



The Xen Para-virtual Frame Buffer

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What, Why and Who

What?

- A para-virtual driver for a virtual frame buffer device

Why?

Want a graphical console

Just like a real machine, just like FV

Whodunnit?

- Anthony Liguori
Design and initial implementation
- Markus Armbruster & others
Flesh out, fix, extend

Architecture

Similar to common split driver architecture:

- **Frontend in domU:**
xenfb and xenkbd kernel modules
- **Backend in dom0:**
user space VNC server or built-in viewer
- **Communicate** through
shared memory page and event channel
shared frame buffer
- **Forward compatible** protocol

Status

Features:

- VNC or built-in viewer (SDL)
- Smart frame buffer update tracking
- Partial support for funny keyboards
- Support for absolute pointer
- Support for save/restore

Status

Non-features:

- Dynamic resolution
- Multiple frame buffers per guest

Misfeatures:

- Should share more code with FV
- and possibly other user space backends
- PTE update race

Availability

- Merged in Xen 3.0.4
- Shipped in major distributions

Funny Keyboards: What's the problem?

The situation:

- User types on a real keyboard
- System maps his keystrokes to key events
- Virtualization software conjures up a virtual keyboard
- Virtual system maps virtual keystrokes to key events

The problematic step:

Mapping real key events to virtual keystrokes

Funny Keyboards: Preserve key events

Idea: make virtual key events = real key events

Need to know virtual mapping

Unless virtual keyboard/keymap = real keyboard/keymap:

- virtual keystrokes \neq real keystrokes
- virtual keystroke may not exist
- may not be able to produce all virtual keys

Funny Keyboards: Keys, not key events

Idea: map real key to virtual key

Virtual keys: Linux input layer key codes

Identify real keys?

X key code depends on hardware

built-in viewer assumes Xorg & PC

VNC's RFB protocol doesn't provide it

VNC server maps from X keysym

this needs to invert the real keymap

choose one in domU config

if multiple keys map to same keysym: guess

Lessons Learned: Protocol

Forward-compatible protocol sound so far, but

dumb oversights:

- Shared data-structures varied 32 vs. 64 bit
- Shared pages not zeroed

Solved using excessive cleverness

Lessons Learned: Implementation

- Playing VM games is subtle business
- Split driver initialization and shutdown pitfalls
- VNC's RFB protocol doesn't give us keys



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