Window Systems

Goals: Virtual Devices

- Virtual display abstraction
- Multiplex physical input devices
- Simulated or higher level "devices"
- Limited resource management

2 Views of the Window System

- User Interface
- Application Interface
  - Imaging model
  - Input model

Higher Level Imaging Models e.g. Postscript-based

- e.g. NeWS & NeXT [AKA OpenStep]
- Real valued coordinate system
- Support for full transformations
  - e.g., scale & rotate
- Richer primitives
  - e.g., Curves
- Stencil and paint model

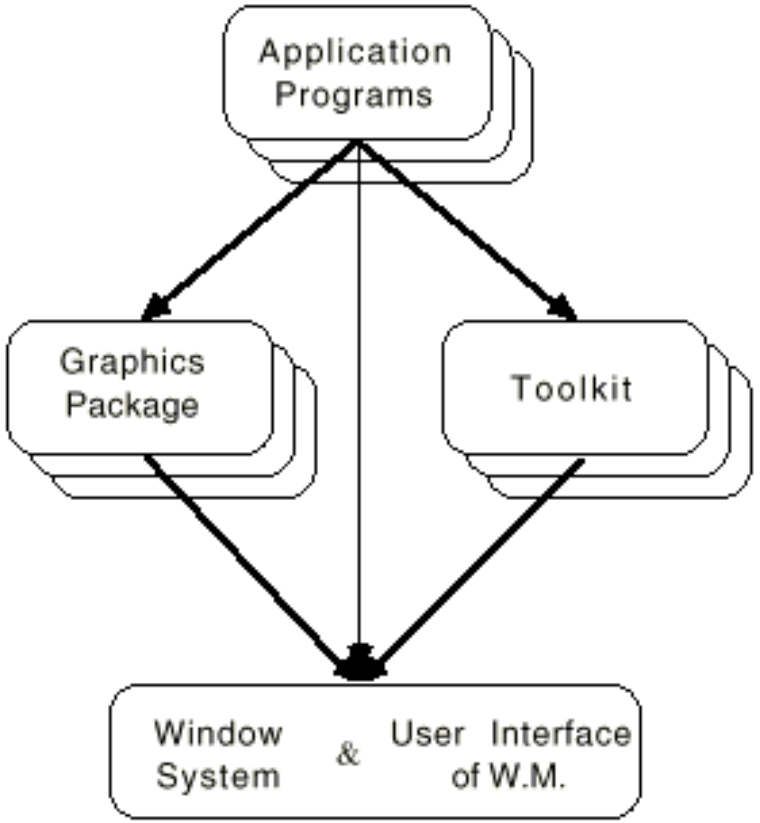
Higher Level Imaging Models: one more word

- See the "Primal Screens" article for why NeWS died

- Despite this, I prefer them and feel they will come back

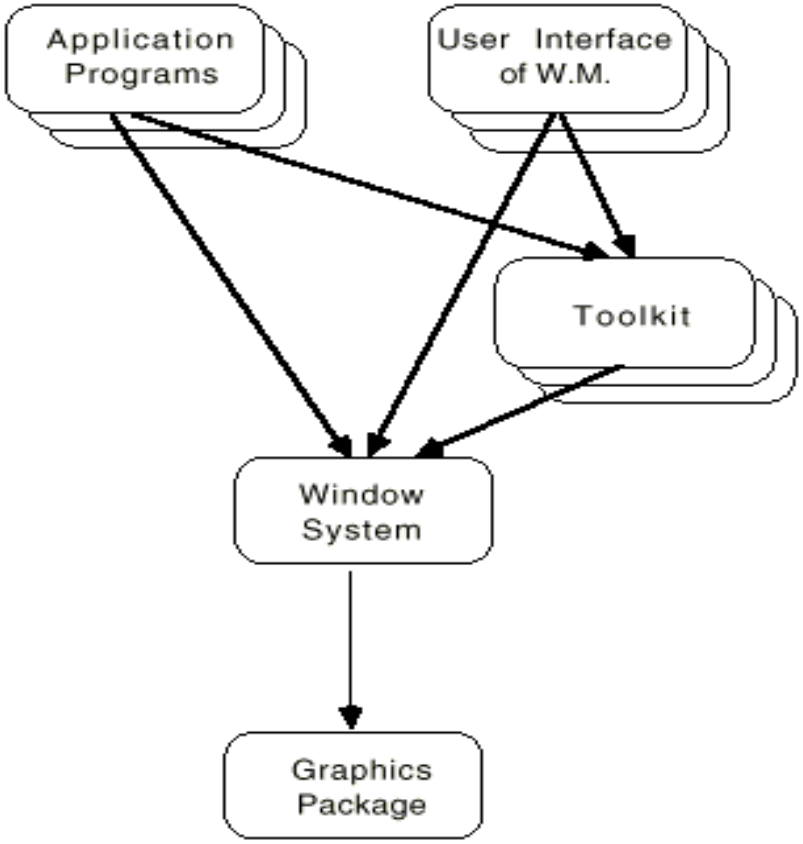
Early Output Architecture

- E.g. Sapphire, SunWindows

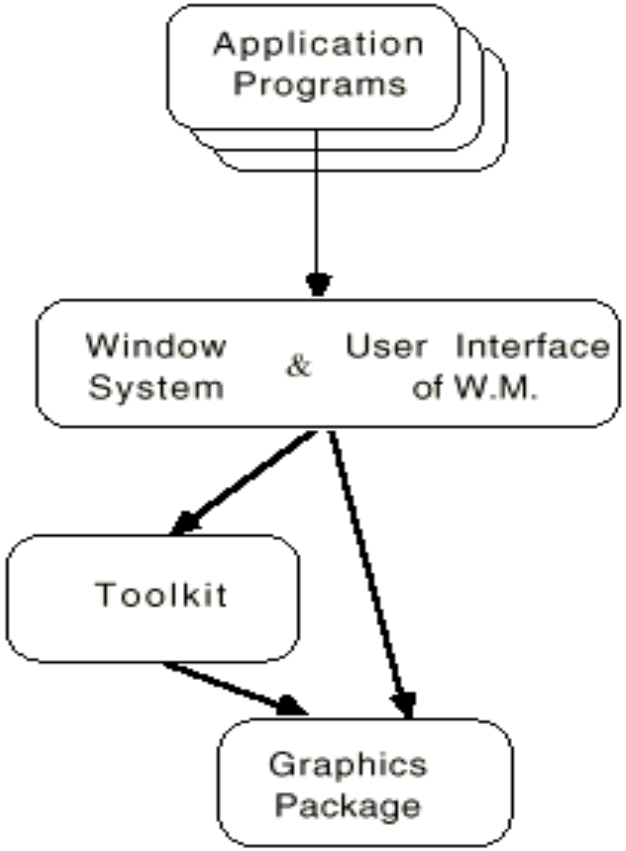


Current architectures

NeWS, X



Macintosh, NeXT, Win32



Input models

- Handling input devices tedious
  - Want an abstraction for input
    - As disks, etc. are to file systems
- The "uniform event" input model
  - An event is a record of an input action
  - Events placed in a queue
    - processed asynchronously
  - "producer/consumer" between system/user

An event record

- What caused the event
  - e.g., left mouse button went down
- Where was the mouse
- When did the event occur
- Value associated with device action
  - e.g. ascii value of key, position of knob
- Additional Context
  - e.g. modifiers

Example

- The Java 1.2 MouseEvent

http://java.sun.com/products/jdk/1.2/docs/api/java.awt.event.MouseEvent.html

Special events

- Not just for simple input device actions
- e.g.

Using events: Return of basic paradigm

```
Main_Event_Loop()
        Set_input_mask();
        repeat
                Wait_for_event(E)
                case E of
                        ...
                        dispatch event E
                        ...
                end;
                redraw_screen();
        until done;
```

Life with Events

- Continuous handling
- Higher level abstractions
  - Asynchrony: FSMs

Issues

- One channel (no "back channel")
  - Flow control characters inserted in queue
- Fixed set of events
  - Handling new ***kinds*** of devices hard
- Events are asynchronous

  => User asynch with program

Synchronization Issues

- How typically dealt with?

- Implication?

Example:

Synchronization Issues

- Separate queues don't help

- Each thread needs one unified queue
  - Can be one per thread