The Input Method Protocol

Version 1.0

X Consortium Standard

X Version 11, Release 6.4

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ABSTRACT

This specifies a protocol between IM library and IM (Input Method) Server for internationalized text input, which is independent from any specific language, any specific input method and the transport layer used in communication between the IM library and the IM Server, and uses a client-server model. This protocol allows user to use his/her favorite input method for all applications within the stand-alone distributed environment.

1. Introduction

1.1. Scope

The internationalization in the X Window System Version 11, Release 5 (X11R5) provides a common API which application developers can use to create portable internationalized programs and to adapt them to the requirements of different native languages, local customs, and character string encodings (this is called ‘‘localization’’). As one of its internationalization mechanisms X11R5 has defined a functional interface for internationalized text input, called XIM (X Input Method).

When a client-server model is used with an IM (Input Method) implementation, a protocol must be established between the client and the server. However, the protocol used to interface Input Method Servers (IM Servers) with the Input Method libraries (IM libraries) to which applications are linked was not addressed in X11R5. This led application developers to depend on vendor-specific input methods, decreased the user’s choice of available input methods, and made it more difficult for developers to create portable applications. This paper describes the Input Method Protocol developed for X11R6 to resolve the above problems and to address the requirements of existing and future input methods.

The Input Method Protocol is independent from the transport layer used in communication between the IM library and the IM Server. Thus, the input method protocol can be built on any inter-process communication mechanism, such as TCP/IP or the X protocol.

In addition, the protocol provides for future extensions such as differing input model types.

1.2. Background

Text input is much more simple for some languages than others. English, for instance, uses an alphabet of a manageable size, and input consists of pressing the corresponding key on a keyboard, perhaps in combination with a shift key for capital letters or special characters.

Some languages have larger alphabets, or modifiers such as accents, which require the addition of special key combinations in order to enter text. These input methods may require ‘‘dead-keys’’ or ‘‘compose-keys’’ which, when followed by different combinations of key strokes, generate different characters.

Text input for ideographic languages is much less simple. In these languages, characters represent actual objects rather than phonetic sounds used in pronouncing a word, and the number of characters in these languages may continue to grow. In Japanese, for instance, most text input methods involve entering characters in a phonetic alphabet, after which the input method searches a dictionary for possible ideographic equivalents (of which there may be many). The input method then presents the candidate characters for the user to choose from.

In Japanese, either Kana (phonetic symbols) or Roman letters are typed and then a region is selected for conversion to Kanji. Several Kanji characters may have the same phonetic representation. If that is the case with the string entered, a menu of characters is presented and the user must choose the appropriate one. If no choice is necessary or a preference has been established, the input method does the substitution directly.

These complicated input methods must present state information (Status Area), text entry and edit space (Preedit Area), and menu/choice presentations (Auxiliary Area). Much of the protocol between the IM library and the IM Server involves managing these IM areas. Because of the size and complexity of these input methods, and because of how widely they vary from one language or locale to another, they are usually implemented as separate processes which can serve many client processes on the same computer or network.

1.3. Input Method Styles

X11 internationalization support includes the following four types of input method:

- on-the-spot: The client application is directed by the IM Server to display all pre-edit data at the site of text insertion. The client registers callbacks invoked by the input method during pre-editing.
- off-the-spot: The client application provides display windows for the pre-edit data to the input method which displays into them directly.
- over-the-spot: The input method displays pre-edit data in a window which it brings up directly over the text insertion position.
- root-window: The input method displays all pre-edit data in a separate area of the screen in a window specific to the input method.

Client applications must choose from the available input methods supported by the IM Server and provide the display areas and callbacks required by the input method.

2. Architecture

2.1. Implementation Model

Within the X Window System environment, the following two typical architectural models can be used as an input method's implementation model.

- Client/Server model: A separate process, the IM Server, processes input and handles preediting, converting, and committing. The IM library within the application, acting as client to the IM Server, simply receives the committed string from the IM Server.
- Library model: All input is handled by the IM library within the application. The event process is closed within the IM library and a separate IM Server process may not be required.

Most languages which need complex preediting, such as Asian languages, are implemented using the Client/Server IM model. Other languages which need only dead key or compose key processing, such as European languages, are implemented using the Library model.

In this paper, we discuss mainly the Client/Server IM model and the protocol used in communication between the IM library (client) and the IM Server.

2.2. Structure of IM

When the client connects or disconnects to the IM Server, an open or close operation occurs between the client and the IM Server.

The IM can be specified at the time of XOpenIM() by setting the locale of the client and a locale modifier. Since the IM remembers the locale at the time of creation XOpenIM() can be called multiple times (with the setting for the locale and the locale modifier changed) to support multiple languages.

In addition, the supported IM type can be obtained using XGetIMValues().

The client usually holds multiple input (text) fields. Xlib provides a value type called the ‘‘Input Context’’ (IC) to manage each individual input field. An IC can be created by specifying XIM using XCreateIC(), and it can be destroyed using XDestroyIC().

The IC can specify the type of IM which is supported by XIM for each input field, so each input field can handle a different type of IM.

Most importantly information such as the committed string sent from the IM Server to the client, is exchanged based on each IC.

Since each IC corresponds to an input field, the focused input field should be announced to the IM Server using XSetICFocus(). (XUnsetICFocus() can also be used to change the focus.)

2.3. Event Handling Model

Existing input methods support either the FrontEnd method, the BackEnd method, or both. This protocol specifically supports the BackEnd method as the default method, but also supports the FrontEnd method as an optional IM Server extension.

The difference between the FrontEnd and BackEnd methods is in how events are delivered to the IM Server. (Fig. 1)

2.3.1. BackEnd Method

In the BackEnd method, client window input events are always delivered to the IM library, which then passes them to the IM Server. Events are handled serially in the order delivered, and therefore there is no synchronization problem between the IM library and the IM Server.

Using this method, the IM library forwards all KeyPress and KeyRelease events to the IM Server (as required by the Event Flow Control model described in section 2.4. ‘‘Event Flow Control’’), and synchronizes with the IM Server (as described in section 4.16. ‘‘Filtering Events’’).

2.3.2. FrontEnd Method

In the FrontEnd method, client window input events are delivered by the X server directly to both the IM Server and the IM library. Therefore this method provides much better interactive performance while preediting (particularly in cases such as when the IM Server is running locally on the user’s workstation and the client application is running on another workstation over a relatively slow network).

However, the FrontEnd model may have synchronization problems between the key events handled in the IM Server and other events handled in the client, and these problems could possibly cause the loss or duplication of key events. For this reason, the BackEnd method is the core method supported, and the FrontEnd method is made available as an extension for performance purposes. (Refer to Appendix A for more information.)

... 0.05 6.513 4.737 10.45 ... 0.000i 3.937i 4.687i 0.000i

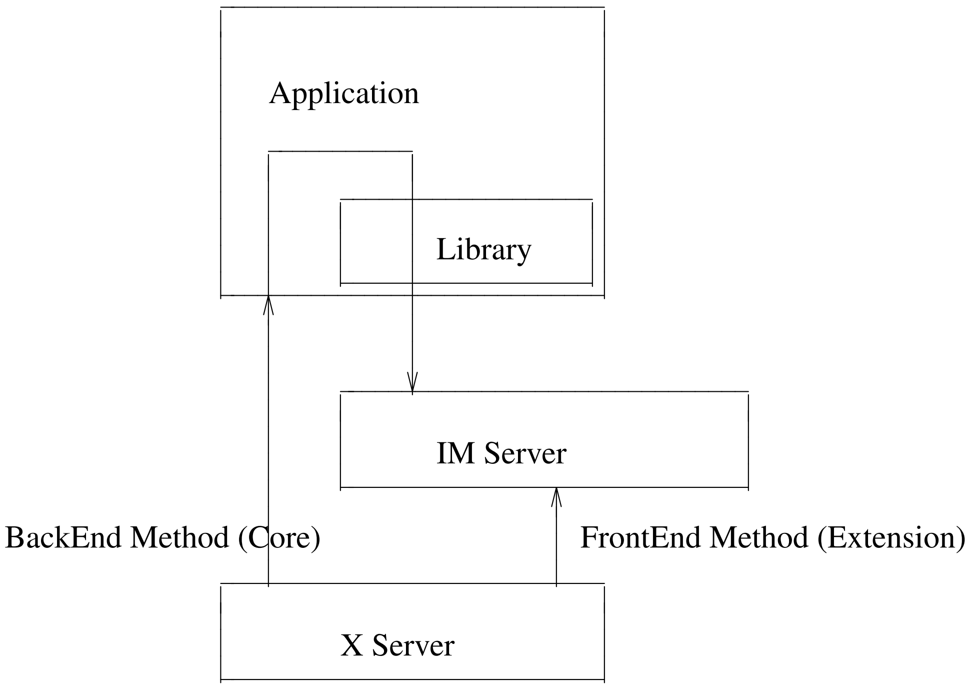

Fig.1 The Flow of Events

2.4. Event Flow Control

This protocol supports two event flow models for communication between the IM library and the IM Server (Static and Dynamic).

Static Event Flow requires that input events always be sent to the IM Server from the client.

Dynamic Event Flow, however, requires only that those input events which need to be processed (converted) be sent to the IM Server from the client.

For instance, in the case of inputing a combination of ASCII characters and Chinese characters, ASCII characters do not need to be processed in the IM Server, so their key events do not have to be sent to the IM Server. On the other hand, key events necessary for composing Chinese characters must be sent to the IM Server.

Thus, by adopting the Dynamic Event Flow, the number of requests among the X Server, the client, and the IM Server is significantly reduced, and the number of context switches is also reduced, resulting in improved performance. The IM Server can send **XIM_REGISTER_TRIGGERKEYS** message in order to switch the event flow in the Dynamic Event Flow.

The protocol for this process is described in section 4.5. ‘‘Event Flow Control’’.

3. Default Preconnection Convention

IM Servers are strongly encouraged to register their symbolic names as the ATOM names into the IM Server directory property, **XIM_SERVERS,** on the root window of the screen_number 0.

This property can contain a list of ATOMs, and the each ATOM represents each possible IM Server. IM Server names are restricted to POSIX Portable Filename Character Set. To discover if the IM Server is active, see if there is an owner for the selection with that atom name. To learn the address of that IM Server, convert the selection target **TRANSPORT,** which will return a string form of the transport address(es). To learn the supported locales of that IM Server, convert the selection target **LOCALES,** which will return a set of names of the supported locales in the syntax X/Open defines.

The basic semantics to determine the IM Server if there are multiple ATOMs are found in **XIM_SERVERS** property, is first fit if the IM Server name is not given as a X modifier's category **im.**

The address information retrievable from the **TRANSPORT** target is a transport-specific name. The preregistered formats for transport-specific names are listed in Appendix B. Additional transport-specific names may be registered with X Consortium.

For environments that lack X connections, or for IM Servers which do not use the X Window System, the preconnection convention with IM Server may be given outside the X Window system (e.g. using a Name Service).

4. Protocol

The protocol described below uses the bi-directional synchronous/asynchronous request/reply/error model and is specified using the same conventions outlined in Section 2 of the core X Window System protocol [1]:

4.1. Basic Requests Packet Format

This section describes the requests that may be exchanged between the client and the IM Server.

The basic request packet header format is as follows.

major-opcode:	CARD8
minor-opcode:	CARD8
length:	CARD16

The MAJOR-OPCODE specifies which core request or extension package this packet represents. If the MAJOR-OPCODE corresponds to a core request, the MINOR-OPCODE contains 8 bits of request-specific data. (If the MINOR-OPCODE is not used, it is 0.) Otherwise, the MAJOR-OPCODE and the MINOR-OPCODE are specified by **XIM_QUERY_EXTENSION** message. (Refer to 4.7. Query the supported extension protocol list.) The LENGTH field specifies the number of 4 bytes elements following the header. If no additional data is followed by the header, the LENGTH field will be 0.

4.2. Data Types

The following data types are used in the core X IM Server protocol:

BITMASK16
    CARD16

BITMASK32
    CARD32

PADDING FORMAT
    Where N is some expression, and Pad(N) is the number of bytes needed to round N up to a

multiple of four.

Pad(N) = (4 - (N mod 4)) mod 4

LPCE

1	A character from the4 X Portable Character Set in Latin Portable Character Encoding

STRING

2	n	length of string in bytes
n	LISTofLPCE	string
p		unused, p=Pad(2+n)

STR

1	n	length of name in bytes
n	STRING8	name

XIMATTR

2	CARD16	attribute ID (*1)
2	CARD16	type of the value (*2)
2	n	length of im-attribute
n	STRING8	im-attribute
p		unused, p = Pad(2+n)

The im-attribute argument specifies XIM values such as XNQueryInputStyle.

XICATTR

2	CARD16	attribute ID (*1)
2	CARD16	type of the value (*2)
2	n	length of ic-attribute
n	STRING8	ic-attribute
p		unused, p = Pad(2+n)

(*1) XIMATTR and XICATTR are used during the setup stage and XIMATTRIBUTE and XICATTRIBUTE are used after each attribute ID has been recognized by the IM Server and the IM library.

(*2) The value types are defined as follows:

values	**data**	**format**		
#0	Separator of NestedList	----- (*3)		
#1	byte data	CARD8		
#2	word data	CARD16		
#3	long data	CARD32		
#4	char data	STRING8		
#5	Window	CARD32		
#10	XIMStyles	2	n	number of XIMStyle list
		2		unused
		n	CARD32	XIMStyle list
#11	XRectangle	2	INT16	X
		2	INT16	Y
		2	CARD16	width
		2	CARD16	height
#12	XPoint	2	INT16	X
		2	INT16	Y
#13	XFontSet	2	n	length of Base font name

values	data	format		
		n	STRING8	Base font name list
		p		unused, p = Pad(2+n)
#15	XIMHotKeyTriggers	4	n	number of XIMTRIGGERKEY list (*4)
		n	XIMTRIGGERKEY	XIMHotkeyTrigger list
#16	XIMHotKeyState		XIMHOTKEYSTATE	HotKey processing state
#17	XIMStringConversion	XIMSTRCONVTEXT		
#18	XIMPreeditState	XIMPREEDITSTATE		
#19	XIMResetState	XIMRESETSTATE		
#x7fff	NestedList	-----		

(*3) The IC value for the separator of NestedList is defined as follows,

#define XNSeparatorofNestedList ‘‘separatorofNestedList’’

, which is registered in X Consortium and cannot be used for any other purpose.

(*4) LISTofFOO

A Type name of the form LISTof FOO means a counted list of elements of type FOO. The size of the length field may vary (it is not necessarily the same size as a FOO), and in some cases, it may be implicit.

XIMTRIGGERKEY

4	CARD32	keysym
4	CARD32	modifier
4	CARD32	modifier mask

ENCODINGINFO

2	n	length of encoding info
n	STRING8	encoding info
p		unused, p=Pad(2+n)

EXT

1	CARD8	extension major-opcode
1	CARD8	extension minor-opcode
2	n	length of extension name
n	STRING8	extension name
p		unused, p = Pad(n)

XIMATTRIBUTE

2	CARD16	attribute ID
2	n	value length
n		value
p		unused, p = Pad(n)

XICATTRIBUTE

2	CARD16	attribute ID
2	n	value length

n	value
p	unused, p = Pad(n)

XIMSTRCONVTEXT

2	CARD16	XIMStringConversionFeedback
	#x0000001	XIMStringConversionLeftEdge
	#x0000002	XIMStringConversionRightEdge
	#x0000004	XIMStringConversionTopEdge
	#x0000008	XIMStringConversionBottomEdge
	#x0000010	XIMStringConversionConvealed
	#x0000020	XIMStringConversionWrapped
2	n	byte length of the retrieved string
n	STRING8	retrieved string
p		unused, p = Pad(n)
2	m	byte length of feedback array
2		unused
m	LISTofXIMSTRCONVFEEDBACK	feedback array(*1)

(*1) This field is reserved for future use.

XIMFEEDBACK

4	CARD32	XIMFeedback
	#x000001	XIMReverse
	#x000002	XIMUnderline
	#x000004	XIMHighlight
	#x000008	XIMPrimary
	#x000010	XIMSecondary
	#x000020	XIMTertiary
	#x000040	XIMVisibleToForward
	#x000080	XIMVisibleToBackward
	#x000100	XIMVisibleCenter

XIMHOTKEYSTATE

4	CARD32	XIMHotKeyState
	#x0000001	XIMHotKeyStateON
	#x0000002	XIMHotKeyStateOFF

XIMPREEDITSTATE

4	CARD32	XIMPreeditState
	#x0000001	XIMPreeditEnable
	#x0000002	XIMPreeditDisable

XIMRESETSTATE

4	CARD32	XIMResetState
	#x0000001	XIMInitialState
	#x0000002	XIMPreserveState

4.3. Error Notification

Both the IM Server and the IM library return **XIM_ERROR** messages instead of the corresponding reply messages if any errors occur during data processing.

At most one error is generated per request. If more than one error condition is encountered in processing a request, the choice of which error is returned is implementation-dependent.

XIM_ERROR (IM Server ←→ IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	BITMASK16	flag (*1)
	#0000	Both Input-Method-ID and Input-Context-ID are invalid
	#0001	Input-Method-ID is valid
	#0002	Input-Context-ID is valid
2	CARD16	Error Code
	#1	BadAlloc
	#2	BadStyle
	#3	BadClientWindow
	#4	BadFocusWindow
	#5	BadArea
	#6	BadSpotLocation
	#7	BadColormap
	#8	BadAtom
	#9	BadPixel
	#10	BadPixmap
	#11	BadName
	#12	BadCursor
	#13	BadProtocol
	#14	BadForeground
	#15	BadBackground
	#16	LocaleNotSupported
	#999	BadSomething (*2)
2	n	byte length of error detail.
2	CARD16	type of error detail (*3)
n	STRING8	error detail (*4)
p		unused, p = Pad(n)

(*1) Before an IM is created, both Input-Method-ID and Input-Context-ID are invalid. Before an IC is created, only Input-Method-ID is valid. After that, both of Input-Method-ID and Input-Context-ID are valid.

(*2) Unspecific error, for example ‘‘language engine died’’

(*3) This field is reserved for future use.

(*4) Vendor defined detail error message

4.4. Connection Establishment

XIM_CONNECT message requests to establish a connection over a mutually-understood virtual stream.

XIM_CONNECT (IM library → IM Server)

1		byte order
	#x42 MSB first	
	#x6c LSB first	
1		unused
2	CARD16	client-major-protocol-version (*1)

2	CARD16	client-minor-protocol-version (*1)
2	CARD16	number of client-auth-protocol-names
n	LISTofSTRING	client-auth-protocol-names

(*1) Specify the version of IM Protocol that the client supports.

A client must send **XIM_CONNECT** message as the first message on the connection. The list specifies the names of authentication protocols the sending IM Server is willing to perform. (If the client need not authenticate, the list may be omited.)

XIM_AUTH_REQUIRED message is used to send the authentication protocol name and protocol-specific data.

XIM_AUTH_REQUIRED (IM library ←→ IM Server)

1	CARD8	auth-protocol-index
3		unused
2	n	length of authentication data
2		unused
n	<varies>	data
p		unused, p = Pad(n)

The auth-protocol is specified by an index into the list of names given in the **XIM_CONNECT** or **XIM_AUTH_SETUP** message. Any protocol-specific data that might be required is also sent.

The IM library sends **XIM_AUTH_REPLY** message as the reply to **XIM_AUTH_REQUIRED** message, if the IM Server is authenticated.

XIM_AUTH_REPLY (IM library → IM Server)

2	n	length of authentication data
2		unused
2	n	length of authentication data
2		unused
n	<varies>	data
p		unused, p = Pad(n)

The auth data is specific to the authentication protocol in use.

XIM_AUTH_NEXT message requests to send more auth data.

XIM_AUTH_NEXT (IM library ←→ IM Server)

2	n	length of authentication data
2		unused
n	<varies>	data
p		unused, p = Pad(n)

The auth data is specific to the authentication protocol in use.

The IM Server sends **XIM_AUTH_SETUP** message to authenticate the client.

XIM_AUTH_SETUP (IM Server → IM library)

2	CARD16	number of client-auth-protocol-names
2		unused

n	LISTofSTRING	server-auth-protocol-names

The list specifies the names of authentication protocols the client is willing to perform.

XIM_AUTH_NG message requests to give up the connection.

XIM_AUTH_NG (IM library ←→ IM Server)

The IM Server sends **XIM_CONNECT_REPLY** message as the reply to **XIM_CONNECT** or **XIM_AUTH_REQUIRED** message.

XIM_CONNECT_REPLY (IM Server → IM library)

2	CARD16	server-major-protocol-version (*1)
2	CARD16	server-minor-protocol-version (*1)

(*1) Specify the version of IM Protocol that the IM Server supports. This document specifies major version one, minor version zero.

Here are the state diagrams for the client and the IM Server.

State transitions for the client

init_status:
Use authorization function → *client_ask*
Not use authorization function → *client_no_check*

start:
Send **XIM_CONNECT**
If *client_ask* → *client_wait1*
If *client_no_check*, client-auth-protocol-names may be omited → *client_wait2*

client_wait1:
Receive **XIM_AUTH_REQUIRED** → *client_check*
Receive <other> → *client_NG*

client_check:
If no more auth needed, send **XIM_AUTH_REPLY** → *client_wait2*
If good auth data, send **XIM_AUTH_NEXT** → *client_wait1*
If bad auth data, send **XIM_AUTH_NG** → give up on this protocol

client_wait2:
Receive **XIM_CONNECT_REPLY** → connect
Receive **XIM_AUTH_SETUP** → *client_more*
Receive **XIM_AUTH_NEXT** → *client_more*
Receive **XIM_AUTH_NG** → give up on this protocol
Receive <other> → *client_NG*

client_more:
Send **XIM_AUTH_REQUIRED** → *client_wait2*

client_NG:
Send **XIM_AUTH_NG** → give up on this protocol

State transitions for the IM Server

init-status:
Use authorization function → *server_ask*
Not use authorization function → *server_no_check*

start:
Receive **XIM_CONNECT** → *start2*
Receive <other> → *server_NG*

start2:
If *client_ask*, send **XIM_AUTH_REQUIRED** → *server_wait1*
If *client_no_check* and *server_ask*, send **XIM_AUTH_SETUP** → *server_wait2*
If *client_no_check* and *server_no_check*, send **XIM_CONNECT_REPLY** → connect

server_wait1:
Receive **XIM_AUTH_REPLY** → *server2*
Receive **XIM_AUTH_NEXT** → *server_more*
Receive <other> → *server_NG*

server_more
Send **XIM_AUTH_REQUIRED** → *server_wait1*

server2
If *server_ask*, send **XIM_AUTH_SETUP** → *server_wait2*
If *server_no_check*, send **XIM_CONNECT_REPLY** → connect

server_wait2
Receive **XIM_AUTH_REQUIRED** → *server_check*
Receive <other> → *server_NG*

server_check
If no more auth data, send **XIM_CONNECT_REPLY** → connect
If bad auth data, send **XIM_AUTH_NG** → give up on this protocol
If good auth data, send **XIM_AUTH_NEXT** → *server_wait2*

server_NG
Send **XIM_AUTH_NG** → give up on this protocol

XIM_DISCONNECT message requests to shutdown the connection over a mutually-understood virtual stream.

XIM_DISCONNECT (IM library → IM Server)

XIM_DISCONNECT is a synchronous request. The IM library should wait until it receives either an **XIM_DISCONNECT_REPLY** packet or an **XIM_ERROR** packet.

XIM_DISCONNECT_REPLY (IM Server → IM library)

XIM_OPEN requests to establish a logical connection between the IM library and the IM Server.

XIM_OPEN (IM library → IM Server)

n	STR	locale name
p		unused, p = Pad(n)

XIM_OPEN is a synchronous request. The IM library should wait until receiving either an **XIM_OPEN_REPLY** packet or an **XIM_ERROR** packet.

XIM_OPEN_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	n	byte length of IM attributes supported
n	LISTofXIMATTR	IM attributes supported
2	m	byte length of IC attributes supported
2	CARD16	unused
m	LISTofXICATTR	IC attributes supported

XIM_OPEN_REPLY message returns all supported IM and IC attributes in LISTofXIMATTR and LISTofXICATTR. These IM and IC attribute IDs are used to reduce the amount of data which must be transferred via the network. In addition, this indicates to the IM library what kinds of IM/IC attributes can be used in this session, and what types of data will be exchanged. This allows the IM Server provider and application writer to support IM system enhancements with new IM/IC attributes, without modifying Xlib. The IC value for the separator of NestedList must be included in the LISTofXICATTR.

XIM_CLOSE message requests to shutdown the logical connection between the IM library and the IM Server.

XIM_CLOSE (IM library → IM Server)

2	CARD16	input-method-ID
2		unused

XIM_CLOSE is a synchronous request. The IM library should wait until receiving either an **XIM_CLOSE_REPLY** packet or an **XIM_ERROR** packet.

XIM_CLOSE_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2		unused

4.5. Event Flow Control

An IM Server must send **XIM_SET_EVENT_MASK** message to the IM library in order for events to be forwarded to the IM Server, since the IM library initially doesn't forward any events to the IM Server. In the protocol, the IM Server will specify masks of X events to be forwarded and which need to be synchronized by the IM library.

XIM_SET_EVENT_MASK (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	EVENTMASK	forward-event-mask (*1)
4	EVENTMASK	synchronous-event-mask (*2)

(*1) Specify all the events to be forwarded to the IM Server by the IM library.

(*2) Specify the events to be forwarded with synchronous flag on by the IM library.

XIM_SET_EVENT_MASK is an asynchronous request. The event masks are valid immediately after they are set until changed by another **XIM_SET_EVENT_MASK** message. If input-context-ID is set to zero, the default value of the input-method-ID will be changed to the event masks specified in the request. That value will be used for the IC's which have no individual values.

Using the Dynamic Event Flow model, an IM Server sends **XIM_REGISTER_TRIGGERKEYS** message to the IM library before sending **XIM_OPEN_REPLY** message. Or the IM library may suppose that the IM Server uses the Static Event Flow model.

XIM_REGISTER_TRIGGERKEYS (IM Server → IM library)

2	CARD16	input-method-ID
2		unused
4	n	byte length of on-keys
n	LISTofXIMTRIGGERKEY	on-keys list
4	m	byte length of off-keys
m	LISTofXIMTRIGGERKEY	off-keys list

XIM_REGISTER_TRIGGERKEYS is an asynchronous request. The IM Server notifys the IM library of on-keys and off-keys lists with this message.

The IM library notifys the IM Server with **XIM_TRIGGER_NOTIFY** message that a key event matching either on-keys or off-keys has been occurred.

XIM_TRIGGER_NOTIFY (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	CARD32	flag
	#0	on-keys list
	#1	off-keys list
4	CARD32	index of keys list
4	EVENTMASK	client-select-event-mask (*1)

(*1) Specify the events currently selected by the IM library with XSelectInput.

XIM_TRIGGER_NOTIFY is a synchronous request. The IM library should wait until receiving either an **XIM_TRIGGER_NOTIFY_REPLY** packet or an **XIM_ERROR** packet.

XIM_TRIGGER_NOTIFY_REPLY (IM Server → IM library)

2	CARD16	input-method-ID

2	CARD16	input-context-ID

4.6. Encoding Negotiation

XIM_ENCODING_NEGOTIATION message requests to decide which encoding to be sent across the wire. When the negotiation fails, the fallback default encoding is Portable Character Encoding.

XIM_ENCODING_NEGOTIATION (IM library → IM Server).sp 6p

2	CARD16	input-method-ID
2	n	byte length of encodings listed by name
n	LISTofSTR	list of encodings supported in the IM library.
p		unused, p = Pad(n)
2	m	byte length of encodings listed by detailed data
2		unused
m	LISTofENCODINGINFO	list of encordings supported in the IM library

The IM Server must choose one encoding from the list sent by the IM library. If index of the encording determined is -1 to indicate that the negotiation is failed, the fallback default encoding is used. The message must be issued after sending **XIM_OPEN** message via XOpenIM(). The name of encoding may be registered with X Consortium.

XIM_ENCODING_NEGOTIATION is a synchronous request. The IM library should wait until receiving either an **XIM_ENCODING_NEGOTIATION_REPLY** packet or an **XIM_ERROR** packet.

XIM_ENCODING_NEGOTIATION_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	category of the encoding determined.
	#0	name
	#1	detailed data
2	INT16	index of the encoding determinated.
2		unused

4.7. Query the supported extension protocol list

XIM_QUERY_EXTENSION message requests to query the IM extensions supported by the IM Server to which the client is being connected.

XIM_QUERY_EXTENSION (IM library → IM Server)

2	CARD16	input-method-ID
2	n	byte length of extensions supported by the IM library
n	LISTofSTR	extensions supported by the IM library
p		unused, p = Pad(n)

An example of a supported extension is FrontEnd. The message must be issued after sending **XIM_OPEN** message via XOpenIM().

If n is 0, the IM library queries the IM Server for all extensions.

If n is not 0, the IM library queries whether the IM Server supports the contents specified in the list.

If a client uses an extension request without previously having issued a **XIM_QUERY_EXTENSION** message for that extension, the IM Server responds with a **BadProtocol** error. If the IM Server encounters a request with an unknown MAJOR-OPCODE or MINOR-OPCODE, it responds with a **BadProtocol** error.

XIM_QUERY_EXTENSION is a synchronous request. The IM library should wait until receiving either an **XIM_QUERY_EXTENSION_REPLY** packet or an **XIM_ERROR** packet.

XIM_QUERY_EXTENSION_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	n	byte length of extensions supported by both the IM library and the IM Server
n	LISTofEXT	list of extensions supported by both the IM library and the IM Server

XIM_QUERY_EXTENSION_REPLY message returns the list of extensions supported by both the IM library and the IM Server. If the list passed in **XIM_QUERY_EXTENSION** message is NULL, the IM Server returns the full list of extensions supported by the IM Server. If the list is not NULL, the IM Server returns the extensions in the list that are supported by the IM Server.

A zero-length string is not a valid extension name. The IM library should disregard any zero-length strings that are returned in the extension list. The IM library does not use the requests which are not supported by the IM Server.

4.8. Setting IM Values

XIM_SET_IM_VALUES requests to set attributes to the IM.

XIM_SET_IM_VALUES (IM library → IM Server)

2	CARD16	input-method-ID
2	n	byte length of im-attribute
n	LISTofXIMATTRIBUTE	im-attributes

The im-attributes in **XIM_SET_IM_VALUES** message are specified as a LISTofXIMATTRIBUTE, specifying the attributes to be set. Attributes other than the ones returned by **XIM_OPEN_REPLY** message should not be specified.

XIM_SET_IM_VALUES is a synchronous request. The IM library should wait until receiving either an **XIM_SET_IM_VALUES_REPLY** packet or an **XIM_ERROR** packet, because it must receive the error attribute if **XIM_ERROR** message is returned.

XIM_SET_IM_VALUES_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2		unused

XIM_SET_IM_VALUES_REPLY message returns the input-method-ID to distinguish replies from multiple IMs.

4.9. Getting IM Values

XIM_GET_IM_VALUES requests to query IM values supported by the IM Server currently being connected.

XIM_GET_IM_VALUES (IM library → IM Server)

2	CARD16	input-method-ID
2	n	byte length of im-attribute-id
n	LISTofCARD16	im-attribute-id
p		unused, p=Pad(n)

XIM_GET_IM_VALUES is a synchronous request. The IM library should wait until it receives either an **XIM_GET_IM_VALUES_REPLY** packet or an **XIM_ERROR** packet.

XIM_GET_IM_VALUES_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	n	byte length of im-attributes returned
n	LISTofXIMATTRIBUTE	im-attributes returned

The IM Server returns IM values with **XIM_GET_IM_VALUES_REPLY** message. The order of the returned im-attribute values corresponds directly to that of the list passed with the **XIM_GET_IM_VALUES** message.

4.10. Creating an IC

XIM_CREATE_IC message requests to create an IC.

XIM_CREATE_IC (IM library → IM Server)

2	CARD16	input-method-ID
2	n	byte length of ic-attributes
n	LISTofXICATTRIBUTE	ic-attributes

The input-context-id is specified by the IM Server to identify the client (IC). (It is not specified by the client in **XIM_CREATE_IC** message.), and it should not be set to zero.

XIM_CREATE_IC is a synchronous request which returns the input-context-ID. The IM library should wait until it receives either an **XIM_CREATE_IC_REPLY** packet or an **XIM_ERROR** packet.

XIM_CREATE_IC_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

4.11. Destroying the IC

XIM_DESTROY_IC message requests to destroy the IC.

XIM_DESTROY_IC (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

XIM_DESTROY_IC is a synchronous request. The IM library should not free its resources until it receives an **XIM_DESTROY_IC_REPLY** message because **XIM_DESTROY_IC** message may result in Callback packets such as **XIM_PREEDIT_DRAW** and **XIM_PREEDIT_DONE.**

XIM_DESTROY_IC_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

4.12. Setting IC Values

XIM_SET_IC_VALUES messages requests to set attributes to the IC.

XIM_SET_IC_VALUES (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	n	byte length of ic-attributes
2		unused
n	LISTofXICATTRIBUTE	ic-attributes

The ic-attributes in **XIM_SET_IC_VALUES** message are specified as a LISTofXICATTRIBUTE, specifying the attributes to be set. Attributes other than the ones returned by **XIM_OPEN_REPLY** message should not be specified.

XIM_SET_IC_VALUES is a synchronous request. The IM library should wait until receiving either an **XIM_SET_IC_VALUES_REPLY** packet or an **XIM_ERROR** packet, because it must receive the error attribute if **XIM_ERROR** message is returned.

XIM_SET_IC_VALUES_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

4.13. Getting IC Values

XIM_GET_IC_VALUES message requests to query IC values supported by the IM Server currently being connected.

XIM_GET_IC_VALUES (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	n	byte length of ic-attribute-id
n	LISTofCARD16	ic-attribute-id
p		unused, p=Pad(2+n)

In LISTofCARD16, the appearance of the ic-attribute-id for the separator of NestedList shows the end of the heading nested list.

XIM_GET_IC_VALUES is a synchronous request and returns each attribute with its values to show the correspondence. The IM library should wait until receiving either an **XIM_GET_IC_VALUES_REPLY** packet or an **XIM_ERROR** packet.

XIM_GET_IC_VALUES_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	n	byte length of ic-attribute
2		unused
n	LISTofXICATTRIBUTE	ic-attribute

4.14. Setting IC Focus

XIM_SET_IC_FOCUS message requests to set the focus to the IC.

XIM_SET_IC_FOCUS (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

XIM_SET_IC_FOCUS is an asynchronous request.

4.15. Unsetting IC Focus

XIM_UNSET_IC_FOCUS message requests to unset the focus to the focused IC.

XIM_UNSET_IC_FOCUS (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

XIM_UNSET_IC_FOCUS is an asynchronous request.

4.16. Filtering Events

Event filtering is mainly provided for BackEnd method to allow input method to capture X events transparently to clients.

X Events are forwarded by **XIM_FORWARD_EVENT** message. This message can be operated both synchronously and asynchronously. If the requester sets the synchronous flag, the receiver must send **XIM_SYNC_REPLY** message back to the requester when all the data processing is done.

Protocol flow of BackEnd model

With BackEnd method, the protocol flow can be classified into two methods in terms of synchronization, depending on the synchronous-eventmask of **XIM_SET_EVENT_MASK** message. One can be called on-demand-synchronous method and another can be called as full-synchronous method.

In on-demand-synchronous method, the IM library always receives **XIM_FORWARD_EVENT** or **XIM_COMMIT** message as a synchronous request. Also, the IM Server needs to synchronously process the correspondent reply from the IM library and the following **XIM_FORWARD_EVENT** message sent from the IM library when any of the event causes the IM Server to send **XIM_FORWARD_EVENT** or **XIM_COMMIT** message to the IM library, so that the input service is consistent. If the IM library gets the control back from the application after receiving the synchronous request, the IM library replies for the synchronous request before processing any of the events. In this time, the IM Server blocks **XIM_FORWARD_EVENT** message which is sent by the IM library, and handles it after receiving the reply. However, the IM Server handles the other protocols at any time.

In full-synchronous method, the IM library always sends **XIM_FORWARD_EVENT** message to the IM Server as a synchronous request. Therefore, the reply to it from the IM Server will be put between the **XIM_FORWARD_EVENT** message and its **XIM_SYNC_REPLY** message. In case of sending **XIM_FORWARD_EVENT** or **XIM_COMMIT** message, the IM Server should set the synchronous flag off. Because the synchronization can be done by the following **XIM_SYNC_REPLY** message.

Sample Protocol flow chart 1

Following chart shows one of the simplest protocol flow which only deals with keyevents for preediting operation.

... 0.425 6.888 6.3 10.296 ... 0.000i 3.408i 5.875i 0.000i

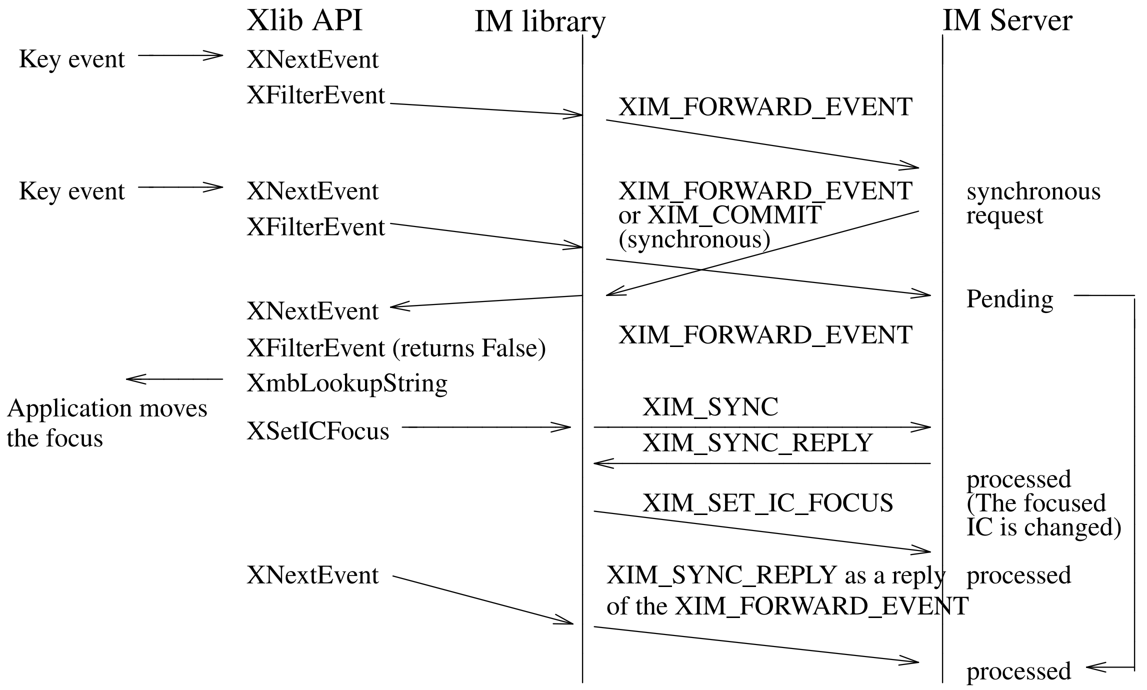

Fig.2 Sample Protocol Flow

Sample Protocol flow chart 2

Following chart shows one of the complex protocol flow, which deals with multiple focus windows and button press event as well as keyevent, and the focus is moved by the application triggered by both of keyevent and button press event.

... 0.425 5.575 6.3 10.296 ... 0.000i 4.721i 5.875i 0.000i

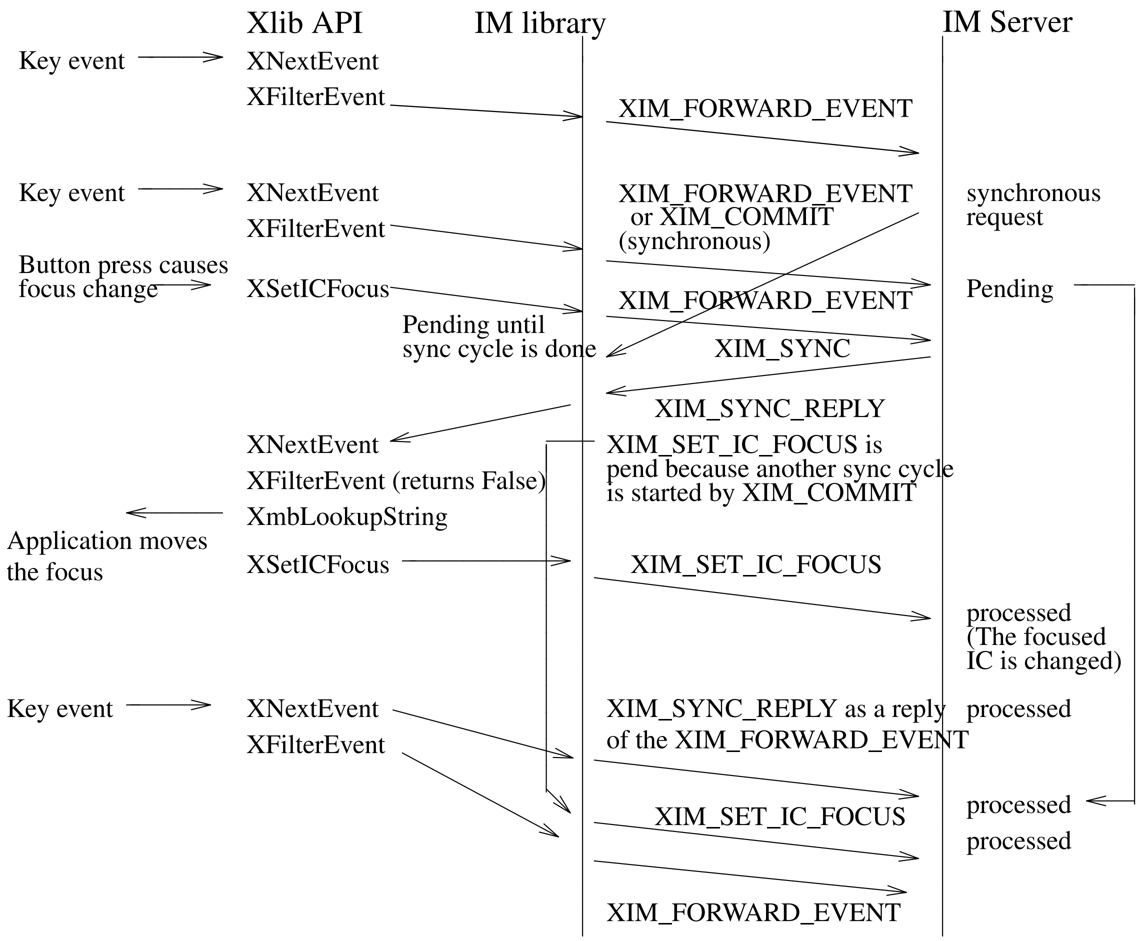

Fig.3 Sample Protocol Flow chart

XIM_FORWARD_EVENT (IM library ←→ IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	BITMASK16	flag
	#0001	synchronous
	#0002	request filtering (*1)
	#0004	request lookupstring (*2)
2	CARD16	serial number
	XEVENT	X event

(*1) Indicate the receiver should filter events and possible preedit may be invoked.

(*2) Indicate the receiver should only do lookup string. The IM Server is expected to just do a conversion of the key event to the best candidate. This bit may affect the state of the preedit state (e.g. compose of dead key sequences).

XEVENT format is same as the X Protocol event format(xEvent). As the value of xEvent's sequenceNumber is the bottom of 16 bit of XEvent's xany.serial, the top of 16 bit is sent by serial number(INT16).

XIM_FORWARD_EVENT message is used for forwarding the events from the IM library to the IM Server in order for IM to be able to filter the event. On the other hand, this message is also used for forwarding the events from the IM Server to the IM library if the event forwarded from the IM library is not filtered. The IM Server, which receives **XIM_FORWARD_EVENT** message without synchronous bit, should set synchronous bit. If both ‘‘request event filtering’’ and ‘‘request lookupstring’’ flag are set, then both filtering and lookup should be done for the same event.

4.17. Synchronizing with the IM Server

XIM_SYNC message requests to synchronize the IM library and the IM Server.

XIM_SYNC (IM library ←→ IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

This synchronization can be started either on the IM library side or on the IM Server side. The side which receives **XIM_SYNC** message should process all XIM requests before replying. The input-context-ID is necessary to distinguish the IC with which the IM library and the IM Server are synchronized.

XIM_SYNC_REPLY (IM Server ←→ IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

The side which receives **XIM_FORWARD_EVENT,** **XIM_COMMIT** or any other message with synchronous bit, should process all XIM request before replying, and send **XIM_SYNC_REPLY** message as the reply to the previous message.

4.18. Sending a committed string

When the IM Server commits a string, the IM Server sends either the committed string or list of KeySym, or both, by **XIM_COMMIT** message.

XIM_COMMIT (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	BITMASK16	flag
	#0001	synchronous
	#0002	XLookupChars
	#0004	XLookupKeySym
	#0006	XLookupBoth = XLookupChars | XLookupKeySym

If flag is XLookupKeySym, the arguments continue as follows:

2		unused
4	KEYSYM	KeySym

If flag is XLookupChars, the arguments continue as follows:

2	m	byte length of committed string

m	LISTofBYTE	committed string
p		unused, p = Pad(m)

If flag is XLookupBoth, the arguments continue as follows:

2		unused
4	KEYSYM	KeySym
2	n	byte length of committed string
n	LISTofBYTE	committed string
p		unused, p = Pad(2+n)

The IM Server which receives **XIM_COMMIT** message without synchronous bit should set synchronous bit.

4.19. Reset IC

XIM_RESET_IC message requests to reset the status of IC in the IM Server.

XIM_RESET_IC (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

XIM_RESET_IC is a synchronous request. The IM library should wait until receiving either an **XIM_RESET_IC_REPLY** packet or an **XIM_ERROR** packet.

XIM_RESET_IC_REPLY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	n	byte length of preedit string
n	LISTofBYTE	preedit string
p		unused, p = Pad(2+n)

XIM_RESET_IC_REPLY message returns the input-context-ID to distinguish replies from multiple ICs.

4.20. Callbacks

If XIMStyle has XIMPreeditArea or XIMStatusArea set, XIMGeometryCallback may be used, and if XIMPreeditCallback and/or XIMStatusCallback are set, corresponding callbacks may be used.

Any callback request may be sent from an IM Server to an IM client asynchronously in response to any request previously sent by the IM client to the IM Server.

When an IM Server needs to send a callback request synchronously with the request previously sent by an IM client, the IM Server sends it before replying to the previous request.

4.20.1. Negotiating geometry

The IM Server sends **XIM_GEOMETRY** message to start geometry negotiation, if XIMStyle has XIMPreeditArea or XIMStatusArea set.

XIM_GEOMETRY (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

There is always a single Focus Window, even if some input fields have only one IC.

4.20.2. Converting a string

XIM_STR_CONVERSION (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	CARD16	XIMStringConversionPosition
2		unused
4	CARD32	XIMCaretDirection
	#0	XIMForwardChar
	#1	XIMBackwardChar
	#2	XIMForwardWord
	#3	XIMBackwardWord
	#4	XIMCaretUp
	#5	XIMCaretDown
	#6	XIMNextLine
	#7	XIMCPreviousLine
	#8	XIMLineStart
	#9	XIMLineEnd
	#10	XIMAbsolutePosition
	#11	XIMDontChange
2	CARD16	factor
2	CARD16	XIMStringConversionOperation
	#0001	XIMStringConversionSubstitution
	#0002	XIMStringConversionRetrieval
2	INT16	byte length to multiply the XIMStringConversionType

XIM_STR_CONVERSION message may be used to start the string conversion from the IM Server.

XIM_STR_CONVERSION_REPLY (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	CARD32	XIMStringConversionFeedback
	XIMSTRCONVTEXT	XIMStringConversionText

XIM_STR_CONVERSION_REPLY message returns the string to be converted and the feedback information array.

4.20.3. Preedit Callbacks

The IM Server sends **XIM_PREEDIT_START** message to call the XIMPreeditStartCallback function.

XIM_PREEDIT_START (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

The reply to this message must be sent synchronously. The reply forwards the return value from the callback function to the IM Server.

XIM_PREEDIT_START_REPLY (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	INT32	return value

XIM_PREEDIT_START_REPLY message returns the input-context-ID to distinguish replies from multiple IC's. The return value contains the return value of the function XIMPreeditStart-Callback.

The IM Server sends **XIM_PREEDIT_DRAW** message to call the XIMPreeditDrawCallback function.

XIM_PREEDIT_DRAW (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	INT32	caret
4	INT32	chg_first
4	INT32	chg_length
4	BITMASK32	status
	#x0000001	no string
	#x0000002	no feedback
2	n	length of preedit string
n	STRING8	preedit string
p		unused, p = Pad(2+n)
2	m	byte length of feedback array
2		unused
m	LISTofXIMFEEDBACK	feedback array

The fields "caret", "chg_first" and "chg_length" correspond to the fields of XIMPreeditDraw-CallbackStruct. When the "no string" bit of the status field is set, the text field of XIMPreedit-DrawCallbackStruct is NULL. When the "no feedback" bit of the status field is set, the text feedback field of XIMPreeditDrawCallbackStruct is NULL. When the above bits are not set, "preedit string" contains the preedit string to be displayed, and the feedback array contains feed-back information.

The IM Server sends **XIM_PREEDIT_CARET** message to call the PreeditCaretCallback function.

XIM_PREEDIT_CARET (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	INT32	position
4	CARD32	direction
	#0	XIMForwardChar

	#1	XIMBackwardChar
	#2	XIMForwardWord
	#3	XIMBackwardWord
	#4	XIMCaretUp
	#5	XIMCaretDown
	#6	XIMNextLine
	#7	XIMCPreviousLine
	#8	XIMLineStart
	#9	XIMLineEnd
	#10	XIMAbsolutePosition
	#11	XIMDontChange
4	CARD32	style
	#0	XIMInvisible
	#1	XIMCPrimary
	#2	XIMSecondary

Each entry corresponds to a field of XIMPreeditCaretCallbackStruct. Since this callback sets the caret position, its reply must be sent synchronously.

XIM_PREEDIT_CARET_REPLY (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	CARD32	position

The position is the value returned by the callback function after it has been called.

The IM Server sends **XIM_PREEDIT_DONE** message to call the XIMPreeditDoneCallback function.

XIM_PREEDIT_DONE (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

4.20.4. Preedit state notify

XIM_PREEDITSTATE (IM Server → IM Library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	BITMASK32	XIMPreeditState
	#x0000000	XIMPreeditUnknown
	#x0000001	XIMPreeditEnable
	#x0000002	XIMPreeditDisable

XIM_PREEDITSTATE message is used to call the XIMPreeditStateNotifyCallback function.

4.20.5. Status Callbacks

The IM Server sends **XIM_STATUS_START** message to call the XIMStatusStartCallback function.

XIM_STATUS_START (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

The IM Server sends **XIM_STATUS_DRAW** message to call the XIMStatusDrawCallback function.

XIM_STATUS_DRAW (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	CARD32	type
	#0	XIMTextType
	#1	XIMBitmapType

If type is XIMTextType, the arguments continue as follows.

4	BITMASK32	status
	#x0000001	no string
	#x0000002	no feedback
2	n	length of status string
n	STRING8	status string
p		unused, p = Pad(2+n)
2	m	byte length of feedback array
2		unused
m	LISTofXIMFEEDBACK	feedback array

If type is XIMBitmapType, the arguments continue as follows.

4	PIXMAP	pixmap data

The field ‘‘type’’ corresponds to the field in XIMStatusDrawCallbackStruct.

The IM Server sends **XIM_STATUS_DONE** message to call the XIMStatusDoneCallback function.

XIM_STATUS_DONE (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID

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6. References

All of the following documents are X Consortium standards available from MIT:

[1] Scheifler, Robert W., *“X Window System Protocol Version 11”*

[2] Scheifler, Robert W. etc., *“Xlib − C Language X Interface”*

Appendix A

Common Extensions

Extension opcodes and packet names (e.g. **XIM_EXT_SET_EVENT_MASK**) for additional extensions may be registered with X Consortium. The following is a commonly well-known extended packet.

(1) Extension to manipulate the event handling

XIM_EXT_SET_EVENT_MASK message specifies the set of event masks that the IM library should manipulate.

XIM_EXT_SET_EVENT_MASK (IM Server → IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
4	EVENTMASK	filter-event-mask (*1)
4	EVENTMASK	intercept-event-mask (*2)
4	EVENTMASK	select-event-mask (*3)
4	EVENTMASK	forward-event-mask (*4)
4	EVENTMASK	synchronous-event-mask (*5)

(*1) Specify the events to be neglected by the IM library via XFilterEvent.

(*2) Specify the events to be deselected by the IM library with XSelectInput.

(*3) Specify the events to be selected by the IM library with XSelectInput.

(*4) Specify all the events to be forwarded to the IM Server by the IM library.

(*5) Specify the events to be forwarded with synchronous flag on by the IM library.

The IM library must reply **XIM_SYNC_REPLY** message to the IM Server. This request is valid after the ic is created.

(2) Extension for improvement of performance

The following requests may be used for improvement of performance.

XIM_EXT_FORWARD_KEYEVENT message may be used instead of **XIM_FORWARD_EVENT** message.

XIM_EXT_FORWARD_KEYEVENT (IM Server ←→ IM library)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	BITMASK16	flag
	#0001	synchronous
2	CARD16	sequence number
1	BYTE	xEvent.u.u.type
1	BYTE	keycode
2	CARD16	state
4	CARD32	time
4	CARD32	window

XIM_EXT_MOVE message may be used to change the spot location instead of XIM_SET_IC_VALUES message. It is effective only if the client specified XIMPreeditPosition.

XIM_EXT_MOVE (IM library → IM Server)

2	CARD16	input-method-ID
2	CARD16	input-context-ID
2	INT16	X
2	INT16	Y

XIM_EXT_MOVE message is a asynchronous request.

Appendix B

The list of transport specific IM Server address format registered

The following format represents the ATOM contained in **XIM_SERVERS** property and the string returned from the request converting selection target LOCALES and TRANSPORT.

“{@*category*=[*value*,...]}...”

The following categories are currently registered.

server	: IM Server name (used for XIM_SERVERS)
locale	: XPG4 locale name (LOCALES)
transport	: transport-specific name (TRANSPORT)

The preregistered formats for transport-specific names are as follows:

TCP/IP Names

The following syntax should be used for system internal domain names:

<*local name*> ::= “local/”<*hostname*>“:”<*pathname*>

Where <*pathname*> is a path name of socket address.

IM Server’s name should be set to <*pathname*> to run multiple IM Server at the same time

The following syntax should be used for Internet domain names:

<*TCP name*> ::= “tcp/”<*hostname*>“:”<*ipportnumber*>

where <*hostname*> is either symbolic (such as expo.lcs.mit.edu) or numeric decimal (such as 18.30.0.212). The <*ipportnumber*> is the port on which the IM Server is listening for connections. For example:

tcp/expo.lcs.mit.edu:8012
tcp/18.30.0.212:7890

DECnet Names

The following syntax should be used for DECnet names:

<*DECnet name*> ::= “decnet/”<*nodename*>“::IMSERVER$”<*objname*>

where <*nodename*> is either symbolic (such as SRVNOD) or the numeric decimal form of the DECnet address (such as 44.70). The <*objname*> is normal, case-insensitive DECnet object name. For example:

DECNET/SRVNOD::IMSERVER$DEFAULT
decnet/44.70::IMSERVER$other

X Names

The following syntax should be used for X names:

<*X name*> ::= “X/”

If a given category has multiple values, the value is evaluated in order of setting.

Appendix C

Protocol number

Major Protocol number

XIM_CONNECT	#001
XIM_CONNECT_REPLY	#002
XIM_DISCONNECT	#003
XIM_DISCONNECT_REPLY	#004
XIM_AUTH_REQUIRED	#010
XIM_AUTH_REPLY	#011
XIM_AUTH_NEXT	#012
XIM_AUTH_SETUP	#013
XIM_AUTH_NG	#014
XIM_ERROR	#020
XIM_OPEN	#030
XIM_OPEN_REPLY	#031
XIM_CLOSE	#032
XIM_CLOSE_REPLY	#033
XIM_REGISTER_TRIGGERKEYS	#034
XIM_TRIGGER_NOTIFY	#035
XIM_TRIGGER_NOTIFY_REPLY	#036
XIM_SET_EVENT_MASK	#037
XIM_ENCODING_NEGOTIATION	#038
XIM_ENCODING_NEGOTIATION_REPLY	#039
XIM_QUERY_EXTENSION	#040
XIM_QUERY_EXTENSION_REPLY	#041
XIM_SET_IM_VALUES	#042
XIM_SET_IM_VALUES_REPLY	#043
XIM_GET_IM_VALUES	#044
XIM_GET_IM_VALUES_REPLY	#045
XIM_CREATE_IC	#050
XIM_CREATE_IC_REPLY	#051
XIM_DESTROY_IC	#052
XIM_DESTROY_IC_REPLY	#053
XIM_SET_IC_VALUES	#054
XIM_SET_IC_VALUES_REPLY	#055
XIM_GET_IC_VALUES	#056
XIM_GET_IC_VALUES_REPLY	#057
XIM_SET_IC_FOCUS	#058
XIM_UNSET_IC_FOCUS	#059
XIM_FORWARD_EVENT	#060
XIM_SYNC	#061
XIM_SYNC_REPLY	#062
XIM_COMMIT	#063

XIM_RESET_IC	#064
XIM_RESET_IC_REPLY	#065
XIM_GEOMETRY	#070
XIM_STR_CONVERSION	#071
XIM_STR_CONVERSION_REPLY	#072
XIM_PREEDIT_START	#073
XIM_PREEDIT_START_REPLY	#074
XIM_PREEDIT_DRAW	#075
XIM_PREEDIT_CARET	#076
XIM_PREEDIT_CARET_REPLY	#077
XIM_PREEDIT_DONE	#078
XIM_STATUS_START	#079
XIM_STATUS_DRAW	#080
XIM_STATUS_DONE	#081
XIM_PREEDITSTATE	#082

(*) The IM Server's extension protocol number should be more than #128.

Appendix D

Implementation Tips

(1) FrontEnd Method

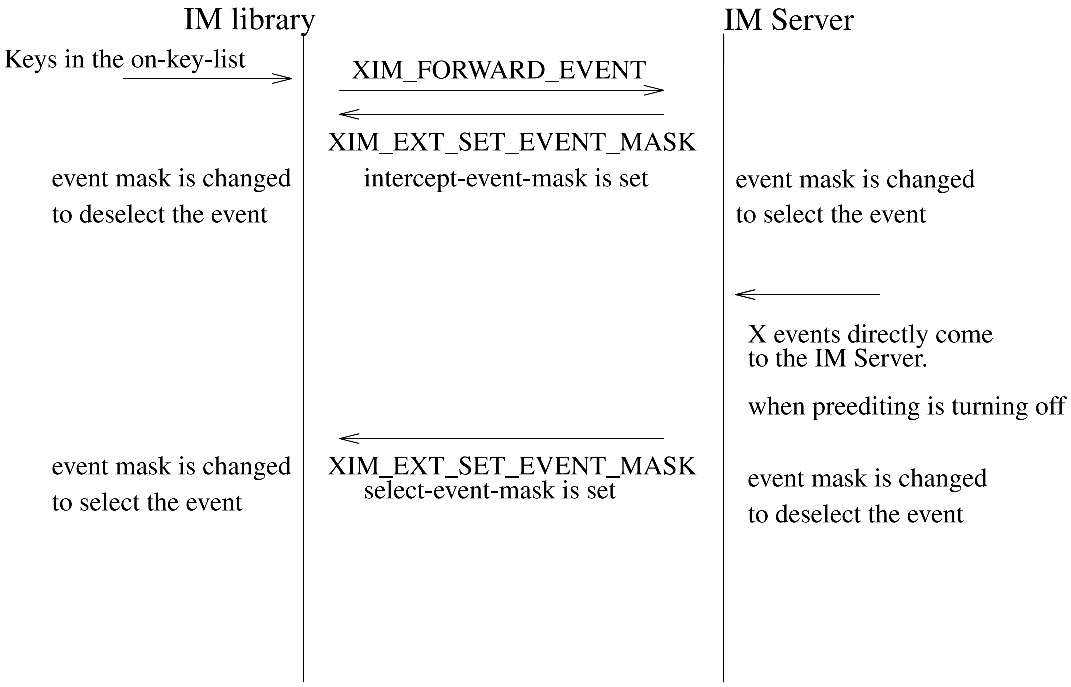
FrontEnd method is recognized as a performance acceleration by the trade off of the variety of the reliability.

In order to use the FrontEnd method, the IM library must query the IM Server to see if the FrontEnd extension is available. The query is made by using the **XIM_QUERY_EXTENSION** message. The IM Server may send **XIM_EXT_SET_EVENT_MASK** message with intercept-event-mask, forward-event-mask, and synchronous-event-mask values set after replying **XIM_QUERY_EXTENSION_REPLY** message.

FrontEnd method can be implemented in a couple of ways depending on how the IM Server utilize **XIM_EXT_SET_EVENT_MASK** message.

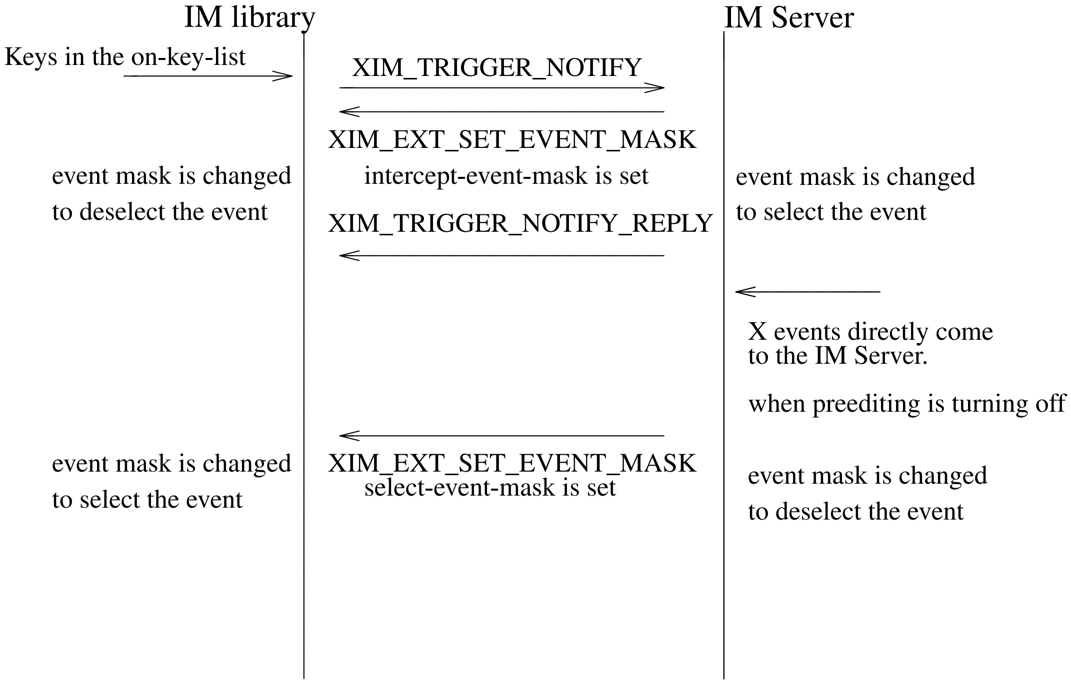
One approach is to update both of the input mask and the filter-event-mask depending on the preeidting state. The sample protocol sequence using the static event flow is as follows:

... 1.675 6.888 6.237 10.296 ... 0.000i 3.408i 4.562i 0.000i



To pursuit a maximum performance regardless of the preediting mode, the IM Server may use the dynamic event flow with the following sample protocol sequence.

... 1.675 6.888 6.237 10.296 ... 0.000i 3.408i 4.562i 0.000i



This method can reduce the XIM protocol traffic dramatically by updating intercept-event-mask and select-event-mask accordingly. The tradeoff of this performance improvement is that the key events may be lost or disordered in some particular situation, such as when the user types the keyboard in following sequence really fast:

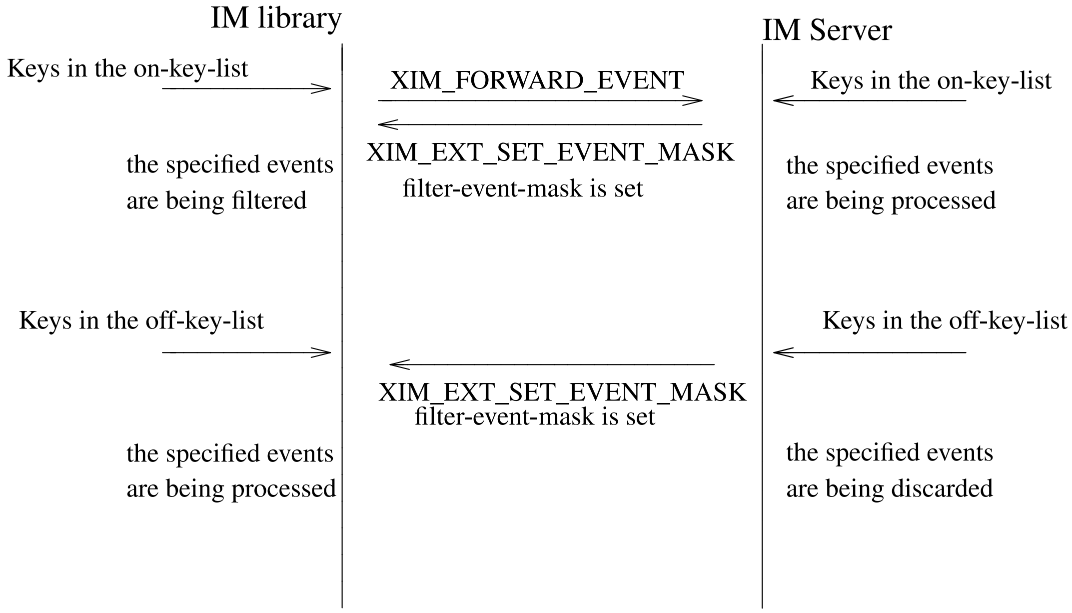
<preediting on key>‘‘some strings’’<preediting off key>‘‘another string’’

Since this method requires the input mask updates to the both the IM Server and Xlib when turning on and off the preediting, and there is a time lag till the requests take effect when two client issues the input mask updates simultaneously.

Another approach of the FrontEnd method is to update the filter-event-mask depending on the preediting state and not to update the input mask. The IM Server must register both of the preediting on key list and off key list by **XIM_REGISTER_TRIGGERKEYS** message. In this method, Both the IM Server and the IM client select the same events on the same client’s window, so that the events are delivered to both of the IM Server and the client. The preediting on and off states are expressed by whether the key events are filtered or not. The sample protocol sequence are as follows:

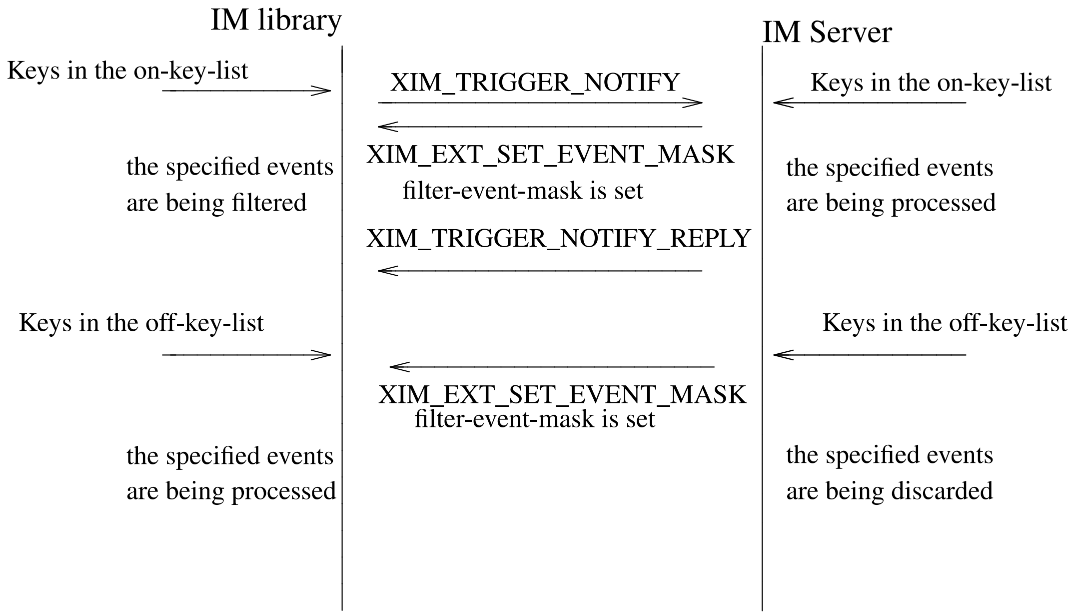
<<Using static event flow>>

... 1.488 7.325 6.487 10.358 ... 0.000i 3.033i 4.999i 0.000i



<<Using the dynamic event flow>>

... 1.488 7.325 6.487 10.358 ... 0.000i 3.033i 4.999i 0.000i



This method does not have the problem of the time lag when going across the preediting on and off mode, however, the amount of the performance acceleration is not as good as the method described above.

In general, the FrontEnd method requires some synchronization to some of the X protocols, such as the ChangeWindowAttribute protocol for the event mask change or the GrabKey protocol, since it relies on the X's principal event dispatching mechanism. Any X protocol bindings do not consider the synchronization might cause some mis-synchronization between the IM clients and the IM Server.

(2) Transport Layer

The Xlib XIM implementation is layered into three functions, a protocol layer, an interface layer and a transport layer. The purpose of this layering is to make the protocol independent of transport implementation. Each function of these layers are:

The protocol layer
: implements overall function of XIM and calls the interface layer functions when it needs to communicate to IM Server.

The interface layer
: separates the implementation of the transport layer from the protocol layer, in other words, it provides implementation independent hook for the transport layer functions.

The transport layer
: handles actual data communication with IM Server. It is done by a set of several functions named transporters.

The interface layer and the transport layer make various communication channels usable such as X Protocol, TCP/IP, DECnet or STREAM. The following is a sample implementation for the transporter using the X connection. Refer to "xtrans" for the transporter using Socket Transport.

At the beginning of the X Transport connection for the XIM transport mechanism, two different windows must be created either in an Xlib XIM or in an IM Server, with which the Xlib and the IM Server exchange the XIM transports by using the ClientMessage events and Window Properties. In the following, the window created by the Xlib is referred as the "client communication window", and on the other hand, the window created by the IM Server is referred as the "IMS communication window".

Connection

In order to establish a connection, a communication window is created. A ClientMessage in the following event's format is sent to the owner window of XIM_SERVER selection, which the IM Server has created.

Refer to "The Input Method Protocol" for the XIM_SERVER atom.

Table D-1; The ClientMessage sent to the IMS window.

Structure Member		**Contents**
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	IMS Window ID
Atom	message_type	XInternAtom(display, ‘‘_XIM_XCONNECT’’, False)
int	format	32
long	data.l[0]	client communication window ID
long	data.l[1]	client-major-transport-version (*1)
long	data.l[2]	client-major-transport-version (*1)

In order to establish the connection (to notify the IM Server communication window), the IM Server sends a ClientMessage in the following event's format to the client communication window.

Table D-2; The ClientMessage sent by IM Server.

Structure Member		**Contents**
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	client communication window ID
Atom	message_type	XInternAtom(display, ‘‘_XIM_XCONNECT’’, False)
int	format	32
long	data.l[0]	IMS communication window ID
long	data.l[1]	server-major-transport-version (*1)
long	data.l[2]	server-minor-transport-version (*1)
long	data.l[3]	dividing size between ClientMessage and Property (*2)

(*1) major/minor-transport-version

The read/write method is decided by the combination of major/minor-transport-version, as follows:

Table D-3; The read/write method and the major/minor-transport-version

Transport-version		**read/write**
major	**minor**	
0	0 1 2	only-CM & Property-with-CM only-CM & multi-CM only-CM & multi-CM & Property-with-CM
1	0	PropertyNotify
2	0 1	only-CM & PropertyNotify only-CM & multi-CM & PropertyNotify

only-CM	:	data is sent via a ClientMessage
multi-CM	:	data is sent via multiple ClientMessages
Property-with-CM	:	data is written in Property, and its Atom is send via ClientMessage
PropertyNotify	:	data is written in Property, and its Atom is send via PropertyNotify

The method to decide major/minor-transport-version is as follows:

(1) The client sends 0 as major/minor-transport-version to the IM Server. The client must support all methods in Table D-3. The client may send another number as major/minor-transport-version to use other method than the above in the future.

(2) The IM Server sends its major/minor-transport-version number to the client. The client sends data using the method specified by the IM Server.

(3) If major/minor-transport-version number is not available, it is regarded as 0.

(*2) dividing size between ClientMessage and Property
If data is sent via both of multi-CM and Property, specify the dividing size between ClientMessage and Property. The data, which is smaller than this size, is sent via multi-CM (or only-CM), and the data, which is lager than this size, is sent via Property.

read/write

The data is transferred via either ClientMessage or Window Property in the X Window System.

Format for the data from the Client to the IM Server

ClientMessage

If data is sent via ClientMessage event, the format is as follows:

Table D-4; The ClientMessage event's format (first or middle)

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	IMS communication window ID
Atom	message_type	XInternAtom(display, ‘‘_XIM_MOREDATA’’, False)
int	format	8
char	data.b[20]	(read/write DATA : 20 byte)

Table D-5; The ClientMessage event's format (only or last)

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	IMS communication window ID
Atom	message_type	XInternAtom(display, ‘‘_XIM_PROTOCOL’’, False)
int	format	8
char	data.b[20]	(read/write DATA : MAX 20 byte) (*1)

(*1) If the data is smaller than 20 byte, all data other than available data must be 0.

Property

In the case of large data, data will be sent via the Window Property for the efficiency. There are the following two methods to notify Property, and transport-version is decided which method is used.

(1) The XChangeProperty function is used to store data in the client communication window, and Atom of the stored data is notified to the IM Server via ClientMessage event.

(2) The XChangeProperty function is used to store data in the client communication window, and Atom of the stored data is notified to the IM Server via PropertyNotify event.

The arguments of the XChangeProperty are as follows:

Table D-6; The XChangeProperty event's format

Argument		Contents
Display	*display	The display to which connects
Window	window	IMS communication window ID
Atom	property	read/write property Atom (*1)
Atom	type	XA_STRING
int	format	8
int	mode	PropModeAppend
u_char	*data	read/write DATA
int	nelements	length of DATA

(*1) The read/write property ATOM allocates the following strings by **XInternAtom**.
"_clientXXX"

The client changes the property with the mode of PropModeAppend and the IM Server will read it with the delete mode i.e. (delete = True).

If Atom is notified via ClientMessage event, the format of the ClientMessage is as follows:

Table D-7; The ClientMessage event's format to send Atom of property

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	IMS communication window ID
Atom	message_type	XInternAtom(display, "_XIM_PROTOCOL", False)
int	format	32
long	data.l[0]	length of read/write property Atom
long	data.l[1]	read/write property Atom

Format for the data from the IM Server to the Client

ClientMessage

The format of the ClientMessage is as follows:

Table D-8; The ClientMessage event's format (first or middle)

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	client communication window ID

Structure Member		Contents
Atom	message_type	XInternAtom(display, ‘‘_XIM_MOREDATA’’, False)
int	format	8
char	data.b[20]	(read/write DATA : 20 byte)

Table D-9; The ClientMessage event's format (only or last)

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	client communication window ID
Atom	message_type	XInternAtom(display, "_XIM_PROTOCOL", False)
int	format	8
char	data.b[20]	(read/write DATA : MAX 20 byte) (*1)

(*1) If the data size is smaller than 20 bytes, all data other than available data must be 0.

Property

In the case of large data, data will be sent via the Window Property for the efficiency. There are the following two methods to notify Property, and transport-version is decided which method is used.

(1) The XChangeProperty function is used to store data in the IMS communication window, and Atom of the property is sent via the ClientMessage event.

(2) The XChangeProperty function is used to store data in the IMS communication window, and Atom of the property is sent via PropertyNotify event.

The arguments of the XChangeProperty are as follows:

Table D-10; The XChangeProperty event's format

Argument		Contents
Display	*display	The display which to connects
Window	window	client communication window ID
Atom	property	read/write property Atom (*1)
Atom	type	XA_STRING
int	format	8
int	mode	PropModeAppend
u_char	*data	read/write DATA
int	nelements	length of DATA

(*1) The read/write property ATOM allocates some strings, which are not allocated by the client, by **XInternAtom**.

The IM Server changes the property with the mode of PropModeAppend and the client reads it with the delete mode, i.e. (delete = True).

If Atom is notified via ClientMessage event, the format of the ClientMessage is as follows:

Table D-11; The ClientMessage event's format to send Atom of property

Structure Member		Contents
int	type	ClientMessage
u_long	serial	Set by the X Window System
Bool	send_event	Set by the X Window System
Display	*display	The display to which connects
Window	window	client communication window ID
Atom	message_type	XInternAtom(display, ‘‘_XIM_PROTOCOL’’, False)
int	format	32
long	data.l[0]	length of read/write property ATOM
long	data.l[1]	read/write property ATOM

Closing Connection

If the client disconnect with the IM Server, shutdown function should free the communication window properties and etc..

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