Scaling Issues: How to Make EPICS Fit NLC

EPICS Collaboration Meeting, SLAC 1999

Size
Network
Issues
NLC Control System Size

• **How big is it?**
  - 10 Km of Linac + 5 Km of Beam Delivery *2
  - 18 Km of fiber optic cable from Central Controls to furthest node
    • $\leq 200\mu$S maximum round trip propagation delay!
  - 192 major clusters of control system devices
  - Pulse train of 95 bunches every 8 ms (120Hz)
  - 1000 PV per IOC = 1.5 million; more like 3 to 5 million
  - Some users are requesting “all the data all the time”
EPICS Hardware Distribution

Workstations:
- Sun
- Hp
- PC

I/O Controllers
- VME/VXI/PCI

Remote I/O and Signal Conditioning
- CAN-Bus, Industry Pack
- VME, VXI, PCI, ISA
- CAMAC, GPIB
- Profibus, Bitbus, Serial,
  Allen-Bradley, Modbus,
  IEEE 1394 (Firewire)
NLC Network Node Counts

- 380 Pulsed Control System IOCs (282 linac + 98 other)
- 192 Slow Control System IOCs
  - Actual IOC count depends on exact local I/O counts
- 828 Linac RF IOCs (pulsed)
- 60 Special purpose IOCs (some pulsed)
  - Damping rings, diagnostic sections, Master Pattern Generator, Feedback, Machine Protection System
- Total \(\cong 1500\) IOCs
- 1000 support nodes in the alcoves
- 300 servers and workstations in the Central Controls area
- Grand total \(\cong 2800\) total nodes in this network (for now)
Global Network

- Global network to provide alcove connectivity
  - Model uses Gigabit Ethernet as the physical layer protocol
  - Scaleable, fault tolerant, commercial network
  - TCP/IP based protocols to allow network segmentation
  - Backbone is 100% optical fiber, node access is mixed fiber/copper
  - Redundant systems are used for reliability
  - Long fiber runs from central campus area to every third sector in main linac for future expansion capabilities
  - Integrated network monitoring and management tools
Point of Presence Diagram

POP-a
fiber to
Segment
Switch

POP-b
fiber to
Segment
Switch

POP switch in Alcove
22 inputs, 2 outputs

100baseFX - now
1000baseFX - future

Point to Point
fiber or copper
runs for
10/100 Ethernet

High QoS port for
realtime latencies

Devices

Video
PPS/other

900MHz
or I/R

Terminal
server

X-WIN

Data
Store

Diag
Box

RF
IOC

Pulsed
IOC
Distributed Backbone cont.

Main fiber plant:
- 44 total cables for future (?)
- 22 total terminated cables

11 sets of Redundant Segment Switches per 1/2 machine

9 sets of Point of Presence Switches to one Segment Switch

Central Controls Backbone

MPG

MPS

FBK

Servers, Workstations, World, Etc.
NLC - The Next Linear Collider Project

Distributed Backbone

Machine wide Segments

Central Controls
Central Controls Area

- Core Switch - a Realtime / QoS Systems
- Core Switch - b Global Systems
- Gigabit EtherChannel
- 1000baseSX
- Isolation Router
- Workgroup Switch
- To Segment Switches via main fiber trunk

- Master Pattern Generator
- Fast Feedback Farm
- Machine Protection Farm
- IOC Server Farm
- Office Computing
- Development OPI + IOCs
- Development Workstations
- Development Server Farm
- Application Server Farm
- OPIs
- Displays
- Network Monitors
- Storage Area Network
- Firewall
- Storage Area Network
- Campus
- Fibre Channel

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5/25/99
Slide 9
Scale Issues

• Network
  – IOC booting and initialization
    • VxWorks image in local flash memory
    • Multiple configuration servers
  – Broadcasts (ARP, routing, beacons, other)
    • Segment using routers and VLANs (if OK by QoS)
  – Need Quality of Service (QoS) for realtime IP based transfers
    • QoS guarantees as traffic rate increases

• Software
  – Channel Access location services
    • Channel Access name server or directory services such as DNS or Novel to provide server redundancy, coherency
  – EPICS gateways and application servers for multiple users
Scale cont.

• **Hard limits in an IOC**
  – Maximum number of connected clients (memory size?)
  – Maximum number of PVs in a single IOC
  – VxWorks limits such as the max number of TCP sockets

• **Network monitoring and diagnostics**
  – SNMP added to IOC for integration into enterprise monitoring

• **Bulk data movement**
  – Compression and streaming techniques
  – Local data storage until it’s moved to central area
Summary

- It’s BIG!
- New opportunities abound!
- CA hooks are very important
- Need to know what has worked and what hasn’t
- Need to identify big ticket items we might have missed