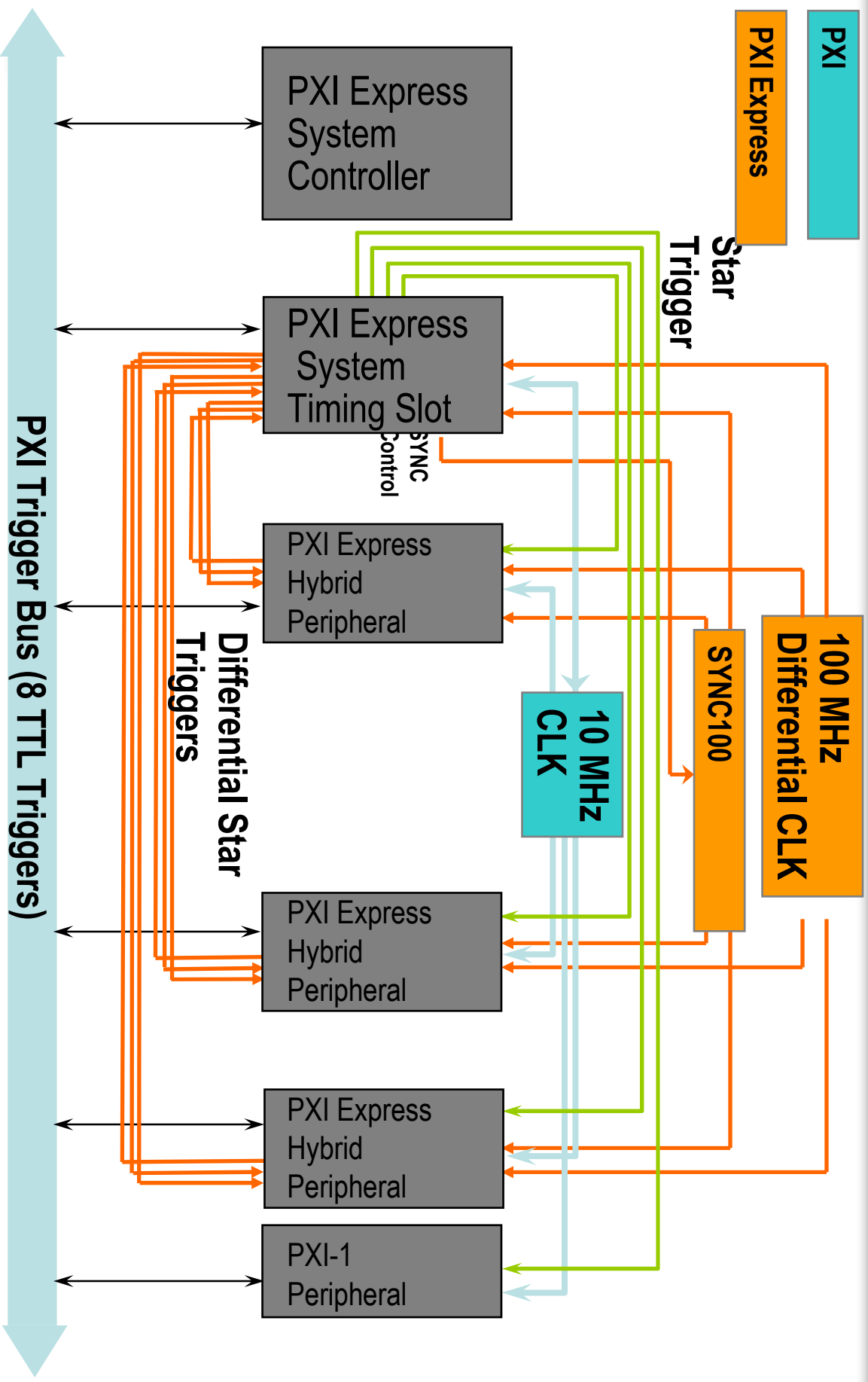
	PXIe_CLK100	PXI_CLK10
Frequency	100 MHz	10 MHz
Logic Family	LVPECL, Diff	TTL, SE
Freq. Accuracy	± 100 ppm or better	± 100 ppm or better
Skew	≤ 200 ps	≤ 1 ns



PXle_SYNC100

- Delivered to each PXle peripheral slot
- Differential LVPECL signal
- 10ns pulse coordinated to PXI_CLK10





Differential Star Triggers

- PXIe_DSTARA, PXIe_DSTARB, PXIe_DSTARC
- Differential, point-to-point connections
- Matched length to within 150ps
- PXIe Peripheral Slots and the System Timing Slot
- Allows for increased clock frequency distribution

Integrating PCI Express into the PXI Backplane

- Up to 2 GB/s dedicated bandwidth per slot
- Enhanced synchronization capabilities
 - 100 MHz differential clock, differential triggering
- Backwards compatibility
 - Complete software compatibility
 - Hybrid slot definition - install modules with either PCI or PCI Express signaling in a single slot

Real Time Architectures on PXI



Non-Deterministic

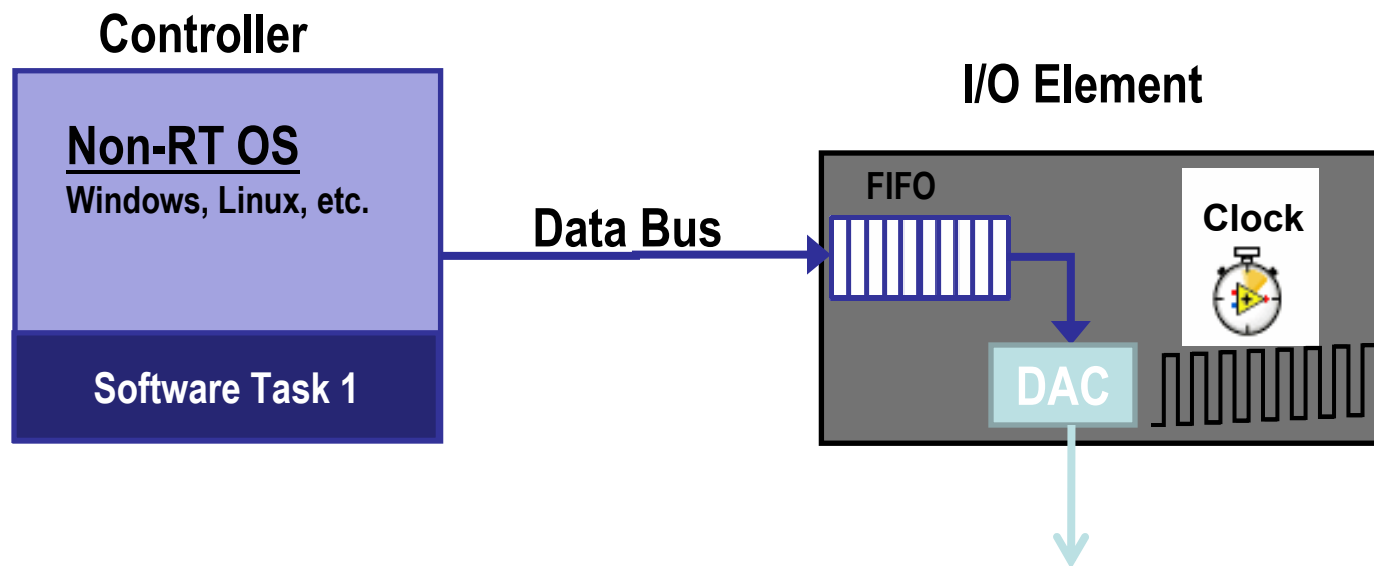


Deterministic

HW-Timed I/O

Non-Deterministic

Deterministic

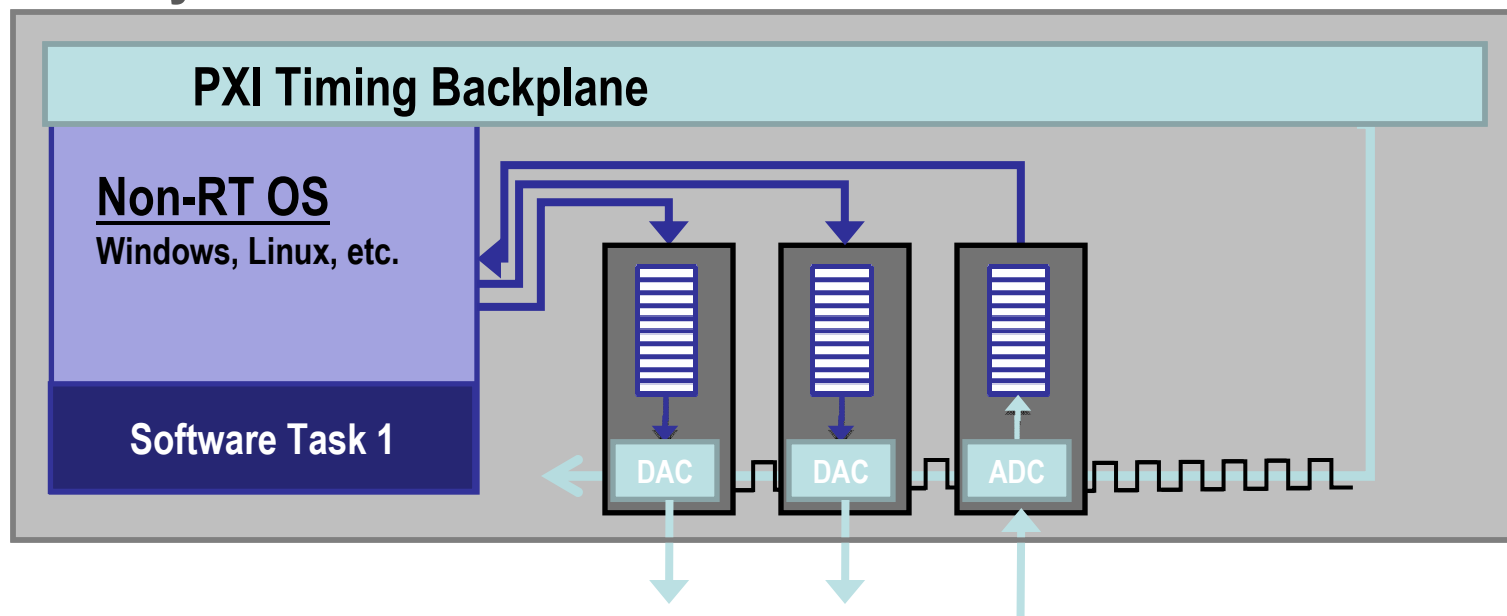


Clocked I/O

Non-Deterministic

Deterministic

PXI System

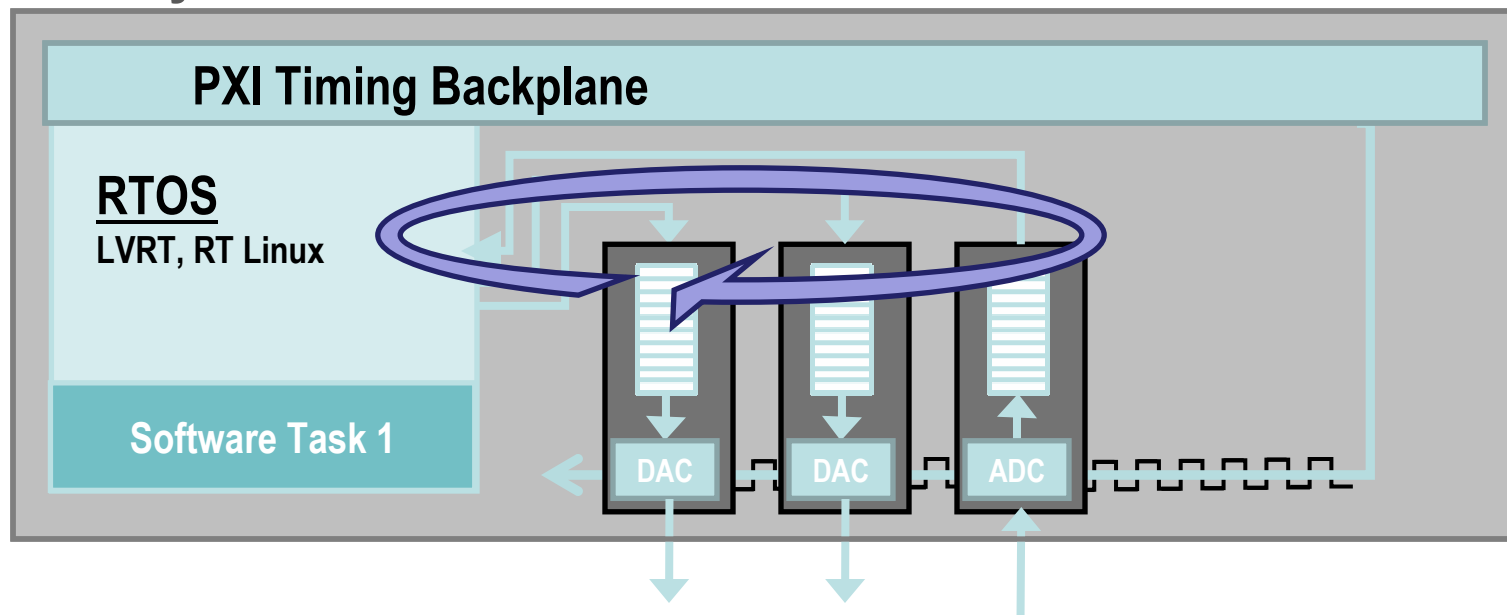


RTOS

Non-Deterministic

Deterministic

PXI System

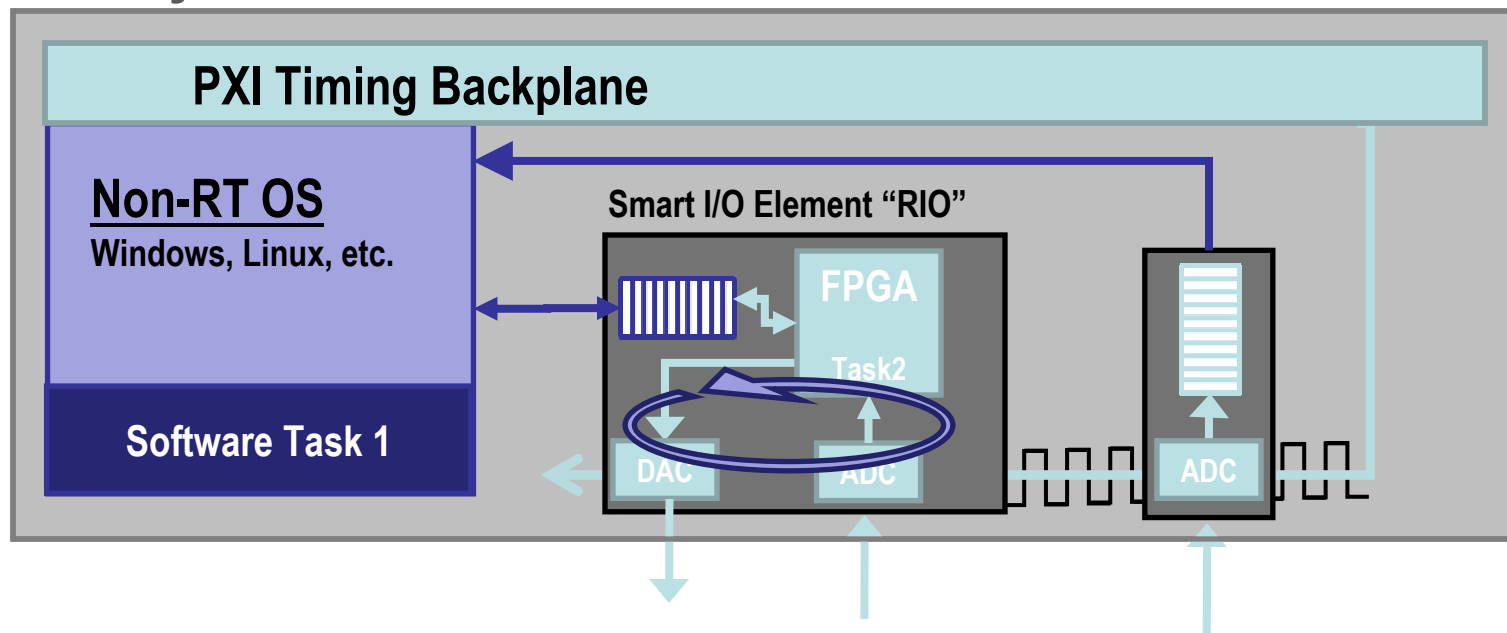


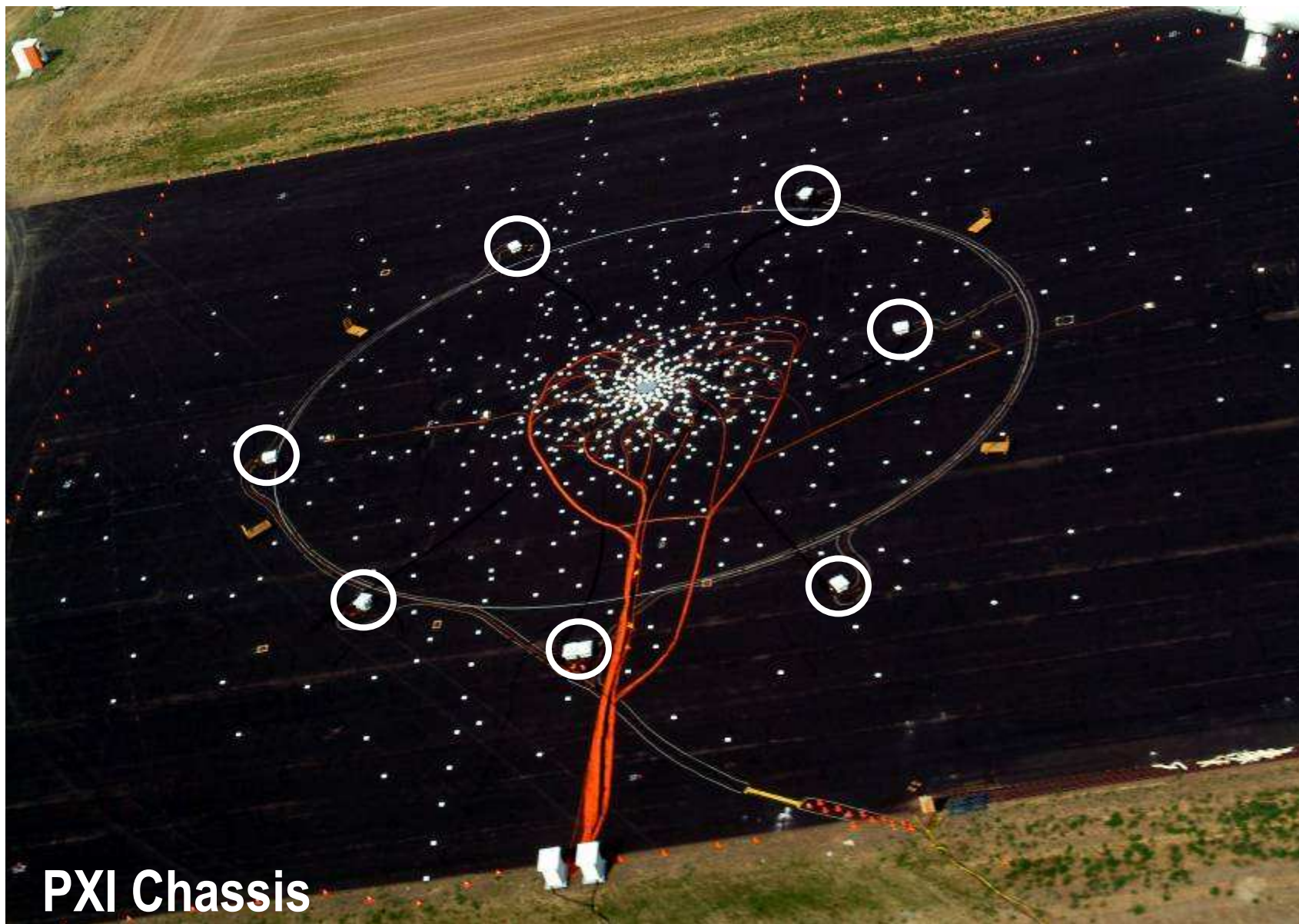
On-Board Processing

Non-Deterministic

Deterministic

PXI System





PXI Chassis

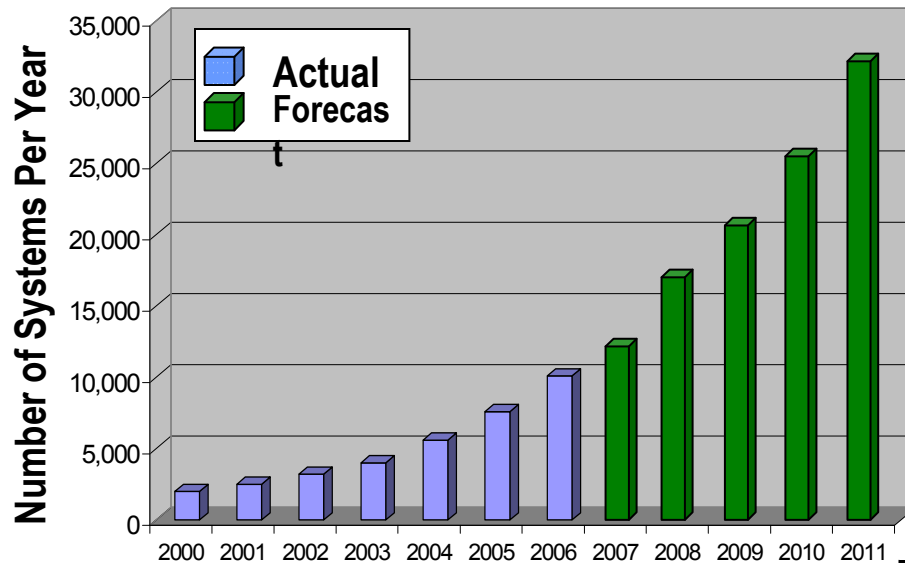
Partial PXISA Member List



Complete list at pxisa.org

PXI – The Fastest Growing Standard in Test

PXI System Sales Unit Forecast



**More than 1,500 PXI
Products Available!**

**23% CAGR forecast
for 2006 – 2012**

Source: World VXI & PXI Test Equipment
Markets, Frost & Sullivan, September 2006

	VXI	PXI
Est Market Revenue (\$Mil) in '06	255	170
Est # of Systems (Units) in '06	3600	10100
Avg System Price (\$K)	70.8	16.8
2005-2010 CAGR	4.2%	25.1%
# of Products	<1000	>1200

Source: Frost & Sullivan, World PXI and VXI Test Equipment Markets, April 2005, P3

Future PXI Growth Vs. Other Areas of T&M

Growth Through 2011

- Oscilloscopes 2.9%
- Multimeters 2.4%
- Overall T&M 5.0%
- PXI 25.1%

*Electronic Design
2006 Technology Forecast,
1/12/2006*

TEST & MEASUREMENT REVENUE FORECAST

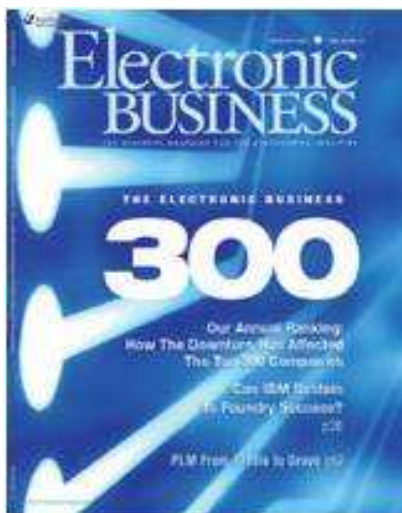
Instrument type	Revenues (\$ millions)		Compound annual growth rate
	2004	2011	
Electronic counters	55.0	69.6	3.4%
Signal generators	516.0	687.9	4.2%
Logic analyzers	217.1	260.8	2.7%
Oscilloscopes	1019.9	1245.7	2.9%
Network analyzers	282.9	380.2	4.3%
Spectrum analyzers	589.1	813.5	4.7%
Power meters	73.3	97.7	4.2%
Multimeters	447.8	529.4	2.4%
LCR meters	49.5	70.1	5.1%
PC-based	140.9	231.6	7.4%
VXI-based	236.6	315.0	4.2%
PXI-based	118.1	564.9	25.1%
AWG/function generators	93.7	141.3	6.0%
Total	3839.9	5407.7	5.0%

Source: Frost & Sullivan

With overall T&M revenues expected to grow by 5% per year, the greatest demand seems to lie in computer-based systems.

PXI Industry Adoption – Electronics Industry

- **9 of the 10** top Contract Manufacturers use PXI
- **17 of the 20** top Electronic Businesses use PXI



Source (Rankings): *Electronic Business*, August 2005
Source (PXI Use): *National Instruments*, June 2005

Electronic Business 300 – The Rankings

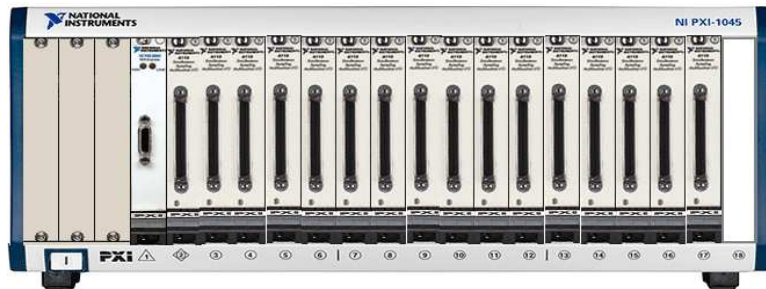
Rank	Company
1	IBM
2	Hewlett-Packard
3	Matsushita Electric Industrial
4	Siemens
5	Samsung Electronics
6	Dell Computer
7	Hitachi
8	NEC
9	Fujitsu
10	Sony
11	Nokia
12	Microsoft
13	Toshiba
14	Intel
15	Motorola
16	Canon
17	Philips Electronics
18	Ingram Micro
19	LG Electronics
20	Cisco Systems

Real-Time Measurements for Tokamak Control with Multicore PC and PXI Systems

Dell 2 Quad Core server connected to PXI-1045 (18 slots) by MXI-Express 2-port 8362 - 160MB/s



Max-Planck-Institut
für Plasmaphysik
EURATOM Association



- Fusion
- DAQ system + magnetic probes
- Magnetic equilibrium/Grad-Shafranov
- Function parameterisation
- Multicore processing application



Harvard Research Group Uses NI LabVIEW and PXI to Study Nanowire Growth

Application: Developing a highly flexible and compact lock-in amplifier

Challenge: Creating a virtual, high-channel-count, lock-in amplifier for nanotechnology research.

Products: LabVIEW, Modular Instruments, PXI/CompactPCI

Key Benefit: Flexibility to combine multiple PXI modules and instruments into one project.



“The system provides improved cost, smaller dimensions, and more flexibility than its traditional counterpart. NI: \$93,100 USD, Traditional: \$512,000 USD”

[Harvard Research Group Uses NI LabVIEW and PXI to Study Nanowire Growth](#)

Case Study – Freightliner Selects National Instruments LabVIEW and PXI to Verify Truck Assembly

- Freightliner selected LabVIEW and PXI to verify electrical assembly on its new line of heavy-duty trucks.
- Freightliner engineers integrated electrical test, machine vision and physical measurements into a system that not only ensures high-quality vehicles but also instructs operators on the correct assembly process.

“We set out to design a high-performance test system that would give us the flexibility of a completely off-the-shelf solution. This system delivers on both requirements and the successful development is reflective of the valuable relationships Freightliner enjoys with both external and internal resources.”



Case Study - PSA Peugeot Citroën Simulates Automotive Environments with NI LabWindows™/CVI and PXI

- PSA is Europe's second-leading automotive manufacturer, with strong growth in Latin America and China
- The company developed a modular test system for prototype vehicles that reduced functional test by half over traditional instruments

“By using an approach based on National Instruments LabVIEW software, integrating our simulation models with real-world I/O, we cut development time nearly in half, to 14 days. This is a key element to consider when reducing vehicle time-to-market.”

PSA PEUGEOT CITROËN



Testing a Multitone Transceiver with PXI and NI LabVIEW

Application: Use the NI PXI signal generation and digitizer hardware and the National Instruments LabVIEW Real-Time Module to provide hardware and software platforms for the physical layer of a real-time communications system.

Challenge: Prototype the physical layer of a communications systems to rapidly evaluate system design tradeoffs.

Products: LabVIEW RT, PXI and Modular Instruments

Key Benefit: Time savings, easy-to-make GUI

“The LabVIEW Real-Time Module and the PXI hardware allowed us to avoid time-consuming embedded programming and analog circuit design.”

Submitted paperr

