X11 Input Extension Protocol Specification

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1.1. Input Extension Overview

This document defines an extension to the X11 protocol to support input devices other than the core X keyboard and pointer. An accompanying document defines a corresponding extension to Xlib (similar extensions for languages other than C are anticipated). This first section gives an overview of the input extension. The next section defines the new protocol requests defined by the extension. We conclude with a description of the new input events generated by the additional input devices.

1.2. Design Approach

The design approach of the extension is to define requests and events analogous to the core requests and events. This allows extension input devices to be individually distinguishable from each other and from the core input devices. These requests and events make use of a device identifier and support the reporting of n-dimensional motion data as well as other data that is not reportable via the core input events.

1.3. Core Input Devices

The X server core protocol supports two input devices: a pointer and a keyboard. The pointer device has two major functions. First, it may be used to generate motion information that client programs can detect. Second, it may also be used to indicate the current location and focus of the X keyboard. To accomplish this, the server echoes a cursor at the current position of the X pointer. Unless the X keyboard has been explicitly focused, this cursor also shows the current location and focus of the X keyboard.

The X keyboard is used to generate input that client programs can detect.

The X keyboard and X pointer are referred to in this document as the core devices, and the input events they generate (KeyPress, KeyRelease, ButtonPress, ButtonRelease, and MotionNotify) are known as the core input events. All other input devices are referred to as extension input devices and the input events they generate are referred to as extension input events.

Note

This input extension does not change the behavior or functionality of the core input devices, core events, or core protocol requests, with the exception of the core grab requests. These requests may affect the synchronization of events from extension devices. See the explanation in the section titled "Event Synchronization and Core grabs".

Selection of the physical devices to be initially used by the server as the core devices is left implementation-dependent. Requests are defined that allow client programs to change which physical devices are used as the core devices.

1.4. Extension Input Devices

The input extension controls access to input devices other than the X keyboard and X pointer. It allows client programs to select input from these devices independently from each other and independently from the core devices.

A client that wishes to access a specific device must first determine whether that device is connected to the X server. This is done through the ListInputDevices request, which will return a list of all devices that can be opened by the X server. A client can then open one or more of these devices using the OpenDevice request, specify what events they are interested in receiving, and receive and process input events from extension devices in the same way as events from the X keyboard and X pointer. Input events from these devices are of extension types (DeviceKeyPress, DeviceKeyRelease, DeviceButtonPress, DeviceButtonRelease, DeviceMotionNotify, etc.) and contain a device identifier so that events of the same type coming from different input devices can be distinguished.
Any kind of input device may be used as an extension input device. Extension input devices may have 0 or more keys, 0 or more buttons, and may report 0 or more axes of motion. Motion may be reported as relative movements from a previous position or as an absolute position. All valuators reporting motion information for a given extension input device must report the same kind of motion information (absolute or relative).

This extension is designed to accommodate new types of input devices that may be added in the future. The protocol requests that refer to specific characteristics of input devices organize that information by input classes. Server implementors may add new classes of input devices without changing the protocol requests. Input classes are unique numbers registered with the X Consortium. Each extension input device may support multiple input classes.

All extension input devices are treated like the core X keyboard in determining their location and focus. The server does not track the location of these devices on an individual basis, and therefore does not echo a cursor to indicate their current location. Instead, their location is determined by the location of the core X pointer. Like the core X keyboard, some may be explicitly focused. If they are not explicitly focused, their focus is determined by the location of the core X pointer.

Input events reported by the server to a client are of fixed size (32 bytes). In order to represent the change in state of an input device the extension may need to generate a sequence of input events. A client side library (such as Xlib) will typically take these raw input events and format them into a form more convenient to the client.

1.4.1. Event Classes

In the core protocol a client registers interest in receiving certain input events directed to a window by modifying that window’s event-mask. Most of the bits in the event mask are already used to specify interest in core X events. The input extension specifies a different mechanism by which a client can express interest in events generated by this extension.

When a client opens an extension input device via the OpenDevice request, an XDevice structure is returned. Macros are provided that extract 32-bit numbers called event classes from that structure, that a client can use to register interest in extension events via the SelectExtensionEvent request. The event class combines the desired event type and device id, and may be thought of as the equivalent of core event masks.

1.4.2. Input Classes

Some of the input extension requests divide input devices into classes based on their functionality. This is intended to allow new classes of input devices to be defined at a later time without changing the semantics of these requests. The following input device classes are currently defined:

- **KEY** The device reports key events.
- **BUTTON** The device reports button events.
- **VALUATOR** The device reports valuator data in motion events.
- **PROXIMITY** The device reports proximity events.
- **FOCUS** The device can be focused and reports focus events.
- **FEEDBACK** The device supports feedbacks.
- **OTHER** The ChangeDeviceNotify, DeviceMappingNotify, and DeviceStateNotify macros may be invoked passing the XDevice structure returned for this device.
Each extension input device may support multiple input classes. Additional classes may be added in the future. Requests that support multiple input classes, such as the ListInputDevices function that lists all available input devices, organize the data they return by input class. Client programs that use these requests should not access data unless it matches a class defined at the time those clients were compiled. In this way, new classes can be added without forcing existing clients that use these requests to be recompiled.

2. Requests
Extension input devices are accessed by client programs through the use of new protocol requests. This section summarizes the new requests defined by this extension. The syntax and type definitions used below follow the notation used for the X11 core protocol.

2.1. Getting the Extension Version
The GetExtensionVersion request returns version information about the input extension.

GetExtensionVersion
  name: STRING
=>
  present: BOOL
  protocol-major-version: CARD16
  protocol-minor-version: CARD16

The protocol version numbers returned indicate the version of the input extension supported by the target X server. The version numbers can be compared to constants defined in the header file XI.h. Each version is a superset of the previous versions.

2.2. Listing Available Devices
A client that wishes to access a specific device must first determine whether that device is connected to the X server. This is done through the ListInputDevices request, which will return a list of all devices that can be opened by the X server.

ListInputDevices
=>
  input-devices: LISTofDEVICEINFO

where

DEVICEINFO:
  [type: ATOM
   id: CARD8
   num_classes: CARD8
   use: [IsXKeyboard, IsXPointer, IsExtensionDevice]
   info: LISTofINPUTINFO
   name: STRING8]

INPUTINFO:
  [KEYINFO, BUTTONINFO, VALUATORINFO]

KEYINFO:
  [class: CARD8
   length: CARD8
   min-keycode: KEYCODE
   max-keycode: KEYCODE
   num-keys: CARD16]
This request returns a list of all devices that can be opened by the X server, including the core X keyboard and X pointer. Some implementations may open all input devices as part of X initialization, while others may not open an input device until requested to do so by a client program.

- The information returned for each device is as follows:

  The **type** field is of type Atom and indicates the nature of the device. Clients may determine device types by invoking the XInternAtom request passing one of the names defined in the header file XI.h. The following names have been defined to date:

  ```
  MOUSE
  TABLET
  KEYBOARD
  TOUCHSCREEN
  TOUCHPAD
  BUTTONBOX
  BARCODE
  KNOB_BOX
  TRACKBALL
  QUADRATURE
  SPACEBALL
  DATAGLOVE
  EYETRACKER
  CURSORKEYS
  FOOTMOUSE
  ID_MODULE
  ONE_KNOB
  NINE_KNOB
  ```

  The **id** is a small cardinal value in the range 0-128 that uniquely identifies the device. It is assigned to the device when it is initialized by the server. Some implementations may not open an input device until requested by a client program, and may close the device when the last client accessing it requests that it be closed. If a device is opened by a client program via XOpenDevice, then closed via XCloseDevice, then opened again, it is not guaranteed to have the same id after the second open request.
The **num_classes** field is a small cardinal value in the range 0-255 that specifies the number of input classes supported by the device for which information is returned by `ListInputDevices`. Some input classes, such as class **Focus** and class **Proximity** do not have any information to be returned by `ListInputDevices`.

The **use** field specifies how the device is currently being used. If the value is `IsXKeyboard`, the device is currently being used as the X keyboard. If the value is `IsXPointer`, the device is currently being used as the X pointer. If the value is `IsXExtensionDevice`, the device is available for use as an extension device.

The **name** field contains a pointer to a null-terminated string that corresponds to one of the defined device types.

- **InputInfo** is one of: **KeyInfo**, **ButtonInfo** or **ValuatorInfo**. The first two fields are common to all three:
  
  The **class** field is a cardinal value in the range 0-255. It uniquely identifies the class of input for which information is returned.

  The **length** field is a cardinal value in the range 0-255. It specifies the number of bytes of data that are contained in this input class. The length includes the class and length fields.

  The remaining information returned for input class **KEYCLASS** is as follows:

  - **min_keycode** is of type **KEYCODE**. It specifies the minimum keycode that the device will report. The minimum keycode will not be smaller than 8.
  - **max_keycode** is of type **KEYCODE**. It specifies the maximum keycode that the device will report. The maximum keycode will not be larger than 255.
  - **num_keys** is a cardinal value that specifies the number of keys that the device has.

  The remaining information returned for input class **BUTTONCLASS** is as follows:

  - **num_buttons** is a cardinal value that specifies the number of buttons that the device has.

  The remaining information returned for input class **VALUATORCLASS** is as follows:

  - **mode** is a constant that has one of the following values: **Absolute** or **Relative**. Some devices allow the mode to be changed dynamically via the **SetDeviceMode** request.
  - **motion_buffer_size** is a cardinal number that specifies the number of elements that can be contained in the motion history buffer for the device.

  The **axes** field contains a pointer to an **AXISINFO** structure.

  - The information returned for each axis reported by the device is:

    - The **resolution** is a cardinal value in counts/meter.

    - The **min_val** field is a cardinal value in that contains the minimum value the device reports for this axis. For devices whose mode is **Relative**, the min_val field will contain 0.

    - The **max_val** field is a cardinal value in that contains the maximum value the device reports for this axis. For devices whose mode is **Relative**, the max_val field will contain 0.

2.3. Enabling Devices

Client programs that wish to access an extension device must request that the server open that device. This is done via the **OpenDevice** request.

```plaintext
OpenDevice
    id: CARD8
=>
```
DEVICE: [device_id: XID
num_classes: INT32
classes: LISToFINPUTCLASSINFO]

INPUTCLASSINFO: [input_class: CARD8
event_type_base: CARD8]

Errors: Device

This request returns the event classes to be used by the client to indicate which events the client program wishes to receive. Each input class may report several event classes. For example, input class Keys reports DeviceKeyPress and DeviceKeyRelease event classes. Input classes are unique numbers registered with the X Consortium. Input class Other exists to report event classes that are not specific to any one input class, such as DeviceMappingNotify, ChangeDeviceNotify, and DeviceStateNotify.

- The information returned for each device is as follows:
  - The **device_id** is a number that uniquely identifies the device.
  - The **num_classes** field contains the number of input classes supported by this device.
  - For each class of input supported by the device, the **InputClassInfo** structure contains the following information:
    - The **input_class** is a small cardinal number that identifies the class of input.
    - The **event_type_base** is a small cardinal number that specifies the event type of one of the events reported by this input class. This information is not directly used by client programs. Instead, the **Device** is used by macros that return extension event types and event classes. This is described in the section of this document entitled "Selecting Extension Device Events".

Before it exits, the client program should explicitly request that the server close the device. This is done via the **CloseDevice** request.

A client may open the same extension device more than once. Requests after the first successful one return an additional **XDevice** structure with the same information as the first, but otherwise have no effect. A single **CloseDevice** request will terminate that client’s access to the device.

Closing a device releases any active or passive grabs the requesting client has established. If the device is frozen only by an active grab of the requesting client, the queued events are released when the client terminates.

If a client program terminates without closing a device, the server will automatically close that device on behalf of the client. This does not affect any other clients that may be accessing that device.

CloseDevice
device: DEVICE

Errors: Device
2.4. Changing The Mode Of A Device

Some devices are capable of reporting either relative or absolute motion data. To change the mode of a device from relative to absolute, use the `SetDeviceMode` request. The valid values are `Absolute` or `Relative`.

This request will fail and return `DeviceBusy` if another client already has the device open with a different mode. It will fail and return `AlreadyGrabbed` if another client has the device grabbed. The request will fail with a `BadMatch` error if the requested mode is not supported by the device.

```
SetDeviceMode
  device: DEVICE
  mode: {Absolute, Relative}

Errors: Device, Match, Mode
```

=>

```
status: {Success, DeviceBusy, AlreadyGrabbed}
```

2.5. Initializing Valuators on an Input Device

Some devices that report absolute positional data can be initialized to a starting value. Devices that are capable of reporting relative motion or absolute positional data may require that their valuators be initialized to a starting value after the mode of the device is changed to `Absolute`. To initialize the valuators on such a device, use the `SetDeviceValuators` request.

```
SetDeviceValuators
  device: DEVICE
  fi rst_valuator: CARD8
  num_valuators: CARD8
  valuators: LISTOFINT32

Errors: Length, Device, Match, Value
```

=>

```
status: {Success, AlreadyGrabbed}
```

This request initializes the specified valuators on the specified extension input device. Valuators are numbered beginning with zero. Only the valuators in the range specified by `fi rst_valuator` and `num_valuators` are set. If the number of valuators supported by the device is less than the expression `fi rst_valuator + num_valuators`, a `Value` error will result.

If the request succeeds, `Success` is returned. If the specified device is grabbed by some other client, the request will fail and a status of `AlreadyGrabbed` will be returned.

2.6. Getting Input Device Controls

```
GetDeviceControl
  device: DEVICE
  control: XID
```
This request returns the current state of the specified device control. The device control must be supported by the target server and device or an error will result.

If the request is successful, a pointer to a generic DeviceState structure will be returned. The information returned varies according to the specified control and is mapped by a structure appropriate for that control.

GetDeviceControl will fail with a BadValue error if the server does not support the specified control. It will fail with a BadMatch error if the device does not support the specified control.

Supported device controls and the information returned for them include:

DEVICE_RESOLUTION: [control: CARD16
length: CARD16
num_valuators: CARD8
resolutions: LISTofCARD32
min_resolutions: LISTofCARD32
max_resolutions: LISTofCARD32]

This device control returns a list of valuators and the range of valid resolutions allowed for each. Valuators are numbered beginning with 0. Resolutions for all valuators on the device are returned. For each valuator \( i \) on the device, resolutions\[i\] returns the current setting of the resolution, min_resolutions\[i\] returns the minimum valid setting, and max_resolutions\[i\] returns the maximum valid setting.

When this control is specified, XGetDeviceControl will fail with a BadMatch error if the specified device has no valuators.

ChangeDeviceControl
device: DEVICE
XID: controlId
control: DeviceControl

where

DeviceControl: DeviceResolutionControl

Errors: Length, Device, Match, Value

=>
status: {Success, DeviceBusy, AlreadyGrabbed}
The information passed with this request varies according to the specified control and is mapped by a structure appropriate for that control. ChangeDeviceControl will fail with a BadValue error if the server does not support the specified control. It will fail with a BadMatch error if the server supports the specified control, but the requested device does not. The request will fail and return a status of DeviceBusy if another client already has the device open with a device control state that conflicts with the one specified in the request. It will fail with a status of AlreadyGrabbed if some other client has grabbed the specified device. If the request succeeds, Success is returned. If it fails, the device control is left unchanged.

Supported device controls and the information specified for them include:

DEVICE_RESOLUTION: [control: CARD16
length: CARD16
first_valuator: CARD8
num_valuators: CARD8
resolutions: LISTofCARD32]

This device control changes the resolution of the specified valuators on the specified extension input device. Valuators are numbered beginning with zero. Only the valuators in the range specified by first_valuator and num_valuators are set. A value of -1 in the resolutions list indicates that the resolution for this valuator is not to be changed. num_valuators specifies the number of valuators in the resolutions list.

When this control is specified, XChangeDeviceControl will fail with a BadMatch error if the specified device has no valuators. If a resolution is specified that is not within the range of valid values (as returned by XGetDeviceControl) the request will fail with a BadValue error. If the number of valuators supported by the device is less than the expression first_valuator + num_valuators, a BadValue error will result.

If the request fails for any reason, none of the valuator resolutions will be changed.

2.7. Selecting Extension Device Events

Extension input events are selected using the SelectExtensionEvent request.

SelectExtensionEvent
window: WINDOW
interest: LISTofEVENTCLASS

Errors: Window, Class, Access

This request specifies to the server the events within the specified window which are of interest to the client. As with the core XSelectInput function, multiple clients can select input on the same window.

XSelectExtensionEvent requires a list of event classes. An event class is a 32-bit number that combines an event type and device id, and is used to indicate which event a client wishes to receive and from which device it wishes to receive it. Macros are provided to obtain event classes from the data returned by the XOpenDevice request. The names of these macros correspond to the desired events, i.e. the DeviceKeyPress is used to obtain the event class for DeviceKeyPress events. The syntax of the macro invocation is:

DeviceKeyPress (device, event_type, event_class);
device: DEVICE
event_type: INT
event_class: INT

The value returned in event_type is the value that will be contained in the event type field of the XDeviceKeyPressEvent when it is received by the client. The value returned in event_class is the value that should be passed in making an XSelectExtensionEvent request to receive DeviceKeyPress events.

For DeviceButtonPress events, the client may specify whether or not an implicit passive grab should be done when the button is pressed. If the client wants to guarantee that it will receive a DeviceButtonRelease event for each DeviceButtonPress event it receives, it should specify the DeviceButtonPressGrab event class as well as the DeviceButtonPress event class. This restricts the client in that only one client at a time may request DeviceButtonPress events from the same device and window if any client specifies this class.

If any client has specified the DeviceButtonPressGrab class, any requests by any other client that specify the same device and window and specify DeviceButtonPress or DeviceButtonPress-Grab will cause an Access error to be generated.

If only the DeviceButtonPress class is specified, no implicit passive grab will be done when a button is pressed on the device. Multiple clients may use this class to specify the same device and window combination.

A client may also specify the DeviceOwnerGrabButton class. If it has specified both the DeviceButtonPressGrab and the DeviceOwnerGrabButton classes, implicit passive grabs will activate with owner_events set to True. If only the DeviceButtonPressGrab class is specified, implicit passive grabs will activate with owner_events set to False.

The client may select DeviceMotion events only when a button is down. It does this by specifying the event classes Button1Motion through Button5Motion, or ButtonMotion. An input device will only support as many button motion classes as it has buttons.

2.8. Determining Selected Events

To determine which extension events are currently selected from a given window, use GetSelectedExtensionEvents.

GetSelectedExtensionEvents
    window: WINDOW
=>
    this-client: LISTofEVENTCLASS
    all-clients: LISTofEVENTCLASS

Errors: Window

This request returns two lists specifying the events selected on the specified window. One list gives the extension events selected by this client from the specified window. The other list gives the extension events selected by all clients from the specified window. This information is equivalent to that returned by your-event-mask and all-event-masks in a GetWindowAttributes request.

2.9. Controlling Event Propagation

Extension events propagate up the window hierarchy in the same manner as core events. If a window is not interested in an extension event, it usually propagates to the closest ancestor that is interested, unless the dont_propagate list prohibits it. grabs of extension devices may alter the set of windows that receive a particular extension event.

Client programs may control extension event propagation through the use of the following two requests.
XChangeDeviceDontPropagateList adds an event to or deletes an event from the do_not_propagate list of extension events for the specified window. This list is maintained for the life of the window, and is not altered if the client terminates.

```c
ChangeDeviceDontPropagateList
    window: WINDOW
    eventclass: LISTofEVENTCLASS
    mode: {AddToList, DeleteFromList}

Errors: Window, Class, Mode
```

This function modifies the list specifying the events that are not propagated to the ancestors of the specified window. You may use the modes AddToList or DeleteFromList.

```c
GetDeviceDontPropagateList
    window: WINDOW

=>
    dont-propagate-list: LISTofEVENTCLASS
```

This function returns a list specifying the events that are not propagated to the ancestors of the specified window.

### 2.10. Sending Extension Events

One client program may send an event to another via the XSendExtensionEvent function. The event in the XEvent structure must be one of the events defined by the input extension, so that the X server can correctly byte swap the contents as necessary. The contents of the event are otherwise unaltered and unchecked by the X server except to force send_event to True in the forwarded event and to set the sequence number in the event correctly.

XSendExtensionEvent returns zero if the conversion-to-wire protocol failed, otherwise it returns nonzero.

```c
SendExtensionEvent
    device: DEVICE
    destination: WINDOW
    propagate: BOOL
    eventclass: LISTofEVENTCLASS
    event: XEVENT

Errors: Device, Value, Class, Window
```

### 2.11. Getting Motion History

```c
GetDeviceMotionEvents
    device: DEVICE
    start, stop: TIMESTAMP or CurrentTime

=>
```
nevents_return: CARD32
mode_return: {Absolute, Relative}
axis_count_return: CARD8
events: LISTofDEVICETIMECOORD

where

DEVICETIMECOORD: [data:LISTofINT32 time:TIMESTAMP]

Errors: Device, Match

This request returns all positions in the device’s motion history buffer that fall between the specified start and stop times inclusive. If the start time is in the future, or is later than the stop time, no positions are returned.

The data field of the DEVICETIMECOORD structure is a sequence of data items. Each item is of type INT32, and there is one data item per axis of motion reported by the device. The number of axes reported by the device is returned in the axis_count variable.

The value of the data items depends on the mode of the device, which is returned in the mode variable. If the mode is Absolute, the data items are the raw values generated by the device. These may be scaled by the client program using the maximum values that the device can generate for each axis of motion that it reports. The maximum and minimum values for each axis are reported by the ListInputDevices request.

If the mode is Relative, the data items are the relative values generated by the device. The client program must choose an initial position for the device and maintain a current position by accumulating these relative values.

2.12. Changing The Core Devices

These requests are provided to change which physical device is used as the X pointer or X keyboard.

Note

Using these requests may change the characteristics of the core devices. The new pointer device may have a different number of buttons than the old one did, or the new keyboard device may have a different number of keys or report a different range of keycodes. Client programs may be running that depend on those characteristics. For example, a client program could allocate an array based on the number of buttons on the pointer device, and then use the button numbers received in button events as indices into that array. Changing the core devices could cause such client programs to behave improperly or abnormally terminate.

These requests change the X keyboard or X pointer device and generate an ChangeDeviceNotify event and a MappingNotify event. The ChangeDeviceNotify event is sent only to those clients that have expressed an interest in receiving that event via the XSelectExtensionEvent request. The specified device becomes the new X keyboard or X pointer device. The location of the core device does not change as a result of this request.

These requests fail and return AlreadyGrabbed if either the specified device or the core device it would replace are grabbed by some other client. They fail and return GrabFrozen if either device is frozen by the active grab of another client.

These requests fail with a BadDevice error if the specified device is invalid, or has not previously been opened via OpenDevice.
To change the X keyboard device, use the ChangeKeyboardDevice request. The specified device must support input class Keys (as reported in the ListInputDevices request) or the request will fail with a BadMatch error. Once the device has successfully replaced one of the core devices, it is treated as a core device until it is in turn replaced by another ChangeDevice request, or until the server terminates. The termination of the client that changed the device will not cause it to change back. Attempts to use the CloseDevice request to close the new core device will fail with a BadDevice error.

The focus state of the new keyboard is the same as the focus state of the old X keyboard. If the new keyboard was not initialized with a FocusRec, one is added by the ChangeKeyboardDevice request. The X keyboard is assumed to have a KbdFeedbackClassRec. If the device was initialized without a KbdFeedbackClassRec, one will be added by this request. The KbdFeedbackClassRec will specify a null routine as the control procedure and the bell procedure.

\[
\text{ChangeKeyboardDevice} \\
\text{device: DEVICE} \\
\text{Errors: Device, Match} \\
\Rightarrow \\
\text{status: Success, AlreadyGrabbed, Frozen}
\]

To change the X pointer device, use the ChangePointerDevice request. The specified device must support input class Valuators (as reported in the ListInputDevices request) or the request will fail with a BadMatch error. The valuators to be used as the x- and y-axes of the pointer device must be specified. Data from other valuators on the device will be ignored.

The X pointer device does not contain a FocusRec. If the new pointer was initialized with a FocusRec, it is freed by the ChangePointerDevice request. The X pointer is assumed to have a ButtonClassRec and a PtrFeedbackClassRec. If the device was initialized without a ButtonClassRec or a PtrFeedbackClassRec, one will be added by this request. The ButtonClassRec added will have no buttons, and the PtrFeedbackClassRec will specify a null routine as the control procedure.

If the specified device reports absolute positional information, and the server implementation does not allow such a device to be used as the X pointer, the request will fail with a BadDevice error.

Once the device has successfully replaced one of the core devices, it is treated as a core device until it is in turn replaced by another ChangeDevice request, or until the server terminates. The termination of the client that changed the device will not cause it to change back. Attempts to use the CloseDevice request to close the new core device will fail with a BadDevice error.

\[
\text{ChangePointerDevice} \\
\text{device: DEVICE} \\
\text{xaxis: CARD8} \\
\text{yaxis: CARD8} \\
\text{Errors: Device, Match} \\
\Rightarrow \\
\text{status: Success, AlreadyGrabbed, Frozen}
\]
2.13. Event Synchronization And Core Grabs

Implementation of the input extension requires an extension of the meaning of event synchronization for the core grab requests. This is necessary in order to allow window managers to freeze all input devices with a single request.

The core grab requests require a `pointer_mode` and `keyboard_mode` argument. The meaning of these modes is changed by the input extension. For the `XGrabPointer` and `XGrabButton` requests, `pointer_mode` controls synchronization of the pointer device, and `keyboard_mode` controls the synchronization of all other input devices. For the `XGrabKeyboard` and `XGrabKey` requests, `pointer_mode` controls the synchronization of all input devices except the X keyboard, while `keyboard_mode` controls the synchronization of the keyboard. When using one of the core grab requests, the synchronization of extension devices is controlled by the mode specified for the device not being grabbed.

2.14. Extension Active Grabs

Active grabs of extension devices are supported via the `GrabDevice` request in the same way that core devices are grabbed using the core GrabKeyboard request, except that a `Device` is passed as a function parameter. A list of events that the client wishes to receive is also passed. The `UngrabDevice` request allows a previous active grab for an extension device to be released.

To grab an extension device, use the `GrabDevice` request. The device must have previously been opened using the `OpenDevice` request.

```
GrabDevice
device: DEVICE
grab-window: WINDOW
owner-events: BOOL
event-list: LISTofEVENTCLASS
this-device-mode: {Synchronous, Asynchronous}
other-device-mode: {Synchronous, Asynchronous}
time: TIMESTAMP or CurrentTime
=>
status: Success, AlreadyGrabbed, Frozen, InvalidTime, NotViewable

Errors: Device, Window, Value
```

This request actively grabs control of the specified input device. Further input events from this device are reported only to the grabbing client. This request overrides any previous active grab by this client for this device.

The event-list parameter is a pointer to a list of event classes. These are used to indicate which events the client wishes to receive while the device is grabbed. Only event classes obtained from the grabbed device are valid.

If `owner-events` is `False`, input events generated from this device are reported with respect to `grab-window`, and are only reported if selected by being included in the event-list. If `owner-events` is `True`, then if a generated event would normally be reported to this client, it is reported normally, otherwise the event is reported with respect to the `grab-window`, and is only reported if selected by being included in the event-list. For either value of `owner-events`, unreported events are discarded.

If `this-device-mode` is `Asynchronous`, device event processing continues normally. If the device is currently frozen by this client, then processing of device events is resumed. If `this-device-mode` is `Synchronous`, the state of the grabbed device (as seen by means of the protocol) appears to freeze, and no further device events are generated by the server until the grabbing client issues
a releasing AllowDeviceEvents request or until the device grab is released. Actual device input events are not lost while the device is frozen; they are simply queued for later processing.

If other-device-mode is Asynchronous, event processing is unaffected by activation of the grab. If other-device-mode is Synchronous, the state of all input devices except the grabbed one (as seen by means of the protocol) appears to freeze, and no further events are generated by the server until the grabbing client issues a releasing AllowDeviceEvents request or until the device grab is released. Actual events are not lost while the devices are frozen; they are simply queued for later processing.

This request generates DeviceFocusIn and DeviceFocusOut events.

This request fails and returns:
- **AlreadyGrabbed** If the device is actively grabbed by some other client.
- **NotViewable** If grab-window is not viewable.
- **InvalidTime** If the specified time is earlier than the last-grab-time for the specified device or later than the current X server time. Otherwise, the last-grab-time for the specified device is set to the specified time and CurrentTime is replaced by the current X server time.
- **Frozen** If the device is frozen by an active grab of another client.

If a grabbed device is closed by a client while an active grab by that client is in effect, that active grab will be released. Any passive grabs established by that client will be released. If the device is frozen only by an active grab of the requesting client, it is thawed.

To release a grab of an extension device, use UngrabDevice.

UngrabDevice

```
device: DEVICE
time: TIMESTAMP or CurrentTime
```

Errors: Device

This request releases the device if this client has it actively grabbed (from either GrabDevice or GrabDeviceKey) and releases any queued events. If any devices were frozen by the grab, UngrabDevice thaws them. The request has no effect if the specified time is earlier than the last-device-grab time or is later than the current server time.

This request generates DeviceFocusIn and DeviceFocusOut events.

An UngrabDevice is performed automatically if the event window for an active device grab becomes not viewable.

### 2.15. Passively Grabbing A Key

Passive grabs of buttons and keys on extension devices are supported via the GrabDeviceButton and GrabDeviceKey requests. These passive grabs are released via the UngrabDeviceKey and UngrabDeviceButton requests.

To passively grab a single key on an extension device, use GrabDeviceKey. That device must have previously been opened using the OpenDevice request.

GrabDeviceKey

```
device: DEVICE
keycode: KEYCODE or AnyKey
modifiers: SETofKEYMASK or AnyModifier
modifier-device: DEVICE or NULL
grab-window: WINDOW
```
This request is analogous to the core \texttt{GrabKey} request. It establishes a passive grab on a device. Consequently, in the future:

- IF the device is not grabbed and the specified key, which itself can be a modifier key, is logically pressed when the specified modifier keys logically are down on the specified modifier device (and no other keys are down),
- AND no other modifier keys logically are down,
- AND EITHER the grab window is an ancestor of (or is) the focus window OR the grab window is a descendent of the focus window and contains the pointer,
- AND a passive grab on the same device and key combination does not exist on any ancestor of the grab window,
- THEN the device is actively grabbed, as for \texttt{GrabDevice}, the last-device-grab time is set to the time at which the key was pressed (as transmitted in the \texttt{DeviceKeyPress} event), and the \texttt{DeviceKeyPress} event is reported.

The interpretation of the remaining arguments is as for \texttt{GrabDevice}. The active grab is terminated automatically when logical state of the device has the specified key released (independent of the logical state of the modifier keys).

Note that the logical state of a device (as seen by means of the X protocol) may lag the physical state if device event processing is frozen.

A modifier of \texttt{AnyModifier} is equivalent to issuing the request for all possible modifier combinations (including the combination of no modifiers). It is not required that all modifiers specified have currently assigned keycodes. A key of \texttt{AnyKey} is equivalent to issuing the request for all possible keycodes. Otherwise, the key must be in the range specified by min-keycode and max-keycode in the \texttt{ListInputDevices} request. If it is not within that range, \texttt{GrabDeviceKey} generates a \texttt{Value} error.

\texttt{NULL} may be passed for the modifier_device. If the modifier_device is \texttt{NULL}, the core X keyboard is used as the modifier_device.

An \texttt{Access} error is generated if some other client has issued a \texttt{GrabDeviceKey} with the same device and key combination on the same window. When using \texttt{AnyModifier} or \texttt{AnyKey}, the request fails completely and the X server generates a \texttt{Access} error and no grabs are established if there is a conflicting grab for any combination.

This request cannot be used to grab a key on the X keyboard device. The core \texttt{GrabKey} request should be used for that purpose.

To release a passive grab of a single key on an extension device, use \texttt{UngrabDeviceKey}.

\begin{verbatim}
UngrabDeviceKey
device: DEVICE
keycode: KEYCODE or AnyKey
modifiers: SETofKEYMASK or AnyModifier
modifier-device: DEVICE or NULL
grab-window: WINDOW

Errors: Device, Match, Window, Value, Alloc
\end{verbatim}
This request is analogous to the core UngrabKey request. It releases the key combination on the specified window if it was grabbed by this client. A modifier of AnyModifier is equivalent to issuing the request for all possible modifier combinations (including the combination of no modifiers). A key of AnyKey is equivalent to issuing the request for all possible keycodes. This request has no effect on an active grab.

NULL may be passed for the modifier_device. If the modifier_device is NULL, the core X keyboard is used as the modifier_device.

2.16. Passively Grabbing A Button
To establish a passive grab for a single button on an extension device, use GrabDeviceButton.

GrabDeviceButton
    device: DEVICE
    button: BUTTON or AnyButton
    modifiers: SETofKEYMASK or AnyModifier
    modifier-device: DEVICE or NULL
    grab-window: WINDOW
    owner-events: BOOL
    event-list: LISTofEVENTCLASS
    this-device-mode: {Synchronous, Asynchronous}
    other-device-mode: {Synchronous, Asynchronous}

Errors: Device, Match, Window, Access, Value

This request is analogous to the core GrabButton request. It establishes an explicit passive grab for a button on an extension input device. Since the server does not track extension devices, no cursor is specified with this request. For the same reason, there is no confine-to parameter. The device must have previously been opened using the OpenDevice request.

The GrabDeviceButton request establishes a passive grab on a device. Consequently, in the future,
- IF the device is not grabbed and the specified button is logically pressed when the specified modifier keys logically are down (and no other buttons or modifier keys are down),
- AND the grab window contains the device,
- AND a passive grab on the same device and button/key combination does not exist on any ancestor of the grab window,
- THEN the device is actively grabbed, as for GrabDevice, the last-grab time is set to the time at which the button was pressed (as transmitted in the DeviceButtonPress event), and the DeviceButtonPress event is reported.

The interpretation of the remaining arguments is as for GrabDevice. The active grab is terminated automatically when logical state of the device has all buttons released (independent of the logical state of the modifier keys).

Note that the logical state of a device (as seen by means of the X protocol) may lag the physical state if device event processing is frozen.

A modifier of AnyModifier is equivalent to issuing the request for all possible modifier combinations (including the combination of no modifiers). It is not required that all modifiers specified have currently assigned keycodes. A button of AnyButton is equivalent to issuing the request for all possible buttons. It is not required that the specified button be assigned to a physical button.

NULL may be passed for the modifier_device. If the modifier_device is NULL, the core X keyboard is used as the modifier_device.
An Access error is generated if some other client has issued a **GrabDeviceButton** with the same device and button combination on the same window. When using **AnyModifier** or **AnyButton**, the request fails completely and the X server generates a Access error and no grabs are established if there is a conflicting grab for any combination. The request has no effect on an active grab.

This request cannot be used to grab a button on the X pointer device. The core **GrabButton** request should be used for that purpose.

To release a passive grab of a button on an extension device, use **UngrabDeviceButton**.

**UngrabDeviceButton**

- **device**: DEVICE
- **button**: BUTTON or AnyButton
- **modifiers**: SETofKEYMASK or AnyModifier
- **modifier-device**: DEVICE or NULL
- **grab-window**: WINDOW

Errors: Device, Match, Window, Value, Alloc

This request is analogous to the core UngrabButton request. It releases the passive button/key combination on the specified window if it was grabbed by the client. A modifiers of **AnyModifier** is equivalent to issuing the request for all possible modifier combinations (including the combination of no modifiers). A button of **AnyButton** is equivalent to issuing the request for all possible buttons. This request has no effect on an active grab. The device must have previously been opened using the **OpenDevice** request otherwise a Device error will be generated.

**NULL** may be passed for the modifier_device. If the modifier_device is **NULL**, the core X keyboard is used as the modifier_device.

This request cannot be used to ungrab a button on the X pointer device. The core **UngrabButton** request should be used for that purpose.

**2.17. Thawing A Device**

To allow further events to be processed when a device has been frozen, use **AllowDeviceEvents**.

**AllowDeviceEvents**

- **device**: DEVICE
- **event-mode**: {AsyncThisDevice, SyncThisDevice, AsyncOtherDevices, ReplayThisdevice, AsyncAll, or SyncAll}
- **time**: TIMESTAMP or CurrentTime

Errors: Device, Value

The **AllowDeviceEvents** request releases some queued events if the client has caused a device to freeze. The request has no effect if the specified time is earlier than the last-grab time of the most recent active grab for the client, or if the specified time is later than the current X server time.

The following describes the processing that occurs depending on what constant you pass to the event-mode argument:

- If the specified device is frozen by the client, event processing for that device continues as usual. If the device is frozen multiple times by the client on behalf of multiple separate grabs, AsyncThisDevice thaws for all. AsyncThisDevice has no effect if the specified device is not frozen by the client, but the device need not be grabbed by the client.
• If the specified device is frozen and actively grabbed by the client, event processing for that device continues normally until the next button or key event is reported to the client. At this time, the specified device again appears to freeze. However, if the reported event causes the grab to be released, the specified device does not freeze. SyncThisDevice has no effect if the specified device is not frozen by the client or is not grabbed by the client.

• If the specified device is actively grabbed by the client and is frozen as the result of an event having been sent to the client (either from the activation of a GrabDeviceButton or from a previous AllowDeviceEvents with mode SyncThisDevice, but not from a Grab), the grab is released and that event is completely reprocessed. This time, however, the request ignores any passive grabs at or above (towards the root) the grab-window of the grab just released. The request has no effect if the specified device is not grabbed by the client or if it is not frozen as the result of an event.

• If the remaining devices are frozen by the client, event processing for them continues as usual. If the other devices are frozen multiple times by the client on behalf of multiple separate grabs, AsyncOtherDevices “thaws” for all. AsyncOtherDevices has no effect if the devices are not frozen by the client, but those devices need not be grabbed by the client.

• If all devices are frozen by the client, event processing (for all devices) continues normally until the next button or key event is reported to the client for a grabbed device (button event for the grabbed device, key or motion event for the device), at which time the devices again appear to freeze. However, if the reported event causes the grab to be released, then the devices do not freeze (but if any device is still grabbed, then a subsequent event for it will still cause all devices to freeze). SyncAll has no effect unless all devices are frozen by the client. If any device is frozen twice by the client on behalf of two separate grabs, SyncAll "thaws" for both (but a subsequent freeze for SyncAll will only freeze each device once).

• If all devices are frozen by the client, event processing (for all devices) continues normally. If any device is frozen multiple times by the client on behalf of multiple separate grabs, AsyncAll "thaws" for all. AsyncAll has no effect unless all devices are frozen by the client.

AsyncThisDevice, SyncThisDevice, and ReplayThisDevice have no effect on the processing of events from the remaining devices. AsyncOtherDevices has no effect on the processing of events from the specified device. When the event_mode is SyncAll or AsyncAll, the device parameter is ignored.

It is possible for several grabs of different devices (by the same or different clients) to be active simultaneously. If a device is frozen on behalf of any grab, no event processing is performed for the device. It is possible for a single device to be frozen because of several grabs. In this case, the freeze must be released on behalf of each grab before events can again be processed.

2.18. Controlling Device Focus

The current focus window for an extension input device can be determined using the GetDeviceFocus request. Extension devices are focused using the SetDeviceFocus request in the same way that the keyboard is focused using the SetInputFocus request, except that a device is specified as part of the request. One additional focus state, FollowKeyboard, is provided for extension devices.

To get the current focus state, revert state, and focus time of an extension device, use GetDeviceFocus.

GetDeviceFocus

    device: DEVICE

=>

    focus: WINDOW, PointerRoot, FollowKeyboard, or None
    revert-to: Parent, PointerRoot, FollowKeyboard, or None
    focus-time: TIMESTAMP
This request returns the current focus state, revert-to state, and last-focus-time of an extension device.

To set the focus of an extension device, use `SetDeviceFocus`.

```
SetDeviceFocus
  device: DEVICE
  focus: WINDOW, PointerRoot, FollowKeyboard, or None
  revert-to: Parent, PointerRoot, FollowKeyboard, or None
  focus-time: TIMESTAMP

Errors: Device, Window, Value, Match
```

This request changes the focus for an extension input device and the last-focus-change-time. The request has no effect if the specified time is earlier than the last-focus-change-time or is later than the current X server time. Otherwise, the last-focus-change-time is set to the specified time, with `CurrentTime` replaced by the current server time.

The action taken by the server when this request is requested depends on the value of the focus argument:

- If the focus argument is `None`, all input events from this device will be discarded until a new focus window is set. In this case, the revert-to argument is ignored.
- If a window ID is assigned to the focus argument, it becomes the focus window of the device. If an input event from the device would normally be reported to this window or to one of its inferiors, the event is reported normally. Otherwise, the event is reported relative to the focus window.
- If you assign `PointerRoot` to the focus argument, the focus window is dynamically taken to be the root window of whatever screen the pointer is on at each input event. In this case, the revert-to argument is ignored.
- If you assign `FollowKeyboard` to the focus argument, the focus window is dynamically taken to be the same as the focus of the X keyboard at each input event.

The specified focus window must be viewable at the time of the request (else a `Match` error). If the focus window later becomes not viewable, the X server evaluates the revert-to argument to determine the new focus window.

```
DeviceFocus
  device: DEVICE
  focus: WINDOW, PointerRoot, FollowKeyboard, or None
  revert-to: Parent, PointerRoot, FollowKeyboard, or None
  focus-time: TIMESTAMP

Errors: Device, Window, Value, Match
```

When the focus reverts, the X server generates `DeviceFocusIn` and `DeviceFocusOut` events, but the last-focus-change time is not affected.

This request causes the X server to generate `DeviceFocusIn` and `DeviceFocusOut` events.

### 2.19. Controlling Device Feedback

To get the settings of feedbacks on an extension device, use `GetFeedbackControl`. This request provides functionality equivalent to the core `GetKeyboardControl` and `GetPointerControl` functions. It also provides a way to control displays associated with an input device that are capable of displaying an integer or string.
GetFeedbackControl
    device: DEVICE
=>
    num_feedbacks_return: CARD16
    return_value: LISTofFEEDBACKSTATE

where

    FEEDBACKSTATE: [KbdFeedbackState, PtrFeedbackState, IntegerFeedbackState, StringFeedbackState, BellFeedbackState, LedFeedbackState]

Feedbacks are reported by class. Those feedbacks that are reported for the core keyboard device are in class \texttt{KbdFeedback}, and are returned in the \texttt{KbdFeedbackState} structure. The members of that structure are as follows:

\begin{verbatim}
CLASS Kbd: [class: CARD8
    length: CARD16
    feedback id: CARD8
    key_click_percent: CARD8
    bell_percent: CARD8
    bell_pitch: CARD16
    bell_duration: CARD16
    led_value: BITMASK
    global_auto_repeat: {AutoRepeatModeOn, AutoRepeatMode-Off}
    auto_repeats: LISTofCARD8]
\end{verbatim}

Those feedbacks that are equivalent to those reported for the core pointer are in feedback class \texttt{PtrFeedback} and are reported in the \texttt{PtrFeedbackState} structure. The members of that structure are:

\begin{verbatim}
CLASS Ptr: [class: CARD8
    length: CARD16
    feedback id: CARD8
    accelNumerator: CARD16
    accelDenominator: CARD16
    threshold: CARD16
\end{verbatim}

Some input devices provide a means of displaying an integer. Those devices will support feedback class \texttt{IntegerFeedback}, which is reported in the \texttt{IntegerFeedbackState} structure. The members of that structure are:

\begin{verbatim}
CLASS Integer: [class: CARD8
    length: CARD16
    feedback id: CARD8
    resolution: CARD32
    min-val: INT32
    max-val: INT32]
\end{verbatim}

Some input devices provide a means of displaying a string. Those devices will support feedback class \texttt{StringFeedback}, which is reported in the \texttt{StringFeedbackState} structure. The members of that structure are:
CLASS String:  [class: CARD8
  length: CARD16
  feedback id: CARD8
  max_symbols: CARD16
  num_keysym_supported: CARD16
  keysyms_supported: LISTofKEYSYM]

Some input devices contain a bell. Those devices will support feedback class BellFeedback, which is reported in the BellFeedbackState structure. The members of that structure are:

CLASS Bell:  [class: CARD8
  length: CARD16
  feedback id: CARD8
  percent: CARD8
  pitch: CARD16
  duration: CARD16]

The percent sets the base volume for the bell between 0 (off) and 100 (loud) inclusive, if possible. Setting to −1 restores the default. Other negative values generate a Value error.

The pitch sets the pitch (specified in Hz) of the bell, if possible. Setting to −1 restores the default. Other negative values generate a Value error.

The duration sets the duration (specified in milliseconds) of the bell, if possible. Setting to −1 restores the default. Other negative values generate a Value error.

A bell generator connected with the console but not directly on the device is treated as if it were part of the device. Some input devices contain LEDs. Those devices will support feedback class Led, which is reported in the LedFeedbackState structure. The members of that structure are:

CLASS Led:  [class: CARD8
  length: CARD16
  feedback id: CARD8
  led_mask: BITMASK
  led_value: BITMASK]

Each bit in led_mask indicates that the corresponding led is supported by the feedback. At most 32 LEDs per feedback are supported. No standard interpretation of LEDs is defined.

This function will fail with a BadMatch error if the device specified in the request does not support feedbacks.

Errors: Device, Match

To change the settings of a feedback on an extension device, use ChangeFeedbackControl.

ChangeFeedbackControl
  device: DEVICE
  feedbackid: CARD8
  value-mask: BITMASK
  value: FEEDBACKCONTROL

Errors: Device, Match, Value
Feedback controls are grouped by class. Those feedbacks that are equivalent to those supported by the core keyboard are controlled by feedback class `KbdFeedbackClass` using the `KbdFeedbackControl` structure. The members of that structure are:

```
KBDFeedbackCtl: 
    [class: CARD8
     length: CARD16
     feedback id: CARD8
     key_click_percent: INT8
     bell_percent: INT8
     bell_pitch: INT16
     bell_duration: INT16
     led_mask: INT32
     led_value: INT32
     key: KEYCODE
     auto_repeat_mode: [AutoRepeatModeOn,
                        AutoRepeatModeOff, AutoRepeatModeDefault]
```

The `key_click_percent` sets the volume for key clicks between 0 (off) and 100 (loud) inclusive, if possible. Setting to -1 restores the default. Other negative values generate a `Value` error.

If both `auto_repeat_mode` and `key` are specified, then the `auto_repeat_mode` of that key is changed, if possible. If only `auto_repeat_mode` is specified, then the global auto-repeat mode for the entire keyboard is changed, if possible, without affecting the per-key settings. It is a `Match` error if a key is specified without an `auto_repeat_mode`.

The order in which controls are verified and altered is server-dependent. If an error is generated, a subset of the controls may have been altered.

Those feedback controls equivalent to those of the core pointer are controlled by feedback class `PtrFeedbackClass` using the `PtrFeedbackControl` structure. The members of that structure are as follows:

```
PtrFeedbackCtl: 
    [class: CARD8
     length: CARD16
     feedback id: CARD8
     accelNumerator: INT16
     accelDenominator: INT16
     threshold: INT16
```

The acceleration, expressed as a fraction, is a multiplier for movement. For example, specifying 3/1 means the device moves three times as fast as normal. The fraction may be rounded arbitrarily by the X server. Acceleration only takes effect if the device moves more than threshold pixels at once and only applies to the amount beyond the value in the threshold argument. Setting a value to -1 restores the default. The values of the `do-accel` and `do-threshold` arguments must be nonzero for the device values to be set. Otherwise, the parameters will be unchanged. Negative values generate a `Value` error, as does a zero value for the `accel-denominator` argument.

Some devices are capable of displaying an integer. This is done using feedback class `IntegerFeedbackClass` using the `IntegerFeedbackControl` structure. The members of that structure are as follows:
Some devices are capable of displaying a string. This is done using feedback class \texttt{StringFeedbackClass} using the \texttt{StringFeedbackCtl} structure. The members of that structure are as follows:

\begin{verbatim}
STRINGCTL: [class: CARD8
  length: CARD16
  feedback id: CARD8
  syms_to_display: LISTofKEYSYMS]
\end{verbatim}

Some devices contain a bell. This is done using feedback class \texttt{BellFeedbackClass} using the \texttt{BellFeedbackControl} structure. The members of that structure are as follows:

\begin{verbatim}
BELLCTL: [class: CARD8
  length: CARD16
  feedback id: CARD8
  percent: INT8
  pitch: INT16
  duration: INT16]
\end{verbatim}

Some devices contain LEDs. These can be turned on and off using the \texttt{LedFeedbackControl} structure. The members of that structure are as follows:

\begin{verbatim}
LEDCTL: [class: CARD8
  length: CARD16
  feedback id: CARD8
  led_mask: BITMASK
  led_value: BITMASK]
\end{verbatim}

Errors: Device, Match, Value

\subsection*{2.20. Ringing a Bell on an Input Device}

To ring a bell on an extension input device, use \texttt{DeviceBell}.

\begin{verbatim}
DeviceBell
  device: DEVICE
  feedbackclass: CARD8
  feedbackid: CARD8
  percent: INT8
\end{verbatim}

Errors: Device, Value

This request is analogous to the core \texttt{Bell} request. It rings the specified bell on the specified input device feedback, using the specified volume. The specified volume is relative to the base volume for the feedback. If the value for the percent argument is not in the range -100 to 100 inclusive, a \texttt{Value} error results. The volume at which the bell rings when the percent argument is nonnegative is:
The volume at which the bell rings when the percent argument is negative is:

\[
\text{base} + \left\lfloor \left( \text{base} \times \text{percent} \right) / 100 \right\rfloor
\]

To change the base volume of the bell, use the `ChangeFeedbackControl` request.

### 2.21. Controlling Device Encoding

To get the keyboard mapping of an extension device that has keys, use the `GetDeviceKeyMapping`.

#### GetDeviceKeyMapping

```plaintext
GetDeviceKeyMapping

device: DEVICE
first-keycode: KEYCODE
count: CARD8

=>

keysyms-per-keycode: CARD8
keysyms: LISTofKEYSYM

Errors: Device, Match, Value
```

This request returns the symbols for the specified number of keycodes for the specified extension device, starting with the specified keycode. The first-keycode must be greater than or equal to the min-keycode as returned in the connection setup (else a `Value` error), and

\[
\text{first-keycode} + \text{count} - 1
\]

must be less than or equal to max-keycode as returned in the connection setup (else a `Value` error). The number of elements in the keysyms list is

```
count \times \text{keysyms-per-keycode}
```

and KEYSYM number \(N\) (counting from zero) for keycode \(K\) has an index (counting from zero) of

\[
\left( K - \text{first-keycode} \right) \times \text{keysyms-per-keycode} + N
\]

in keysyms. The keysyms-per-keycode value is chosen arbitrarily by the server to be large enough to report all requested symbols. A special KEYSYM value of `NoSymbol` is used to fill in unused elements for individual keycodes.

If the specified device has not first been opened by this client via `OpenDevice`, or if that device does not support input class Keys, this request will fail with a `Device` error.

To change the keyboard mapping of an extension device that has keys, use the `ChangeDeviceKeyMapping`.

#### ChangeDeviceKeyMapping

```plaintext
ChangeDeviceKeyMapping

device: DEVICE
first-keycode: KEYCODE
keysyms-per-keycode: CARD8
keysyms: LISTofKEYSYM
num_codes: CARD8

Errors: Device, Match, Value, Alloc
```
This request is analogous to the core **ChangeKeyMapping** request. It defines the symbols for the specified number of keycodes for the specified extension device. If the specified device has not first been opened by this client via *OpenDevice*, or if that device does not support input class *Keys*, this request will fail with a **Device** error.

The number of elements in the keysyms list must be a multiple of keysyms_per_keycode. Otherwise, **ChangeDeviceKeyMapping** generates a **Length** error. The specified first_keycode must be greater than or equal to the min_keycode value returned by the *ListInputDevices* request, or this request will fail with a **Value** error. In addition, if the following expression is not less than the max_keycode value returned by the *ListInputDevices* request, the request will fail with a **Value** error:

\[
\text{first_keycode} + \left(\frac{\text{num_codes}}{\text{keysyms\_per\_keycode}}\right) - 1
\]

To obtain the keycodes that are used as modifiers on an extension device that has keys, use **GetDeviceModifierMapping**.

**GetDeviceModifierMapping**

```plaintext```
device: DEVICE
=>
   keycodes-per-modifier: CARD8
   keycodes: LISTofKEYCODE

Errors: Device, Match
```

This request is analogous to the core **GetModifierMapping** request. This request returns the keycodes of the keys being used as modifiers. The number of keycodes in the list is 8*keycodes-per-modifier. The keycodes are divided into eight sets, with each set containing keycodes-per-modifier elements. The sets are assigned in order to the modifiers *Shift*, *Lock*, *Control*, *Mod1*, *Mod2*, *Mod3*, *Mod4*, and *Mod5*. The keycodes-per-modifier value is chosen arbitrarily by the server; zeroes are used to fill in unused elements within each set. If only zero values are given in a set, the use of the corresponding modifier has been disabled. The order of keycodes within each set is chosen arbitrarily by the server.

To set which keycodes that are to be used as modifiers for an extension device, use **SetDeviceModifierMapping**.

**SetDeviceModifierMapping**

```plaintext```
device: DEVICE
   keycodes-per-modifier: CARD8
   keycodes: LISTofKEYCODE
=>
   status: {Success, Busy, Failed}

Errors: Device, Match, Value, Alloc
```

This request is analogous to the core **SetModifierMapping** request. This request specifies the keycodes (if any) of the keys to be used as modifiers. The number of keycodes in the list must be 8*keycodes-per-modifier (else a **Length** error). The keycodes are divided into eight sets, with each set containing keycodes-per-modifier elements. The sets are assigned in order to the modifiers *Shift*, *Lock*, *Control*, *Mod1*, *Mod2*, *Mod3*, *Mod4*, and *Mod5*. Only non-zero keycodes are used within each set; zero values are ignored. All of the non-zero keycodes must be in the range specified by min-keycode and max-keycode in the *ListInputDevices* request.
(else a Value error). The order of keycodes within a set does not matter. If no non-zero values are specified in a set, the use of the corresponding modifier is disabled, and the modifier bit will always be zero. Otherwise, the modifier bit will be one whenever at least one of the keys in the corresponding set is in the down position.

A server can impose restrictions on how modifiers can be changed (for example, if certain keys do not generate up transitions in hardware or if multiple keys per modifier are not supported). The status reply is Failed if some such restriction is violated, and none of the modifiers are changed.

If the new non-zero keycodes specified for a modifier differ from those currently defined, and any (current or new) keys for that modifier are logically in the down state, then the status reply is Busy, and none of the modifiers are changed.

This request generates a DeviceMappingNotify event on a Success status. The DeviceMappingNotify event will be sent only to those clients that have expressed an interest in receiving that event via the XSelectExtensionEvent request.

A X server can impose restrictions on how modifiers can be changed, for example, if certain keys do not generate up transitions in hardware or if multiple modifier keys are not supported. If some such restriction is violated, the status reply is MappingFailed, and none of the modifiers are changed.

If the new keycodes specified for a modifier differ from those currently defined and any (current or new) keys for that modifier are in the logically down state, the status reply is MappingBusy, and none of the modifiers are changed.

2.22. Controlling Button Mapping

These requests are analogous to the core GetPointerMapping and ChangePointerMapping requests. They allow a client to determine the current mapping of buttons on an extension device, and to change that mapping.

To get the current button mapping for an extension device, use GetDeviceButtonMapping.

GetDeviceButtonMapping
  device: DEVICE
  nmap: CARD8
=>
  map_return: LISTofCARD8

Errors: Device, Match

The GetDeviceButtonMapping function returns the current mapping of the buttons on the specified device. Elements of the list are indexed starting from one. The length of the list indicates the number of physical buttons. The nominal mapping is the identity mapping map[i]=i.

nmap indicates the number of elements in the map_return array. Only the first nmap entries will be copied by the library into the map_return array.

To set the button mapping for an extension device, use SetDeviceButtonMapping.

SetDeviceButtonMapping
  device: DEVICE
  map: LISTofCARD8
  nmap: CARD8
=>
  status: CARD8
The SetDeviceButtonMapping function sets the mapping of the specified device and causes the X server to generate a DeviceMappingNotify event on a status of MappingSuccess. Elements of the list are indexed starting from one. The length of the list, specified in nmap, must be the same as GetDeviceButtonMapping would return. Otherwise, SetDeviceButtonMapping generates a Value error. A zero element disables a button, and elements are not restricted in value by the number of physical buttons. However, no two elements can have the same nonzero value. Otherwise, this function generates a Value error. If any of the buttons to be altered are in the down state, the status reply is MappingBusy and the mapping is not changed.

2.23. Obtaining The State Of A Device

To obtain vectors that describe the state of the keys, buttons and valuators of an extension device, use QueryDeviceState.

QueryDeviceState
  device: DEVICE
=>
  device-id: CARD8
  data: LISTofINPUTCLASS

where

INPUTCLASS:  {VALUATOR, BUTTON, KEY}

CLASS VALUATOR:
  [class: CARD8
   num_valuators: CARD8
   mode: CARD8
     #x01 device mode
       (0 = Relative, 1 = Absolute)
     #x02 proximity state
       (0 = InProximity, 1 = OutOfProximity)
   valuators: LISTofINT32]

CLASS BUTTON:
  [class: CARD8
   num_buttons: CARD8
   buttons: LISTofCARD8]

CLASS KEY:
  [class: CARD8
   num_keys: CARD8
   keys: LISTofCARD8]

Errors: Device

The QueryDeviceState request returns the current logical state of the buttons, keys, and valuators on the specified input device. The buttons and keys arrays, byte N (from 0) contains the bits for key or button 8N to 8N+7 with the least significant bit in the byte representing key or button 8N. If the device has valuators, a bit in the mode field indicates whether the device is reporting Absolute or Relative data. If it is reporting Absolute data, the valuators array will contain the current value of the valuators. If it is reporting Relative data, the valuators array will contain undefined data.
If the device reports proximity information, a bit in the mode field indicates whether the device is InProximity or OutOfProximity.

3. Events

The input extension creates input events analogous to the core input events. These extension input events are generated by manipulating one of the extension input devices.

3.1. Button, Key, and Motion Events

DeviceKeyPress
DeviceKeyRelease
DeviceButtonPress,
DeviceButtonRelease
DeviceMotionNotify

<table>
<thead>
<tr>
<th>device: CARD8</th>
</tr>
</thead>
<tbody>
<tr>
<td>root, event: WINDOW</td>
</tr>
<tr>
<td>child: Window or None</td>
</tr>
<tr>
<td>same-screen: BOOL</td>
</tr>
<tr>
<td>root-x, root-y, event-x, event-y: INT16</td>
</tr>
<tr>
<td>detail: &lt;see below&gt;</td>
</tr>
<tr>
<td>state: SETofKEYBUTMASK</td>
</tr>
<tr>
<td>time: TIMESTAMP</td>
</tr>
</tbody>
</table>

These events are generated when a key, button, or valuator logically changes state. The generation of these logical changes may lag the physical changes, if device event processing is frozen. Note that DeviceKeyPress and DeviceKeyRelease are generated for all keys, even those mapped to modifier bits. The “source” of the event is the window the pointer is in. The window with respect to which the event is normally reported is found by looking up the hierarchy (starting with the source window) for the first window which any client has selected interest in the event. The actual window used for reporting can be modified by active grabs and by the focus window. The window the event is reported with respect to is called the “event” window.

The root is the root window of the “source” window, and root-x and root-y are the pointer coordinates relative to root’s origin at the time of the event. Event is the “event” window. If the event window is on the same screen as root, then event-x and event-y are the pointer coordinates relative to the event window’s origin. Otherwise, event-x and event-y are zero. If the source window is an inferior of the event window, then child is set to the child of the event window that is an ancestor of (or is) the source window. Otherwise, it is set to None. The state component gives the logical state of the buttons on the core X pointer and modifier keys on the core X keyboard just before the event. The detail component type varies with the event type:

<table>
<thead>
<tr>
<th>Event</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeviceKeyPress, DeviceKeyRelease</td>
<td>KEYCODE</td>
</tr>
<tr>
<td>DeviceButtonPress, DeviceButtonRelease</td>
<td>BUTTON</td>
</tr>
<tr>
<td>DeviceMotionNotify</td>
<td>{ Normal, Hint }</td>
</tr>
</tbody>
</table>

The granularity of motion events is not guaranteed, but a client selecting for motion events is guaranteed to get at least one event when a valuator changes. If DeviceMotionHint is selected, the server is free to send only one DeviceMotionNotify event (with detail Hint) to the client for the event window, until either a key or button changes state, the pointer leaves the event window, or the client issues a QueryDeviceState or GetDeviceMotionEvents request.
3.2. DeviceValuator Event

DeviceValuator

  device: CARD8
  device_state: SETofKEYBUTMASK
  num_valuators: CARD8
  fi rst_valuator: CARD8
  valuators: LISTofINT32

DeviceValuator events are generated to contain valuator information for which there is insufficient space in DeviceKey, DeviceButton, DeviceMotion, and Proximity wire events. For events of these types, a second event of type DeviceValuator follows immediately. The library combines these events into a single event that a client can receive via XNextEvent. DeviceValuator events are not selected for by clients, they only exist to contain information that will not fit into some event selected by clients.

The device_state component gives the state of the buttons and modifiers on the device generating the event.

Extension motion devices may report motion data for a variable number of axes. The valuators array contains the values of all axes reported by the device. If more than 6 axes are reported, more than one DeviceValuator event will be sent by the server, and more than one DeviceKey, DeviceButton, DeviceMotion, or Proximity event will be reported by the library. Clients should examine the corresponding fields of the event reported by the library to determine the total number of axes reported, and the first axis reported in the current event. Axes are numbered beginning with zero.

For Button, Key and Motion events on a device reporting absolute motion data the current value of the device’s valuators is reported. For devices that report relative data, Button and Key events may be followed by a DeviceValuator event that contains 0s in the num_valuators field. In this case, only the device_state component will have meaning.

3.3. Device Focus Events

DeviceFocusIn
DeviceFocusOut

  device: CARD8
  time: TIMESTAMP
  event: WINDOW
  mode: { Normal, WhileGrabbed, Grab, Ungrab }
  detail: { Ancestor, Virtual, Inferior, Nonlinear, NonlinearVirtual, Pointer, PointerRoot, None }

These events are generated when the input focus changes and are reported to clients selecting DeviceFocusChange for the specified device and window. Events generated by SetDeviceFocus when the device is not grabbed have mode Normal. Events generated by SetDeviceFocus when the device is grabbed have mode WhileGrabbed. Events generated when a device grab actives have mode Grab, and events generated when a device grab deactivates have mode Ungrab.

All DeviceFocusOut events caused by a window unmap are generated after any UnmapNotify event, but the ordering of DeviceFocusOut with respect to generated EnterNotify, LeaveNotify, VisibilityNotify and Expose events is not constrained.

DeviceFocusIn and DeviceFocusOut events are generated for focus changes of extension devices in the same manner as focus events for the core devices are generated.

3.4. Device State Notify Event

DeviceStateNotify
time: TIMESTAMP
device: CARD8
num_keys: CARD8
num_buttons: CARD8
num_valuators: CARD8
classes_reported: CARD8 \{SetOfDeviceMode | SetOfInputClass\}
    SetOfDeviceMode:
      #x80 ProximityState
        0 = InProximity, 1 = OutOfProximity
      #x40 Device Mode
        (0 = Relative, 1 = Absolute)
    SetOfInputClass:
      #x04 reporting valuators
      #x02 reporting buttons
      #x01 reporting keys
buttons: LISTofCARD8
keys: LISTofCARD8
valuators: LISTofCARD32

This event reports the state of the device just as in the \texttt{QueryDeviceState} request. This event is reported to clients selecting \texttt{DeviceStateNotify} for the device and window and is generated immediately after every \texttt{EnterNotify} and \texttt{DeviceFocusIn}. If the device has no more than 32 buttons, no more than 32 keys, and no more than 3 valuators, This event can report the state of the device. If the device has more than 32 buttons, the event will be immediately followed by a \texttt{DeviceButtonStateNotify} event. If the device has more than 32 keys, the event will be followed by a \texttt{DeviceKeyStateNotify} event. If the device has more than 3 valuators, the event will be followed by one or more \texttt{DeviceValuator} events.

3.5. Device KeyState and ButtonState Notify Events

\texttt{DeviceKeyStateNotify}

device: CARD8
keys: LISTofCARD8

\texttt{DeviceButtonStateNotify}

device: CARD8
buttons: LISTofCARD8

These events contain information about the state of keys and buttons on a device that will not fit into the \texttt{DeviceStateNotify} wire event. These events are not selected by clients, rather they may immediately follow a \texttt{DeviceStateNotify} wire event and be combined with it into a single \texttt{DeviceStateNotify} client event that a client may receive via \texttt{XNextEvent}.

3.6. DeviceMappingNotify Event

\texttt{DeviceMappingNotify}

time: TIMESTAMP
device: CARD8
request: CARD8
first_keycode: CARD8
count: CARD8

This event reports a change in the mapping of keys, modifiers, or buttons on an extension device. This event is reported to clients selecting \texttt{DeviceMappingNotify} for the device and window and is generated after every client \texttt{SetDeviceButtonMapping}, \texttt{ChangeDeviceKeyMapping}, or \texttt{ChangeDeviceModifierMapping} request.
3.7. ChangeDeviceNotify Event

ChangeDeviceNotify
  device: CARD8
  time: TIMESTAMP
  request: CARD8

This event reports a change in the physical device being used as the core X keyboard or X pointer device. ChangeDeviceNotify events are reported to clients selecting ChangeDeviceNotify for the device and window and is generated after every client ChangeKeyboardDevice or ChangePointerDevice request.

3.8. Proximity Events

ProximityIn
ProximityOut
  device: CARD8
  root, event: WINDOW
  child: Window or None
  same-screen: BOOL
  root-x, root-y, event-x, event-y: INT16
  state: SETofKEYBUTMASK
  time: TIMESTAMP
  device-state: SETofKEYBUTMASK
  axis-count: CARD8
  first-axis: CARD8
  axis-data: LISTofINT32

These events are generated by some devices (such as graphics tablets or touchscreens) to indicate that a stylus has moved into or out of contact with a positional sensing surface.

The “source” of the event is the window the pointer is in. The window with respect to which the event is normally reported is found by looking up the hierarchy (starting with the source window) for the first window on which any client has selected interest in the event. The actual window used for reporting can be modified by active grabs and by the focus window. The window the event is reported with respect to is called the “event” window.

The root is the root window of the “source” window, and root-x and root-y are the pointer coordinates relative to root’s origin at the time of the event. Event is the “event” window. If the event window is on the same screen as root, then event-x and event-y are the pointer coordinates relative to the event window’s origin. Otherwise, event-x and event-y are zero. If the source window is an inferior of the event window, then child is set to the child of the event window that is an ancestor of (or is) the source window. Otherwise, it is set to None. The state component gives the logical state of the buttons on the core X pointer and modifiers on the core X keyboard just before the event. The device-state component gives the state of the buttons and modifiers on the device generating the event.
Appendix A

Input Extension Protocol Encoding

Syntactic Conventions

All numbers are in decimal, unless prefixed with #x, in which case they are in hexadecimal (base 16).

The general syntax used to describe requests, replies, errors, events, and compound types is:

```
NameofThing
    encode-form
    ...
    encode-form
```

Each encode-form describes a single component.

For components described in the protocol as:

```
name: TYPE
```

the encode-form is:

```
N          TYPE   name
```

N is the number of bytes occupied in the data stream, and TYPE is the interpretation of those bytes. For example,

```
depth: CARD8
```

becomes:

```
1          CARD8  depth
```

For components with a static numeric value the encode-form is:

```
N          value  name
```

The value is always interpreted as an N-byte unsigned integer. For example, the first two bytes of a Window error are always zero (indicating an error in general) and three (indicating the Window error in particular):

```
1          0   Error
1          3   code
```

For components described in the protocol as:

```
name: {Name1, ..., NameI}
```

the encode-form is:

```
N
    name
    ...
    name
```

The value is always interpreted as an N-byte unsigned integer. Note that the size of N is sometimes larger than that strictly required to encode the values. For example:

```
class: {InputOutput, InputOnly, CopyFromParent}
```

becomes:

```
2
    class
    0          CopyFromParent
    1          InputOutput
    2          InputOnly
```

For components described in the protocol as:
NAME: TYPE or Alternative1 ... or AlternativeI

the encode-form is:

\[
\begin{array}{ccc}
N & TYPE & NAME \\
value1 & Alternative1 \\
... & ... \\
valueI & AlternativeI \\
\end{array}
\]

The alternative values are guaranteed not to conflict with the encoding of TYPE. For example:

destination: WINDOW or PointerWindow or InputFocus

becomes:

\[
\begin{array}{ccc}
4 & WINDOW & destination \\
0 & PointerWindow \\
1 & InputFocus \\
\end{array}
\]

For components described in the protocol as:

value-mask: BITMASK

the encode-form is:

\[
\begin{array}{ccc}
N & BITMASK & value-mask \\
mask1 & mask-name1 \\
... & ... \\
maskI & mask-nameI \\
\end{array}
\]

The individual bits in the mask are specified and named, and N is 2 or 4. The most-significant bit in a BITMASK is reserved for use in defining chained (multiword) bitmasks, as extensions augment existing core requests. The precise interpretation of this bit is not yet defined here, although a probable mechanism is that a 1-bit indicates that another N bytes of bitmask follows, with bits within the overall mask still interpreted from least-significant to most-significant with an N-byte unit, with N-byte units interpreted in stream order, and with the overall mask being byte-swapped in individual N-byte units.

For LISTofVALUE encodings, the request is followed by a section of the form:

VALUEs

code-form

... 
code-form

listing an encode-form for each VALUE. The NAME in each encode-form keys to the corresponding BITMASK bit. The encoding of a VALUE always occupies four bytes, but the number of bytes specified in the encoding-form indicates how many of the least-significant bytes are actually used; the remaining bytes are unused and their values do not matter.

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 example:

\[
\begin{array}{ccc}
2 & 3+n & request length \\
4n & LISTofPOINT & points \\
\end{array}
\]

For unused bytes (the values of the bytes are undefined and do not matter), the encode-form is:

\[
\begin{array}{ccc}
N & unused \\
\end{array}
\]

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

\[
\begin{array}{ccc}
p & unused, p=pad(E) \\
\end{array}
\]

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

\[
\text{pad}(E) = (4 - (E \mod 4)) \mod 4
\]
Common Types

LISTofFOO

In this document the LISTof notation strictly means some number of repetitions of the FOO encoding; the actual length of the list is encoded elsewhere.

SETofFOO

A set is always represented by a bitmask, with a 1-bit indicating presence in the set.

BITMASK: CARD32
WINDOW: CARD32
BYTE: 8-bit value
INT8: 8-bit signed integer
INT16: 16-bit signed integer
INT32: 32-bit signed integer
CARD8: 8-bit unsigned integer
CARD16: 16-bit unsigned integer
CARD32: 32-bit unsigned integer
TIMESTAMP: CARD32
EVENTCLASS: CARD32

INPUTCLASS

<table>
<thead>
<tr>
<th></th>
<th>KeyClass</th>
<th>ButtonClass</th>
<th>ValuatorClass</th>
<th>FeedbackClass</th>
<th>ProximityClass</th>
<th>FocusClass</th>
<th>OtherClass</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>KeyClass</td>
<td>ButtonClass</td>
<td>ValuatorClass</td>
<td>FeedbackClass</td>
<td>ProximityClass</td>
<td>FocusClass</td>
<td>OtherClass</td>
</tr>
<tr>
<td>1</td>
<td>ButtonClass</td>
<td>ValuatorClass</td>
<td>FeedbackClass</td>
<td>ProximityClass</td>
<td>FocusClass</td>
<td>OtherClass</td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>FeedbackClass</td>
<td>ProximityClass</td>
<td>FocusClass</td>
<td>OtherClass</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>FocusClass</td>
<td>OtherClass</td>
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<tr>
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<td>FocusClass</td>
<td>OtherClass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>FocusClass</td>
<td>OtherClass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>OtherClass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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</table>

INPUTCLASS

<table>
<thead>
<tr>
<th></th>
<th>KbdFeedbackClass</th>
<th>PtrFeedbackClass</th>
<th>StringFeedbackClass</th>
<th>IntegerFeedbackClass</th>
<th>LedFeedbackClass</th>
<th>BellFeedbackClass</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>KbdFeedbackClass</td>
<td>PtrFeedbackClass</td>
<td>StringFeedbackClass</td>
<td>IntegerFeedbackClass</td>
<td>LedFeedbackClass</td>
<td>BellFeedbackClass</td>
</tr>
<tr>
<td>1</td>
<td>PtrFeedbackClass</td>
<td>StringFeedbackClass</td>
<td>IntegerFeedbackClass</td>
<td>LedFeedbackClass</td>
<td>BellFeedbackClass</td>
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</tr>
<tr>
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<td>StringFeedbackClass</td>
<td>IntegerFeedbackClass</td>
<td>LedFeedbackClass</td>
<td>BellFeedbackClass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IntegerFeedbackClass</td>
<td>LedFeedbackClass</td>
<td>BellFeedbackClass</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>LedFeedbackClass</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BellFeedbackClass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INPUTINFO

<table>
<thead>
<tr>
<th></th>
<th>KEYINFO</th>
<th>BUTTONINFO</th>
<th>VALUATORINFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>KEYINFO</td>
<td>BUTTONINFO</td>
<td>VALUATORINFO</td>
</tr>
<tr>
<td>1</td>
<td>BUTTONINFO</td>
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</tr>
<tr>
<td>2</td>
<td>VALUATORINFO</td>
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</tbody>
</table>

DEVICEMODE

<table>
<thead>
<tr>
<th></th>
<th>Relative</th>
<th>Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Relative</td>
<td>Absolute</td>
</tr>
<tr>
<td>1</td>
<td>Absolute</td>
<td></td>
</tr>
</tbody>
</table>

PROXIMITYSTATE

<table>
<thead>
<tr>
<th></th>
<th>InProximity</th>
<th>OutOfProximity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>InProximity</td>
<td>OutOfProximity</td>
</tr>
<tr>
<td>1</td>
<td>OutOfProximity</td>
<td></td>
</tr>
</tbody>
</table>

BOOL

<table>
<thead>
<tr>
<th></th>
<th>False</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>False</td>
<td>True</td>
</tr>
<tr>
<td>1</td>
<td>True</td>
<td></td>
</tr>
</tbody>
</table>

KEYSYM: CARD32
KEYCODE: CARD8
BUTTON: CARD8
SETofKEYBUTMASK

#x0001 Shift
#x0002 Lock
#x0004 Control
#x0008 Mod1
#x0010 Mod2
#x0020 Mod3
#x0040 Mod4
#x0080 Mod5
#x0100 Button1
#x0200 Button2
#x0400 Button3
#x0800 Button4
#x1000 Button5
#xe000 unused but must be zero

SETofKEYMASK

encodings are the same as for SETofKEYBUTMASK, except with
#xff00 unused but must be zero

STRING8: LISTofCARD8

STR

1 n length of name in bytes
n STRING8 name

Errors

Request

1 0 Error
1 1 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Value

1 0 Error
1 2 code
2 CARD16 sequence number
4 <32-bits> bad value
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Window

1 0 Error
1 3 code
2 CARD16 sequence number
4 CARD32 bad resource id
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused
Match
1 0 Error
1 8 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Access
1 0 Error
1 10 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Alloc
1 0 Error
1 11 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Name
1 0 Error
1 15 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Device
1 0 Error
1 CARD8 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Event
1 0 Error
1 CARD8 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused
Mode
1 0 Error
1 CARD8 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Class
1 0 Error
1 CARD8 code
2 CARD16 sequence number
4 unused
2 CARD16 minor opcode
1 CARD8 major opcode
21 unused

Keyboards
KEYCODE values are always greater than 7 (and less than 256).
KEYSYM values with the bit #x10000000 set are reserved as vendor-specific.
The names and encodings of the standard KEYSYM values are contained in appendix F.

Pointers
BUTTON values are numbered starting with one.

Requests
GetExtensionVersion
1 CARD8 input extension opcode
1 1 GetExtensionVersion opcode
2 2+(n+p)/4 request length
2 n length of name
2 unused
n STRING8 name
p unused, p=pad(n)

=>
1 1 Reply
1 1 GetExtensionVersion opcode
2 CARD16 sequence number
4 0 reply length
2 CARD16 major version
2 CARD16 minor version
1 BOOL present
19 unused

ListInputDevices
1 CARD8 input extension opcode
1 2 ListInputDevices opcode
2 1 request length

=>
1 1 Reply
1 2 ListInputDevices opcode
2 CARD16 sequence number
4 (n+p)/4 reply length
1 CARD8 number of input devices
23 unused
n LISTofDEVICEINFO info for each input device
p unused, p=pad(n)
DEVICEINFO
  4  CARD32  device type
  1  CARD8  device id
  1  CARD8  number of input classes this device reports
  1  CARD8  device use
     0  IsXPointer
     1  IsXKeyboard
     2  IsXExtensionDevice
  1  unused
n  LISTofINPUTINFO  input info for each input class
m  STR  name
p  unused, p=pad(m)

INPUTINFO  KEYINFO or BUTTONINFO or VALUATORINFO

KEYINFO
  1  0  class id
  1  8  length
  1  KEYCODE  minimum keycode
  1  KEYCODE  maximum keycode
  2  CARD16  number of keys
  2  unused

BUTTONINFO
  1  1  class id
  1  4  length
  1  CARD16  number of buttons

VALUATORINFO
  1  2  class id
  1  8+12n  length
  1  n  number of axes
  1  SETofDEVICEMODE  mode
  4  CARD32  size of motion buffer
12n  LISTofAXISINFO  valuator limits

AXISINFO
  4  CARD32  resolution
  4  CARD32  minimum value
  4  CARD32  maximum value

OpenDevice
  1  CARD8  input extension opcode
  1  3  OpenDevice opcode
  2  2  request length
  1  CARD8  device id
  3  unused

=>

  1  1  Reply
  1  3  OpenDevice opcode
  2  CARD16  sequence number
  4  (n+p)/4  reply length
  1  CARD8  number of input classes
23  unused
n  LISTofINPUTCLASSINFO  input class information
p  unused, p=pad(n)
INPUTCLASSINFO
1 CARD8  input class id
  0 KEY
  1 BUTTON
  2 VALUATOR
  3 FEEDBACK
  4 PROXIMITY
  5 FOCUS
  6 OTHER
1 CARD8  event type base code for this class

CloseDevice
1 CARD8  input extension opcode
1 4 CloseDevice opcode
2 2 request length
1 CARD8  device id
3 unused

SetDeviceMode
1 CARD8  input extension opcode
1 5 SetDeviceMode opcode
2 2 request length
1 CARD8  device id
1 CARD8  mode
2 unused

=>
1 1 Reply
1 5 SetDeviceMode opcode
2 CARD16 sequence number
4 0 reply length
1 CARD8 status
0 Success
3 + fi rst_error DeviceBusy
23 unused

SelectExtensionEvent
1 CARD8  input extension opcode
1 6 SelectExtensionEvent opcode
2 3+n request length
4 Window event window
2 CARD16 count
2 unused
4n LISTSofEVENTCLASS desired events

GetSelectedExtensionEvents
1 CARD8  input extension opcode
1 7 GetSelectedExtensionEvents opcode
2 2 request length
4 Window event window
XI nput Extension Protocol Speci®cation X11, Release 6.7

\[ \text{GetSelecteExtensionEvents opcode} \]
\[ \text{CARD16} \]\n\[ \text{sequence number} \]
\[ \text{n + m} \]\n\[ \text{reply length} \]
\[ \text{n} \]\n\[ \text{this client count} \]
\[ \text{m} \]\n\[ \text{all clients count} \]
\[ \text{ARD16} \]

\[ \text{LISTofEVENTCLASS} \]\n\[ \text{this client list} \]
\[ \text{ARD16} \]
\[ \text{all clients list} \]

\[ \text{GetDeviceDontPropagateList opcode} \]
\[ \text{CARD8} \]
\[ \text{input extension opcode} \]
\[ \text{8} \]\n\[ \text{ChangeDeviceDontPropagateList opcode} \]
\[ \text{3+n} \]\n\[ \text{request length} \]
\[ \text{Window} \]\n\[ \text{event window} \]
\[ \text{n} \]\n\[ \text{count of events} \]
\[ \text{mode} \]
\[ \text{0} \]\n\[ \text{AddToList} \]
\[ \text{1} \]\n\[ \text{DeleteFromList} \]
\[ \text{ARD8} \]

\[ \text{LISTofEVENTCLASS} \]\n\[ \text{desired events} \]

\[ \text{GetDeviceDontPropagateList opcode} \]
\[ \text{CARD8} \]
\[ \text{input extension opcode} \]
\[ \text{9} \]\n\[ \text{GetDeviceDontPropagateList opcode} \]
\[ \text{2} \]\n\[ \text{request length} \]
\[ \text{Window} \]\n\[ \text{event window} \]

\[ \text{GetDeviceMotionEvents opcode} \]
\[ \text{CARD8} \]
\[ \text{input extension opcode} \]
\[ \text{10} \]\n\[ \text{GetDeviceMotionEvents opcode} \]
\[ \text{4} \]\n\[ \text{request length} \]
\[ \text{TIMESTAMP} \]\n\[ \text{start} \]
\[ \text{0} \]\n\[ \text{CurrentTime} \]
\[ \text{4} \]\n\[ \text{TIMESTAMP} \]\n\[ \text{stop} \]
\[ \text{0} \]\n\[ \text{CurrentTime} \]
\[ \text{CARD8} \]\n\[ \text{device id} \]
\[ \text{3} \]\n\[ \text{used} \]

\[ \text{GetDeviceMotionEvents opcode} \]
\[ \text{CARD8} \]
\[ \text{GetDeviceMotionEvents opcode} \]
\[ \text{10} \]\n\[ \text{GetDeviceMotionEvents opcode} \]
\[ \text{CARD16} \]\n\[ \text{sequence number} \]
\[ \text{(m+1)n} \]\n\[ \text{reply length} \]
\[ \text{n} \]\n\[ \text{number of DEVICETIMECOORDs in events} \]
\[ \text{m} \]\n\[ \text{number of valuators per event} \]
\[ \text{CARD8} \]\n\[ \text{mode of the device} \]
\[ \text{0} \]\n\[ \text{Absolute} \]
\[ \text{1} \]\n\[ \text{Relative} \]
\[ \text{18} \]\n\[ \text{used} \]
\[ \text{(4m+4)n} \]\n\[ \text{LISTofDEVICETIMECOORD} \]\n\[ \text{events} \]
DEVICETIMECOORD
  4  TIMESTAMP  time
  4m LISTofINT32  valuators

ChangeKeyboardDevice
  1  CARD8  input extension opcode
  1  11  ChangeKeyboardDevice opcode
  2  2  request length
  1  CARD8  device id
  3  unused

=>
  1  1  Reply
  1  11  ChangeKeyboardDevice opcode
  2  CARD16  sequence number
  4  0  reply length
  1  status
    0  Success
    1  AlreadyGrabbed
    2  DeviceFrozen
  23  unused

ChangePointerDevice
  1  CARD8  input extension opcode
  1  12  ChangePointerDevice opcode
  2  2  request length
  1  CARD8  x-axis
  1  CARD8  y-axis
  1  CARD8  device id
  1  unused

=>
  1  1  Reply
  1  12  ChangePointerDevice opcode
  2  CARD16  sequence number
  4  0  reply length
  1  status
    0  Success
    1  AlreadyGrabbed
    2  DeviceFrozen
  23  unused

GrabDevice
  1  CARD8  input extension opcode
  1  13  GrabDevice opcode
  2  5+n  request length
  4  WINDOW  grab-window
  4  TIMESTAMP  time
    0  CurrentTime
    2  n  count of events
    1  this-device-mode
      0  Synchronous
      1  Asynchronous
    1  other-devices-mode
      0  Synchronous
      1  Asynchronous
    1  BOOL  owner-events
    1  CARD8  device id
    2  unused
  4n LISTofEVENTCLASS  event list
=>
1 1  
1 13  
2 CARD16  
4 0  
1  
0 Success  
1 AlreadyGrabbed  
2 InvalidTime  
3 NotViewable  
4 Frozen  
23 unused  

UngrabDevice  
1 CARD8  
1 14  
2 3  
4 TIMESTAMP  
0 CurrentTime  
1 CARD8  
3 unused  

GrabDeviceKey  
1 CARD8  
1 15  
2 5+n  
4 WINDOW  
2 n  
2 SETofKEYMASK  
#x8000 AnyModifier  
1 CARD8 #x0FF UseXKeyboard  
1 CARD8 KEYCODE  
0 AnyKey  
1 0 Synchronous  
1 Asynchronous  
1 0 Synchronous  
1 Asynchronous  
1 BOOL  
2 unused  
4n LISTofEVENTCLASS  

UngrabDeviceKey  
1 CARD8  
1 16  
2 4  
4 WINDOW  
2 SETofKEYMASK  
#x8000 AnyModifier  
1 CARD8 #x0FF UseXKeyboard  
1 KEYCODE  
0 AnyKey  
1 CARD8  
3 unused
GrabDeviceButton
1 CARD8 input extension opcode
1 17 GrabDeviceButton opcode
2 5+n request length
4 WINDOW grab-window
1 CARD8 grabbed device
1 CARD8 modifier device
#x0FF UseXKeyboard
2 n count of desired events
2 SETofKEYMASK modifiers
1 this-device-mode 0 Synchronous 1 Asynchronous
1 other-device-mode 0 Synchronous 1 Asynchronous
1 BUTTON button 0 AnyButton
1 BOOL owner-events #x8000 AnyModifier
2 unused
4n LISTofEVENTCLASS event list

UngrabDeviceButton
1 CARD8 input extension opcode
1 18 UngrabDeviceButton opcode
2 4 request length
4 WINDOW grab-window
2 SETofKEYMASK modifiers
1 CARD8 modifier device
#x0FF UseXKeyboard
1 BUTTON button 0 AnyButton
1 CARD8 grabbed device 3 unused

AllowDeviceEvents
1 CARD8 input extension opcode
1 19 AllowDeviceEvents opcode
2 3 request length
4 TIMESTAMP time
0 CurrentTime
1 mode 0 AsyncThisDevice 1 SyncThisDevice 2 ReplayThisDevice 3 AsyncOtherDevices 4 AsyncAll 5 SyncAll
1 CARD8 device id
2 unused

GetDeviceFocus
1 CARD8 input extension opcode
1 20 GetDeviceFocus opcode
2 2 request length
1 CARD8 device
3 unused
Input Extension Protocol Specification

SetDeviceFocus
1 CARD8 input extension opcode
1 21 SetDeviceFocus opcode
2 4 request length
4 WINDOW focus
0 None
1 PointerRoot
3 FollowKeyboard
4 TIMESTAMP time
0 CurrentTime
1 revert-to
0 None
1 PointerRoot
2 Parent
3 FollowKeyboard
1 CARD8 device
2 unused

GetFeedbackControl
1 CARD8 input extension opcode
1 22 GetFeedbackControl opcode
2 2 request length
1 CARD8 device id
3 unused

Reply
1 1 GetFeedbackControl opcode
1 22 GetFeedbackControl opcode
2 CARD16 sequence number
4 m/4 reply length
2 n number of feedbacks supported
22 unused
m LISTofFEEDBACKSTATE feedbacks

FEEDBACKSTATE KBDFEEDBACKSTATE, PTRFEEDBACKSTATE, INTEGERFEEDBACKSTATE,
STRINGFEEDBACKSTATE, BELLFEEDBACKSTATE, or LEDFEEDBACKSTATE
KBDFEEDBACKSTATE
1 0 feedback class id
1 CARD8 id of this feedback
2 20 length
2 CARD16 pitch
2 CARD16 duration
4 CARD32 led_mask
4 CARD32 led_values
1
0 Off
1 On
1 CARD8 click
1 CARD8 percent
1 unused
32 LIST of CARD8 auto_repeats

PTRFEEDBACKSTATE
1 0 feedback class id
1 CARD8 id of this feedback
2 12 length
2 unused
2 CARD16 acceleration-numerator
2 CARD16 acceleration-denominator
2 CARD16 threshold

INTEGERFEEDBACKSTATE
1 0 feedback class id
1 CARD8 id of this feedback
2 16 length
4 CARD32 resolution
4 INT32 minimum value
4 INT32 maximum value

STRINGFEEDBACKSTATE
1 1 feedback class id
1 CARD8 id of this feedback
2 4n+8 length
2 CARD16 max_symbols
2 n number of keysyms supported
4n LIST of KEYSYM key symbols supported

BELLFEEDBACKSTATE
1 1 feedback class id
1 CARD8 id of this feedback
2 12 length
1 CARD8 percent
1 unused
2 CARD16 pitch
2 CARD16 duration

LEDFEEDBACKSTATE
1 1 feedback class id
1 CARD8 id of this feedback
2 12 length
4 CARD32 led_mask
4 BITMASK led_values
#x0001 On
#x0002 Off
ChangeFeedbackControl
1 CARD8      input extension opcode
1 23         ChangeFeedbackControl opcode
2 3+N/4      request length
4 BITMASK    value-mask (has n bits set to 1)
   #x0001  key-click-percent
   #x0002  bell-percent
   #x0004  bell-pitch
   #x0008  bell-duration
   #x0100  led
   #x0200  led-mode
   #x0400  key
   #x0800  auto-repeat-mode
   #x1000  string
   #x1001  integer
   #x1001  acceleration-numerator
   #x1002  acceleration-denominator
   #x1004  acceleration-threshold
1 CARD8      device id
1 CARD8      feedback class id
2 unused
n FEEDBACKCLASS

FEEDBACKCLASS     KBDFEEDBACKCTL, PTRFEEDBACKCTL, INTEGERFEEDBACKCTL,
                  STRINGFEEDBACKCTL, BELLFEEDBACKCTL, or LEDFEEDBACKCTL

KBDFEEDBACKCTL
1 0           feedback class id
1 CARD8       id of this feedback
2 20          length
1 KEYCODE     key
1 0            auto-repeat-mode
   Off
   1      On
   2      Default
1 INT8        key-click-percent
1 INT8        bell-percent
2 INT16       bell-pitch
2 INT16       bell-duration
4 CARD32      led_mask
4 CARD32      led_values

PTRFEEDBACKCTL
1 1           feedback class id
1 CARD8       id of this feedback
2 12          length
2 unused
2 INT16       numerator
2 INT16       denominator
2 INT16       threshold

STRINGCTL
1 2           feedback class id
1 CARD8       id of this feedback
2 4N+8        length
2 unused
2 n           number of keysyms to display
4n LISTofKEYSYM  list of key symbols to display
**INTEGERCTL**

1  3 feedback class id
1  CARD8 id of this feedback
2  8 length
4  INT32 integer to display

**LEDCTL**

1  4 feedback class id
1  CARD8 id of this feedback
2  12 length
4  CARD32 led_mask
4  BITMASK led_values
#x0001 On
#x0002 Off

**BELLCCTL**

1  5 feedback class id
1  CARD8 id of this feedback
2  8 length
1  INT8 percent
3  unused
2  INT16 pitch
2  INT16 duration

**GetDeviceKeyMapping**

1  CARD8 input extension opcode
1  24 GetDeviceKeyMapping opcode
2  2 request length
1  CARD8 device
1  KEYCODE fi rst-keycode
1  CARD8 count
1  unused

=>

1  1 Reply
1  24 GetDeviceKeyMapping opcode
2  CARD16 sequence number
4  nm reply length (\(m = \text{count field from the request}\))
1  n keysyms-per-keycode
23 unused
4nm LISTofKEYSYM keysyms

**ChangeDeviceKeyMapping**

1  CARD8 input extension opcode
1  25 ChangeDeviceKeyMapping opcode
2 2+nm request length
1  CARD8 device
1  KEYCODE fi rst-keycode
1  m keysyms-per-keycode
1  n keycode-count
1  unused
4nm LISTofKEYSYM keysyms

**GetDeviceModifierMapping**

1  CARD8 input extension opcode
1  26 GetDeviceModifierMapping opcode
2  2 request length
1  CARD8 device
3  unused
XI
Input Extension Protocol Specification

GetDeviceModifierMapping opcode
1 26 CARD16 sequence number
4 2n reply length
1 n keycodes-per-modifier
23 unused
8n LISTofKEYCODE keycodes

SetDeviceModifierMapping
1 8 CARD8 input extension opcode
1 27 SetDeviceModifier opcode
2 2n+2 request length
1 CARD8 device
1 n keycodes-per-modifier
2 unused
8n LISTofKEYCODE keycodes

GetDeviceButtonMapping opcode
1 28 CARD16 sequence number
4 0 reply length
1 status
0 Success
1 Busy
2 Failed
23 unused

SetDeviceButtonMapping
1 29 CARD8 SetDeviceButtonMapping opcode
2 2n+2 request length
1 CARD8 device
1 n length of map
2 unused
n LISTofCARD8 map
p unused, p=pad(n)

=>
1 1 Reply
1 26 GetDeviceModifierMapping opcode
2 CARD16 sequence number
4 2n reply length
1 n keycodes-per-modifier
23 unused
8n LISTofKEYCODE keycodes

=>
1 1 Reply
1 27 SetDeviceModifier opcode
2 2n request length
1 CARD8 device
1 n keycodes-per-modifier
2 unused
8n LISTofKEYCODE keycodes

=>
1 1 Reply
1 28 GetDeviceButtonMapping opcode
2 CARD16 sequence number
4 n reply length
1 n number of elements in map list
23 unused
n LISTofCARD8 map
p unused, p=pad(n)

SetDeviceButtonMapping
1 29 CARD8 SetDeviceButtonMapping opcode
2 2n+2 request length
1 CARD8 device
1 n length of map
2 unused
n LISTofCARD8 map
p unused, p=pad(n)
XI nput Extension Protocol Speci®cation

=>
1  1  Reply
1  29  SetDeviceButtonMapping opcode
2  CARD16  sequence number
4  0  reply length
1  status
 0  Success
 1  Busy
23  unused

QueryDeviceState
1  CARD8  input extension opcode
1  30  QueryDeviceState opcode
2  2  request length
1  CARD8  device
3  unused

=>
1  1  Reply
1  30  QueryDeviceState opcode
2  CARD16  sequence number
4  m/4  reply length
1  n  number of input classes
23  unused
m LISTofINPUTSTATE

INPUTSTATE  KEYSTATE or BUTTONSTATE or VALUATORSTATE

KEYSTATE
1  CARD8  key input class id
1  36  length
1  CARD8  num_keys
1  unused
32 LISTofCARD8  status of keys

BUTTONSTATE
1  CARD8  button input class id
1  36  length
1  CARD8  num_buttons
1  unused
32 LISTofCARD8  status of buttons

VALUATORSTATE
1  CARD8  valuator input class id
1  4n + 4  length
1  n  number of valuators
1  mode
  #x01  DeviceMode (0 = Relative, 1 = Absolute)
  #x02  ProximityState (0 = InProximity, 1 = OutOfProximity)
4n LISTofCARD32  status of valuators
SendExtensionEvent

1  CARD8  input extension opcode
1  31  SendExtensionEvent opcode
2  4 + 8n + m  request length
4  WINDOW  destination
1  CARD8  device
1  BOOL  propagate
2  CARD16  eventclass count
1  CARD8  num_events
3  unused
32n LISTofEVENTS  events to send
4m LISTofEVENTCLASS  desired events

DeviceBell

1  CARD8  input extension opcode
1  32  DeviceBell opcode
2  2  request length
1  CARD8  device id
1  CARD8  feedback id
1  CARD8  feedback class
1  INT8  percent

SetDeviceValuators

1  CARD8  input extension opcode
1  33  SetDeviceValuators opcode
2  2 + n  request length
1  CARD8  device id
1  CARD8  first valuator
1  n  number of valuators
1  unused
4n LISTofINT32  valuator values to set

=>

1 1  Reply
1 33  SetDeviceValuators opcode
2  CARD16  sequence number
4  0  reply length
1  CARD8  status
0  Success
1  AlreadyGrabbed
23  unused

GetDeviceControl

1  CARD8  input extension opcode
1  34  GetDeviceControl opcode
2  2  request length
2  CARD16  device control type
1  CARD8  device id
1  unused

=>

1 1  Reply
1 34  GetDeviceControl opcode
2  CARD16  sequence number
4  n/4  reply length
1  CARD8  status
0  Success
1  AlreadyGrabbed
3 + first_error  DeviceBusy
23  unused
n  DEVICESTATE
DEVICESTATE  \hspace{1cm}  DEVICERESOLUTIONSTATE

DEVICERESOLUTIONSTATE
\begin{align*}
2 & \quad 0 \hspace{1cm} \text{control type} \\
2 & \quad 8 + 12n \hspace{1cm} \text{length} \\
4 & \quad n \hspace{1cm} \text{num_valuators} \\
4n & \quad \text{LISTOfCARD32 resolution values} \\
4n & \quad \text{LISTOfCARD32 resolution min_values} \\
4n & \quad \text{LISTOfCARD32 resolution max_values}
\end{align*}

ChangeDeviceControl
\begin{align*}
1 & \quad \text{CARD8} \hspace{1cm} \text{input extension opcode} \\
1 & \quad 35 \hspace{1cm} \text{ChangeDeviceControl opcode} \\
2 & \quad 2+n/4 \hspace{1cm} \text{request length} \\
2 & \quad \text{CARD16} \hspace{1cm} \text{control type} \\
1 & \quad \text{CARD8} \hspace{1cm} \text{device id} \\
1 & \quad \text{unused} \\
& \quad \text{DEVICECONTROL}
\end{align*}

DEVICECONTROL  \hspace{1cm}  DEVICERESOLUTIONCTL

DEVICERESOLUTIONCTL
\begin{align*}
2 & \quad 1 \hspace{1cm} \text{control type} \\
2 & \quad 8 + 4n \hspace{1cm} \text{length} \\
1 & \quad \text{CARD8} \hspace{1cm} \text{rst_valuator} \\
1 & \quad n \hspace{1cm} \text{num_valuators} \\
2 & \quad \text{unused} \\
4n & \quad \text{LISTOfCARD32 resolution values}
\end{align*}

=&>
\begin{align*}
1 & \quad 1 \hspace{1cm} \text{Reply} \\
1 & \quad 35 \hspace{1cm} \text{ChangeDeviceControl opcode} \\
2 & \quad \text{CARD16} \hspace{1cm} \text{sequence number} \\
4 & \quad 0 \hspace{1cm} \text{reply length} \\
1 & \quad \text{CARD8} \hspace{1cm} \text{status} \\
0 & \quad \text{Success} \\
1 & \quad \text{AlreadyGrabbed} \\
3 & \quad \text{DeviceBusy} \\
23 & \quad \text{unused}
\end{align*}

Events
DeviceKeyPress, DeviceKeyRelease, DeviceButtonPress, DeviceButtonRelease, ProximityIn, ProximityOut, and DeviceStateNotify events may be followed by zero or more DeviceValuator events. DeviceMotionNotify events will be followed by one or more DeviceValuator events.

DeviceValuator
\begin{align*}
1 & \quad \text{CARD8} \hspace{1cm} \text{code} \\
1 & \quad \text{CARD8} \hspace{1cm} \text{device id} \\
2 & \quad \text{CARD16} \hspace{1cm} \text{sequence number} \\
2 & \quad \text{SETofKEYBUTMASK} \hspace{1cm} \text{state} \\
1 & \quad n \hspace{1cm} \text{number of valuators this device reports} \\
1 & \quad m \hspace{1cm} \text{number of rst_valuator in this event} \\
24 & \quad \text{LISTofINT32 valuators}
\end{align*}
DeviceKeyPress
1  CARD8          code
1  KEYCODE        detail
2  CARD16         sequence number
4  TIMESTAMP      time
4  WINDOW         root
4  WINDOW         event
4  WINDOW         child
0          None
2  INT16         root-x
2  INT16         root-y
2  INT16         event-x
2  INT16         event-y
2  SETofKEYBUTMASK state
1  BOOL          same-screen
1  CARD8         device id
    #x80        MORE EVENTS follow

DeviceKeyRelease
1  CARD8          code
1  KEYCODE        detail
2  CARD16         sequence number
4  TIMESTAMP      time
4  WINDOW         root
4  WINDOW         event
4  WINDOW         child
0          None
2  INT16         root-x
2  INT16         root-y
2  INT16         event-x
2  INT16         event-y
2  SETofKEYBUTMASK state
1  BOOL          same-screen
1  CARD8         device id
    #x80        MORE EVENTS follow

DeviceButtonPress
1  CARD8          code
1  BUTTON         detail
2  CARD16         sequence number
4  TIMESTAMP      time
4  WINDOW         root
4  WINDOW         event
4  WINDOW         child
0          None
2  INT16         root-x
2  INT16         root-y
2  INT16         event-x
2  INT16         event-y
2  SETofKEYBUTMASK state
1  BOOL          same-screen
1  CARD8         device id
    #x80        MORE EVENTS follow
DeviceButtonRelease
1  CARD8        code
1  BUTTON      detail
2  CARD16      sequence number
4  TIMESTAMP   time
4  WINDOW      root
4  WINDOW      event
4  WINDOW      child
   0       None
2  INT16     root-x
2  INT16     root-y
2  INT16     event-x
2  INT16     event-y
2  SETofKEYBUTMASK state
1  BOOL      same-screen
1  CARD8      device id
 #x80    MOREEVENTS follow

DeviceMotionNotify
1  CARD8        code
1                 detail
0  Normal
   1      Hint
2  CARD16      sequence number
4  TIMESTAMP   time
4  WINDOW      root
4  WINDOW      event
4  WINDOW      child
   0       None
2  INT16     root-x
2  INT16     root-y
2  INT16     event-x
2  INT16     event-y
2  SETofKEYBUTMASK state
1  BOOL      same-screen
1  CARD8      device id
 #x80    MOREEVENTS follow

DeviceFocusIn
1  CARD8        code
1                 detail
0  Ancestor
  1    Virtual
  2    Inferior
  3    Nonlinear
  4    NonlinearVirtual
  5    Pointer
  6    PointerRoot
  7    None
2  CARD16      sequence number
4  TIMESTAMP   time
4  WINDOW      event
1  mode
0      Normal
1      Grab
2      Ungrab
3      WhileGrabbed
1  CARD8      device id
18     unused
DeviceFocusOut

1  CARD8  code
1  detail
0  Ancestor
1  Virtual
2  Inferior
3  Nonlinear
4  NonlinearVirtual
5  Pointer
6  PointerRoot
7  None
2  CARD16  sequence number
4  TIMESTAMP  time
4  WINDOW  event
1  mode
0  Normal
1  Grab
2  Ungrab
3  WhileGrabbed
1  CARD8  device id
18  unused

ProximityIn

1  CARD8  code
1  unused
2  CARD16  sequence number
4  TIMESTAMP  time
4  WINDOW  root
4  WINDOW  event
4  WINDOW  child
0  None
2  INT16  root-x
2  INT16  root-y
2  INT16  event-x
2  INT16  event-y
2  SETofKEYBUTMASK  state
1  BOOL  same-screen
1  CARD8  device id
#x80
MORE_EVENTS follow

ProximityOut

1  CARD8  code
1  unused
2  CARD16  sequence number
4  TIMESTAMP  time
4  WINDOW  root
4  WINDOW  event
4  WINDOW  child
0  None
2  INT16  root-x
2  INT16  root-y
2  INT16  event-x
2  INT16  event-y
2  SETofKEYBUTMASK  state
1  BOOL  same-screen
1  CARD8  device id
#x80
MORE_EVENTS follow

DeviceStateNotify events may be immediately followed by zero or one DeviceKeyStateNotify and/ or zero or more DeviceValuator events.
**DeviceStateNotify**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD8</td>
<td>code</td>
</tr>
<tr>
<td>CARD8</td>
<td>device id</td>
</tr>
<tr>
<td>#x80</td>
<td>MORE_EVENTS follow</td>
</tr>
<tr>
<td>CARD16</td>
<td>sequence number</td>
</tr>
<tr>
<td>4</td>
<td>TIMESTAMP time</td>
</tr>
<tr>
<td>CARD8</td>
<td>num_keys</td>
</tr>
<tr>
<td>CARD8</td>
<td>num_buttons</td>
</tr>
<tr>
<td>CARD8</td>
<td>num_valuators</td>
</tr>
<tr>
<td>CARD8</td>
<td>v aluator mode and input classes reported</td>
</tr>
<tr>
<td>#x01</td>
<td>reporting keys</td>
</tr>
<tr>
<td>#x02</td>
<td>reporting buttons</td>
</tr>
<tr>
<td>#x04</td>
<td>reporting valuators</td>
</tr>
<tr>
<td>#x40</td>
<td>device mode (0 = Relative, 1 = Absolute)</td>
</tr>
<tr>
<td>#x80</td>
<td>proximity state (0 = InProximity, 1 = OutOfProximity)</td>
</tr>
<tr>
<td>4</td>
<td>LISTofCARD8 fi rst 32 keys (if reported)</td>
</tr>
<tr>
<td>4</td>
<td>LISTofCARD8 fi rst 32 buttons (if reported)</td>
</tr>
<tr>
<td>12</td>
<td>LISTofCARD32 fi rst 3 valuators (if reported)</td>
</tr>
</tbody>
</table>

**DeviceKeyStateNotify**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD8</td>
<td>code</td>
</tr>
<tr>
<td>CARD8</td>
<td>device id</td>
</tr>
<tr>
<td>#x80</td>
<td>MORE_EVENTS follow</td>
</tr>
<tr>
<td>CARD16</td>
<td>sequence number</td>
</tr>
<tr>
<td>28</td>
<td>LISTofCARD8 state of keys 33-255</td>
</tr>
</tbody>
</table>

**DeviceButtonStateNotify**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD8</td>
<td>code</td>
</tr>
<tr>
<td>CARD8</td>
<td>device id</td>
</tr>
<tr>
<td>#x80</td>
<td>MORE_EVENTS follow</td>
</tr>
<tr>
<td>CARD16</td>
<td>sequence number</td>
</tr>
<tr>
<td>28</td>
<td>LISTofCARD8 state of buttons 33-255</td>
</tr>
</tbody>
</table>

**DeviceValuator**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD8</td>
<td>code</td>
</tr>
<tr>
<td>CARD8</td>
<td>device id</td>
</tr>
<tr>
<td>2</td>
<td>SETofKEYBUTMASK state</td>
</tr>
<tr>
<td>2</td>
<td>number of valuators this device reports</td>
</tr>
<tr>
<td>1</td>
<td>number of fi rstvaluator in this event</td>
</tr>
<tr>
<td>24</td>
<td>LISTofINT32 valuators</td>
</tr>
</tbody>
</table>

**DeviceMappingNotify**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD8</td>
<td>code</td>
</tr>
<tr>
<td>CARD8</td>
<td>device id</td>
</tr>
<tr>
<td>2</td>
<td>CARD16 sequence number</td>
</tr>
<tr>
<td>1</td>
<td>request</td>
</tr>
<tr>
<td>0</td>
<td>MappingModifier</td>
</tr>
<tr>
<td>1</td>
<td>MappingKeyboard</td>
</tr>
<tr>
<td>2</td>
<td>MappingPointer</td>
</tr>
<tr>
<td>1</td>
<td>KEYCODE fi rst-keycode</td>
</tr>
<tr>
<td>1</td>
<td>CARD8 count</td>
</tr>
<tr>
<td>1</td>
<td>unused</td>
</tr>
<tr>
<td>4</td>
<td>TIMESTAMP time</td>
</tr>
<tr>
<td>20</td>
<td>unused</td>
</tr>
</tbody>
</table>
ChangeDeviceNotify

1  CARD8  code
1  CARD8  id of device specified on change request
2  CARD16  sequence number
4  TIMESTAMP  time
1  request

0  NewPointer
1  NewKeyboard

23  unused
Appendix A − Input Extension Protocol Encoding

3.8. Proximity Events

3.7. ChangeDeviceNotify Event

3.6. DeviceMappingNotify Event

3.5. Device KeyState and ButtonState Notify Events

3.4. Device State Notify Event

3.3. Device Focus Events

3.2. DeviceValuator Event

3.1. Button, Key, and Motion Events

2. Events

2.23. Obtaining The State Of A Device

2.22. Controlling Button Mapping

2.21. Controlling Device Feedback

2.20. Ringing a Bell on an Input Device

2.19. Controlling Device Focus

2.18. Changing The Mode Of A Device

2.17. Thawing A Device

2.16. Passively Grabbing A Button

2.15. Passively Grabbing A Key

2.14. Extension Active Grabs

2.13. Event Synchronization And Core Grabs

2.12. Changing The Core Devices

2.11. Getting Motion History

2.10. Sending Extension Events

2.9. Controlling Event Propagation

2.8. Determining Selected Events

2.7. Selecting Extension Device Events

2.6. Getting Input Device Controls

2.5. Initializing Valuators on an Input Device

2.4. Changing The Mode Of A Device

2.3. Enabling Devices

2.2. Listing Available Devices

2.1. Getting the Extension Version

1. Requests

1.4.2. Input Classes

1.4.1. Event Classes

1.4. Extension Input Devices

1.3. Core Input Devices

1.2. Design Approach

1.1. Input Extension Overview

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