



***Ethernet-Based  
Instrumentation for ATE  
&  
Data Acquisition***

High-Density Modular Instruments  
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# An Aging Instrumentation Interface

## ➤ Today's Primary Standard

### ✓ GPIB

#### ❖ Proven Standard but Limited

- > 40 Years Old
- Slow Data Transfer Rates
- Limited Interconnect Distances
- Difficult to Route Cabling

## ➤ Typical Application Space

- ✓ Small to Medium Density

## ➤ Technical Challenges

- ✓ Increased Bandwidth
- ✓ High-speed Transfer Rates
- ✓ Synchronization
- ✓ Open Standard Compatibility
- ✓ Interoperability
- ✓ Ease of Use



# Ethernet Emerges as the Logical Choice

## ➤ High Speed Serial

- ✓ Eliminates Cabling Concerns
- ✓ Provides Required Bandwidth & Data Rates

## ➤ Wide Range of Choices Have Emerged

- ✓ Firewire
- ✓ USB
- ✓ CAN
- ✓ Ethernet

## ➤ Ethernet Leads the Way

- ✓ The Most Widely Used Communications Interface
- ✓ Vanilla Flavor Still Not Suitable for ATE

## ➤ LXI Standard

- ✓ Addresses Instrumentation Specific Ethernet Requirements

# What Is LXI?

## ➤ LAN eXtensions for Instrumentation

- ✓ Addressing the Growing Need for a Standard Interface to Replace IEEE-488 GPIB & PCI Variants

## ➤ **Key Advantages of LXIbus**

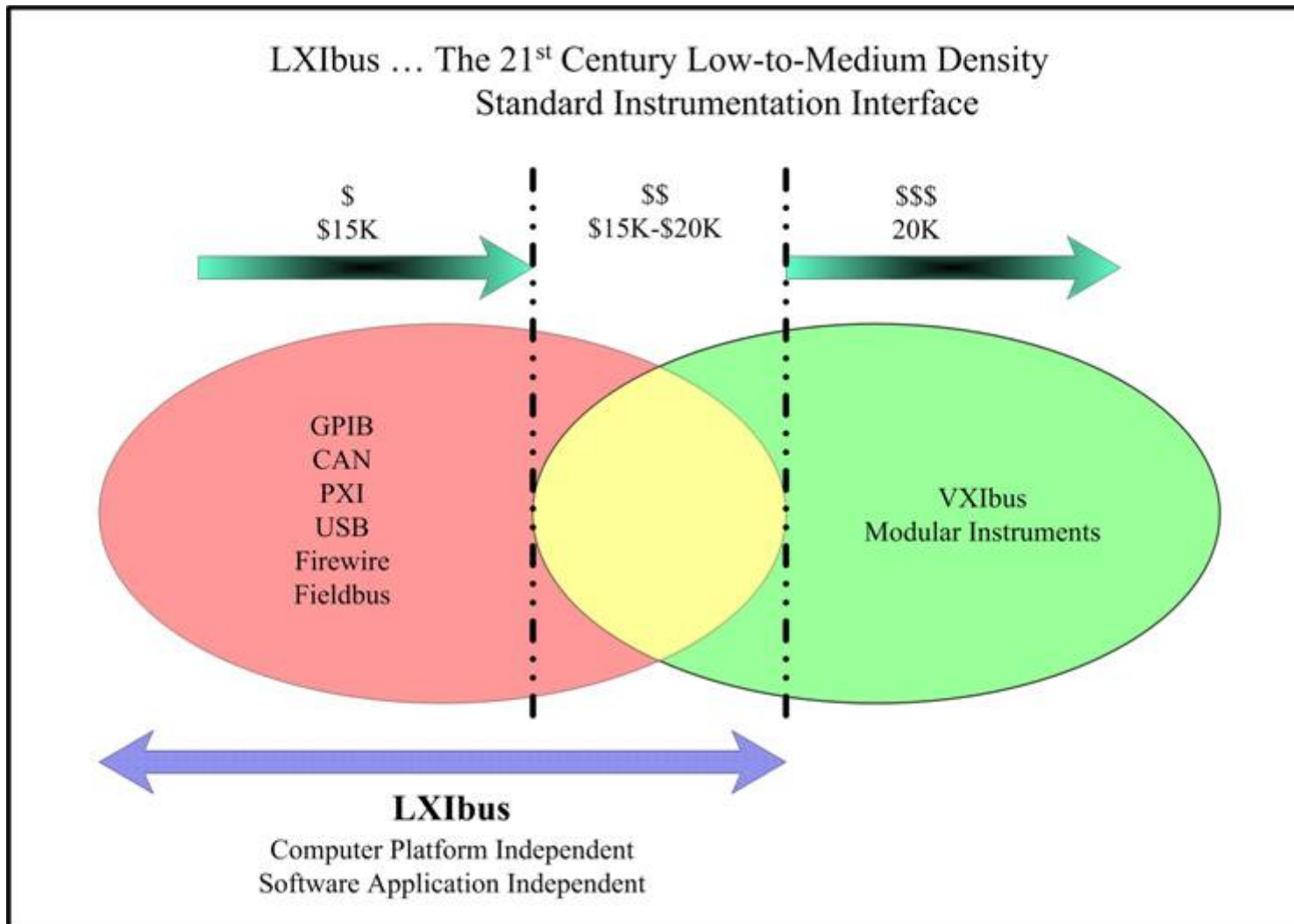
- ✓ High-speed I/O
- ✓ Instrument Grade Measurements
- ✓ Compact / Flexible Packaging
- ✓ Tight Device Synchronization
- ✓ Standard API
- ✓ Modularity
- ✓ Resolves Vanilla Ethernet Limitations
- ✓ Ideal for Small to Medium Size Applications



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# LXI Application Space



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# LXI Fundamentals

## ➤ LXI Standards Definition

- ✓ Cooling
- ✓ Triggering
- ✓ Hardware Interfaces
- ✓ Software Interfaces
- ✓ EMI/RFI
- ✓ Device Synchronization
- ✓ Mechanical Parameters
- ✓ Electrical
- ✓ Device Interoperability
- ✓ Power

# LXI Fundamentals

## ➤ Standard Ethernet I/O

- ✓ Based on IEEE802.3 Ethernet Technology
  - ❖ Continually Evolving
    - 10Mb → 100Mb → 1Gb → 10Gb → +++
  - ❖ Backward Compatibility
  - ❖ Standard Connections
- ✓ Most Widely Used Communications Interface
  - ❖ Available on Virtually Every Computer
  - ❖ Independent of OS Implementation
  - ❖ Built-in Interfaces
    - Eliminates Cost of Additional GPIB Card

# LXI Fundamentals

## ➤ Standard Ethernet I/O

### ✓ Long Inter-device Connectivity

- ❖ 100 Meters Point-to-Point
- ❖ 200 Meters w/Router/Switch
- ❖ Kilometers Utilizing Fiber

### ✓ Simplifies Cabling

- ❖ Standard CAT-5
- ❖ Easy to Route and Install

### ✓ Device Interconnect

- ❖ Inexpensive Hubs, Routers, Switches



# LXI Fundamentals

## ➤ Standard Software Implementation

- ✓ TCP/IP
  - ❖ Provides Basic Services
  - ❖ Guaranteed Message Delivery
- ✓ VXI-11
  - ❖ Instrument Broadcast & Discovery
  - ❖ Required VISA Library Support
- ✓ Standard API Interface
  - ❖ Simplifies Development
  - ❖ Common Syntax
  - ❖ Supports PC Industry Standards
  - ❖ COM & C
- ✓ Embedded Web Server Interface



# LXI Key Advantages

## ➤ Standard Synchronization & Timing

- ✓ Network Time Protocol (NTP)
  - ❖ Most Commonly Used Network Time Protocol
    - Typical Millisecond Level Accuracies
  - ❖ Sufficient for Average Computer Time
  - ❖ Many T&M Applications Require Better Synchronization
- ✓ LXI Expands Basic Ethernet Functionality
  - ❖ IEEE 1588 Precision Timing Protocol (PTP)
  - ❖ LXI Trigger Bus Auxiliary Interface

# LXI Key Advantages

## ➤ Standard Synchronization & Timing

### ✓ IEEE 1588 / Precision Time Protocol (PTP)

#### ❖ Provides Deterministic Time Synchronization

- Nano-second Level (Gigabit Ethernet)

#### ❖ Implementations

- Userland
- Kernel-level Driver Modification
- Hardware Implementation

#### ❖ IEEE-1588 Standards Continue to Evolve

### ✓ Trigger Bus

#### ❖ Precise LVDS Auxiliary Trigger Interface

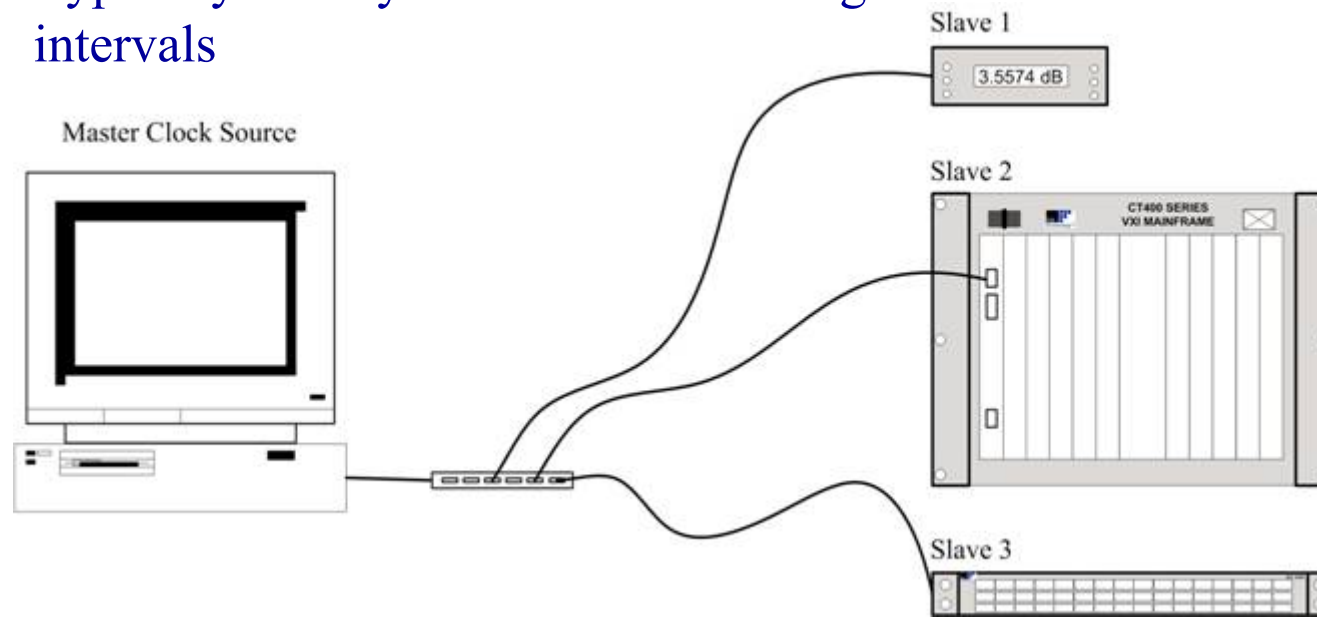
#### ❖ Permits Integration of VXI & Other Non-LXI Interfaces

#### ❖ Dedicated Hardware Trigger Implementation

# PTP Implementation

## ➤ Synchronization Process

- 1) Master clock device transmits initial message with PTP time stamp
- 2) All slave devices receive message and log time
- 3) Master transmits follow-up message with exact time of first transmission
  - a) Compensates for latencies due to collisions, processing, etc.
- 4) All slaves receive follow-up message and compute exact time based on initial and follow-up time stamp data
- 5) Typically PTP synchronization messages will be transmitted at 2 second intervals



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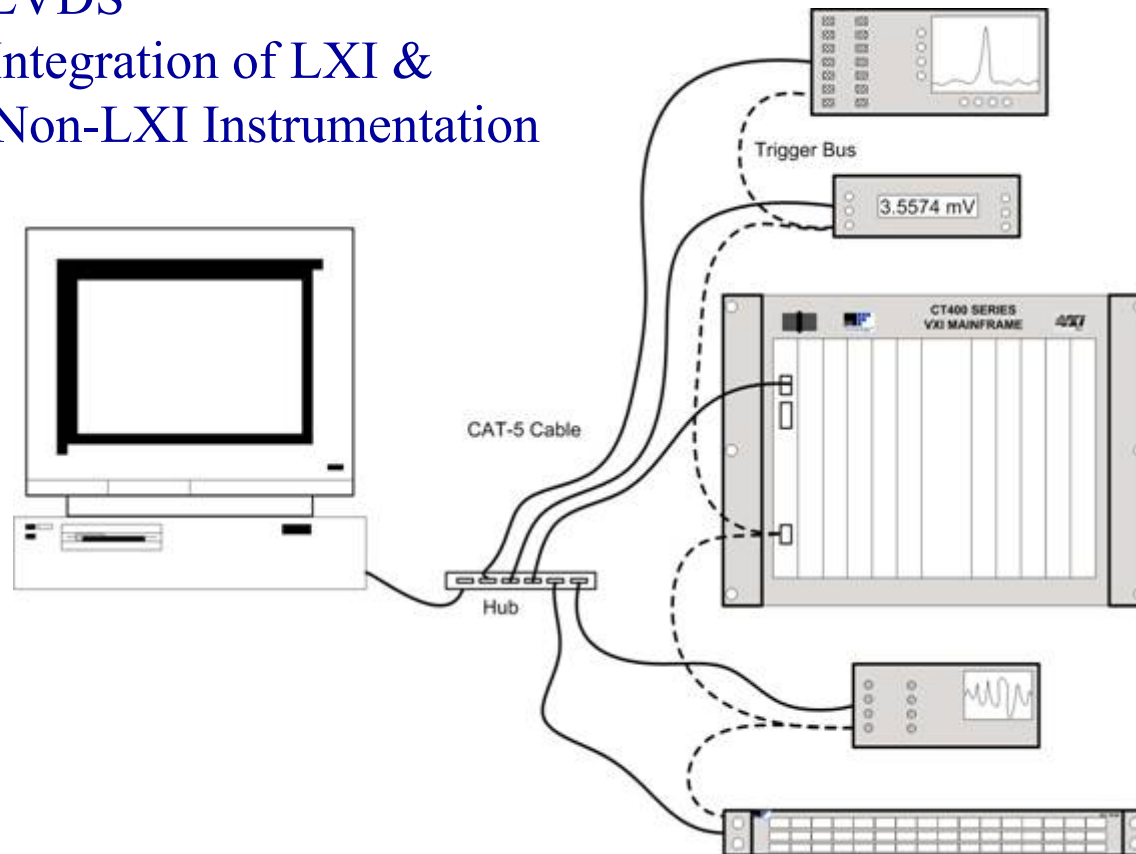
# Trigger Bus Implementation

## ➤ Trigger Bus Configuration

✓ Deterministic Device Triggering

❖ LVDS

❖ Integration of LXI &  
Non-LXI Instrumentation



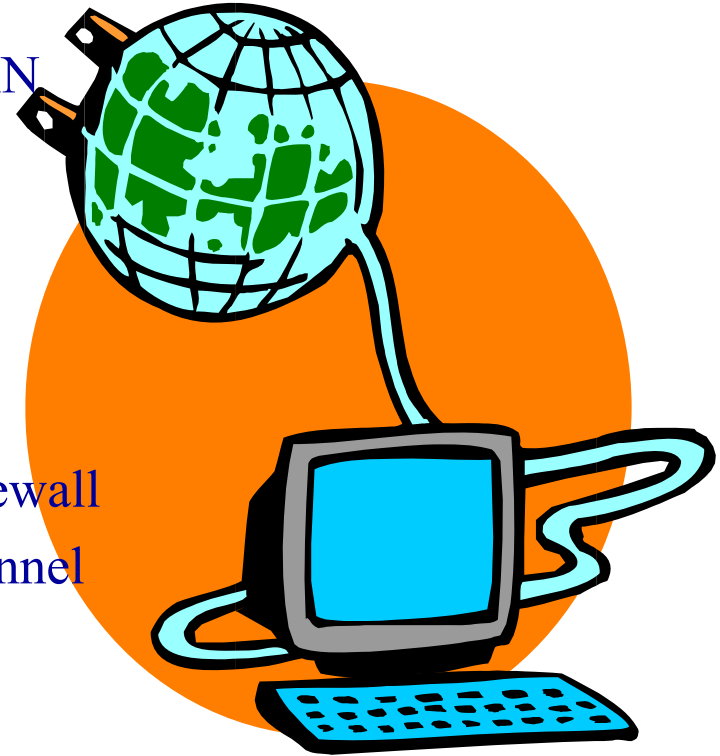
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# ATE LAN Implementation

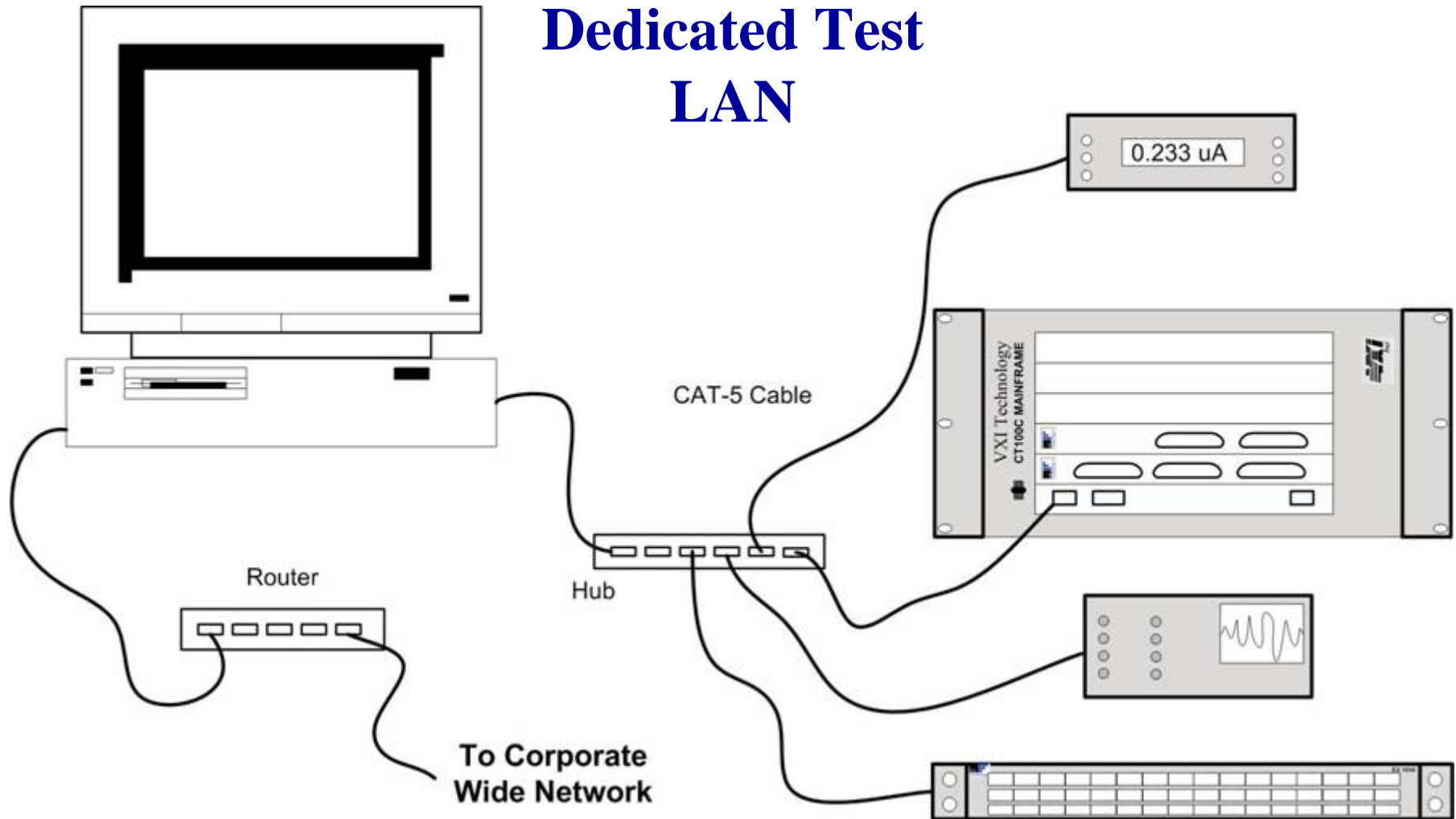
## ➤ Dedicated Test LAN

- ✓ Partitioning
  - ❖ Separates Corporate LAN & Test LAN
- ✓ LAN Traffic
  - ❖ Minimizes Collisions
  - ❖ Reduces Latencies
- ✓ Security
  - ❖ Contains LAN Behind Corporate Firewall
  - ❖ Restricts Access to Authorized Personnel
- ✓ Corporate IS
  - ❖ Minimizes IS Interaction
  - ❖ Reduces TCP/IP Allocation Issues



# ATE LAN Implementation

## Dedicated Test LAN



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# LXIbus Consortium

## ➤ Who Are We?

- ✓ Not-for-profit Corporation Comprised of Leading Companies in the Test and Measurement Community

## ➤ Our Goal

- ✓ Develop, Support, and Promote the LXIbus Standard

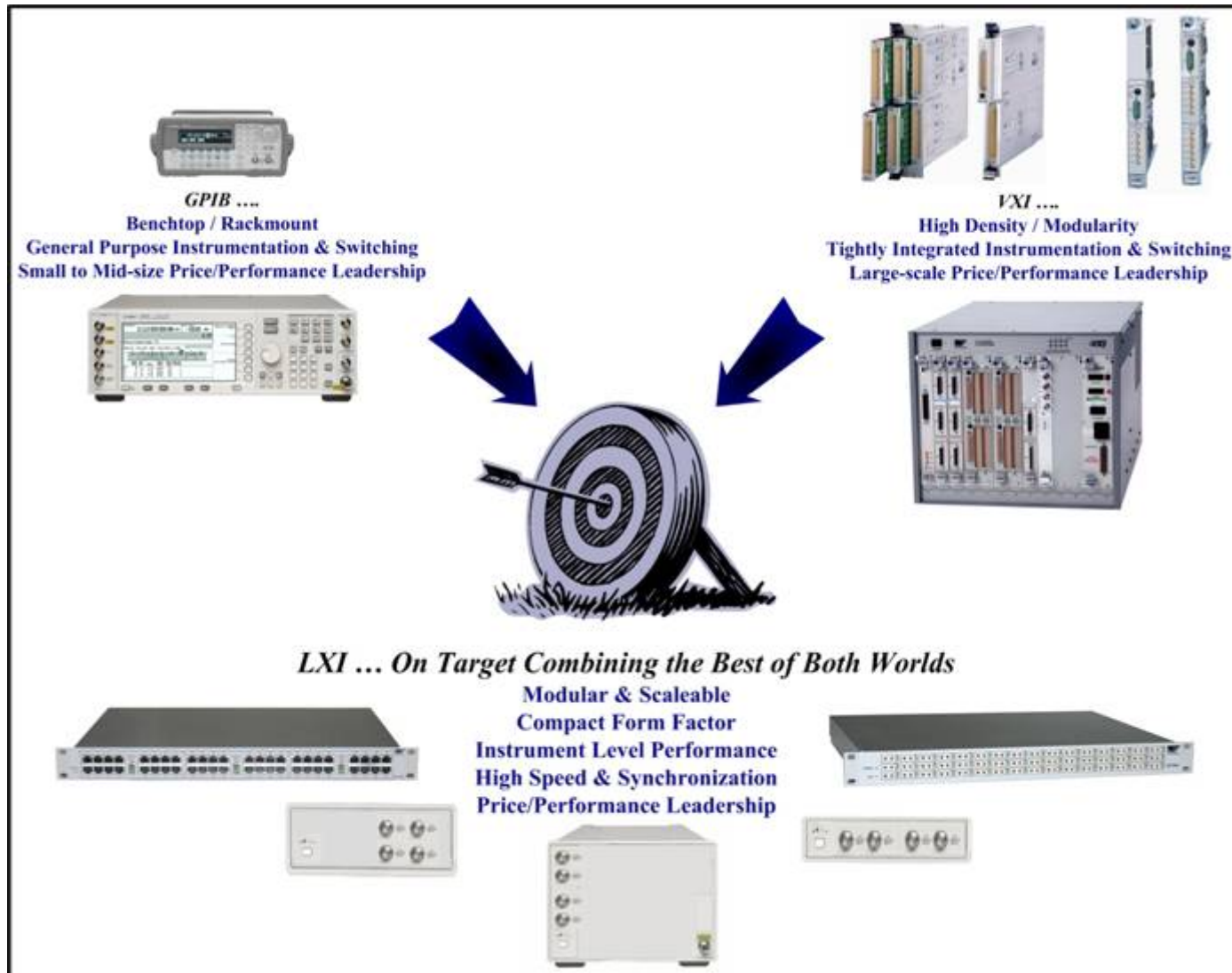
## ➤ Founding Members

- ✓ VXI Technology, Inc.
- ✓ Agilent Technologies

## ➤ Why Agilent & VXI Technology?

- ✓ Both Companies Have Been Independently Involved in Significant LAN-based Product Development Activities

# LXI ... 21<sup>st</sup> Century Solution



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