

NLC - The Next Linear Collider Project



Scaling Issues: How to Make EPICS Fit NLC

EPICS Collaboration Meeting, SLAC 1999

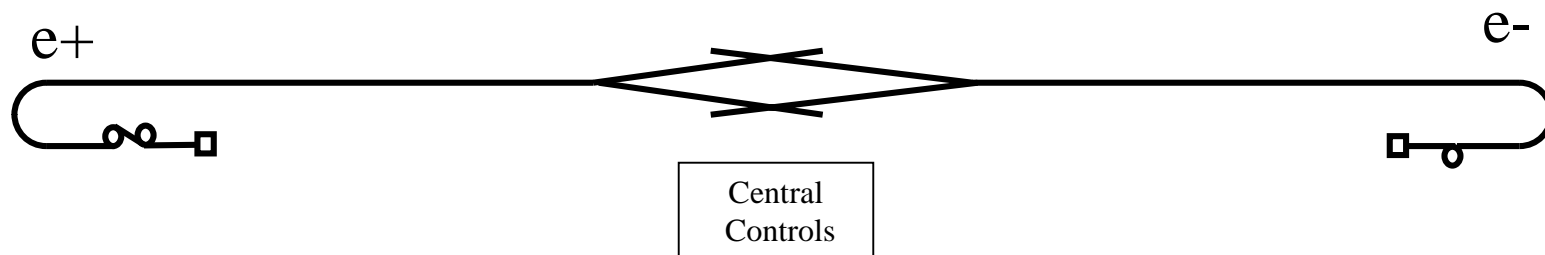
**Size
Network
Issues**

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5/25/99*



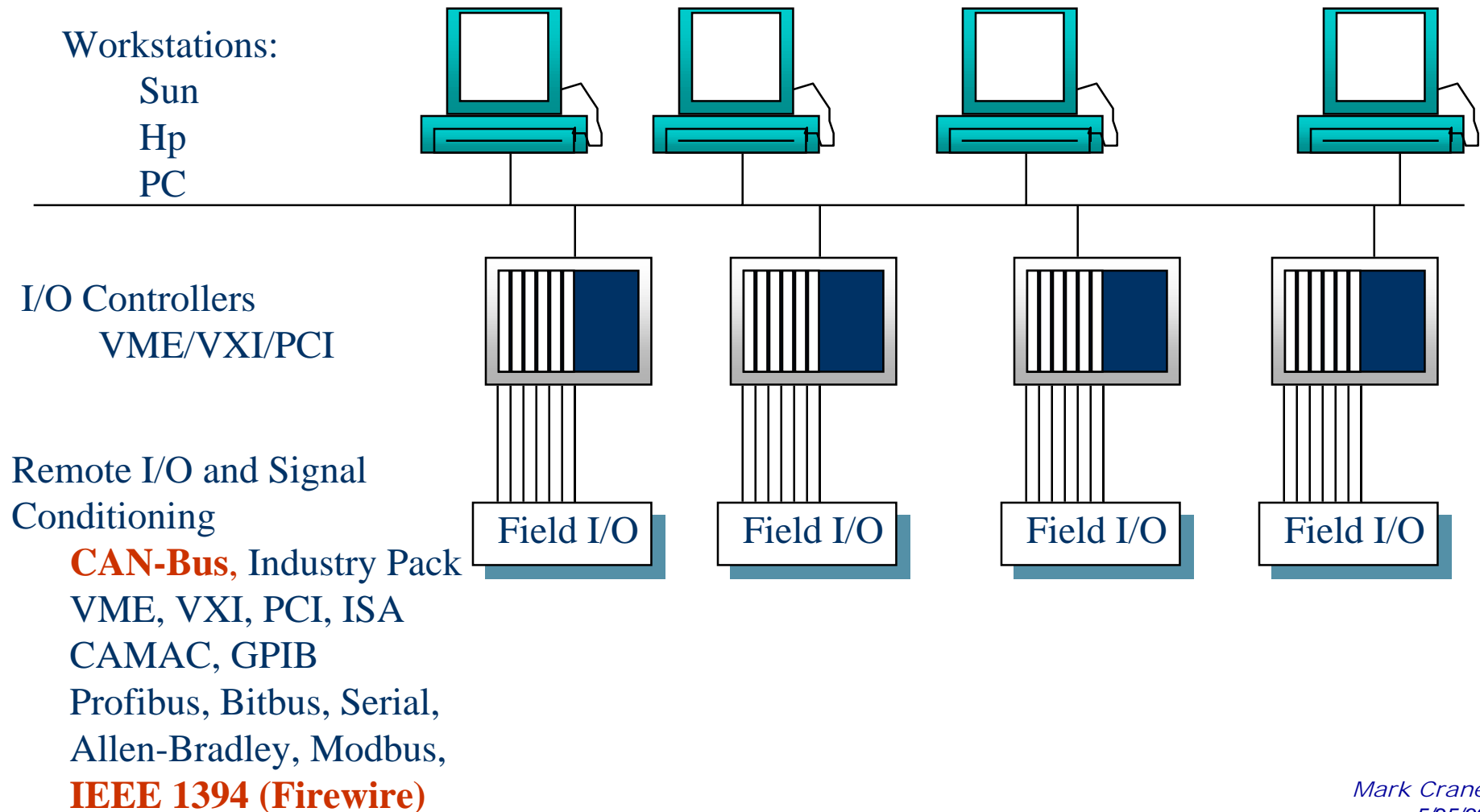
NLC Control System Size

- 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
 - $\cong 200\mu\text{s}$ 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





NLC Network Node Counts

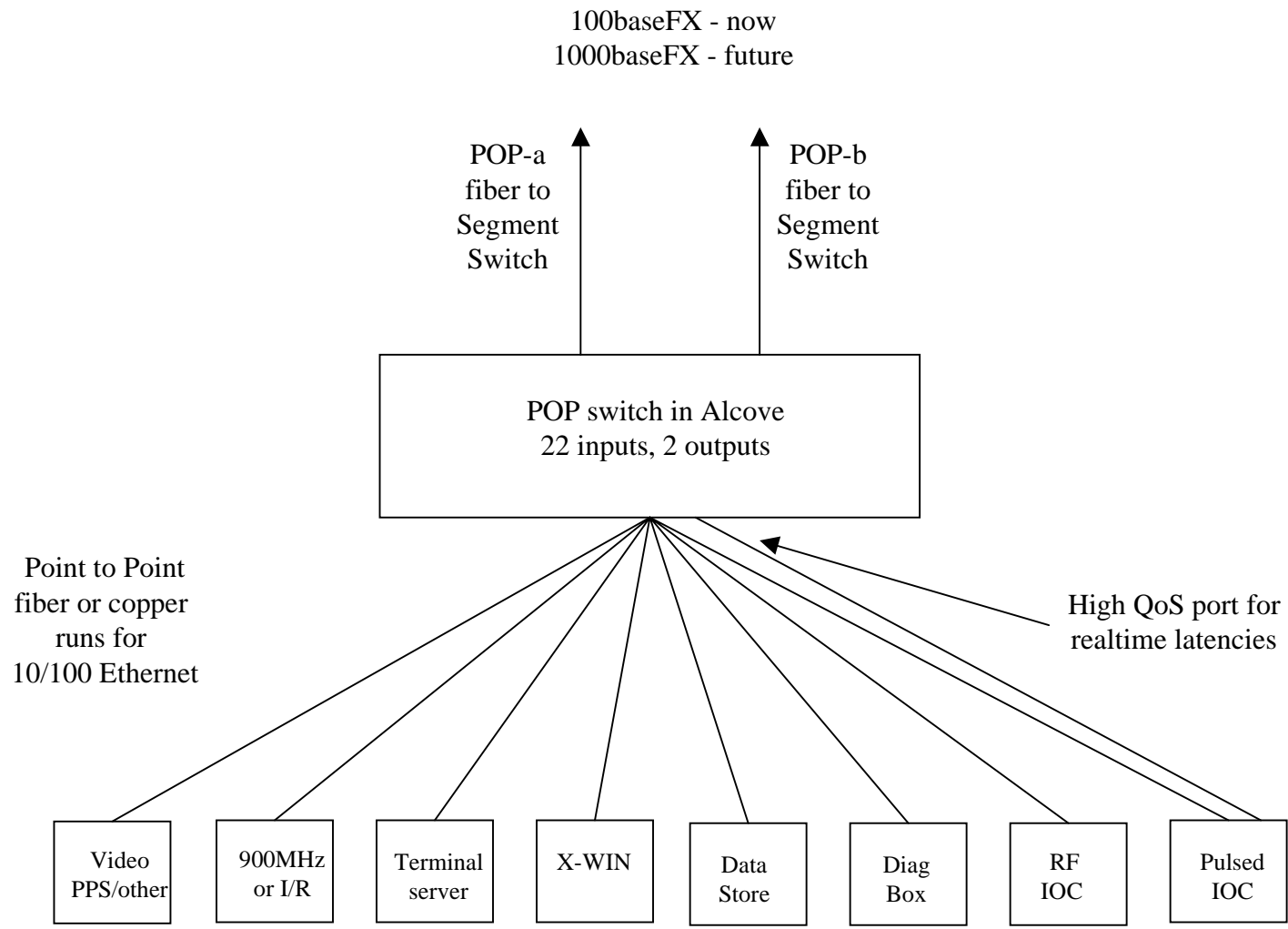
- 380 Pulsed Control System IOCs (282 linac + 98 other)
- 192 Slow Control System IOCs
 - Actual IOC count depends on exact local I/O counts
- 828 Linac RF IOCs (pulsed)
- 60 Special purpose IOCs (some pulsed)
 - Damping rings, diagnostic sections, Master Pattern Generator, Feedback, Machine Protection 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



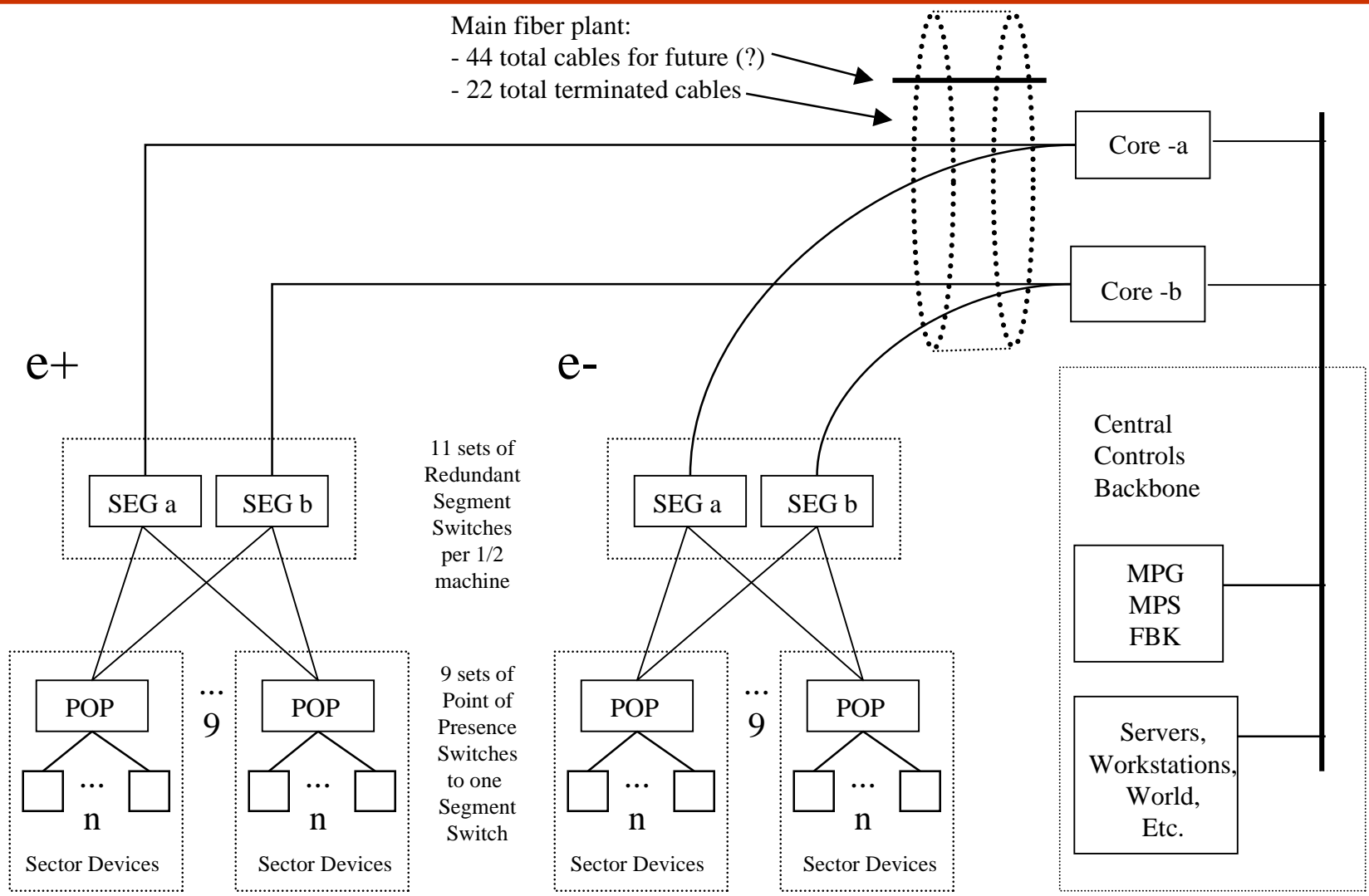
Point of Presence Diagram



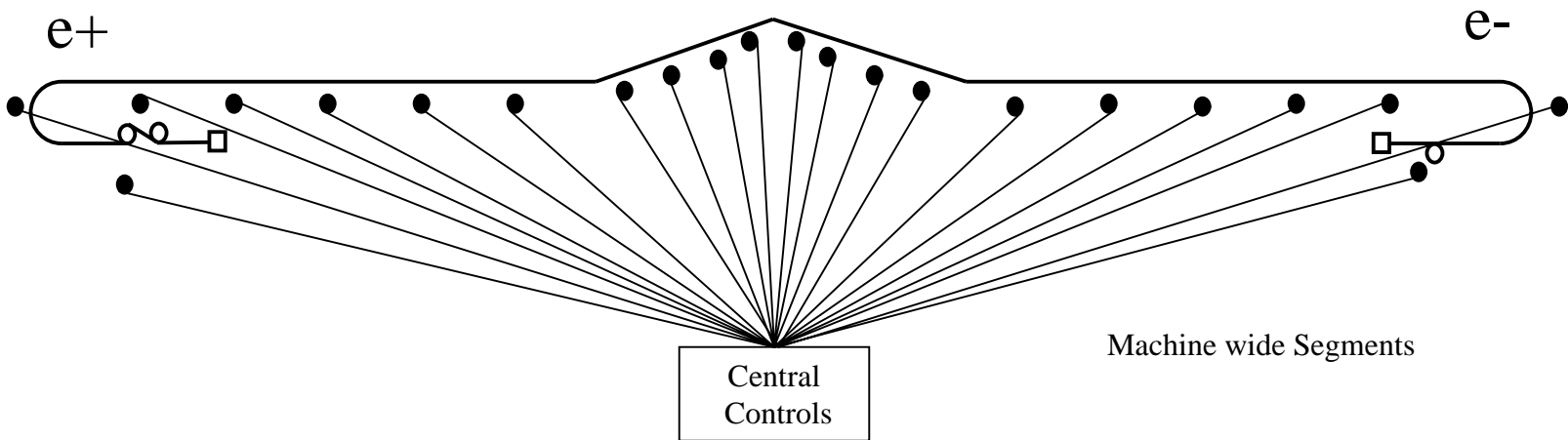


Distributed Backbone cont.

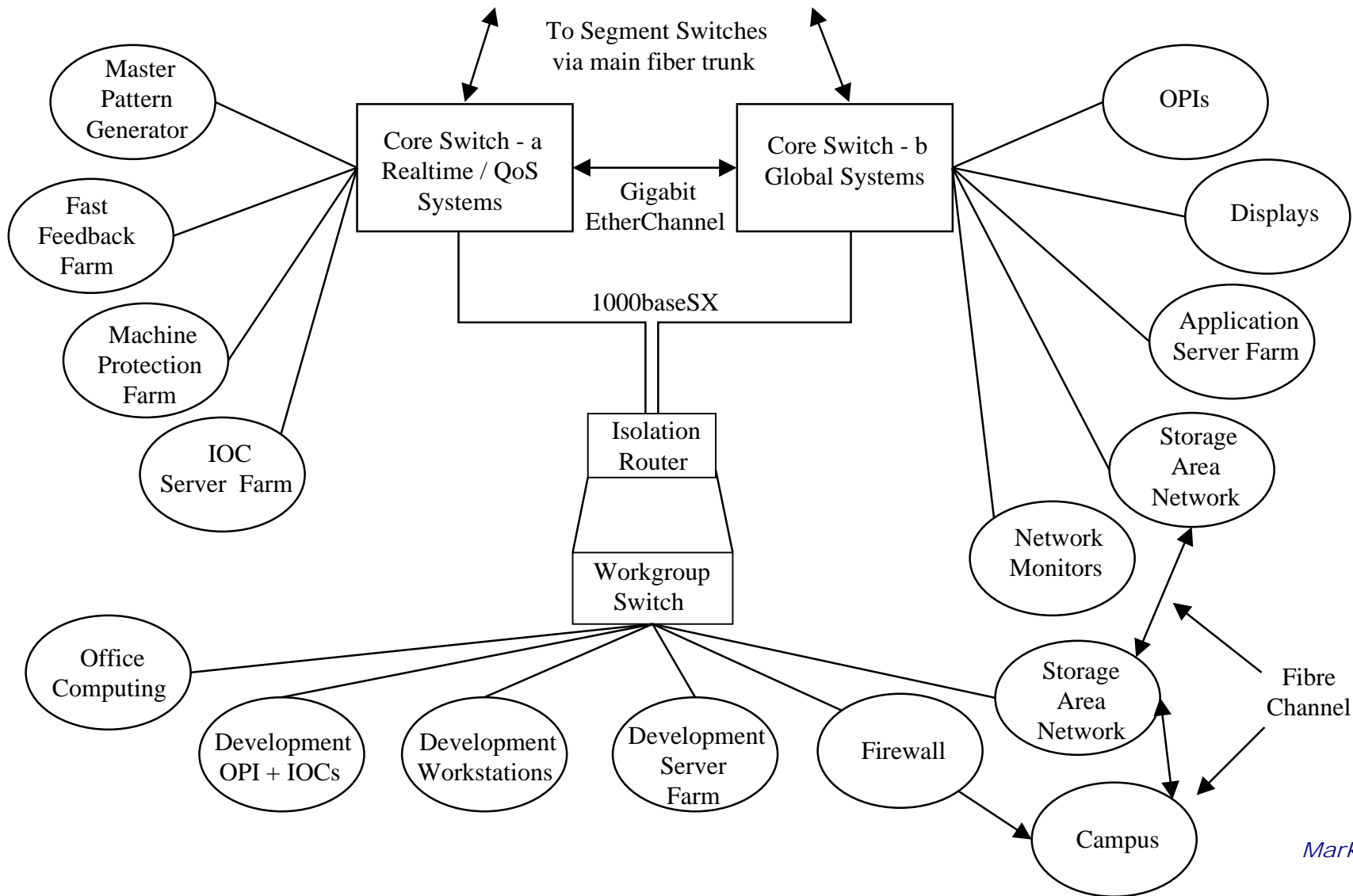
Main fiber plant:
- 44 total cables for future (?)
- 22 total terminated cables



Distributed Backbone



Central Controls Area



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