How Xlib Is Implemented (And What We're Doing About It)

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X Window System Architecture

Client

Toolkit

I18N

Protocol

Xlib

Transport

Server

Protocol

Transport
Xlib Architecture

- Transport layer: conveys requests and responses between client and server
- Protocol layer: constructs requests and unpacks replies
- Utilities layer: does everything else

```
utility
- cut buffers
- gc
- image
- icccm
- resource db
- cms
- xkb
- region

protocol
- core protocol
- events

transport
```

```
i18n
  \rightarrow
  xlc

  \rightarrow
  xom

  \rightarrow
  xim
```
Some Xlib Issues

- Large size
- Inflexible code
- Unpredictable behavior
- Excessive latency
- Confusing thread support

Xlib Component Sizes

- transport
- core protocol
- cms
- xkb
- xom
- xlc
- xim
- other
Starting Over: XCB

- Simpler, smaller implementation
- Focus on transport, protocol
- New domain-specific language for X protocol description provides
  - flexibility
  - maintainability
Porting Xlib to XCB

- Goal: provide a migration path for Xlib-based applications and libraries
- First try: XCL
  - Idea: re-implement Xlib's API from scratch using XCB
  - Problem: Xlib's API is huge
- Current approach: start migration at bottom
  - Replace transport and locking with XCB
    - Prototype implemented in a few days!
  - Slowly migrate protocol layer to XCB
Results

- X Test Suite and real workloads confirm substantial correctness; some bugs remain
- Locking and transport are simpler and smaller; protocol port not yet complete

Any changes in performance are imperceptible
Other Xlib Projects

Redesigning other Xlib components

- cms
- xkb
- xom/xlc/xim
Conclusion

- Installed size of X client libraries are reduced significantly
- Clarity, maintainability, and extensibility are improved as well
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- USENIX
Availability

XCB: http://xcb.freedesktop.org/
Xlib: http://freedesktop.org/Software/X11