
# Version 3

*Scalable Message Oriented Middleware for Distributed Computing*

# User Guide

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# X♦IPC VERSION 3.3.0

# USER GUIDE

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# 1. INTRODUCING X•IPC

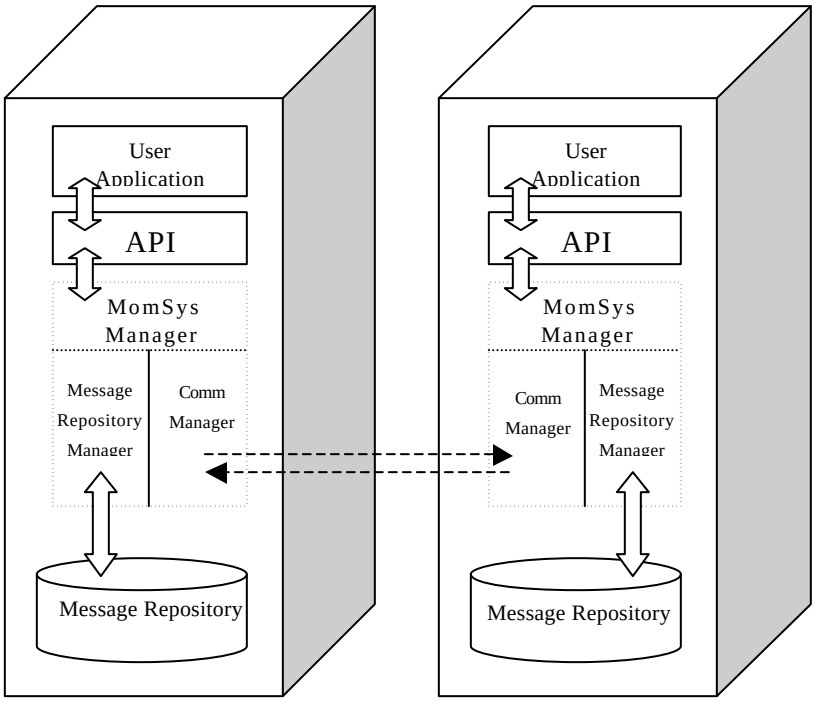
## 1.1 Purpose

This document presents User guidance for Version 3.3.0 of X•IPC, the Extended Interprocess Communication Facilities product from Envoy Technologies Inc.

X•IPC is a toolkit for developing software systems employing Interprocess Communication (IPC). X•IPC is comprised of four IPC subsystems, each with a library of functions and support utilities:

- MomSys, the Message Oriented Middleware subsystem

The X•IPC message oriented middleware subsystem, MomSys, is a highly scalable, dynamically configurable, guaranteed message delivery facility. Ideal for mission-critical, enterprise-wide applications, MomSys ensures the constant trackability of all messages.




- QueSys, the Message Queue System

The X•IPC message queue system, QueSys is a complete message queuing facility. Many advanced features are included (e.g., individualized queue sizing, dynamic queue spooling, queue multiplexing, etc.) to facilitate most necessary message queuing requirements.

- SemSys, the Semaphore System

The X•IPC semaphore subsystem is known as SemSys. SemSys includes a comprehensive implementation of event and resource semaphores. Its wide range of operations and the various waiting and acquiring alternatives ensures that almost every semaphore-related system requirement can be easily implemented.

- MemSys, the Shared Memory System

The X•IPC shared memory system is known as MemSys MemSys is a complete shared-memory management system. It includes memory allocation as well as access control, synchronization, locking and protection at the byte level.

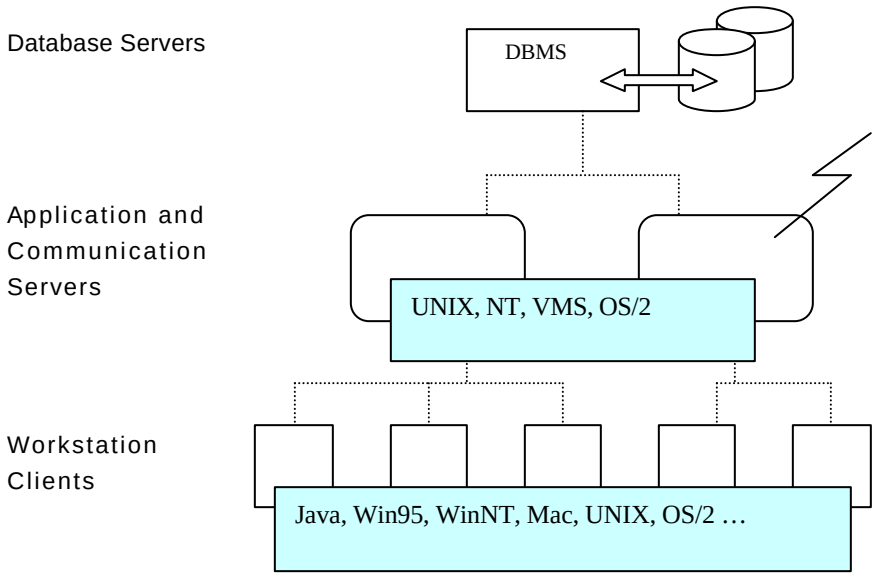
This User Guide describes the X•IPC product without specific reference to the individual subsystems. It provides a global presentation of X•IPC concepts–most importantly, *instances*–and usage; it is accompanied by a Reference Manual. Separate documentation is available for the subsystems. Used together or individually, these subsystems provide significant enhancements to the native IPC facilities of the supported operating systems. X•IPC additionally provides its full functionality distributed over a network.

X•IPC is a set of libraries and support utilities that greatly simplifies software development involving stand-alone or network IPC. X•IPC provides the systems developer with a state-of-the-art IPC development environment, including: on-line interactive IPC monitoring and debugging; extended basic and advanced functionality; immediate inter-operating system IPC source-code portability; guaranteed message delivery; complete network transparency; and dynamic configuration.

X•IPC benefits are realized throughout all phases of the software development cycle:

- System design is simplified by the availability of X•IPC 's rich set of basic and advanced IPC functions. System design decisions are no longer constrained by non-existent or deficient IPC capabilities.

  Distributed application design also benefits from X•IPC 's full functionality being transparently available over a network.




- The development phase is enhanced at the unit test level and, more significantly, during system integration. IPC problems resulting from programmer error or misinterpretation are identified and resolved rapidly via X•IPC 's on-line monitoring and debugging facilities.

  Network application development is further simplified by the fact that all IPC-related development can occur in a stand-alone environment and subsequently be distributed over a network with virtually no modification.

- System maintenance is similarly enhanced by the ability to remotely monitor live (stand-alone or network) applications in the field, if and when they exhibit problems.

- Porting IPC-laden systems between dissimilar operating systems is reduced to a recompile instead of a total redesign.

- Spreading an application over a network requires no program modification. Distributed processes can communicate using X•IPC functionality regardless of their network location.

*X•IPC provides network-transparent connectivity*

In short, X•IPC redefines how the IPC components of sophisticated multitasking, multi-platform and distributed software systems are designed and developed.

## 1.2 Scope

This X•IPC User Guide is for experienced software developers, who are familiar with the basic concepts of IPC as well as with common software development practices. These developers need the enhancements provided by X•IPC for easing and expediting the development of quality, portable applications in a multitasking or distributed environment.

This volume, the X•IPC User Guide, is put to best advantage if you first read Chapters 1 through 4 thoroughly to become well acquainted with the X•IPC product and its key concepts. Chapter 5 addresses basic programming techniques, while Chapter 6 presents more advanced topics in greater detail. Technical Notes, which discuss special issues and product enhancements, are provided in Chapter 7, the Appendix.

## 1.3 Availability

X•IPC is available on a wide variety of operating system platforms and, when used in a networking environment, includes support for a wide range of protocol families. This platform and environmental independence is one of the major benefits of working with X•IPC: It provides for immediate IPC source code portability. It additionally allows for flexible configuration of a distributed application's processing components, since they are not bound to any particular operating system platform.

Note that all platform-specific information, from installation and program compiling/linking to configuration and administration guidance, is found in the individual Platform Notes documentation that is available for each supported platform.

## 1.4 Documentation Roadmap

The following publications are available to support X•IPC Version 3.3.0:

- Getting Started is a brief introduction to X•IPC. It gives the user a "fast track" to select the relevant documentation, install the software and rapidly begin using X•IPC.

- X•IPC Platform Notes provide platform-specific information regarding product installation, program compilation, program linking and, where appropriate, configuration and administration guidance. The supported environments are individually documented.
- X•IPC system level documentation:
  - The X•IPC User Guide describes in detail how to employ X•IPC for distributed application development. This document is generic in that it presents X•IPC without regard to any particular hardware platform, operating system or network protocol. The information is presented at an X•IPC -system-level, i.e., it is X•IPC -subsystem-independent.
  - The X•IPC Reference Manual provides X•IPC (system level) commands, functions and macros, as well as function calling sequences and possible return codes. Included are code segments and sample programs.
- QueSys/MemSys/SemSys documentation:
  - The QueSys/MemSys/SemSys User Guide describes in detail how to use these three X•IPC subsystems for distributed application development. It includes API descriptions as well as topical presentations on special subsystem features.
  - The QueSys/MemSys/SemSys Reference Manual provides subsystem-level functions and macros, interactive commands and sample programs, as well function calling sequences and possible return codes.
- MomSys documentation:
  - The MomSys User Guide describes in detail how to use the MomSys subsystem for distributed application development. It includes API descriptions as well as topical presentations on special subsystem features.
  - The MomSys Reference Manual provides subsystem-level functions and macros, interactive commands and sample programs, as well function calling sequences and possible return codes.

## 1.5 Getting Started

### *1.5.1 SYSTEM REQUIREMENTS*

X•IPC utilizes certain native operating system resources when it is used. The quantities and sizes of these resources are relatively small and are usually available within the standard operating system configuration. Formulae for calculating required native resources are operating-system dependent and are described in the Platform Notes accompanying the product.

When using X•IPC in a networking environment, certain network resources are used. The nature and quantities of these resources are network-dependent and are outlined as well in the Platform Notes.

### *1.5.2 INSTALLATION*

Installation is operating system and network dependent. Consult the Platform Notes for details of the installation procedure.

# 2. X•IPC CONCEPTS

## 2.1 Interprocess Communication (IPC)

### 2.1.1 MULTITASKING – STAND-ALONE IPC

With the emergence of powerful microprocessors, multitasking operating environments have become increasingly popular, most recently at the micro-computer level. This is a direct result of the increased processing power provided by these processors. Such power is a prerequisite for an operating system performing as a multitasking scheduler.

The popularity of UNIX systems, from workstations to super-micros, the increasing acceptance of Windows NT and Windows 95, along with the continued popularity of OS/2 and VMS, are all indicative of the movement toward employing sophisticated multitasking programming techniques for solving increasingly complex system requirements.

The key to such systems is Interprocess Communication. IPC is the mechanism by which multiple active tasks dynamically synchronize and pass information between one another. IPC provides the tools for affecting process synchronization, message passing and resource and memory sharing needed within the context of multitasking systems.

### 2.1.2 DISTRIBUTED COMPUTING - NETWORK IPC

More recently, a second form of IPC requirement has grown in demand. While processing power has become less expensive and increasingly diversified, network technologies have matured and become widespread. The convergence of these factors has led to an upsurge in demand for distributed computing applications. Of particular interest is the growing need for guaranteed message delivery.

Such distributed applications often have the same kinds of IPC requirements as stand-alone multitasking IPC applications: interprocess synchronization, message passing and resource and memory sharing. The difference is that the processes in a distributed application are not confined to one computing platform and may be spread across a network.

### 2.1.3 GUARANTEED MESSAGE DELIVERY

IPC tools have facilitated the successful design and implementation of multitasking and distributed application systems which can make possible the building of reliable, large-scale mission critical distributed applications which demand guaranteed message delivery. The spread of these enterprise-wide applications has been accompanied by a demand for guaranteed message delivery. As the technological environment increases in complexity, incorporating disparate operating systems, platforms and applications, the risks associated with messaging among them has risen dramatically. Only with guaranteed message delivery provided by IPC network tools can such environments by operated and expanded with reliability, with the confidence that *messages cannot be lost*.

## 2.2 Why X•IPC?

A major shortcoming of earlier IPC approaches is that they reflect the state and limitations of software development methods of a decade ago. This is most apparent in the areas of IPC software engineering techniques, IPC functionality, IPC source code portability, network IPC transparency and system scalability.

X•IPC overcomes these problems in a consistent and cohesive manner.

### 2.2.1 X•IPC'S ADVANCED IPC SOFTWARE ENGINEERING TOOLS AND METHODS

X•IPC provides the systems developer with a set of IPC tools and techniques that support the latest programming methods. For instance:

- On-line monitoring and interactive debugging at the IPC level of a system's execution is not possible with current IPC tools. X•IPC provides the developer with the ability to view, in real-time, all of his IPC resources as they are created, manipulated and deleted–irrespective of whether the IPC activity is occurring on a stand-alone platform or dispersed over a network.

  This facility reduces time spent in testing and integration phases of a system's development. In addition, it enhances product support efforts by providing the ability to remotely monitor live production systems in the field if and when they exhibit problems.

- X•IPC makes it possible to develop a distributed application using a stand-alone IPC environment, and to subsequently disperse the application's component processes to positions on a network with virtually no IPC code modifications.

- X•IPC moves all aspects of IPC configuration and parameterization out of the kernel. Most current IPC tools place any possible IPC parameterization together with other kernel-related parameter values. This, in effect, forces all applications to share in the parameterization decisions and in the resulting IPC resource allocation pools, regardless of differing and sometimes conflicting needs. And when changes are agreed upon, they can only be affected after the kernel has been brought down, thus interrupting everyone using the system.

  The setting and tuning of IPC parameter values is done at the application level, each application according to its own specific requirements. Concurrently active X•IPC intensive applications have no relationship with one another and can be configured and fine-tuned individually. X•IPC monitoring and debugging is performed and segregated on an application-dependent basis as well.

### 2.2.2 X•IPC'S ENHANCED IPC BASIC AND EXTENDED FUNCTIONALITY

The native IPC facilities of the various operating systems are frequently inadequate. X•IPC affords the developer a more complete set of IPC functionality. New basic and advanced IPC features are provided. A few examples follow.

- X•IPC provides guaranteed message delivery––assuring that *no message can be lost*–– to support the demands of today's large-scale, mission-critical, globally distributed applications.
- The queue system provides individualized queue sizing in terms of bytes and/or messages, thus allowing for throttling of message-producing tasks. Automatic spooling for overflowing queues is also provided as an option in order to avoid losing peak-period messages.
- Atomic operations involving multiple queues provide the multiplexing functionality often needed for building complex systems such as transaction processing monitors. Messages designated "oldest," "youngest," "highest-priority," etc., can be retrieved atomically from groups of queues.
- X•IPC's fully functional queue system eliminates the shortcomings of some of the underlying native IPC facilities. For example, queue ownership restrictions inherent in OS/2 are removed.
- Additional X•IPC functions include a comprehensive implementation of event and resource semaphores. Multiple semaphores can be operated on in single X•IPC operations thus allowing for a variety of waiting and acquiring alternatives ("any," "all-atomic," "all-cumulative").
- X•IPC's shared memory system provides for memory read-and-write locking and protection at the byte level. This too is unique to X•IPC.

X♦IPC additionally supports synchronous and asynchronous operations. X♦IPC also supports asynchronous triggers that monitor specific aspects of an application's IPC environment (e.g., queue "xyz" rises above 90% capacity).

Many more enhancements exist and are described in their appropriate sections below.

The wide array of additional X♦IPC functional capabilities elevates the task of system design to a higher and more abstract level. The difficult job of reducing complex system requirements to meet the low-level realities of native IPC functionality is significantly alleviated.

### 2.2.3 X♦IPC'S IMMEDIATE INTER-OPERATING SYSTEM IPC SOFTWARE PORTABILITY

The API used to access X♦IPC is independent of the host operating system. Thus, the IPC components of a system written using X♦IPC are immediately portable from one operating system to another.

The most difficult part of porting an application between operating systems is often the IPC portion. This is due to the gross dissimilarities in functionality, calling sequences and underlying IPC methodologies employed by the operating systems involved. Bridging these differences frequently requires extensive modifications to the code and sometimes a total redesign. In such cases, multiple versions of source code have to be maintained and kept in sync.

In contrast, portable IPC code is an immediate by-product of using X♦IPC. . The benefits are manifold:

- There is no need to maintain multiple versions of a multi-platform application's source code, or to edit the source code for porting. The cost of version control is significantly reduced.
- System architects can design multiple-platform applications based on the application's requirements, rather than according to the lowest common denominator IPC constraints of the specific platforms involved.
- In-house expertise of the native IPC facilities for each operating system is no longer necessary. Training new programmers in IPC coding is performed once, regardless of the operating system to be used.

### 2.2.4 X♦IPC'S NETWORK IPC TRANSPARENCY

X♦IPC presents a uniform approach for handling both stand-alone and distributed forms of IPC. Processes synchronize, communicate and share data with one another using the *same* set of function calls whether they are on a single multitasking platform or distributed over a network of heterogeneous platforms .

The resulting benefits for the developer are:

- Full X♦IPC functionality is extended transparently across a network.
- The need for network programming expertise is eliminated.
- Operating system differences are no longer an IPC concern.
- Network protocols are no longer an IPC concern.
- Stand-alone multitasking IPC applications can be distributed over a network with virtually no code modifications.

# 3. THE X♦IPC PLATFORM

Before a computer platform can be used for supporting X♦IPC activity, the appropriate underlying X♦IPC environment must first be established on that platform. This environment is referred to as the "X♦IPC Platform Environment." This section discusses the following aspects of the X♦IPC Platform Environment:

- Function of the X♦IPC Platform Environment
- X♦IPC Platform Environment Configuration
- X♦IPC Platform Environment Commands

## 3.1 Function of the X♦IPC Platform Environment

As stated above, a computer platform that is to support any form of X♦IPC activity must first have its X♦IPC platform environment started. A platform's X♦IPC environment encompasses a number of background processes as well as underlying system data structures.

The X♦IPC platform environment is the infrastructure used to support all X♦IPC activity on that platform. Components within the X♦IPC platform environment include:

- an internal X♦IPC instance that is used by X♦IPC for supporting internal interprocess communication within the platform
- a number of X♦IPC daemon/service programs that operate in the background for supporting various X♦IPC -related functions, such as: catalog and namespace services, asynchronous operation services, idle-user detection services, etc.

## 3.2 X♦IPC Platform Configuration

The X♦IPC platform environment must be properly configured in order for X♦IPC -based applications running on the platform to operate properly. This configuration is based on a single configuration file, called `xipc.env`. The `xipc.env` file is read by an X♦IPC utility command, `xipcinit`, to start the X♦IPC platform envuironment. The `xipcinit` command reads the parameter definitions contained within the `xipc.env` file for setting up the X♦IPC platform environment. (The location and contents of the `xipc.env` file will be discussed below.)

The `xipc.env` file supports a set of parameter definitions that describe the nature of the X♦IPC platform environment that will be started. Some of these parameters will be described in the following sections. The complete list of parameter sections, parameter names and possible parameter values are listed on the X♦IPC Reference Manual page for the `xipcinit` command.

### 3.2.1 X♦IPC PLATFORM CLASSIFICATION

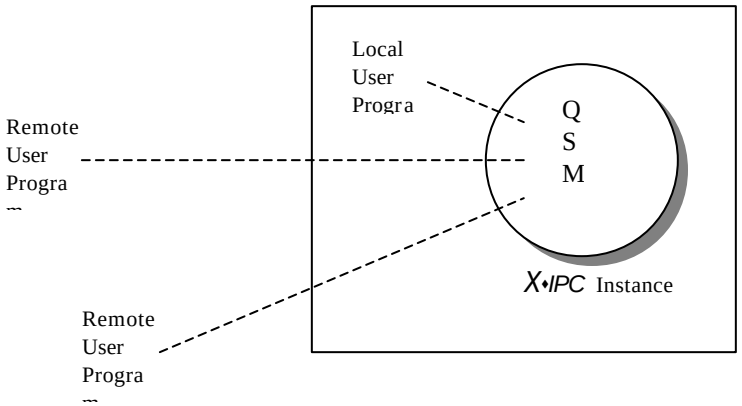
There are two general forms of X♦IPC platform configurations: "X♦IPC Server Platform Configuration" and "X♦IPC Client Platform Configuration". These are now described.

#### 3.2.1.1 X♦IPC Server Platform Configuration

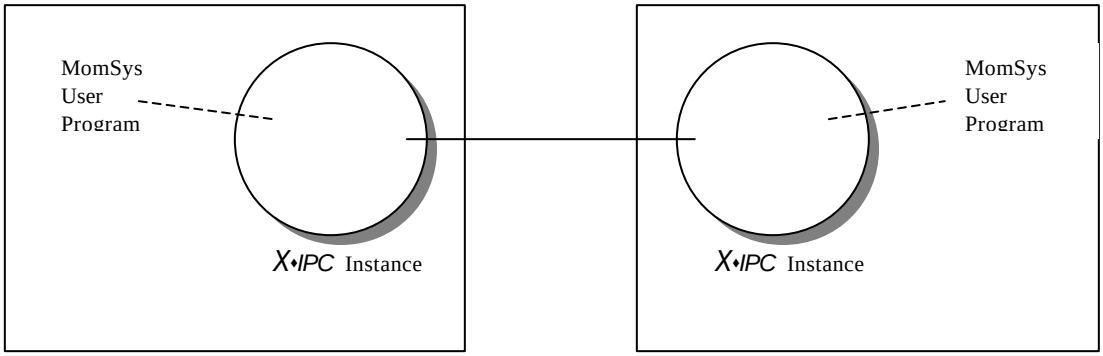
A computer platform which will be used for supporting one or more X♦IPC instances is referred to as an "X♦IPC Server Platform."

The two typical situations where server platform configuration is required are as follows:

- In configuring an X•IPC platform that will host an X•IPC instance that is to be accessed by local and/or remote QueSys / MemSys / SemSys users, as depicted in the following diagram:




- In configuring an X•IPC platform that will be used as part of a MomSys application, as depicted in the following diagram:




Note that programs employing the MomSys subsystem require a local X•IPC instance to be active for supporting the MomSys activity. Hence, MomSys users must configure all involved computer platforms as X•IPC server platforms.

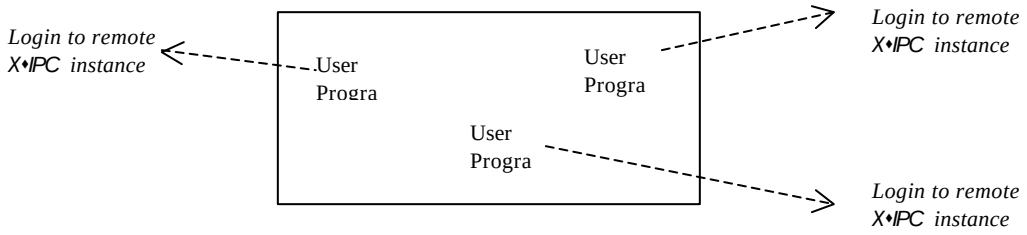
The `xipc.env` file for such a configuration requires that all X•IPC services/daemons be started on that platform. This is the default behavior for an `xipc.env` file that does not specify the `START` parameter within the file's `[xipcinit]` section. A default `xipc.env` file for an X•IPC server configuration has the following contents:

Default X•IPC Server Platform Configuration (`xipc.env`)

```
[xipcinit]

[catalog]

[catalog_tcpip]
```

### 3.2.1.2 X♦IPC Client Platform Configuration

A computer platform that will not support any X♦IPC instances is referred to as an "X♦IPC Client Platform." Thus, for example, a platform that is to be used for supporting QueSys / MemSys / SemSys programs that access remote X♦IPC instances exclusively may be configured as an X♦IPC client platform.




The `xipc.env` file for such a configuration requires that a limited subset of X♦IPC daemon/service programs be started on that platform. This is specified via the START parameter within the `xipc.env` file's `[xipcinit]` section. An example of such a file is as follows:

Typical X♦IPC Client Platform Configuration (`xipc.env`) File

```
[xipcinit]
START          xipciad   # Only starts this program.

[catalog]

[catalog.tcpip]
```

Where the platform will not employ any of X♦IPC's asynchronous functionality, the `xipciad` name can be deleted from the START parameter. In such a case, the START parameter should appear with no values assigned to it, as follows:

X♦IPC Client Platform Configuration (`xipc.env`) File supporting no asynchronous functionality or catalog access.

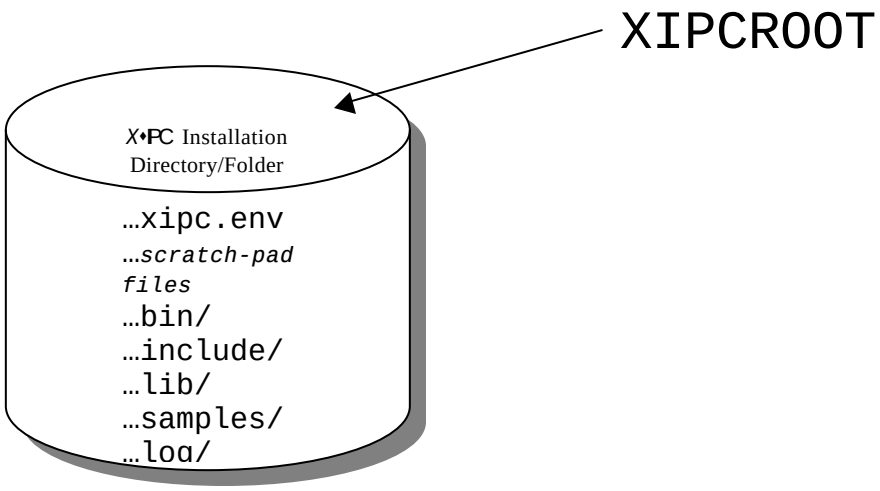
```
[xipcinit]
START     # Has no parameters. Starts no background programs.

[catalog]

[catalog.tcpip]
```

## 3.3 X•IPC Platform Commands

The two X•IPC commands that initialize and terminate a platform's X•IPC platform environment are `xipcinit` and `xipcterm`, respectively. These commands make particular use of the `XIPCROOT` environment variable that must be defined in order for them to function.

### 3.3.1 THE XIPCROOT ENVIRONMENT VARIABLE

When X•IPC is started on a platform--via the `xipcinit` command--X•IPC sets up its internal platform environment for supporting all subsequent X•IPC activity on that platform. As part of this initialization, `xipcinit` reads the `xipc.env` platform configuration file to ascertain which platform-wide resources need to be set up. The location of the `xipc.env` file is defined by the `XIPCROOT` environment variable. If `XIPCROOT` is not set, or if it is set, but points to a directory/folder having no `xipc.env` file, the `xipcinit` command will fail.




`xipcinit`'s work includes the creation of a number of scratch-pad files within the `XIPCROOT` directory. As such, the `XIPCROOT` directory must be situated within a writeable area of the file-system.

The `XIPCROOT` environment variable typically has a second function: defining for `xipcinit` where to find the installed X•IPC product. Thus, `xipcinit` uses the value of `XIPCROOT` to find the product's `bin` directory for starting internal processes that are installed therein.

Typically, these two roles of `XIPCROOT`:

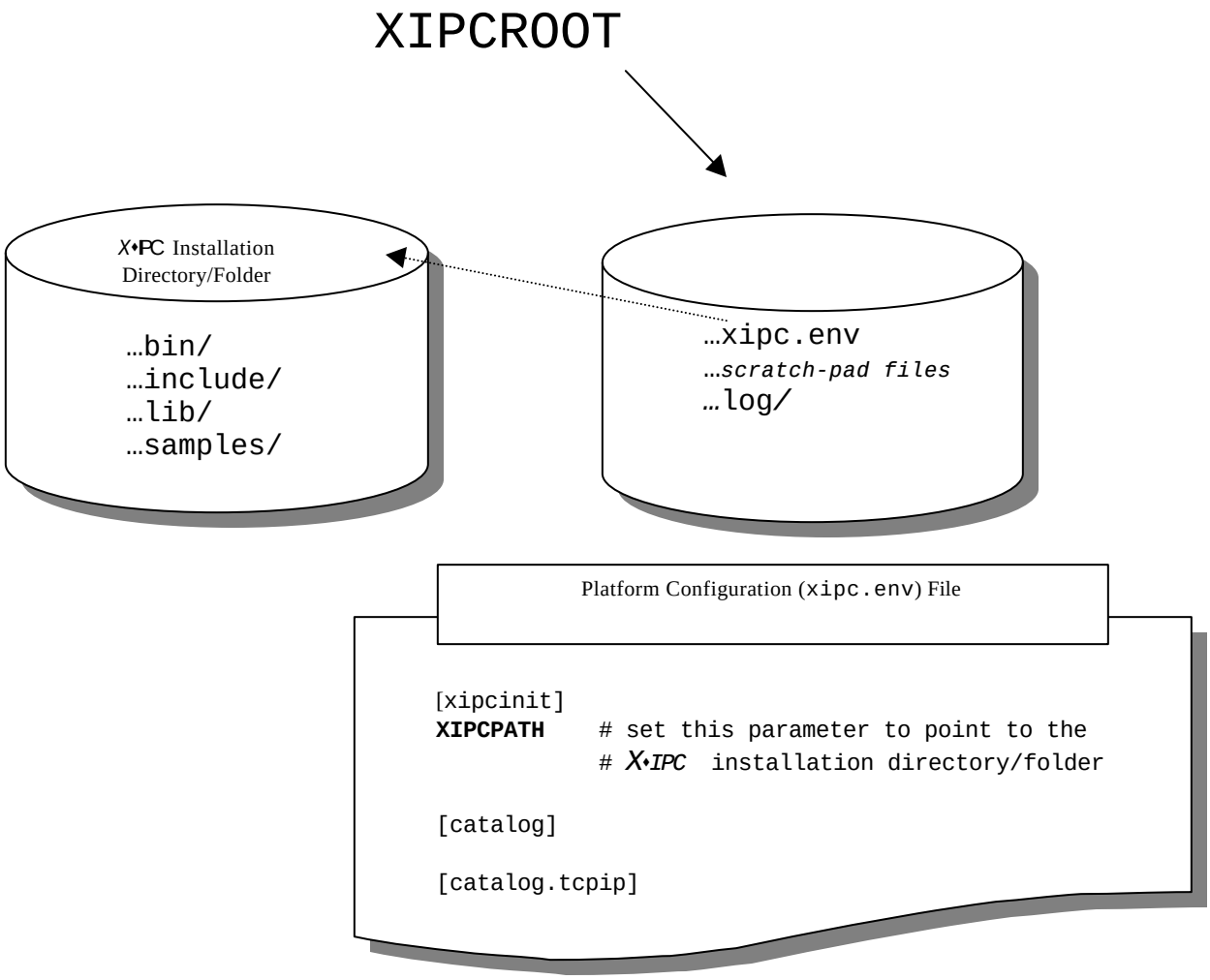
- identifying the directory in which `xipcinit` will find the `xipc.env` file and in which it will create scratch- pad files, and
- identifying the location of the installed X•IPC product

are addressed in a unified manner. In such a case, `XIPCROOT` is set pointing to the installation directory in which the `xipc.env` file is positioned and in which `xipcinit` creates scratch-pad files. This is depicted in the above diagram.

Occasionally, it is desired to have the X•IPC product installed in an area of the file system that is read-only. In this case, it is undesirable (and, in fact, impossible) for `xipcinit` to use the installation directory for its scratch-pad files.

The prescribed approach, therefore, is to move the `xipc.env` file and the `log` directory to a writeable directory and set `XIPCROOT` pointing there. `xipcinit` now knows where to find `xipc.env` and where to do scratch-pad file work, when invoked. `xipcinit` must still, however, be guided to the X•IPC installation directory, which is elsewhere (in a read-only directory); this is accomplished by adding, within the `[xipcinit]` section of the `xipc.env` file, the `XIPCPATH` parameter set with the directory path of the installed X•IPC product. This is depicted in the following diagram:




## 3.3.2 THE `xipcinit` COMMAND

The `xipcinit` command is used for initializing the X•IPC platform environment. `xipcinit` must be the first X•IPC command issued on the platform when the platform is started. `xipcinit` reads the `xipc.env` file and sets up all internal structures and background processes needed for supporting X•IPC activity on the platform, based on the file's parameter settings.

`xipcinit` requires the setting of the `XIPCROOT` environment variable as described above. It takes no arguments. See the X•IPC Reference Manual for parameter guidelines.

### 3.3.3 THE `xipcterm` COMMAND

A bracketing command, `xipcterm`, is used to terminate the X◆IPC environment on a given platform. `xipcterm` should be the last X◆IPC command issued when the platform is stopped. `xipcterm` closes all internal structures and background processes needed for supporting X◆IPC activity on the platform.

`xipcterm` takes no arguments, but it too requires the `XIPCROOT` environment variable to be set.

Refer to the X◆IPC Reference Manual for details on `xipcinit, xipcterm` and for information about the parameters that may be defined within the `xipc.env` file. The `XIPCROOT` environment variable is defined as well in the same Reference Manual.

## 3.4 X◆IPC Logging

There are two types of logging relevant to X◆IPC: *Platform Environment Logging* and *Instance Logging*. Descriptions follow.

### 3.4.1 PLATFORM ENVIRONMENT LOGGING

X◆IPC 's platform environment generates a set of log files containing information about the activities occurring within the X◆IPC platform environment. These log files are generated within the X◆IPC platform's log directory (i.e., the `log` directory/folder within the directory/folder pointed at by the `XIPCROOT` environment variable. Refer to the diagrams earlier in this section.)

These log files are actually divided into two groups:

- The single X◆IPC system summary log file - `xipcsys.log`
- Individual log files for each of the platform-level background service/daemon programs

#### 3.4.1.1 X◆IPC System Summary Log File – `xipcsys.log`

The `xipcsys.log` file provides a high-level running summary of X◆IPC activity occurring on a platform. Included within this file are entries such as:

- "`xipcinit` has initialized the platform environment"
- "`xipcterm` has terminated the platform environment"
- "User xipc instance … was started"
- "User xipc instance … was stopped"

The `xipcsys.log` file will also include reports of high-level warnings or errors occurring within other X◆IPC components. As such, the `xipcsys.log` file is the central repository of overall X◆IPC activity occurring on a platform; it should be examined first when tracking down suspected problems.

#### 3.4.1.2 Background Service/Daemon Logging

Each background service/daemon program may log errors and warnings specific to its function within a log file specific to it. As with the `xipcsys.log` file, these log files are generated within the platform's `log` directory. These files follow the naming convention `<ProgramName>.log`. For example, the `xipcisd` background program generates the `xipcisd.log` file.

### 3.4.2 INSTANCE LOGGING

A second form of logging occurs at the X•IPC instance level and, then, only within instances running the MomSys subsystem. In this case, a series of log files, specific to the MomSys subsystem of that instance, are generated in the instance's anchor directory/folder (i.e., the directory/folder in which the instance's configuration file is situated).

Assuming that the instance's configuration file was named `test.cfg`, then the generated MomSys log files will have names such as: `test.SSS`, `test.MRI`, `test.MRO`, `test.CSI`, `test.CSO` and `test.CLK`, corresponding to the internal components of the instance's MomSys subsystem.

# 4. X•IPC INSTANCES

## 4.1 What is an X•IPC Instance?

An important X•IPC concept is that of an *instance*. An X•IPC instance is an environment for doing X•IPC work. An X•IPC instance is comprised of one or more of X•IPC 's subsystems: MomSys, QueSys, SemSys and MemSys.

In the case of QueSys, SemSys and MemSys, an X•IPC instance is the true *hub* of X•IPC activity; it is in this context that instances are discussed here.

In the case of MomSys, instances serve as *gateways* to route messaging activity; MomSys' utilization of instances is discussed at greater length in the MomSys documentation.

In general, the reader should refer to the respective subsystem manuals for further information on the establishment and use of instances and for all other subsystem-specific details.

X•IPC instances are typically utilized on an application-by-application basis, with instances defined to meet the specific IPC requirements of a given application and configured to optimize IPC performance of the application.

In short, an X•IPC instance is an IPC environment tailored to the specific needs of an application and its programs that will use it.

## 4.2 Defining an X•IPC Instance

An X•IPC instance is defined via an X•IPC instance configuration file. An instance configuration file is a flat ASCII file containing the parameterization definitions that describe the X•IPC instance. X•IPC instance configuration file names have the form:

```
<InstanceFileName>.cfg
```

Examples for various platforms:

```
frontend.cfg            stress.cfg          userdisk:[email]production.cfg

/usr/demo.cfg               tpsys.cfg

/tmp/test.cfg               c:\appls\transact.cfg
```

The maximum length of *InstanceFileName* depends on the host operating system's file naming rules.

## 4.3 Configuration (.cfg) Files

An X•IPC configuration file (.cfg file) completely describes an X•IPC instance. As such, it contains all necessary information needed to describe and parameterize the instance.

The configuration file is comprised of separate sections for each of the X•IPC subsystems. The sections contain the definitions and parameters specific to that subsystem. An additional section is required for instances that will be used in a network environment.

The order of the sections is insignificant. Blank lines and comments are ignored. Comment lines can be started using almost any non-alphanumeric character. Comments can also occur in lines following any parameter definition. The exact details of the syntax are specified in the X•IPC Reference Manual, as well as in the individual subsystem manuals.

The sample configuration file below defines an X•IPC instance for an E-Mail application having an Instance File Name of `/usr/email`. It references the QueSys, MemSys and SemSys subsystems, whose documentation should be referred to for further information.

A transaction processing application would likely define its own IPC environment separately, in a different configuration file, perhaps named `tpsys.cfg`. Certain supported operating systems require additional operating system specific parameters to be specified within their configuration files. These parameters (if any) are listed and described in the Platform Notes for the respective platforms.

```
#============================================================
#
# File: /usr/email.cfg
# Created: May 22, 2001
#
#------------------------------------------------------------
#
# This XIPC instance is used for demonstrating the basic
# functions of our E-Mail application. Various limitations are
# imposed on system capacity since it is a demo.
#
#------------------------------------------------------------

[SEMSYS]
MAX_SEMS     10      # the demo system uses 10 semaphores.
MAX_USERS        10      # five programs plus expected async activity.
MAX_NODES        50      # general formula given in Reference Manual.

[QUESYS]
MAX_QUEUES       20      # never needs more than 20 queues.
MAX_USERS        10      # programs plus expected async activity.
MAX_NODES        50
MAX_HEADERS      100     # worst case: assuming heavy traffic.
SIZE_MSGPOOL 48      # worst case: assumes download activity.
SIZE_MSGTICK 64      # smallest message is 64 bytes.
SIZE_SPLTICK 128

[MEMSYS]
MAX_SEGS     15      # depends on length of demo.
MAX_USERS        10      # programs plus expected async activity.
MAX_NODES        50
MAX_SECTIONS 100
SIZE_MEMPOOL 32      # must not be less than 16 K for demo.
SIZE_MEMTICK 256     # smallest segment to be used.


[REMOTE_USER]
MAX_TEXTSIZE 1024


#============================================================
```

## 4.4 Defining An Instance Having A Null Subsystem

In some situations it may be desirable to define an X•IPC instance that supports a subset of X•IPC 's subsystems. For example, one applications may require an instance that only uses QueSys message queuing, while a second application may have the need for an instance that supports semaphores and shared memory.

For addressing these situations, the developer can define an instance that has a subset of its subsystems designated as null. Such an instance will support only those IPC services corresponding to the subsystems that are defined. Attempts to issue X•IPC operations using the services of the null-defined subsystems are returned as an error.

```
#============================================================
#
# File: /usr/subset1.cfg
# Created: May 22, 2001
#
#------------------------------------------------------------
#
# This XIPC instance demonstrates configuring an instance that
# has no QueSys (or MomSys) subsystems.
#
#------------------------------------------------------------

[SEMSYS]
MAX_SEMS    10
MAX_USERS       10
MAX_NODES       50

[MEMSYS]
MAX_SEGS    15
MAX_USERS       10
MAX_NODES       50
MAX_SECTIONS 100
SIZE_MEMPOOL 32
SIZE_MEMTICK 256

[REMOTE_USER]
MAX_TEXTSIZE 1024
#============================================================
```

The above instance is defined to have a null QueSys (and a null MomSys), simply by virtue of omitting them as section headers.

It is important to bear in mind that if a subsystem is defined as null within an instance, then no X•IPC operations of that nature are possible within that instance. As an example, in the above defined instance, it would be an error to issue a QueSys or MomSys command.

The advantage of using a null subsystem is that doing so reduces the memory size of an instance (i.e., the amount of native shared memory required by X•IPC for supporting the instance).

## 4.5 XIPCROOT

XIPCROOT is the platform directory environment variable. It is required in all cases, for stand-alone, local and network instances alike.

When X•IPC is started on a platform--via the `xipcinit` command--X•IPC sets up its internal platform environment for supporting all subsequent X•IPC activity on that platform. As part of this initialization, `xipcinit` reads the `xipc.env` platform configuration file to ascertain which platform-wide resources need to be set up. The location of the `xipc.env` file is defined by the `XIPCROOT` environment variable. If `XIPCROOT` is not set, or if it is set, but points to a directory/folder having no `xipc.env` file, the `xipcinit` command will fail. See chapter 3 for a more detailed description.

## 4.6 Starting an X•IPC Instance

An X•IPC instance must be started before it can be used. (And, recall that the X•IPC platform configuration environment must be initialized using `xipcinit` before *any* X•IPC activity can be initiated.). This is accomplished using the `xipcstart` command. `xipcstart` starts an X•IPC instance. Its argument is the instance configuration file name of the instance to be started—–or to be more precise, the full or relative path name of the instance configuration file *excluding* the `.cfg` suffix.

Consider the following UNIX example:

```
xipcstart /projects/local/tpsys
```

Programs attempting to use an instance that has not been started will receive an error code indicating the problem. This will be elaborated on in the discussion of "login" functions below.

The Instance File Name can be omitted from the command line. In such a case, `xipcstart` uses the value of the `XIPC` environment variable as the Instance File Name of the instance to start.

Starting an instance that is to be used in a network environment requires an additional command argument. This is described in the X•IPC Reference Manual.

As described in the Advanced Topics section of this User Guide, an instance can also be started under program control.

### *4.6.1 TEST STARTING AN INSTANCE*

`xipcstart`, when executed, generates a report that specifies the amount of native operating system memory resources required by the instance.

It is possible to have `xipcstart` run in test mode, so that it produces a report indicating the memory resources that *would* be required by the instance, had the instance actually been started, and to *not* actually start the instance. This mechanism is useful for scoping the size of an instance before it is actually started. The test flag (`-t`) directs `xipcstart` to produce a test report regarding an instance.

Examples:

```
xipcstart /projects/local/tpsys -t
```

## 4.7 Stopping an X•IPC Instance

An X•IPC instance is stopped using the `xipcstop` command. `xipcstop` terminates an active instance, and releases all resources associated with that instance. Its argument is the Instance File Name of the instance to be stopped.

Example:

```
xipcstop /projects/local/tpsys
```

The above command stops the X•IPC instance that had been started using the Instance File Name shown (`tpsys`). Programs requiring the instance's X•IPC facilities can no longer be run.

Programs still using an instance at the time that it is stopped receive an error code indicating the stoppage of the instance.

Here, too, the Instance File Name can be omitted from the command line. In such a case, `xipcstop` also uses the value of the `XIPC` environment variable as the Instance File Name of the instance to stop.

As described in the Advanced Topics section of this book, an instance can also be stopped under program control.

## 4.8 User-Controlled Configuration

As we have seen, each X•IPC instance is individually configured by the user, without the need to modify the operating system kernel parameters.

This has a number of obvious advantages:

- Each application's X•IPC environment can be configured and optimized according to its own specific IPC needs.
- X•IPC configurationchanges can be applied without affecting the X•IPC instances of other applications.
- Special X•IPC instances can be devised for testing various aspects of an application's performance. Such test instances can be used to verify the correctness of special case logic within a system by artificially forcing those special situations to "occur." Examples include borderline testing (e.g., insufficient message headers: create an instance with an artificially low number of headers), and stress testing (e.g., insufficient shared memory space: create an instance having an artificially small-sized MemSys). In this manner, obscure paths in a system's code can be thoroughly tested.
- Production copies of a system can be individually tailored for different customer and/or site requirements, without the need to modify the kernel at each site.

## 4.9 Multiple X•IPC Instances

X•IPC permits multiple instances to be started and to exist concurrently. In this manner it is possible to have multiple applications running, each involved with its own X•IPC instance. Multiple active X•IPC instances are completely segregated from one another.

The ability to define and start multiple X•IPC instances provides significant software management, development and maintenance benefits:

- It is easy to segregate projects and applications running on a single processor or over a network. Using X•IPC instances, the IPC resource requirements of each application are drawn from the application's own local private pool of IPC resources, instead of from some operating system's global pool of IPC resources. This ensures IPC resource availability for each application, without the need to constantly monitor the system-wide IPC pool for usage and contention.
- It is possible to run development and production versions of a system concurrently on a *single* processor or network. Development and support can occur side-by-side on one machine or network without any compromises or special adjustments.

- *X•IPC* instances are independent of one another. Distinct instances for each application lighten the management task of allocating IPC resource identifiers. As an example, each application can create and use its own `Test_Queue` without ever colliding with some other application's identically named queue.

- Finally, the segregation of instances guarantees that the activities within one instance have no impact on another. For example, debugging of problems in one instance (perhaps due to abusive use of *X•IPC* resources) has no effect on other active *X•IPC* instances.

## 4.10 Stand-Alone Instances

An *X•IPC* instance can be confined to a single processor in one of two ways. One approach is to start such an instance as a stand-alone instance. (The second approach, using a local instance, is described in the next section.

A stand-alone instance defines an *X•IPC* environment that is accessible by local processes only. Processes on other machines have no access to such an instance.

Because an *X•IPC* /stand-alone instance is *not* named or registered in any manner within any *X•IPC* naming catalog, it is ideal for establishing an *X•IPC* instance that is:

- inaccessible from any remote node
- invisible (except to programs that use it) within the node on which it is running
- used by intra-nodal *X•IPC* applications where no networking is involved.

### *4.10.1 INSTANCE NAMING*

As was shown above, an instance that is local to one machine is identified by its instance configuration file name.

Example:

```
xipcstart  /home/sys/email
```

The above command starts the instance described by the "/home/sys/email.cfg" file. Had the "email.cfg" file been in the current directory, the following command would have had the same effect.

Example:

```
xipcstart  email
```

Each active instance is anchored to its host platform through its instance configuration file.

### *4.10.2 CONFIGURATION*

The basic configuration sections `[XIPC], [MOMSYS], [SEMSYS], [QUESYS]` and `[MEMSYS]`, as described in the respective subsystem Reference Manuals, are sufficient for starting a stand-alone instance. If a `[REMOTE_USER]` (formerly `[NETWORK]`) section appears in the instance configuration file, it is ignored.

### *4.10.3 ENVIRONMENT*

The only environment variables used in conjunction with a stand-alone *X•IPC* instance are `XIPCROOT`, which is required at all times, and `XIPC`. When set, `XIPC` is assumed to contain the Instance File Name of the instance to be worked with. *X•IPC* commands requiring an Instance File Name as an argument refer to the `XIPC` environment variable when the Instance File Name argument is omitted from the command invocation.

### 4.10.4 STAND-ALONE COMMANDS

The following commands are used to start, stop and view an X•IPC stand-alone instance. .

#### 4.10.4.1 xipcstart

`xipcstart` is used *without* the “-l” flag or "-n" flag which denote local or network instances. The instance started is based on the Instance File Name specified as an argument. If no Instance File Name argument is given, `xipcstart` uses the value of the `XIPC` environment variable.

#### 4.10.4.2 xipcstop

The instance stopped is based on the Instance File Name specified as an argument. If no Instance File Name argument is given, `xipcstop` uses the value of the `XIPC` environment variable.

#### 4.10.4.3 momview, queview, memview and semview

The instance monitored is based on the Instance File Name specified as an argument. If no Instance File Name argument is given, the monitor program uses the value of the `XIPC` environment variable.

### 4.10.5 PROGRAMMING TO ACCESS A STAND-ALONE INSTANCE

#### 4.10.5.1 Environment

The `XIPCROOT` environment variable is required by programs that access a stand-alone X•IPC instance.

#### 4.10.5.2 Logging into a Stand-Alone Instance

The XipcLogin() function identifies the target local instance by means of its Instance File Name.

Example:

```
XipcLogin ("/home/sys/email", "startup");
```

#### 4.10.5.3 Program Linking

Programs that are to access a stand-alone X•IPC instance may be linked using either the X•IPC Stand-Alone library or the X•IPC Combined library. The topic of library selection is discussed in detail in the Advanced Topics section of this Guide.

## 4.11 Local Instances

An X•IPC /local instance is an X•IPC instance that is named, but whose name is only visible within the bounds of the node on which it is started.

An X•IPC /local instance is ideal for establishing an X•IPC instance that is:

- inaccessible from any remote node

- accessible within its platform in an operating system transparent manner (i.e., by its name)
- used to advantage by MomSys programming because that environment most often invokes processes logging into instances on the local node.

Such an instance may be accessed either by its local name *(@InstanceName)* or by its Instance File Name.

An instance is given its local characteristic at instance start time. An added argument is specified as part of the `xipcstart` command that gives the instance its *Instance Local Name*. This argument is specified using a "-l" flag.

Example:

```
xipcstart  /usr/demo  -lLocalDemo
```

The above command starts an instance defined by the /usr/demo.cfg instance configuration file, and attaches the "LocalDemo" local name to it. By binding a local name to an instance, the instance becomes inaccessible from any remote node and accessible only within its platform. It may be accessed either by its local name (`@LocalDemo`) or by its Instance File Name ( `/usr/demo`).

The details of starting, stopping and working within a network instance are given in the Advanced Topics section of this Guide.

### 4.11.1 INSTANCE NAMING

An instance is given its local characteristic at instance start time. An argument specified as part of the `xipcstart` command assigns an *Instance Local Name* to the instance. The local name is specified using the "-l" flag as follows:

```
xipcstart  /home/sys/email  -l EMail
```

A local instance can also be named by setting the `LOCALNAME` parameter in the configuration file. (This is described in the X•IPC Reference Manual.)

If no naming parameters are specified, the instance is started as a stand-alone instance with no registered name.

### 4.11.2 CONFIGURATION

The basic configuration sections `[XIPC], [MOMSYS], [SEMSYS], [QUESYS]` and `[MEMSYS]`, as described in the respective subsystem Reference Manuals, are sufficient for starting a local instance. If a `[REMOTE_USER]` (formerly `[NETWORK]`) section appears in the instance configuration file, it is ignored.

### 4.11.3 ENVIRONMENT

The only environment variables used in conjunction with a local X•IPC instance are `XIPCROOT`, which is required at all times, and `XIPC`. When set, `XIPC` is assumed to contain the Instance Local Name of the instance to be worked with. X•IPC commands requiring an Instance Local Name as an argument refer to the `XIPC` environment variable when the Instance Local Name argument is omitted from the command invocation.

### 4.11.4 LOCAL COMMANDS

The following commands are used to start, stop and view an X•IPC local instance.

### 4.11.4.1 xipcstart

`xipcstart` is used with the “-l” flag which denotes a local instances. The instance started is based on the Instance Local Name specified as an argument. If no Instance Local Name argument is given, `xipcstart` uses the value of the `XIPC` environment variable. Some examples follow:

```
xipcstart  /home/sys/email  -l EMail
xipcstart  -lEMail  /home/sys/email
xipcstart  -l EMail  /home/sys/email
```

### 4.11.4.2 xipcstop

The instance stopped is based on the Instance Local Name specified as an argument. If no Instance Local Name argument is given, `xipcstop` uses the value of the `XIPC` environment variable. An example follows:

```
xipcstop  /home/sys/email
```

### 4.11.4.3 momview, queview, memview and semview

The instance monitored is based on the Instance Local Name specified as an argument. If no Instance Local Name argument is given, the monitor program uses the value of the `XIPC` environment variable.

## 4.11.5 PROGRAMMING TO ACCESS A LOCAL INSTANCE

### 4.11.5.1 Environment

The `XIPCROOT` environment variable is required by programs that access a local X•IPC instance.

### 4.11.5.2 Logging Into a Local Instance

An XipcLogin() function call that is targeting a local instance specifies the instance by its local name with an "@" prefixed to it.

Example:

```
XipcLogin ("@EMail", "InitPgm");
```

In the above example, a program identifying itself as "InitPgm" logs into the local instance "EMail."

### 4.11.5.3 Program Linking

Programs that are to access a local X•IPC instance may be linked using the X•IPC Combined library. The topic of library selection is discussed in detail in the Advanced Topics section of this Guide.

## 4.12 Network Instances

An X•IPC instance that is to support processes which access it over a network is called a network instance.

An X•IPC /network instance is ideal for establishing an instance that:

- must be accessed in a network-transparent manner across the network
- is used, therefore, to advantage by QueSys, SemSys and MemSys programming, where network-transparent access to an instance is a primary feature

An instance is given its network characteristic at instance start time. An added argument is specified as part of the `xipcstart` command that gives the instance its *Instance Network Name*. This argument is specified using a "-n" flag.

Example:

```
xipcstart  /usr/demo  -nNetDemo
```

The above command starts an instance defined by the /usr/demo.cfg instance configuration file, and attaches the "NetDemo" network name to it. By binding a network name to an instance, the instance becomes accessible to processes across the network. They will refer to the instance by the instance's network name "NetDemo."

The details of starting, stopping and working within a network instance are given in the Advanced Topics section of this Guide.

### *4.12.1 INSTANCE NAMING*

An instance that is defined across a network in order to provide X•IPC services between processes spread over the network is called a network instance.

An instance is given its network characteristic at instance start time. An argument specified as part of the `xipcstart` command, assigns an *Instance Network Name* to the instance. The network name is specified using the "-n" flag as follows:

Example:

```
xipcstart  /home/sys/email  -nEMail
```

The above command starts the instance defined by the "/home/sys/email.cfg" instance configuration file, and attaches the "EMail" network name to it. By binding a network name to an instance, the instance becomes accessible to processes across the network. They refer to the instance by its network name ("EMail").

A network instance can also be named by setting the `NETNAME` parameter in the configuration file. (This is described in the X•IPC Reference Manual.)

If no naming parameters are specified, the instance is started as a stand-alone instance with no registered name.

An Instance Network Name can be any ASCII string up to 255 characters in length.

### *4.12.2 CONFIGURATION*

A configuration file that is to be used as part of a network instance requires the inclusion of a `[REMOTE_USER]` (formerly `[NETWORK]`) section, in addition to the basic subsystem sections being used.

### 4.12.3 NETWORK INSTANCE LOCATION

When working within an X•IPC /Network environment, it is possible to have multiple instances concurrently active on the network. Each active instance is physically located on the network node where it was started.

It is possible to have some nodes supporting more than one instance and others supporting no instances.

Of course, processes using a network instance have *no concern* for the instance's physical location since they refer to the instance by its network name.

### 4.12.4 NETWORK INSTANCE SEARCH RANGE

X•IPC commands and programs working within a network instance locate the physical position of the target instance as part of their instance login procedure. The range of machines searched is referred to as the *instance search range*.

The instance search range can be set in one of three ways:

- By explicitly specifying the instance's node name in the XipcLogin() call (demonstrated below).
- By specifying the name of one or more hosts (network nodes) where the instance should be searched for via the `XIPCHOST` and `XIPCHOSTLIST` environmental variables.
- By specifying the name of one or more *Catalog Nodes* where X•IPC maintains a catalog of network instances, via the `XIPCCAT` and `XIPCCATLIST` environmental variables.

Controlling the search range is accomplished using the following environment variables: `XIPCHOST`, `XIPCHOSTLIST`, `XIPCCAT` and `XIPCCATLIST`. Each program can set and control its own search range, using these variables. The order in which instance search range specification parameters are used follows:

1. The `XIPCHOST` environment variable.
2. The `XIPCHOSTLIST` environment variable.
3. The `XIPCCAT` environment variable.
4. The `XIPCCATLIST` environment variable.

*When more than one search specification is present, XIPC uses the first one in the order listed above and ignores the rest.* (These environment variables are discussed below.)

### 4.12.5 SPECIFYING A NODE NAME IN XIPCLOGIN()

When invoking the XipcLogin() verb to log into a network instance, you can specify the specific node name where the instance resides.

In the following example, the process logs into network instance “ServerInstance” on node “sneezy.”

```
RetCode = XipcLogin("@sneezy:ServerInstance", "George");
```

### 4.12.6 THE XIPCHOST ENVIRONMENT VARIABLE

When the `XIPCHOST` environment variable is set, it is assumed to contain a list of node names (separated by white spaces, commas, colons or semicolons) that should be the target of instance searches. Instance searching is limited to those listed nodes, in the order listed.

Example:

```
XIPCHOST=sneezy:dopey:sleepy
```

### 4.12.7 THE XIPCHOSTLIST ENVIRONMENT VARIABLE

When the `XIPCHOSTLIST` environmental variable is set, it is assumed to contain the path name of a file in which a *list* of node names appears, one name per line. Instance searching is limited to those listed nodes, in the order listed.

### 4.12.8 THE XIPCCAT ENVIRONMENT VARIABLE

When the `XIPCCAT` environment variable is set, it is assumed to contain a list of *Catalog Node* names that should be queried for the instance discovery.

### 4.12.9 THE XIPCCATLIST ENVIRONMENT VARIABLE

When the `XIPCCATLIST` environmental variable is set, it is assumed to contain the path name of a file in which a *list* of *Catalog Node* names appears, one name per line. The catalog nodes should be queried for instance discovery.

### 4.12.10 INSTANCE SEARCH RANGE SPECIFICATION PRECEDENCE

The following list describes the order of precedence in which instance search range specification parameters are used:

1. Node name specification in the XipcLogin() verb.
2. The environment variable `XIPCHOST`.
3. The environment variable `XIPCHOSTLIST`.
4. The environment variable `XIPCCAT`.

5. The environment variable `XIPCCATLIST`.

When more than one search specification is present, X•IPC uses the first one in the order listed above and ignores the rest.

## 4.12.11 NETWORK COMMANDS

The following commands are used to start, list, stop and view instances in a networked environment.

### 4.12.11.1 xipcstart

Starting an instance that is to be used over a network requires that an Instance Network Name be specified as part of the `xipcstart` command.

Example:

```
xipcstart  /home/sys/email  -n EMail
```

The above command starts an instance defined by the "/home/sys/email.cfg" instance configuration file and attaches "EMail" to it as its Instance Network Name.

Other possible forms of the same command include:

Example:

```
xipcstart  /home/sys/email  -nEMail
xipcstart  -nEMail  /home/sys/email
xipcstart  -n EMail  /home/sys/email
```

Were an `XIPC` environment variable set to "/home/sys/email," then the command could have been reduced to:

```
xipcstart  -nEMail
```

The specified Instance Network Name must be unique within the prescribed search range.

When `xipcstart` is invoked with the "-n" flag for starting a network instance, it searches the network for the existence of an active instance having the specified network name. If such an instance is found, the `xipcstart` command fails.

It is also possible to start an instance from under program control, using the XipcStart() function call. This function is described in the Advanced Topics chapter of this Guide and in the X•IPC Reference Manual.

### 4.12.11.2 xipclist - Listing Active Network Instances

It is occasionally important to know which network instances are active and where they are physically located. `xipclist` serves that purpose. It lists all active instances in the defined search range.Example:

```
xipclist
```

If a machine name is specified as an argument, then `xipclist` reporting is limited to that machine. In such a case, the search range is ignored.

Example:

```
xipclist nodeA
```

### 4.12.11.3 xipcstop

The `xipcstop` command for stopping a network instance is identical to the command for stopping a local or stand-alone instance. Its lone argument is the Instance File Name of the instance being stopped.

Example:

```
xipcstop  /home/sys/email
```

Of course, the Instance File Name can be omitted, in which case the value of the `XIPC` environment variable is used.

It is also possible to stop an instance from under program control, using the XipcStop() function call. This function is described in the Advanced Topics chapter of this Guide and in the X•IPC Reference Manual.

### 4.12.11.4 momview, queview, memview and semview

The syntax for starting the X•IPC monitors is unchanged when monitoring a network instance. No reference is made of the instance's network name. Its lone argument is the instance configuration file name of the instance being monitored.

Example:

```
queview  250  /home/sys/email
```

Here, too, the Instance File Name can be omitted, in which case the value of the `XIPC` environment variable is used.

## 4.12.12 PROGRAMMING TO ACCESS A NETWORK INSTANCE

### 4.12.12.1 Environment

The `XIPCHOST, XIPCHOSTLIST, XIPCCAT` and/or `XIPCCATLIST` environment variables must define an instance search range when X•IPC programs are used within a network instance. Specifically, it is required by the XipcLogin function call that refers to a network instance by its Instance Network Name. These functions conduct a search for the specified network instance within the indicated search range.

### 4.12.12.2 Logging Into a Network Instance

An XipcLogin() function call that is targeting a network instance specifies the instance by its network name with an "@" prefixed to it.

Example:

```
XipcLogin ("@EMail", "InitPgm");
```

In the above example, a program identifying itself as "InitPgm" logs into the network instance "EMail." The search for the "EMail" instance is conducted based on the settings of the `XIPCHOST, XIPCHOSTLIST, XIPCCAT` and `XIPCCATLIST` environment variables.

### *4.12.12.3 Program Linking*

Programs that are to access a network X•IPC instance may be linked using either the X•IPC Network library or the X•IPC Combined library. The topic of library selection is discussed in detail in the Advanced Topics section of this Guide.

## 4.13 Multi-Instance Applications

In many cases, a one-to-one mapping scheme between an application and an X•IPC instance provides a sufficient level of abstraction for configuring and supporting the application's IPC requirements.

There are, however, situations—particularly when building larger applications—where it makes sense to split the application's IPC resources along certain physical or logical seams and to employ more than one instance for supporting the application's IPC activity. Such an application is a *multi-instance application*.

Issues related to the development of multi-instance applicationsare discussed in the Advanced Topics chapter of this Guide, in the section entitled "Working With X•IPC Instances."

# 5. X•IPC PROGRAMMING

## 5.1 Accessing An X•IPC Instance

### 5.1.1 XipcLogin() - LOGGING INTO AN INSTANCE

A user program must log into an instance before it can use its X•IPC environment. This is accomplished using the XipcLogin() function.

XipcLogin() takes the following arguments:

- The identity of the target instance.
- A login name by which the user will be known within the instance.

The target instance is specified in one of the following forms:

- Stand-alone instances are identified by their instance configuration file name.

  Example:

  ```
  RetCode = XipcLogin("/usr/demo", "myprog");
  ```

- Local and Network instances are identified by their Instance Local Name or Instance Network Name. An '@' character must be prefixed to the name to distinguish it from a stand-alone name.

  Example:

  ```
  RetCode = XipcLogin("@NetDemo", "myprog");
  ```

In the above examples, the calling program attempts to log into the instance named “NetDemo,” using the login name "myprog.”

Duplicate login names are permitted within an instance. It would thus be possible to have more than one user log in as "myprog" within the same instance.

XipcLogin() returns a non-negative instance "User Id" as its value when successful. This value is of minor significance and is generally not needed subsequently.

### 5.1.2 XipcLogout() - LOGGING OUT OF AN INSTANCE

A user logs out of an instance using XipcLogout(). XipcLogout() severs any connection between the calling user and the instance it is logged into.

XipcLogout() takes no arguments.

Example:

```
RetCode = XipcLogout();
```

XipcLogout() releases all held resources of the instance before it logs the user out. It is a good programming practice to have application program termination functions (such as trap handlers) call XipcLogout() before terminating.

Users that fail to log out of an instance can be forcibly removed from the instance by another logged-in user, using XipcAbort(). Refer to the Appendix containing the Technical Note on the X•IPC Idle User Detection Mechanism for further details.

### 5.1.3 XipcAbort() - ABORTING AN INSTANCE USER - FORCING A LOGOUT

Occasionally a user program that has logged into an instance will fail to log out from the instance before terminating. In such a situation, instance resources are locked up by the inactive user.

XipcAbort() can be called by a logged in user to forcibly remove another user from the instance. In the case of users that are no longer executing, XipcAbort() is a useful tool for cleaning up and recovering instance resources.

XipcAbort() can also be called to violently log another active user out of an instance. In most situations this will not be appropriate, but the capability exists.

XipcAbort() takes the following argument:

- The Uid of the user to be aborted.

Example:

```
RetCode = XipcAbort(Uid);
```

XipcAbort() takes as its argument the user id (Uid) of the user that is to be aborted. Recall that the Uid is returned as the value of a successful XipcLogin() operation.

## 5.2 X•IPC Blocking Options

Many X•IPC operations have the potential for blocking or completing asynchronously. X•IPC offers a complete set of synchronous and asynchronous options for controlling such behavior.

### 5.2.1 SYNCHRONOUS OPTIONS

X•IPC provides three synchronous blocking options.

#### The NOWAIT Option

The `NOWAIT` option is the most straightforward. It is in fact a blocking option that directs X•IPC *not* to block. When specified as part of a potentially blocking function, it stipulates that the function should not block if the operation cannot complete.

In such a case, an appropriate error code is returned by the function indicating that the function's operation was not accomplished and that waiting will *not* take place.

#### The WAIT Option

The `WAIT` option instructs the function to block indefinitely when it cannot complete immediately.

When `WAIT` is specified, the invoking user becomes blocked when the function cannot complete. The process then remains blocked until conditions necessary for the function's completion exist, at which time the function completes and the user is woken up.

### The TIMEOUT Option

The `TIMEOUT` option is identical to the `WAIT` option except that, when blocking occurs, it is limited to the specified number of seconds of real time.

Should the blocked operation complete within the timeout period, the user is awakened and allowed to proceed. If, however, the stipulated time period expires, then the user's blockage is cancelled and an appropriate error code is returned by the function.

## 5.2.2 ASYNCHRONOUS OPTIONS

X•IPC additionally provides three asynchronous options for situations where it is desired that an operation complete in the "background." As such, it is possible–and often desirable–for a program to initiate multiple X•IPC operations that remain pending in the background until conditions permit them to complete.
The common denominator of the three asynchronous options is that the X•IPC operation does *not* cause the calling program to block. It continues unimpeded. The options differ in their method of completion notification. A key component of these approaches is the usage of a user-declared Asynchronous Result Control Block (ACB) variable. Each X•IPC operation that is directed to complete asynchronously has a user-specified ACB associated with it. The ACB allows the tracking (and possible aborting) of the operation if and when it blocks asynchronously. The ACB structure is additionally used by X•IPC for returning data from the asynchronous operation, when the operation completes.

Note that an X•IPC operation that is coded with an asynchronous option completes asynchronously whether or not it is forced to block before completing. This is the default behavior of the asynchronous options.

It is, however, sometimes required that an asynchronous option be applied *only* if the subject operation is forced to block, and to otherwise return synchronously if it can complete without blocking. This behavior can be accomplished by specifying the `RETURN` option flag together with the asynchronous option. Examples of using this option are given in the Advanced Topics section of this Guide.

### The CALLBACK Option

The `CALLBACK` option directs X•IPC to notify of an asynchronous operation's completion by means of a user-defined callback function. The specified callback function is invoked when the blocked operation completes. The function's single argument is a pointer to the ACB associated with the completing operation. In this way, one function can be used to serve multiple asynchronous X•IPC operations.

### The POST Option

The `POST` option directs X•IPC to mark the completion of the operation by setting a user-specified X•IPC event semaphore. The semaphore is set when the operation completes. A typical scenario would have another program or thread waiting for that semaphore to be set, and then to react appropriately. Alternatively, the semaphore can be examined at some later point in time by the original calling program or by another program in the instance.

### The IGNORE Option

The `IGNORE` option instructs X•IPC to allow the operation to complete "silently." No explicit notification is given upon its completion. The original calling program may periodically poll the ACB associated with the pending operation, until the operation completes. Or it can ignore it entirely.

Refer to the specific function descriptions below and to the X•IPC Reference Manual for additional related descriptions. Further discussion of working with X•IPC 's asynchronous blocking options is presented in the Advanced Topics section of this Guide.

## 5.2.3 BLOCKING OPTIONS SUMMARY

The table below summarizes the uses of X•IPC 's synchronous and asynchronous blocking options.

The blocking option parameter accepts one of the following values, as listed in the table below. The characters "*XXX*_" in all blocking option codes and return codes should be replaced by MOM_, SEM_, QUE_ or MEM_, depending on the subsystem called.

All X•IPC functions that have the potential to block or complete asynchronously, have a *BlockOpt* parameter that is used to specify the appropriate option for the function call. The asynchronous options refer to a user-declared Asynchronous Result Control Block structure (ACB). The function of this control block was described above.

| **SYNCHRONOUS Blocking Options** | **Description** |
|---|---|
| *XXX*_NOWAIT | If the request specified in the function call cannot be satisfied, the function returns immediately with RC = *XXX*_ER_NOWAIT. |
| *XXX*_WAIT | If the request specified in the function call cannot be satisfied, the caller is blocked until the request is completed. |
| *XXX*_TIMEOUT(*n*) | If the request specified in the function call cannot be satisfied, the caller is blocked until the request is completed or until *n* seconds have elapsed after which the function returns with RC = *XXX*_ER_TIMEOUT. |
| **ASYNCHRONOUS Blocking Options** | **Description** |
| *XXX*_CALLBACK (*Func, AcbPtr*) | The function returns immediately with RC = *XXX*_ER_ASYNC. When the request is completed, the ACB pointed to by *AcbPtr* is filled with the results of the operation and the function *Func* is called with *AcbPtr* passed as its only argument. |
| *XXX*_POST(*Sid, AcbPtr*) | The function returns immediately with RC = *XXX*_ER_ASYNC. When the request is completed, the ACB pointed to by *AcbPtr* is filled with the results of the operation and the event semaphore *Sid* is set. |
| *XXX*_IGNORE(*AcbPtr*) | The function returns immediately with RC = *XXX*_ER_ASYNC. When the request is completed, the ACB pointed to by *AcbPtr* is filled with the results of the operation. |

The three asynchronous options cause *all* successful operation completions to occur using the prescribed asynchronous mechanism, including operations that can be completed immediately.

It is sometimes required that operations which complete immediately–without blocking–should return their result *synchronously* and have the specified asynchronous option apply *only* to blocking situations. This behavior can be achieved by specifying the *XXX*_RETURN option flag along with the asynchronous options, as in:

```
XXX_RETURN | XXX_CALLBACK(Func, AcbPtr)

XXX_RETURN | XXX_POST(Sid, AcbPtr)

XXX_RETURN | XXX_IGNORE(AcbPtr)
```

In each of the above cases, the specified asynchronous mechanism is employed *only* if the operation cannot complete immediately. Operations that can complete immediately return synchronously with their results.

## 5.3 Using X•IPC With Threads

Thread-safe versions of X•IPC are available. This means that it is possible to develop a multithreaded program that employs threads for X•IPC operations without having to be concerned for the integrity of X•IPC's internal data

structures. There are, however, rules that must be followed and understood in order to program multithreaded applications successfully.

This section describes general rules regarding the use of X•IPC within threaded programs. Operating system specific rules are delineated within the respective X•IPC Platform Notes. The reader is encouraged to refer to those notes after reading this general section.

### 5.3.1 X•IPC LOGIN PER THREAD

The first rule is that each thread must explicitly manage its own X•IPC logins, as it needs them. X•IPC logins *cannot be shared* across multiple threads. So, for example, an X•IPC program having five threads, each performing X•IPC operations, must be written so that each of the five threads performs its own XipcLogin() and XipcLogout() operations as necessary. In our example, that would translate into five separate logins. It is not possible for one thread to perform one login and have the context of that login shared by the five threads. (Of course, threads not doing X•IPC work need not log in to an instance.)

The "login per thread" rule has ramifications regarding X•IPC asynchronous programming. This is discussed below.

### 5.3.2 PROGRAMMING RESTRICTIONS

Following is a list of additional restrictions that are imposed on X•IPC –based threaded applications:

- The following three X•IPC list-building utility functions are *not* thread-safe: `QueList(), SemList(), MemList()`. These functions use internal static data areas which cannot be relied upon in a multithreaded environment. The other list building functions (e.g., `QueListBuild(), QueListAdd(),` etc.) are thread safe.
- Threaded programs, written for the supported **UNIX Operating System** platforms, cannot perform X•IPC operations that specify the *XXX*`_TIMEOUT()` blocking option.
- The MemSys function `MemSection()` is not thread-safe. One should use the `MemSectionBuild()` function instead.
- X•IPC, by default, cannot support more than 64 threads per process. In order to override this limit, one must set the external X•IPC variable `XipcMaxThreads` with the override value before the process performs its first `XipcLogin()` call.

### 5.3.3 ASYNCHRONOUS OPERATIONS

The `XipcAsyncEventHandler()` function that is called by an application upon completion of an asynchronous operation must be called by the same thread that issued the original X•IPC operation. It is possible to have another thread wait for the associated system event to occur (e.g., in UNIX to wait for the I/O descriptor to become set; in Windows NT to wait for the Event object to become set), but the final processing step of the operation – the calling of `XipcAsyncEventHandler()` – must be performed by the thread that initiated the original X•IPC operation.

UNIX-based multithreaded programs that issue X•IPC asynchronous operations are not able to receive notification of operation completion via system signals. Rather, they must use the I/O descriptor method of asynchronous notification. See the Technical Note "Using I/O Descriptors for Asynchronous Notification" for details on how this is programmed.

Each thread within a UNIX-based multithreaded program **must** set the `XIPC_SETOPT_PRIVATEQUEUE` option in order for its asynchronous operations to complete successfully. This is accomplished by having each thread call the XipcSetOpt() function, as follows, before it logs into X•IPC.

Example:

```
/*
 * Set XIPC option to use a private UNIX queue used for
 * implementing this thread's asynchronous XIPC activity.
 * Then log in to the XIPC instance ...
 */

XipcSetOpt( XIPC_SETOPT_PRIVATEQUEUE);

XipcLogin(..., ...);
```

### 5.3.4 PROGRAM LINKING

The method for linking a multithreaded X◊IPC program is platform-dependent. On some platforms, the standard X◊IPC libraries are inherently thread-safe (e.g., Windows NT). On other platforms, special reentrant versions of the X◊IPC libraries are provided (e.g., most UNIX platforms). Here, too, one should refer to the specific Platform Notes for details.

## 5.4 X◊IPC On-Line Monitoring

X◊IPC includes full-screen interactive monitors that provide continuous real-time views of the activities occurring within an X◊IPC instance. Monitoring an instance's subsystems is accomplished using the subsystem monitors: `momview, queview, semview` and `memview.` Details for each can be found in the respective subsystem documentation.

The monitoring facility does not require that applications be specially prepared for monitoring (e.g., "debug" mode). The facility can be invoked for any active X◊IPC instance––including those of production systems out in the field––without any extra provisions and without incurring performance overhead in the application when monitoring is not in use.

As such, the monitor can be used by an application's support personnel to remotely (via a remote login) perform analysis of a dead or dying system, without having to be present at the customer site.

When invoked, monitoring becomes an invaluable tool for identifying problems, particularly when the problems result from incorrect or misunderstood usage of an application's IPC resources––i.e., semaphores, queues and segments. The delicate task of application integration testing and debugging is greatly simplified.

### 5.4.1 STARTING THE X◊IPC MONITORS

The X◊IPC monitors are started from the command line. The name of the subsystem monitor is followed by two arguments:

- The first argument is the initial "interval" snapshot setting. It will be described in detail below. Briefly, the interval defines, in milliseconds, the initial update frequency of the monitor.
- The second argument is the Instance File Name of the instance to be monitored.

Example:

```
semview 100 /usr/demo
```

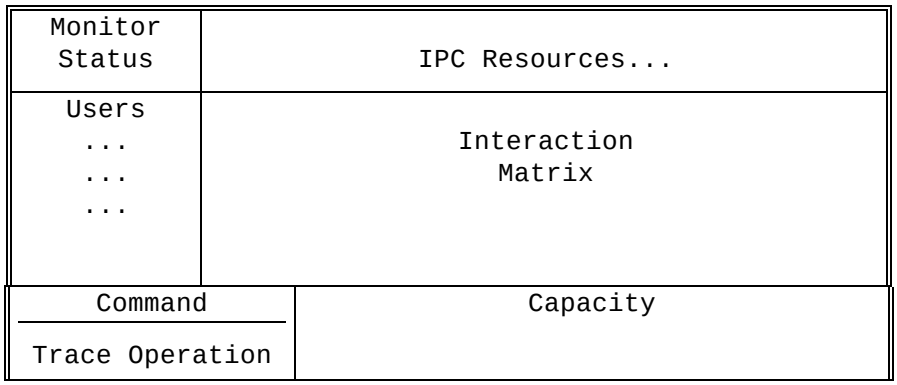
The above command starts the `semview` monitor for the SemSys of the "/usr/demo" instance. The initial update frequency is set to 100 milliseconds.

As was the case with `xipcstart` and `xipcstop`, the Instance File Name can be omitted from the command line. In such a case, `semview` also uses the value of the `XIPC` environment variable for the Instance File Name of the instance to start monitoring.

## 5.4.2 MONITOR FUNCTIONS AND LAYOUT

The X•IPC monitors are very similar in layout and function, sharing the same general "look and feel." Information is presented in a matrix-like display, where the users and the IPC entities make up the axes of the matrix. Interaction between users and IPC entities is displayed within the body of the matrix.

Asynchronously blocked X•IPC operations are treated as pseudo-users and receive an Asynchronous Uid (AUid) while they are pending. Information regarding AUids is displayed on the X•IPC monitors in the same manner as ordinary users. This provides a consistent means of monitoring pending asynchronous operations.




Important subsystem capacity data is displayed at the lower right portion of the screen. Monitor status data is shown at the top left of the screen. The command entry window is at the lower left of the screen. The same format is used for all four subsystem monitors.

The trace window (located at the bottom of the command window) is active when the monitor is in one of the trace update modes (Flow or Step). It reports the next X•IPC operation to be executed and the Uid of the user performing the operation.

## 5.4.3 MONITOR MODES

X•IPC monitors operate in one of two modes:

- Update Mode
- Command Mode

### 5.4.3.1 Update Mode

When in Update Mode, the monitor updates the display of X•IPC activity in one of the following ways:

- "Interval Snapshot Mode" causes the monitor display to be refreshed at a user-specified interval rate (specified in milliseconds). Activity occurring between snapshots is not shown. This mode is useful for observing the general ebb and flow of activity occurring within an X•IPC instance.

The interval value is user-defined and controls how frequently the snapshots occur. Setting the interval to 50, for example, results in 50 millisecond intervals between snapshots.

A small interval value causes screen updates to occur frequently. Increased screen update activity often results in significant performance overhead for the instance being monitored *and* its client programs. This should be considered when monitoring X•IPC activity of real-time systems.

- "Trace Flow Mode" results in the monitor being refreshed before *every* X•IPC operation in the monitored subsystem. The trace operation window reports the next X•IPC operation to be executed and the identity of the Uid performing the operation. The monitor then pauses for "interval" milliseconds, after which it continues.

  Trace flow mode is often used for watching an instance's activity in "slow motion." Setting "interval" to 1000 while within trace flow mode can produce such an effect.

- "Trace Step Mode" causes activity in the monitored subsystem to completely stop after each X•IPC operation is performed. There too the trace operation window reports the next X•IPC operation to be executed and the Uid performing the operation. The user must depress a key to perform the next X•IPC operation. This mode is useful when the slow motion provided by the trace flow mode is still too fast. This is likely to be the case during intense logic debugging sessions.

When first activated, the monitor is in "Interval Snapshot Mode." The initial interval value is set to the value specified on the command line.

Note that monitoring an instance's subsystem (in any mode) has no effect on the performance of other subsystems in the instance or on other concurrently active instances.

### 5.4.3.2 Command Mode

In order to enter commands to the monitor it must first be temporarily taken out of Update Mode and placed in Command Mode. The exact keystrokes to be used are operating system dependent and are specified in the appropriate Platform Notes.

Once in Command Mode, the user is prompted with:

```
Command> _
```

After a command is entered, the monitor automatically returns to Update Mode.

## 5.4.4 BASIC COMMANDS

The X•IPC monitors are very similar in their basic functionality, with several basic commands common to all X•IPC monitors (`momview, queview, semview, memview`). Specific capabilities particular to the individual monitors and their appropriate commands are described below and in the subsystem documentation.

### 5.4.4.1 Setting the Interval Value

Setting the interval value is accomplished using the command:

```
Command> iN
```

where N specifies the new interval value in milliseconds. N must be greater than or equal to zero.

Examples:

```
Command> i2000
Command> i50
```

The first example sets interval to 2000 milliseconds, or two seconds. The second example sets "interval" to 50 milliseconds.

Very low interval settings will often cause performance degradation in the monitored instance subsystem.

#### 5.4.4.2 Entering Trace Flow Mode

Entering Trace Flow Mode is accomplished by entering:

```
Command> tf
```

#### 5.4.4.3 Entering Trace Step Mode

Entering Trace Step Mode is accomplished by entering:

```
Command> ts
```

#### 5.4.4.4 Exiting Trace Mode

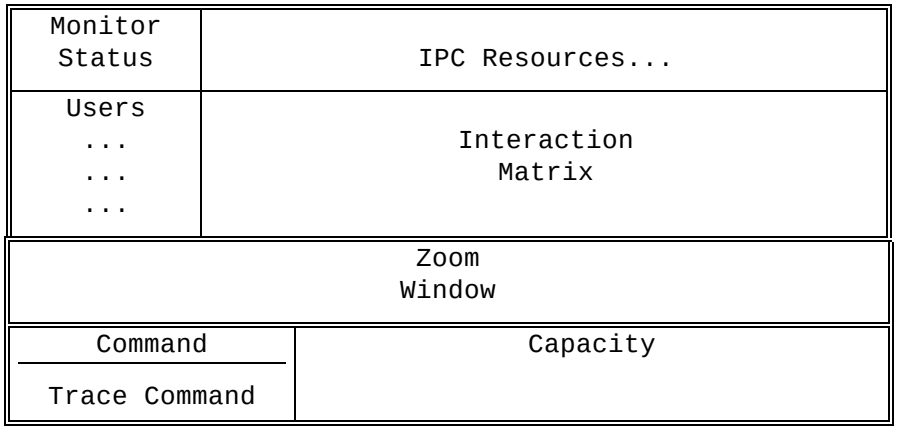
Leaving either Trace Mode returns the monitor to Interval Snapshot Mode. This is achieved by entering the Trace Off command:

```
Command> to
```

### 5.4.5 ZOOMING

X•IPC monitors provide a set of facilities for examining aspects of an instance with additional scrutiny. One of these tools is the monitor "zoom window." The other facility, the "browse screen," will be described shortly.

The monitor Zoom Window allows the developer to watch general X•IPC instance activity and at the same time focus on the activity of a specific aspect of the instance subsystem being viewed.




Each of the subsystem monitors provides a wide array of Zoom Window options from which to choose. The specific option codes and their applications are outlined in the subsystem specific sections below and in the X•IPC Reference Manual.

All zooming commands begin with the letter `z`. The remaining characters specify which Window to activate.

Examples:

```
Command> zs5
```

The above `semview` command activates a Zoom Window for observing, in detail, the activities of the semaphore having an 'Sid' of 5. (We will see later that an 'Sid' is a handle used for identifying and manipulating a specific X•IPC semaphore.)

```
Command> zp
```

This command activates a Zoom Window for observing, in detail, the activities of the message text pool of a QueSys instance.

## 5.4.6 UN-ZOOMING

Zooming in on a particular aspect or entity within an instance can be stopped in three ways:

- The easiest approach is to enter the UnZoom command:

  ```
  Command> uz
  ```

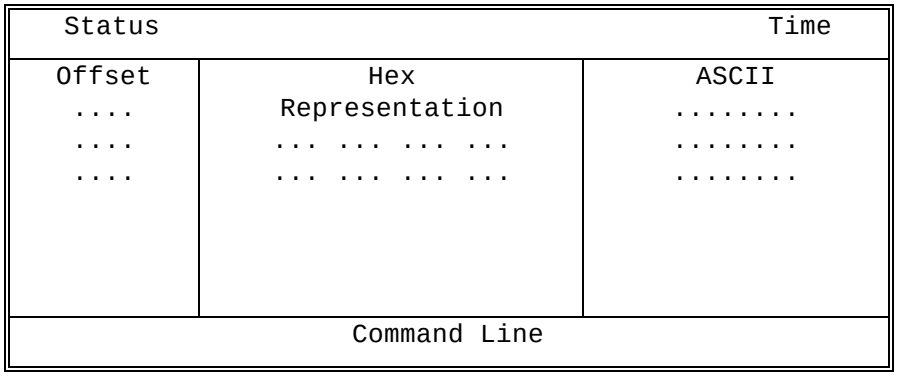
- A second possibility is to start zooming on a new aspect of the instance. This will replace the current zoom data.

- Third, deleting the resource being zoomed automatically brings down the zoom window.

## 5.4.7 BROWSING

A second and more powerful means of monitoring the status of an X•IPC instance is via the "browsing" facility. Browsing is possible from within the `momview, queview` and `memview` monitors for scanning the contents of message queues and shared memory segments.

The general layout of the browse screen is as follows:




## 5.4.8 WATCHING

Within `memview`, a third form of monitoring is provided: Watching. Memory segment watching allows the developer to observe the contents of shared memory segments in real-time. An additional section watching facility lets the developer monitor the lock status of segment data down to the byte level.

### 5.4.9 PANNING

As we have seen, X•IPC monitors are matrix-like in their layout. As such, they can be manipulated as on a spreadsheet when certain "off the screen" portions of the matrix are required for viewing. This is accomplished by Panning.

Panning can be performed horizontally or vertically. The exact format of the panning commands are subsystem specific and are provided in the susbsystem volumes.

### 5.4.10 EXITING THE MONITOR

Monitoringof an X•IPC instance is terminated using the q command. This is true for all subsystem monitors: `momview, queview, semview` and `memview.`

Example:

```
Command> q
```

Of course, bringing down an X•IPC monitor has no effect on the underlying instance, its ongoing activities or its client programs.

When monitoring is off, there is virtually no overhead to the performance of the instance (one additional machine instruction per X•IPC operation). This removes any need for building separate "debug" and "production" versions of a system. X•IPC production systems are automatically subject to X•IPC monitoring, even out in the field. It is thus possible for technical support personnel to remotely log into installed systems for analysis purposes using X•IPC monitors, if and when there are problems.

## 5.5 X•IPC Function Return Codes - Using XipcError()

X•IPC functions return negative integer codes whenever they do not complete successfully. These codes and their interpretations are described in the X•IPC Reference Manual and in appropriate sections of the subsystem-specific documentation.

By testing for a negative return value, it is immediately possible to check on a function's success or failure.

The XipcError() function is used for translating an error code returned by a failed X•IPC function call.

XipcError() takes one argument:

- ☐ The X•IPC error code whose translation is desired.

XipcError() returns a pointer to a static string containing a brief translation of the error code it is passed. It returns a pointer to an appropriate message for undefined error codes.

Example:

```
RetCode = QueCreate(...);

if (RetCode < 0)
{
    /* Error handling code */
    printf("QueCreate Error: %s\n", XipcError(RetCode));
}
```

# 6. ADVANCED TOPICS

This section of the X•IPC User Manual presents in-depth discussions of several advanced topics that can be central to optimizing your use of X•IPC. Most of the topics are presented from the perspective of the QueSys, SemSys and MemSys subsystems. Advanced Topics that are especially pertinent to MomSys are presented in the MomSys User Guide and MomSys Reference Manual.

## 6.1 Advanced Instance Configuration

This section describes instance configuration parameters that can be employed for making an X•IPC application take advantage of the specific hardware and operating system environment that it is running on.

The behavior of an X•IPC instance – and consequently of applications using the instance – can be influenced by a number of platform resources. The most critical platform resources involved are:

- The number of CPUs (processors) running on the platform
- The manner in which the instance's underlying memory sharing is implemented

X•IPC provides instance configuration parameters that can be used for influencing how an instance uses these resources.

### *6.1.1 CONFIGURING X•IPC FOR MULTIPLE-CPU (SMP) SYSTEMS*

An X•IPC instance that will run on a multi-CPU platform such as a Symmetric Multiprocessor (SMP) computer should be configured differently than a single-CPU platform. The parameter that is involved is the `CSEC_ALGORITHM` instance configuration parameter. This parameter, found within the `[XIPC]` section, has two alternative values: `Gate` and `Semaphore`. (Some platforms support only one of these values, however; see the Platform Notes regarding your particular platform.)

The *usual* default value for `CSEC_ALGORITHM` is `Gate`. This setting is optimal for single-CPU systems. Multi-CPU systems should have their instances configured with `CSEC_ALGORITHM` set to `Semaphore` to override the default value.

Example:

```
[XIPC]
CSEC_ALGORITHM   Semaphore
```

The alternative value, `Semaphore`, can in certain circumstances be the default value. On certain UNIX platforms (e.g., HP-UX, Solaris and AIX 4.1 and higher), X•IPC is able to detect whether the underlying hardware is an SMP, or not. If it detects more than one processor active, then the `CSEC_ALGORITHM` parameter is set to a default value of `Semaphore`, which can be overridden to `Gate`. See the Platform Notes for details.

### *6.1.2 CONFIGURING AN INSTANCE'S MEMORY UTILIZATION*

An X•IPC instance uses the operating system's underlying memory resources for supporting the activities of the instance. Exactly how this is accomplished depends on the operating system involved. The following table summarizes the *default* mechanisms used for implementing an instance's memory sharing requirements.

| Operating System | Instance Memory Elements (*Default*) | Single / Multiple (*Default*) |
|---|---|---|
| UNIX | Shared memory | Multiple |
| Win32 | Memory-mapped files | Multiple |
| VMS | Global sections | Multiple |

To understand the above table let us examine the entries for UNIX. An instance is by default implemented on UNIX using multiple shared memory segments. The exact meaning of the word *multiple* depends on the combination of subsystems configured for the instance.

The following table describes how each subsystem contributes to this value:

| MomSys | QueSys | SemSys | MemSys |
|---|---|---|---|
| 2 | 2 | 1 | 2 |

Thus, a full (four-subsystem) instance on UNIX will, by default, consume seven shared memory segments. (Note that this number does *not* include the resources used by the X•IPC Platform Environment which typically consumes an extra four elements.)

### 6.1.2.1 Configuring to Use a Single Memory Element

X•IPC permits the user to stipulate that the instance will use a *single* memory sharing element instead of the default *multiple* element approach. This is useful for situations where it is preferred that the system not create multiple elements when starting the instance, but rather implement all necessary memory sharing within a single memory element.

One example where this is important is for configuring instances on certain UNIX platforms that limit the number of shared memory segments that a process can attach to at one time. If a limit of six segments existed, then it would be impossible for a process on that platform to log into an instance having all four subsystems. (See the respective UNIX X•IPC Platform Notes for details on such limitations.)

The SHARED_MEM configuration parameter is used for controlling whether a single or multiple memory element approach is used by the instance.

Example:

```
# In the following example, SHARED_MEM is set in the [XIPC]
# section causing all subsystems within the instance to
# consolidate their underlying shared memory elements into
# a single element. This instance will thus use one memory
# elements instead of four.


[XIPC]
SHARED_MEM      SINGLE

[QUESYS]

[MEMSYS]
```

### 6.1.2.2 Configuring to Use Memory Mapped Files on UNIX

X•IPC instances that run on UNIX have the added flexibility that they may be configured to employ memory-mapped files instead of shared memory as the mechanism for supporting the instance's memory sharing elements. This is useful in situations where the UNIX system places size limitations on the size of shared-memory segments that can be created, thus inhibiting the size of the instances that can be run.

The `MAPFILE_CTL` and `MAPFILE_POOL` configuration parameters are used for specifying that the instance should use memory-mapped files instead of shared memory. The parameter is configured by specifying a file-system path name for the memory-mapped file that is to be created. The `MAPFILE_CTL` parameter defines where the shared control data should be created. The `MAPFILE_POOL` is only relevant for subsystems that have a text pool.

Example:

```
[QUESYS]
MAPFILE_CTL      /usr/harvey/quesys.ctl
MAPFILE_POOL /usr/harvey/quesys.pool
```

The following table lists the map-file configuration parameters that are valid in the respective instance configuration sections.

| Section | Memory-Map Parameters (*UNIX only*) |
|---|---|
| `[XIPC]` | `MAPFILE` |
| `[MOMSYS]` | *(Not Supported)* |
| `[QUESYS]` | `MAPFILE_CTL, MAPFILE_POOL` |
| `[SEMSYS]` | `MAPFILE_CTL` |
| `[MEMSYS]` | `MAPFILE_CTL, MAPFILE_POOL` |

Note that the configuring `MAPFILE` within the `[XIPC]` section is only valid when the `SHARED_MEM` parameter is also specified in that section. Such a configuration directs X•IPC to configure the entire instance as a single memory element, where the memory element is to be implemented as a memory mapped file.

Example:

```
# In the following example all subsystems within the instance
# consolidate into a single element that is implemented as a
# memory mapped file.

[XIPC]
SHARED_MEM      SINGLE
MAPFILE         /usr/projects/foo/xipc.ctl

[QUESYS]

[MEMSYS]
```

### 6.1.2.3 Configuring to Use Memory-Mapped Files on Windows NT, 95 and VMS

X•IPC instances that run on Win32 or VMS platforms always employ the operating system's native memory-mapping facilities for implementing an instance's underlying shared-memory elements. X•IPC by default chooses names for these memory-sharing elements that should normally be left untouched.

In those cases where it is necessary to override these default names, X•IPC allows this to be accomplished using the MAPNAME, MAPNAME_CTL and MAPNAME_POOL instance configuration parameters. Their rules of usage are identical to the MAPFILE, MAPFILE_CTL and MAPFILE_POOL parameters described above, except that instead of specifying a *file-system path name* for a memory mapped file, one specifies a valid memory element *name*. The syntax for these names is operating system dependent.

Example:

```
# In the following, all subsystems within the instance
# consolidate into a single entity that is implemented as a
# native memory mapped entity having the name "xipcstuff".

[XIPC]
SHARED_MEM      SINGLE
MAPNAME         xipcstuff

[QUESYS]

[MEMSYS]
```

Example:

```
# In the following, the QueSys subsystem is implemented as
# native memory mapped entities.

[QUESYS]
MAPNAME_CTL     quesys.ctl
MAPNAME_POOL quesys.pool
```

## 6.2 Asynchronous Operations

### 6.2.1 INTRODUCTION

X•IPC operations that can block can complete synchronously or asynchronously. The `WAIT` and `TIMEOUT` synchronous blocking options actually block the program that initiated the X•IPC operation until the operation completes–either successfully or in failure–at which time the program becomes unblocked and continues its processing.

X•IPC asynchronous options provide a more powerful set of alternatives. Unlike the synchronous options, asynchronous options indicate that the subject X•IPC operation should complete in the background, without blocking the calling program. The program is allowed to proceed. When the operation completes, some form of notification is given by X•IPC, depending on the asynchronous option specified at the start of the operation.

X•IPC supports three asynchronous options. Each describes a different form of notification to be given by X•IPC at the completion of the operation.

- The `CALLBACK` option directs X•IPC to execute a user-specified callback function upon completion.
- The `POST` option directs X•IPC to set a SemSys event semaphore when the operation completes.
- The `IGNORE` option directs X•IPC to allow the operation to complete "silently" with no explicit form of notification.

The three options are described in more detail below. An operation that is invoked asynchronously returns the `MOM_ER_ASYNC, QUE_ER_ASYNC, SEM_ER_ASYNC` or `MEM_ER_ASYNC` return code, as appropriate. It is important to note that flags must always be ORed *to the left* of (before) the blocking option.

### 6.2.2 THE ASYNCRESULT CONTROL BLOCK (ACB)

Tracking of an asynchronous X•IPC operation is achieved using an Asynchronous Result Control Block (ACB). An ACB is a user-declared structure (of type ASYNCRESULT) that is associated with an asynchronous X•IPC operation. Each X•IPC operation that is coded with an asynchronous blocking option is required to specify an ACB (actually, a pointer to an ACB) along with the option. (Examples are provided below.) The ACB is the vehicle by which X•IPC transmits return data when the operation completes.

An ACB also contains a number of fields that support the tracking of asynchronous operations while they are still pending.

When an X•IPC operation executes asynchronously, the operation's ACB is set with information for tracking the operation.

- An asynchronously blocked operation is treated as a pseudo-user within the subsystem that it blocked. As such, the pending operation is recorded as an entry in the subsystem's user table and is assigned its own User ID—or, more precisely, an Asynchronous User Id (AUid). The **AUid** field of the ACB is set with the blocked operation's AUid.

User information functions that accept a Uid as an argument, such as SemInfoUser(), accept an AUid as well. X•IPC 's subsystem monitors present status on AUid's in the same manner as for ordinary Uid's. This provides the developer with the means for tracking all pending asynchronous operations occurring within an instance, *without* having to "invent" specialized async monitoring tools. Asynchronous operations that succeed without blocking have the AUid field of their associated ACB set to zero.

- The **AsyncStatus** field remains set as `XIPC_ASYNC_INPROGRESS` as long as the operation is pending completion. When the operation completes, the field is set to `XIPC_ASYNC_COMPLETED`. This is most useful for asynchronous operations started with the IGNORE option. In that case, the AsyncStatus field being set to `XIPC_ASYNC_COMPLETED` is the only direct indication given by X•IPC that the operation has completed.
- The **User Data** fields are useful for passing application information between the point where the asynchronous operation is initiated and the logic that handles its notification of completion. The information passed is application-dependent.
- The **OpCode** field is set to the appropriate `XIPC_OPCODE_APINAME` macro value that identifies the X•IPC function call associated with the ACB. Examples include `XIPC_OPCODE_SEMWAIT`, `XIPC_OPCODE_QUESEND`, etc.

The remaining elements within the ACB are a union of structures, one structure per blockable X•IPC API. The appropriate structure is set with return data from the completing asynchronous operation with which it is associated.

Definition of the ASYNCRESULT structure follows:

```
/*
 *  The ASYNCRESULT Control Block (ACB) structure is used to examine the
 *  results of an asynchronous operation.  The structure contains a union
 *  that defines returned fields for every XIPC operation that can block.
 */

/*********************************************************************
**     Macros
*********************************************************************/

#define XIPC_ASYNC_INPROGRESS     1
#define XIPC_ASYNC_COMPLETED      2

#define ACB_FIELD(AcbPtr, Function, Field)      AcbPtr->Api.Function.Field

/*********************************************************************
**     'ACB' - ASYNCRESULT Control Block ---
*********************************************************************/

struct _ASYNCRESULT /* Result of Async API call */
{
       XINT  AUid;                /* Async Uid  "receipt" */
       XINT  AsyncStatus;         /* XIPC_ASYNC_INPROGRESS or XIPC_ASYNC_COMPLETED */
       XINT  UserData1;           /* ------ user defined usage ---- */
       XINT  UserData2;           /* ------ user defined usage ---- */
       XINT  UserData3;           /* ------ user defined usage ---- */
       XINT  OpCode;              /* Async operation, key to union  */
```

```
union
{
        struct
        {
                XINT          RetSid;
                XINT          RetCode;      /* of completed async operation */
        }
        SemWait;

        struct
        {
                XINT          RetSid;
                XINT          RetCode;      /* of completed async operation */
        }
        SemAcquire;

        struct
        {
                MSGHDR MsgHdr;              /* The resultant MsgHdr */
                CHAR FAR      *MsgBuf;
                XINT          RetCode;      /* of completed async operation */
        }
        QueWrite;

        struct
        {
                MSGHDR MsgHdr;              /* The resultant MsgHdr */
                XINT          RetQid;
                XINT          RetCode;
        }
        QuePut;

        struct
        {
                MSGHDR MsgHdr;              /* The resultant MsgHdr */
                XINT          Priority;
                XINT          RetQid;
                XINT          RetCode;
        }
        QueGet;

        struct
        {
                CHAR FAR      *MsgBuf;
                XINT          RetQid;
                XINT          RetCode;
        }
        QueSend;

        struct
        {
                CHAR FAR      *MsgBuf;
                XINT          MsgLen;
                XINT          Priority;
                XINT          RetQid;
                XINT          RetCode;
        }
```

```
QueReceive;

struct
{
       /*
        * Only used for passing error info re
        * failed QueBurstSend() operation.
        /
       XINT          SeqNo;        /* of burst-send message that failed */
       XINT          TargetQid;
       XINT          Priority;
       XINT          RetQid;
       XINT          RetCode;
}
QueBurstSend;

struct
{
       /*
        * Only used for handling an asynchronous
        * QueBurstSendSync() operation.
        */
       XINT          SeqNo;        /* of last burst-send msg enqueued */
       XINT          RetCode;
}
QueBurstSendSync;

struct
{
       XINT          Mid;          /* of target */
       XINT          Offset;       /* of target */
       XINT          Length;       /* of target */
       CHAR FAR      *Buffer;
       XINT          RetCode;
}
MemWrite;

struct
{
       XINT          Mid;          /* of target */
       XINT          Offset;       /* of target */
       XINT          Length;       /* of target */
       CHAR FAR      *Buffer;
       XINT          RetCode;
}
MemRead;

struct
{
       SECTION       RetSec;
       XINT          RetCode;
}
MemSecOwn;

struct
{
```

```
                SECTION       RetSec;
                XINT          RetCode;
            }
            MemLock;

            struct
            {
                MOM_MSGID     MsgId;
                XINT          RetCode;
            }
            MomSend;

            struct
            {
                CHAR FAR      *MsgBuf;
                XINT          MsgLen;
                MOM_MSGID     MsgId;
                XINT          ReplyAppQueue;
                XINT          RetCode;
                XINT          TrackingLevel;
            }
            MomReceive;

        }
        Api;

};
```

### 6.2.3 ACB RETURN VALUES

The results of an asynchronously blocked operation are returned within the ACB of the completed operation. The one important exception to this is the treatment of what can be generalized as "text data."

When an *X•IPC* operation that specifies a text buffer as an argument blocks asynchronously and then subsequently completes, the originally specified user text buffer is used when the operation completes. So, for example, a completing QueReceive() operation receives data into the text data buffer that was specified when the QueReceive() was initially called. This is true for all of the *X•IPC* functions that manipulate "text data." They are: MomSend(), MomReceive(), QueRead(), QueWrite(), QueSend(), QueReceive(), MemWrite() and MemRead().

It is therefore a dangerous practice to pass stack space variables as text data arguments to asynchronously blocking *X•IPC* functions calls. Static or heap storage variables should be used instead.

### 6.2.4 THE CALLBACK OPTION

The `CALLBACK` option directs *X•IPC* to interrupt the calling program when the asynchronously blocked operation completes by having it execute a user-specified callback function. This form of completion notification is the most severe in terms of "rudeness" and should be used in situations where the indicated urgency is called for.

Example:

```
/*
 * Wait for any one of three event semaphores to become
 * set. A callback function will execute when the
 * operation completes.
 */

ASYNCRESULT Acb;
VOID        Funct();
XINT        RetSid;
XINT        RetCode;


RetCode = SemWait  (SEM_ANY,
                    SemList(Sid1, Sid2, Sid3, SEM_EOL),
                    &RetSid,
                    SEM_CALLBACK(Funct, &Acb)
                   );

if (RetCode == SEM_ER_ASYNC)
{
    /*
     * Operation executing asynchronously.
     */

    printf ("SemWait executing asynchronously, AUid = %d\n",
          Acb.AUid );
}
else
{
    /*
     * Error !!
     */
}
...
...


VOID
Funct (Acb)
ASYNCRESULT *Acb;
{
    printf ("SemWait completed.\n");
    printf ("RetCode = %d\n", Acb->Api.SemWait.RetCode);
    printf ("RetSid  = %d\n", Acb->Api.SemWait.RetSid);

    ...
}
```

Because it is sometimes important that an operation return *synchronously* if it can complete without blocking, you should resort to the asynchronous option *only* when the operation cannot immediately complete.

The preceding example could be modified as follows to force such behavior:

```
/*
 * Wait for any one of three events semaphores to become
 * set. Block asynchronously, if necessary. Otherwise,
 * return immediately with the operation's result.
 */


ASYNCRESULT Acb;
VOID        Funct();
XINT        RetSid;
XINT        RetCode;

RetCode = SemWait  (SEM_ANY,
                    SemList(Sid1, Sid2, Sid3, SEM_EOL),
                    &RetSid,
                    SEM_RETURN | SEM_CALLBACK(Funct, &Acb)
                   );


if (RetCode == SEM_ER_ASYNC)
{
    /*
     * Operation blocked asynchronously.
     */

    printf ("SemWait blocked asynchronously, AUid = %d\n",
          Acb.AUid );
}
else
{
    /*
     * Operation completed immediately. Process results in-line.
     */
    ...
    ...
}
...
...


VOID
Funct (Acb)
ASYNCRESULT *Acb;
{
    printf ("SemWait completed.\n");
    printf ("RetCode = %d\n", Acb->Api.SemWait.RetCode);
    printf ("RetSid  = %d\n", Acb->Api.SemWait.RetSid);

    ...
}
```

It is often convenient to have a single callback function serve multiple pending asynchronous operations. In that case, the application could utilize the various ACB User Data fields to distinguish between the pending operations as they complete. One possibility would be to assign an identifying code to each ACB, using one of the User Data fields.

### 6.2.5 THE POST OPTION

The POST option directs X•IPC to set the specified SemSys event semaphore upon completion of the specified operation. This form of completion notification is less intrusive than the CALLBACK option in that no program is directly interrupted as a result of the operation's completion.

Example:

```
/*
 * Receive message having Priority = 100.
 * Semaphore "PostSid" is to be set when the message is received.
 */


RetCode = QueReceive  (QUE_Q_ANY,
                        QueList( QUE_M_PREQ(Qid1, 100), QUE_EOL),
                        MsgBuf,
                        MsgLen,
                        &RetPrio,
                        &RetQid,
                        QUE_POST(PostSid, &Acb)
                       );

if (RetCode == QUE_ER_ASYNC)
{
    /*
     * Operation executing asynchronously.
     */

    printf ("QueReceive executing asynchronously, AUid = %d\n",
          Acb.AUid );
    ...
    ...
}
else
{
    /*
     * Error !!
     */
}
```

This example may also be modified to return *synchronously* if the operation succeeds without blocking:

```
/*
 * Receive message having Priority = 100. Block
 * asynchronously if necessary.  Otherwise, operation
 * results are returned immediately.
 */

RetCode = QueReceive  (QUE_Q_ANY,
                        QueList( QUE_M_PREQ(Qid1, 100), QUE_EOL),
                        MsgBuf,
                        MsgLen,
                        &RetPrio,
                        &RetQid,
                        QUE_RETURN | QUE_POST(PostSid, &Acb)
                       );
if (RetCode == QUE_ER_ASYNC)
{
    /*
     * Operation blocked asynchronously.
     */

    printf ("QueReceive blocked asynchronously, AUid = %d\n",
          Acb.AUid );
}
else
{
    /*
     * Operation completed immediately.  Process results in-line.
     */
    ...
    ...
}
```

Reacting to a completed asynchronous operation that specified the `POST` option can be handled by the original calling program at some later point in its logic when it is convenient for it to issue a SemWait call regarding the post semaphore, or possibly by a second program waiting for the post semaphore to become set.

In fact, the wait for the post semaphore can be asynchronous as well. It is plain to see how a domino-effect can very easily be created between processes.

## 6.2.6 THE IGNORE OPTION

The `IGNORE` option directs *X•IPC* to complete the subject operation silently, if it blocks asynchronously. This form of notification is the most passive of the asynchronous options in that no explicit notice of the operation's completion is given by *X•IPC*. The ACB's *AsyncStatus* field is set to `XIPC_ASYNC_COMPLETED` when the operation it represents completes. The field may be examined periodically to determine when this has occurred.

Consider the following example: If segment Mid is locked at the time of the MemWrite() calls, then the two operations will remain pending asynchronously until the segment is unlocked and the MemWrite() operations are permitted to complete. No explicit notice is given by *X•IPC* when the operations complete. The two ACB's can be examined later to confirm completion.

Example:

```
/*
 * Write two records to a shared memory table.
 * The operations complete silently in the background.
 */

XINT      Mid, Offset1, Offset2;
XINT      Size1, Size2, RetCode;
ASYNCRESULT   Acb1, Acb2;


RetCode = MemWrite (Mid, Offset1, Size1, MEM_IGNORE(&Acb1) );

if (RetCode != MEM_ER_ASYNC)
    /*
     * Error !!
     */
...
...


RetCode = MemWrite (Mid, Offset2, Size2, MEM_IGNORE(&Acb2) );

if (RetCode != MEM_ER_ASYNC)
    /*
     * Error !!
     */

...
...
```

Here again the MemWrite function calls could have been coded to return synchronously, if they complete without blocking, by specifying the `MEM_RETURN` flag logically ORed to the left of the `MEM_IGNORE` option.

Example:

```
RetCode = MemWrite(..., MEM_RETURN | MEM_IGNORE(...));
```

## 6.2.7 ABORTING A PENDING ASYNCHRONOUS OPERATION

It is occasionally necessary for a program to abort a pending asynchronous operation before it completes. The functions MomAbortAsync(), QueAbortAsync(), SemAbortAsync() and MemAbortAsync() can be used to cancel blocked asynchronous operations in their respective subsystems.

The functions take one argument:

- The AUid of the asynchronous operation to abort.

Example:

```
if  (SemWait (SEM_ANY,
              SidList,
              &RetSid,
              SEM_IGNORE(&Acb)) == SEM_ER_ASYNC)
{
    /*
     * Do other work ...
     */

    ...
    ...

    /*
     * If operation is still pending, then
     * abort it.
     */

    if (Acb.AsyncStatus == XIPC_ASYNC_INPROGRESS)
        SemAbortAsync(Acb.AUid);
}
```

## 6.2.8 MIXING ASYNCHRONOUS AND SYNCHRONOUS OPERATIONS

The current version of *X•IPC* employs an interrupt mechanism for implementing asynchronous functionality on most of its supported platforms. Exceptions include MS-Windows 3.x, Windows NT and X-Windows. This means that a process that issues an *X•IPC* asynchronous operation must be prepared to be *silently* interrupted by *X•IPC* when the operation completes. At that time, *X•IPC* internally reacts to the operation's completion.

This is an important consideration if the process can block synchronously at points within its logic. Calls to such synchronous operations should be coded so that they are restarted if interrupted.

The interrupt mechanisms employed are platform-specific. Information about each mechanism can be found within the relevant Platform Notes.

## 6.2.9 CONCLUSION

Using *X•IPC*'s asynchronous blocking options it is possible to have a single program initiate multiple parallel *X•IPC* operations and to react to them individually as they complete. When used in conjunction with *X•IPC*'s asynchronous trigger mechanism it becomes possible to build elaborate event-driven network applications of immense capability–and to do so with relative ease.

## 6.3 Network Timeout Detection

### 6.3.1 DESCRIPTION

X•IPC 's Network Timeout Detection feature makes network clients aware that a server is not responding (e.g., someone "powers off" the server machine). For this feature to work, the **`xipciad`** ***daemon must be running on the server platform***.

The following parameters are used by the X•IPC Network Timeout Detection Mechanism:

| | |
|---|---|
| **`RECVTIMEOUT`** | This value determines the network receive timeout.<br>There is no default value for this parameter. |
| **`PINGTIMEOUT`** | This value determines the network ping timeout.<br>The default value for this parameter is 0 milliseconds. |
| **`PINGRETRIES`** | This value determines the network ping retry number.<br>The default value for this parameter is 3. |
| **`PINGFUNCTION`** | This value identifies the ping function used to find out the remote host status. By default, `PINGFUNCTION` is a pointer to an internal X•IPC function. The user has the option of writing his own ping routine that can be installed as the ping function, as described in the description of the XipcSetOpt() function in the X•IPC Reference Manual. In this case, a pointer to a string containing the IP address of the remote connection, in the base-256 notation "d.d.d.d", is passed as an argument to the routine. |

### 6.3.2 CHANGING DEFAULT BEHAVIOR

By default, the X•IPC Network Timeout Detection Mechanism is not active. If an application wants to activate this feature, it should set both the `PINGTIMEOUT` and `RECVTIMEOUT` parameters to non-zero values by using the XipcSetOpt()function (discussed in the X•IPC Reference Manual). To deactivate the Network Timeout Detection Mechanism, set the `RECVTIMEOUT` value to zero.
The X•IPC user has the option of changing the network timeout detection parameter values to his needs either before or after a login (with two exceptions, as noted in the Reference Manual). If the parameters are modified *before* login, then it will affect all the corresponding logins for that specific thread. If the parameters are changed *after* login then only that particular login will be affected by this change.

Please refer to the XipcGetOpt(), XipcSetOpt() and XipcPing() function descriptions in the X•IPC Reference Manual for further information.

## 6.4 Working With X♦IPC Instances

Central to any application built using X♦IPC is the role of X♦IPC instances. This section describes the issues related to working with X♦IPC instances, as they relate primarily to the QueSys, SemSys and MemSys subsystems. Refer to the MomSys User Guide for detailed discussion of MomSys' utilization of X♦IPC instances.

### 6.4.1 X♦IPC INSTANCES: THE APPLICATION PERSPECTIVE

The role of instances in an X♦IPC-based application can be understood from an *application* perspective and from a *process* perspective, as described in the following sections. At a high level, X♦IPC instances are building blocks for defining an application's IPC environment. This environment can be monolithic or it may be divided into a number of parts. Strictly speaking, an application built using X♦IPC is comprised of one or more X♦IPC instances.

#### 6.4.1.1 Single-Instance Applications

In many situations the level of abstraction provided by one X♦IPC instance is sufficient for an application's IPC requirements. In such situations there is a one-to-one relationship between application and instance. Such an application is a *single-instance application*. The following diagram schematically presents an example of a single-instance application.

Of course, there is no restriction on the number of single-instance applications that can coexist on a single node or on a network, nor is there any restriction as to the type of instance (stand-alone or network) used in such applications.

Single-instance applications are the most basic way of using X♦IPC to provide segregated IPC environments. Multiple applications sharing a machine or a network are automatically insulated from one another at the IPC level.

As an example, consider the following diagram depicting an environment in which three independent single-instance applications are active. The environment may be a single node or a multi-node network.

### 6.4.1.2 Multi-Instance Applications

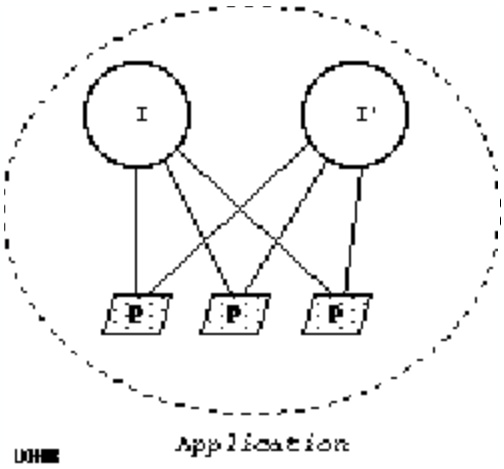
There are situations, particularly when larger applications are involved, when it is desirable to split an application's IPC environment along certain physical or logical seams within the application. Such applications are *multi-instance applications.*

Building an application using multiple instances allows the application architect to strategically position the IPC components of the application where they *fit* best. Working with multiple instances further encourages the logical division of the application's IPC resources according to the application's varying internal IPC constraints.

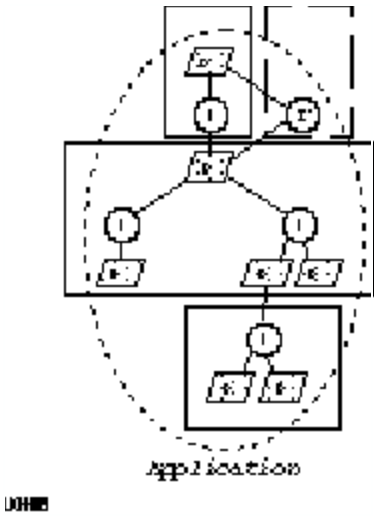
The multi-instance application model broadens the class of applications requirements that can be met using X•IPC. A large application having a hierarchical structure of processes can have its IPC environment constructed along similar hierarchical lines.

The actual physical positioning of the application's IPC components can then be determined in a manner that addresses the application's topological characteristics The following diagram offers two alternatives for positioning the previous application's processes and X•IPC instances. Either selection would have no effect on the X•IPC portion of the application.

Application architects may further employ the multi-instance application model to incorporate varying degrees of redundancy within their application's IPC environment. Critical elements of the IPC environment may be duplicated by using multiple instances in a primary (I) and backup (I') role. By duplicating its IPC activity, the application can be designed to recover if an outage occurs on the primary instance platform.




This form of redundancy can be isolated to only the most critical portions of the application's IPC environment, thus limiting the costs of such a capability to where it is truly necessary. Consider the following example. The topmost instance is duplicated on a second node because of its critical role within the overall application. The application may thus be engineered to recover from a failure within the primary instance.




## 6.4.2 X•IPC INSTANCES: THE PROCESS PERSPECTIVE

The flip side of the X•IPC instance paradigm is an understanding of how a process interacts with an application's X•IPC environment, specifically, the application's X•IPC instance(s).

### 6.4.2.1 Logging Into An Instance

Before a process can engage in an instance's IPC activity, it must first log into that instance. This is accomplished by the process issuing an XipcLogin() function call to the target instance. The XipcLogin() operation establishes a login session between the process and the instance. A User Id (Uid) integer returned by XipcLogin() uniquely identifies the process's new session with the instance.

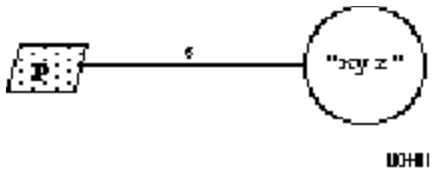
In fact, a process may log into an instance more than once, with each XipcLogin() operation establishing an independent logical session having a unique Uid within the instance. Examples of this appear later in this section.

A login session between a process and an instance may be expressed schematically as:

or algebraically as:

$$login = (I, Uid)$$

Thus, for example, when a process successfully logs into instance "xyz" and is assigned a Uid of 5 within the instance, this can be expressed as:




$$login = ("xyz", 5)$$

Processes that are part of a single-instance application will generally establish one login session with that application's one instance.

### 6.4.2.2 A Process's Working Set of Logins

Basic utilization of the X•IPC toolset typically involves processes that log in to a single X•IPC instance. This, in fact, is a limited usage of a much broader capability.

As indicated above, a process may establish multiple login sessions with a single instance or, for that matter, with multiple instances. Such is usually the situation regarding processes in a multi-instance application. Processes there will typically log into more than one of the application's instances.

A process having multiple logins into one or more instances can be expressed schematically as:

Algebraically, such a process is said to have a *working set of logins*, connoted as:

$$L = \{ login1, login2, login3 \}$$

$$L = \{ (I1, Uid1), (I2, Uid2), (I3, Uid3) \}$$

As an example, when a process successfully logs into three instances–"xyz," "abc" and "qrs"–with 10, 20 and 30 being the respective login Uid's, the situation may be expressed as:

$$L = \{ ("xyz", 10), ("abc", 20), ("qrs", 30) \}$$

The earlier case of a process logging into a single instance had a working set of logins containing a single element:

$$L = \{ ("xyz", 5) \}$$

The above notation is extremely useful for describing relationships between user processes and X•IPC instances.

### 6.4.2.3 Some Examples

The following examples essentially cover the gamut of possible cases:

- *Not Logged In Anywhere*

  A process that is not logged into any instance, such as when it first starts executing, is defined as having a working set of logins that is empty:

  $$L = \{ \}$$

- *Multiple Logins/Multiple Instances*

  An example of a process that has logged into multiple instances one or more times is:

  $$L = \{ (\text{"xyz"}, 2), (\text{"xyz"}, 3), (\text{"xyz"}, 10), (\text{"abc"}, 20), (\text{"qrs"}, 30) \}$$

- *Single Login/Instance*

  A process that logs into mu ltiple instances, one login per instance:

*L = { ("xyz", 2), ("abc", 5), ("qrs", 2) }*

- *Multiple Logins/Single Instance*

  A process that establishes multiple login sessions with a single instance:

*L = { ("xyz", 2), ("xyz", 5), ("xyz", 4) }*

This form of utilization is usually associated with a server process that is required to multiplex between multiple independent login sessions within a single instance.

### 6.4.2.4 A Process's Current Login

A process that has established multiple login sessions is actually connected to at most one of the logins at any point in time. That login session is referred to as the process's *Current Login*. X•IPC function calls that access and/or manipulate X•IPC objects do so using the context of the calling process's current login (i.e., its instance and Uid). As such, a process's current login defines, for that process, the instance being dealt with and the Uid being used within that instance, when X•IPC function calls are issued. It is thus generally an error for a process to execute an X•IPC function call while its current login is not defined. This is elaborated on below.

Consider the following example. Process P has established login sessions with two X•IPC instances. Two login sessions (Uids 3 and 14) are with instance "xyz." A third is with instance "abc." The process's current login is highlighted.

$$L = \{ (\text{"xyz"}, 3), \mathbf{(\text{"xyz"}, 14)}, (\text{"abc"}, 5) \}$$

$$current\_login = (\text{"xyz"}, 14)$$

A process can control which login (from its working set of logins) is its current login by means of calls to the XipcLogin(), XipcLogout(), XipcConnect() and XipcDisconnect() functions. This is now demonstrated.

### 6.4.2.5 Modifying a Process's Working Set of Logins, Current Login

As was mentioned earlier, a process's working set of logins is initially empty:

$$L = \{ \}$$

In addition, the process's current login is initially undefined:

$$current\_login = ?$$

The means for adding and deleting logins from the working set and for setting the current login is by calls to XipcLogin(), XipcLogout(), XipcConnect () and XipcDisconnect(). The best vehicle for describing how these functions are employed for such activity is to present an example.

Example:

```
/*
 * The following example demonstrates how calls to XipcLogin(), XipcLogout(),
 * XipcConnect()  and  XipcDisconnect()  affect  the calling process's
 * working set of logins and its current login. The comments along
 * the side provide a running trace of the changing contents of the
 * working set of logins. The login from the working set that is the current
 * login (if one is defined) is highlighted. If no login is highlighted,
 * then the process's current login is undefined.
 */

VOID
 main()

{

    CHAR    *I1 = "@abc";
    CHAR    *I2 = "@xyz";
    CHAR    *I3 = "@qrs";
    CHAR    *Name = "Example";
    XINT    Uid1, Uid2, Uid3;

                                    /* {Working Set Logins: initially empty} */

    Uid1 = XipcLogin (I1, Name); /* { (I1, Uid1) } */
    XipcDisconnect ();              /* { (I1, Uid1) } */

    Uid2 = XipcLogin (I2, Name); /* { (I1, Uid1), (I2, Uid2) } */
    XipcDisconnect ();              /* { (I1, Uid1), (I2, Uid2) } */

    Uid3 = XipcLogin (I3, Name); /* { (I1, Uid1), (I2, Uid2), (I3, Uid3) } */
    XipcDisconnect ();              /* { (I1, Uid1), (I2, Uid2), (I3, Uid3) } */

    XipcConnect (I1, Uid1);         /* { (I1, Uid1), (I2, Uid2), (I3, Uid3) } */

    XipcLogout ();                  /* { (I2, Uid2), (I3, Uid3) } */

}
```

The above example demonstrates a number of points:

- A process's working set of logins is initially empty.
- A process's current login is initially undefined.
- XipcLogin() adds a login to the calling process's working set of logins and sets the process's current login to that login.
- XipcDisconnect() resets the calling process's current login, leaving it undefined.
- XipcConnect() sets the calling process's current login to the specified login.
- XipcLogout() deletes the calling process's current login from its working set of logins. It also resets the process's current login, leaving it undefined.

Functional descriptions follow for the XipcConnect() and XipcDisconnect() function calls as well as supplementary descriptions of XipcLogin() and XipcLogout(), describing how they affect a process's working set of logins and current login.

### 6.4.2.5.1 XIPCCONNECT() - Connect to a Login Session

The XipcConnect() function call sets the calling process's current login to the login session specified by the function's arguments. It is an error to call XipcConnect() when the process's current login is defined. In such a situation the process's current login must first be reset either by a call to XipcDisconnect() or by a call to XipcLogout(). These functions are described below.

XipcConnect() takes the following arguments:

- The instance name of the targeted login.
- The Uid of the targeted login.

The two arguments passed to XipcConnect() uniquely identify the login to connect to. Recall that an *X•IPC* login session is connoted as the pair (*Instance*, *Uid*). The specified login must be a member of the calling process's working set of logins.

Example:

```
Uid = XipcLogin ("@xyz", "AnyUser");
XipcDisconnect();
     ...
     ...
XipcConnect ("@xyz", Uid);
```

### 6.4.2.5.2 XIPCDISCONNECT() - Disconnect from the Current Login Session

The XipcDisconnect() function call resets the calling process's current login, leaving it undefined. It is an error to call XipcDisconnect() when the process's current login is not defined.

It is generally an error to issue an *X•IPC* function call when a process's current login is undefined. The exceptions to this rule are:

- XipcConnect() - to set the current login to an existing login session
- XipcLogin() - to establish a new login session, setting the current login to the new login
- XipcStart() - to start an *X•IPC* instance
- XipcStop() - to stop an *X•IPC* instance
- XipcInfoLogin() - to query information about the process's working set of logins. This function is described below.

XipcDisconnect() takes no arguments.

Example:

```
Uid = XipcLogin ("@abc", "AnyUser");
XipcDisconnect();
```

#### 6.4.2.5.3 XIPCLOGIN() - Effect on Working Set of Logins, Current Login

The XipcLogin() function call is the basic entry point for working with an *X•IPC* instance. A successful call to XipcLogin() adds the newly established login session to the calling process's working set of logins. It additionally sets the process's current login to the new login session.

It is an error to issue an XipcLogin() call while the calling process's current login is defined.

Example:

```
/*
 * INCORRECT ...
 */

Uid1 = XipcLogin ("@qrs", "AnyUser");
Uid2 = XipcLogin ("@xyz", "AnyUser");
/*
 * CORRECT ...
 */

Uid1 = XipcLogin ("@qrs", "AnyUser");
XipcDisconnect();
Uid2 = XipcLogin ("@xyz", "AnyUser");
```

#### 6.4.2.5.4 XIPCLOGOUT () - Effect on Working Set of Logins, Current Login

The XipcLogout() function call is the basic exit point from working with an *X•IPC* instance. A successful call to XipcLogout() deletes the current login session from the calling process's working set of logins. It also resets the process's current login, leaving it undefined.

The rule against issuing *X•IPC* function calls while a process's current login is undefined (as stipulated regarding XipcDisconnect()) applies here as well.

### *6.4.2.6 Programming Within a Multi-Instance Environment*

An important tool for coding programs that are to operate within multiple instance environments is the XipcInfoLogin () function call. Using the XipcInfoLogin() function in conjunction with the other login-related functions (XipcLogin(), XipcLogout(), XipcConnect() and XipcDisconnect()), it is possible to build high levels of *X•IPC* object transparency. This is shown in the following sections.

#### 6.4.2.6.1 XIPCINFOLOGIN() - Access Information About the Working Set of Logins

The XipcInfoLogin() function call returns information about the calling process's working set of logins. Using this function it is possible to access information about one or more of the logins currently in the calling process's working set of logins.

In its most basic form, this function takes three arguments that allow for a wide range of flexibility in specifying the subset of logins about which information should be returned. There are, however, a number of convenient macro definitions that may be specified as arguments to the function for querying common XipcInfoLogin() operations.

The basic interface to the XipcInfoLogin() function is presented below, followed by the more important interface which uses predefined macros as arguments.

XipcInfoLogin(), when used in its basic form, takes the following arguments:

- A pointer to a user-declared structure (or perhaps to the first element of an array of structures) of type XIPCINFOLOGIN, in which the requested login information is returned. This data type is described below. If this argument is `NULL`, then the function returns the number of elements currently in the working set of logins.

- The number of entries in the specified array.

- A pointer to a cursor variable used by *X•IPC* when using XipcInfoLogin() to enumerate the elements within the working set of logins. If the cursor pointer variable is `NULL`, information about the calling process's current login is returned.

XipcInfoLogin() generally returns as its value the number of login information structures filled and returned by the function call. XipcInfoLogin() returns a zero when no login information is returned.

A high-level interface to the XipcInfoLogin() function is provided by means of predefined macros that may be used as arguments to the function:

- The `XIPC_LOGIN_CURRENT` macro may be used to access information about the calling process's current login.

  Example:

  ```
  XIPCINFOLOGIN InfoLogin;

  XipcInfoLogin (&InfoLogin, XIPC_LOGIN_CURRENT);
  ```

  When called using the `XIPC_LOGIN_CURRENT` macro, the function returns information about the calling process's current login within the XIPCINFOLOGIN structure.

- The `XIPC_LOGIN_COUNT` macro may be used for accessing the size of the calling process's working set of logins.

  Example:

  ```
  XINT SetSize;

  SetSize = XipcInfoLogin (XIPC_LOGIN_COUNT);
  ```

- The XIPC_LOGIN_INIT_ENUMERATION and XIPC_LOGIN_NEXT macros may be used for enumerating the logins currently in the calling process's working set of logins.

  Example:

```
XIPCINFOLOGIN InfoLogin;
XINT c;

c = XIPC_LOGIN_INIT_ENUMERATION;
while ( XipcInfoLogin(&InfoLogin, XIPC_LOGIN_NEXT(c)) )
{
    /* Process InfoLogin */
}
```

### 6.4.2.6.2 THE XIPCINFOLOGIN DATA TYPE

An XIPCINFOLOGIN structure, when used in conjunction with the XipcInfoLogin() function call, is returned with login information about one of the logins in the calling process's working set of logins.

The XIPCINFOLOGIN data type definition includes the following:

```
typedef struct _XIPCINFOLOGIN        /* Login Information */
{
    ...

    CHAR    *InstanceName;           /* Pointer to Instance Name */
    XINT    UserId;                  /* User Id within instance  */
}
XIPCINFOLOGIN;
```

where:

- InstanceName - is a character pointer that is set by XipcInfoLogin(), pointing to an internal (user space) string containing the instance name of the login session, and

- UserId - is the login session's Uid within the instance.

Working with XipcLogin(), XipcLogout(), XipcConnect(), XipcDisconnect() and XipcInfoLogin(), it is possible to build a layer of *X•IPC* object transparency for working in a multi-instance programming environment.

Consider the situation in which a program is to send messages onto various queues within a multi-instance application, where the queues are specified by their names. The queues may in fact be defined on any of the application's instances, but this is to be hidden from the main program. The following example outlines one method of addressing this problem.

[Note that, for the sake of concept clarity, error checking is not included as part of the coding example.]

Example:

```
/*
 * The following sample program demonstrates a mechanism for performing
 * queue dispatch operations within a multi-instance XIPC environment.
 * The application's XIPC environment involves three instances: "abc",
 * "xyz" and "qrs". The application accesses two message queues named
 * "EMailQueue" and "DataBaseQueue". The application is not required to
 * know in which instance each queue is.
 */

VOID
main()

{

    CHAR    *I1 = "@abc";
    CHAR    *I2 = "@xyz";
    CHAR    *I3 = "@qrs";
    CHAR    *Name = "Example";
    XINT    Uid1, Uid2, Uid3;


    Uid1 = XipcLogin (I1, Name);
    XipcDisconnect ();

    Uid2 = XipcLogin (I2, Name);
    XipcDisconnect ();

    Uid3 = XipcLogin (I3, Name);
    XipcDisconnect ();

    SendMsg ("EMailQueue",   "This is an EMail message",   100);
    SendMsg ("DataBaseQueue", "This is a database message", 200);

    XipcConnect (I1, Uid1);
    XipcLogout ();

    XipcConnect (I2, Uid2);
    XipcLogout ();

    XipcConnect (I3, Uid3);
    XipcLogout ();
}
```

```
XINT
SendMsg (QueueName, Message, Priority)
CHAR *QueueName;
CHAR *Message;
XINT Priority;

{
    /*
     * This function calls FindQueue() to connect to the login session
     * whose instance contains the targeted queue. It then sends the
     * message. It finally disconnects the process from the login.
     */

    XINT    Qid;
    XINT    RetQid;

    Qid = FindQueue (QueueName);

    QueSend (QUE_ANY, QueList(Qid, QUE_EOL), Message, strlen(Message)+1,
            Priority, &RetQid, QUE_WAIT );

    XipcDisconnect();
}


XINT
FindQueue (QueueName)
CHAR *QueueName;

{
    /*
     * This function traverses the logins in the calling process's
     * working set of logins, searching each login session to see whether
     * its instance has an XIPC message queue of the specified name. If it
     * finds such a queue, the process remains connected to that login and
     * returns the Qid found. Otherwise, it returns -1, indicating that no
     * such queue was found.
     */

    XIPCINFOLOGIN   InfoLogin;
    XINT        c;
    XINT        Qid;

    c = XIPC_LOGIN_INIT_ENUMERATION;

    while (XipcInfoLogin(&InfoLogin, XIPC_LOGIN_NEXT(c)))
    {
        XipcConnect(InfoLogin.Instance, InfoLogin.Uid);
        if ( (Qid = QueAccess(QueueName)) >= 0 )
            return(Qid);
        XipcDisconnect();
    }

    return (-1);
}
```

This approach can be employed to provide transparent multi-instance access to X•IPC semaphores and shared-memory segments as well. Enhancements can be added to optimize for situations where repeated accesses are to occur, such as building a table of accessed objects within the FindQueue() function. One approach is included as part of an example that is presented later in this section.

### 6.4.2.7 Asynchronous Operations in a Multi-Instance Environment

Ongoing X•IPC asynchronous activity related to a particular process is *not* affected by the current login setting of that process.

Specifically, a process working within a multi-instance environment may initiate numerous asynchronous operations within these instances and, when the operations complete, the process will be notified of each completion in the manner that was specified when the operation was started (i.e., callback function, post semaphore or ignore), regardless of the process's current login at the time the operation completes.

This can be described by means of the following diagram. Process P is currently logged into three instances "xyz", "abc" and "qrs" (twice to "xyz"). The process has initiated a number of asynchronous X•IPC operations in the course of its work within the three instances. Perhaps it is waiting asynchronously for certain events to occur, or for certain messages to arrive within those instances. It is currently connected to login ("qrs", 3). Otherwise stated, the login ("qrs", 3) is the process's current login.

The process will be notified of each asynchronous operation completion as it occurs within any of the three instances, regardless of the fact that the process is currently connected to a login session within instance "qrs." In fact, it would work as well if the process had not been connected to any of its login sessions at the time that the asynchronous operation(s) completed.

Essentially, notification of asynchronous X•IPC events is passed to a process regardless of the process's current login status.

As an example of this concept, consider a modified version of the previous example where the process now issues asynchronous QueReceive() operations using queues that are defined within the multi-instance environment.

Example:

```
/*
 * The following sample program demonstrates a mechanism for performing
```

```
 * asynchronous queue retrieval operations in a multi-instance environment.
 */

VOID
main()

{

    CHAR        *I1 = "@abc";
    CHAR        *I2 = "@xyz";
    CHAR        *I3 = "@qrs";
    CHAR        *Name = "Example";
    XINT        Uid1, Uid2, Uid3;
    CHAR        DataBaseMsgBuf[100];
    CHAR        EMailMsgBuf[100];
    ASYNCRESULT EMailAcb;
    ASYNCRESULT DataBaseAcb;


    /*
     * Establish logins into the application's XIPC instances.
     */

    Uid1 = XipcLogin (I1, Name);
    XipcDisconnect ();

    Uid2 = XipcLogin (I2, Name);
    XipcDisconnect ();

    Uid3 = XipcLogin (I3, Name);
    XipcDisconnect ();

    /*
     * Issue two asynchronous requests: one for any incoming EMail messages,
     * and one also for incoming DataBase transactions. Both operations are to
     * run asynchronously so that the process can do other work while the
     * requests are pending.
     */

    RecvMsgAsync ("EMailQueue", EMailMsgBuf, 100, EMailCallBack, &EMailAcb);

    RecvMsgAsync ("DataBaseQueue", DataBaseMsgBuf, 100, DataBaseCallBack,
                  &DataBaseAcb);
    /*
     * Do other work while operations are
     * completing asynchronously ...
     */
    ...
    ...

    XipcConnect (I1, Uid1);
    XipcLogout ();

    XipcConnect (I2, Uid2);
    XipcLogout ();
```

```
    XipcConnect (I3, Uid3);
    XipcLogout ();

}


XINT
RecvMsgAsync (QueueName, MsgBuf, MsgBufSize, CallBack, Acb)
CHAR *QueueName;
CHAR *MsgBuf;
XINT MsgBufSize;
VOID (*CallBack)();
ASYNCRESULT *Acb;

{
    /*
     * This function calls FindQueue() to connect to the login session
     * whose instance contains the desired queue. It then issues the receive
     * operation. It then disconnects the process from the login.
     */

    XINT    Qid;
    XINT    RetQid;
    XINT    Priority;

    Qid = FindQueue (QueueName);

    QueReceive (QUE_EA,
                QueList(Qid, QUE_EOL),
                MsgBuf,
                MsgBufSize,
                &Priority,
                &RetQid,
                QUE_CALLBACK(CallBack, Acb));

    XipcDisconnect();

}
```

```
XINT
FindQueue (QueueName)
CHAR *QueueName;

{
    /*
     * This function traverses the logins in the calling process's
     * working set of logins, searching each login session to see
     * whether its instance has an XIPC message queue of the specified
     * name. If it finds such a queue, the process remains connected to that
     * login and returns the Qid found. Otherwise, it returns -1, indicating
     * that no such queue was found.
     */


    XIPCINFOLOGIN   InfoLogin;
    XINT            c;
    XINT            Qid;

    c = XIPC_LOGIN_INIT_ENUMERATION;

    while (XipcInfoLogin(&InfoLogin, XIPC_LOGIN_NEXT(c)))
    {
        XipcConnect(InfoLogin.Instance, InfoLogin.Uid);
        if ( (Qid = QueAccess(QueueName)) >= 0 )
            return(Qid);
        XipcDisconnect();
    }

    return (-1);
}


VOID
EMailCallBack (Acb)
ASYNCRESULT *Acb;

{
    /*
     * Process EMail message that has arrived asynchronously ...
     */
}


VOID
DataBaseCallBack (Acb)
ASYNCRESULT *Acb;

{
    /*
     * Process DataBase message that has arrived asynchronously ...
     */
}
```

## 6.5 Starting and Stopping Instances Under Program Control

### *6.5.1 XipcStart() - STARTING AN INSTANCE*

The XipcStart() function call is used for starting an *X•IPC* instance**Error! Reference source not found.** from within a program. This form of instance control is needed for situations in which using the `xipcstart` command is not appropriate.

The XipcStart() function call takes the following arguments:

- The Instance File Name of the instance to be started. Recall that the Instance File Name identifies the configuration file (excluding the "`.cfg`" extension) to be used when starting the instance.

- The Instance Name (Local or Network) to be assigned to the instance. In the case that the instance is being used in a stand-alone environment, this parameter must be set to `NULL`. If `NULL`, the name will be taken from the parameter specified in the `[XIPC]` section of the Instance Configuration File If no naming parameters are specified within the `.cfg` file either, then the instance is started as a Stand-Along instance having no registered name. Such an instance is only accessible via its Instance File Name. (See the *X•IPC* Reference Manual for further information.)

- An Options parameter to indicate reporting, testing, initializing and other options.

Example:

```
/*
 * Start an instance that is based on the
 * "/projects/tpsys.cfg" configuration file.
 * Assign it the network name: "TPSYS".
 * The startup report is generated on 'stdout'.
 */

 XipcStart ("/projects/tpsys", "TPSYS",
XIPC_START_REPORT|XIPC_START_NETWORK);
```

Example:

```
/*
 * Start the same instance as in the previous example,
 * but this time as a stand-alone instance. Also, suppress
 * the startup report.
 */

 XipcStart ("/projects/tpsys", NULL, 0);
```

XipcStart() creates the IPC environment as described within its Instance Configuration File. As such, it must be called before any program can log into the instance and use its IPC environment.

The XipcStart() function will only succeed when called as part of an *X•IPC* /Stand-Alone program to start a local instance. It will otherwise return `XIPC_ER_NOTLOCAL`.

## 6.5.2 XipcStop() - STOPPING AN INSTANCE

The XipcStop() function call is used for stopping an X•IPC instance from within a program. This form of instance control is needed in situations where using the `xipcstop` command is not appropriate.

The XipcStop() function call takes the following arguments:

- The Instance File Name of the instance to be stopped. The Instance File Name identifies the configuration file (excluding the "`.cfg`" extension) that was used when starting the instance.
- An Options parameter to indicate whether a report that lists stopped subsystems should be written to standard output; whether an instance should be "force" stopped; or neither.

Example:

```
/*
 * Stop the instance started above.
 */

 XipcStop ("/projects/tpsys", XIPC_STOP_REPORT);
```

The XipcStop() function will only succeed when called as part of an X•IPC /Stand-Alone or X•IPC /Local program to stop a local instance. It will otherwise return `XIPC_ER_NOTLOCAL`.

## 6.6 Using X•IPC Libraries

### 6.6.1 INTRODUCTION

The X•IPC toolset includes a number of libraries for building applications using the X•IPC API. Technical instructions for using these libraries are generally platform-specific in nature and are therefore included as part of the Platform Notes for each of the platforms supported by X•IPC.

This section presents a high-level discussion of the issues relating to the usage of the different X•IPC API libraries, focusing on the advantages and disadvantages of using each of the libraries in various application settings. The term *library*, as used in this section, is applied in its generic sense. Some of the platforms that support the X•IPC toolset refer to collections of object modules using different terminology. For the sake of simplicity, this section will use the term *library*.

The X•IPC API library can be used in three modes, each of which addresses a specific application class. The three modes are generally referred to as:

- The X•IPC Stand-Alone Library
- The X•IPC Network Library
- The X•IPC Combined Library

The determining factor in deciding which library to use for linking a program is the program's intended proximity relative to the X•IPC instance(s) that it will be working with. Examples of different scenarios that cover the range of possible situations are presented below.

### 6.6.2 THE X•IPC STAND-ALONE LIBRARY

Consider the following situation:

In the above scenario, X•IPC instances I1 and I2 have been started on a stand-alonecomputer platform. Programs P1, P2 and P3 are to log into the instance(s) to access and manipulate their IPC objects. Specifically, P1, P2 and P3 are to log into I1. P3 is also to log into instance I2. A common aspect of these programs is that they are all accessing X•IPC instance(s) that are local to them. Because of this locality, the programs can be linked using the X•IPC Stand-Alone Library. Such programs are said to belong to the class of X•IPC Stand-Alone programs.

Using the X•IPC Stand-Alone Library guarantees that the process–instance interaction is performed directly, without any network activity.

Programs that will *always* run on the same platform as the X•IPC instance(s) they work with may be linked with the X•IPC Stand-Alone Library. As shown below, such programs may also be linked with the X•IPC Combined Library.

To summarize, the advantage of using the X•IPC Stand-Alone Library is that:

- ☐ The executables that are produced make no reference to any networking capabilities and can therefore be linked and run on platforms on which there is no network installed.

The disadvantage of using the X•IPC Stand-Alone Library is that:

- ☐ The resulting executables can only interact with local instances.

### 6.6.3 THE X•IPC NETWORK LIBRARY

Programs that are intended to interact with remote X•IPC instances *exclusively* may be linked using the X•IPC Network Library. Such programs are said to belong to the class of X•IPC Network programs.

Consider the following situation:

Programs P1, P2 and P3 (on nodes N1 and N2) are intended to access X•IPC instances I1 and I2, where the instances are started on remote platforms (nodes N3 and N4). In such a situation, the programs may be linked with the X•IPC Network Library. As shown below, these programs may also be linked using the X•IPC Combined Library.

The advantage of using the X•IPC Network Library is that:

- It produces a smaller executable than those produced by either the X•IPC Stand-Alone Library or the X•IPC Combined Library.

The disadvantage of using the X•IPC Network Library is that:

- The resulting executables can only interact with remote X•IPC instances.

### 6.6.4 THE X•IPC COMBINED LIBRARY

Maximum flexibility is achieved using the X•IPC Combined Library. Programs that are intended to interact with local and/or remote X•IPC instances should be linked using the X•IPC Combined Library. Such programs are said to belong to the class of X•IPC Combined programs.

Consider the following situation:

Program P1 is linked with the X•IPC Combined Library. It can therefore interact with either or both of instances I1 and I2, even though I1 is local and I2 is remote. In addition, the interaction between P1 and I1 is carried out in a manner as direct as if the program were linked using the X•IPC Stand-Alone Library (i.e., avoiding the network environment entirely).

The same P1 executable would work *without relinking* (assuming N1 and N2 are homogeneous platforms) in the following three situations:

The advantage of using the X•IPC Combined Library is that:

- The produced executables can interact with local and/or remote instances. This flexibility allows for simplified application run-time configuration. The positioning of an application's processes can be determined at run-time, regardless of the location of the application's X•IPC instance(s). This flexibility is visible in the above diagram.

The disadvantages of using the X•IPC Combined Library are that:

- Linking and running programs that use the X•IPC Combined Library generally require the availability of a networking environment on the platform. This makes it all but impossible to use the X•IPC Combined Library on platforms that have no network capabilities, where X•IPC is being used for its intra-nodal IPC capabilities.

- Executables that are produced using the X•IPC Combined Library are larger than those produced using the Stand-Alone or Network libraries.

### 6.6.5 CONCLUSION

The three types of X•IPC API Library provide a wide range of flexibility for using the X•IPC toolset under different application settings.

In most situations, linking with the X•IPC Combined Library is a safe choice–unless there is no network available whatsoever, in which case the X•IPC Stand-Alone Library is required. As an application evolves, its individual programs can subsequently be linked using either of the other X•IPC libraries to benefit from their advantages, where possible.

## 6.7 Trap Handling

Applications using X•IPC can be designed to react promptly to asynchronous interrupt situations. There is no conflict between X•IPC 's implementation and underlying operating system signal or trap mechanisms.

Trap service functions can be written to respond to operating system level signals or traps. Such functions can include X•IPC function calls as well. For example, a trap function may respond to an asynchronous interrupt signal or trap by setting a SemSys semaphore or by issuing QueSys messages.

The use of trap functions in conjunction with X•IPC requires, however, that the trap functions be coded with a call to the `XIPC_TRAP_FUNCTION_TEST`() macro inserted at the start of the function.

The macro should be placed as the first executable statements in the trap function–possibly preceded only by the necessary operating system calls required to re-enable the signal or trap, if so desired. The `XIPC_TRAP_FUNCTION_TEST`() macro prevents trap service function execution at times when X•IPC trap masking is in effect.

A user's trap function mask becomes active in two situations:

- X•IPC automatically activates a user's trap function mask to prevent trap function execution at times when the user is executing internally within one of X•IPC 's critical regions. Trap function execution, when prevented for these situations, is delayed momentarily.

- An application program can explicitly mask traps on its own at other times as well, using the XipcMaskTraps() and XipcUnmaskTraps() function calls. Trap function execution, when prevented with this approach can be delayed for as long as the program wishes. In this manner, an application can prevent trap function execution during critical moments in its execution.

Both XipcMaskTraps() and XipcUnmaskTraps() take no arguments.

Example:

```
/*
 * Prevent trap handling.
 */

XipcMaskTraps();


/*
 * Do work that is uninterruptable.
 */

...
...

/*
 * Restore trap handling. Any functions that
 * were prevented from running while the mask
 * was active are now run.
 */

XipcUnmaskTraps();
```

The XIPC_TRAP_FUNCTION_TEST() macro requires arguments that are operating system specific. Refer to the appropriate Platform Notes for details of its calling sequence.

As an example, consider the following body of a trap service function:

```
{

    /*
     * System call to reset the operating system 'signal'
     * or 'trap' flag should go here (if required).
     */

    XIPC_TRAP_FUNCTION_TEST( ... );

    /*
     * The remainder of the function can safely
     * service the asynchronous 'signal' or 'trap'.
     */

    ...
    ...
    ...

    return;
}
```

A note regarding trap service functions and the SemList(), QueList() and MemList() functions: Recall that these list functions build their lists in their own internal static memory. Calling these functions from within a trap service function is thus dangerous, since the interrupted process might have been in the middle of using this same static area.

It is therefore much safer to use the SemListBuild(), QueListBuild() and MemListBuild() functions instead, because they build their lists using user-specified list variables. These list variables (of type SIDLIST, QIDLIST or MIDLIST) should ideally be automatic (i.e., stack) variables; as such, they would avoid the above-stated problem.

Two important notes regarding XipcMaskTraps() are:

- It only prevents the complete execution of trap handling functions (assuming they are coded with the XIPC_TRAP_FUNCTION_TEST() macro at their start). It *does not* control whether signals arrive at the process. A process that can receive a signal while traps are masked should be coded to restart interrupted synchronous operations executed during that period.

- Asynchronous X•IPC operations that complete while traps are masked are prevented from having their completion processing performed (e.g., running a callback function), until the mask is lifted via a call to XipcUnmaskTraps().

It is therefore advisable to use XipcMaskTraps() and XipcUnmaskTraps() to mask traps for limited periods of time and only when necessary.

## 6.8 XipcFreeze(), XipcUnfreeze() - Freezing and Unfreezing an Instance

The ability to freeze activity within an instance is most often only necessary at the subsystem level. Thus, for example, a process can call QueFreeze() to freeze activity in an instance's QueSys for the purpose of browsing message queues, etc.

For situations where the entire instance must be frozen, X•IPC provides the XipcFreeze() and XipcUnfreeze() function calls. These functions call their three respective subsystem functions as a unit, the result being the freezing or unfreezing of the entire instance.

Neither XipcFreeze() nor XipcUnfreeze() take any arguments:

Example:

```
/*
 * Freeze the instance. This gives the caller exclusive
 * access to all subsystems of the instance.
 */

XipcFreeze();


/*
 * Do exclusive work.
 */

...
...

/*
 * Unfreeze the instance. Other users are now permitted
 * to execute XIPC operations within the instance.
 */

XipcUnfreeze();
```

## 6.9 Extending *X•IPC* 's Functionality

*X•IPC* provides the developer with the means for extending *X•IPC*'s capabilities beyond its basic functionality. User-written functions, built upon the *X•IPC* API, can provide greatly expanded and specialized forms of IPC functionality.

Examples of extending *X•IPC*'s functionality could include user-written functions that:

- Increment a word of shared memory "atomically."
- Analyze the contents of all the messages on a message queue.
- Collect IPC statistics as part of a user-designed IPC monitoring system; collected data can be used for display purposes or for dynamic system intervention.
- Capture periodic images of message queue, shared memory contents or event semaphore settings.

### *6.9.1 INCREMENT A SHARED MEMORY WORD ATOMICALLY*

Consider writing a user function that increments a four-byte "word" of *X•IPC* shared memory "atomically." The target memory word is to be identified by *Mid* and *Offset*. The function should return the value of the incremented word.

By masking MemSys traps and then freezing the subsystem, a series of MemSys operations can be issued that are guaranteed to be run as an "atomic" unit, without trap function interruption and without other MemSys user operations executing interwoven within.

This is a basic requirement for coding a user-defined atomic operation that issues multiple *X•IPC* function calls.

Example:

```
/*
 * MemIncr() --- Version 1.
 */

XINT
MemIncr (Mid, Offset)
XINT Mid;
XINT Offset;
{
    XINT    Data;

    /*
     * Stop everything.
     */

    XipcMaskTraps();
    MemFreeze();

    /*
     * Perform the necessary MemSys operations.
     */

    MemRead (Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);
```

```
    Data ++;

    MemWrite (Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);

    /*
     * Restart everything.
     */

    MemUnfreeze();
    XipcUnmaskTraps();

    return (Data);
}
```

The above example is sufficient for situations where it is known that the MemRead() and MemWrite() function calls will always have read/write access to the targeted area.

For situations where this is not the case, a more generalized solution can be built. MemLock() and MemUnlock() are resorted to if the targeted area is not read/write accessible.

Example:

```
/*
 * MemIncr() --- Version 2.
 */

XINT
MemIncr (Mid, Offset)
XINT Mid;
XINT Offset;
{
    XINT        Data;
    XINT        RC;


    /*
     * Stop everything.
     */

    XipcMaskTraps();
    MemFreeze();


    /*
     * Attempt without locking.
     */

    RC = MemRead(Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);

    if (RC == MEM_ER_NOWAIT)
    {
        MemUnfreeze();
        XipcUnmaskTraps();
        return(MemIncrLock(Mid, Offset));
    }

    Data ++;

    RC= MemWrite(Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);

    if (RC == MEM_ER_NOWAIT)
    {
        MemUnfreeze();
        XipcUnmaskTraps();
        return(MemIncrLock(Mid, Offset));
    };
```

```
    /*
     * Restart everything.
     */

    MemUnfreeze();
    XipcUnmaskTraps();
    return (Data);
}


/*.....................................................*/
/*
 * MemIncrLock() --- Performs increment operation using
 *                   MemLock and MemUnlock.
 */

XINT
MemIncrLock(Mid, Offset)
XINT Mid;
XINT Offset;
{
    SECTION TempSec, RetSec;
    MIDLIST MidList;
    XINT        Data;

    /*
     * Perform the MemIncr operation
     * using MemLock/MemUnlock to wait
     * for target to become accessible.
     */

    XipcMaskTraps();

    MemListBuild(MidList,
        *MemSection(&TempSec, Mid, Offset, 4L),
        MEM_EOL );

    MemLock (MEM_ALL, MidList, &RetSec, MEM_WAIT);
    MemRead (Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);

    Data ++;

    MemWrite (Mid, Offset, (CHAR *)&Data, 4L, MEM_NOWAIT);
    MemUnlock (MidList, &RetSec);

    XipcUnmaskTraps();
    return (Data);
}
```

This version will perform like the first example, so long as the calling user has read/write access to the targeted memory area. If the area is found inaccessible by either MemRead() or MemWrite() then the operation is performed using a memory locking approach by a call to MemIncrLock().

To summarize, the ability to extend *X•IPC*'s functionality greatly broadens the range of IPC application requirements that can be addressed using the *X•IPC* product.

## 6.10 Info Function List Manipulation

### 6.10.1 INTRODUCTION

Many of the Information functions provided within X•IPC's subsystems return *list* data in addition to identification and statistical information. The method for accessing list data is uniform across all "Info" functions providing such information.

This section describes in detail how to request and receive complete representations of the various internal X•IPC lists, using the Information function calls. The method that is demonstrated applies in a similar vein to all "Info" function list data.

### 6.10.2 INFORMATION VERBS

X•IPC provides a number of verbs that allow a user to extract information regarding subsystem activity within an instance. The major information verbs are:

*MOMSYS*

- `MomInfoSys`() - Provides general, message repository and communication manager information
- `MomInfoAppQueue`() - Provides application queue information
- `MomInfoUser`() - Provides user information; also used for providing information about pending asynchronous operations and MomSys events
- `MomInfoMessage`() - Provides the latest information regarding a message
- `MomInfoLink`() - Provides information about MomSys links to other X•IPC instances

*QUESYS*

- `QueInfoQue`() - Provides queue information
- `QueInfoSys`() - Provides QueSys information
- `QueInfoUser`() - Provides user information; also provides information about pending asynchronous operations and QueSys events.

*MEMSYS*

- `MemInfoMem`() - Provides memory segment information
- `MemInfoSec`() - Provides section information
- `MemInfoSys`() - Provides MemSys information
- `MemInfoUser`() - Provides user information; also provides information about pending asynchronous operations and MemSys events.

*SEMSYS*

- `SemInfoSem`() - Provides semaphore information
- `SemInfoSys`() - Provides SemSys information

- `SemInfoUser()` - Provides user information; also provides information about pending asynchronous operations and SemSys events.

Other secondary information verbs are provided as well for reporting less significant information occurring within the specified subsystem.

Using these verbs it is possible to build customized monitor processes within an application that oversee the internal operations of the application. It is additionally possible to build customized GUI-based application monitors that display data retrieved from these functions in a customized display format.

## 6.10.3 UNDERSTANDING X♦IPC INFORMATION VERBS

Within the family of Information verbs, all of the verbs listed above can be employed to obtain information about a *series* of subsystem data items. The programming method for looping through the series of items in this group, using a MomSys example, is:

1. Initially, call `MomInfo`*`Xxx`*`(MOM_INFO_FIRST, &...)` .
2. Subsequently, call `MomInfo`*`Xxx`*`(MOM_INFO_NEXT(...), &...)` .
3. Stop when the return code is `MOM_ER_NOMORE` .

Two other verbs in the MomSys subsystem -- `MomInfoAppQueueWList()` and `MomInfoUserAlist()` -- can be used to report more detailed MomSys information. The programming method looping through the series of items in this group is:

1. Initially, call the corresponding `MomInfo`*`Xxx`*`()` verb, and use its output parameter both to initialize a cursor variable (e.g., `MyCursor`) to the position of the first element of the *X*List, and also to obtain information about that element
2. Then, call `MomInfo`*`XxxX`*`List(..., &MyCursor, &...)`. This advances `MyCursor` to the position of the next element of the *X*List and obtains information about that element.
3. Stop when the return code is `MOM_ER_NOMORE`.

## 6.10.4 CODING EXAMPLES OF MOMSYS INFORMATION VERBS

The following two code templates illustrate the two styles of information-gathering loops (including error checking).

Example 1:

```
/*
 * Sample of MomInfoXxx()verb usage - e.g. for MomInfoAppQueue().
 * Loop through all the app-queues in the current instance,
 * retrieving and processing the status data of each app-queue.
 */

MOMINFOAPPQUEUE MyInfoAppQueue;
XINT            RC, MyAQid;

for (RC  = MomInfoAppQueue( MOM_INFO_FIRST, &MyInfoAppQueue );
     RC != MOM_ER_NOMORE;
     RC  = MomInfoAppQueue( MOM_INFO_NEXT( MyAQid ), &MyInfoAppQueue ))
{
    if (RC < 0)
    {
        /* Take appropriate error action for MyInfoAppQueue */
        . . .
        break;
```

```
        }

        MyAQid = MyInfoAppQueue.AQid;

        /* Process MyInfoAppQueue data for MyAQid */
        . . .
    } /* for */
```

Example 2:

```
/*
 * Sample of MomInfoXxxXList() verb usage - e.g. for MomInfoAppQueueWList().
 * Loop through the entire wait-list for the specific app-queue
 * identified by MyAQid, retrieving and processing the status
 * data of each wait-list element.
 */


XINT                    RC, MyAQid, MyCursor;
MOMINFOAPPQUEUE         MyInfoAppQueue;
MOM_APPQUEUEWLISTITEM   MyWListItem;


MyAQid = ...; /* AQid of app-queue whose wait-list is to be traversed */

if ( (RC = MomInfoAppQueue( MyAqid, &MyInfoAppQueue )) < 0 )  /
{
    if (RC != MOM_ER_NOMORE)
    {
        /* Take appropriate error action for MomInfoAppQueue() */
        . . .
    }
}
else    /* we have at least one element in the wait-list */
{
    for (MyCursor = MyInfoAppQueue.WListInitialCursor,
            MyWListItem = MyInfoAppQueue.WListFirstItem;
         RC != MOM_ER_NOMORE;
         RC = MomInfoAppQueueWList( MyAQid, &MyCursor, &MyWListItem ))

    {
        if (RC != MOM_ER_NOMORE)
        {
            /* Take appropriate error action for MomInfoAppQueueWList */
            . . .
            break;
        }

        /* Process MyWListItem data */
        . . .

    } /* for */

} /* else */
```

If one wanted to loop through *all* the app-queues' wait-lists, then the second code segment above would be nested within the first segment, so that the processing of each app-queue would entail traversing its wait-list.
Refer to the respective Reference Manual pages for additional details on the usage of these verbs.

## 6.10.5 SAMPLE QUESYS FUNCTION

Consider the QUEINFOSYS data structure. A pointer to such a structure is passed as a parameter to the QueInfoSys() function for accessing status information about an instance's QueSys.

The QUEINFOSYS structure returns with assorted identification and statistical data that describe the status of the QueSys subsystem. QueInfoSys() additionally returns with *Wait List* data relating to the subsystem's Message Text Pool. The Wait List identifies the list of QueSys users currently blocked on QueWrite() operations to the Message Text Pool.

The QUEINFOSYS data type includes the following fields:

```
typedef struct
{
    /*
     * Identification and statistical data.
     */

    ...
    ...

    /*
     * List data.
     */

    XINT            WListTotalLength;
    XINT            WListOffset;
    XINT            WListLength;
    QUE_SYSWLISTITEM;   WList[QUE_LEN_INFOLIST];

} QUEINFOSYS;
```

where the `QUE_SYSWLISTITEM` data type is defined as:

```
typedef struct
{
    XINT            Uid;
    XINT            MsgSize;

} QUE_SYSWLISTITEM;
```

The *WListOffset* field of the QUEINFOSYS structure should be set before QueInfoSys() is called. Setting it to zero instructs the function to return with WList data, starting with the first element on the list.

Example:

```
/*
 * Report all blocked QueWrite operations
 * currently occurring in QueSys.
 */

QUEINFOSYS   InfoSys;
XINT         i;

/*
 * Set offset to zero so that WList data is returned
 * from the start of the list.
 */

InfoSys.WListOffset = 0;

QueInfoSys ( &InfoSys );

for (i=0; i < InfoSys.WListLength; i++)
    printf("Uid %d is blocked on QueWrite of %ld bytes",
        InfoSys.WList[i].Uid, InfoSys.WList[i].MsgSize);
```

The WList is defined so that it may hold up to `QUE_LEN_INFOLIST` elements. The above example assumes that the Wait List of blocked QueWrite() operations is within this limit. In such a case, *InfoSys.WListLength* will equal *InfoSys.WListTotalLength*, and the entire list will be printed.

It is, however, possible that the current Wait List has more than `QUE_LEN_INFOLIST` elements. In such a situation, the value of *InfoSys.WListTotalLength* will be set to the total number of blocked QueWrite() operations, and *InfoSys.WListLength* will be equal to `QUE_LEN_INFOLIST.`

Getting the entire Wait List would then require a loop of QueInfoSys() calls.

Example:

```
/*
 * Report all blocked QueWrite operations
 * currently occurring in QueSys.
 */

QUEINFOSYS   InfoSys;
XINT         i;

/*
 * Set offset to zero so that WList data is returned
 * from the start of the list.
 */

InfoSys.WListOffset = 0;

do
{
    QueInfoSys ( &InfoSys );

    for (i=0; i < InfoSys.WListLength; i++)
        printf("Uid %d blocked on QueWrite of %ld bytes",
        InfoSys.WList[i].Uid, InfoSys.WList[i].MsgSize);

    InfoSys.WListOffset += InfoSys.WListLength;

} while (InfoSys.WListOffset < InfoSys.WListTotalLength );
```

The problem with issuing multiple calls to QueInfoSys() to report on Wait List status is one of data variability. Things can happen between the calls.

This can be prevented by freezing QueSys and masking traps for the duration of the reporting loop. This will guarantee that the collected Wait List data is complete, accurate and consistent.

The method outlined in the next example for acquiring Wait List data can be applied in a similar manner to all of *X•IPC*'s "Info" function list data.

In summary, by using the "Info" function calls in conjunction with the XxxFreeze() and XipcMaskTraps() function calls, it is possible to build customized IPC reporting and monitoring capabilities into your product, tailored to the specific real-time reporting needs of the application. An example of this approach follows:

Example:

```
/*
 * Report all blocked QueWrite operations
 * currently occurring in QueSys.
 */

QUEINFOSYS   InfoSys;
XINT         i;


/*
 * Stop everything.
 */
```

```
XipcMaskTraps();
QueFreeze();



/*
 * Set offset to zero so that WList data is returned
 * from the start of the list.
 */

InfoSys.WListOffset = 0;

do
{
    QueInfoSys ( &InfoSys );

    for (i=0; i<InfoSys.WListLength; i++)
        printf("Uid %d blocked on QueWrite of %ld bytes",
        InfoSys.WList[i].Uid, InfoSys.WList[i].MsgSize);

    InfoSys.WListOffset += InfoSys.WListLength;

} while (InfoSys.WListOffset < InfoSys.WListTotalLength );

/*
 * Restart everything.
 */

QueUnfreeze();
XipcUnmaskTraps();
```

## 6.11 The X•IPC Command Interpreter

The X•IPC toolset provides the application developer with the ability to manipulate an X•IPC instance and its IPC objects interactively. This is accomplished using the `xipc` interactive command interpreter.

`xipc` provides an interactive interface to all the X•IPC API's. `xipc` is most useful in situations where access to an instance and its IPC objects are required on an ad-hoc basis. This need can arise throughout the application development process.

With `xipc` it is possible, for example, to:

- Create or delete X•IPC objects (queues, app-queues, semaphores, segments)
- Set or clear event semaphores
- Initialize the contents of a shared memory segment
- Extract arbitrary messages from a message queue
- Lock (or otherwise set the access privileges of) areas in shared memory
- Clean up after "untidy" user programs
- Insert messages onto one or more message queues
- Control a queue's overflow spooling activity
- Set or reset X•IPC triggers
- Initiate an asynchronous X•IPC operation that, when completed, executes another X•IPC command or native operating system command
- Log into a corrupted X•IPC instance to examine its status
- etc.

The `xipc` interactive interpreter is based on a language of commands. The exact syntax and details of using the `xipc` interactive command language are described in the chapter on X•IPC Commands in the X•IPC Reference Manual.

### *6.11.1 SAMPLE USAGE OF THE X•IPC INTERACTIVE COMMAND INTERPRETER*

This section presents a selection of sample `xipc` sessions. The examples demonstrate the types of situations where using `xipc` can provide important time-saving development assistance.

*Sample 1*: Run a native Operating System command.

```
xipc> # UNIX example of operating system command
xipc> !date
      Thu May 21 10:58:20 EDT 1996


xipc> # VMS example of operating system command
xipc> !show time
      21-May-1996 10:58:20


xipc> # OS/2 example of operating system command
xipc> !date
      The current date is: Thu 5-21-1996
      Enter the new date: (mm-dd-yy)
```

*Sample 2*: Initiate an asynchronous operation and arrange that its completion runs a second XIPC command.

```
xipc> # Assign callback variable cba with xipc command to send
xipc> # an application shutdown message into queue 0
xipc> callback cba "quesend any 0 999 \"Shutdown\" wait"
      Command saved
xipc> # Initiate an asynchronous operation that waits for
xipc> # three events to occur. When they all have occurred,
xipc> # callback cba is run, i.e., the above xipc command
xipc> # is executed.
xipc> semwait all 0,1,2 callback(cba,a)
      RetCode = -1097
      Operation continuing asynchronously
```

*Sample 3*: Initiate an asynchronous operation and arrange that its completion runs a native operating system command to print report xyz.

```
xipc> # Assign callback variable cbz with xipc "!" command
xipc> # which will execute an operating system command to
xipc> # produce report xyz
xipc> callback cbz "! print xyz"
      Command saved
xipc> # Initiate an asynchronous operation that waits for
xipc> # any of events 10,20,30 to occur. When this happens,
xipc> # callback cbz is run, i.e., the above operating system
xipc> # command is executed.
xipc> semwait any 10,20,30 callback(cbz,c)
      RetCode = 0
```

*Sample 4* : Log into two instances.

```
xipc> xipclogin /proj/xipc/demo Jack
      Uid = 11
xipc> xipcdisconnect
      RetCode = 0
xipc> xipclogin @DB Jack
      Uid = 15
xipc> xipcinfologin
      Uid   Instance
      ---   --------
       15   @DB
       11   /proj/xipc/demo
```

A brief note regarding this last example: The `superuser` capability, in providing a means for logging into an otherwise inaccessible instance, also returns the instance to a state where it may be accessed on a general basis (such as by the *X•IPC* monitor programs).

There is no guarantee, however, that the instance is in complete working order. The `superuser` login is most useful for ascertaining the identity of the program that last accessed the instance, i.e., the one that was the likely cause of the instance becoming corrupted.

# 7. TECHNICAL NOTES

This section contains Technical Notes that have been issued by Envoy Technologies Inc. to address special issues and to provide optional enhancements to the *X•IPC* product. Each Note is, in effect, an independent document with its own Table of Contents.

The Technical Notes which follow are:

- The *X•IPC* Idle User Detection Mechanism
- Using Event Objects for Asynchronous Operations on Windows NT/Windows 95
- Using I/O Descriptors for Asynchronous Operations on UNIX
- The *X•IPC* Data Translation System

# 8. INDEX