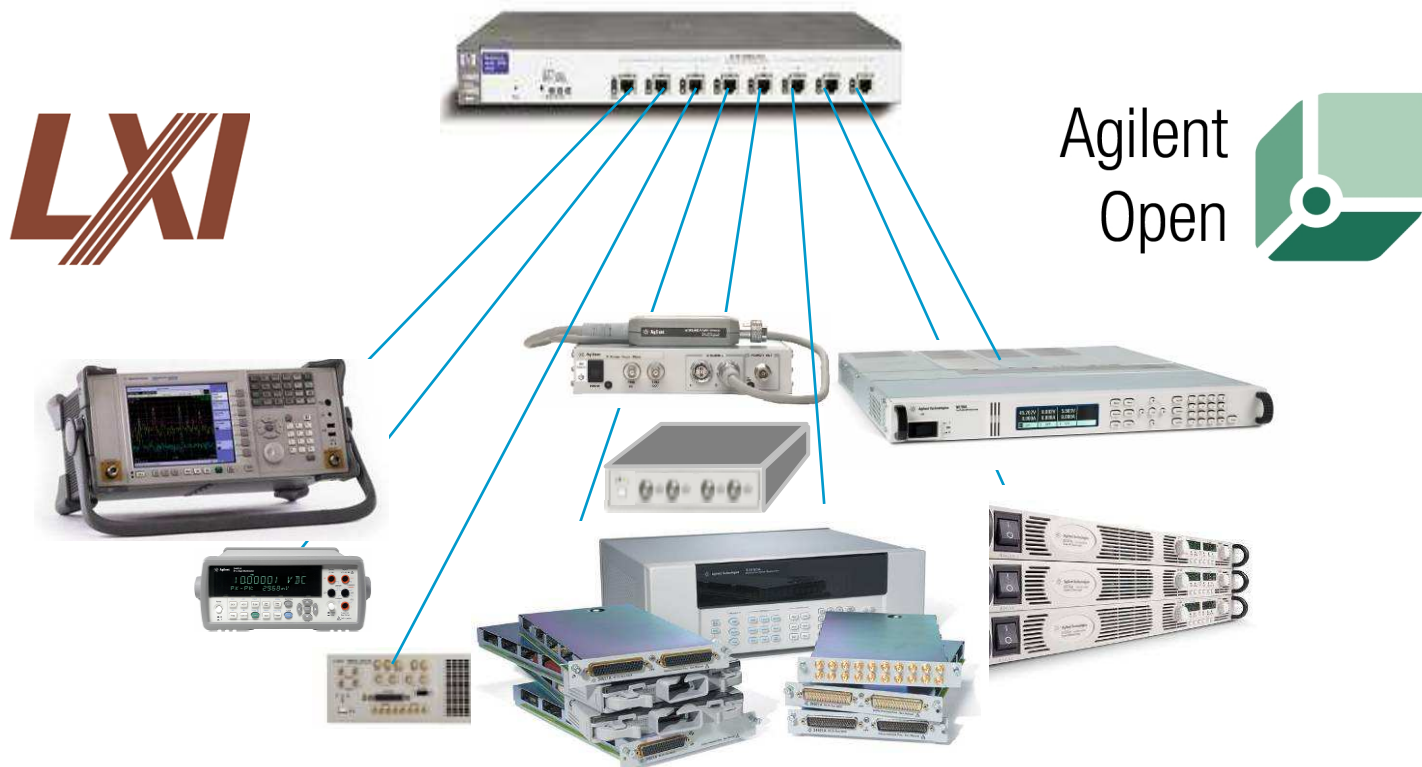


The Next Generation of Test

LXI and
Agilent Open



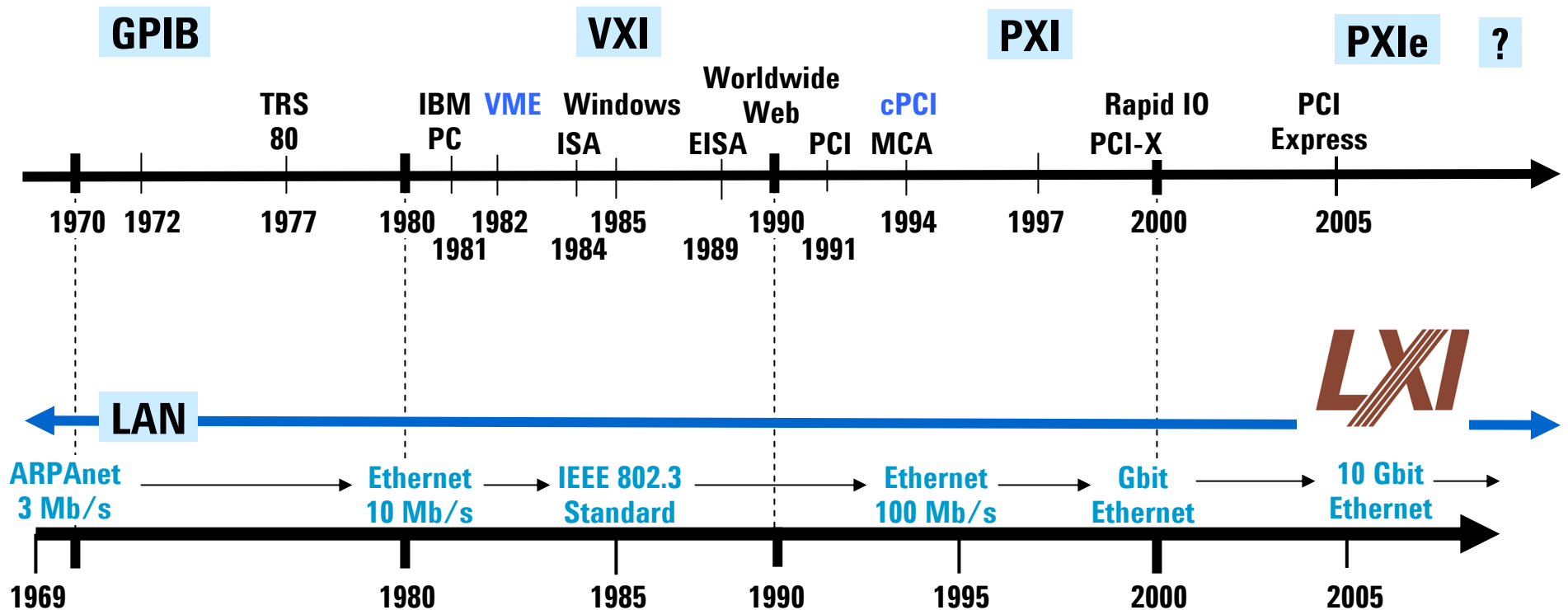
Major Test Challenges Today:

- Cost** – Instruments, rack, cables, software, training, transitions
- Performance** – Measurement accuracy/resolution/bandwidth, system throughput
- Compatibility** – Application software, PC standard I/O, existing instruments
- Flexibility** – Built-in measurements, personalities, test topologies, triggering
- Longevity** – Measurement performance, PC standard I/O, support life
- Ease of use** – Front panel operation, drivers, manuals, program monitoring
- Size** – Sized for performance, reduce rack space, faceless modules (military)

Today's Test System Architectures

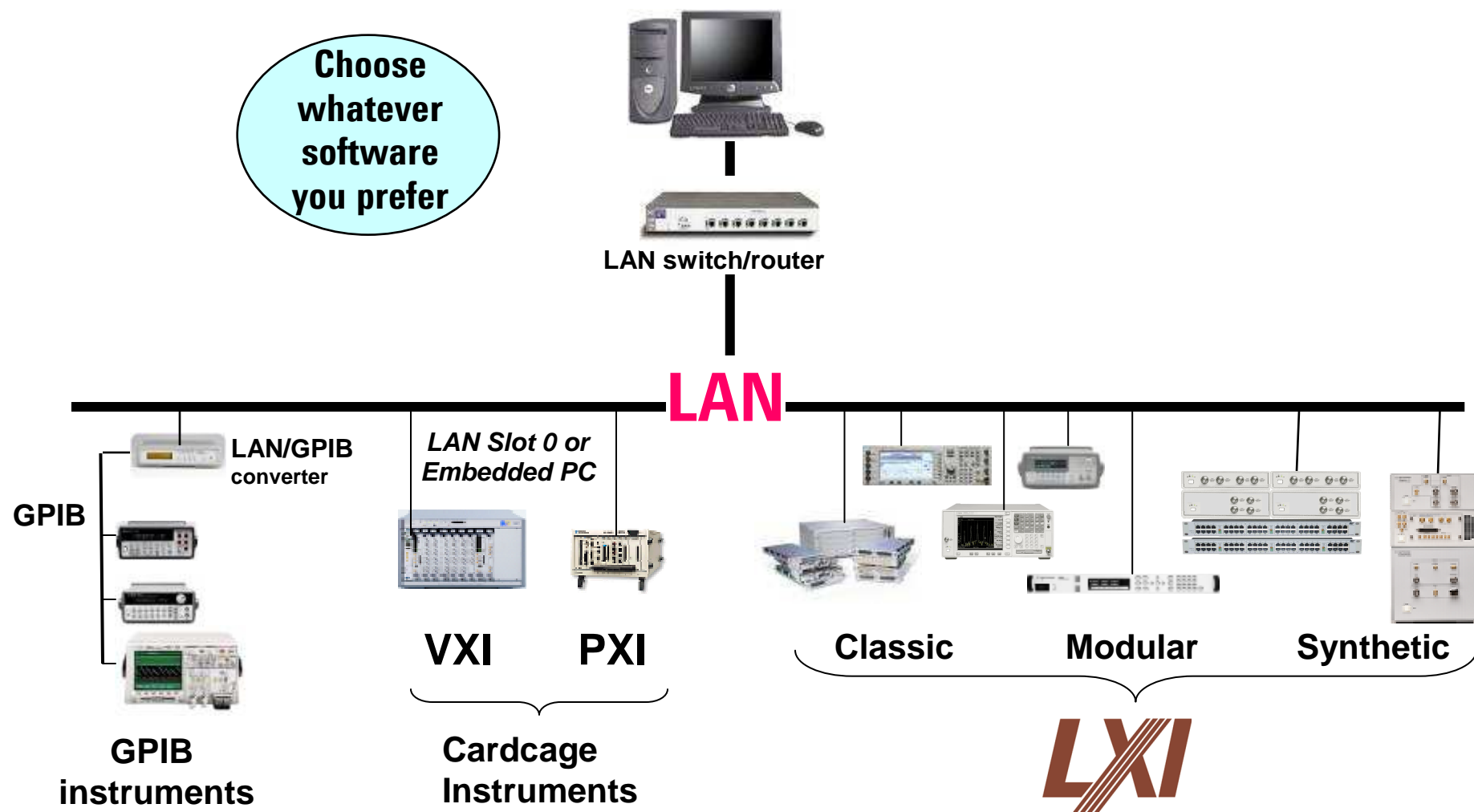
	GPIB	VXI	PXI
Cost	GPIB card and expensive cables	Cardcage, Slot 0, MXI card/cable	Cardcage, Slot 0, MXI card/cable
Measurement performance	Best measurement performance	Limited by module size power / cooling	Limited by module size / power / shielding
I/O performance	Slow interface (1 MB/sec)	Fast backplane and I/O	Fast backplane and I/O
Compatibility	>90% of existing test systems, T&M I/O	Cardcage, non-standard I/O (MXI)	Cardcage, non-standard I/O (MXI)
Flexibility	Download personalities Limited to 14 instruments	13-slot Cardcage, Limited intelligence	17-slot cardcage, No intelligence
Longevity	All major vendors (>30 years)	Based on VME, limited suppliers	Based on C-PCI, data acquisition
Ease-of-use	Front panel, SCPI, drivers, built-in intelligence	No front panel, Mostly register-based	No front panel, Register-based
Size	Sized for performance with front panel	Large modules that require a cardcage	Small modules that require a cardcage

Why LXI?



- PC backplanes change too rapidly
- Test industry is moving to PC standard I/O (LAN, USB)
- LAN has demonstrated longevity and backwards compatibility
- Computer industry continues to improve LAN

LAN as the system backbone



LXI is widely endorsed



The LXI Consortium is a not-for-profit corporation made up of the leading companies in the Test and Measurement Industry.

www.lxistandard.org

LXI Consortium Members

- Agilent
- VXI Technology
- Keithley
- Rohde & Schwarz
- Pickering
- National Instruments
- Aeroflex
- BAE Systems
- Xantrex Technology
- TTI - Thurlby Thandar Instruments
- Anritsu
- Bruel & Kjaer
- Adlink
- California Instruments
- Complete Networks
- Beijing Aerospace
- Beijing Institute of Metrology & Meas
- Goepel
- Lambda
- EADS N. Am. Defense
- LXI Instruments
- Teradyne
- Tektronix
- The Math Works
- Universal Switching
- Ztec Instruments
- Acqiris
- AMREL
- JDS Uniphase Corp
- Intepro Systems
- Pacific Power Source
- Com DEV, Ltd.
- Symmetricom
- Altera Corp.
- Holding Informtest
- SofTec Microsystems
- C&H Technologies
- Circuit Assembly Corp
- Data Patterns
- Data Translation
- Dept of Defense
- Geotest/Marvin
- Kepco
- Pacific MindWorks
- Hitech Group Intl.
- Symtx
- Yokogawa Electric
- Digalog Systems
- Rigol Technologies

Consortium President: Bob Rennard, Agilent

What is LXI?



LAN Extensions for Instruments



What is LXI?



Based on
existing
standards

Applying proven standards to test & measurement

Physical standards

(IEC sizes, Power, Cooling, Front panel Indicators, Reset button)

Instrument web pages

(Information, Set-up, control, and data access from a web browser)

Interface standards

(IVI driver, VXI-11 discovery, Device locking, Security)

Ethernet standards

(TCP/IP, DHCP, URL / IP addresses, Dynamic DNS, Auto-MDIX)

Trigger standards (optional)

(LAN triggers, IEEE 1588 time synchronization, Trigger bus)



Major components of the LXI Standard

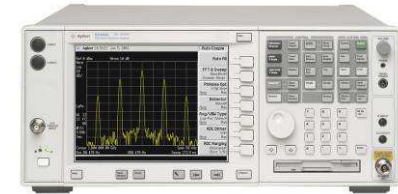
Physical	Physical Consistency
Synchronization & Triggering Hardware Triggering Module to Module Communications	New synchronization
LXI Programming (Drivers)	IVI drivers
LAN Connection LAN Configuration LAN Discovery	Ethernet
Web Interface	Instrument pages
Security Documentation Trademark and licensing Compliance	LXI compliance

LXI allows flexible sizes

**Classic
Bench**



High performance



**Faceless
modular**



No cardcage



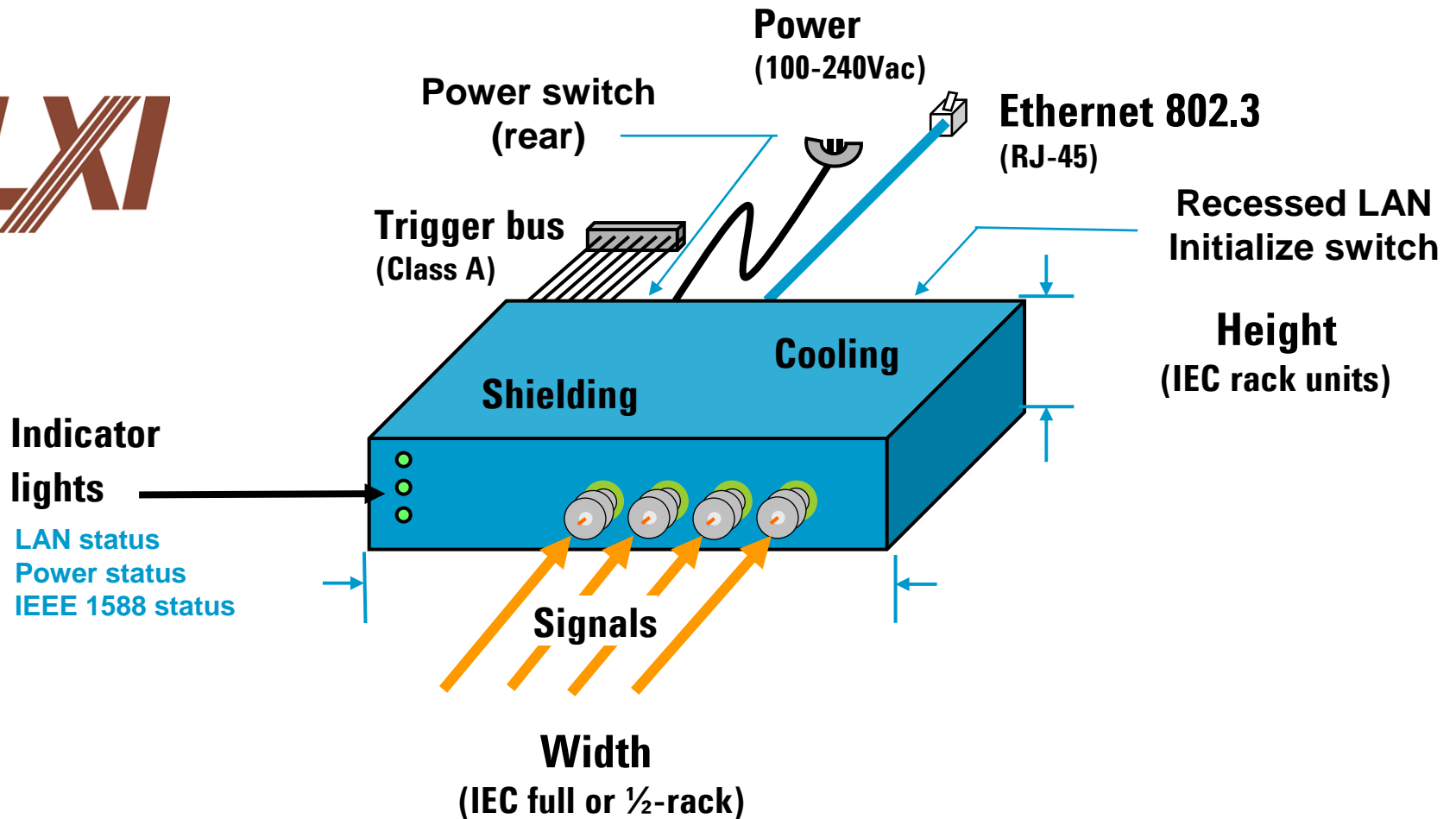
**Remote
devices**



Remote operations



Physical standards for modules



NOTE: The LXI specification defines 1U, 1/2-rack modules and their rack mounting

LXI devices serve a web page



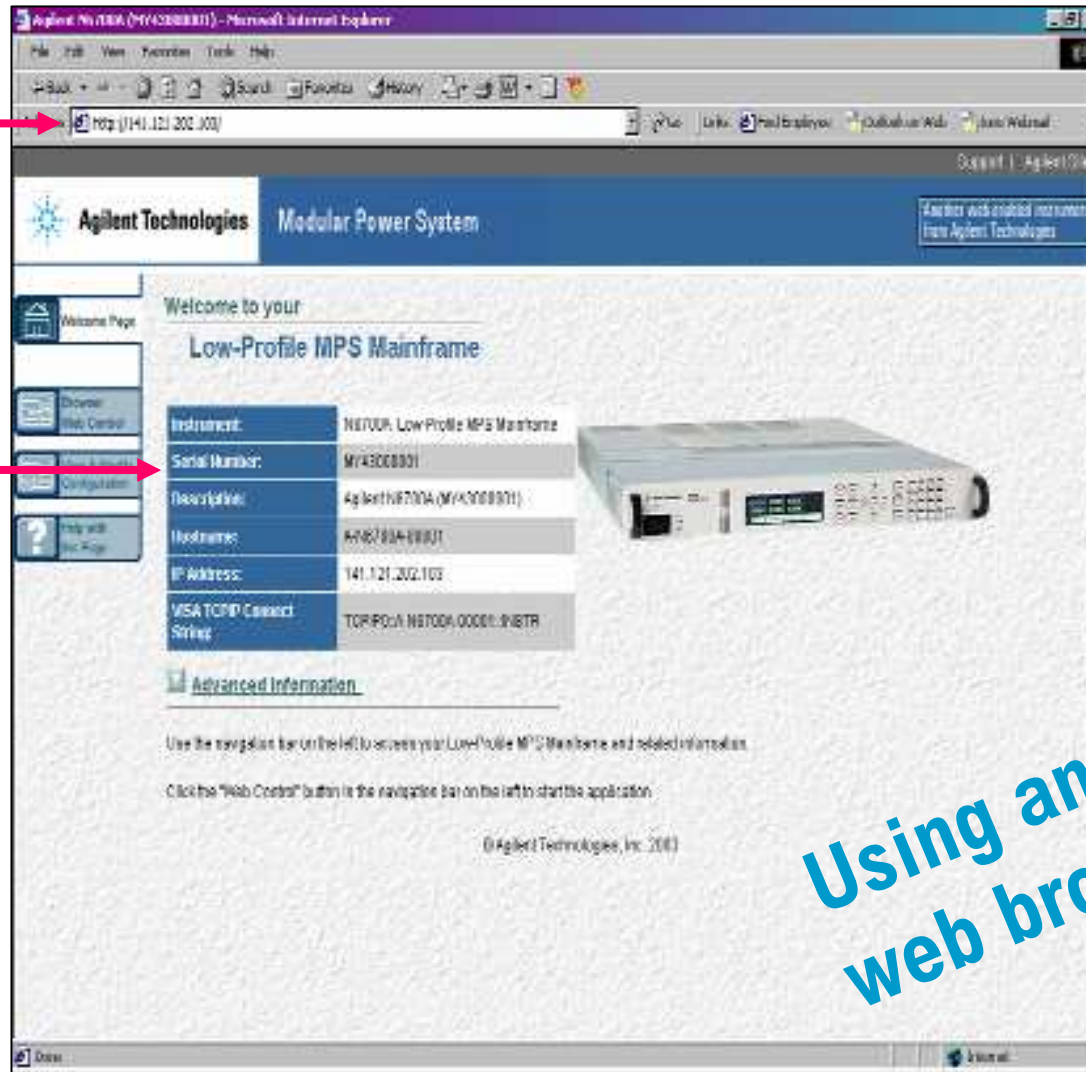
IP Address



Manufacturer
Model #
Serial #
Firmware rev.
IP Address
Domain name
etc.



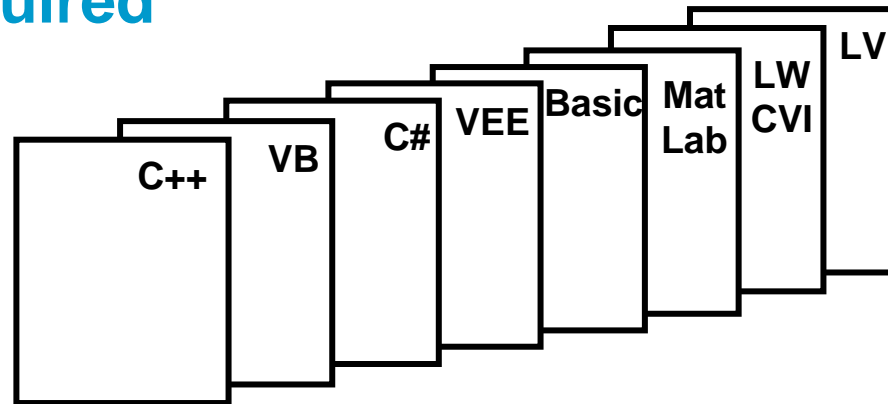
Ability to
change the
IP address



Using any standard
web browser

LXI provides a programmatic interface – IVI driver required

Work in the software environment you prefer



Use industry standard drivers

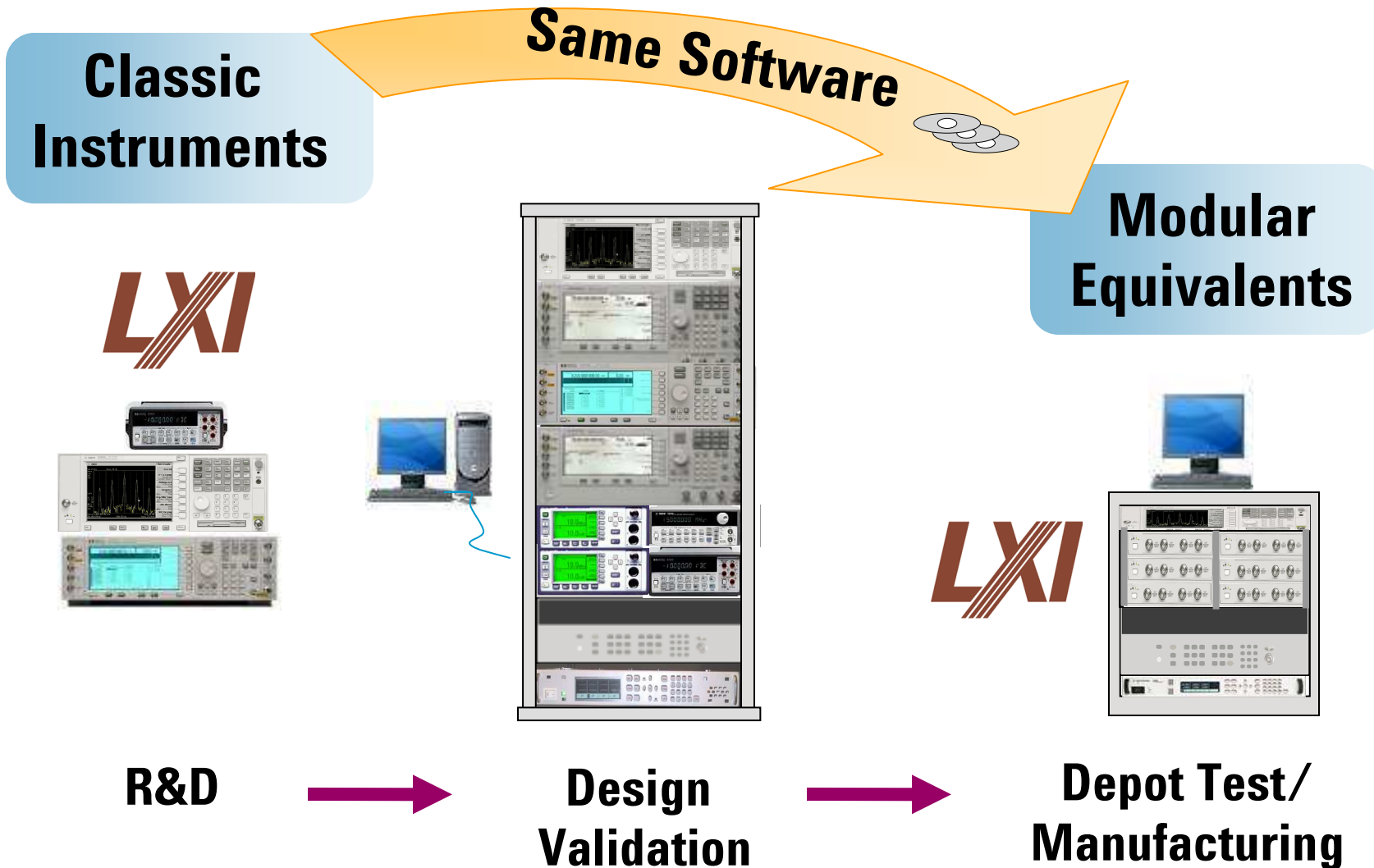


Work with all types of instruments

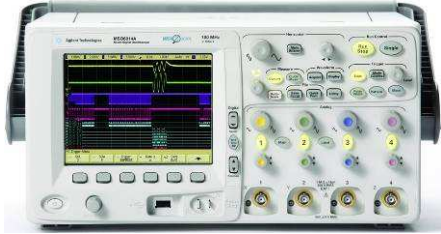


Build a versatile system

Leverage your software



Examples of standard, modular and compact instruments



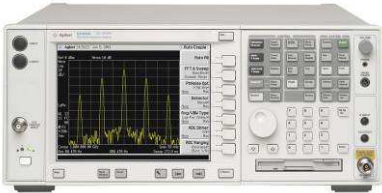
Power supplies

RF Signal Generator

Oscilloscope



Power meter



Time trigger



Switch/measure

**Spectrum Analyzer
Synthetic Instruments**



DMM

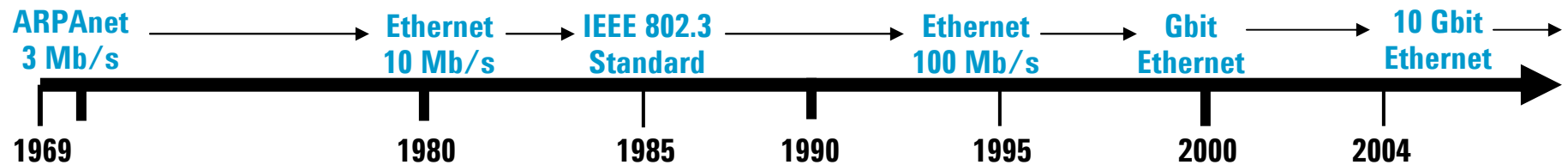


LXI increases I/O speed

GPIB	1.0 MB/s
USB 1.0	1.5 MB/s
100 Mb LAN	12.5 MB/s
USB 2.0	60.0 MB/s
VXI	80.0 MB/s
Gbit LAN	125.0 MB/s



125x improvement



LXI reduces overhead costs

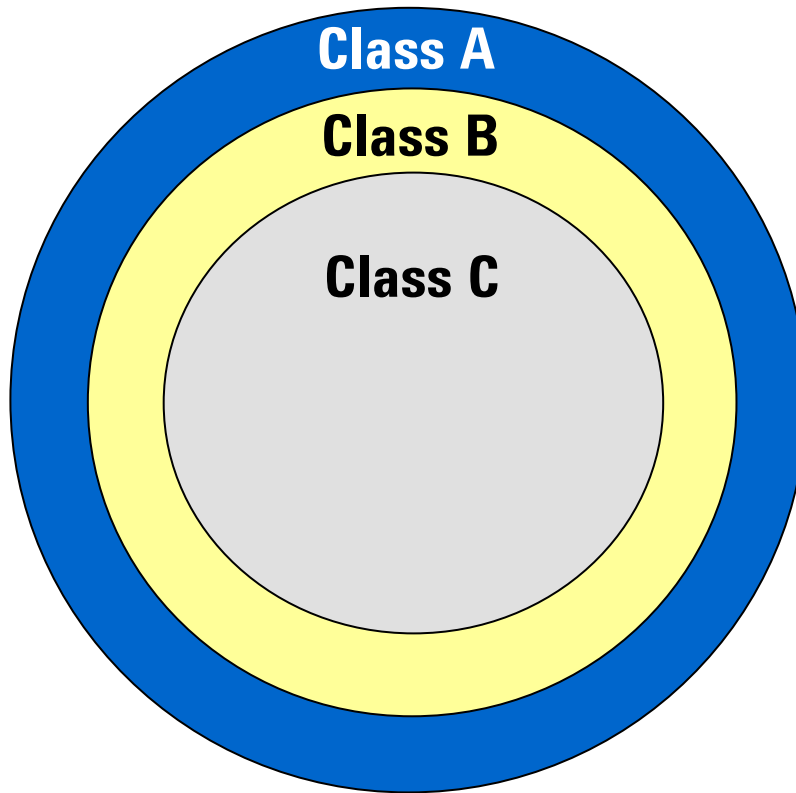
System costs for up to 7 instruments (US\$)



	VXI 13-slot	PXI 14-slot	GPIB	LAN
Interface card	\$50 (Firewire)	\$700 (MXI-4)	\$500	\$70*
Cable	\$	\$125	\$700	\$25
Cardcage	\$4400	\$3500	\$0	\$0
Slot 0	\$2534	\$800	\$0	\$0
Total	\$6984	\$5125	\$1200	\$95

* No interface card required – use 16-port switch – Linksys SR216 (\$70)

3 Classes of LXI



Class C (base class)

Ethernet standards
IVI driver
Instrument web page
Physical
Size / Shielding
Power / Cooling
Indicators / reset button

Class B

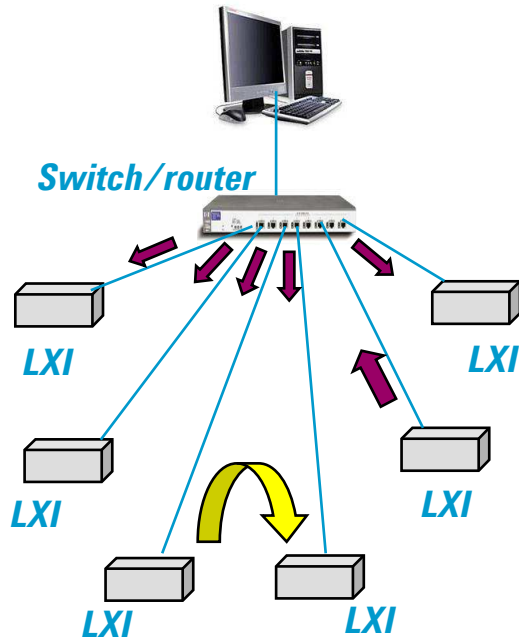
Class C plus
IEEE 1588 time sync
LAN messaging

Class A

Class B & C plus
Hardware trigger bus

LXI Triggering

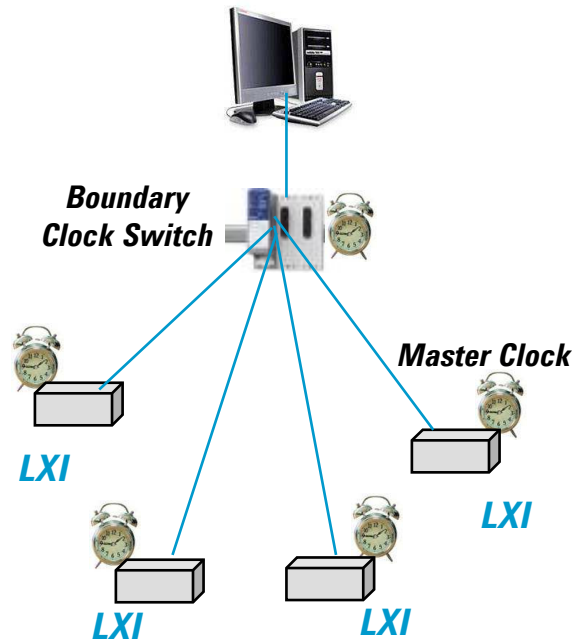
LAN triggers (Class B)



Message
Peer-to-peer
Multi-cast

< 1 ms

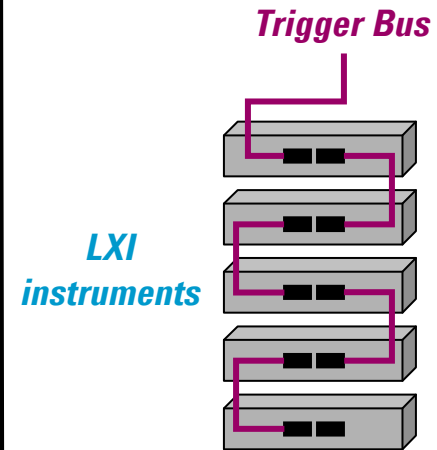
IEEE-1588 triggers (Class B)



Time
Time synchronization
Time stamps

<100 ns

Trigger Bus (Class A)

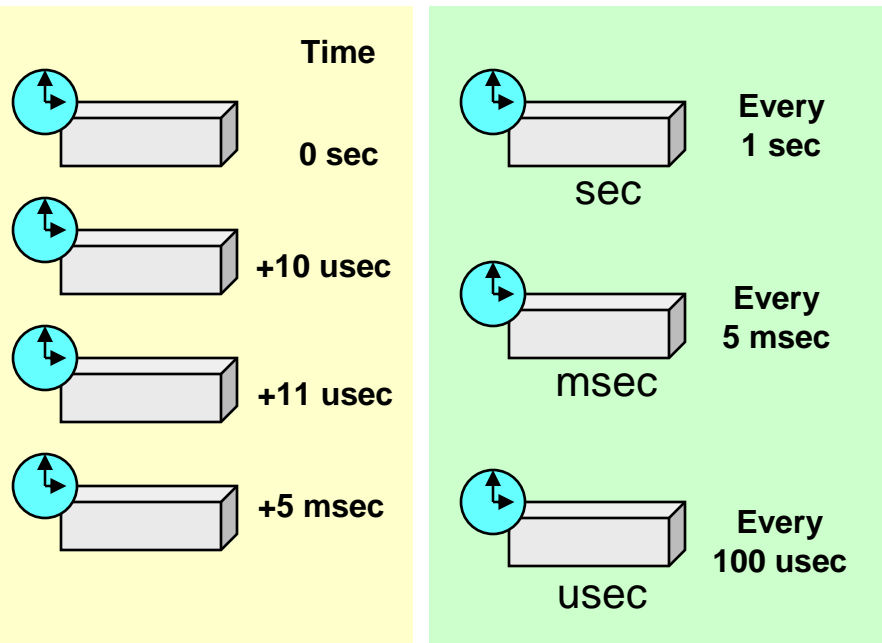


Hardware
Instruments close
together

5 ns/ meter

What does IEEE 1588 give you?

Synchronization



Start actions
in a sequence

Synchronize timing
even when running
at multiple rates

Time Stamps

Measurement 1	000000	Instrument #1	0100	15.11178	EVENT
Measurement 2	000200	Instrument #1	0200	15.23422	
Trigger 3	000300	Instrument #1	0300	16.00101	
Measurement 3	000310	Instrument #2	0100	385443	
Measurement 3	008000	Instrument #2	0200	386332	
Measurement 4	008030	Instrument #2	0300	387119	
Trigger 5	010000	Instrument #3	0100	000333	
Measurement 5	010030	Instrument #3	0200	000335	
Measurement 6	012000	Instrument #3	0300	000440	
Measurement 7	030000				

Troubleshoot
test sequences

Correlate
data

LXI is the Future of Test

	GPIB	VXI	PXI	LXI
Cost	GPIB card and cables	Cardcage, Slot 0, MXI card/cable	Cardcage, Slot 0, MXI card/cable	LAN built into PC LAN cable = \$5
Measurement performance	Best measurement performance	Limited functionality	Limited functionality	Best measurement performance
I/O performance	Slow interface (1MB/sec)	Fast backplane and I/O	Fast backplane and I/O	Gbit LAN = 125x GPIB
Compatibility	>90% of existing test systems, T&M I/O	Cardcage, non-standard I/O (MXI)	Cardcage, non-standard I/O (MXI)	LAN as the backbone + converters for other architectures
Flexibility	Personalities, 14 instruments, Limited distance	13-slot cardcage, Limited intelligence	17-slot cardcage, Small modules, No intelligence	Intelligence, Long distances, Unlimited instruments, New triggering
Longevity	All major vendors (>30 years)	VME, limited suppliers	C-PCI, data acquisition	All major vendors + computer standards
Ease-of-use	Front panel + drivers	No front panel, Register-based	No front panel, Register-based	Front panels + drivers + web interface
Size	Front panel	Large modules require cardcage	Small modules require cardcage	Flexible sizes, Front panel or faceless