asynDriver

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asynDriver: Asynchronous Driver Support

Release 3.2

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June 22, 2004

License Agreement

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- Local Serial Port
- TCP/IP or UDP/IP Port
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- Green Springs IP488
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Diagnostic Aids
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Purpose

asynDriver is a general purpose facility for interfacing device specific code to low level communication drivers.

A primary target for asynDriver is EPICS IOC device support but, other than using libCom, it is independent of EPICS.

The following are some of the existing EPICS general purpose device support systems that have been converted to use asynDriver.

- gpibCore is the operating−system−independent version of the Winans/Franksen GPIB support.
- mpfSerial is the serial support provided with MPFOSI (Message Passing Facility)

The following are some of the existing EPICS general purpose device support systems that could be converted to use asynDriver.

- streams is the protocol file based support for serial/GPIB/CAN from Dirk Zimoch.
- devAscii/drvAscii is serial support from KECK Observatory.

Each of these systems is used at EPICS facilities for accessing GPIB and/or serial devices. Because device support has been written for many instruments and thousands of database records use the device support, users will not be easily persuaded to switch from their existing solution. Thus asynDriver implements a framework below device support that can be used by all of the above systems so that all can share the same drivers.

Each system needs to be modified so that the device support component is compatible with existing use but replace the driver part with asynDriver. The benefit is that all could share the same set of low level drivers.

gpibCore and mpfSerial have already been converted and is included with asynDriver.

Hopefully Dirk Zimoch will get time soon to convert streams and Allen Honey time to convert devAscii.

In the future other protocols will be supported especially for Ethernet based devices.

Status

This version provides

- asynManager, i.e. the software layer between device support and drivers.
- asynRecord: EPICS record support that provides a generic interface to asynManager, asynCommon, asynOctet, and asynGpib.
- devGpib: EPICS device support that replaces the device support layer of the Winans/Franksen gpibCore support.
- asynGpib: a replacement for the drvGpibCommon layer of the Franksen gpibCore support.
- drvAsynSerialPort: Support for devices connected to serial ports.
- drvAsynIPPort: Support for devices connected to devices connected through Ethernet/Serial converter boxes, TCP/IP sockets or UDP/IP sockets.
- vxi11: A replacement for the vxi11 support of the Franksen gpibCore support.
- gsIP488: A low level driver for the Greensprings IP488 Industry Pack module. This support is only implemented for vxWorks.

Acknowledgments

The idea of creating asynDriver resulted from many years of experience with writing device support for serial and GPIB devices. The following individuals have been most influential.

John Winans
: John provided the original EPICS GPIB support. Databases using John's support can be used without modification with devGpib. With small modifications, device support modules written for John's support can be used.

Benjamin Franksen
: John's support only worked on vxWorks. In addition the driver support was implement as a single source file. Benjamin defined an interface between drvCommon and low level controllers and split the code into

drvGpib and the low level drivers. He also created the support for drvVxi11.

Eric Norum

Eric started with Benjamin's code and converted it to use the Operating System Independent features of EPICS 3.14.

Marty Kraimer

Marty started with Eric's version and made changes to support secondary addressing and to replace ioctl with code to support general bus management, universal commands, and addressed commands.

Pete Owens

Pete, for the Diamond Light Source, did a survey of several types of device/driver support packages for serial devices. Diamond decided to use the streams support developed by Dirk Zimoch.

Dirk Zimoch

Dirk developed streams, which has a single device support model, but supports arbitrary low level message based drivers, i.e. GPIB, serial, etc.

Jun−ichi Odagare

Jun−ichi developed NetDev, a systems that provides EPICS device support for network based devices. It has a single device support model but provides a general framework for communicating with network based devices.

Overview of asynDriver

asynDriver is a software layer between device specific code and communication drivers that send/receive messages to/from devices. asynDriver defines the following terminology:

- interface

  All communication between software layers is done via interfaces. An interface definition is a C language structure consisting entirely of function pointers. An asynDriver interface is analogous to a C++ or Java pure virtual interface. Although the implementation is in C, the spirit is object oriented. Thus this document uses the term "member" rather than "function pointer".
- port

  A communication entity over which messages are sent. Whenever this document uses the word port without a qualifier, it means a communication port. A port provides access to one or more devices.
- device

  A device (instrument) connected to a port. For example if the port driver is a GPIB interface it can have up to 15 devices connected to each port. Whenever this document uses the word device without a quailifier, it means something that is connected to a port.
- asynDriver

  This is the name for the support described in this manual. It is also the name of the header file that describes the core interfaces
- asynManager

  The code which implements the asynManager and asynTrace methods..

Standard interfaces are defined so that most device specific code can communicate with multiple port drivers. If device support does all it's communication via reads and writes consisting of 8 bit bytes (octets) then it should work with almost all port drivers. If device support requires more complicated support then the types of ports will be more limited. Additional interfaces can be defined. It is expected that additional standard interfaces will be

defined.

Examples of ports are GPIB controllers, serial ports, Ethernet ports, etc. One or more devices can be attached to a port. For example only one device can be attached to an RS−232 port but up to 15 devices can be attached to a GPIB port.

Multiple layers can exist between device specific code and a port driver. A software layer calls interposeInterface in order to be placed between device specific code and drivers.

For more complicated protocols additional layers can be created. For example GPIB support is implemented as an asynGpib interface which is called by user code and a asynGpibPort interface which is called by asynGpib.

A driver can implement multiple interfaces. For example asynGpib implements asynCommon, asynOctet, and asynGpib.

asynManager uses the Operating System Independent features of EPICS base. It is, however, independent of record/device support. Thus it can be used by other code, e.g. a sequence program.

Standard Asynchronous Driver Interfaces

This section briefly describes the interfaces provided by asynManager and standard interfaces implemented by port drivers. asynManager members are called by normal threads. Except for asynCommon:report, port driver methods can only be called from the user supplied callback supplied in the call to createAsynUser..

The interfaces are:

- asynManager This provides services for communicating with a device connected to a port. The following services are provided
    - ♦ report − A method that reports the status of all ports.
    - ♦ A thread for each communication port.
    - ♦ Methods to connect/disconnect to a device or port.
    - ♦ A method for locating port driver interfaces.
    - ♦ queueRequest. This is a non−blocking method, i.e. it can be called from scan threads. A callback specified by the user is called by the interface thread. The user callback can then make an arbitrary number of calls to the driver. These calls may be blocking calls.
    - ♦ Methods that provide a transaction service, i.e. members lock/unlock can lock out other users while multiple queueRequests are issued.
    - ♦ Methods for registering ports and interfaces.
    - ♦ Methods called by a driver when it connects or disconnects from a port or device.
    - ♦ A Method for interposing an interface between clients and drivers.
    - ♦ Methods for enable and autoConnect.
- asynCommon asynCommon is a set of methods that must be implemented by all drivers. The methods are:
    - ♦ report − Report status of port.
    - ♦ connect − Connect to the port or device.
    - ♦ disconnect − Disconnect from the port or device.
    - ♦ setOption − Set device option.
    - ♦ showOption − Show device option.
- asynOctet asynOctet is a set of methods implemented by any driver that accepts octet messages (messages consisting of 8−bit bytes) and returns octet responses. This interface will be sufficient for most device

specific code. For example the code for streams protocol files needs only this interface. The term octet is used instead of ASCII because the only requirement is that messages consist of 8−bit bytes. The methods are:

- read − input a message. The routine returns the number of 8−bit bytes read from the device or −1 to indicate error.
- write − output a message. The routine returns the number of 8−bit bytes written to the device or −1 to indicate error.
- flush − if input is buffered flush the buffer.
- setEos − Specify an end of message string for detecting the end of input messages.
- getEos − Get the currect end of message string.

- asynTrace asynTrace is a set of methods for generating diagnostic messages.
- asynSyncIO asynSyncIO is a set of methods for performing synchronous I/O using asynManager and asynOctet. This interface is convenient for code that is running in a thread that is allowed to wait. Examples include motor drivers, SNL programs and the shell commands described later in this document. The methods are:
  - connect − connect to a device and port, create asynUser for use by other methods.
  - openSocket− open a TCP/IP or UDP/IP socket and port, creating an asyn port.
  - read − read device, wait for response. Optionally flush input before the read, and optionally set end of message string. The routine returns the number of 8−bit bytes read from the device or −1 to indicate error.
  - write − write device, wait for response. The routine returns the number of 8−bit bytes written to the device or −1 to indicate error.
  - writeRead − perform a "write" and then a "read" as an atomic operation. The routine returns the number of 8−bit bytes read from the device or −1 to indicate error.
  - flush − if input is buffered flush the buffer, wait for completion.

Overview

During initialization port drivers registers each communication port as well as all supported interfaces.

User code creates an asynUser by calling pasynManager−>createAsynUser(). The address of the asynUser is passed to most other asynDriver methods.

User code connects to a device, which is located located at some address on a port, and communicates with the device via combination of asynManager and one or more interfaces.

User code communicates with drivers via the following method:

1. It calls:

```
pasynManager−>queueRequest(...)
```

2. The callback specified in createAsynUser calls the driver via one of the driver interfaces.

Comments:

1. Streams, devAscii, and mpfSerial need only asynManager and asynOctet. devGpib needs only asynManager, asynCommon, asynOctet, and asynGpib.
2. It is expected that most users will connect to these interfaces via device support. However other code can call it. Examples are sequence programs, test programs, utility commands, etc.
3. Device support can consist of more than one type of support. For example most functions could be

accessed via streams but asynGpib could be used to handle SRQs.

asynDriver Structures and Interfaces

asynDriver.h describes the following:

- asynStatus − An enum that describes the status returned by many methods.
- asynException − An enum that describes exceptions.
- asynQueuePriority − An enum that describes the queue priorities,
- asynUser − A struture that contains generic information and is the "handle" for calling most methods.
- asynInterface − a structure that describes an interface.
- asynManager − An interface for communicating with asynDriver.
- asynCommon − An interface providing methods that must be implemented by all low level drivers.
- asynOctet − An interface providing I/O methods that most low level drivers implement.
- asynTrace − An interface plus associated functions and definitions that implement the trace facility.

asynStatus

Defines the status returned by most methods. If a method returns a status other than asynSuccess and one of the arguments to the method is pasynUser then the method is expected to write a message into pasynUser−>errorMessage.

```
typedef enum {
    asynSuccess,asynTimeout,asynOverflow,asynError
}asynStatus;
```

asynStatus

asynSuccess	The request was successfull.
asynTimeout	The request failed with a timeout.
asynOverflow	The caller did not supply a buffer large enough to hold all input. What happens to the remaining bytes depends on the low level driver.
asynError	Some other error occured.

asynException

Defines the exceptions for method exceptionOccurred

```
typedef enum {
    asynExceptionConnect,asynExceptionEnable,asynExceptionAutoConnect,
    asynExceptionTraceMask,asynExceptionTraceIOMask,
    asynExceptionTraceFile,asynExceptionTraceIOTruncateSize
} asynException;
```

asynException

asynExceptionConnect	The connection state of the port or device has changed.
asynExceptionEnable	The enable state of the port or device has changed.
asynExceptionAutoConnect	The autoConnect state of the port or device has changed.
asynExceptionTraceMask	The traceMask for the port or device has changed.

asynExceptionTraceIOMask	The traceIOMask for the port or device has changed.
asynExceptionTraceFile	The trace file for the port or device has changed.
asynExceptionTraceIOTruncateSize	The traceIOTruncateSize for the port or device has changed.

asynQueuePriority

This defines the priority passed to queueRequest.

```
typedef enum {
    asynQueuePriorityLow,asynQueuePriorityMedium,asynQueuePriorityHigh,asynQueuePriorityConnect
}asynQueuePriority;
```

asynQueuePriority

asynQueuePriorityLow	Lowest queue priority.
asynQueuePriorityMedium	Medium queue priority.
asynQueuePriorityHigh	High queue priority.
asynQueuePriorityConnect	Queue a connect or disconnect request. This priority must be used only for connect/disconnect requests.

asynUser

Describes a structure that user code passes to most asynManager and driver methods. Code must allocate and free an asynUser by calling asynManager:createAsynUser and asynManager:freeAsynUser.

```
typedef struct asynUser {
    char *errorMessage;
    int errorMessageSize;
    /* The following must be set by the user */
    double timeout;  /*Timeout for I/O operations*/
    void *userPvt;
    /* The following are for additional information from method calls */
    int          auxStatus; /*For auxillary status*/
}asynUser;
```

asynUser

errorMessage	When either asynManager or a driver returns an error, it should put an error message into errorMessage via a call to `epicsSnprintf(pasynUser->errorMessage,pasynUser->errorMessageSize,"<format>",...)`
errorMessageSize	The size of errorMessage. The user can not change this value.
timeout	The number of seconds before timeout for I/O requests. This is set by the user and can be changed between calls to drivers. The user must provide a non zero value or many low level drivers will timeout. A timeout value < 0.0 means wait forever.
puserPvt	For use by the user. The user should set this immediately after the call to pasynManager->createAsynUser. If this is changed while asynUser is queued, the results are undefined, e.g. it could cause a crash.
auxStatus	Any method can provide additional return information in auxStatus. The meaning is determined by the method.

asynInterface

This defines an interface registered with asynPortManager:registerPort or asynManager:interposeInterface.

```
typedef struct asynInterface{
    const char *interfaceType; /*For example asynCommonType*/
    void *pinterface;          /*For example pasynCommon */
    void *drvPvt;
}asynInterface;
```

asynInterface

interfaceType	A character string describing the interface.
pinterface	A pointer to the interface. The user must cast this to the correct type.
drvPvt	For the exclusive use of the code that called registerPort or interposeInterface.

asynManager

This is the main interface for communicating with asynDriver.

```
typedef void (*userCallback)(asynUser *pasynUser);
typedef void (*exceptionCallback)(asynUser *pasynUser,asynException exception);

typedef struct asynManager {
    void      (*report)(FILE *fp,int details);
    asynUser  *(*createAsynUser)(userCallback queue,userCallback timeout);
    asynStatus (*freeAsynUser)(asynUser *pasynUser);
    asynStatus (*isMultiDevice)(asynUser *pasynUser,
                                const char *portName,int *yesNo);
    /* addr = (-1,>=0) => connect to (port,device) */
    asynStatus (*connectDevice)(asynUser *pasynUser,
                                const char *portName,int addr);
    asynStatus (*disconnect)(asynUser *pasynUser);
    asynStatus (*exceptionCallbackAdd)(asynUser *pasynUser,
                                       exceptionCallback callback);
    asynStatus (*exceptionCallbackRemove)(asynUser *pasynUser);
    asynInterface *(*findInterface)(asynUser *pasynUser,
                           const char *interfaceType,int interposeInterfaceOK);
    asynStatus (*queueRequest)(asynUser *pasynUser,
                               asynQueuePriority priority,double timeout);
    asynStatus (*cancelRequest)(asynUser *pasynUser,int *wasQueued);
    asynStatus (*lock)(asynUser *pasynUser);   /*lock portName,addr */
    asynStatus (*unlock)(asynUser *pasynUser);
    asynStatus (*getAddr)(asynUser *pasynUser,int *addr);
    /* drivers call the following*/
    asynStatus (*registerPort)(const char *portName,
                               int multiDevice,int autoConnect,
                               unsigned int priority,unsigned int stackSize);
    asynStatus (*registerInterface)(const char *portName,
                               asynInterface *pasynInterface);
    asynStatus (*exceptionConnect)(asynUser *pasynUser);
    asynStatus (*exceptionDisconnect)(asynUser *pasynUser);
    /*any code can call the following*/
    asynStatus (*interposeInterface)(const char *portName, int addr,
                               asynInterface *pasynInterface,
                               asynInterface **ppPrev);
    asynStatus (*enable)(asynUser *pasynUser,int yesNo);
    asynStatus (*autoConnect)(asynUser *pasynUser,int yesNo);
    asynStatus (*isConnected)(asynUser *pasynUser,int *yesNo);
```

```
    asynStatus (*isEnabled)(asynUser *pasynUser,int *yesNo);
    asynStatus (*isAutoConnect)(asynUser *pasynUser,int *yesNo);
}asynManager;
epicsShareExtern asynManager *pasynManager;
```

asynManager

report	Reports status about the asynPortManager. It also calls asynCommon:report for each registered port driver.
createAsynUser	Creates an asynUser. The caller specifies two callbacks, one for successful queueRequests and one if a queueRequest has a timeout. The timeout callback is optional. If it is not provided and a queueRequest with a non−zero timeout is requested, an error message is issued and no timeout will occur. errorMessageSize characters are allocated for errorMessage. The amount of storage can not be changed. This method doesn't return if it is unable to allocate the storage.
freeAsynUser	Free an asynUser. The user must free an asynUser only via this call. The call will fail if the asynUser is connected to a device.
isMultiDevice	Does the port support multiple devices? This method can be called before calling connectDevice.
connectDevice	Device code calls this to connect to a device. It passes the name of the communication port and the address of the device. The port Name is the same as that specified in the call to registerPort. The call will fail if the asynUser is already connected to a device. If the port does not support multiple devices than addr is ignored. The call will fail if the asynUser is already connected to a device. connectDevice only connects a user to the port driver for the portName,addr. The port driver may or may not be connected to the actual device. Thus connectDevice and asynCommon:connect are completely different. See the Theory of Operation section for a description of the difference between single and multi−device port drivers.
disconnect	Disconnect from the port,addr to which connectDevice connected. The call will fail if the asynUser is queued or locked or has an exception callback. Note that asynManager:disconnect and asynCommon:disconnect are completely different.
exceptionCallbackAdd	The callback will be called whenever one of the exceptions defined by asynException occurs. The callback can call isConnected, isEnabled, or isAutoConnect to find the new state.
exceptionCallbackRemove	The callback is removed. This must be called before disconnect.

findInterface	Find a driver interface. If interposeInterfaceOK is true then findInterface returns the last interface registered or interposed. Otherwise the interface registered by registerPort is returned. It returns 0 if the interfaceType is not supported.
	
	The user needs the address of the drivers interface and of pdrvPvt so that calls can be made to the driver. For example:
	
	`asynInterface *pasynInterface;`
	`asynOctet *pasynOctet;`
	`void *pasynOctetPvt;`
	`...`
	`pasynInterface = pasynManager->findInterface(`
	`  pasynUser,asynOctetType,1);`
	`if(!pasynInterface) { /*error do something*/}`

	`pasynOctet = (asynOctet *)pasynInterface->pinterface;`
	`pasynOctetPvt = pasynInterface->pdrvPvt;`
	`/* The following call must be made from a callback */`
	`pasynOctet->read(pasynOctetPvt,pasynUser,...`

queueRequest	A device support thread never calls a driver directly. Instead it calls queueRequest. After the thread associated with the port takes this request from the queue, it calls the queue callback specified in the call to createAsynUser. The callback makes calls to the driver. If the asynUser is already on a queue, asynError is returned. The timeout starts when the request is queued. A value less than or equal to 0.0 means no timeout. The request is removed from the queue before the callback is called. Thus callbacks are allowed to unlock and issue new queue requests. The priority asynQueuePriorityConnect must be used for asynCommon:connect and asynCommon:disconnect calls and must NOT be used for any other calls.
cancelRequest	If a asynUser is queued remove it from the queue. If it is not on a queue nothing is done. In particular if the callback is active, this call has no effect. If the return value is asynSuccess, then wasQueued (0,1) if a request (was not, was) canceled, i.e. removed from the queue.
lock/unlock	lock/unlock are used to block other users from accessing a device while a user is making a series of queueRequests. Only the addr specified in the connectDevice request is locked. asynManager locks when a queueRequest for is taken from the queue. At that point all other entries in the queue must wait until unlock is called by the same pasynUser that locked. lock/unlock fail if a request is currently queued. The addr argument passed to connectDevice determines if the port or only a device is locked.
getAddr	*addr is set equal to the address which the user specified in the call to connectDevice. See the Theory of Operation section for a description of the difference between single and multi−device port drivers.
registerPort	This method is called by drivers. A call is made for each communication interface instance. multiDevice is (0,1) of the driver (does not, does) support multiple devices. autoConnect, which is (0,1) for (no,yes), provides the initial value for the port and all devices connected to the port. If priority is 0 then a default will be assigned. If stackSize is 0 a default is assigned. The portName argument specifies the name by which the upper levels of the asyn code will refer to this communication interface instance.
registerInterface	This is called by port drivers for each supported interface.
exceptionConnect	This method must be called by the driver when and only when it connects to a port or device.
exceptionDisconnect	This method must be called by the driver when and only when it disconnects from a port or device.
interposeInterface	This is called by a software layer between client code and the port driver. For example if a device echos writes then a software module that issues a read after each write could be created and call interposeInterface for interface asynOctet. Multiple interposeInterface calls for a port/addr/interface can be issued. *ppPrev is set to the address of the previous asynInterface. Thus the software module that last called interposeInterface is called by user code. It in turn can call the software module that was second last to call interposeInterface. This continues until the actual port driver is

	called. interposeInterface can also be called with an asynInterface that has not been previously registered or replaced. In this case *ppPrev will be null. Thus new interfaces that are unknown to the low level driver can be implemented.
enable	If enable is set yes than queueRequests are not dequeued unless their queue timeout occurs.
autoConnect	If autoConnect is true when asynThread is ready to take a request from a queue and the port or device is not connected, asynManager calls pasynCommon−>connect. See the discussion of Flow of Control below for details.
isConnected	*yesNo is set to (0,1) if the port or device (is not, is) connected.
isEnabled	*yesNo is set to (0,1) if the port or device (is not, is) enabled.
isAutoConnect	*yesNo is set to (0,1) if the portThread (will not, will) autoConnect for the port or device.

asynCommon

```
/* Device Interface supported by ALL asyn drivers*/
#define asynCommonType "asynCommon"
typedef struct  asynCommon {
    void       (*report)(void *drvPvt,FILE *fp,int details);
    /*following are to connect/disconnect to/from hardware*/
    asynStatus (*connect)(void *drvPvt,asynUser *pasynUser);
    asynStatus (*disconnect)(void *drvPvt,asynUser *pasynUser);
    /*The following are generic methods to set/get device options*/
    asynStatus (*setOption)(void *drvPvt, asynUser *pasynUser,
                            const char *key, const char *val);
    asynStatus (*getOption)(void *drvPvt, asynUser *pasynUser,
                            const char *key, char *val, int sizeval);
}asynCommon;
```

asynCommon describes the methods that must be implemented by drivers.

asynCommon

report	Generates a report about the hardware device. This is the only asynCommon method that does not have to be called by the queueRequest callback.
connect	Connect to the hardware device or communication path. The queueRequest must specify priority asynQueuePriorityConnect.
disconnect	Disconnect from the hardware device or communication path. The queueRequest must specify priority asynQueuePriorityConnect.
setOption	This is a generic routine for setting a device option. The arguments are key,value pairs. The meaning is driver specific. If a driver does not accept options it can return asynError.
getOption	This is a generic routine for getting a device option. The value for the key is written into val. If a driver does not accept options it can return asynError.

asynOctet

```
/* Device Interface supported by low level octet drivers. */
#define asynOctetType "asynOctet"
typedef struct asynOctet{
    asynStatus (*read)(void *drvPvt,asynUser *pasynUser,
```

```
                        char *data,int maxchars,int *nbytesTransfered);
    asynStatus (*write)(void *drvPvt,asynUser *pasynUser,
                        const char *data,int numchars,int *nbytesTransfered);
    asynStatus (*flush)(void *drvPvt,asynUser *pasynUser);
    asynStatus (*setEos)(void *drvPvt,asynUser *pasynUser,
                         const char *eos,int eoslen);
    asynStatus (*getEos)(void *drvPvt,asynUser *pasynUser,
                        char *eos, int eossize, int *eoslen);
}asynOctet;
```

NOTE: The name octet is used instead of ASCII because it implies that communication is done via 8−bit bytes.

asynOctet describes the methods implemented by drivers that use octet strings for sending commands and receiving responses from a device.

asynOctet

read	Read a message from the device. *nbytesTransfered is the number of 8−bit bytes read from the device.
write	Send a message to the device. *nbytesTransfered is the number of 8−bit bytes sent to the device.
flush	Flush the input buffer.
setEos	Set End Of String. For example "\n". Note that gpib drivers usually accept at most a one character string.
getEos	Get the current end of string.

Trace Interface

```
/*asynTrace is implemented by asynManager*/
/*All asynTrace methods can be called from any thread*/
/* traceMask definitions*/
#define ASYN_TRACE_ERROR     0x0001
#define ASYN_TRACEIO_DEVICE  0x0002
#define ASYN_TRACEIO_FILTER  0x0004
#define ASYN_TRACEIO_DRIVER  0x0008
#define ASYN_TRACE_FLOW      0x0010

/* traceIO mask definitions*/
#define ASYN_TRACEIO_NODATA 0x0000
#define ASYN_TRACEIO_ASCII  0x0001
#define ASYN_TRACEIO_ESCAPE 0x0002
#define ASYN_TRACEIO_HEX    0x0004

/* asynPrint and asynPrintIO are macros that act like
   int asynPrint(asynUser *pasynUser,int reason, const char *format, ... );
   int asynPrintIO(asynUser *pasynUser,int reason,
        const char *buffer, int len, const char *format, ... );
*/
typedef struct asynTrace {
    /* lock/unlock are only necessary if caller performs I/O other then*/
    /* by calling asynTrace methods                                    */
    asynStatus (*lock)(asynUser *pasynUser);
    asynStatus (*unlock)(asynUser *pasynUser);
    asynStatus (*setTraceMask)(asynUser *pasynUser,int mask);
    int        (*getTraceMask)(asynUser *pasynUser);
    asynStatus (*setTraceIOMask)(asynUser *pasynUser,int mask);
    int        (*getTraceIOMask)(asynUser *pasynUser);
    asynStatus (*setTraceFILE)(asynUser *pasynUser,FILE *fp);
    FILE       *(*getTraceFILE)(asynUser *pasynUser);
    asynStatus (*setTraceIOTruncateSize)(asynUser *pasynUser,int size);
```

```
    int        (*getTraceIOTruncateSize)(asynUser *pasynUser);
    int        (*print)(asynUser *pasynUser,int reason, const char *pformat, ...);
    int        (*printIO)(asynUser *pasynUser,int reason,
               const char *buffer, int len,const char *pformat, ...);
}asynTrace;
epicsShareExtern asynTrace *pasynTrace;
```

asynTrace

asynDriver provides a trace facility with the following attributes:

- Tracing is turned on/off for individual devices, i.e. a portName,addr
- Trace has a global trace mask for asynUsers not connected to a port ot port,addr.
- The output is sent to a file or to stdout.
- A mask determines the type of information that can be displayed. The various choices can be ored together.
    - ♦ ASYN_TRACE_ERROR Run time errors are reported, e.g. timeouts.
    - ♦ ASYN_TRACEIO_DEVICE High level device support reports I/O activity.
    - ♦ ASYN_TRACEIO_FILTER Any layer between device support and the low level driver reports any filtering it does on I/O.
    - ♦ ASYN_TRACEIO_DRIVER Low level driver reports I/O activity.
    - ♦ ASYN_TRACE_FLOW Report logic flow. Device support should report all queue requests, callbacks entered, and all calls to drivers. Layers between device support and low level drivers should report all calls they make to lower level drivers. Low level drivers report calls they make to other support.
- Another mask determines how message buffers are printed. The various choices can be ored together.
    - ♦ ASYN_TRACEIO_NODATA Dont print any data from the message buffers
    - ♦ ASYN_TRACEIO_ASCII Print with a "%s" style format.
    - ♦ ASYN_TRACEIO_ESCAPE Call epicsStrPrintEscaped.
    - ♦ ASYN_TRACEIO_HEX Print each byte with " %2.2x".

In order for the trace facility to perform properly, device support, and all drivers must use the trace facility. Device and driver support can directly call the asynTrace methods. The asynPrint and asynPrintIO macros are provided so that it is easier for device/driver support. Support can have calls like.

```
    asynPrintIO(pasynUser,ASYN_TRACE_FLOW,"%s Calling queueRequest\n",
        someName);
```

The asynPrintIO call is designed for device support or drivers that issue read or write requests. They make calls like:

```
    asynPrintIO(pasynUser,ASYN_TRACEIO_DRIVER,data,nchars,"%s nchars %d",someName,nchars);
```

The asynTrace methods are implemented by asynManager. These methods can be used by any code that has created an asynUser and connected to a device. All methods can be called by any thread. If a thread performs all I/O via calls to print or printIO, then it does not have to call lock or unlock. If it does want to do it's own I/O, it must lock before any I/O and unlock after. For example:

```
    pasynTrace->lock(pasunUser);
    fd = pasynTrace->getTraceFILE(pasunUser);
    /*perform I/O of fd */
    pasynTrace->unlock(pasunUser);
```

If the asynUser is not connected to a port, i.e. pasynManager−>connectDevice has not been called, then a "global" device is assumed. This is usefull when asynPrint is called before connectDevice.

asynTrace

lock/unlock	These are only needed if some code wants to do it's own I/O instead of using print and printIO. The set methods, print, and printIO all lock while performing their operations. The get routines do not lock but except for getTraceFILE they are safe. The worst that happens is that the user gets a little more or a little less output.
setTraceMask	Set the trace mask. Normally set by the user requesting it via a shell command or the devTrace device support.
getTraceMask	Get the trace mask. Support that wants to issue trace messages calls this to what trace options have been requested.
setTraceIOMask	Set the traceIO mask. Normally set by the user requesting it via a shell command or the devTrace device support.
getTraceIOMask	Get the traceIO mask. Support that wants to issue it's own IO messages instead of calling asynPrintIO should call this and honor the mask settings. Most code will not need it.
setTraceFILE	Set the stream to use for output. A NULL argument means use errlog. Normally set by the user requesting it via a shell command or by the devTrace device support. If the current output stream is none of (NULL, stdout, stderr) then the current output stream is closed before the new stream is used.
getTraceFILE	Get the file descriptor to use for output. Support that wants to issue it's own IO messages instead of calling asynPrintIO should call this and honor the mask settings. In this case lock must have been called first. Most code will not need it. If return value is 0 then ouput should be directed to errlog
setTraceIOTruncateSize	Determines how much data is printed by printIO. In all cases it determines how many bytes of the buffer are displayed. The actual number of characters printed depends on the traceIO mask. For example ASYN_TRACEIO_HEX results in 3 characters being printed for each byte. Normally set by the user requesting it via a shell command or the devTrace device support.
getTraceIOTruncateSize	Get the current truncate size. Called by asynPrintIO. Code that does it's own I/O should also support the traceIO mask.
print	If reason ored with the current traceMask is not zero then the message is printed. Most code should call asynPrint instead of calling this method
printIO	If reason ored with the current traceMask is not zero then the message is printed. If len is >0 then the buffer is printed using the traceIO mask and getTraceIOTruncateSize to decide how to print. Most code should call asynPrintIO instead of calling this method

Synchronous Interface to asynDriver

asynSyncIO.h describes the following:

```
/* Synchronous Interface to the asynManager and asynOctet interfaces. */
typedef struct asynSyncIO {
   asynStatus (*connect)(const char *port, int addr, asynUser **ppasynUser);
   asynStatus (*openSocket)(const char *server, int port,
                  char **portName);
   int        (*write)(asynUser *pasynUser, char const *buffer, int buffer_len,
```

```
                double timeout);
   int        (*read)(asynUser *pasynUser, char *buffer, int buffer_len,
                const char *ieos, int ieos_len, int flush, double timeout);
   int        (*writeRead)(asynUser *pasynUser,
                const char *write_buffer, int write_buffer_len,
                char *read_buffer, int read_buffer_len,
                const char *ieos, int ieos_len, double timeout);
   asynStatus (*flush)(asynUser *pasynUser);
} asynSyncIO;
epicsShareExtern asynSyncIO *pasynSyncIO;
```

asynSyncIO provides a convenient interface for software that needs to perform "synchronous" I/O to an asyn device, i.e. that starts an I/O operation and then blocks while waiting for the response. The code does not need to handle callbacks or the understand the details of the asynManager and asynOctet interfaces. Examples include motor drivers running in their own threads, SNL programs, and the shell commands described later in this document.

asynSyncIO

connect	Connects to an asyn port and address, returns a pointer to an asynUser structure.
openSocket	Opens a new connection to a TCP/IP or UDP/IP socket, returning the name of a newly created asyn port. The name of the port created is of the form "server:port [protocol]", i.e. "corvette:21" or "164.54.160.50:21" or "corvette:21 UDP".
write	Calls asynOctet−>write and waits for the operation to complete or time out.
read	Calls asynOctet−>setEos (if ieos_len is non−zero), asynOctet flush (if flush=1), and asynOctet−>read. Waits for the operation to complete or time out.
writeRead	Calls asynOcter−>write, asynOctet−>setEos (if ieos_len is non−zero), asynOctet flush (if flush=1), and asynOctet−>read. Waits for the operations to complete or time out.
flush	Calls asynOctet−>flush and waits for the operation to complete.

Theory of Operation

Multiple Device vs Single Device port drivers

When a low level driver calls registerPort it must say if it supports multiple devices. This determines how the addr argument to connectDevice is handled and what getAddr returns.

- multiDevice false

  The addr argument to connectDevice is ignored and getAddr always returns −1
- multiDevice true

  If connectDevice is called with addr<0 the connection is to the port and getAddr always returns −1. If addr>=0 then the caller is connected to the device at the specified address. getAddr will return this address.

Connection Management

asynManager keeps track of the following states:

- connection

  Is the port or device connected? This state is initialized to disconnected.
- enabled

  Is the port or device enabled? This state is initialized to enabled.
- autoConnect

  Does asynManager call connect if it finds the port or device disconnected. This is initialized to the state specified in the call to registerPort.

If the port does not support multiple devices then port and device status are the same. If the port does support multiple devices than asynManager keeps the states for the port and for every device connected to the port.

Whenever any of the states change for a port or device than all users that called exceptionCallbackAdd for that port or device are called.

Low level drivers must call pasynManager:exceptionConnect whenever they connect to a port or port,addr and must call exceptionDisconnect whenever they disconnect.

Flow of Control

The methods asynManager:report and asynCommon:report can be called by any thread but the caller is blocked until the report finishes. The following discussion applys to all methods except report.

The asynManager methods can be called by any thread including portThread. None of these methods except report block.

The methods for interfaces asynCommon (except report), asynOctet, and asynGpib must only be called by the queue callback specified in the call to createAsynUser.

portThread

When a low level driver calls registerPort, asynManager creates a thread for the port. Each portThread has it's own set of queues for the calls to queueRequest. portThread runs forever implementing the following algorithm:

1. Wait for work by calling epicsEventMustWait. Other code such as queueRequest call epicsEventSignal.
2. If the port is disabled return 1.
3. For every element in queue asynQueuePriorityConnect:
   - ♦ Remove the element from the queue.
   - ♦ Calls the user's callback
4. If the port is not connected and autoConnect is true for the port then attempt to connect to the port.
5. If the port is still not connected return 1.
6. For each element of the queues asynQueuePriorityHigh,...,asynQueuePriorityLow.
   - ♦ If disabled skip this element.
   - ♦ If not connected and autoConnect is true for the device then attempt to connect to the device.
   - ♦ If not connected skip this element.
   - ♦ If locked and not lock holder skip this element.
   - ♦ If not locked and user has requested lock then set locked,
   - ♦ remove from queue and call user callback.

The actual code is more complicated because it unlocks before it calls code outside asynManager. This means that the queues can be modified and exceptions may occur.

asynRecord: Generic EPICS Record Support

A special record type asynRecord is provided. Details are described in asynRecord. This section provides a brief description of how to use it.

Each IOC can load one or more instances of asynRecord. An example is:

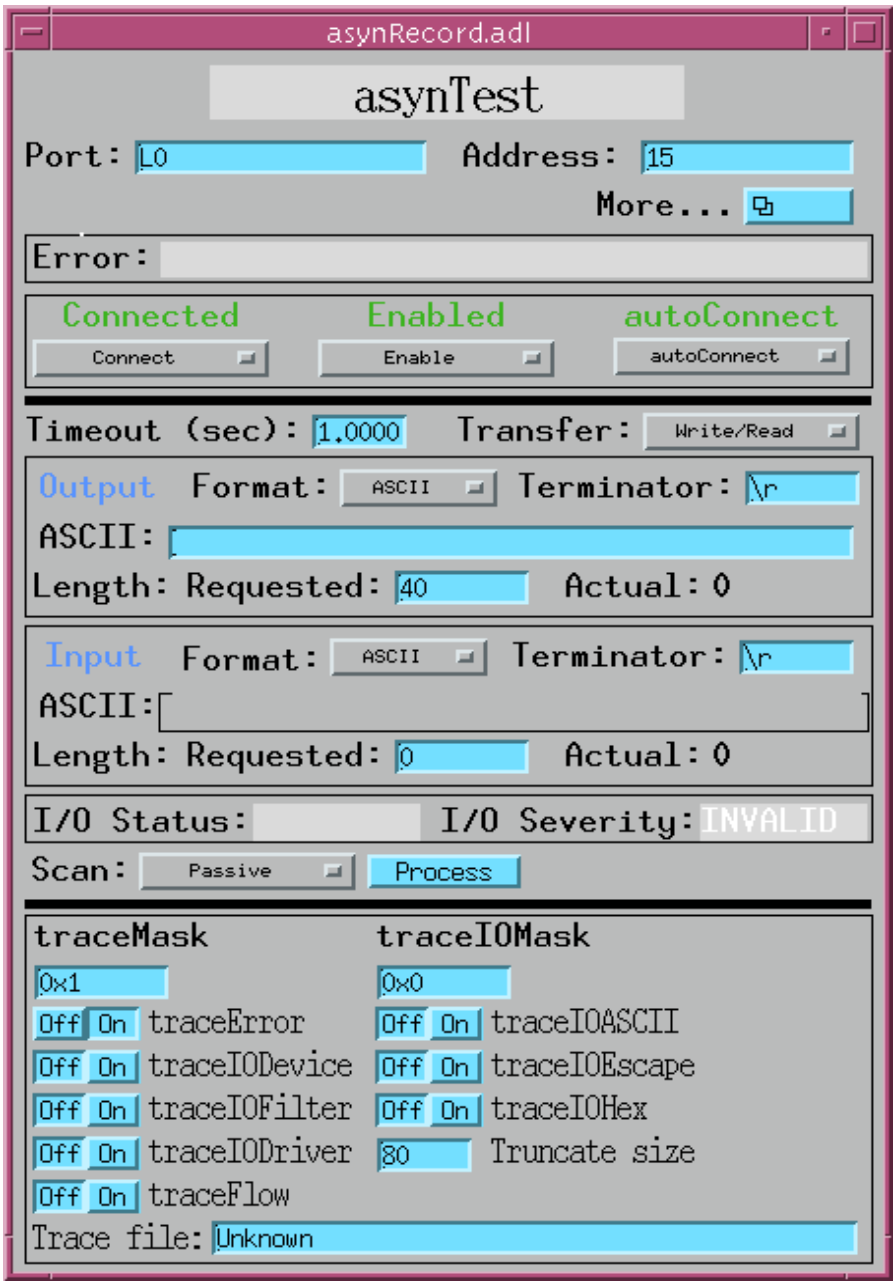
```
cd ${ASYN}
dbLoadRecords("db/asynRecord.db","P=asyn,R=Test,PORT=L0,ADDR=15,IMAX=0,OMAX=0")
```

The example creates a record with name "asynTest" (formed from the concatenation of the P and R macros) that will connect to port "L0" and addr 15. After the ioc is started, it is possible to change PORT and/or ADDR. Thus a single record can be used to access all asyn devices connected to the IOC. Multiple records are only needed if one or more devices need a dedicated record.

An medm display is available for accessing an asynRecord. It is started as follows:

```
cd <asyn>/medm
medm -x -macro "P=asyn,R=Test" asynRecord.adl
```

The following medm display appears.



Example

The following reads from an device via octet messages.

```
#include <asynDriver.h>
...
#define BUFSIZE 80
typedef struct myData {
    asynOctet *pasynOctet;
    void *pdrvPvt;
    char buffer[BUFSIZE];
}myData;

void queueCallback(asynUser *pasynUser)
    myData *pmydata = (myData *)puserPvt;
```

```
    asynOctet *pasynOctet = pmydata->pasynOctet;
    void *pdrvPvt = pmydata->pdrvPvt;
    asynStatus status;
    int retlen;

    asynPrint(pasynUser,ASYN_TRACE_FLOW,"queueCallback entered\n");
    status = pasynOctet->setEos(pdrvPvt,pasynUser,"\n",1);
    if(status!=asynSuccess) {
        asynPrint(pasynUser,ASYN_TRACE_ERROR,
            "queueCallback setEos failed %s\n",pasynUser->errorMessage);
    }
    status = pasynOctet->read(pdrvPvt,pasynUser,pmydata->buffer,BUFSIZE,&retlen);
    if(status!=asynSuccess || retlen<=0) {
        asynPrint(pasynUser,ASYN_TRACE_ERROR,
            "queueCallback read failed %s\n",pasynUser->errorMessage);
    } else {
        asynPrintIO(pasynUser,ASYN_TRACEIO_DEVICE,
            pmydata->buffer,BUFSIZE,
            "queueCallback read returned: retlen %d data %s\n",
            retlen,pmydata->buffer);
    }
}

void mainThread(void)
{
    myData *pmyData;
    asynUser *pasynUser;
    asynStatus status;
    asynInterface *pasynInterface;

    pmyData = calloc(1,sizeof(myData));
    pasynUser = pasynManager->createAsynUser(queueCallback,0);
    pasynUser->userPvt = pmyData;
    status = pasynManager->connectDevice(pasynUser,"serialPort1",0)
    if(status!=asynSuccess) {
        printf("can't connect to serialPort1 %s\n",pasynUser->errorMessage);
        exit(1);
    }
    pasynInterface = pasynManager->findInterface(
        pasynUser,asynOctetType,1);
    if(!pasynInterface) {
        printf("%s driver not supported\n",asynOctetType);
        exit(-1);
    }
    pmyData->pasynOctet = (asynOctet *)pasynInterface->pinterface;
    pmyData->pdrvPvt = pasynInterface->pdrvPvt;
    status = pasynManager->queueRequest(pasynUser,asynQueuePriorityLow, 0.0);
    if(status) {
        asynPrint(pasynUser,ASYN_TRACE_ERROR,
            "queueRequest failed %s\n",pasynUser->errorMessage);
        exit(1);
    }
    /*Note that callback will be called by another thread*/
    ...
}
```

The flow of control is as follows:

1. A port driver calls registerPort. This step is not shown in the above example.
2. mainThread allocates myData and an asynUser.
3. mainThread connects to a device and to the asynOctet interface for the port driver..

4. When it is ready to communicate with the driver it calls queueRequest.
5. The thread associated with the port calls the callback which then calls the port driver's setEos and read methods.

Test Example

The asynDriver distribution includes code to test asynDriver. It is also an example of how to interface to asynManager. The example resides in <top>/testApp and contains the following components:

```
Db/
   test.db
adl/
   test.adl
src/
   devAsynTest.c
   devAsynTest.dbd
   echoDriver.c
   interposeInterface.c
```

echoDriver is a port driver that echos messages it receives. It implements asynCommon and asynOctet. When asynOctet:write is called it saves the message. When asynOctet:read is called the saved message is returned and the message is flushed. echoDriverInit has an argument that determines if it acts like a multiDevice or single device port driver.

test.db is a template containing three records: a calc record, which forward links to a stringout record which forward links to a stringin record. The string records attach to the device support supplied by devAsynTest.c. The stringout and stringin records share the same asynUser. When the stringout record processes it:

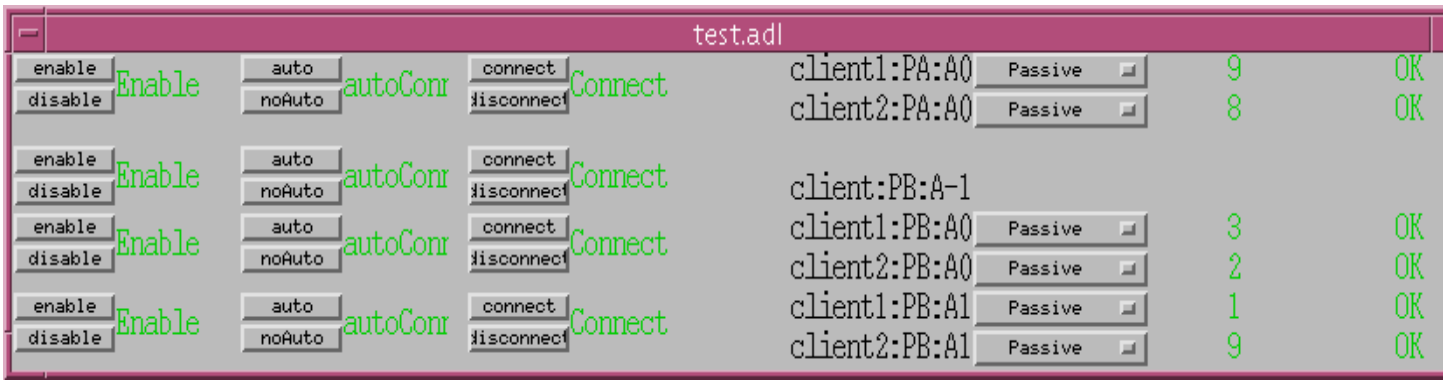
- fetches the current value from the calc record (converted to ascii).
- calls pasynManager−>lock.
- Calls pasynManager−>queueRequest.
- The callback calls pasynOctet−>write and then asks for the record to complete processing.
- The stringout record forward links to the stringin record

The stringin records does the following:

- Calls pasynManager−>queueRequest.
- The callback routine:
    - ♦ calls pasynOctet−>read
    - ♦ Checks what it received vs what the stringout record wrote. If the values match it sets it's VAL field to "OK", otherwise it writes an error message into VAL.
    - ♦ Asks for the record to complete processing.
- The stringin record calls pasynManager−>unlock.

devAsynTest also does additional checking for connect state, enable/disable.

Executing "medm −x test.adl" produces the display:



It assumes that an ioc has been started via:

```
cd <top>/iocBoot/ioctest
../../bin/solaris-sparc/test st.cmd
```

This starts two versions of echoDriver as port "A" and "B". port A acts as single device port. port B acts as a multiDevice port that has two devices. For each of the three possible devices, the st.cmd file starts up two sets of records from test.db The st.cmd file also loads a set of records from asynTest.db for port A and for port B and for each of the two devices attached to port B. It also loads a set of records from asynGeneric.db.

---

asynGpib

GPIB has additional features that are not supported by asynCommon and asynOctet. asynGpib defines two interfaces.

- asynGpib − This is the interface that device support calls.. It provides the following:
  - ♦ A set of GPIB specific methods that device support can call.
  - ♦ Code that handles generic GPIB functions like SRQ polling.
  - ♦ A registerPort method which is called by GPIB port drivers.
- asynGpibPort − A set of methods implemented by GPIB drivers

asynGpibDriver.h

asynGpibDriver.h contains the following definitions:

```
#include "asynDriver.h"
#define asynGpibType "asynGpib"
/* GPIB drivers */
typedef void (*srqHandler)(void *userPrivate,int gpibAddr,int statusByte);
typedef struct asynGpib asynGpib;
typedef struct asynGpibPort asynGpibPort;
/*asynGpib defines methods called by gpib aware users*/
struct asynGpib{
    /*addressedCmd,...,ren are just passed to device handler*/
    asynStatus (*addressedCmd) (void *drvPvt,asynUser *pasynUser,
        const char *data, int length);
    asynStatus (*universalCmd) (void *drvPvt,asynUser *pasynUser, int cmd);
    asynStatus (*ifc) (void *drvPvt,asynUser *pasynUser);
    asynStatus (*ren) (void *drvPvt,asynUser *pasynUser, int onOff);
    /* The following are implemented by asynGpib */
    asynStatus (*registerSrqHandler)(void *drvPvt,asynUser *pasynUser,
        srqHandler handler, void *srqHandlerPvt);
```

```
    void (*pollAddr)(void *drvPvt,asynUser *pasynUser, int onOff);
    /* The following are called by low level gpib drivers */
    /*srqHappened is passed the pointer returned by registerPort*/
    void *(*registerPort)(
        const char *portName,
        int multiDevice,int autoConnect,
        asynGpibPort *pasynGpibPort, void *asynGpibPortPvt,
        unsigned int priority, unsigned int stackSize);
    void (*srqHappened)(void *asynGpibPvt);
};
struct asynGpibPort {
    /*asynCommon methods */
    void (*report)(void *drvPvt,FILE *fp,int details);
    asynStatus (*connect)(void *drvPvt,asynUser *pasynUser);
    asynStatus (*disconnect)(void *drvPvt,asynUser *pasynUser);
    asynStatus (*setOption)(void *drvPvt,asynUser *pasynUser,
                            const char *key,const char *val);
    asynStatus (*getOption)(void *drvPvt,asynUser *pasynUser,
                            const char *key,char *val,int sizeval);
    /*asynOctet methods passed through from asynGpib*/
    asynStatus (*read)(void *drvPvt,asynUser *pasynUser,
                            char *data,int maxchars,int *nbytesTransfered);
    asynStatus (*write)(void *drvPvt,asynUser *pasynUser,
                            const char *data,int numchars,int *nbytesTransfered);
    asynStatus (*flush)(void *drvPvt,asynUser *pasynUser);
    asynStatus (*setEos)(void *drvPvt,asynUser *pasynUser,
                 const char *eos,int eoslen);
    asynStatus (*getEos)(void *drvPvt,asynUser *pasynUser,
                 char *eos, int eossize, int *eoslen);
    /*asynGpib methods passed thrtough from asynGpib*/
    asynStatus (*addressedCmd) (void *drvPvt,asynUser *pasynUser,
                 const char *data, int length);
    asynStatus (*universalCmd) (void *drvPvt, asynUser *pasynUser, int cmd);
    asynStatus (*ifc) (void *drvPvt,asynUser *pasynUser);
    asynStatus (*ren) (void *drvPvt,asynUser *pasynUser, int onOff);
    /*asynGpibPort specific methods */
    int (*srqStatus) (void *drvPvt);
    asynStatus (*srqEnable) (void *drvPvt, int onOff);
    asynStatus (*serialPollBegin) (void *drvPvt);
    int (*serialPoll) (void *drvPvt, int addr, double timeout);
    asynStatus (*serialPollEnd) (void *drvPvt);
};
```

asynGpib

asynGpib describes the interface for device support code. It provides gpib specific functions like SRQ handling. It makes calls to asynGpibPort. Note that asynGpib.c also implements asynCommon and asynOctet.

asynGpib

addressedCmd	The request is passed to the low level driver.
universalCmd	The request is passed to the low level driver.
ifc	The request is passed to the low level driver.
ren	The request is passed to the low level driver.
registerSrqHandler	Register an srq handler for device. The handler will be called when an SRQ is detected for that device.
pollAddr	

	Set SRQ polling on or off. onOff = (0,1) means (disable, enable) SRQ polling of specified address.
registerPort	Register a port. When asynGpib receives this request it calls asynManager.registerPort.
srqHappened	Called by low level driver when it detects that a GPIB device issues an SRQ.

asynGpibPort

asynGpibPort is the interface that is implemented by gpib drivers, e.g. the vxi11. It provides:

asynGpibPort

asynCommon methods	All the methods of asynCommon
asynOctet methods	All the methods of asynOctet
addressedCmd	Issue a GPIB addressed command.
universalCmd	Issue a GPIB universal command.
ifc	Issue a GPIB Interface Clear command.
ren	Issue a GPIB Remote Enable command
srqStatus	Returns (0,1) if SRQ (is not, is) set. Normally only called by asynGpib.
srqEnable	Enable or disable SRQs. Normally only called by asynGpib.
serialPollBegin	Start of serial poll. Normally only called by asynGpib.
serialPoll	Poll the specified address and return its response. Normally only called by asynGpib.
serialPollEnd	End of serial poll. Normally only called by asynGpib.

Port Drivers

Local Serial Port

The drvAsynSerialPort driver supports devices connected to serial ports on the IOC.

Serial ports are configured with the `drvAsynSerialPortConfigure` and `asynSetOption` commands:

```
drvAsynSerialPortConfigure("portName","ttyName",priority,noAutoConnect,noEos)
asynSetOption("portName",addr,"key","value")
```

where the arguments are:

- portName − The portName that is registered with asynGpib.
- ttyName − The name of the local serial port (e.g. "/dev/ttyS0").
- priority − Priority at which the asyn I/O thread will run. If this is zero or missing then epicsThreadPriorityMedium is used.
- noAutoConnect − Zero or missing indicates that portThread should automatically connect. Non−zero if explicit connect command must be issued.
- noEos − Zero or missing indicates that the input routines should search for the end−of−string character(s), if any. Non−zero inhibits end−of−string search.
- addr − This argument is ignored since serial devices are configured with multiDevice=0.

The following table summarizes the drvAsynSerialPort driver asynSetOption keys and values. Default values are enclosed in square brackets.

Key	Value
baud	[9600] 50 75 110 134 150 200 300 600 1200 ... 230400
bits	[8] 7 6 5
parity	[none] even odd
stop	[1] 2
clocal	[Y] N
ctrscts	[N] Y

The clocal and crtscts parameter names are taken from the POSIX termios serial interface definition. The clocal parameter controls whether the modem control lines (Data Terminal Ready, Carrier Detect/Received Line Signal Detect) are used (clocal=N) or ignored (clocal=Y). The crtscts parameter controls whether the hardware handshaking lines (Request To Send, Clear To Send) are used (crtscts=Y) or ignored (crtscts=N). The default parameter values (clocal=Y, crtscts=N) are those of a 'data−leads−only' serial interface.

The vxWorks serial driver does not provide independent control of the hardware handshaking and modem control lines thus clocal=Y implies crtscts=N and clocal=N implies crtscts=Y.

vxWorks IOC serial ports may need to be set up using hardware−specific commands. Once this is done the standard drvAsynSerialPortConfigure and asynSetOption commands can be issued. For example, the following example shows the configuration procedure for a port on a GreenSprings octal UART Industry−Pack module on a GreenSprings VIP616−01 carrier.

```
ipacAddVIPC616_01("0x6000,B0000000")
tyGSOctalDrv(1)
tyGSOctalModuleInit("RS232", 0x80, 0, 0)
tyGSOctalDevCreate("/tyGS/0/0",0,0,1000,1000)
drvAsynSerialPortConfigure("L0","/tyGS/0/0",0,0,0)
asynSetOption("L0",0,"baud","9600")
```

TCP/IP or UDP/IP Port

The drvAsynIPPort driver supports devices which communicate over a TCP/IP or UDP/IP connection. A typical example is a device connected through an Ethernet/Serial converter box.

TCP/IP or UDP/IP connections are configured with the `drvAsynIPPortConfigure` command:

```
drvAsynIPPortConfigure("portName","hostInfo",priority,noAutoConnect,noEos)
```

where the arguments are:

- portName − The portName that is registered with asynGpib.
- hostInfo − The Internet host name, port number and optional IP protocol of the device (e.g. "164.54.9.90:4002", "serials8n3:4002", "serials8n3:4002 TCP" or "164.54.17.43:5186 udp"). If no protocol is specified, TCP will be used.
- priority − Priority at which the asyn I/O thread will run. If this is zero or missing then epicsThreadPriorityMedium is used.

- noAutoConnect − Zero or missing indicates that portThread should automatically connect. Non−zero if explicit connect command must be issued.
- noEos − Zero or missing indicates that the input routines should search for the end−of−string character(s), if any. Non−zero inhibits end−of−string search.

There are no asynSetOption key/value pairs associated with drvAsynIPPort connections.

vxi11

VXI−11 is a TCP/IP protocol for communicating with IEEE 488.2 devices. It is an RPC based protocol. In addition to the VXI−11 standard three additional standards are defined.

- VXI−11.1 − A standard for communicating with VXIbus devices. These devices have a vxiName that starts with "vxi".
- VXI−11.2 − A standard for communicating with a IEEE 488.1 device. This means that the TCP/IP connection is talking to a GPIB controller that is talking to a GPIB bus. These devices have an vxiName that starts with "gpib".
- VXI−11.3 − A standard for communicating with IEEE 488.2 devices. This means that the TCP/IP connection is talking directly with an device. These devices have an vxiName that starts with "inst".

Consult the following documents (available on−line for free) for details.

```
VMEbus Extensions for Instrumentation
    VXI−11   TCP/IP Instrument Protocol Specification
    VXI−11.1 TCP/IP−VXIbus Interface Specification
    VXI−11.2 TCP/IP−IEEE 488.1 Interface Specification
    VXI−11.3 TCP/IP−IEEE 488.2 Instrument Interface Specification
```

The following commands may be specified in the st.cmd file

```
    E2050Reboot("inet_addr")
    E5810Reboot("inet_addr","password")
    vxi11Configure("portName","inet_addr",recoverWithIFC,timeout,
        "vxiName",priority,noAutoConnect)
```

where

- inet_addr − Internet Address
- password − password. If given as 0 the default E5810 is used.
- portName − The portName that is registered with asynGib.
- inet_addr − Internet address.
- recoverWithIFC − (0,1) => (don't, do) issue IFC when error occurs.
- timeout − I/O operation timeout in seconds as a double. If 0.0 then a default is assigned.
- vxiName − Must be chosen as specified above.
- priority − Priority at which the asyn I/O thread will run. If this is zero or missing then epicsThreadPriorityMedium is used.
- noAutoConnect − Zero or missing indicates that portThread should automatically connect. Non−zero if explicit connect command must be issued.

Green Springs IP488

This is support for the Green Springs Industry Pack GPIB carrier. The configuration command is:

```
gsIP488Configure(portName,carrier,module,intVec,priority,noAutoConnect)
```

where

- portName − An ascii string specifying the port name the will be registered with asynDriver.
- carrier − An integer identifying the Industry Pack Carrier
- module − An integer identifying the module on the carrier
- intVec − An integer specifying the interrupt vector
- priority − In integer specifying the priority of the port thread. A value of 0 will result in a defalt value being assigned
- noAutoConnect − Zero or missing indicates that portThread should automatically connect. Non−zero if explicit connect command must be issued.

An example is:

```
#The following is for the Greensprings IP488 on an MV162
ipacAddMVME162("A:l=3,3 m=0xe0000000,64")
gsIP488Configure("L0",0,0,0x61,0,0)
```

National Instruments GPIB−1014D

This is support for a National Instruments VME GPIB interface. The configuration command is:

```
gsIP488Configure(portNameA,portNameB,base,vector,level,priority,noAutoConnect)
```

where

- portNameA − An ascii string specifying the port name that will be registered with asynDriver for portA.
- portNameB − An ascii string specifying the port name that will be registered with asynDriver for portB. If only one port should be registered than leave this as a null string. The support should also work for a single port NI1014 butb has not been tested.
- base − VME A16 base address.
- vector − VME interrupt vector.
- level − An integer specifying the interrupt level.
- priority − In integer specifying the priority of the port thread. A value of 0 will result in a defalt value being assigned
- noAutoConnect − Zero or missing indicates that portThread should automatically connect. Non−zero if explicit connect command must be issued.

An example is:

```
#The following is for the Greensprings IP488 on an MV162
ni1014Config("L0","L1",0x5000,0x64,5,0,0)
```

NOTES:

- Ports A and B are almost but not quite the same. Thus the code for connecting to port A is slightly

different than the code for portB.
- In order to disconnect and reconnect either port, BOTH ports must be disconnected and reconnected.
- When the ports are connected, portA MUST be connected before portB.
- Programmed I/O, via interrupts, rather than DMA is implemented. Thus no A24 address space is required.

Diagnostic Aids

iocsh commands

```
asynReport(filename,level)
asynInterposeFlushConfig(portName,addr,timeout)
asynInterposeEosConfig(portName,addr)
asynSetTraceMask(portName,addr,mask)
asynSetTraceIOMask(portName,addr,mask)
asynSetTraceFile(portName,addr,filename)
asynSetTraceIOTruncateSize(portName,addr,size)
asynSetOption(portName,addr,key,val)
asynShowOption(portName,addr,key)
asynConnect(entry,portName,addr,oeos,ieos,timeout,buffer_len)
asynAutoConnect(portName,addr,yesNo)
asynEnable(portName,addr,yesNo)
asynRead(entry,nread,flush)
asynWrite(entry,output)
asynWriteRead(entry,output,nread)
asynFlush(entry)
```

`asynReport` calls `asynCommon:report` for all registered drivers and processModules.

`asynInterposeFlushConfig` is a generic interposeInterface that implement flush for low level drivers that don't implement flush. It just issues read requests until no bytes are read. The timeout is used for the read requests.

`asynInterposeEosConfig` is a generic interposeInterface that implements end of string processing for low level drivers that don't.

`asynSetTraceMask` calls `asynTrace:setTraceMask` for the specified port and address.

`asynSetTraceIOMask` calls `asynTrace:setTraceIOMask` for the specified port and address.

`asynSetTraceFile` calls `asynTrace:setTraceFile`. filename is handled as follows:

- Not specified − A NULL pointer is passed to setTraceFile. Subsequent messages are sent to errlog.
- An empty string ("") or "stdout" − stdout is passed to setTraceFile.
- Any other string − The specified file is opened with an option of "w" and the file pointer is passed to setTraceFile.

`asynSetTraceIOTruncateSize` calls `asynTrace:setTraceIOTruncateSize`

`asynSetOption` calls `asynCommon:setOption`. `asynShowOption` calls `asynCommon:getOption`.

asynConnect,...asynFlush provide shell access to asynSyncIO methods. entry is a character string constant that identifys the port,addr.

where

- filename (for report) − An ascii string naming a file to which the report is sent. If this is null or a null string then the output is sent to `stdout`
- level − The report level.
- portName − An ascii string specifying the portName of the driver.
- addr − In integer specifying the address of the device. For multiDevice ports a value of −1 means the port itself. For ports that support a single device addr is ignored.
- mask − The mask value to set. See the mask bit definitions in asynDriver.h
- key − The key for the option desired.
- val − The value for the option.
- yesNo − The value (0,1) means (no,yes).
- entry − A character string that identifies the asynConnect request.
- oeos,ieos − The output and input end of string terminator. Default="\r"
- timeout − timeout as an integer in milliseconds. The default is 1;
- buffer_len − length of buffer for I/O. Default=80.
- nread − max number of bytes to read. Default=buffer_len.
- flush − (0,1) means (don't, do) flush before reading. Default=0.
- output − output string.

The commands asynConnect, asynRead, asynWrite, asynWriteRead, asynFlush allow I/O to a device from the ioc shell. Examples are:

```
asynConnect("myid","A",0,"\n","\n",1,20)
asynWrite("myid","testnew")
asynRead("myid")
testnew\n
asynWriteRead("myid","this is test")
this is test\n
```

Install and Build

Install and build asynDriver

After obtaining a copy of the distribution, it must be installed and built for use at your site. These steps only need to be performed once for the site (unless versions of the module running under different releases of EPICS and/or the other required modules are needed).

1. Create an installation directory for the module, usually this will end with

   ```
   .../support/asyn/
   ```

2. Place the distribution file in this directory. Then issue the commands (Unix style)

   ```
   gunzip <file>.tar.gz
   tar xvf <file>.tar
   ```

3. This creates a support <top>.

   ```
   .../support/asyn/X-Y
   ```

   where X−Y is the release. For example.

   ```
   .../support/asyn/3-1
   ```

4. Edit the `config/RELEASE` file and set the paths to your installation of EPICS_BASE and IPAC. IPAC is only needed if you are building for vxWorks.
5. Run `make` in the top level directory and check for any compilation errors.

Using asynDriver components with an EPICS iocCore application

Since asynDriver does NOT provide support for specific devices an application must obtain device specific support elsewhere. This section only explains how to include asynDriver components.

In the `configure/RELEASE` file add definitions for `IPAC`, `ASYN`, and `EPICS_BASE`.

In the src directory where the application is built

- Add the following to `Makefile`

```
<app>_LIBS += asyn
```

- Add the following to `<app>Include.dbd and uncomment the line or lines appropriate for your application:`

```
#include "drvAsynSerialPort.dbd"
#include "drvAsynIPPort.dbd"
#include "drvVxi11.dbd"
#include "drvGsIP488.dbd"
#include "drvIpac.dbd"
#registrar(mv162ipRegistrar)
```

In the `st.cmd` file add.
dbLoadRecords("db/asynRecord.db","P=<ioc>,R=<record>,PORT=<port>,ADDR=<addr>,OMAX=<omax>,IMAX=<ima

You must provide values for <ioc>, <record>, <port>, <addr>, <omax>, and <imax>.

Once the application is running, medm displays for an ioc can be started by: medm −x −macro "P=<ioc>,R=<record>" <asyntop>/medm/asynRecord.adl &

You must provide correct values for <ioc> and <record>. Once asynRecord is started it can be connected to different devices.

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