Making the Connection Between LXI and VXI

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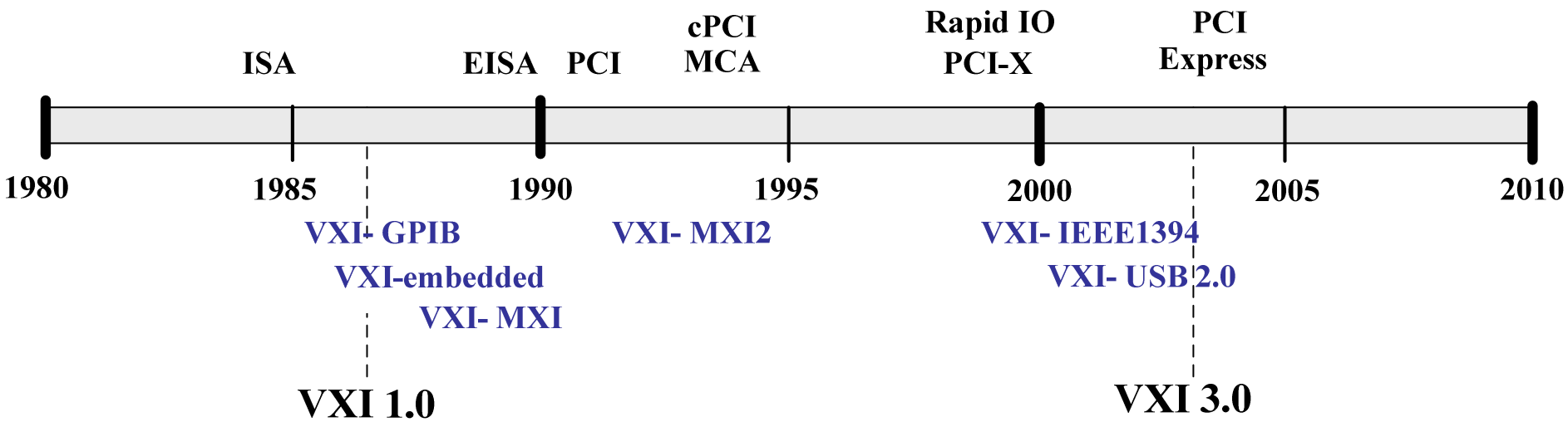
LXI tm LAN eXtensions for Instrumentation

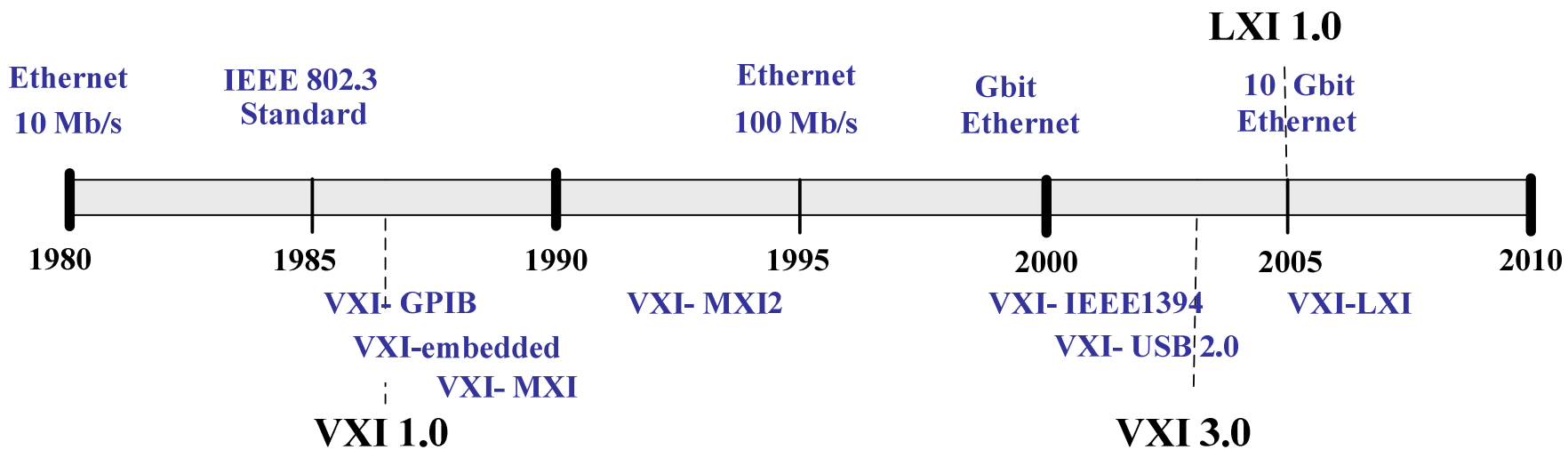
VXI – A Resilient Instrumentation Platform

- The VXI platform has consistently adapted to newer communication bus technologies over its 19 year history
- Provides a thick layer of insulation from obsolescence issues inherent to PC bus architecture which ensures test systems will outlive the products that are tested on it



Enhancing VXI Through LXI

- Large installed base of VXI-based systems, especially in mil-aero
- Continues to excel in high-density ATE applications
- LXI provides a stable, and platform-independent comms interface consistent with VXIbus history



Why Ethernet as a link to VXI?

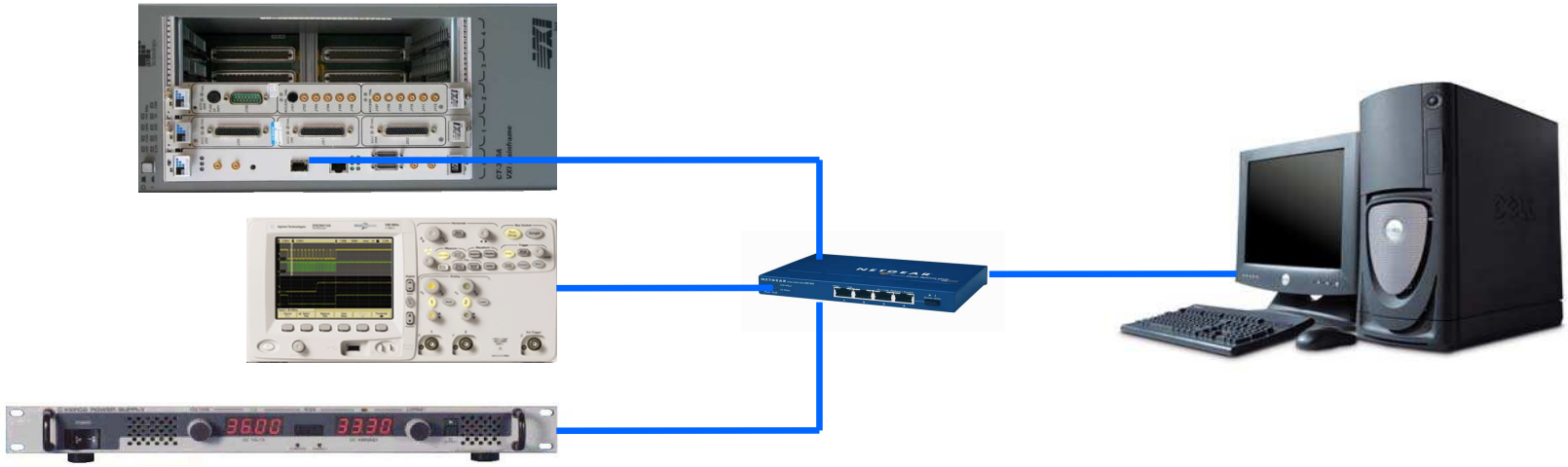
- High-speed bus that continues to evolve
- Simplified hardware infrastructure
  - Low-cost COTS cabling and accessories (switching/routers…)
  - No additional hardware needed in PC
- Stable architecture that provides b/w compatibility with previous implementations
  - Mitigates risk for long-term application requirements critical to applications requiring long support cycles
- Significant distances between host PC and instrumentation
  - Allows for distribution of measurement functions across distances
  - Enables test development assets to be shared <u>globally</u>

Why LXI as a link to VXI?

- As with VXI to VME and PXI to cPCI, LXI adds mission critical extensions to Ethernet, specific to T&M applications
- Builds upon the strengths previously mentioned
- Provides a standard to which all suppliers must adhere
  - Essential for vendor-vendor interoperability
- TriggerBus extensions for precision inter-module handshaking
- IEEE-1588 for precision synchronization of network notion of time
- Embedded web interface
  - Simplified maintenance infrastructure

VXI and LXI Hybrid Systems

- Goal is to preserve existing investment in VXIbus hardware and software while integrating new LXI products
- Adapt VXI systems by integrating a VXI-LXI slot 0 ‘bridge’ device, such that VXI subsystems can be discovered on an LXI network
- Maintain backward compatibility for seamless integration



LXI-VXI Slot 0 Bridge Implementation

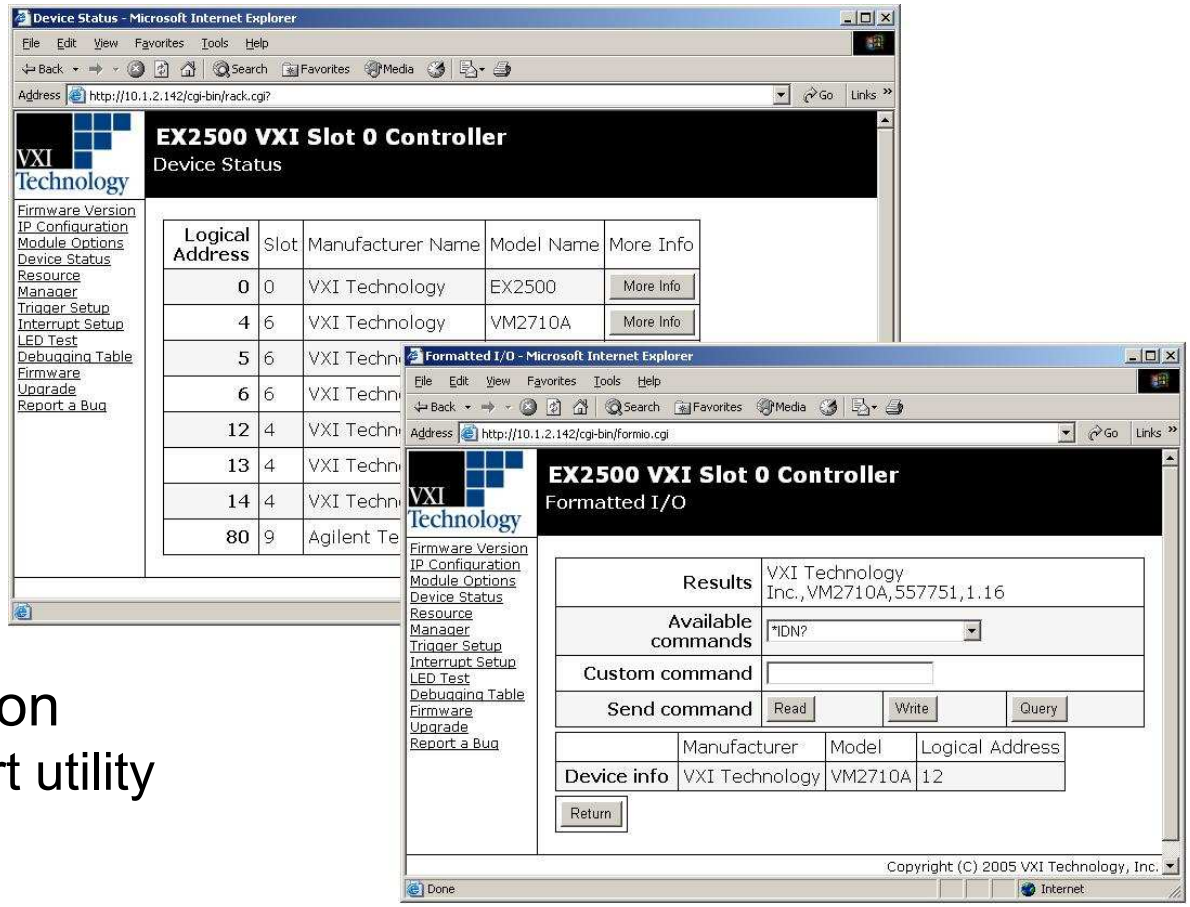
- CLK/Trigger I/O for legacy system compatibility
- Class B LXISync trigger implementation for synchronizing with other LXI devices
- LXI TriggerBus extends VXI TTL triggers outside of mainframe (LVDS)
- Built-in Fiber-optic interface
  - Supports PC-Mainframe separation of up to 10 km
- Supports LXI device discovery protocol
- Standard VISA implementation (NI and Agilent)

Web-powered VXI subsystems

- Embedded web page requires no software apart from standard browser support familiar to any internet user

- Interactive Control Utility
  - Register/Message-based communication

- "Out-of-the-box" operation
  - First-level field support utility



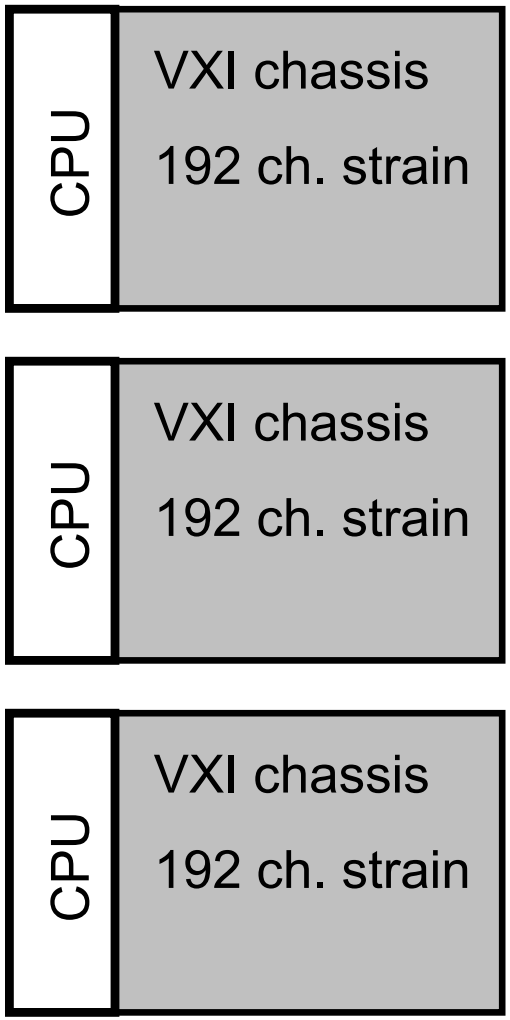
Distributing VXI-based Measurements

- The VXIbus was originally designed for high channel count or high-mix ATE and data acquisition applications
- Distributing measurement channels across distances has been left to small, low performance, proprietary network modules
- For higher-density, higher performance requirements, embedding a PC has been the preferred mechanism
  - Costly interface per mainframe
  - Not ‘maintenance-friendly’ and prone to obsolescence
  - Correlating data from multiple processes is a challenge

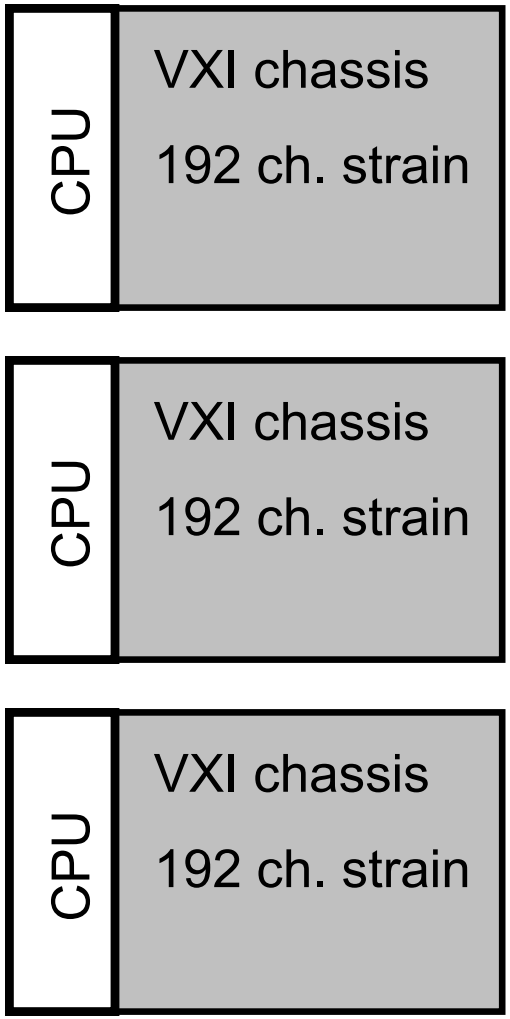
Application – Pavement Testing

- Characterize material properties of runway pavement
- >1000 channels of strain gages distributed across test track
- Track is subjected to a repeated load over time
- VXIbus acquisition and signal conditioning in six mainframes
- Previous implementation embedded six PCs
- Intensive post-processing required
- LXI slot 0 bridges replaced PCs and connected to a single remote host through a fiber optic switch

Using LXI to Distribute VXI Measurements



WAS:
6 Autonomous CPUs
Up to 1000 ft. separation
Post-process for data correlation



Using LXI to Distribute VXI Measurements

EX2500
VXI chassis
192 ch. strain

EX2500
VXI chassis
192 ch. strain

EX2500
VXI chassis
192 ch. strain

IS:
6 EX2500s
Fiberoptic Switch
Single CPU
Immediate Data Correlation
Class B LXI Synchronization

EX2500
VXI chassis
192 ch. strain

EX2500
VXI chassis
192 ch. strain

EX2500
VXI chassis
192 ch. strain

Distributing Accelerometer Measurements

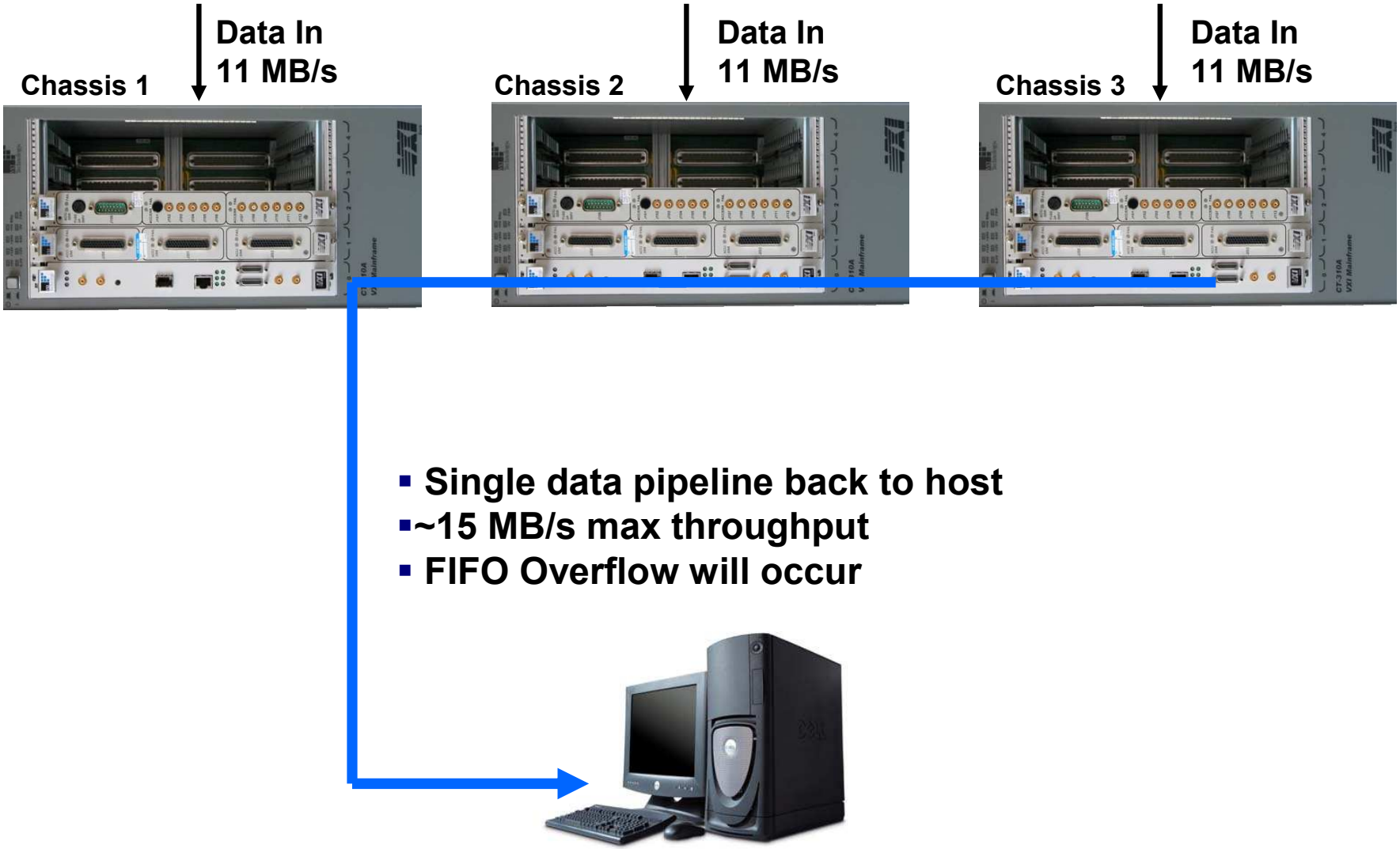
- VXIbus 3.0 increased backplane speed to 160 MB/s
- The reality is that for many module implementations, the transfer of data from module to backplane is the limiting factor
  - Bus cycle times
  - Limited size of mapped memory
- For demanding high-channel count, high sampling rate applications, there is risk of memory overflows if the data input rate exceeds the rate at which the data can be offloaded
  - Results in undesirable gaps in data
- The challenge is to increase the overall throughput rate through a single ‘pipeline’ back to the host that exceeds the capacity of a single interface

Application – Rotorcraft Testing

- Wind tunnel test measuring vibration and acoustics over range of RPM
- 1/5 scale model operating at 2000 RPM
- 2048 tachometer pulses per revolution
- 240 channels of sensors
- Simultaneous acquisition of all channels
  - >16 hours of gap-free data required
- Complex algorithm resamples and aligns the data with every tach edge
  - 2048 pulse/rev * 2000/60 = 68,266 Sa/s/ch
  - 68,266 * 2 bytes * 240 = 32 MSa/s

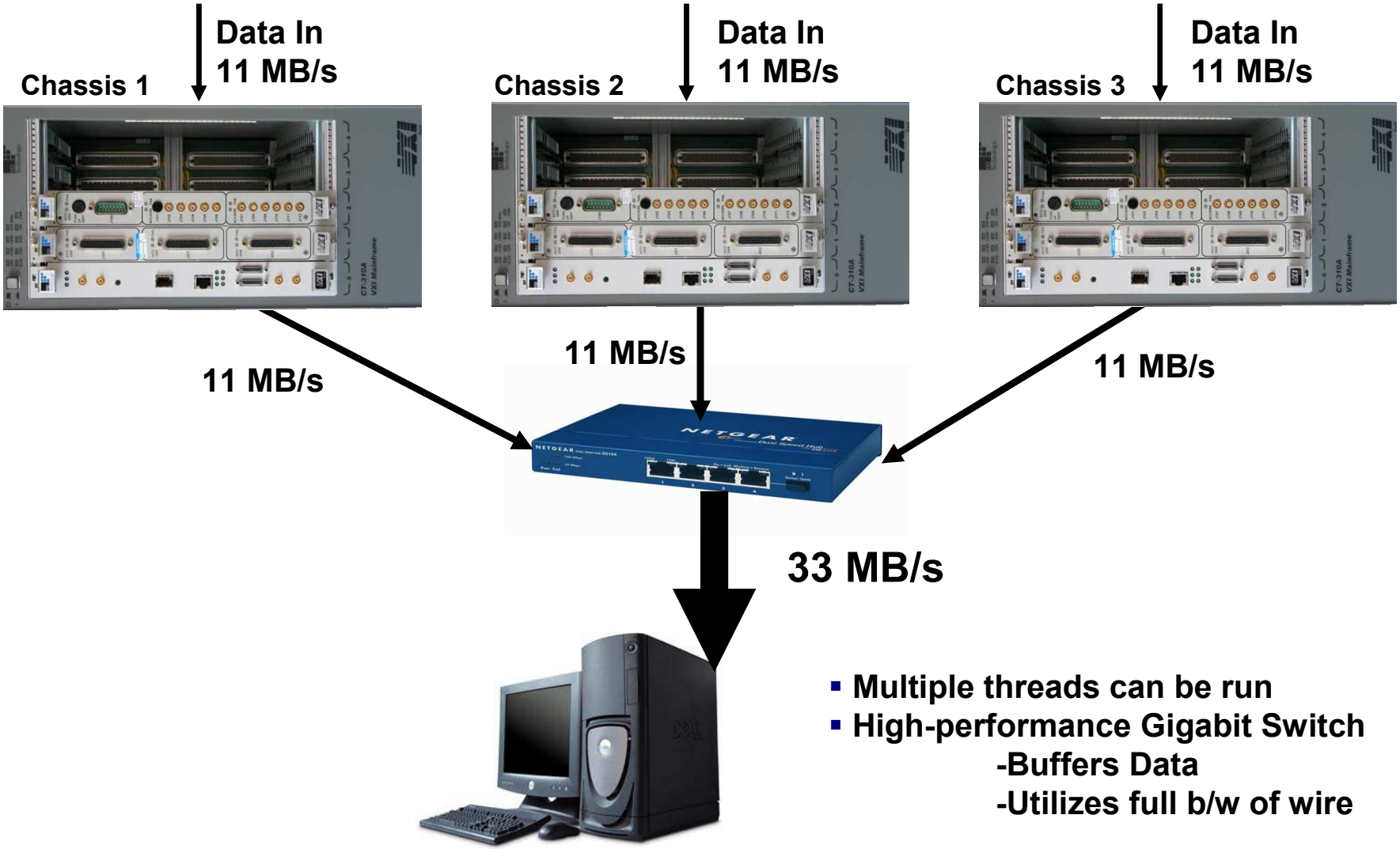
- Exceeds the throughput capability that can be supported by a single pipeline back to host

Using LXI to Increase Data Throughput



- Single data pipeline back to host
- ~15 MB/s max throughput
- FIFO Overflow will occur

Using LXI to Increase Data Throughput



- Multiple threads can be run
- High-performance Gigabit Switch
  - -Buffers Data
  - -Utilizes full b/w of wire

Summary

- The VXIbus has established a large installed based over its 20 year history in applications that require the test platform outlive the products being tested
- Likewise, Ethernet has proven to be a stable communication bus with proven backward compatibility for over 25+ years
- LXI provides the necessary means to leverage the benefits of Ethernet in instrumentation products and delivers a stable platform that is built for the future
- By building a ‘bridge’ between the two technologies, the end users can protect their existing investment in VXIbus products and seamlessly integrate them within an LXI systems network