EPICS Overview

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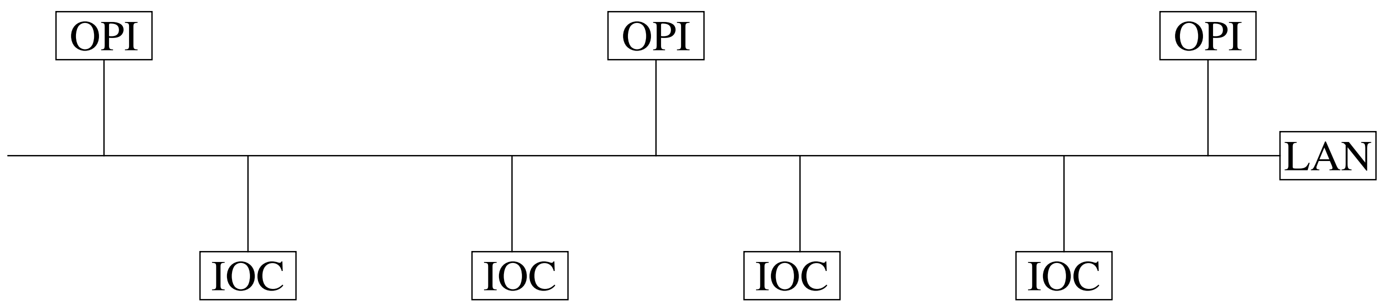
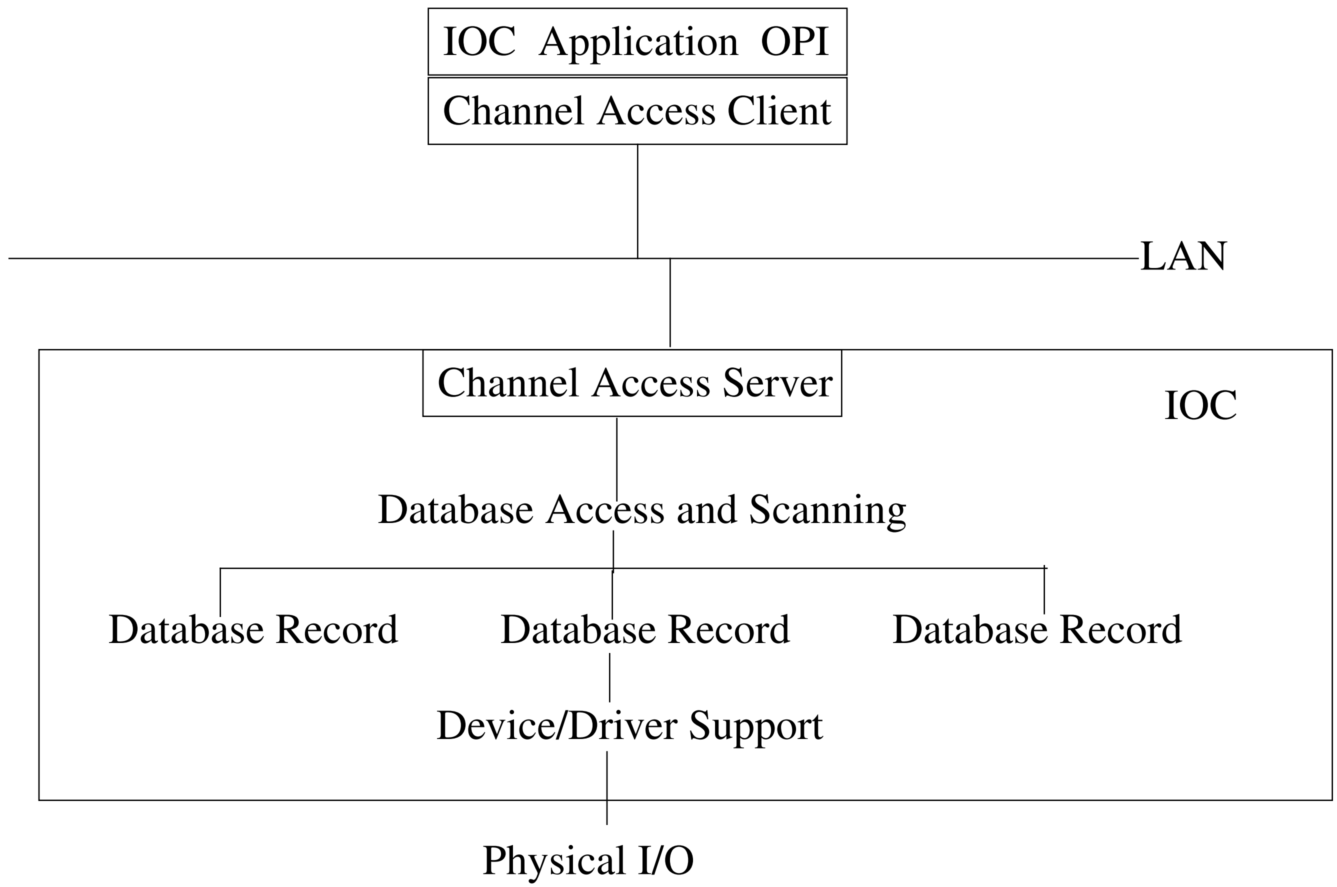
EPICS System Architecture: Physical



OPI Operator Interface and/or Applications
LAN Local Area Network
IOC Input Output Controller

EPICS System Architecture: Logical



Basic Attributes Of Epics

- EPICS IS NOT THE CONTROL SYSTEM!!!
  - EPICS is a collection of software tools and other components
  - Application Developers use EPICS to create control system
- Tool Based
  - Minimize Custom Coding
  - Uniform Operator Interface
- Completely Distributed
  - No Single Bottle-Neck
  - Scales Nicely
  - IOC is autonomous system

Basic Attributes Of Epics (cont.)

- Event Driven
  - No Polling
  - Quick Response
- High Performance
  - Workstation (Sun4)
    - >2000 screen updates per second
    - Quick Display Call-up (goal of < 2 seconds)
  - IOC (68040)
    - Process >5000 records per second.

Hardware - Software Platforms (Vendor Supplied)

- OPI
    - Hardware
        - UNIX based Workstation (currently sun4)
    - Software
        - UNIX Operating System
        - X Windows
        - Motif Toolkit
- LAN
    - Hardware
        - Ethernet/FDDI Now
        - ATM
    - Software
        - TCP/IP Protocols via sockets

Hardware - Software Platforms(cont.)

- IOC
    - Hardware
        - VME bus and crates
        - Motorola 68020, 68040, 68060 (Power PC in future)
        - Various VME/VXI modules: ADCs, DACs, Binary Input, Binary Output, etc.
        - Allen Bradley Scanner (Most Allen Bradley I/O modules)
        - GPIB devices
        - BitBus devices
    - Software (vxWorks)
        - Real time kernel
        - Extensive ”Unix like” libraries

Basic Control System Components

- OPI Tools
  - Display Editor/Manager - Graphics tool monitor&control displays
  - Database Configuration Tool
  - State Sequence Compiler
  - Alarm Handler
  - Archiver
  - BURT - Backup/Restore Tool
  - Interfaces to Commercial Products (IDL,Wingz, Mathematica, etc)
  - Programs, e.g. automatic beam tuning, can be interfaced via Channel Access

Basic Control System Components (cont.)

- LAN
  - Channel Access
- IOC
  - Memory Resident Database
  - Database Access
  - Database Scanners
  - Record Support
  - Device Support
  - Driver Support
  - Sequencer (Finite State Machine)
  - Custom Code

Channel Access

Network Transparent Access to IOC Databases

- Client/Server Model
    - Clients
        - UNIX, IOC, VMS, Windows NT (Some)
        - Future: ?
    - Servers
        - Today: IOC
        - Future: ?
- A client can communicate with an arbitrary set of servers
- A server accepts connections from an arbitrary set of clients
- Supporting a new OS and/or CPU means porting client (relatively easy)

Channel Access (cont.)

- Basic Functions
  - Search - Locate process variables, Establish connections
  - Get - Get value of process variable + extra info (alarm status, etc.)
  - Put - Change value of process variable
  - Add Event - Add change of state callback (alarm status, value change)

Database

- Memory resident
- Records can be added/deleted only via a database configuration tool
- Some field values, e.g. links, can be modified only via DCT
- Most field values can be changed dynamically
- Multiple record types
    - AI - Analog Input
    - AO - Analog Output
    - CALC - Calculation

    . . . (Currently 27 supported record types)

Database (cont.)

- Each record type has fixed set of fields
  - Common to all record types
    - NAME - Unique identifier for record
    - STAT - Alarm Status
    - SEVR - Alarm Severity

    . . .
  - Record specific
    - I/O values
    - Links to other records
    - High/Low Operating Ranges
    - Alarm Limits (HIHI, HIGH, LOW, LOLO)

    . . .

Record Processing

- Some combination of the following
    - Read Inputs
        - Analog Inputs
        - Binary Inputs
        - Fields from other database records
    - Conversion
        - None
        - Linear
        - Break Point Tables
    - Write Outputs
        - Analog Outputs
        - Binary Outputs
        - Fields in other database records
    - Check for Alarms
    - Trigger Monitors (Channel Access callbacks)
    - Trigger processing of linked records

Record Processing (cont.)

- Relatively easy to add new Record types
- Device Support (relatively easy to add new devices) hides hardware details
  - Several different ADCs supported. All use same record support module
  - Same for Analog Outputs, Binary I/O, Timers, etc.
- Device Drivers for complicated I/O interfaces

Database Scanning

- Determines when a record is processed

- Event Scanning - Triggered by sequence program or some other program
- Periodic Scanning - Current rates vary from .1 secs to 10 secs
- I/O Event Scanning - Triggered by external interrupt, i.e. driver interrupt routine
- Passive - Triggered by other records being processed

IOC Summary

- Autonomous device to control a subsystem
- OPI, via Channel Access, has easy access for control and monitoring
- Control algorithms can be implemented via scanning and record links
- Sequencer provides a general purpose software tool modeled as a finite state machine
- Other special purpose support can be added to an IOC
- Relatively easy to add new record and device support
- A single 68040 IOC can process >5000 records/sec

Channel Access Summary

- Transparent LAN access from client to multiple servers

OPI Summary

- Graphics Editor allows relatively easy creation of monitor&control displays
- Monitor&control displays can handle >2000 screen updates/sec
- Alarm Handler
- Archiver
- Other Applications can communicate via Channel Access