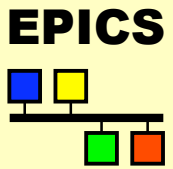
NSRL
EPICS
Seminar



Portable Channel Access Server

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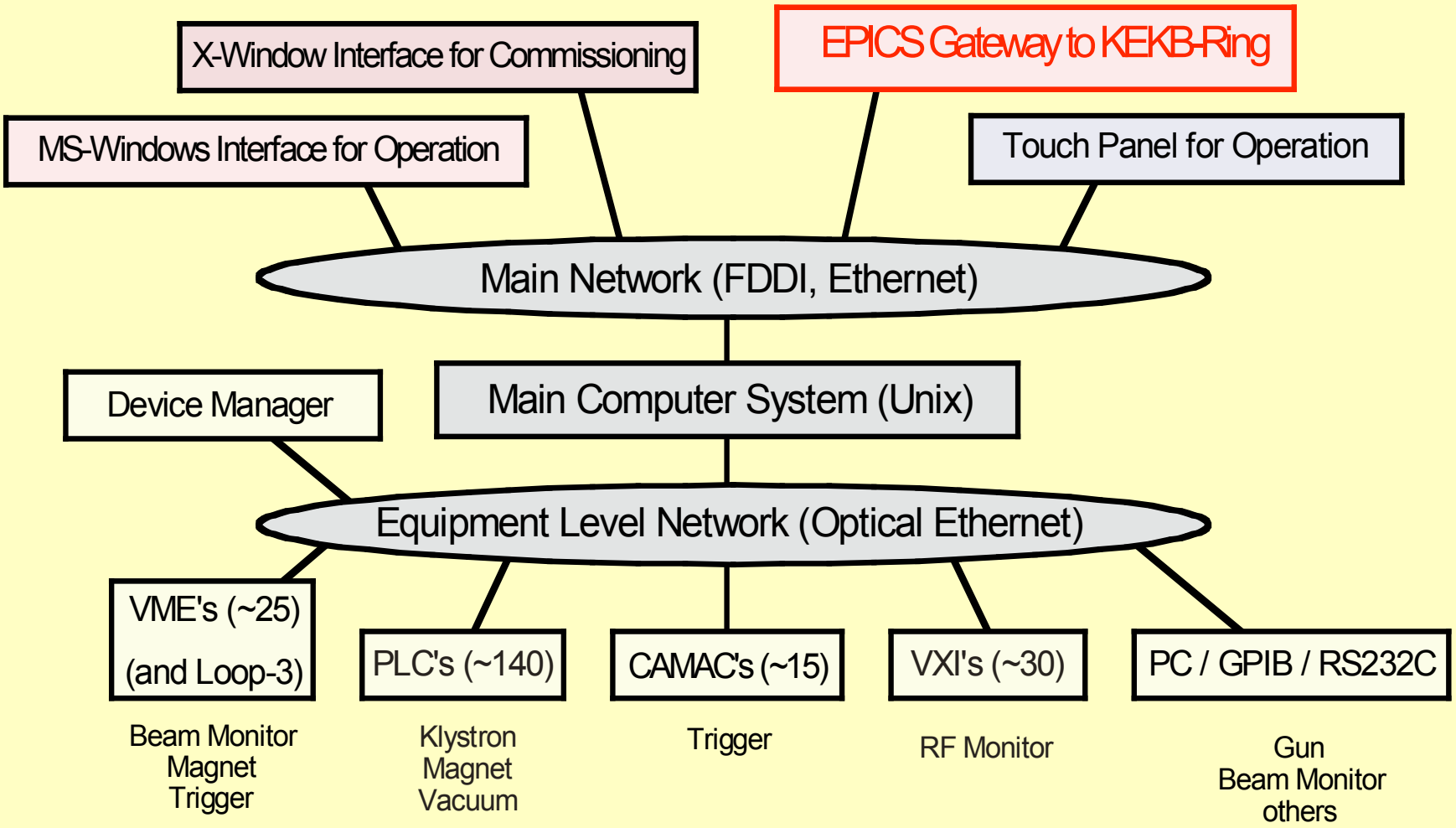
(Marty Kraimer, APS, USPAS1999)

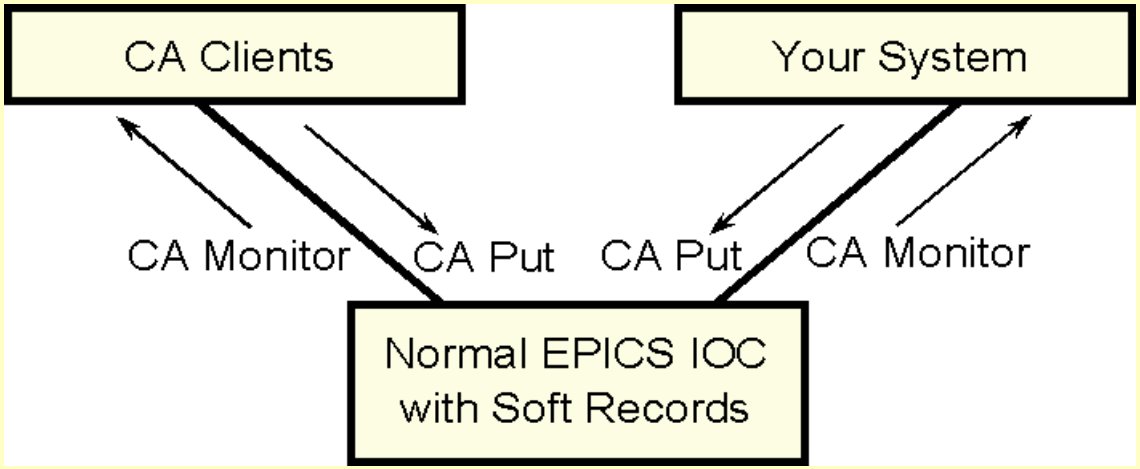
Pre-Overview

- Why Channel Access Server? Example: KEK Linac

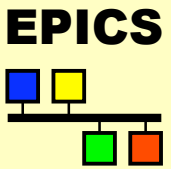


Pre-Overview 2

- Why Channel Access Server?
  - You may want to provide your information to the EPICS world from Platforms other than EPICS IOC's
  - You want to save/restore intermediate results on the machine other than EPICS IOC's
- There are Several Possibilities
- [1] Simple IOC Gateway - Simplest

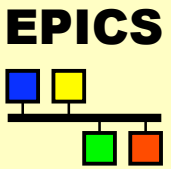


Pre-Overview 3



- [2] Another Possibility on Win32 Environment
  - LANL ActiveX example
  - For Small Number of Variables
- [3] More Platforms will be Supported as IOC's
  (with or without Realtime Processing)
  - With 3.14 or Later
  - Not only with CA service but also with Database Processing
- [4] Portable Channel Access Server
  - Current Standard way in EPICS Base
  - Definition of Server-side API
    - IOC's will use the same common library software
  - C++ templates are provided to develop application software
  - "Channel Access Portable Server – API Tutorial" (LANL)

Overview



- What is the Portable Channel Access Server?

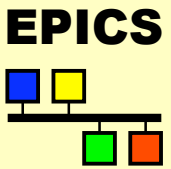
  The Portable Server consists of a C++ library with a simple class interface.

- Purpose of the Server library

  Using the simple interface to the library, a developer can create a Channel Access server tool that can interact with the EPICS database as well as other applications.

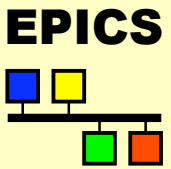
- Example ca servers
  - Channel access gateway
  - Directory server
  - Fault logger APT HPRF
  - KECK instruments
  - KEKB gateway to LINAC control system
  - SLAC gateway to SLAC control system
  - Gateways to other control systems at DESY

Overview (cont.)

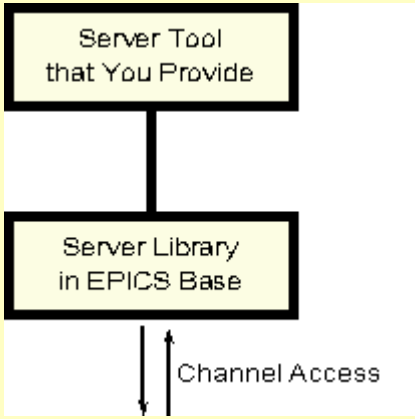


- Advantages of a Server Tool
  - Your application becomes an EPICS server tool
  - Your data become EPICS process variables
  - MEDM and other EPICS tools can interact with your application
- Talk purpose
  - Describe the server interface
  - Show simple C++ example server

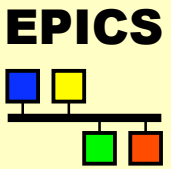
Basic Concepts



- Server Tool
  - Developer creates a channel access server tool
  - Provides interface classes and methods required by the server library
  - Server Tool Functions
    - Creates/deletes server instance
    - Responds to client requests
      - PV search
      - Attach/detach request
      - Read/write requests
    - Posts change of state events
- Server Library
  - C++ library with simple class interface
  - Calls the C++ server interface functions
  - Developer only needs to know server interface
  - Hides complexity of channel access
  - Available in EPICS base
  - Runs on Unix, WIN32, and VMS

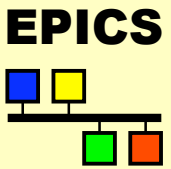


Basic Concepts (cont.)



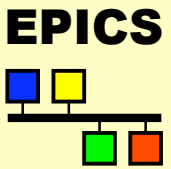
- Process Variable (PV)
  - Variable which server tool keeps track of
  - Server tool provides clients with current value when requested (read request)
  - Server tool changes current value upon client request (write request)
  - Server tool can inform client when the current value changes (monitoring)
  - Has attributes (e.g. alarm limits, operating range) which server tool keeps track of
- Channel
  - A connection between a client and a PV
  - Each client establishes a separate connection to the PV

C++ Server Interface



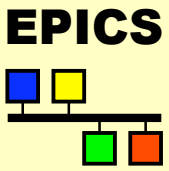
- 9 classes comprise the Portable Server API
  - Server class, caServer
  - Process variable class , casPV
  - pvExistReturn
  - pvAttachReturn
  - Channel class, casChannel
  - casAsyncPVExistIO
  - casAsyncCreatePVIO
  - casAsyncReadIO
  - casAsyncWriteIO.
- The first four classes are required to implement the server tool
- The channel class and the asynchronous IO classes can be used to add more functionality
- Each class has several member functions which server tool must define

caServer Class



- Every server tool must include a class derived from the caServer class
- Defines maximum length of a PV name
- Defines debug level determining amount of output printed
- Determines maximum number of simultaneous IO operations allowed
- Informs the server library if a PV is associated with the server tool
- Attaches a PV when a client wishes to establish a connection
- Server tool must provide implementations of the virtual functions
  - pvExistTest()
  - pvAttach()

Example Server



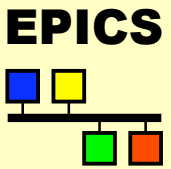
- Server definition

```
class myServer : public caServer
{
public:
    myServer(unsigned pvCountIn,char *nameIn);
    virtual ~myServer(void);
    virtual pvExistReturn pvExistTest(const casCtx& c,
          const char* pvname);
    virtual pvAttachReturn pvAttach(const casCtx& c,
          const char* pvname);
private:
    friend class myPV;
    myPV *mypv;
    char *pvName;
    int pvNameLength;
    gdd* value;
};
```

- Server creation

```
 int main(int argc, char* argv[]){
    myServer* server;
    int forever=1;

    if(argc<2) {
          fprintf(stderr,"Usage: %s pvName\n",argv[0]);
          return -1;
    }
    server = new myServer(1,argv[1]);
    osiTime delay(1000u,0u);
    while(forever) {
          fileDescriptorManager.process(delay);
    }
    return 0;
}
```

pvExistTest




```
pvExistReturn pvExistTest(const casCtx &ctx, const char
   *pPVAliasName)
```

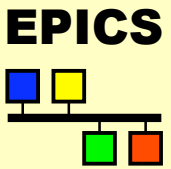
- Response to a client CA search
- The server tool may accept multiple PV name aliases for the same PV.
- The request is allowed to complete asynchronously (server tool uses asynchronous IO classes).
- Server tool passes ctx to asynchronous completion constructors
- Return values (class pvExistReturn)
  - `return pverExistsHere;`

    Server has PV
  - `return pverDoesNotExistHere;`

    Server does not know of this PV
  - `return pverAsynchCompletion;`

    Deferred result

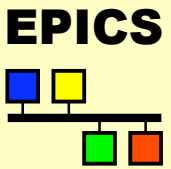
pvAttach




```
pvAttachReturn pvAttach (const casCtx &ctx,
    const char *pPVAliasName)
```

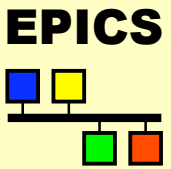
- Called when client wishes to attach to PV
- Allowed to complete asynchronously
- Server tool must detect attempts to create a 2nd PV with the same name
- Return values (class pvAttachReturn)
  - `return pPV;`
    Success (pass by pointer)
  - `return PV;`
    Success (pass by ref)
  - `return S_casApp_pvNotFound;`
    No PV by that name here
  - `return S_casApp_noMemory;`
    No resources to create pv
  - `return S_casApp_asyncCompletion;`
    Deferred completion
  - `return S_casApp_postponeAsyncIO;`
    Too many simultaneous IO operations

Example Server Methods



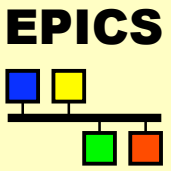

```
myServer::myServer(unsigned pvCountIn,char *nameIn)
{
    pvNameLength = strlen(nameIn);
    pvName = new char [pvNameLength+1];
    strcpy(pvName,nameIn);
    value = new gddScalar(appvalue,aitEnumFloat64);
    value->reference();
    value->put(0);
    value->setStatSevr(0,0);
    mypv = new myPV(*this,pvName);
}

pvExistReturn myServer::pvExistTest(const casCtx&,
    const char* name)
{
    if(strncmp(name,pvName,pvNameLength)==0)
          return pverExistsHere;
    return pverDoesNotExistHere;
}

pvAttachReturn myServer::pvAttach(const casCtx&,const char* name)
{
    if(strncmp(name,pvName,pvNameLength)==0) return *mypv;
    return NULL;
}

myserver::~myserver(void)
{
    delete [] pvName;
    value->unreference();
    delete mypv;
}
```

casPV Class



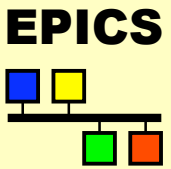
- Responds to read/write PV requests
  - Server must implement the virtual functions
    - `read()`
    - `write()`
- Responds to a request for a PV monitor
  - Server implements the virtual functions
    - `interestRegister()`
    - `interestDelete()`
  - Calls `postEvent()`
- Other important functions
    - `getName()`
    - `bestExternalType()`
    - `beginTransaction(),endTransaction()`
    - `destroy()`
- Do nothing default implementations exist.
- Server tool need not implement those functions it does not want.

Example casPV Class Definition



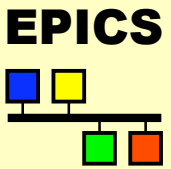

```
class myPV : public casPV
{
public:
    myPV(myServer& serverIn,char* nameIn);
    virtual ~myPV(void);
    virtual void destroy(void);
    virtual caStatus read(const casCtx &, gdd &prototype);
    virtual caStatus write(const casCtx &, gdd &dd);
    virtual aitEnum bestExternalType(void) const;
    virtual caStatus interestRegister(void);
    virtual void interestDelete(void);
    virtual const char *getName() const;
private:
    myServer& server;
    char *pvName;
    int interest;
};
```

Example casPV Methods



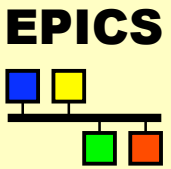

```
myPV::myPV (myServer& svrIN,char * nameIn):
    server(svrIN),interest(0)
{
    pvName = new char [strlen(nameIn)+1];
    strcpy(pvName,nameIn);
}


caStatus myPV::read(const casCtx&, gdd &dd)
{
    dd.put(server.value);
    return S_casApp_success;
}


caStatus myPV::write(const casCtx&, gdd &dd)
{
    aitFloat64 newValue;

    dd.get(&newValue, aitEnumFloat64);
    server.value->put(newValue);
    if (interest) postEvent(server.valueEventMask,*value);
    return S_casApp_success;
}
```

Example casPV Methods (cont.)



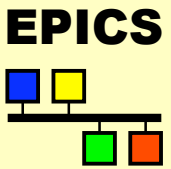

```
aitEnum myPV::interestRegister(void)
{
    interest =1;
    return S_casApp_success;
}

void myPV::interestDelete(void) { interest = 0; }

const char *myPV::getName() const { return pvName; }

aitEnum myPV::bestExternalType() const
{
    return aitEnumFloat64;
}

myPV::~myPV(void){delete [] pvName;}

void myPV::destroy(void) { }
```

Data Types



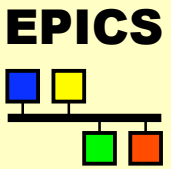
- Channel Access client request types
  - DBR types defined in db_access.h
    - e.g. DBR_STS_CHAR, DBR_GR_DOUBLE
- EPICS database native types
  - DBF types defined in db_access.h
    - e.g. DBF_DOUBLE, DBF_STRING,...
- Server has two types which describe data
  - Architecture Independent Type (AIT) defined in aitTypes.h
    - aitInt8 aitUint8 aitInt16
    - aitUint16 aitFloat32 aitFloat64
    - aitEnum16 aitIndex aitPointer
    - aitStatus
  - Application type defined in gddAppTable.h
    - e.g. precision, limits, status
- GDD library converts data from one type to another

Writing Your Own Server Tool



- Next steps
  - Try existing samples
  - Study sample code
  - Study casdef.h
  - Read documentation

Documentation



On-line documents at LANL

- Portable Server Tutorial
- Portable Server Reference
- A Server-Level API for EPICS (paper)
- Channel Access Server Update (slides)