

# Low Bandwidth X Extension

Protocol Version 1.0

X Consortium Standard

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\$XConsortium: lbx.mif /main/4 1996/12/21 19:36:48 ray \$

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## 1 Introduction

Low Bandwidth X (LBX) is a network-transparent protocol for running X Window System applications over transport channels whose bandwidth and latency are significantly worse than that used in local area networks. It combines a variety of caching and reencoding techniques to reduce the volume of data that must be sent over the wire. It can be used with existing clients by placing a proxy between the clients and server, so that the low bandwidth/high latency communication occurs between the proxy and server.

This extension was designed and implemented by Jim Fulton, David Lemke, Keith Packard, and Dale Tonogai, all of Network Computing Devices (NCD). Chris Kent Kantarjiev (Xerox PARC) participated in early design discussions. Ralph Mor (X Consortium) designed and implemented additional sections. Donna Converse (X Consortium) authored the protocol description and encoding from design notes and the implementation. Ray Tice (X Consortium) resolved the open issues in the design and specification. Bob Scheifler (X Consortium) helped out in many areas.

The extension name is "LBX".

## 2 Description

The design center for LBX is to use a proxy as an intermediary between the client and server. The proxy reencodes and compresses requests, events, replies and errors, as well as the resulting data stream. Additionally, the proxy can cache information from the server to provide low-latency replies to clients. This reply generation by the proxy is known as short-circuiting. A proxy can handle multiple clients for a given server, but does not prevent clients from connecting directly to the server. The design allows the proxy to multiplex multiple clients into a single data stream to the server.

Much of LBX is implemented as an extension. The compression and reencoding changes can be isolated to the transport and dispatch portions of the server, while short-circuiting requires minor changes to the server's colormap and property code.

LBX employs several different compression and short-circuiting methods. Use of these methods is negotiable, and in some cases, the algorithm used by a given method is negotiable as well. LBX also provides for negotiation of extensions to LBX.

### 2.1 Data Flow

The LBX data stream goes through a number of layers:

0. Client requests
1. Read by LBX and potential byte-swapping
2. Request-specific compression
3. Potential byte swapping
4. Multiplexing of client request streams
5. Delta replacement
6. Stream compression

Transport

6. Stream decompression
5. Delta substitution
4. Demultiplexing of client request streams
3. Potential byte swapping

2. Reencoding
1. Request processing

The reverse process occurs with X server replies, events, and errors.

## 2.2 Tags

Tags are used to support caching of large data items that are expected to be queried multiple times. Such things as the keyboard map and font metrics are often requested by multiple clients. Rather than send the data each time, the first time the data is sent it includes a tag. The proxy saves this data, so that subsequent requests can send only the tag to refer to that same data. The different types of tags are used for connection information, keyboard maps, modifier maps, fonts information and properties.

Tag usage is negotiated as a boolean in the `LbxStartProxy` message. The proxy controls how many tags are stored in the proxy. The server may wish to observe the proxy's `InvalidateTag` behavior to limit how many tags are cached at any one time. Tagged data is not shared across types of tags, but the number space used for the tag ids is. The tag ids are generated by the server.

The X server keeps track of what tags are known to the proxy. The proxy can invalidate a tag if no tag bearing replies of that type are pending. The proxy sends an `LbxInvalidateTag` message to release the tagged data. The proxy must not invalidate connection tags unless instructed to do so by the server.

If the server wishes to discard tagged data, it must either have received an `LbxInvalidateTag` request from the proxy or send an `LbxInvalidateTag` event to the proxy for that tag.

### 2.2.1 Tag Substitution in Requests

Many substitution requests have a tag field, followed by fields marked optional. For these requests, if the optional fields are present, the data in them is stored in the indicated tag, unless the tag is 0. If the optional fields are absent, the tag field indicates the tag that contains the data for the "optional" fields.

### 2.2.2 Property Tags

Property data makes special use of tags. A common use of properties is for inter-client communication. If both clients use the proxy, it is wasteful to send the data to the server and then back, when the server may never need it. `LbxChangeProperty` request does the same work as the core `ChangeProperty` request, but it does not send the data. The reply to this request contains a tag id corresponding to the data. If the property information is used locally, the server responds to `LbxGetProperty` with the tag, and the property data need never be sent to the server. If the server does require the data, it can issue an `LbxQueryTag` message. The proxy can also send the data on at any time if it judges it appropriate (i.e., when the wire goes idle). Since the proxy owns the property data, it must not invalidate the tag before sending the data back to the server via an `LbxTagData` request.

## 2.3 Short-circuiting

Short-circuiting is used to handle constant data. This includes atoms, color name/RGB mappings, and `AllocColor` calls. Atoms and color name/RGB mappings stay constant for the life of the server. `AllocColor` replies are constant for each colormap. Short-circuiting replaces round-trip requests with one-way requests, and can sometimes use one in place of many.

Atoms are used heavily for ICCCM communication. Once the proxy knows the string to atom mapping, it has no need to send subsequent requests for this atom to the server.

Colormap/RGB mappings are constant, so once the proxy sees the response from `LookupColor`, it need not forward any subsequent requests.

Clients often use the same color cells, so once a read-only color allocation has occurred, the proxy knows what RGB values should be returned to the client. The proxy doesn't need to forward any `AllocColor` requests it can resolve, but it must tell the server to modify the color cell's reference count. `LbxIncrementPixel` is used to support this.

For all three classes of short-circuiting, the proxy must still tell the server a request has occurred, so that the request sequence numbers stay in sync. This is done with `LbxModifySequence`.

Sequence numbers cause the major complication with short-circuiting. X guarantees that any replies, events or errors generated by a previous request will be sent before those of a later request. This means that any requests that can be handled by the proxy must have their reply sent after any previous events or errors.

If a proxy's applications do not require strict adherence to the X protocol ordering of errors or events, a proxy might provide further optimization by avoiding the overhead of maintaining this ordering, however, the resulting protocol is not strictly X11 compliant.

## 2.4 Graphics Re-encoding

The LBX proxy attempts to reencode `PolyPoint`, `PolyLine`, `PolySegment`, `PolyRectangle`, `PolyArc`, `FillPoly`, `PolyFillRectangle`, `PolyFillArc`, `CopyArea`, `CopyPlane`, `PolyText8`, `PolyText16`, `ImageText8`, and `ImageText16` requests. If the request can be re-encoded, it may be replaced by an equivalent LBX form of the request. The requests are reencoded by attempting to reduce 2-byte coordinate, length, width and angle fields to 1 byte. Where applicable, the coordinate mode is also converted to `Previous` to improve the compressibility of the resulting data. In image requests, the image data may also be compressed.

## 2.5 Motion events

To prevent clogging the wire with `MotionNotify` events, the server and proxy work together to control the number of events on the wire. This is done with the `LbxAllowMotion` request. The request adds an amount to an allowed motion count in the server, which is kept on a per-proxy basis. Every motion notify event sent to the proxy decrements the allowed motion counter. If the allowed motion count is less than or equal to zero, motion events not required by the X protocol definition are not sent to the proxy. The allowed motion counter has a minimum value of  $-2^{31}$ .

## 2.6 Event Squishing

In the core protocol, all events are padded as needed to be 32 bytes long. The LBX extension reduces traffic by removing padding at the end of events, and implying the event length from its type. This is known as squishing.

## 2.7 Master Client

When the initial X connection between the proxy and the server is converted to LBX mode, the proxy itself becomes the master client. New client requests and some tag messages are sent in the context of the master client.

## 2.8 Multiplexing of Clients

The LBX proxy multiplexes the data streams of all its clients into one stream, and then splits them apart again when they are received. The `LbxSwitch` message is used to tell each end which client is using the wire at the time.

The server should process delta requests in the order that they appear on the LBX connection. If the server does not maintain the interclient request order for requests sent by the proxy, it must still obey the semantics implied by the interclient request order so that the delta cache functions correctly.

The server can affect the multiplexing of clients by the proxy using the `LbxListenToOne` and `LbxListenToAll` messages. This is useful during grabs, since the master connection can not be blocked during grabs like other clients. The proxy is responsible for tracking server grabs issued by its clients so that the proxy can multiplex the client streams in an order executable by the server.

Replies must be ordered in the multiplexed data stream from the server to the proxy such that the reply carrying tagged data precedes replies that refer to that tagged data.

## 2.9 Swapping

Swapping is handled as with any X extension, with one caveat. Since a proxy can be supporting clients with different byte orders, and they all share the same wire, the length fields of all messages between the server and proxy are expressed in the proxy byte order. This prevents any problems with length computation that may occur when clients are switched.

## 2.10 Delta cache

LBX takes advantage of the fact that an X message may be very similar to one that has been previously sent. For example, a `KeyPress` event may differ from a previous `KeyPress` event in just a few bytes. By sending just the bytes that differ (or “deltas”), the number of bytes sent over the wire can be substantially reduced. Delta compaction is used on requests being sent by the proxy as well as on replies and events being sent by the server.

The server and the proxy each keep per-proxy request and response caches. The response cache contains events, errors and replies. All messages are saved in the appropriate delta cache if they are of an appropriate type and more than 8 bytes long but fit within the delta cache. The number of entries in the delta cache and the maximum saved message size are negotiated in the `LbxStartProxy` request.

The LBX requests that are never stored in the request delta cache are the `LbxQueryVersion`, `LbxStartProxy`, `LbxSwitch`, `LbxNewClient`, `LbxAllowMotion`, `LbxDelta`, `LbxQueryExtension`, `LbxPutImage`, `LbxGetImage`, `LbxBeginLargeRequest`, `LbxLargeRequestData`, `LbxEndLargeRequest` and `LbxInternAtoms` requests. The responses that are never stored in the response cache are `LbxSwitchEvent` and `LbxDeltaResponse`. The message carried by a delta message is also cached, if it meets the other requirements. Messages after the `LbxStartProxy` request are

cached starting at index 0, and incrementing the index, modulo the number of entries, thereafter. The request and response caches are independently indexed.

If the current message is cachable and the same length as a message in the corresponding delta cache, a delta message may be substituted in place of the original message in the protocol stream.

## 2.11 Stream Compression

Before being passed down to the transport layer messages can be passed through a general purpose data compressor. The choice of compression algorithm is negotiated with “LbxStartProxy” on page 11. The proxy and server are not required to support any specific stream compressor. As an example, however, the X Consortium implementation of a ZLIB based compressor is described below.

The XC-ZLIB compressor is presented with a simple byte stream - the X and LBX message boundaries are not apparent. The data is broken up into fixed sized blocks. Each block is compressed using zlib 1.0 (by Gailly & Adler), then a two byte header is prepended, and then the entire packet is transmitted. The header has the following information:

```
out[0] = (length & 0xffff) >> 8 | ((compflag) ? 0x80 : 0);
```

```
out[1] = length & 0xff;
```

## 2.12 Authentication Protocols

The current version of LBX does not support multipass authentication protocols for clients of the proxy. These authentication protocols return an `Authenticate` message in response to a connection setup request, and require additional authentication data from the client after the `LbxNewClient` request, and before the reply to `LbxNewClient`. One example of such a protocol is XC-QUERY-SECURITY-1.

## 3 C Library Interfaces

The C Library routines for LBX are in the Xext library. The prototypes are located in a file named "XLbx.h".

### 3.1 Application Library Interfaces

In a proxy environment, applications do not need to call these routines to take advantage of LBX. Clients can, however, obtain information about the LBX extension to the server using this interface. Use of this routine may be altered when connected through a proxy, as described in “C Library Interfaces” on page 7.

#### 3.1.1 XLbxQueryVersion

To determine the version of LBX supported by the X server, call `XLbxQueryVersion`.

```
Bool XLbxQueryVersion(display, major_version_return, minor_version_return)
```

```
Display * display;
```

```
int * major_version_return;
```

```
int * minor_version_return;
```

```
display
```

```
major_version_return
```

```
minor_version_return
```

Specifies the connection to the X server

Returns the extension major version number.

Returns the extension minor version number.

The `XLbxQueryVersion` function determines if the LBX extension is present. If the extension is not present, `XLbxQueryVersion` returns `False`; otherwise, it returns `True`. If the extension is present, `XLbxQueryVersion` returns the major and minor version numbers of the extension as supported by the X server.

## 3.2 Proxy Library Interfaces

The following interfaces are intended for use by the proxy.

### 3.2.1 XLbxQueryExtension

To determine the dynamically assigned codes for the extension, use the Xlib function `XQueryExtension` or the LBX function `XLbxQueryExtension`.

```
Bool XLbxQueryExtension(display, major_opcode_return, first_event_return, first_error_return)
    Display * display;           Specifies the connection to the X server
    int * major_opcode_return;   Returns the major opcode.
    int * first_event_return;    Returns the first event code.
    int * first_error_return;    Returns the first error code.
```

The `XLbxQueryExtension` function determines if the LBX extension is present. If the extension is not present, `XLbxQueryExtension` returns `False`; otherwise, it returns `True`. If the extension is present, `XLbxQueryExtension` returns the major opcode for the extension to `major_opcode_return`, the base event type code to `first_event_return`, and the base error code to `first_error_return`; otherwise, the return values are undefined.

### 3.2.2 XLbxGetEventBase

To determine the base event type code, use the Xlib function `XQueryExtension` or the LBX function `XLbxGetEventBase`.

```
int XLbxGetEventBase(display)
    Display * display;           Specifies the connection to the X server
```

The `XLbxGetEventBase` function returns the base event type code if the extension is present; otherwise, it returns `-1`.

## 4 Protocol

### 4.1 Syntactic Conventions and Common Types

Please refer to the X Window System Protocol specification, as this document uses the syntactic conventions established there and references types defined there.

The following additional types are defined by this extension:

DIFFITEM

1     CARD8                     offset



1 CARD8

diff

LBXANGLE: CARD8 or 2 BYTE

where (in order of precedence):

|  |                                 |
|--|---------------------------------|
| $(0 \leq in \leq A(95)) \ \&\& \ !(in \% A(5))$      | $out = 0x5a + (in / A(5))$      |
| $A(105) \leq in \leq A(360) \ \&\& \ !(in \% A(15))$ | $out = 0x67 + (in / A(15))$     |
| $-A(100) \leq in \leq -A(5) \ \&\& \ !(in \% A(5))$  | $out = 0xa6 + (in / A(5))$      |
| $-A(360) < in \leq -A(105) \ \&\& \ !(in \% A(15))$  | $out = 0x98 + (in / A(15))$     |
| $-A(360) < in \leq A(360)$                           | $out[0] = in >> 8; out[1] = in$ |

LBXARC:

[x, y: LBXINT16,  
width, height: LBXCARD16,  
angle1, angle2: LBXANGLE]

Within a list of arcs, after the first arc, x and y are relative to the corresponding fields of the prior arc.

LBXCARD16: CARD8 or 2 BYTE

where:

|                           |                                      |
|---------------------------|--------------------------------------|
| $0x0000 \leq in < 0x00F0$ | CARD8                                |
| $0x00F0 \leq in < 0x10F0$ | $out[0] = 0xF0   ((in - 0xF0) >> 8)$ |
|                           | $out[1] = in - 0xF0$                 |

LBXGCANDDRAWENT

[ gc-cache-index, drawable-cache-index: CARD4 ]

LBXGCANDDRAWUPDATE

|                    |  |
|--------------------|--|
| drawable: DRAWABLE | <i>/* present only if drawable-cache-index == 0 */</i> |
| gc: GC]            | <i>/* present only if gc-cache-index == 0 */</i>       |

LBXGCANDDRAWABLE

cache-entries: LBXGCANDDRAWENT  
updates: LBXGCANDDRAWUPDATE

LBXINT16: INT8 or 2 BYTE

where:

|                           |  |
|---------------------------|--|
| $0xF790 \leq in < 0xFF90$ | $out[0] = 0x80   (((in + 0x70) >> 8) \& 0x0F)$ |
|                           | $out[1] = in + 0x70$                           |
| $0xFF90 \leq in < 0x0080$ | CARD8  |
| $0x0080 \leq in < 0x0880$ | $out[0] = 0x80   (((in - 0x80) >> 8) \& 0x0F)$ |
|                           | $out[1] = in - 0x80$                           |

LBXPINT16: CARD8 or 2 BYTE

*/\* for usually positive numbers \*/*

where:

|                           |  |
|---------------------------|--|
| $0xFE00 \leq in < 0x0000$ | $out[0] = 0xF0   (((in + 0x1000) >> 8) \& 0x0F)$ |
|                           | $out[1] = in + 0x1000$                           |

0x0000 <= in < 0x00F0  
 0x00F0 <= in < 0x0EF0

CARD8  
 out[0] = 0xF0 | ((in - 0xF0) >>8)  
 out[1] = in - 0xF0

LBXPOINT: [x, y: LBXINT16]

Within a list of points, after the first rectangle, x and y are relative to the corresponding fields of the prior point.

LBXRECTANGLE:

[x, y: LBXINT16,  
 width, height: LBXCARD16]

Within a list of rectangles, after the first rectangle, x and y are relative to the corresponding fields of the prior rectangle.

MASK: CARD8

## 4.2 Errors

As with the X11 protocol, when a request terminates with an error, the request has no side effects (that is, there is no partial execution).

There is one error, `LbxClient`. This error indicates that the client field of an LBX request was invalid, or that the proxy's connection was in an invalid state for a start or stop proxy request.

## 4.3 Requests

There is one request that is expected to be used only by the client: `LbxQueryVersion`

There is one request that is expected to be used by the client or the proxy: `LbxQueryExtension`.

The following requests are expected to be used only by the proxy, and are instigated by the proxy: `LbxStartProxy`, `LbxStopProxy`, `LbxNewClient`, `LbxSwitch`, `LbxCloseClient`, `LbxModifySequence`, `LbxAllowMotion`, `LbxInvalidateTag`, `LbxTagData` and `LbxQueryTag`.

All other requests are sent by the proxy to the LBX server and are instigated by reception of an X request from the client. They replace the X request.

### 4.3.1 Requests Initiated by the Proxy or by the Client

#### `LbxQueryVersion`

→

majorVersion: CARD16  
 minorVersion: CARD16

This request returns the major and minor version numbers of the LBX protocol.

The encoding of this request is on page 32.

### 4.3.2 Requests Initiated or Substituted by the Proxy

#### LbxQueryExtension

```

nbytes: CARD32
name: STRING8
→
num-requests: CARD8
present: BOOL
major-opcode: CARD8
fi rst-event: CARD8
fi rst-error: CARD8
reply-mask: LISTofMASK /* optional */
event-mask:LISTofMASK /* optional */

Errors: Alloc

```

This request is identical to the `QueryExtension` request, with an additional field, and two optional additional fields. When the client issues an `QueryExtension` request, the proxy will substitute an `LbxQueryExtension` request.

This request determines if the named extension is present. If so, the major opcode for the extension is returned, if it has one. Otherwise, zero is returned. Any minor opcode and the request formats are specific to the extension. If the extension involves additional event types, the base event type code is returned. Otherwise, zero is returned. The format of events is specific to the extension. If the extension involves additional error codes, the base error code is returned. Otherwise, zero is returned. The format of additional data in the errors is specific to the extension.

In addition, the number of requests defined by the named extension is returned. If the number of requests is nonzero, and if the information is available, `reply-mask` and `event-mask` will be included in the reply. The `reply-mask` represents a bit-wise one-to-one correspondence with the extension requests. The least significant bit corresponds to the first request, and the next bit corresponds to the next request, and so on. Each element in the list contains eight meaningful bits, except for the last element, which contains eight or fewer meaningful bits. Unused bits are not guaranteed to be zero. The bit corresponding to a request is set if the request could generate a reply, otherwise it is zero. In the same way, the `event-mask` represents a bit-wise one-to-one correspondence with the extension requests. A bit is set if the corresponding request could result in the generation of one or more extension or X11 events. If `reply-mask` is present in the reply, `event-mask` will also be present.

The encoding of this request is on page 43.

### 4.3.3 Control Requests Initiated by the Proxy

#### LbxStartProxy

```

options: LISTofOPTION
→
choices: LISTofCHOICE

Errors: LbxClient, Alloc

```

where:

|        |  |
|--------|--|
| OPTION | [optcode: CARD8,<br>len: OPTLEN,<br>option: (See Table 1, “ StartProxy Options,”on page12) ] |
| CHOICE | [optcode: CARD8,<br>len: OPTLEN,<br>choice: (See Table 1, “ StartProxy Options,”on page12) ] |

TABLE 1. StartProxy Options

| opcode       | option             | choice             | default               |
|--------------|--------------------|--------------------|-----------------------|
| delta-proxy  | DELTAOPT           | DELTACHOICE        | entries=16, maxlen=64 |
| delta-server | DELTAOPT           | DELTACHOICE        | entries=16, maxlen=64 |
| stream-comp  | LISTofNAMEDOPT     | INDEXEDCHOICE      | No Compression        |
| bitmap-comp  | LISTofSTRING8      | LISTofINDEXEDOPT   | No Compression        |
| pixmap-comp  | LISTofPIXMAPMETHOD | LISTofPIXMAPCHOICE | No Compression        |
| use-squish   | BOOL               | BOOL               | True                  |
| use-tags     | BOOL               | BOOL               | True                  |
| colormap     | LISTofSTRING8      | INDEXEDCHOICE      | No Colormap Grabbing  |
| extension    | NAMEDOPT           | INDEXEDCHOICE      | Extension Disabled    |

|               |  |
|---------------|--|
| DELTAOPT      | [minN, maxN, prefN: CARD8<br>minMaxMsgLen, maxMaxMsgLen, prefMaxMsgLen: CARD8]   |
| DELTACHOICE   | [entries, maxlen: CARD8]   |
| INDEXEDCHOICE | [index: CARD8,<br>data: LISTofBYTE]  |
| INDEXEDOPT    | [index, opcode: CARD8]   |
| NAMEDOPT      | [name: STRING8,<br>detail: LISTofBYTE]   |
| OPTLEN        | 1 or 3 CARD8<br>where:<br>(0 < in <= 0xFF): out = in<br>(0 <= in <= 0xFFFF): out[0] = 0; out[1] = in >> 8; out[2] = in & 0xFF; |
| PIXMAPMETHOD  | [name: STRING8,<br>format-mask: BITMASK,<br>depths: LISTofCARD8]   |
| PIXMAPCHOICE  | [index, opcode: CARD8,<br>format-mask: BITMASK,<br>depths: LISTofCARD8]  |

This request negotiates LBX protocol options, and switches the proxy-server connection from X11 protocol to LBX protocol.

The proxy gives the preferred protocol options in the request. The server chooses from the given options and informs the proxy which to use. The options may be listed in any order, and the proxy may choose which options to negotiate. If an option is not successfully negotiated, the default is used.

The server delta cache and proxy delta caches can be configured for number of entries, and the length of entries. (See “ Delta cache”on page6 for details.) The delta caches are configured using the *delta-server* and

*delta-proxy* options. To configure a cache, the proxy sends the minimum, maximum and preferred values for the number of cache entries, (*minN*, *maxN*, *prefN*), and the length of the cache entries, (*minMaxMsgLen*, *maxMaxMsgLen*, *prefMaxMsgLen*). The server's reply fields *entries* and *maxlen*, contains the values to use. These values must be within the ranges specified by the proxy. The server may also specify an *entries* value of 0 to disable delta caching. The cache entry lengths are specified in units of 4 bytes.

The stream compression algorithm is selected using the *stream-comp* option. (Stream compression is described in “Stream Compression” on page 7.) Each algorithm has a name that follows the naming conventions in “Algorithm Naming” on page 31. To negotiate using the stream-comp option, the proxy lists its available compressors. For each candidate algorithm, the proxy sends the name in the *name* field, and uses the *detail* field to send any additional data specific to each compression algorithm. The reply contains a 0-based index into the list of algorithms to indicate which algorithm to use, followed by data specific to that algorithm.

Bitmap compression is negotiated using the *bitmap-comp* option. The proxy sends a list of names of available algorithms, and the server reply lists the algorithms to use. For each bitmap algorithm in the reply, a 0-based index into the list of algorithms indicates the algorithm, and the *opcode* field gives the value for use in requests. The algorithm names follow the conventions in “Algorithm Naming” on page 31.

Pixmap compression is negotiated using the *pixmap-comp* option. The proxy sends a list of available algorithms. For each algorithm, the list includes, the name, a bitmask of supported formats, and a list of depths that the format supports. The server reply lists the algorithms to use. For each pixmap algorithm in the reply, the reply contains a 0-based index into the list of proxy algorithms, the opcode to use in requests when referring to this algorithm, a mask of valid formats, and a list of valid depths. Algorithm names follow the conventions in “Algorithm Naming” on page 31.

Squishing is negotiated using the *use-squish* option. If the proxy desires squishing, it sends a true value. The reply from the server indicates whether to do squishing, and will indicate squishing only if *use-squish* is set to true in the request.

Tag caching, described in “Tags” on page 4, is negotiated using the *use-tag* option. If the proxy desires tag caching, it sends a true value. The reply from the server indicates whether to do tag caching, and will demand caching only if *use-tag* is set to true in the request.

The colormap option is used to negotiate what color matching algorithm will be used by the proxy when the proxy uses the `LbxAllocColor` request to allocate pixels in a grabbed colormap. To negotiate using the colormap option, the proxy lists the names of available colormap algorithms. The choice in the reply contains a 0-based index into the list of algorithms to indicate which algorithm to use, followed by data specific to that algorithm. If no colormap algorithm is successfully negotiated, then the `LbxAllocColor`, `LbxGrabCmap`, and `LbxReleaseCmap` requests will not be used.

The extension option is used to control extensions to LBX. These extensions may, for example, enable other types of compression. To negotiate an extension, the name of the extension is sent, followed by any data specific to that extension. The extension name follows the conventions in “Algorithm Naming” on page 31. The extension option may occur multiple times in the start proxy message, since multiple extensions can be negotiated. The reply to an extension option contains the zero-based index of the extension option, as counted in the `LbxStartProxy` message. This index is followed by extension-specific information. The server does not respond to extensions it does not recognize.

An `LbxClient` error is returned when a client which is already communicating through an LBX proxy to the X server sends a `LbxStartProxy` request.

The encoding for this request is on page 33.

**LbxStopProxy**

Errors: `LbxClient`

This request terminates the connection between the proxy and X server, and terminates any clients connected through the proxy.

The encoding for this request is on page 35.

An `LbxClient` error is returned if the requesting client is not an LBX proxy.

**LbxNewClient**

*byte-order*: CARD8  
*client-id*: CARD32  
*protocol-major-version*: CARD16  
*protocol-minor-version*: CARD16  
*authorization-protocol-name*: STRING8  
*authorization-protocol-data*: STRING8

→

Core X reply (if connection is rejected)

OR

success: BOOL  
change-type: {NoDeltas, NormalClientDeltas, AppGroupDeltas}  
protocol-major-version: CARD16  
protocol-minor-version: CARD16  
tag-id: CARD32  
length: CARD16  
connection-data: CONINFO or CONDIF or CONDIFROOT

where:

|             |  |
|-------------|--|
| CONINFO:    | (the "additional data" portion of the core connection reply for successes)   |
| CONDIF:     | [resource-id-base: CARD32,<br>root-input-masks: LISTofSETofEVENT]  |
| CONDIFROOT: | [resource-id-base: CARD32,<br>root: WINDOW<br>root-visual: VISUALID<br>default-colormap: COLORMAP<br>white-pixel, black-pixel: CARD32<br>root-input-masks: LISTofSETofEVENT] |

Errors: `LbxClient`, `Alloc`

This request, which is sent by the proxy over the control connection, creates a new virtual connection to the server.

Much of the information in the `LbxNewClient` request and reply is identical to the connection setup and reply information in the core X protocol.

For the `LbxNewClient` request, the field unique to LBX is `client-id`. For the `LbxNewClient` reply, `tag-id` and `change-type` are fields unique to LBX, and the contents of `connection-data` may be different in LBX from the core X protocol (see below).

The proxy assigns each virtual connection a unique identifier using the `client-id` field in the `LbxNewClient` request. This `client-id` is used in the LBX protocol to specify the current client (see the `LbxSwitch` request and the `LbxSwitchEvent`). `client-id` 0 is reserved for the proxy control connection. An `LbxClient` error will result if the `LbxNewClient` request contains a `client-id` of 0 or an already in use `client-id`.

If the server rejects this new virtual connection, the server sends a core X connection failure reply to the proxy. The current version of LBX does not support the return of an `Authenticate` reply.

If the `change-type` field is set to `NoDeltas`, then `connection-data` is sent using the `CONINFO` structure, which is identical to the additional data of the core connection reply. If the `tag-id` is non-zero, then the `connection-data` is stored by the proxy using this tag value. Tagged connection data must be stored by the proxy, and can not be invalidated by the proxy until an `LbxInvalidateTag` event is received for that tag.

When the `change-type` field is not set to `NoDeltas`, then `connection-data` is sent as changes against connection information previously sent to the proxy. The `tag-id` field, if non-zero, has the tag of the previously sent data to apply the changes to. A zero `tag-id` indicates that the changes are with respect to the connection information sent when the proxy connected to the server.

If the `change-type` field is set to `NormalClientDeltas`, then `connection-data` is sent using the `CONDIF` structure. The values in the `CONDIF` structure are substituted for the identically named fields of the connection information for the new connection.

If the `change-type` field is set to `AppGroupDeltas`, then `connection-data` is sent using the `CONDIFROOT` structure. The `root`, `root-visual`, and `default-colormap` fields, when nonzero, are substituted for the corresponding fields in the reference connection information. The `white-pixel` and `black-pixel` fields are substituted only when the `default-colormap` field of the reply is non-zero. When `default-colormap` field of the reply is zero, so are `white-pixel` and `black-pixel`. The first entry in the `root-input-masks` field is the current input-mask for the default root window. The remaining entries in `root-input-masks` are input masks for non-video screens, as defined by the X Print Extension. The number of non-video screens is one less than the number of entries in `root-input-masks`. These screens are at the end of screen list in the reference connection information.

The encoding for this request is on page 35.

## LbxCloseClient

*client:* CARD32

Errors: `LbxClient`

This requests the server to close down the connection represented by the specified proxy's client identifier. If the specified client wasn't previously registered with the server by a `LbxNewClient` request, the server will send the `LbxClient` error.

The encoding for this request is on page 36.

## LbxSwitch

*client:* CARD32

Errors: `LbxClient`

This request causes the X server to treat subsequent requests as being from a connection to the X server represented by the specified client identifier.

If the client making the request is not the proxy, or if the client identifier sent in the request was not previously sent in a `LbxNewClient` request, an `LbxClient` error is returned.

The encoding for this request is on page 35.

## **LbxSync**

→

The sync request causes the server to send a reply when all requests before the sync request have been processed.

The encoding for this client is on page 48.

## **LbxModifySequence**

*adjust*: CARD32

Errors: None

This request advances the sequence number of the virtual client connection by the specified amount. The proxy sends the `LbxModifySequence` request to the server when it replies to a client request without forwarding the client request on to the X server.

The encoding for this client is on page 36.

## **LbxAllowMotion**

*num*: CARD32

Errors: None

This request controls the delivery of optional motion notify events, as described in “Motion events” on page 5. The *num* field specifies an increase in the allowed number of motion notify events sent.

The encoding for this request is on page 36.

## **LbxInvalidateTag**

*tag*: CARD32

The LBX proxy sends this notification to the X server when it refuses to store tagged data, or when it releases tagged data which was previously stored and which was not invalidated by a notification from the X server.

The encoding for this request is on page 37.

## **LbxTagData**



*tag*: CARD32  
*real-length*: CARD32  
*data*: LISTofBYTE

This request specifies the data associated with a previously assigned tag. It is sent in two circumstances: in response to receiving a `SendTagDataEvent`, and spontaneously, when the proxy must rely on the server to store data which was not previously received from the server. The data is carried in the byte order and structure as would have originally been sent in the core protocol request.

The encoding for this request is on page 41.

## LbxGrabCmap

*cmap*: Colormap

→

*smart-grab*: BOOL  
*large-pixel*: BOOL /\* optional \*/  
*auto-release*: BOOL /\* optional \*/  
*three-channels*: BOOL /\* optional \*/  
*bits-per-rgb*: CARD4 /\* optional \*/  
*cells*: LISTofCHAN /\* optional \*/

where:

CHAN: LISTofLBXPIXEL  
 LBXPIXEL: PIXELPRIVATE or PIXELPRIVATERANGE or  
 PIXELALLOC or PIXELALLOCRANGE  
 PIXEL: CARD8 or CARD16  
 PIXELPRIVATE: [ pixel: PIXEL ]  
 PIXELPRIVATERANGE: [ first-pixel, last-pixel: PIXEL ]  
 PIXELALLOC: [ pixel: PIXEL,  
 color: COLORSINGLE or COLORTRIPLE ]  
 PIXELALLOCRANGE: [ first-pixel, last-pixel: PIXEL,  
 colors: LISTofCOLORSINGLE or LISTofCOLORTRIPLE ]  
 COLORSINGLE: [ value: CARD8 or CARD16 ]  
 COLORTRIPLE: [ r, g, b: COLORSINGLE ]

Errors: Colormap

This request asks the server for control of allocating new colormap cells in the specified colormap. The server grants control by replying to this request. If no changes have occurred since the last time this proxy grabbed this colormap, then the *smart-grab* field of the reply is set to true, and the optional fields are not sent. Otherwise, the current contents of the colormap are placed in the reply, as described later in this section.

Once the proxy has received the reply, it can use the `LbxAllocColor` request to allocate new colormap cells without the performance penalty of round trips. The proxy is still permitted to use the normal colormap and `LbxIncrementPixel` requests while the colormap is grabbed. The grab is valid across all virtual connections of the proxy.

The `LbxGrabCmap` request is limited to colormaps for the visual types negotiated as part of the colormap algorithm negotiation in the start proxy request at connection setup.

The server and other proxies may not allocate new colormap cells in the colormap while the colormap is grabbed by this proxy. If the server or another proxy needs to allocate new colormap cells, the server sends a `LbxReleaseCmap` event to the proxy holding the grab, which then issues an `LbxReleaseCmap` request.

The server and other proxies may free colormap cells in a colormap grabbed by a proxy. The server will send an `LbxFreeCells` event to the proxy that currently has the colormap grabbed when the cell reference count reaches 0.

If the colormap is a static visual type, such as `StaticGray`, `StaticColor`, `GrayScale`, or `TrueColor`, then the proxy's grab is immediately released by the server, and the proxy must use `LbxIncrementPixel` requests in place of `LbxAllocColor` requests for this colormap.

If the `cmap` field does not refer to a valid colormap or the colormap is already grabbed by this proxy then a `Colormap` error is generated.

The reply describes the contents of the colormap via several arguments and a descriptive list containing one or three channels, with each channel describing allocations in the colormap.

The *large-pixel* argument, if `True`, specifies that `PIXEL` indices will be listed as `CARD16` quantities instead of `CARD8`. The *auto-release* field, if `True`, indicates that this colormap is of a static visual type and the proxy's grab is immediately released by the server.

If *three-channels* is `False`, a single channel is enclosed and color values are described using `COLORTRI-  
PLE`, which has fields for red, green and blue. A single channel is used when the visual type is `noDirect-  
Color` or `TrueColor`.

If *three-channels* is `True`, separate red, green and blue channel lists are enclosed, for describing a `Direct-  
Color` or `TrueColor` colormap. Color values for entries in each channel are sent using `COLORSINGLE` and the corresponding `PIXEL` value refers to the `RGB` subfield of the current channel, as defined by the corresponding red-mask, green-mask and blue-mask of the visual.

The *bits-per-rgb* value is one less than the `bits-per-rgb-value` field of the visual that the colormap belongs to. If the value is 7 or less, then `COLORSINGLE` values in the descriptive list are sent using `CARD8` fields. Otherwise these values are sent using `CARD16` fields.

The list describing current colormap allocations contains entries of the following types:

An `LBXPIXELPRIVATE` entry indicates that the pixel in the *pixel* field is unavailable for allocation.

An `LBXPIXELPRIVATERANGE` entry indicates that a contiguous range of pixels are unavailable for allocation. The range is *first-pixel* to *last-pixel*, and includes *last-pixel*.

An `LBXPIXELALLOC` entry indicates that the pixel in the *pixel* field is allocated as a read-only pixel. The *color* field carries the color information of the pixel.

An `LBXPIXELALLOCRANGE` entry indicates that a contiguous range of pixels are allocated as read-only. The range starts *first-pixel* to *last-pixel*, and includes *last-pixel*. These fields are followed by a list of `COLORSINGLE` or `COLORTRI-  
PLE`, depending on the value of *three-channels*.

A `NEXTCHANNEL` entry indicates that the next channel of the colormap will be described.

A `LISTEND` entry indicates the end of the colormap description.

All pixels not described in the reply are unallocated.

The encoding for this request is on page 46.

### LbxReleaseCmap

*cmap*: Colormap

This request releases the specified grabbed colormap. If the *cmap* field does not refer to a colormap, a `BadColormap` error is produced.

The proxy must remember the state of the colormap when the `LbxReleaseCmap` request is issued if this proxy may at some future time issue another `LbxGrabCmap` request on this colormap before the state of the colormap changes.

The encoding for this request is on page 48.

### LbxInternAtoms

*count*: CARD16

*names*: LISTofSTRING8

→

*atoms*: LISTofATOM

Errors: `Alloc`

This request allows the proxy to intern a group of atoms in a single round trip. The server will create any atoms that do not exist.

The encoding for this request is on page 45.

## 4.3.4 Substitution Requests

### LbxAllocColor

*cmap*: Colormap

*pixel*: CARD32

*red, green, blue*: CARD16

This request is sent by a proxy that has given colormap grabbed to allocate a new read-only cell in the colormap. The proxy may substitute this request for the core `AllocColor` and `AllocNamedColor` requests.

The *pixel* field identifies the colormap cell to allocate. The *red*, *green*, and *blue* fields are the hardware specific color values of the corresponding fields of the core `AllocColor` request. The mapping to hardware specific colormap values by the proxy is performed using the color algorithm negotiated by `LbxStartProxy`.

For colormaps of static visual types, the `LbxIncrementPixel` request is used instead of `LBX AllocColor`.

If the *cmap* field does not identify a grabbed colormap then a `BadAccess` error is produced. If the *pixel* field refers to a read-write entry or the *pixel* field refers to a pixel outside of the range of this colormap, a `BadAlloc` error is produced.

The encoding for this request is on page 48.

### **LbxIncrementPixel**

*cmap*: COLORMAP  
*pixel*: CARD32

Errors: None

This request replaces the `AllocColor` request for read-only pixels currently allocated for the current client. If the visual type of the colormap is of a static type, this request may be used on currently unallocated pixels. The colormap is not required to be grabbed to use this request.

The encoding for this request is on page 36.

### **LbxDelta**

*count*: CARD8  
*cache-index*: CARD8  
*diffs*: LISTofDIFFITEM

This request contains a minimal amount of information relative to a similar prior request. The information is in the form of a difference comparison to a prior request. The prior request is specified by an index to a cache, independently maintained by both the proxy and the server.

The encoding for this request is on page 36.

### **LbxGetModifierMapping**

→

*keyspermod*: CARD8  
*tag*: CARD32  
*keycodes*: LISTofKEYCODE /\* optional \*/

This request is identical to the core `GetModifierMapping` request, with the addition of a tag being returned in the reply. See “Tag Substitution in Requests” on page 4 for a description of the tag field and optional fields.

The encoding for this request is on page 37.

### **LbxGetKeyboardMapping**

*firstKeyCode*: KEYCODE  
*count*: CARD8

→

*keysperkeycode*: CARD8  
*tag*: CARD32  
*keysyms*: LISTofKEYSYM /\* optional \*/

Errors: Value

This request is identical to the X `GetKeyboardMapping` protocol request, with the addition that a tag is returned in the reply. See “`Tag Substitution in Requests`” on page 4 for a description of the *tag* field and optional fields.

The encoding for this request is on page 39.

### LbxGetWinAttrAndGeom

*window*: WINDOW

→

visual: VISUALID  
class: {InputOutput, InputOnly}  
bit-gravity: BITGRAVITY  
win-gravity: WINGRAVITY  
backing-store: {NotUseful, WhenMapped, Always}  
backing-planes: CARD32  
backing-pixel: CARD32  
save-under: BOOL  
colormap: COLORMAP or None  
map-is-installed: BOOL  
map-state: {Unmapped, Unviewable, Viewable}  
all-event-masks, your-event-mask: SETofEVENT  
do-not-propagate-mask: SETofDEVICEEVENT  
override-redirect: BOOL  
root: WINDOW  
depth: CARD8  
x, y: INT16  
width, height, border-width: CARD16

Errors: Window

`GetWindowAttributes` and `GetGeometry` are frequently used together in the X protocol. `LbxGetWinAttrAndGeom` allows the proxy to request the same information in one round trip.

The encoding for this request is on page 45.

### LbxQueryFont

*font*: FONTABLE

→

compression: BOOL  
tag: CARD32  
font-info: FONTINFO /\* optional \*/  
char-infos: LISTofCHARINFO or LISTofLBXCHARINFO /\* optional \*/

where:

LBXCHARINFO: [left-side-bearing: INT6  
right-side-bearing: INT7  
character-width: INT6  
ascent: INT6  
descent: INT7]

Errors: `Font, Alloc`

This request is used to replace the core `QueryFont` request and has identical semantics.

See “`Tag Substitution in Requests`” on page 4 for a description of the `tag` field and optional fields.

The `compression` field is `True` if the `char-infos` field is represented using `LBXCHARINFO`.

The per-character information will be encoded in an `LBXCHARINFO` when, for every character, the character-width, left-side-bearing, and ascent can each be represented in not more than 6 bits, and the right-side-bearing and descent can each be represented in not more than 7 bits, and the `attributes` field is identical the `attributes` field of the `max_bounds` of the `font_info` field of the font.

The encoding for this request is on page 39.

### LbxChangeProperty

*window*: `WINDOW`  
*property*: `ATOM`  
*type*: `ATOM`  
*format*: {0,8,16,32}  
*mode*: {`Replace`, `Prepend`, `Append`}  
*nUnits*: `CARD32`

→

*tag*: `CARD32`

This request is sent to the server when the client sends an `XChangeProperty` request through the proxy. The size of the data is sent with this request, but not the property data itself. The server reply contains a tag identifier for the data, which is stored in the proxy. The proxy must not discard this data before it is sent to the server, or invalidated by the server. This means that before issuing an `LbxStopProxy` request, or exiting, the proxy must send `LbxTagData` requests for these items. If the server loses the connection before the information is sent back, the server should revert the property value to its last known value, if possible.

If the `mode` field is `Prepend` or `Append`, the tag refers only to the prepended or appended data.

If the tag in the reply is zero, then the change was ignored by the server, as defined in the security extension. The proxy should dump the associated data, since the server will never ask for it.

The encoding for this request is on page 40.

### LbxGetProperty

*window*: `WINDOW`  
*property*: `ATOM`  
*type*: `ATOM` or `AnyPropertyType`  
*long-offset*: `CARD32`  
*long-length*: `CARD32`  
*delete*: `CARD8`

→

*type*: `ATOM` or `None`  
*format*: {0, 8, 16, 32}  
*bytes-after*: `CARD32`

*nItems*: CARD32  
*tag*: CARD32  
*value*: LISTofINT8 or LISTofINT16 or LISTofINT32

This request may be used by the proxy as a substitution for a core `GetProperty` request. It allows tags to be used for property data that is unlikely to change often in value, but is likely to be fetched by multiple clients.

The `LbxGetProperty` request has the same arguments as the core `GetProperty` request. The reply for `LbxGetProperty` has all of the fields from the core `GetProperty` reply, but has the additional fields of *nItems* and *tag*.

In order to utilize tags in `LbxGetProperty` for a specific property the server must first send the complete property data to the proxy and associate this data with a tag. More precisely, the server sends an `LbxGetProperty` reply with a new *tag*, *nItems* set to the number of items in the property, the size of the property data in the reply length field, and the complete property data in value. The proxy stores the property data in its tag cache and associates it with the specified tag.

In response to future `LbxGetProperty` requests for the same property, if the server thinks that the proxy has the actual property data in its tag cache, it may choose to send an `LbxGetProperty` reply without the actual property data. In this case, the reply would include a non-zero *tag*, a zero reply length, and no data for value.

If the server chooses not to generate a tagged reply to `LbxGetProperty`, or for some reason is unable to do so, it would send a reply with a *tag* of zero, the size of the property data in the reply length field, and the complete property data in value.

The encoding for this request is on page 40.

## LbxPolyPoint

*gc-and-drawable*: LBXGCANDDRAWABLE  
*points*: LISTofLBXPOINT

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolyPoint` request. Not all `PolyPoint` requests can be represented as `LbxPolyPoint` requests.

The proxy will convert the representation of the points to be relative to the previous point, as described by previous coordinate mode in the X protocol.

The encoding for this request is on page 37.

## LbxPolyLine

*gc-and-drawable*: LBXGCANDDRAWABLE  
*points*: LISTofLBXPOINT

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolyLine` request. Not all `PolyLine` requests can be represented as `LbxPolyLine` requests.

The proxy will convert the representation of the points to be relative to the previous point, as described by previous coordinate mode in the X protocol.

The encoding for this request is on page 37.

### **LbxPolySegment**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*segments*: LISTofLBXSEGMENT

where:  
 LBXSEGMENT; [x1, y1, x2, y2: LBXINT16]

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolySegment` request. Not all `PolySegment` requests can be represented as `LbxPolySegment` requests.

For segments other than the first segment of the request, [x1, y1] is relative to [x1, y1] of the previous segment. For all segments, [x2, y2] is relative to that segment's [x1, y1].

The encoding for this request is on page 37.

### **LbxPolyRectangle**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*rectangles*: LISTofLBXRECTANGLE

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolyRectangle` request. Not all `PolyRectangle` requests can be represented as `LbxPolyRectangle` requests.

The encoding for this request is on page 38.

### **LbxPolyArc**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*arcs*: LISTofLBXARC

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolyArc` request. Not all `PolyArc` requests can be represented as `LbxPolyArc` requests.

The encoding for this request is on page 38.

### **LbxPolyFillRectangle**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*rectangles*: LISTofLBXRECTANGLE

Errors: `Alloc` and those given for the corresponding X request.



This request replaces the `PolyFillRectangle` request. Not all `PolyFillRectangle` requests can be represented as `LbxPolyFillRectangle` requests.

The encoding for this request is on page 38.

### **LbxPolyFillArc**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*arcs*: LISTofLBXARC

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `PolyFillArc` request. Not all `PolyFillArc` requests can be represented as `LbxPolyFillArc` requests.

The encoding for this request is on page 39.

### **LbxFillPoly**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*shape*: BYTE  
*points*: LISTofLBXPOINT

Errors: `Alloc` and those given for the corresponding X request.

This request replaces the `FillPoly` request. Not all `FillPoly` requests can be represented as `LbxFillPoly` requests.

The proxy will convert the representation of the points to be relative to the previous point, as described by previous coordinate mode in the X protocol.

The encoding for this request is on page 38.

### **LbxCopyArea**

*srcCache*: CARD8 /\* source drawable \*/  
*gc-and-drawable*: LBXGCANDDRAWABLE  
*src-Drawable*: CARD32  
*src-x*: LBXPINT16  
*src-y*: LBXPINT16  
*width*: LBXCARD16  
*height*: LBXCARD16  
*dst-x*: LBXPINT16  
*dst-y*: LBXPINT16

Errors: Those given for the corresponding X request.

This request replaces the `CopyArea` request for requests within its encoding range.

The encoding for this request is on page 41.

### **LbxCopyPlane**

*bit-plane*: CARD32

*src-cache*: CARD8 /\* cache reference for source drawable \*/  
*gc-and-drawable*: LBXGCANDDRAWABLE  
*src-drawable*: CARD32  
*src-x*: LBXPINT16  
*src-y*: LBXPINT16  
*width*: LBXCARD16  
*height*: LBXCARD16  
*dst-x*: LBXPINT16  
*dst-y*: LBXPINT16

Errors: Those given for the corresponding X request.

This request replaces the `CopyPlane` request for requests within its coding range.

The encoding for this request is on page 42.

### **LbxPolyText8**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*x*: LBXPINT16  
*y*: LBXPINT16  
*items*: LISTofTEXTITEM8

Errors: `Alloc`, and those given for the corresponding X request.

This request replaces the `PolyText8` request for requests within its encoding range.

The encoding for this request is on page 42.

### **LbxPolyText16**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*x*: LBXPINT16  
*y*: LBXPINT16  
*items*: LISTofTEXTITEM16

Errors: `Alloc`, and those given for the corresponding X request.

This request replaces the `PolyText16` request for requests within its encoding range.

The encoding for this request is on page 42.

### **LbxImageText8**

*gc-and-drawable*: LBXGCANDDRAWABLE  
*nChars*: CARD8  
*x*: LBXPINT16  
*y*: LBXPINT16  
*string*: STRING8

Errors: `Alloc`, and those given for the corresponding X request.

This request replaces the `ImageText8` request for requests within its encoding range.

The encoding for this request is on page 42.

### LbxImageText16

*nChars*: CARD8  
*gc-and-drawable*: LBXGCANDDRAWABLE  
*x*: LBXPINT16  
*y*: LBXPINT16  
*string*: STRING16

Errors: Alloc, and those given for the corresponding X request.

This request replaces the ImageText16 request for requests within its encoding range.

The encoding for this request is on page 43.

### LbxPutImage

*compression-method*: CARD8  
*format*: {Bitmap, XYPixmap, ZPixmap} /\* packed \*/  
*gc-and-drawable*: LBXGCANDDRAWABLE  
*width, height*: LBXCARD16  
*dst-x, dst-y*: LBXPINT16  
*depth*: CARD8 /\* packed \*/  
*left-pad*: CARD8 /\* packed \*/  
*pad-bytes*: CARD8 /\* packed \*/  
*data*: LISTofBYTE

Errors: Alloc, Value

When the request can be usefully compressed, this request replaces the PutImage request. The *compression-method* parameter contains the opcode of a compression method returned in the LbxStartProxy reply. The *pad-bytes* parameter gives the number of unused pad bytes that follow the compressed image data. All other parameters are as in the X request. If the specified compression method is not recognized, the server returns a Value error.

The encoding for this request is on page 43.

### LbxGetImage

*drawable*: DRAWABLE  
*x, y*: INT16  
*width, height*: CARD16  
*plane-mask*: CARD32  
*format*: {XYPixmap, ZPixmap}

→

*depth*: CARD8  
*x-length*: CARD32  
*visual*: VISUALID or None  
*compression-method*: CARD8  
*data*: LISTofBYTE

Errors: Alloc, Match, Value

This request can replace the `GetImage` request. The same semantics apply, with the following exceptions.

The *compression-method* field contains the opcode of the compression method used in the reply. The compression opcodes are supplied in the `LbxStartProxy` reply. The *x-length* field contains the length of the uncompressed version of the reply in 4 byte units.

A `Value` error is returned if the format is not recognized by the X server. A `Match` error is returned under the same circumstances as described by the `GetImage` request.

The encoding for this request is on page 44.

### **LbxBeginLargeRequest**

*large-request-length*: CARD32

Errors: `Alloc`

This request, along with the `LbxLargeRequestData` and `LbxEndLargeRequest` requests, is used to transport a large request in pieces. The smaller size of the resulting requests allows smoother multiplexing of clients on a single low bandwidth connection to the server. The resulting finer-grained multiplexing improves responsiveness for the other clients.

After a `LbxBeginLargeRequest` request is sent, multiple `LbxLargeRequestData` requests are sent to transport all of the data in the large request, and finally an `LbxEndLargeRequest` request is sent. The *large-request-length* field expresses the total length of the transported large request, expressed as the number of bytes in the transported request divided by four.

The encoding for this request is on page 44.

### **LbxLargeRequestData**

*data*: LISTofBYTE

Errors: `Alloc`

This request is used to carry the segments of a larger request, as described in the definition of `LbxBeginLargeRequest`. The data must be carried in order, starting with the request header, and each segment must be multiples of 4 bytes long. If the `LbxLargeRequestData` is not preceded by a corresponding `LbxBeginLargeRequest`, a `BadAlloc` error is generated.

The encoding for this request is on page 45.

### **LbxEndLargeRequest**

Errors: `Length`, `Alloc`

As described in the definition of `LbxBeginLargeRequest`, `LbxEndLargeRequest` is used to signal the end of a series of `LargeRequestData` requests. If the total length of the data transported by the `LbxLargeRequestData` requests does not match the *large-request-length* field of the preceding `LbxBeginLargeRequest` request, then a `Length` error occurs. If the `LbxEndLargeRequest` is not preceded by a corresponding `LbxBeginLargeRequest`, a `BadAlloc` error is generated. The request is executed in order for that client as if it were the request after the request preceding `LbxEndLargeRequest`.

The encoding for this request is on page 45.

## 4.4 Events

### **LbxSwitchEvent**

*client:* CARD32

Notify the proxy that the subsequent replies, events, and errors are relative to the specified client.

The encoding for this event is on page 48.

### **LbxCloseEvent**

*client:* CARD32

Notify the proxy that the specified client's connection to the server is closed.

The encoding for this event is on page 49.

### **LbxInvalidateTagEvent**

*tag:* CARD32

*tag-type:* {Modmap, Keymap, Property, Font, ConnInfo}

This message informs the proxy that the tag and the server data referenced by the tag are obsolete, and should be discarded. The tag type may be one of the following values: `LbxTagTypeModmap`, `LbxTagTypeKeymap`, `LbxTagTypeProperty`, `LbxTagTypeFont`, `LbxTagTypeConnInfo`.

The encoding for this event is on page 49.

### **LbxSendTagDataEvent**

*tag:* CARD32

*tag-type:* {Property}

The server sends this event to the proxy to request a copy of tagged data which is being stored by the proxy. The request contains a tag which was previously assigned to the data by the server. The proxy should respond to `SendTagData` by sending a `TagData` request to the server. The tag type may be one of the following values: `LbxTagTypeProperty`.

The encoding for this event is on page 49.

### **LbxListenToOne**

*client:* CARD32 or 0xffffffff

When the server is grabbed, `ListenToOne` is sent to the proxy. As an X client, the proxy itself is unaffected by grabs, in order that it may respond to requests for data from the X server.

When the client grabbing the server is managed through the proxy, the proxy will permit messages from itself and the grabbing client to be sent immediately to the server, and may buffer requests from other clients of the proxy. The client is identified in the event.

When the client grabbing the server is not managed through the proxy, the client field in the event will be 0xffffffff. The proxy will communicate with the server, and it may buffer requests from other clients. The proxy will continue to handle new connections while the server is grabbed.

The server will send `ListenToAll` to the proxy when the server is ungrabbed. There is no time-out for this interval in the protocol.

The encoding for this event is on page 49.

### **LbxListenToAll**

Notify the proxy that the server has been ungrabbed, and that the proxy may now send all buffered client requests on to the server.

The encoding for this event is on page 49.

### **LbxQuickMotionDeltaEvent**

*deltaTime*: CARD8  
*deltaX*: INT8  
*deltaY*: INT8

This event is used as a replacement for the `MotionNotify` event when possible. The fields are used as deltas to the most recent `MotionNotify` event encoded as a `MotionNotify` event, `LbxQuickMotionDeltaEvent`, or `LbxMotionDeltaEvent`. Not every `MotionNotify` event can be encoded as a `LbxQuickMotionDeltaEvent`.

The encoding for this event is on page 50.

### **LbxMotionDeltaEvent**

*deltaX*: INT8  
*deltaY*: INT8  
*deltaTime*: CARD16  
*deltaSequence*: CARD16

This event is used as a replacement for the `MotionNotify` event when possible. The fields are used as deltas to the most recent `MotionNotify` event encoded as a `MotionNotify` event, `LbxQuickMotionDeltaEvent`, or `LbxMotionDeltaEvent`. Not every `MotionNotify` event can be encoded as a `LbxMotionDeltaEvent`.

The encoding for this event is on page 50.

### **LbxReleaseCmapEvent**

*colormap*: Colormap

This event notifies the proxy that it must release the grab on this colormap via the `ReleaseCmap` request. See “`LbxReleaseCmap`” on page 19.

The encoding for this event is on page 50.

### **LbxFreeCellsEvent**

*colormap*: Colormap  
*pixelStart, pixelEnd*: CARD32

The `LbxFreeCells` event is sent to a proxy that has a colormap grabbed to notify the proxy that the reference count of the described cells were decremented to zero by the server or another proxy. The reference count includes those by this proxy. The proxy must update its copy of the colormap state accordingly if the colormap is still grabbed, or if the proxy may in the future grab the colormap using smart-grab mode. See “`LbxGrabCmap`” on page 17.

The `pixelStart` and `pixelEnd` fields of the event denote a continuous range of cells that were freed.

The encoding for this event is on page 50.

## 4.5 Responses

Responses are messages from the server to the proxy that not, strictly speaking, events, replies or errors.

### **LbxDeltaResponse**

*count*: CARD8  
*cache-index*: CARD8  
*diffs*: LISTofDIFFITEM

This response carries an event, reply, or error that has been encoded relative to a message in the response delta cache. The *cache-index* field is the index into the cache. Each entry in *diffs* provides a byte offset and replacement value to use in reconstructing the response.

The encoding for this event is on page 51.

## 5 Algorithm Naming

To avoid potential clashes between different but similar algorithms for stream, bitmap, and pixmap compression, the following naming scheme will be adhered to:

Each algorithm has a unique name, which is a `STRING8`, of the following form:

<organization>-<some-descriptive-name>

The organization field above is the organization name as registered in section 1 of the X Registry (the registry is provided as a free service by the X Consortium.) This prevents conflicts among different vendor’s extensions.

As an example, the X Consortium defines a zlib-based stream compression algorithm called `XC-ZLIB`.

## 6 Encoding

The syntax and types used in the encoding are taken from the X protocol encoding. Where LBX defines new types, they are defined earlier in this document.

As in the X protocol, in various cases, the number of bytes occupied by a component will be specified by a lowercase single-letter variable name instead of a specific numeric value, and often some other component

will have its value specified as a simple numeric expression involving these variables. Components specified with such expressions are always interpreted as unsigned integers. The scope of such variables is always just the enclosing request, reply, error, event, or compound type structure.

For unused bytes, the encode-form is:

N unused

If the number of unused bytes is variable, the encode-form typically is:

p unused, p=pad(E)

where E is some expression, and pad(E) is the number of bytes needed to round E up to a multiple of four.

$\text{pad}(E) = (4 - (E \bmod 4)) \bmod 4$

In many of the encodings, the length depends on many variable length fields. The variable L is used to indicate the number of padded 4 byte units needed to carry the request. Similarly, the variable Lpad indicates the number of bytes needed to pad the request to a 4 byte boundary.

For counted lists there is a common encoding of NLISTofFOO:

NLISTofFOO

|   |           |           |
|---|-----------|-----------|
| 1 | m         | num items |
| m | LISTofFOO | items     |

For cached GC and Drawables:

|                    |                   |
|--------------------|-------------------|
| LBXGCANDDRAWUPDATE |                   |
| 4 or 0 DRAWBLE     | optional drawable |
| 4 or 0 GC          | optional GC       |

|                      |                          |
|----------------------|--------------------------|
| LBXGCANDDRAWABLE     |                          |
| 8 LBXGCANDDRAWENT    | cache-entries            |
| 8                    | unused                   |
| m LBXGCANDDRAWUPDATE | optional GC and Drawable |

## 6.1 Errors

### LbxClient

|    |        |                 |
|----|--------|-----------------|
| 1  | 0      | Error           |
| 1  | CARD8  | error-base + 0  |
| 2  | CARD16 | sequence number |
| 4  |        | unused          |
| 2  | CARD16 | lbx opcode      |
| 1  | CARD8  | major opcode    |
| 21 |        | unused          |

## 6.2 Requests

### LbxQueryVersion



|    |        |                 |
|----|--------|-----------------|
| 1  | CARD8  | opcode          |
| 1  | 0      | lbx opcode      |
| 2  | 1      | request length  |
| →  |        |                 |
| 1  | 1      | Reply           |
| 1  |        | unused          |
| 2  | CARD16 | sequence number |
| 4  | 0      | reply length    |
| 2  | CARD16 | major version   |
| 2  | CARD16 | minor version   |
| 20 |        | unused          |

The description of this request is on page 10.

**LbxStartProxy**

|   |                       |                  |
|---|-----------------------|------------------|
| 1 | CARD8                 | opcode           |
| 1 | 1                     | lbx opcode       |
| 2 | L                     | request length   |
| n | NLISTofOPTION-REQUEST | options          |
| p |                       | unused, p=pad(n) |

**OPTION-REQUEST**

|   |  |                                       |
|---|--|---------------------------------------|
| 1 | OPTCODE  | option-code                           |
| m | OPTLEN   | option-request-byte-length, (b=m+a+1) |
| a | DELTAOPT or<br>NLISTofNAMEDOPT or<br>NLISTofSTR or<br>NLISTofPIXMAPMETHOD or<br>BOOL | option                                |

The encoding of the option field depends on the option-code. See Table 1, “ StartProxy Options,” on page 12.

|     |                             |                               |
|-----|-----------------------------|-------------------------------|
| 1   | OPTCODE                     | option-code                   |
| 0   | LbxOptionDeltaProxy         |                               |
| 1   | LbxOptionDeltaServer        |                               |
| 2   | LbxOptionStreamCompression  |                               |
| 3   | LbxOptionBitmapCompression  |                               |
| 4   | LbxOptionPixmapCompression  |                               |
| 5   | LbxOptionMessageCompression | /* also known as squishing */ |
| 6   | LbxOptionUseTags            |                               |
| 7   | LbxOptionColormapAllocation |                               |
| 255 | LbxOptionExtension          |                               |

OPTLEN has two possible encodings, depending on the size of the value carried:

|        |       |                  |
|--------|-------|------------------|
| OPTLEN |       |                  |
| 1      | CARD8 | b (0 < b <= 255) |

|        |   |                       |
|--------|---|-----------------------|
| OPTLEN |   |                       |
| 1      | 0 | long length header    |
| 1      | c | length0, c = b >> 8   |
| 1      | d | length1, d = b & #xff |

## DELTAOPT

|   |       |                                      |
|---|-------|--------------------------------------|
| 1 | CARD8 | min-cache-size                       |
| 1 | CARD8 | max-cache-size                       |
| 1 | CARD8 | preferred-cache-size                 |
| 1 | CARD8 | min-message-length                   |
| 1 | CARD8 | max-message-length (in 4-byte units) |
| 1 | CARD8 | preferred-message-length             |

## NAMEDOPT

|   |            |                               |
|---|------------|-------------------------------|
| f | STR        | type-name                     |
| 1 | g+1        | option-data-length            |
| g | LISTofBYTE | option-data (option specific) |

## PIXMAPMETHOD

|   |             |             |
|---|-------------|-------------|
| h | STR         | name        |
| 1 | BITMASK     | format mask |
| 1 | j           | depth count |
| j | LISTofCARD8 | depths      |

→

|   |              |  |
|---|--------------|--|
| 1 | 1            | Reply                                  |
| 1 | CARD8        | count                                  |
|   | 0xff         | options in request cannot be decoded   |
| 2 | CARD16       | sequence number                        |
| 4 | (a+p-32)/4   | reply length                           |
| a | LISTofCHOICE | options-reply                          |
| p |              | unused, if (n<24) p=24-n else p=pad(n) |

## CHOICE

|   |   |                          |
|---|---|--------------------------|
| 1 | CARD8   | request-option-index     |
| b | OPTLEN  | reply-option-byte-length |
| c | DELTA CHOICE or<br>INDEXED CHOICE or<br>NLISTofINDEXEDOPT or<br>NLISTofPIXMAPCHOICE or<br>BOOL or<br>INDEXED CHOICE | choice                   |

The encoding of the choice field depends on the option-code. See Table 1, “StartProxy Options,” on page 12.

## DELTA CHOICE

|   |       |  |
|---|-------|--|
| 1 | CARD8 | preferred cache size                     |
| 1 | CARD8 | preferred message length in 4-byte units |

## INDEXED CHOICE

|   |            |       |
|---|------------|-------|
| 1 | CARD8      | index |
| d | LISTofBYTE | data  |

PIXMAPCHOICE

|   |              |             |
|---|--------------|-------------|
| 1 | CARD8        | index       |
| 1 | CARD8        | opcode      |
| 1 | BITMASK      | format mask |
| e | NLISTofCARD8 | depths      |

The description of this request is on page 11.

**LbxStopProxy**

|   |       |                |
|---|-------|----------------|
| 1 | CARD8 | opcode         |
| 1 | 2     | lbx opcode     |
| 2 | 1     | request length |

The description of this request is on page 14.

**LbxSwitch**

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 3      | lbx opcode     |
| 2 | 2      | request length |
| 4 | CARD32 | client         |

The description of this request is on page 15.

**LbxNewClient**

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 4      | lbx opcode     |
| 2 | L      | request length |
| 4 | CARD32 | client         |

The remaining bytes of the request are the core connection setup.

→

If the connection is rejected, a core connection reply is sent. Otherwise the reply has the form:

|   |        |                      |
|---|--------|----------------------|
| 1 | BOOL   | success              |
| 1 |        | change type          |
|   | 0      | no-deltas            |
|   | 1      | normal-client-deltas |
|   | 2      | app-group-deltas     |
| 2 | CARD16 | major version        |
| 2 | CARD16 | minor version        |
| 2 | 1 + a  | length               |
| 4 | CARD32 | tag id               |

The remaining bytes depend on the value of change-type and length.

For no-deltas, the remaining bytes are the "additional data" bytes of the core reply. (a = length of core reply, in 4 byte quantities).

For normal-client-deltas, the additional bytes have the form, with a length (a = 1 +b):

|    |                  |                  |
|----|------------------|------------------|
| 4  | CARD32           | resource id base |
| 4b | LISTofSETofEVENT | root input masks |

For app-group-deltas, the additional bytes have the following form, with a length of (a = 1 + 4c):

|    |                  |                  |
|----|------------------|------------------|
| 4  | CARD32           | resource id base |
| 4  | WINDOW           | root id base     |
| 4  | VISUALID         | visual           |
| 4  | COLORMAP         | colormap         |
| 4  | CARD32           | white pixel      |
| 4  | CARD32           | black pixel      |
| 4c | LISTofSETofEVENT | root input masks |

The description of this request is on page 14.

### LbxCloseClient

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 5      | lbx opcode     |
| 2 | 2      | request length |
| 4 | CARD32 | client         |

The description of this request is on page 15.

### LbxModifySequence

|   |        |                           |
|---|--------|---------------------------|
| 1 | CARD8  | opcode                    |
| 1 | 6      | lbx opcode                |
| 2 | 2      | request length            |
| 4 | CARD32 | offset to sequence number |

The description of this request is on page 16.

### LbxAllowMotion

|   |        |                               |
|---|--------|-------------------------------|
| 1 | CARD8  | opcode                        |
| 1 | 7      | lbx opcode                    |
| 2 | 2      | request length                |
| 4 | CARD32 | number of MotionNotify events |

The description of this request is on page 16.

### LbxIncrementPixel

|   |          |                |
|---|----------|----------------|
| 1 | CARD8    | opcode         |
| 1 | 8        | lbx opcode     |
| 2 | 3        | request length |
| 4 | COLORMAP | colormap       |
| 4 | CARD32   | pixel          |

The description of this request is on page 20.

### LbxDelta

|   |                |                |
|---|----------------|----------------|
| 1 | CARD8          | opcode         |
| 1 | 9              | lbx opcode     |
| 2 | $1+(2n+p+2)/4$ | request length |
| 1 | n              | count of diffs |

|    |                |                         |
|----|----------------|-------------------------|
| 1  | CARD8          | cache index             |
| 2n | LISTofDIFFITEM | offsets and differences |
| p  |                | unused, p=pad(2n + 2)   |

The description of this request is on page 20.

**LbxGetModifierMapping**

|    |               |                       |
|----|---------------|-----------------------|
| 1  | CARD8         | opcode                |
| 1  | 10            | lbx opcode            |
| 2  | 1             | request length        |
| →  |               |                       |
| 1  | 1             | Reply                 |
| 1  | n             | keycodes-per-modifier |
| 2  | CARD16        | sequence number       |
| 4  | 2n            | reply length          |
| 4  | CARD32        | tag                   |
| 20 |               | unused                |
| 8n | LISTofKEYCODE | keycodes              |

The description of this request is on page 20.

**LbxInvalidateTag**

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 12     | lbx opcode     |
| 2 | 2      | request length |
| 4 | CARD32 | tag            |

The description of this request is on page 16.

**LbxPolyPoint**

|   |                  |                              |
|---|------------------|------------------------------|
| 1 | CARD8            | opcode                       |
| 1 | 13               | lbx opcode                   |
| 2 | 1+(m+n+p)/4      | request length               |
| m | LBXGCANDDRAWABLE | cache entries                |
| n | LISTofLBXPOINT   | points (n is data-dependent) |
| p | 0                | unused, p=Lpad               |

The description of this request is on page 23.

**LbxPolyLine**

|   |                  |                              |
|---|------------------|------------------------------|
| 1 | CARD8            | opcode                       |
| 1 | 14               | lbx opcode                   |
| 2 | 1+(m+n+p)/4      | request length               |
| m | LBXGCANDDRAWABLE | cache entries                |
| n | LISTofLBXPOINT   | points (n is data-dependent) |
| p | 0                | unused, p=Lpad               |

The description of this request is on page 23.

**LbxPolySegment**

|   |                  |                                |
|---|------------------|--------------------------------|
| 1 | CARD8            | opcode                         |
| 1 | 15               | lbx opcode                     |
| 2 | $1+(m+n+p)/4$    | request length                 |
| m | LBXGCANDDRAWABLE | cache entries                  |
| n | LISTofLBXSEGMENT | segments (n is data-dependent) |
| p | 0                | unused, p=Lpad                 |

The description of this request is on page 24.

### LbxPolyRectangle

|   |                    |                                  |
|---|--------------------|----------------------------------|
| 1 | CARD8              | opcode                           |
| 1 | 16                 | lbx opcode                       |
| 2 | $1+(m+n+p)/4$      | request length                   |
| m | LBXGCANDDRAWABLE   | cache entries                    |
| n | LISTofLBXRECTANGLE | rectangles (n is data-dependent) |
| p | 0                  | unused, p=pad(m+n)               |

The description of this request is on page 24.

### LbxPolyArc

|   |                  |                            |
|---|------------------|----------------------------|
| 1 | CARD8            | opcode                     |
| 1 | 17               | lbx opcode                 |
| 2 | $1+(m+n+p)/4$    | request length             |
| m | LBXGCANDDRAWABLE | cache entries              |
| n | LISTofLBXARCS    | arcs (n is data-dependent) |
| p | 0                | unused, p=Lpad             |

The description of this request is on page 24.

### LbxFillPoly

|   |                    |                              |
|---|--------------------|------------------------------|
| 1 | CARD8              | opcode                       |
| 1 | 18                 | lbx opcode                   |
| 2 | $1+(3+m+n+p)/4$    | request length               |
| 1 | LBXGCANDDRAWENT    | cache entries                |
| 1 |                    | shape                        |
|   | 0                  | Complex                      |
|   | 1                  | Nonconvex                    |
|   | 2                  | Convex                       |
| 1 | p                  | pad byte count               |
| m | LBXGCANDDRAWUPDATE | optional gc and drawable     |
| n | LISTofLBXPOINT     | points (n is data-dependent) |
| p | 0                  | unused, p=Lpad               |

The description of this request is on page 25.

### LbxPolyFillRectangle

|   |                  |                |
|---|------------------|----------------|
| 1 | CARD8            | opcode         |
| 1 | 19               | lbx opcode     |
| 2 | $1+(m+n+p)/4$    | request length |
| m | LBXGCANDDRAWABLE | cache entries  |

|   |                    |                                  |
|---|--------------------|----------------------------------|
| n | LISTofLBXRECTANGLE | rectangles (n is data-dependent) |
| p | 0                  | unused, p=Lpad                   |

The description of this request is on page 24.

**LbxPolyFillArc**

|   |                  |                            |
|---|------------------|----------------------------|
| 1 | CARD8            | opcode                     |
| 1 | 20               | lbx opcode                 |
| 2 | 1+(m+n+p)/4      | request length             |
| m | LBXGCANDDRAWABLE | cache entries              |
| n | LISTofLBXARC     | arcs (n is data-dependent) |
| p | 0                | unused, p=Lpad             |

The description of this request is on page 25.

**LbxGetKeyboardMapping**

|     |              |   |
|-----|--------------|---|
| 1   | CARD8        | opcode  |
| 1   | 21           | lbx opcode  |
| 2   | 2            | request length  |
| 1   | KEYCODE      | first keycode   |
| 1   | m            | count   |
| 2   |              | unused  |
| →   |              |   |
| 1   | 1            | Reply   |
| 1   | n            | keysyms-per-keycode                                   |
| 2   | CARD16       | sequence number                                       |
| 4   | nm           | reply length (m = count first field from the request) |
| 4   | CARD32       | tag   |
| 20  |              | unused  |
| 4nm | LISTofKEYSYM | keysyms   |

The description of this request is on page 20.

**LbxQueryFont**

|                                      |          |                   |
|--------------------------------------|----------|-------------------|
| 1                                    | CARD8    | opcode            |
| 1                                    | 22       | lbx opcode        |
| 2                                    | 2        | request length    |
| 4                                    | FONTABLE | font              |
| →                                    |          |                   |
| 1                                    | 1        | Reply             |
| 1                                    | BOOL     | compression       |
| 2                                    | CARD16   | sequence number   |
| 4                                    | L        | reply length      |
| 4                                    | CARD32   | tag               |
| 20                                   |          | unused            |
| All of the following is conditional: |          |                   |
| 12                                   | CHARINFO | min-bounds        |
| 4                                    |          | unused            |
| 12                                   | CHARINFO | max-bounds        |
| 4                                    |          | unused            |
| 2                                    | CARD16   | min-char-or-byte2 |

|     |                   |                                   |
|-----|-------------------|-----------------------------------|
| 2   | CARD16            | max-char-or-byte2                 |
| 2   | CARD16            | default-char                      |
| 2   | n                 | number of FONTPROPs in properties |
| 1   |                   | draw-direction                    |
|     | 0 LeftToRight     |                                   |
|     | 1 RightToLeft     |                                   |
| 1   | CARD8             | min-byte1                         |
| 1   | CARD8             | max-byte1                         |
| 1   | BOOL              | all-chars-exist                   |
| 2   | INT16             | font-ascent                       |
| 2   | INT16             | font-descent                      |
| 4   | m                 | number of elements in char-infos  |
| 8n  | LISTofFONTPROP    | properties                        |
|     | and either        |                                   |
| 12m | LISTofCHARINFO    | char-infos                        |
|     | or                |                                   |
| m   | LISTofLBXCHARINFO | char-infos                        |

The description of this request is on page 21.

### LbxChangeProperty

|    |           |  |
|----|-----------|--|
| 1  | CARD8     | opcode   |
| 1  | 23        | lbx opcode   |
| 2  | 6         | request length   |
| 4  | WINDOW    | window   |
| 4  | ATOM      | property   |
| 4  | ATOM      | type   |
| 1  | CARD8     | format   |
| 1  |           | mode   |
|    | 0 Replace |  |
|    | 1 Prepend |  |
|    | 2 Append  |  |
| 2  |           | unused   |
| 4  | CARD32    | length of data in format units<br>(= n for format = 8)<br>(= n/2 for format = 16)<br>(= n/4 for format = 32) |
| →  |           |  |
| 1  | 1         | Reply  |
| 1  |           | unused   |
| 2  | CARD16    | sequence number  |
| 4  | 0         | reply length   |
| 4  | CARD32    | tag  |
| 20 |           | unused   |

The description of this request is on page 22.

### LbxGetProperty

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 24     | lbx opcode     |
| 2 | 7      | request length |
| 4 | WINDOW | window         |



|   |                   |   |
|---|-------------------|---|
| 4 | ATOM              | property  |
| 4 | ATOM              | type  |
|   | 0 AnyPropertyType |   |
| 1 | CARD8             | delete  |
| 3 |                   | unused  |
| 4 | CARD32            | long-offset   |
| 4 | CARD32            | long-length   |
| → |                   |   |
| 1 | 1                 | Reply   |
| 1 | CARD8             | format  |
| 2 | CARD16            | sequence number   |
| 4 | CARD32            | reply length  |
| 4 | ATOM              | type  |
|   | 0 None            |   |
| 4 | CARD32            | bytes-after   |
| 4 | CARD32            | length of value in format units<br>(= 0 for format = 0)<br>(= n for format = 8)<br>(= n/2 for format = 16)<br>(= n/4 for format = 32) |
| 4 | CARD32            | tag   |
| 8 |                   | unused  |

The description of this request is on page 22.

**LbxTagData**

|   |            |                         |
|---|------------|-------------------------|
| 1 | CARD8      | opcode                  |
| 1 | 25         | lbx opcode              |
| 2 | 3+(n+p)/4  | request length          |
| 4 | CARD32     | tag                     |
| 4 | CARD32     | length of data in bytes |
| n | LISTofBYTE | data                    |
| p |            | unused, p=pad(n)        |

The description of this request is on page 16.

**LbxCopyArea**

|        |                    |                               |
|--------|--------------------|-------------------------------|
| 1      | CARD8              | opcode                        |
| 1      | 26                 | lbx opcode                    |
| 2      | L                  | request length                |
| 1      | CARD8              | source drawable cache entry   |
| 1      | LBXGCANDDRAWENT    | cache entries                 |
| 4 or 0 | DRAWABLE           | optional source drawable      |
| b      | LBXGCANDDRAWUPDATE | optional gc and dest drawable |
| c      | LBXPINT16          | src-x                         |
| d      | LBXPINT16          | src-y                         |
| e      | LBXPINT16          | dst-x                         |
| f      | LBXPINT16          | dst-y                         |
| g      | LBXCARD16          | width                         |
| h      | LBXCARD16          | height                        |
| p      |                    | unused, p=Lpad                |

The description of this request is on page 25.

### LbxCopyPlane

|        |                    |                               |
|--------|--------------------|-------------------------------|
| 1      | CARD8              | opcode                        |
| 1      | 27                 | lbx opcode                    |
| 2      | L                  | request length                |
| 4      | CARD32             | bit plane                     |
| 1      | CARD8              | source drawable cache entry   |
| 1      | LBXGCANDDRAWENT    | cache entries                 |
| 4 or 0 | DRAWABLE           | optional source drawable      |
| b      | LBXGCANDDRAWUPDATE | optional gc and dest drawable |
| c      | LBXPINT16          | src-x                         |
| d      | LBXPINT16          | src-y                         |
| e      | LBXPINT16          | dst-x                         |
| f      | LBXPINT16          | dst-y                         |
| g      | LBXCARD16          | width                         |
| h      | LBXCARD16          | height                        |
| p      |                    | unused, p=Lpad                |

The description of this request is on page 25.

### LbxPolyText8

|   |                    |                          |
|---|--------------------|--------------------------|
| 1 | CARD8              | opcode                   |
| 1 | 28                 | lbx opcode               |
| 2 | L                  | request length           |
| 1 | LBXGCANDDRAWENT    | cache entries            |
| a | LBXGCANDDRAWUPDATE | optional gc and drawable |
| b | LBXPINT16          | x                        |
| c | LBXPINT16          | y                        |
| n | LISTofTEXTITEM8    | items                    |
| p |                    | unused, p=Lpad           |

The description of this request is on page 26.

### LbxPolyText16

|    |                    |                          |
|----|--------------------|--------------------------|
| 1  | CARD8              | opcode                   |
| 1  | 29                 | lbx opcode               |
| 2  | L                  | request length           |
| 1  | LBXGCANDDRAWENT    | cache entries            |
| a  | LBXGCANDDRAWUPDATE | optional gc and drawable |
| b  | LBXPINT16          | x                        |
| c  | LBXPINT16          | y                        |
| 2n | LISTofTEXTITEM16   | items                    |
| p  |                    | unused, p=Lpad           |

The description of this request is on page 26.

### LbxImageText8

|   |       |            |
|---|-------|------------|
| 1 | CARD8 | opcode     |
| 1 | 30    | lbx opcode |

|   |                    |                          |
|---|--------------------|--------------------------|
| 2 | L                  | request length           |
| 1 | LBXGCANDDRAWENT    | cache entries            |
| a | LBXGCANDDRAWUPDATE | optional gc and drawable |
| b | LBXPINT16          | x                        |
| c | LBXPINT16          | y                        |
| n | STRING8            | string                   |
| p |                    | unused, p=Lpad           |

The description of this request is on page 26.

**LbxImageText16**

|    |                    |                          |
|----|--------------------|--------------------------|
| 1  | CARD8              | opcode                   |
| 1  | 31                 | lbx opcode               |
| 2  | L                  | request length           |
| 1  | LBXGCANDDRAWENT    | cache entries            |
| a  | LBXGCANDDRAWUPDATE | optional gc and drawable |
| b  | LBXPINT16          | x                        |
| c  | LBXPINT16          | y                        |
| 2n | STRING16           | string                   |
| p  |                    | unused, p=Lpad           |

The description of this request is on page 27.

**LbxQueryExtension**

|    |                           |                                     |
|----|---------------------------|-------------------------------------|
| 1  | CARD8                     | opcode                              |
| 1  | 32                        | lbx opcode                          |
| 2  | $2+(n+p)/4$               | request length                      |
| 4  | n                         | length of extension name            |
| n  | STRING8                   | extension name                      |
| p  |                           | unused, p=pad(n)                    |
| →  |                           |                                     |
| 1  | 1                         | Reply                               |
| 1  | n                         | number of requests in the extension |
| 2  | CARD16                    | sequence number                     |
| 4  | $0 \text{ or } 2*(m + p)$ | reply length, $m = (n+7)/8$         |
| 1  | BOOL                      | present                             |
| 1  | CARD8                     | major opcode                        |
| 1  | CARD8                     | fi rst event                        |
| 1  | CARD8                     | fi rst error                        |
| 20 |                           | unused                              |
| m  | LISTofMASK                | optional reply-mask                 |
| p  |                           | unused, p=pad(m)                    |
| m  | LISTofMASK                | optional event-mask                 |
| p  |                           | unused, p=pad(m)                    |

The description of this request is on page 11.

**LbxPutImage**

|   |       |                |
|---|-------|----------------|
| 1 | CARD8 | opcode         |
| 1 | 33    | lbx opcode     |
| 2 | L     | request length |

|   |                    |                          |
|---|--------------------|--------------------------|
| 1 | CARD8              | compression method       |
| 1 | LBXGCANDDRAWENT    | cache entries            |
| a | PIPACKED           | bit-packed               |
| b | LBXGCANDDRAWUPDATE | optional gc and drawable |
| c | LBXCARD16          | width                    |
| d | LBXCARD16          | height                   |
| e | LBXPINT16          | x                        |
| f | LBXPINT16          | y                        |
| n | LISTofBYTE         | compressed image data    |
| p |                    | unused, p=Lpad           |

If there is no left padding and the depth is less than or equal to nine, PIPACKED is encoded as follows:

PIPACKED

1 #x80 | (format << 5) | ((depth - 1) << 2)

Otherwise PIPACKED is defined as:

PIPACKED

1 (depth - 1) << 2

1 (format << 5) | left-pad

The description of this request is on page 27.

### LbxGetImage

|    |            |                                      |
|----|------------|--------------------------------------|
| 1  | CARD8      | opcode                               |
| 1  | 34         | lbx opcode                           |
| 2  | 6          | request length                       |
| 4  | DRAWABLE   | drawable                             |
| 2  | INT16      | x                                    |
| 2  | INT16      | y                                    |
| 2  | CARD16     | width                                |
| 2  | CARD16     | height                               |
| 4  | CARD32     | plane mask                           |
| 1  | CARD8      | format                               |
| 3  |            | unused                               |
| →  |            |                                      |
| 1  | 1          | Reply                                |
| 1  | CARD8      | depth                                |
| 2  | CARD16     | sequence number                      |
| 4  | (n+p)/4    | reply length                         |
| 4  | (m+p)/4    | X reply length; if uncompressed, m=n |
| 4  | VISUALID   | visual                               |
|    | 0 None     |                                      |
| 1  |            | compression method                   |
| 15 |            | unused                               |
| n  | LISTofBYTE | data                                 |
| p  |            | unused, p=pad(n)                     |

The description of this request is on page 27.

### LbxBeginLargeRequest

|   |       |        |
|---|-------|--------|
| 1 | CARD8 | opcode |
|---|-------|--------|

|   |        |                      |
|---|--------|----------------------|
| 1 | 35     | lbx opcode           |
| 2 | 2      | request length       |
| 4 | CARD32 | large request length |

The description of this request is on page 28.

**LbxLargeRequestData**

|    |            |                |
|----|------------|----------------|
| 1  | CARD8      | opcode         |
| 1  | 36         | lbx opcode     |
| 2  | 1+n        | request length |
| 4n | LISTofBYTE | data           |

The description of this request is on page 28.

**LbxEndLargeRequest**

|   |       |                |
|---|-------|----------------|
| 1 | CARD8 | opcode         |
| 1 | 37    | lbx opcode     |
| 2 | 1     | request length |

The description of this request is on page 28.

**LbxInternAtoms**

|         |                 |                                 |
|---------|-----------------|---------------------------------|
| 1       | CARD8           | opcode                          |
| 1       | 38              | lbx opcode                      |
| 2       | $1+(2+m+n+p)/4$ | request length                  |
| 2       | m               | num-atoms                       |
| n       | LISTofLONGSTR   | names                           |
| p       |                 | pad p=Lpad                      |
| →       |                 |                                 |
| 1       | 1               | Reply                           |
| 1       |                 | unused                          |
| 2       | CARD16          | sequence number                 |
| 4       | a               | reply length, a = MAX(m - 6, 0) |
| 4*m     | LISTofATOM      | atoms                           |
| p       |                 | pad p = MAX(0, 4*(6 - m))       |
| LONGSTR |                 |                                 |
| 2       | c               | string length                   |
| c       | STRING8         | string                          |

The description of this request is on page 19.

**LbxGetWinAttrAndGeom**

|   |        |                |
|---|--------|----------------|
| 1 | CARD8  | opcode         |
| 1 | 39     | lbx opcode     |
| 2 | 2      | request length |
| 4 | CARD32 | window id      |
| → |        |                |
| 1 | 1      | Reply          |

|   |                  |                       |
|---|------------------|-----------------------|
| 1 |                  | backing store         |
|   | 0                | NotUseful             |
|   | 1                | WhenMapped            |
|   | 2                | Always                |
| 2 | CARD16           | sequence number       |
| 4 | 7                | reply length          |
| 4 | VISUALID         | visual id             |
| 2 |                  | class                 |
|   | 1                | InputOutput           |
|   | 2                | InputOnly             |
| 1 | BITGRAVITY       | bit gravity           |
| 1 | WINGRAVITY       | window gravity        |
| 4 | CARD32           | backing bit planes    |
| 4 | CARD32           | backing pixel         |
| 1 | BOOL             | save under            |
| 1 | BOOL             | map installed         |
| 1 |                  | map state             |
|   | 0                | Unmapped              |
|   | 1                | Unviewable            |
|   | 2                | Viewable              |
| 1 | BOOL             | override              |
| 4 | COLORMAP         | colormap              |
| 4 | SETofEVENT       | all events mask       |
| 4 | SETofEVENT       | your event mask       |
| 2 | SETofDEVICEEVENT | do not propagate mask |
| 2 |                  | unused                |
| 4 | WINDOW           | root                  |
| 2 | INT16            | x                     |
| 2 | INT16            | y                     |
| 2 | CARD16           | width                 |
| 2 | CARD16           | height                |
| 2 | CARD16           | border width          |
| 1 | CARD8            | depth                 |
| 1 |                  | unused                |

The description of this request is on page 21.

### LbxGrabCmap

|   |          |                |
|---|----------|----------------|
| 1 | CARD8    | opcode         |
| 1 | 40       | lbx opcode     |
| 2 | 2        | request length |
| 4 | COLORMAP | colormap       |

→

If smart-grab is true, the reply is as follows:

|    |        |                 |
|----|--------|-----------------|
| 1  | 1      | Reply           |
| 1  | #x80   | flags           |
| 2  | CARD16 | sequence number |
| 4  | 0      | reply length    |
| 24 |        | unused          |

If smart-grab is false, the reply is as follows:

|                   |   |   |                                       |
|-------------------|---|---|---------------------------------------|
| 1                 | 1 |   | Reply                                 |
| 1                 |   | #x40 auto-release   | flags (set of)                        |
|                   |   | #x20 three-channels   |                                       |
|                   |   | #x10 two-byte-pixels  |                                       |
|                   |   | lower four bits specifies bits-perpixel                                     |                                       |
| 2                 |   | CARD16  | sequence number                       |
| 4                 |   | L   | reply length                          |
| m                 |   | CHAN or CHANNELS  | cells (CHAN if !three-channels)       |
| p                 |   | 0   | pad(m)                                |
| CHANNELS          |   |   |                                       |
| a                 |   | CHAN  | red                                   |
| 1                 |   | 5   | next channel                          |
| b                 |   | CHAN  | green                                 |
| 1                 |   | 5   | next channel                          |
| c                 |   | CHAN  | blue                                  |
| 1                 |   | 0   | list end                              |
| CHAN              |   |   |                                       |
| d                 |   | LISTofLBXPIXEL  |                                       |
| LBXPIXEL          |   |   |                                       |
| e                 |   | PIXELPRIVATE or<br>PIXELPRIVATERANGE or<br>PIXELALLOC or<br>PIXELALLOCRANGE |                                       |
| PIXELPRIVATE      |   |   |                                       |
| 1                 |   | 1   | pixel-private                         |
| f                 |   | PIXEL   | pixel                                 |
| PIXEL             |   |   |                                       |
| f                 |   | CARD8 or CARD16   | (CARD8 if !two-byte-pixels)           |
| PIXELPRIVATERANGE |   |   |                                       |
| 1                 |   | 2   | pixel-private-range                   |
| f                 |   | PIXEL   | first-pixel                           |
| f                 |   | PIXEL   | last-pixel                            |
| PIXELALLOC        |   |   |                                       |
| 1                 |   | 3   | pixel-private                         |
| f                 |   | PIXEL   | pixel                                 |
| g                 |   | COLORSINGLE or COLORTRIPL   | color (COLORSINGLE if three-channels) |
| COLORSINGLE       |   |   |                                       |
| h                 |   | CARD8 or CARD16   | value (CARD8 if bits-per-rgb =< 7)    |
| COLORTRIPL        |   |   |                                       |
| h                 |   | COLORSINGLE   | red                                   |
| h                 |   | COLORSINGLE   | green                                 |
| h                 |   | COLORSINGLE   | blue                                  |

**PIXELALLOCRANGE**

|   |  |                                       |
|---|--|---------------------------------------|
| 1 | 4  | pixel-private                         |
| f | PIXEL                                    | fi rst-pixel                          |
| f | PIXEL                                    | last-pixel                            |
| j | LISTofCOLORSINGLE or<br>LISTofCOLORTRIPL | color (COLORSINGLE if three-channels) |

The description of this request is on page 17.

**LbxReleaseCmap**

|   |          |                |
|---|----------|----------------|
| 1 | CARD8    | opcode         |
| 1 | 41       | lbx opcode     |
| 2 | 2        | request length |
| 4 | COLORMAP | cmap           |

The description of this request is on page 19.

**LbxAllocColor**

|   |          |                |
|---|----------|----------------|
| 1 | CARD8    | opcode         |
| 1 | 42       | lbx opcode     |
| 2 | 5        | request length |
| 4 | COLORMAP | colormap       |
| 4 | CARD32   | pixel          |
| 2 | CARD16   | red            |
| 2 | CARD16   | green          |
| 2 | CARD16   | blue           |
| 2 |          | unused         |

The description of this request is on page 19.

**LbxSync**

|    |        |                 |
|----|--------|-----------------|
| 1  | CARD8  | opcode          |
| 1  | 43     | lbx opcode      |
| 2  | 1      | request length  |
| →  |        |                 |
| 1  | 1      | Reply           |
| 1  | n      | unused          |
| 2  | CARD16 | sequence number |
| 4  | 0      | reply length    |
| 24 |        | unused          |

The description of this request is on page 16.

**6.3 Events****LbxSwitchEvent**

|   |          |                 |
|---|----------|-----------------|
| 1 | base + 0 | code            |
| 1 | 0        | lbx type        |
| 2 | CARD16   | sequence number |



|    |        |        |
|----|--------|--------|
| 4  | CARD32 | client |
| 24 |        | unused |

The description of this event is on page 29.

**LbxCloseEvent**

|    |          |                 |
|----|----------|-----------------|
| 1  | base + 0 | code            |
| 1  | 1        | lbx type        |
| 2  | CARD16   | sequence number |
| 4  | CARD32   | client          |
| 24 |          | unused          |

The description of this event is on page 29.

**LbxInvalidateTagEvent**

|    |                      |                 |
|----|----------------------|-----------------|
| 1  | base + 0             | code            |
| 1  | 3                    | lbx type        |
| 2  | CARD16               | sequence number |
| 4  | CARD32               | tag             |
| 4  |                      | tag-type        |
|    | 1 LbxTagTypeModmap   |                 |
|    | 2 LbxTagTypeKeymap   |                 |
|    | 3 LbxTagTypeProperty |                 |
|    | 4 LbxTagTypeFont     |                 |
|    | 5 LbxTagTypeConnInfo |                 |
| 20 |                      | unused          |

The description of this event is on page 29.

**LbxSendTagDataEvent**

|    |                      |                 |
|----|----------------------|-----------------|
| 1  | base + 0             | code            |
| 1  | 4                    | lbx type        |
| 2  | CARD16               | sequence number |
| 4  | CARD32               | tag             |
| 4  |                      | tag-type        |
|    | 3 LbxTagTypeProperty |                 |
| 20 |                      | unused          |

The description of this event is on page 29.

**LbxListenToOne**

|    |            |                                   |
|----|------------|-----------------------------------|
| 1  | base + 0   | code                              |
| 1  | 5          | lbx type                          |
| 2  | CARD16     | sequence number                   |
| 4  | CARD32     | client                            |
|    | #xFFFFFFFF | a client not managed by the proxy |
| 24 |            | unused                            |

The description of this event is on page 29.

**LbxListenToAll**

|    |          |                 |
|----|----------|-----------------|
| 1  | base + 0 | code            |
| 1  | 6        | lbx type        |
| 2  | CARD16   | sequence number |
| 28 |          | unused          |

The description of this event is on page 30.

**LbxQuickMotionDeltaEvent**

|   |          |            |
|---|----------|------------|
| 1 | base + 1 | code       |
| 1 | CARD8    | delta-time |
| 1 | INT8     | delta-x    |
| 1 | INT8     | delta-y    |

This event is not padded to 32 bytes.

The description of this event is on page 30.

**LbxMotionDeltaEvent**

|   |          |                |
|---|----------|----------------|
| 1 | base + 0 | code           |
| 1 | 7        | lbx type       |
| 1 | INT8     | delta-x        |
| 1 | INT8     | delta-y        |
| 2 | CARD16   | delta-time     |
| 2 | CARD16   | delta-sequence |

This event is not padded to 32 bytes.

The description of this event is on page 30.

**LbxReleaseCmapEvent**

|    |          |                 |
|----|----------|-----------------|
| 1  | base + 0 | code            |
| 1  | 8        | lbx type        |
| 2  | CARD16   | sequence number |
| 4  | COLORMAP | colormap        |
| 24 |          | unused          |

The description of this event is on page 30.

**LbxFreeCellsEvent**

|    |          |                 |
|----|----------|-----------------|
| 1  | base + 0 | code            |
| 1  | 9        | lbx type        |
| 2  | CARD16   | sequence number |
| 4  | COLORMAP | colormap        |
| 4  | PIXEL    | pixel start     |
| 4  | PIXEL    | pixel end       |
| 16 |          | unused          |

The description of this event is on page 30.

## 6.4 Re-encoding of X Events

The X protocol requires all X events to be 32 bytes. The LBX server reduces the number of bytes sent between the server and the proxy for some X events by not appending unused pad bytes to the event data. The offsets of X event data are unchanged. The proxy will pad the events to 32 bytes before passing them on to the client.

LBX reencodes X event representations into the following sizes, if squishing is enabled:

|                  |    |
|------------------|----|
| KeyOrButton      | 32 |
| EnterOrLeave     | 32 |
| Keymap           | 32 |
| Expose           | 20 |
| GraphicsExposure | 24 |
| NoExposure       | 12 |
| VisibilityNotify | 12 |
| CreateNotify     | 24 |
| DestroyNotify    | 12 |
| UnmapNotify      | 16 |
| MapNotify        | 16 |
| MapRequest       | 12 |
| Reparent         | 24 |
| ConfigureNotify  | 28 |
| ConfigureRequest | 28 |
| GravityNotify    | 16 |
| ResizeRequest    | 12 |
| Circulate        | 20 |
| Property Notify  | 20 |
| SelectionClear   | 20 |
| SelectionRequest | 28 |
| SelectionNotify  | 24 |
| ColormapNotify   | 16 |
| MappingNotify    | 8  |
| ClientMessage    | 32 |
| Unknown          | 32 |

## 6.5 Responses

### LbxDeltaResponse

|    |                |                            |
|----|----------------|----------------------------|
| 1  | event_base + 0 | event code                 |
| 1  | 2              | lbx type                   |
| 2  | $1+(2+2n+p)/4$ | request length             |
| 1  | n              | count of diffs             |
| 1  | CARD8          | cache index                |
| 2n | LISTofDIFFITEM | offsets and differences    |
| p  |                | unused, $p=\text{pad}(2n)$ |

The description of this response is on page 31.



|   |  |    |
|---|--|----|
| 1 | Introduction.....  | 3  |
| 2 | Description.....   | 3  |
|   | 2.1 Data Flow .....  | 3  |
|   | 2.2 Tags .....   | 4  |
|   | 2.2.1 Tag Substitution in Requests.....                      | 4  |
|   | 2.2.2 Property Tags .....                                    | 4  |
|   | 2.3 Short-circuiting.....                                    | 4  |
|   | 2.4 Graphics Re-encoding .....                               | 5  |
|   | 2.5 Motion events.....                                       | 5  |
|   | 2.6 Event Squishing.....                                     | 5  |
|   | 2.7 Master Client .....                                      | 6  |
|   | 2.8 Multiplexing of Clients .....                            | 6  |
|   | 2.9 Swapping .....   | 6  |
|   | 2.10 Delta cache .....                                       | 6  |
|   | 2.11 Stream Compression .....                                | 7  |
|   | 2.12 Authentication Protocols .....                          | 7  |
| 3 | C Library Interfaces.....                                    | 7  |
|   | 3.1 Application Library Interfaces .....                     | 7  |
|   | 3.1.1 XLbxQueryVersion .....                                 | 7  |
|   | 3.2 Proxy Library Interfaces.....                            | 8  |
|   | 3.2.1 XLbxQueryExtension .....                               | 8  |
|   | 3.2.2 XLbxGetEventBase .....                                 | 8  |
| 4 | Protocol.....  | 8  |
|   | 4.1 Syntactic Conventions and Common Types.....              | 8  |
|   | 4.2 Errors .....   | 10 |
|   | 4.3 Requests .....   | 10 |
|   | 4.3.1 Requests Initiated by the Proxy or by the Client ..... | 10 |
|   | LbxQueryVersion .....  | 10 |
|   | 4.3.2 Requests Initiated or Substituted by the Proxy .....   | 11 |
|   | LbxQueryExtension .....                                      | 11 |
|   | 4.3.3 Control Requests Initiated by the Proxy .....          | 11 |
|   | LbxStartProxy .....  | 11 |
|   | LbxStopProxy .....   | 14 |
|   | LbxNewClient.....  | 14 |
|   | LbxCloseClient .....   | 15 |
|   | LbxSwitch .....  | 15 |
|   | LbxSync .....  | 16 |
|   | LbxModifySequence.....                                       | 16 |
|   | LbxAllowMotion .....   | 16 |
|   | LbxInvalidateTag .....                                       | 16 |
|   | LbxTagData.....  | 16 |
|   | LbxGrabCmap.....   | 17 |
|   | LbxReleaseCmap .....   | 19 |
|   | LbxInternAtoms .....   | 19 |
|   | 4.3.4 Substitution Requests.....                             | 19 |
|   | LbxAllocColor .....  | 19 |
|   | LbxIncrementPixel.....                                       | 20 |
|   | LbxDelta.....  | 20 |
|   | LbxGetModifierMapping.....                                   | 20 |
|   | LbxGetKeyboardMapping .....                                  | 20 |

|     |                               |    |
|-----|-------------------------------|----|
|     | LbxGetWinAttrAndGeom.....     | 21 |
|     | LbxQueryFont.....             | 21 |
|     | LbxChangeProperty.....        | 22 |
|     | LbxGetProperty.....           | 22 |
|     | LbxPolyPoint.....             | 23 |
|     | LbxPolyLine.....              | 23 |
|     | LbxPolySegment.....           | 24 |
|     | LbxPolyRectangle.....         | 24 |
|     | LbxPolyArc.....               | 24 |
|     | LbxPolyFillRectangle.....     | 24 |
|     | LbxPolyFillArc.....           | 25 |
|     | LbxFillPoly.....              | 25 |
|     | LbxCopyArea.....              | 25 |
|     | LbxCopyPlane.....             | 25 |
|     | LbxPolyText8.....             | 26 |
|     | LbxPolyText16.....            | 26 |
|     | LbxImageText8.....            | 26 |
|     | LbxImageText16.....           | 27 |
|     | LbxPutImage.....              | 27 |
|     | LbxGetImage.....              | 27 |
|     | LbxBeginLargeRequest.....     | 28 |
|     | LbxLargeRequestData.....      | 28 |
|     | LbxEndLargeRequest.....       | 28 |
| 4.4 | Events.....                   | 29 |
|     | LbxSwitchEvent.....           | 29 |
|     | LbxCloseEvent.....            | 29 |
|     | LbxInvalidateTagEvent.....    | 29 |
|     | LbxSendTagDataEvent.....      | 29 |
|     | LbxListenToOne.....           | 29 |
|     | LbxListenToAll.....           | 30 |
|     | LbxQuickMotionDeltaEvent..... | 30 |
|     | LbxMotionDeltaEvent.....      | 30 |
|     | LbxReleaseCmapEvent.....      | 30 |
|     | LbxFreeCellsEvent.....        | 30 |
| 4.5 | Responses.....                | 31 |
|     | LbxDeltaResponse.....         | 31 |
| 5   | Algorithm Naming.....         | 31 |
| 6   | Encoding.....                 | 31 |
| 6.1 | Errors.....                   | 32 |
|     | LbxClient.....                | 32 |
| 6.2 | Requests.....                 | 32 |
|     | LbxQueryVersion.....          | 32 |
|     | LbxStartProxy.....            | 33 |
|     | LbxStopProxy.....             | 35 |
|     | LbxSwitch.....                | 35 |
|     | LbxNewClient.....             | 35 |
|     | LbxCloseClient.....           | 36 |
|     | LbxModifySequence.....        | 36 |
|     | LbxAllowMotion.....           | 36 |
|     | LbxIncrementPixel.....        | 36 |
|     | LbxDelta.....                 | 36 |
|     | LbxGetModifierMapping.....    | 37 |

|     |                               |    |
|-----|-------------------------------|----|
|     | LbxInvalidateTag .....        | 37 |
|     | LbxPolyPoint .....            | 37 |
|     | LbxPolyLine.....              | 37 |
|     | LbxPolySegment.....           | 37 |
|     | LbxPolyRectangle.....         | 38 |
|     | LbxPolyArc.....               | 38 |
|     | LbxFillPoly .....             | 38 |
|     | LbxPolyFillRectangle .....    | 38 |
|     | LbxPolyFillArc .....          | 39 |
|     | LbxGetKeyboardMapping .....   | 39 |
|     | LbxQueryFont.....             | 39 |
|     | LbxChangeProperty .....       | 40 |
|     | LbxGetProperty.....           | 40 |
|     | LbxTagData.....               | 41 |
|     | LbxCopyArea.....              | 41 |
|     | LbxCopyPlane.....             | 42 |
|     | LbxPolyText8.....             | 42 |
|     | LbxPolyText16.....            | 42 |
|     | LbxImageText8.....            | 42 |
|     | LbxImageText16.....           | 43 |
|     | LbxQueryExtension .....       | 43 |
|     | LbxPutImage.....              | 43 |
|     | LbxGetImage .....             | 44 |
|     | LbxBeginLargeRequest .....    | 44 |
|     | LbxLargeRequestData .....     | 45 |
|     | LbxEndLargeRequest.....       | 45 |
|     | LbxInternAtoms .....          | 45 |
|     | LbxGetWinAttrAndGeom.....     | 45 |
|     | LbxGrabCmap.....              | 46 |
|     | LbxReleaseCmap .....          | 48 |
|     | LbxAllocColor .....           | 48 |
|     | LbxSync .....                 | 48 |
| 6.3 | Events.....                   | 48 |
|     | LbxSwitchEvent.....           | 48 |
|     | LbxCloseEvent.....            | 49 |
|     | LbxInvalidateTagEvent.....    | 49 |
|     | LbxSendTagDataEvent .....     | 49 |
|     | LbxListenToOne .....          | 49 |
|     | LbxListenToAll.....           | 50 |
|     | LbxQuickMotionDeltaEvent..... | 50 |
|     | LbxMotionDeltaEvent .....     | 50 |
|     | LbxReleaseCmapEvent.....      | 50 |
|     | LbxFreeCellsEvent.....        | 50 |
| 6.4 | Re-encoding of X Events ..... | 51 |
| 6.5 | Responses .....               | 51 |
|     | LbxDeltaResponse .....        | 51 |