NLC Control System Requirements & Challenges

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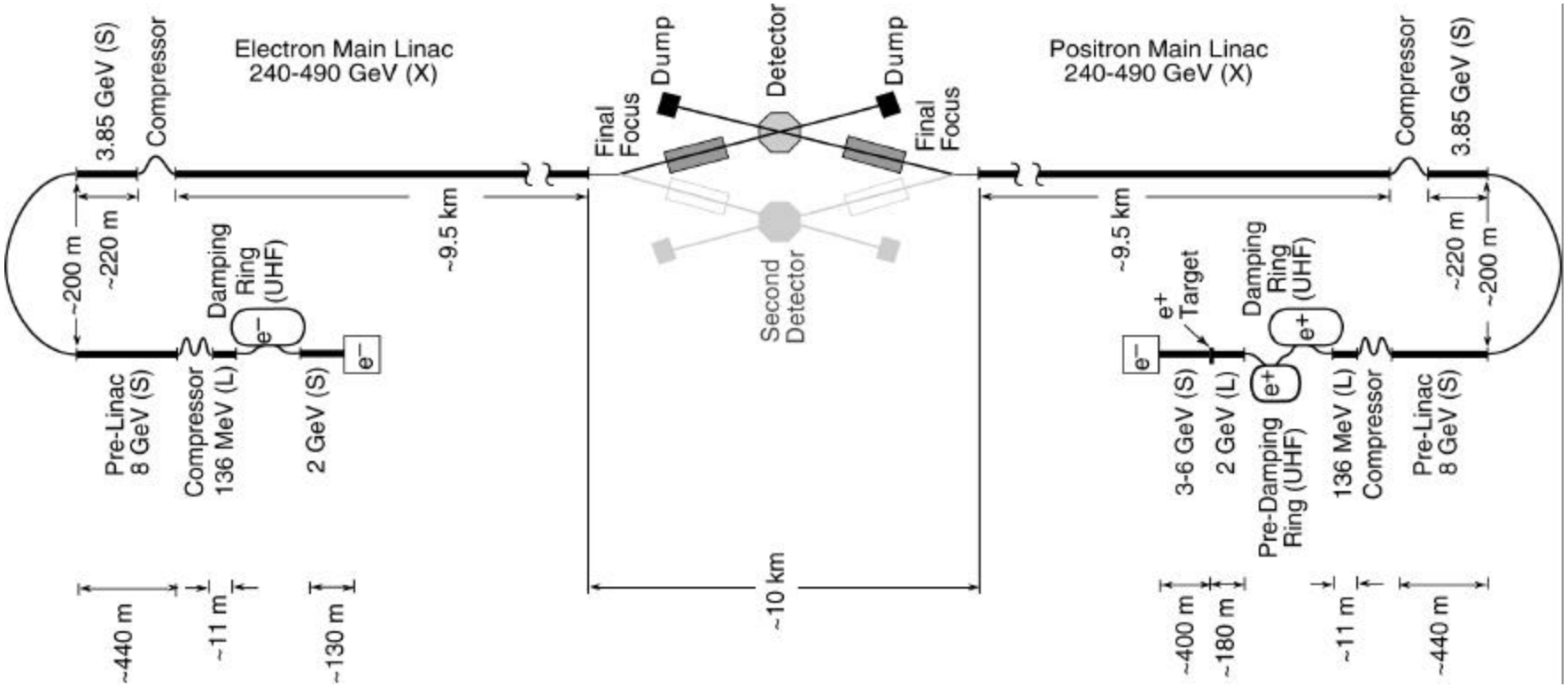
Why an NLC/EPICS Workshop?

- We need help!
  - Large facility - more than 30 kilometers of beam-lines
  - Complicated - multiple pulsed linacs
  - Will potentially be the largest EPICS site
  - Aggressive development schedule
- Our goals:
  - To introduce our issues of concern to the EPICS collaboration.
  - To invite and solicit ideas, comments and suggestions about our plans and approaches.
  - To lay the foundation for strong collaboration now and shared development in the near future.

Next Linear Collider



Some System Parameters

• Center of Mass Energy	500-1000GeV
• Repetition Rate	120Hz
• Bunch Charge	10^{10}
• Bunches/RF Pulse	95
• Unloaded Gradient	77MV/m
• Linac Length	10Km
• Total Length	30Km
• # of Klystrons	3168-6624
• # of BPMs	12000
• Total AC Power	100-200MW

DOE Life-Cycle Milestones

- Decision of Mission Need — Present
  Lehman Review in progress
- CDR Project — 99-Spring 2002
  - Conceptual Report
  - R&D effort
- Project Baseline Approval — Spring 2002
  Pre-construction Engineering and Design
- Construction Start — Fall 2003
- Operational Approval — Fall 2010

General Requirements for the Global Controls System

- Support an accelerator facility spread over a large geographic area.
- Acquire, process and distribute massive amount of data.
- Support pulsed multi-bunch accelerator operation.
- Provide a rich set of applications for commissioning and operation.
- Provide an extensive feedback facility.
- Seamlessly accommodate various data acquisition systems.

Control System Model

- Distributed hardware & software control system
  ⇒ Use EPICS
- Use of commercially available “open” communications Networks
- Support for industry standard I/O buses
- A suite of SLC style user applications
- An extensive feedback facility
- Enterprise-wide consolidated database

Technical Challenges & Schedule Risks

- "Scaling EPICS" is more than just scaling Channel Access & database. We also need to "scale" the features, tools, and the applications.

- System Extensibility: EPICS (Mark Crane)
  - Managing > 1000 IOCs and millions of PVs
- Large Volume, and/or High Rate Beam and RF Data Management (Tera Bytes/day)
- Integrating a High Resolution Timing System with EPICS (120 Hz pulsed operation)

Challenges & Risk Factors

- 120 Hz. Operation, continued
  - Timing stability /jitter <l0 psec (in hardware)
  - Data acquisition, processing and distribution
  - Developing applications requiring synchronized data across the whole accelerator.
- Database and Channel Access upgrades
  - Multi-priority clients
  - Command completion
  - Synchronized Setting of Devices Across IOCs
- Tools and utilities - upgrade & add new ones
  - Archiving, correlation tools, multi-knobs, etc.
  - Button macros, etc.

Challenges & Risk Factors

- Next generation OPI
- One of our Biggest Challenges is to Satisfy Customers Used to SLC Type Applications (not native to EPICS)
- Create a suitable infrastructure for efficient development of millions-of-lines-of-code applications
  - Server/middleware architecture
  - process-to-process communication: Software bus
- An enterprise-wide database
  - to consolidate all relevant machine data and parameters
  - To serve as the central piece for any application development
- Schedule risks

Control Software Effort Roll Up

1	PROJECT	Person-Year
13	GLOBAL CONTROL SYSTEM	
136	GLOBAL CONTROL SYSTEM SOFTWARE	
1361	Control Software	474
13611	Systems Architecture	30
13612	Software Infrastructure	104
13613	Low-Level Applications	137
13614	Tools and Utilities	25
13615	High-Level Applications	23
13616	Feedback Systems	24
13617	Protection Systems	48
13618	Systems Integration	20
13619	Automation	4
1361A	Detector Interface	3
1361B	Supervision	56

The Need for Collaborative Development

- Given the project scale & complexity, SLAC cannot develop this alone:
  - We are relative newcomers to EPICS and need much more expertise to implement it at the required scales.
- The aggressive project timeline requires a ramp-up of control experts also beyond a single lab's capability.
- May use an SNS-model of multi-lab development.
- Along with SNS, NLC is expected to be the drive behind the next major upgrades to EPICS.
- Close collaboration with the EPICS community is essential to NLC.

Collaborative Development Continued

- We need to expand the traditional collaboration boundaries to include additional areas:
  - System architecture design
  - Networks planning
  - System design reviews
  - Proposal of new ideas as well as conceptual designs
  - Actual implementation of NLC software at other labs.
- Develop infrastructure for distributed controls effort
  - Detailed requirements and technical specifications
  - Subsystem and applications Interface definitions
  - Remote project management & communication tools

Conclusion

- Need Help in All Phases of the Project, from the Conceptual Steps to Implementation.
- Users' Experience with EPICS Extremely Valuable to Us.
- The Goal Would be to Use NLC Resources to Enhance EPICS Rather than to Fork.