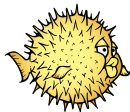


Input handling in wscons and X

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Plan

- 1 Introduction
- 2 Input protocols
- 3 The wscons driver
- 4 Input in X
- 5 Conclusion

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Input device : the other important thing for desktop machines.

- Long history
- Components :
 - Kernel,
 - X server,
 - X libraries,
 - applications.
- New kind of devices : touch-pads, touchscreens, remote controls, multi-touch devices etc.

What is an input device ?

→ a device that allows a user to input data to the computer...

Devices that produce data from the environment of the computer (cameras, temperature or fan speed sensors, GPS, accelerometers) are not considered in this talk.

Sample input devices

- serial console
- keyboard
- mouse
- joystick
- tablet
- touchscreen
- remote control

→ abstraction : input events : keys, button, valuator,....

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The tty interface

Text consoles (teletypes, glass consoles ex. VT100)



2 layers in a tty driver :

- RS232 itself (speed, width, parity, flow control...),
- the line oriented character based protocol.

Implementation : POSIX termios(7).

The graphical workstation



Graphical display + keyboard + mouse
Generally seen as different devices by the kernel.
Examples : SunOS vuid devices, HP HIL, etc.

The PC world



Three generations :

- PC/XT and AT keyboard controller. Mouse was separate (RS232 or proprietary bus interfaces).
- PS/2 style. Common (but specific) driver for one keyboard and one mouse. Not hot-pluggable.
- USB specific keyboard and mouse device classes. Hot-pluggable.

First generations of Unix for PC had only basic input devices handling capabilities. Most of the work was done in XFree86.

Today's systems

- Generalized USB keyboards and mices.
- More protocol handling done in the kernel (Linux evdev driver, wscons, etc.)
- Hot-pluggable

New devices

Touch-screens are becoming more and more popular.
New technologies expand touch-screens possibilities :



Touch screens specific issues

- Screen and input device bound together.
- Calibration needed.
- Pointer : visible or not ?
- no motion-only events : only clicks and drag
- stylus or finger ?
- multitouch...

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Originally written by Chris Demetriou and Matthias Drochner in NetBSD. Also used by OpenBSD.

Provide a high-level console driver.

Features :

- Text consoles with tty interface and terminal emulation (VT220)
- Uses either text or bit-mapped from the display device
- events interface for input devices : keyboards, mice, touch-pads, tablets, touch-screens
- attaches AT, PS/2, USB, proprietary devices

API : `<sys/dev/wscons/wsconsio.h>`

wsccons and multiple devices

Multiple devices and hot-plug are handled :

- one device node per device,
 - /dev/wskbd0, /dev/wskbd1, etc.
 - /dev/wsmouse0, /dev/wsmouse1, etc.
- through *muxes* devices which multiplexes all events to one single device node :
 - /dev/wskbd,
 - /dev/wsmouse

Problem : muxes completely hide the multiple devices from user-land.

WScons configuration

Two utilities :

`wsconscfg` configures wsdDisplays and console emulation

`wsconsctl` configures input device parameters for console mode.

- Keyboard mapping
- Keyboard auto-repeat
- Mouse parameters
- Screen saver

WScons : current and future work

NetBSD :

- synaptics touch pad support recently added.
- touch screen support.
- UTF-8 support.

OpenBSD :

- touch screen support
- legacy keyboard types

All : *write/update documentation...*

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Legacy X input : core devices

- One keyboard,
- One mouse with at most 5 buttons.

Processed between :

DDX : Device Dependant X

DIX : Device Independent X

Keyboard handling

- DIX expects key up/down events from DDX, using *keycodes* to represent the keys.
- keycodes are then translated to *keysyms* and presented to clients.
- XFree86 pushed to standardize keycode among all DDX, using the AT keyboard codes found in `atKeynames.h`.
- Autorepeat can be handled by the X server, or just use the hardware feature if present.
- libX11 (client-side) translates keysyms sequences to strings (ASCII, Latin-1, UTF-8 or whatever) and other events.

WSkbd and the DDX keyboard driver

Two ways to handle wscons keyboards in X

- through the wsdisplay device (/dev/ttyC0 or /dev/ttyE0) in raw mode.

advantages : standards keycodes are seen by X, all keyboards supported by the kernel are useable under X, no extra configuration

drawbacks : X sees only one keyboard, one layout.

- through the wskbd device (/dev/wskbd0) directly.

advantages : separate layouts

drawbacks : need to configure the device explicitly.

X needs to be taught about new wscons keyboard types.

Pointer devices

Mouse, touchpad (relative coordinate events) :

- PS/2, USB devices handled by *wsmouse(4)*.
- Serial devices handled explicitly by the X mouse driver.
- the X mouse driver knows several protocols.

Tablets, touchscreens (absolute coordinates events) :

- can either be handled by *wsmouse* (w/ support for absolute coordinates)
- or by a specific X driver

The Linux evdev driver

Recent Linux kernel and X use a generic event model, similar to wscons. Some differences :

- Linux events device identify themselves as mouse, keyboard, etc.
- Only one X driver (xf86-input-evdev) manages all kind of hardware
- xf86-input-evdev uses HAL to manage hotplug and configuration of individual devices. Configuration moves to `.fdi` files.

Merging wscons support in xf86-input-evdev has been suggested, but probably not worth the pain.

The Xinput extension

Goal : drop the restrictions on input devices :

→ many keyboards, pointer devices

- Xinput is not optional anymore
The mouse and keyboard drivers are Xinput drivers.
- Xinput is being cleaned up / rewritten
- now provides support for input hot-plug, device properties, MPX.

Input device properties

Arbitrary type values attached to an input device, can be modified at run-time.

- set middle mouse button emulation
- configure new pointer acceleration strategies
- calibration data for touchscreen drivers
- etc.

→ coming in xserver 1.6

The XKB extension

Goal : add configurability to keyboard mappings.

Future work :

- clean-up code, remove dead code.
- merge xkbcomp functionality into the X server.
- remove all pre-xkb input handling (XKB becomes mandatory).

Multi-head / multi-seat

How to bind input devices to heads....

- code exists in X to handle this under Linux
- no way to configure multiple independent wsdisplay devices in wscons

Special case : touchscreens – the input device is physically attached to a particular screen...

Multi Pointer X

- Virtual pointers - cursors
 - attached to zero or more physical devices
 - provide the events to the applications
- Virtual keyboards - focus
 - attached to zero or more physical devices
 - provides the events to the applications

→ coming into xserver 1.6

Xaw/Motif/Gnome/KDE/...

- interpret the X events and convert them to action
- handle things like double-click, mapping wheel events to scroll commands, etc.
- multi-touch or gesture handling belongs to toolkits or applications.

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User experience

Problems from the end-user point of view that need improvements :

- keyboard layouts
- mouse emulation
- mouse actions configuration
- touch-pad gestures
- touchscreen calibration
- latency between input and output

Conclusion

- Input plays an important role in user interfaces too
- Some new things : new device software evolutions

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Questions ?