



# SPEAR Control System Architecture

- Who
  - is responsible for this mess?
- Why
  - are we implementing it this way?
- What
  - are we installing?
- When
  - will it be available?
- Where
  - can I find useful links?

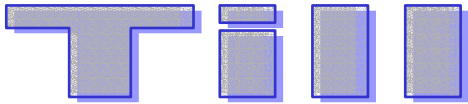


## Our crack software team...

Clemens  
Wermelskirchen



- Fearless leader
- History buffers (+ Save/Restore)
- Bitbus, GPIB drivers
- TSP, QMS control
- Knob utility, configurations
- Curmon
- VMS system management
- CAMAC
  - Ion gauges, BSOICS, thermocouples



**Straumann**



- BPM Data acquisition
  - Echotek and Bergoz
- MCOR drivers
- Fast feedback
- Fast realtime system/timestamps
- Orbit interlock interfaces
- Open software maven
  - Linux, RTEMS, Scilab, etc.
- EPICS guru



# Stephanie Allison



- Keeps us all organized
- CANbus, EtherNetIP ports
- Save/restore utility
- Ethernet/GPIB
- DCCT
- Low level rf
- Alarm handler
- Logging



# Harvey Rarback



- Computing infrastructure
  - System management
    - Windoze
    - Unix (prymatt and zantar)
  - Alarms and logging
- Insertion device control
- Operator interfaces
- SPEAR and beamline MPS
- Kickers

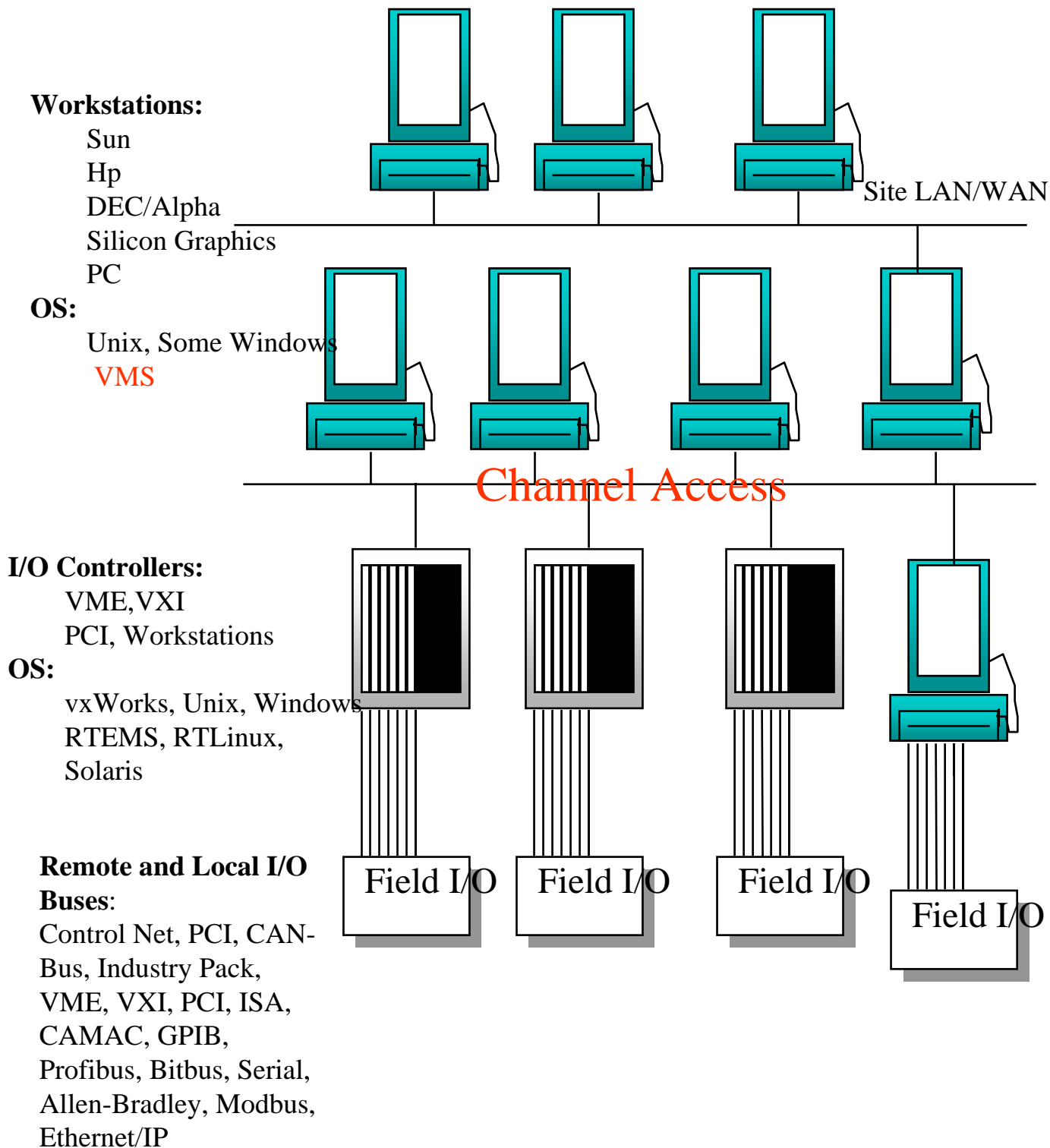
# The EPICS Collaboration

- Over 90 independent projects in North America, Europe and Asia
- Applications in accelerator control, particle physics, astronomy, and industrial control
- Distribute software over the network
- Independent development, co-development and incremental development of code done by members
- Problem reporting and resolution via e-mail exploders
- Documentation available on WWW sites
- Large collaboration meetings to report new work, discuss future directions, explore new applications, and explore new requirements for existing codes
- Small design groups from multiple labs meet to discuss design issues on significant codes: Channel Access, CDEV, Archiving and MMI

# Accelerator Programs Using EPICS

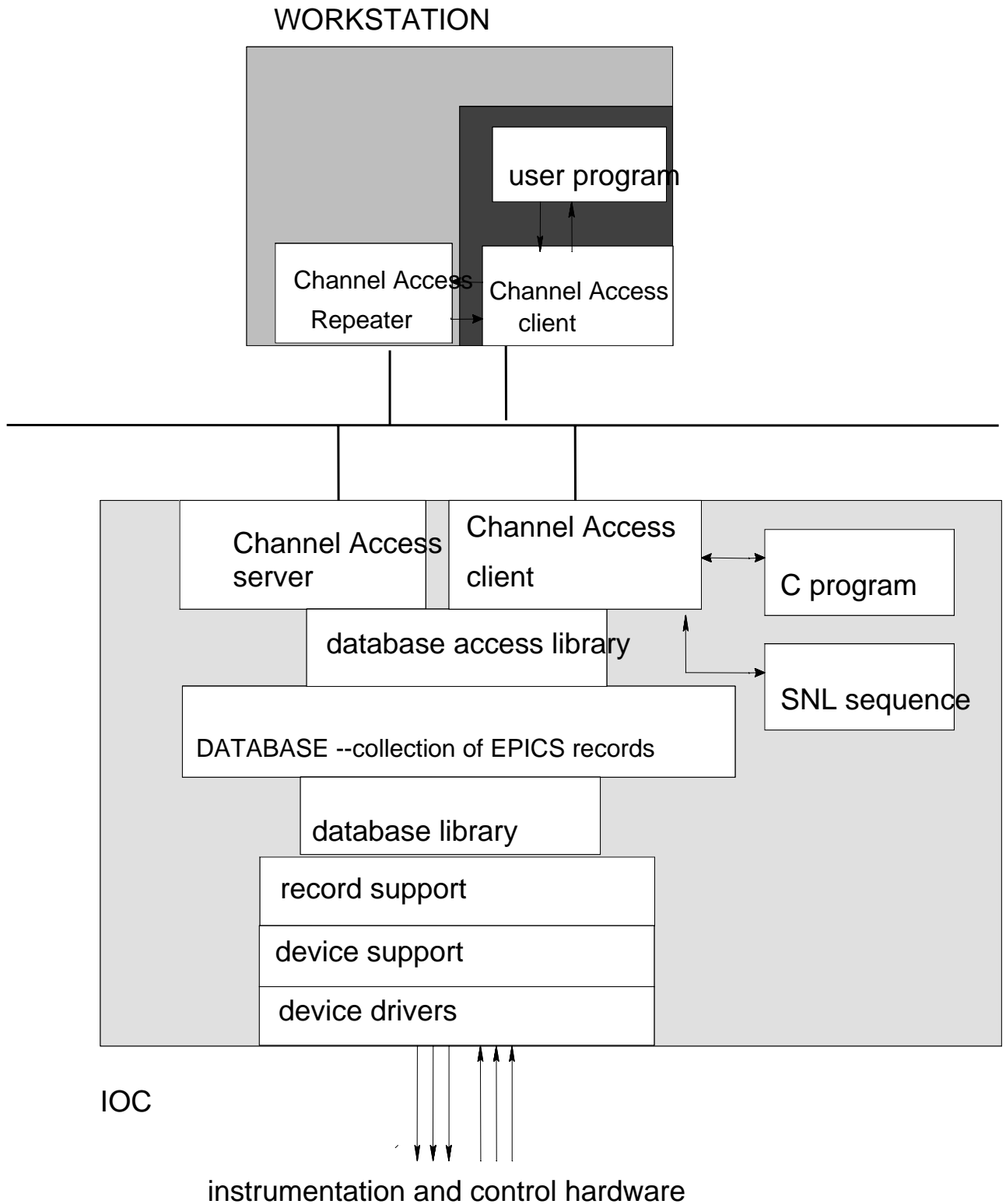
- The Advanced Photon Source and Beamlines @ ANL
- The Advanced Light Source
- The Thomas Jefferson National Accelerator Facility @ Newport News, Va.
- Proton Storage Ring @ LANSCE
- Injection Linac for KEKB Factory @ KEK
- Advanced Free Electron Laser @ LANL
- Duke Free Electron Laser and Mark III Laser @ Duke University
- Heavy Ion Fusion Test Stand @ LBL
- Intense Pulsed Neutron Source @ ANL
- HERA Cryogenic Plant and Tesla Test Facility @ DESY
- **RF and Beamline Control for the B-Factor @ SLAC**
- Bates Linear Accelerator @ Bates MIT
- Racetrack Microtron @ University of Athens
- BESSY II @ BESSY
- **SPEAR3**

# EPICS Supports a Standard Control System Architecture





# EPICS architecture





# What is a PV?

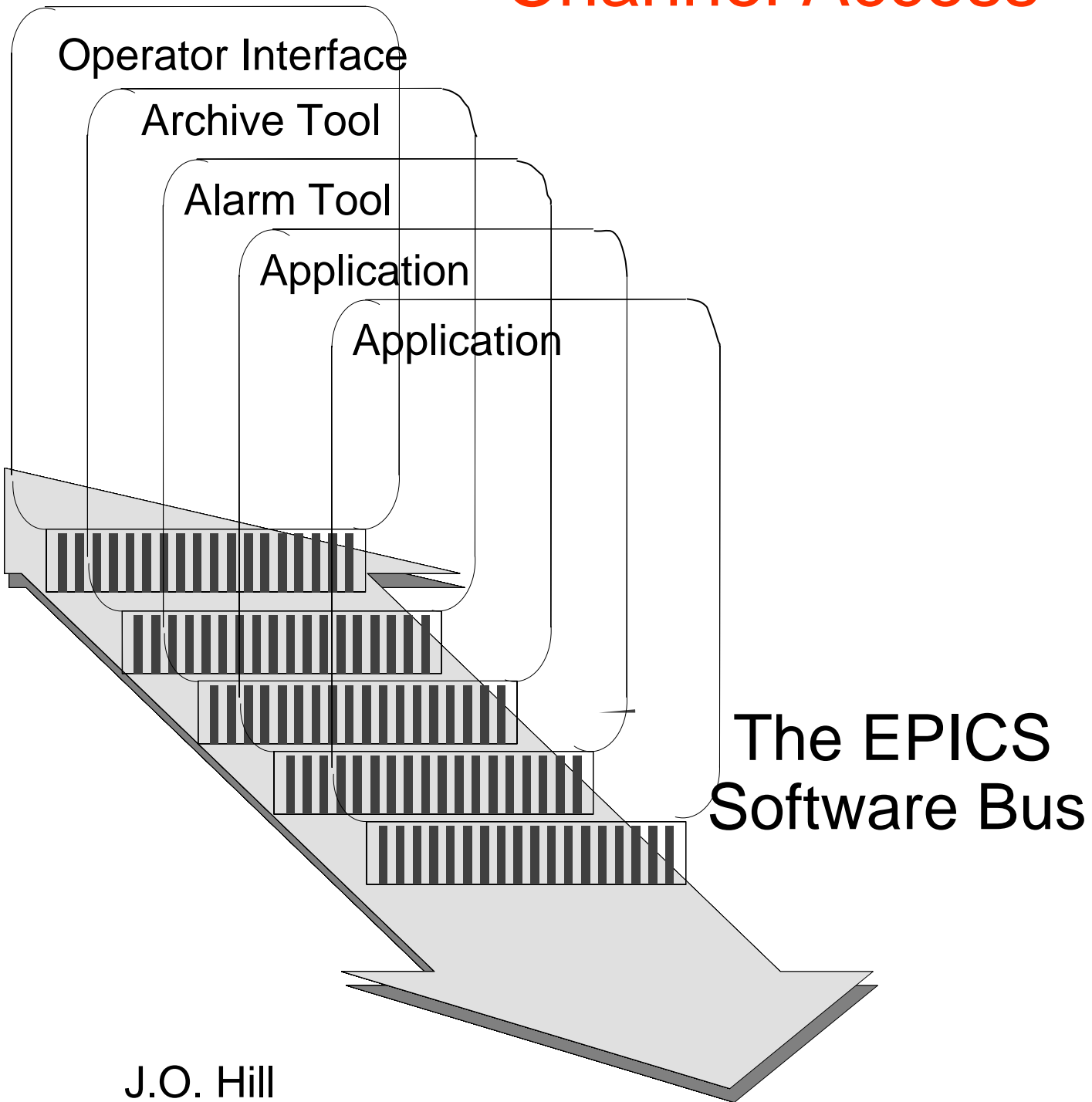
- What is an EPICS record?
  - “Black box” of ioc processing
  - Includes data and processing
    - record types like analog input, binary output
- SPEAR record name convention:
  - <http://www.slac.stanford.edu/~spear/epics/RecNameConv.html>
  - **COMPONENT:Signal**
    - Examples:
      - MS1-BD:CurrSetpt
        - setpoint for bend magnet (MS1 is a magnet string)
      - spr:EPBU1/AM1
        - BSOIC radiation (on VMS)



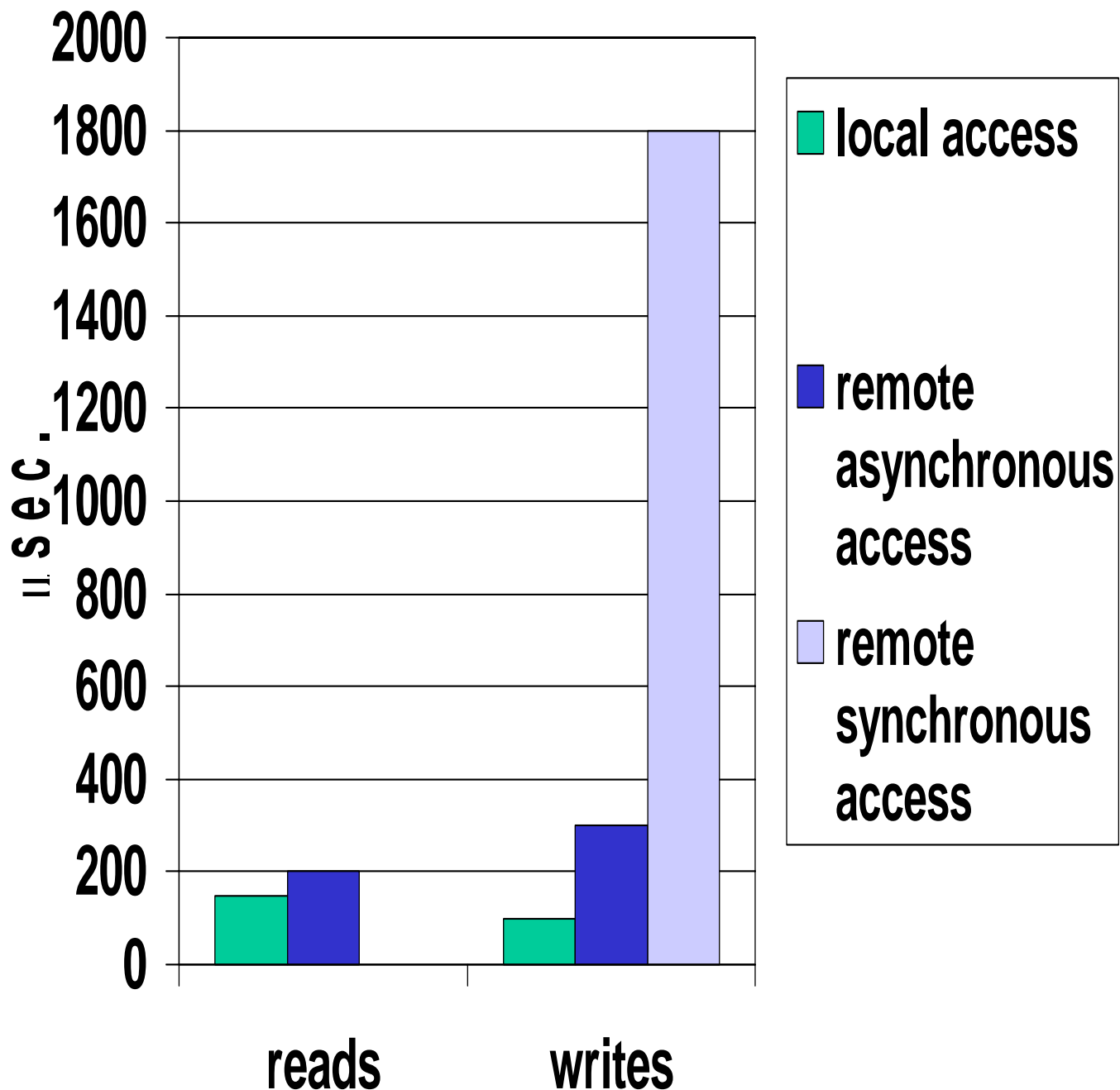
## What is a PV? (cont'd)

- PV==Process Variable
  - Transaction unit of channel access
  - PV name is
    - **Record\_name.FIELD**
    - Field names depend on record type
- Examples:
  - MS1-BD:CurrSetpt.**DESC**
    - Text Description of record
  - MS1-BD:CurrSetpt.**VAL**
    - Value of record
    - MS1-BD:CurrSetpt is shorthand for this PV
- Some EPICS tools manipulate PVs without explicit typing of names

# Channel Access

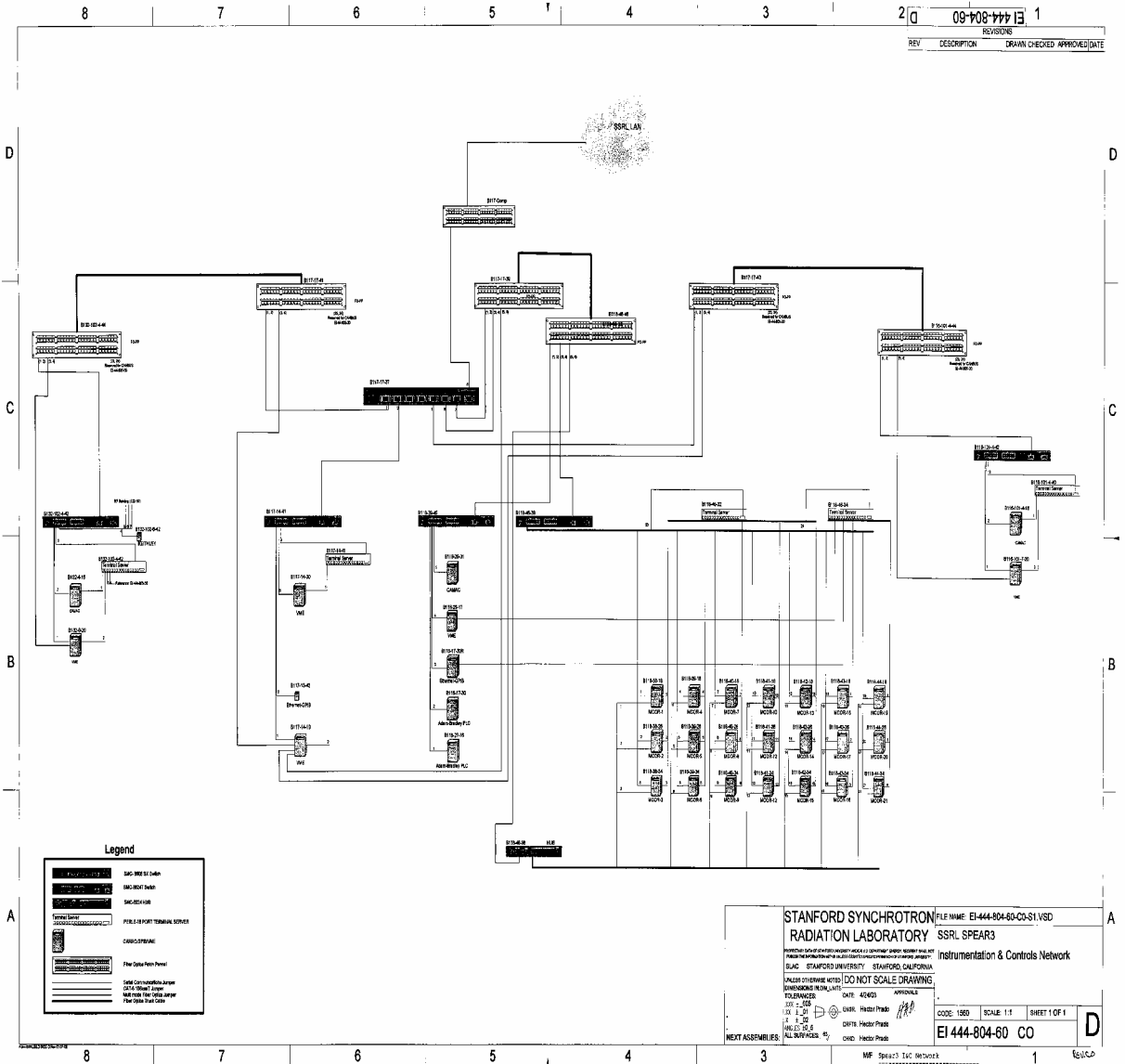


# Channel Access Performance for Simple, Unconverted I/O Channel Reads and Writes

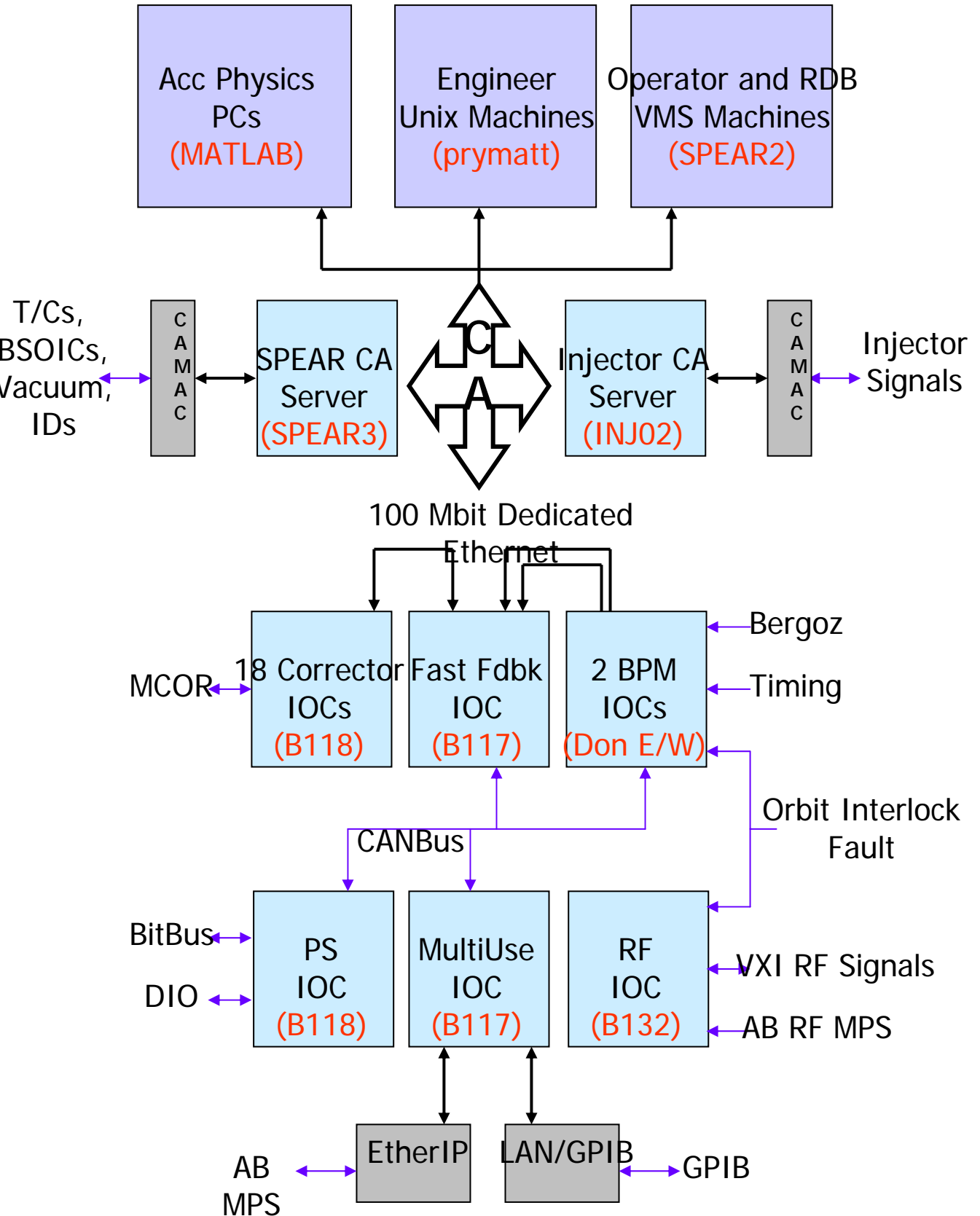




# SPEAR Controls Network



# EPICS at SPEAR



# IOC Hardware



- PPCs (~25): Synergy VME VGM, Kinetics VXI V152
- Crates: Wiener VME 64X, Elma VXI, SLAC/PEP-II MCOR
- Perle Terminal Servers
- Crate I/O:
  - Echotek ECDR-814 Digital Receivers for parallel first/single/multi-turn BPMs
  - Fast ADCs (General Standards 16AI64SS PMC or Hytec 8401 IP) for MUXed multi-turn BPMs
  - INCAA VEBB BitBus Controllers for PEP-II DC Power Supplies
  - SLAC MCOR Interface Modules for PEP-II Corrector Power Supplies
  - Acromag 9670 IP Carriers with TIP/Acromag IPAC Modules
  - SLAC/PEP-II RF VXI Modules
  - AB VME Scanner
  - Hardware timing module
- Ethernet I/O:
  - Agilent GPIB LAN Boxes
    - Master Oscillator, Frequency Meter, Kicker timing, etc.
  - AB EtherIP Modules





# RTEMS IOC Boot

- System image loaded
- Initialization task
  - Also loads symbol file
  - Runs common non-EPICS startup script to load other unbundled apps, set time zone, start tasks, etc
  - Then runs EPICS app startup script identified in NVRAM which loads app image and initializes EPICS
  - **Setpoints are restored**
- Left at Cexp prompt – at this point, can log into ioc and use Cexp tools



# Some IOC Applications

- Corrector PS (108) Control
- Quad/Main PS (70) Control
- Parallel-Button BPM (36) Processing
- MUXed BPM (54) and Beamline Photon Monitor (22) Digitization
- RF System, RF Frequency Control
- MPS Monitoring
- Orbit Interlock Monitoring
- Beam Current/Lifetime
- Kicker Timing
- Booster Injection Timing
- Relay Switching (QMS and TSP)
- Wiener Crate Monitoring



# IOC Applications (Later)

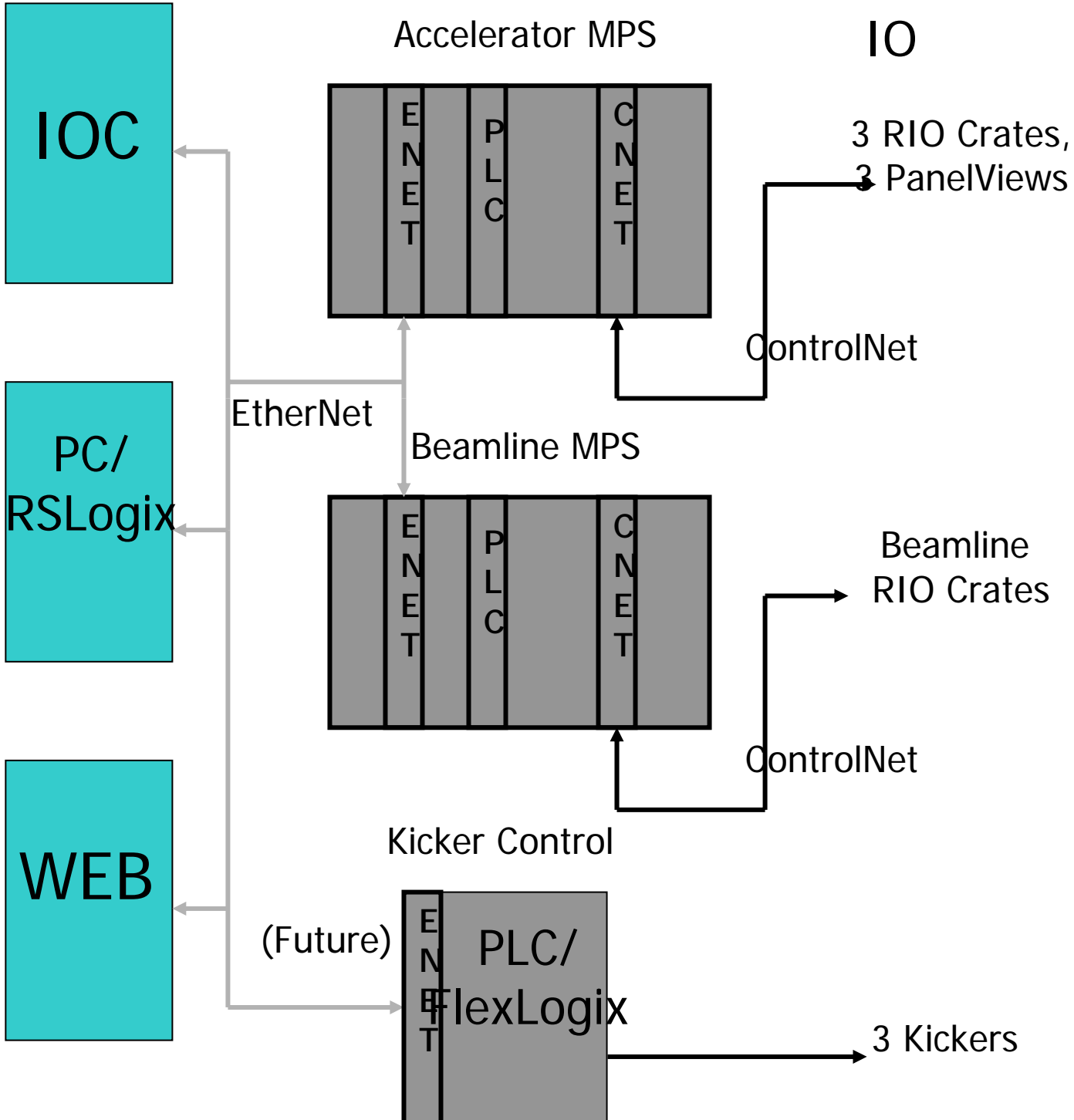
- Fast Orbit Feedback (4kHz)
- Control System Timing
- Synchrotron Light Monitor
- Tune Monitor and Driver Interface
- More GPIB Apps

# EtherIP at SPEAR



AB ControlLogix Crates

AB  
Remote  
IO





# Host Hardware

- OpenVMS AlphaServer (3)
  - SPEAR2, SPEAR3, INJ02
- Tru64 Unix AlphaServer (NFS, ioc boot server)
  - zantar
- Solaris 8 SunBlade-100
  - prymatt
- SLAC Solaris/Linux Servers on other subnets
- Various PCs (Windows and Linux)
- UPS
  - on all important hosts

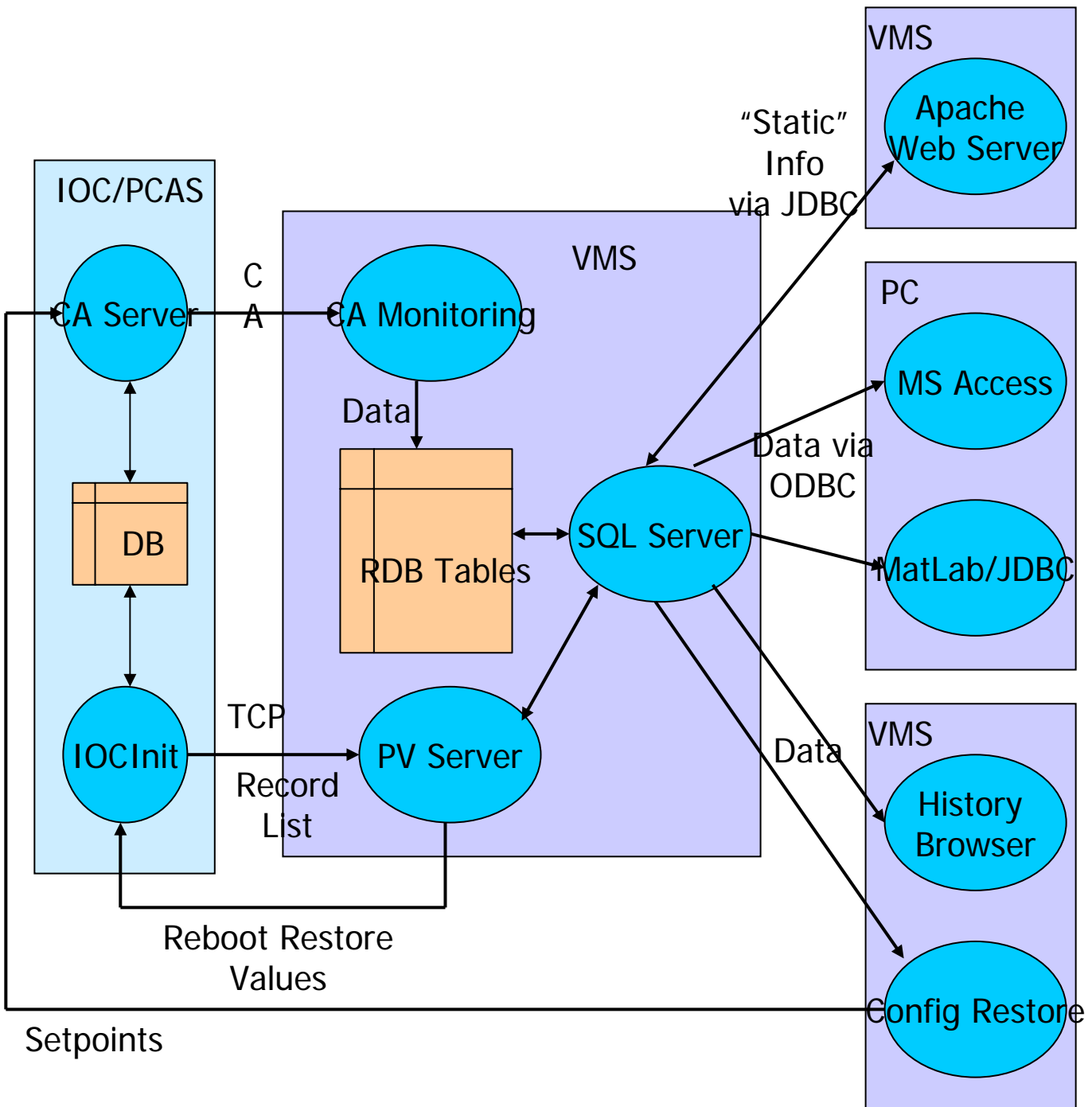


# Host Applications

- EDM Operator Displays
- StripTool
- Data Archiver (to RDB)
- Data Browser (from RDB, X-Windows)
- Event Monitor and Messaging (RDB)
- Configuration Save/Restore (RDB)
- Knobbing (X-Windows)
- Insertion Device Control (IDL)
- SciLab Apps
- RF Apps (MatLab, DM, CMLOG, ALH, CW)
- Acc Physics Lattice Control and Orbit Monitor and Control Apps (MATLAB)



# RDB System



# SPEAR EPICS PV Database



05G-QD1:Curr

12-JUN-2003 12:58:06

PVID 1638

----- History data recording information -----

Recording

Table READBACK

Column T05G\_QD1\$CURR

----- History plot display information -----

Display group

Display parameter

Parameter order

Display name

Units

----- PV information -----

Record type ai

VAL data type DBF\_DOUBLE

Description Current

Dtyp Bitbus

In/Out Link #L2 N4 P0 S33 @

EGU A

[Back to PV list](#)

[Show modification history](#)

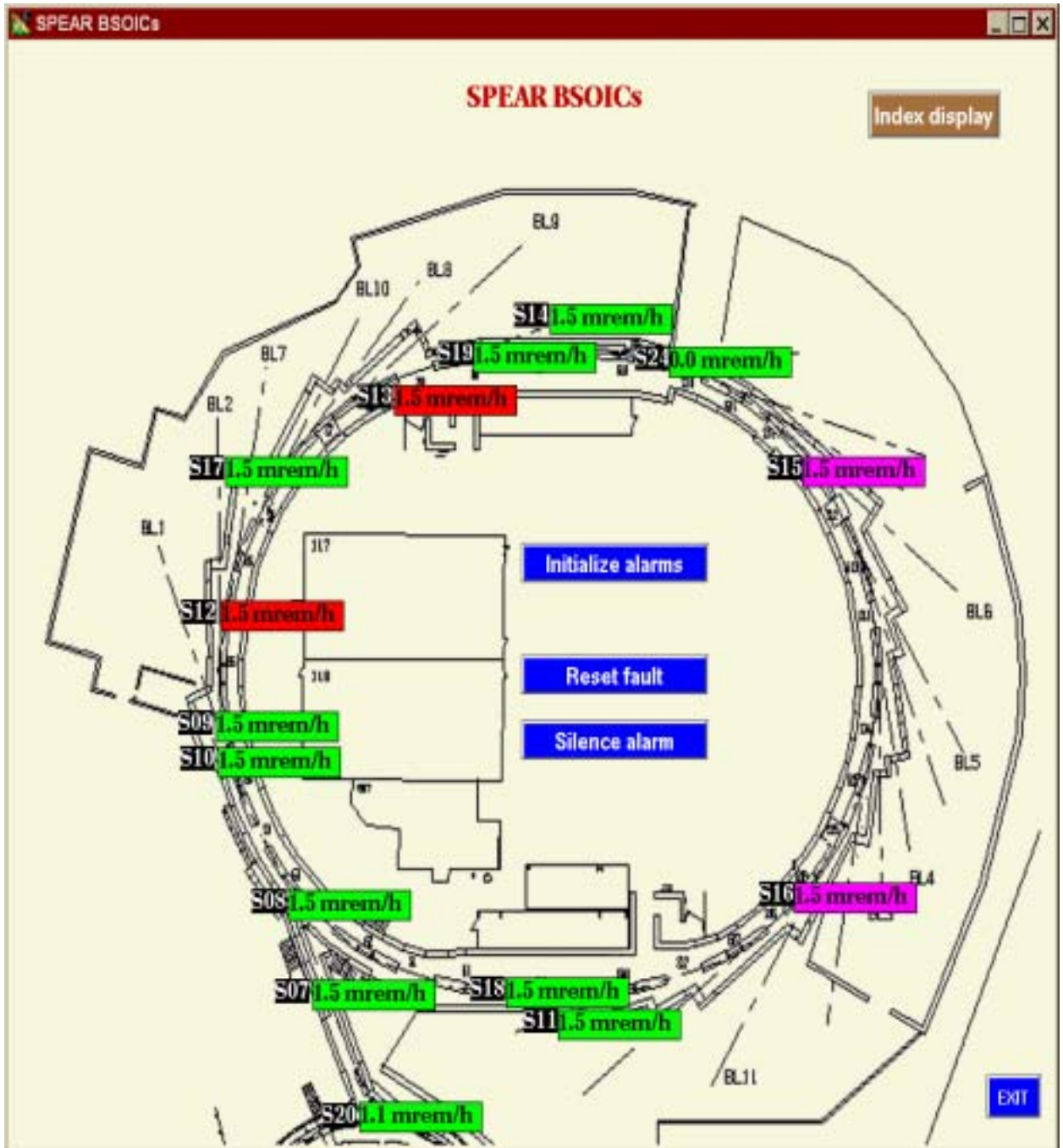




# Current EPICS/OS Versions

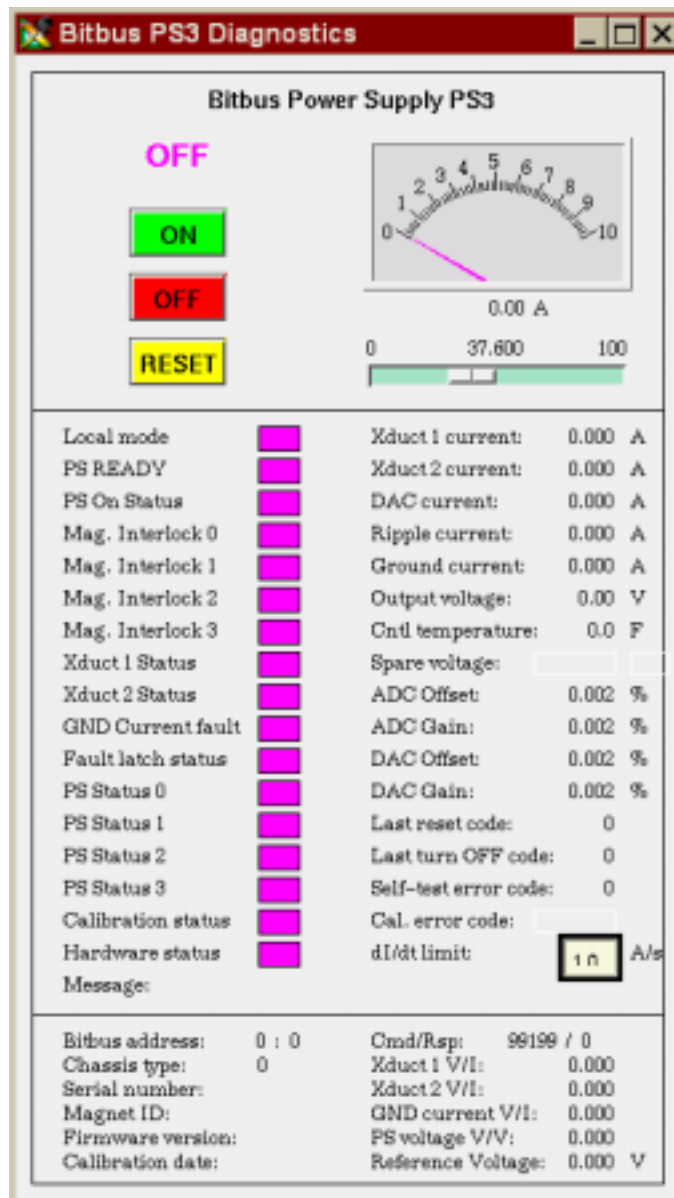
- New IOCs: 3.14.1/RTEMS4.6.0
- RF IOC: 3.13.6/Tornado 2.0.2
- SPEAR/Inj CA Servers: 3.13.1/OpenVMS 7.3-1
- Operator Tools, RDB System: 3.13.1/OpenVMS 7.3-1
- RF Engineer Tools: 3.13.6/Solaris 8
- Developer Tools: 3.13.6 and 3.14.1/  
Linux and Solaris
  
- Acc Phys MatLab Applications: 3.13.4/Windows

# Example EDM display





# Bitbus supply diagnostic panel





## Software Schedule

- Priority 1 Software: Oct 1, 2003
- Commission w/o Beam: Nov 1, 2003
- Commission with Beam: Dec 8, 2003
- Photon Beam to Exp: Early 2004
- Priority 2 Software: Mid 2004

# EPICS 2010

- We are currently strong to make incremental steps
  - EPICS has reached a mature state (this way)
  - Nobody wants to change this!

## But

- Let's start to think about the long term future of EPICS
- Not: What is currently necessary?
- But:
  - What is necessary on the long run?
  - How can we get prepared for future technical trends?

# God smiles on SPEAR...



SPEAR3 Wed Apr 2 17:23:03 2003





## Some useful links



- EPICS home page
  - <http://epics.aps.anl.gov/epics/>
- SLAC EPICS home page
  - <http://www.slac.stanford.edu/comp/unix/package/epics/index.html>
- SPEAR EPICS home page
  - <http://www.slac.stanford.edu/~spear/epics/>
- SPEAR EPICS PV Database
  - <http://www.ssrl.slac.stanford.edu/speardb/pv.jsp>