

NLC - The Next Linear Collider Project



NLC Network R&D Project

Project Overview

Project Goals

More Details

Descriptions (a few)

Schedule

Resources

Status

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Project Overview

- Prototype and examine a system design based on commercial networking equipment which can provide high bandwidth, low latency, and reliable quality of service to meet NLC requirements.
- This network will be used for real time data to the alcoves in the "open" design and used for glass-house intra-IOC connectivity for the "TRIO" design.
- The output of this project will be a test lab capable of simulating the NLC controls network and a written report detailing the test configuration and measured performance details.



Network Overview

- **Global network to provide alcove connectivity**
 - Model uses Gigabit Ethernet as the physical layer protocol
 - Scalable, fault tolerant, commercial network
 - TCP/IP based protocols to allow network segmentation
- **Realtime Network**
 - Provide IOC to IOC data transfer between 120Hz beams
 - Most systems have a separate network for this purpose, new technologies should allow a single network
 - Allows us to use the standard EPICS installation - IOCs in the alcoves
 - The risk is that it works well locally, but cannot be reliably extended to the distances required for the NLC
 - Lost packets, mangled packets, and high latency caused by the number of interfaces between source and destination

Project Goals

- Demonstrate that standard, commercial, “open” network technologies can provide high bandwidth, low latency, and reliable quality of service guaranties.
 - Perform point-to-point, low latency, deterministic communications on the same network as bursty, high bandwidth traffic
 - Segment system and provide wire speed QoS (IP based protocols)
 - Scale to 1300 QoS nodes plus >1500 normal nodes (traffic simulation)
 - Reliably (and cost effectively) extend from 100 meters to 18 kilometers
 - Provide network test bed for sub-system interoperation testing
 - Narrow down technology choices
 - Provide more detailed input to cost model

More Details

- Provide real time network connectivity to every alcove using TCP/IP protocols
- Use 100/1000 Ethernet with QoS enabled hardware/software
- Identify possible VME based fast Ethernet full duplex CPUs or use PCs with VxWorks supported NICs
- Can “open” protocols such as UDP (over IP) be used?
- Determine if the memory-to-memory protocols being developed fit into this architecture (such as VI)
- Provide test applications to simulate 120 Hz real time traffic and measure latencies with loaded network
- Busy n nodes using EPICS Channel Access tools to present background traffic
- Busy n nodes using bursty, high bandwidth streaming data flow

Even More Details

- Determine if network should be "flat" or subnetted to support multicast/broadcast
- Verify wire speed routing and VLAN operations
- Test link aggregation protocols with real time data passing
- Verify Gigabit Ethernet performance over 18Km of fiber
- Discover any long fiber link latency issues (race conditions, protocol timeouts, retries)
- Discover any fiber temperature/routing issues
- Develop test for EMI induced noise and/or specify AC power filtering and EMI shielded rack specifications
- Test failover of network hardware to determine the effects on the Control System

Description

- **Phase 1:**
 - Determine if “open” network equipment and protocols can provide “compute farm” real-time QoS interconnect
- **Phase 2:**
 - Determine if high bandwidth bursty data can be transferred on these same nodes, protocol, and network and still guarantee QoS
- **Phase 3:**
 - Determine if this architecture scales from a few test nodes to 2000 nodes with QoS plus 2000 normal nodes using segmentation
- **Phase 4:**
 - Determine that this can be done with nodes as far away as 18 Km. Refine testing operations and open test bed to other groups for integration testing



Detailed Description

- **Phase 1: Local QoS interconnect?**
 - Develop detailed project goals and requirements (phase 0?)
 - Document the various network configurations and arrange for component availability
 - Write specifications for required test software (real-time VxWorks based network code)
 - Write specifications for network device configurations (Cisco IOS setup and routing scripts)
 - Buy VxWorks license (wish list)
 - FY00 - Buy generic PC based network edge devices
 - Integrate test setup in local lab and perform basic testing
 - Perform Test #1 in local lab- basic connectivity and proof of concept
 - Analyze results and refit test setup as required
 - Perform Test #2 in remote lab - Is there end to end QoS and examine complexities with powerful network systems
 - Analyze results and refit test setup as required

Detailed Description (cont)

- **Phase 2: QoS guarantees even with loaded network?**
 - Characterize bursty data requirements and setup traffic generation
 - Perform Test #3 in remote lab - Is there end to end QoS along with the bursty data
 - Analyze results and refit test setup as required
- **Phase 3: Scalable and segmentable?**
 - Determine the amount of segmentation required and implement changes
 - Perform Test #4 in remote lab - More QoS and wire speed routing using VLANs
 - Analyze results and refit test setup as required
 - Project review before selecting and purchasing network equipment (milestone)

Detailed Description (cont)

- **Phase 4: Long lines, refinement, integration testing**
 - FY01 -New person added to project
 - Purchase network hardware
 - Write new configurations for the purchased equipment
 - Setup local test lab
 - Perform Test #5 in local lab - Proof of system and full time loaded testing
 - Analyze results and refit test setup as required
 - Perform Test #6 in local lab - Possibility that 120hz code is available, test real code
 - Analyze results and write up test results
 - Review these test results along with results from the TRIO design
 - Write CDR text
 - FY02 - Tweak configurations and support 120Hz integration into test lab setup

Schedule

- **FY99**
 - Develop detailed project goals, requirements, and network/software/hardware needs
- **FY00**
 - Test #1 & 2 in local lab - basic connectivity, proof of concept, end to end QoS
 - Test #3 in remote lab - More QoS and wire speed routing
- **FY01**
 - New person, review and purchase hardware
 - Test #4 & 5 in new local lab - Proof of system, loaded testing, test real NLC code
 - Review test results along with results from the TRIO design
- **FY02**
 - Tweak configurations and support 120Hz integration into test lab setup

Team/Resources

- Will require help from the SCS network group
- May require NIC driver software consulting
- Will require hardware and software personnel to integrate
- Some networking equipment may be borrowed
- Most interconnects should be purchased but there may be custom cables/circuits required
- Test system will be installed in:
 - a) old PEP Control Room?
 - b) Building 34?
 - c) elsewhere?

Status

- Investigated other Labs designs and capabilities (RT99)
- Learned details of Real-Time Linux for possible usage
- Investigated Cisco 3500 series as replacements for 29xx
- Studied 3COM Intelligent network solutions for ideas
- Still gathering and classifying bandwidth requirements
- Working on prototype specifications
- Estimating software development time for input to controls group
- Compiling list of items to be purchased (VxWorks license, switches, NIC's, fiber optic cable,etc)