olpcfs

Redesigning the datastore
from the ground up
and top down

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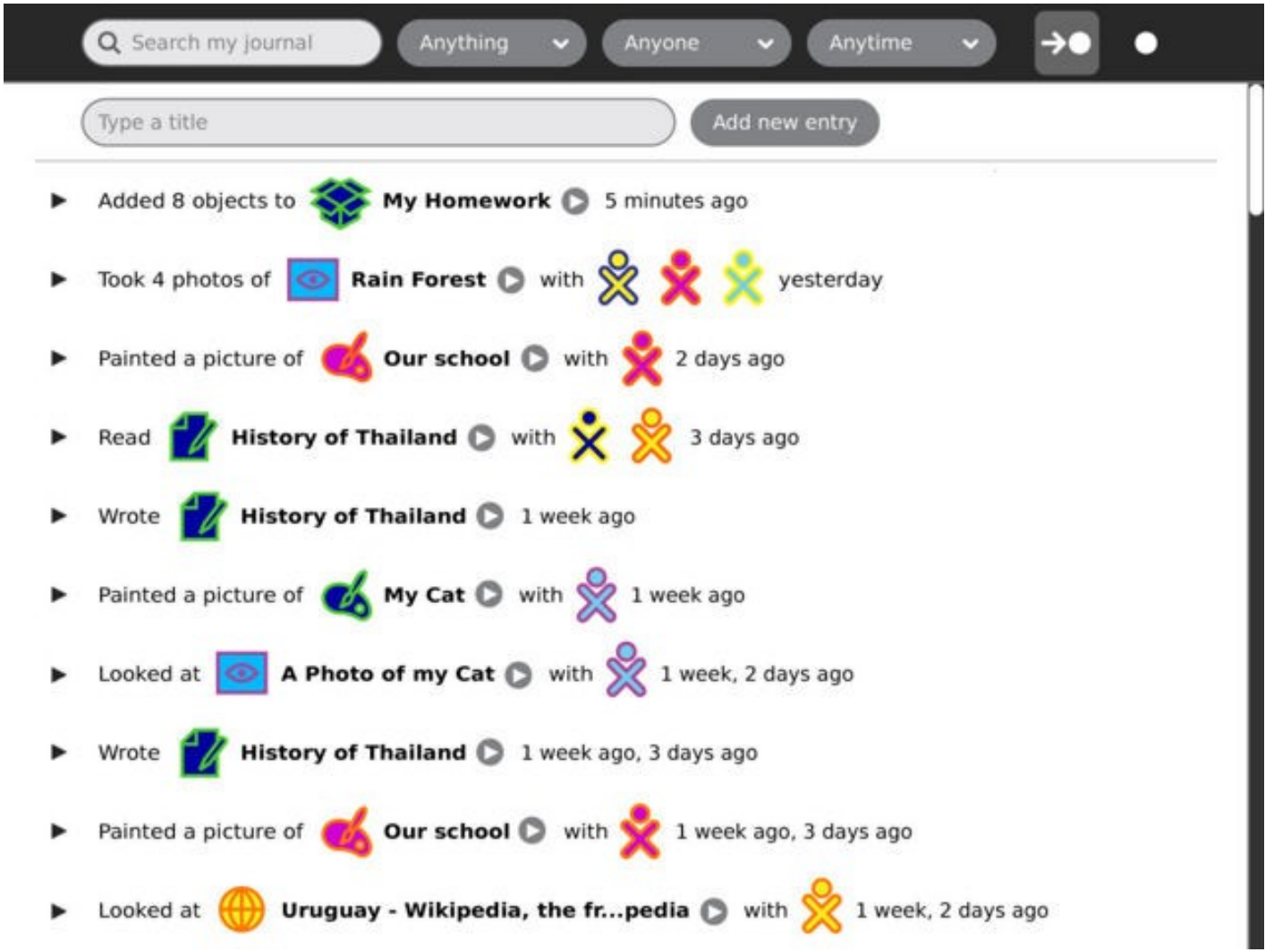
End-user goals

- Support **journal** and **bulletin board** abstractions
- Provide **Bitfrost** P_SF_RUN and P_SF_CORE protections

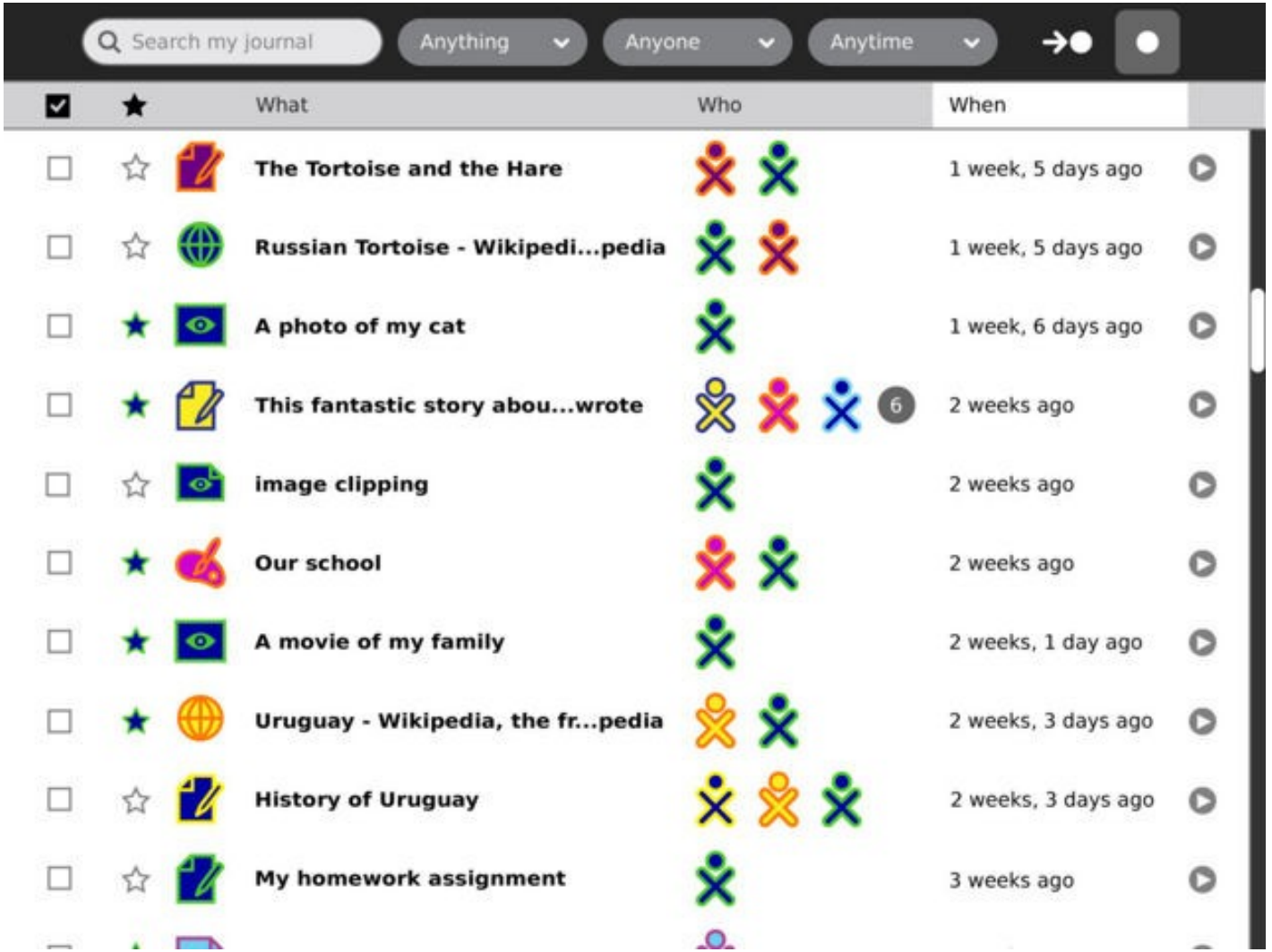
Journal: objects & actions

- Action view



Journal: objects & actions

- Object view



Bitfrost

- P_SF_CORE: no system files may be modified
- P_SF_RUN: the “working copies” of the system can't be modified

Bitfrost: it gets interesting!

- When #P_SF_RUN is disengaged... [i]nstead of loading the stored files directly, a COW (copy on write) image is constructed from them, and system files from that image are initialized as the running system. ... These modifications persist between boots, but only apply to the COW copies: the underlying system files remain untouched.

Bitfrost: turning P_SF_RUN back on.

- If #P_SF_RUN is re-engaged after being disabled, the boot-time loading of system files changes again; the system files are loaded into memory directly with no intermediate COW image, and marked read-only.
- ***End result:***
  - Hacking is safe again!

Design goals

- Filesystem w/ POSIX semantics
  - This is the codeword for “standard filesystem”. Windows, UNIX, and MacOS in various flavors have (more-or-less) POSIX-compliant filesystems.
  - Our first generation design was a “simple” proprietary wrapper: let's move forward!
  - Aim to provide ***best possible*** support for legacy applications

Design goals

- Content-addressable
  - Lots of attempts out there to create global distributed filesystems with unified namespaces – *let's not try this!*
  - Local arrangement & organization of documents is up to the individual user; all we need is an opaque tag to call it by.
  - Commercial support: XAM/Honeycomb (Sun)/Jackrabbit (Apache), etc, etc.

Design goals

- Versioned
  - Support exploratory learning by always allowing user to undo his most recent mistake.
    - “Continuous” versioning.
    - Snapshots don't work for this.
  - Groups of files may have independently modifiable *tagged versions* (“full persistence”)
    - Gives us our P_SF_CORE/P_SF_RUN support
    - Also very useful when importing collaborative work

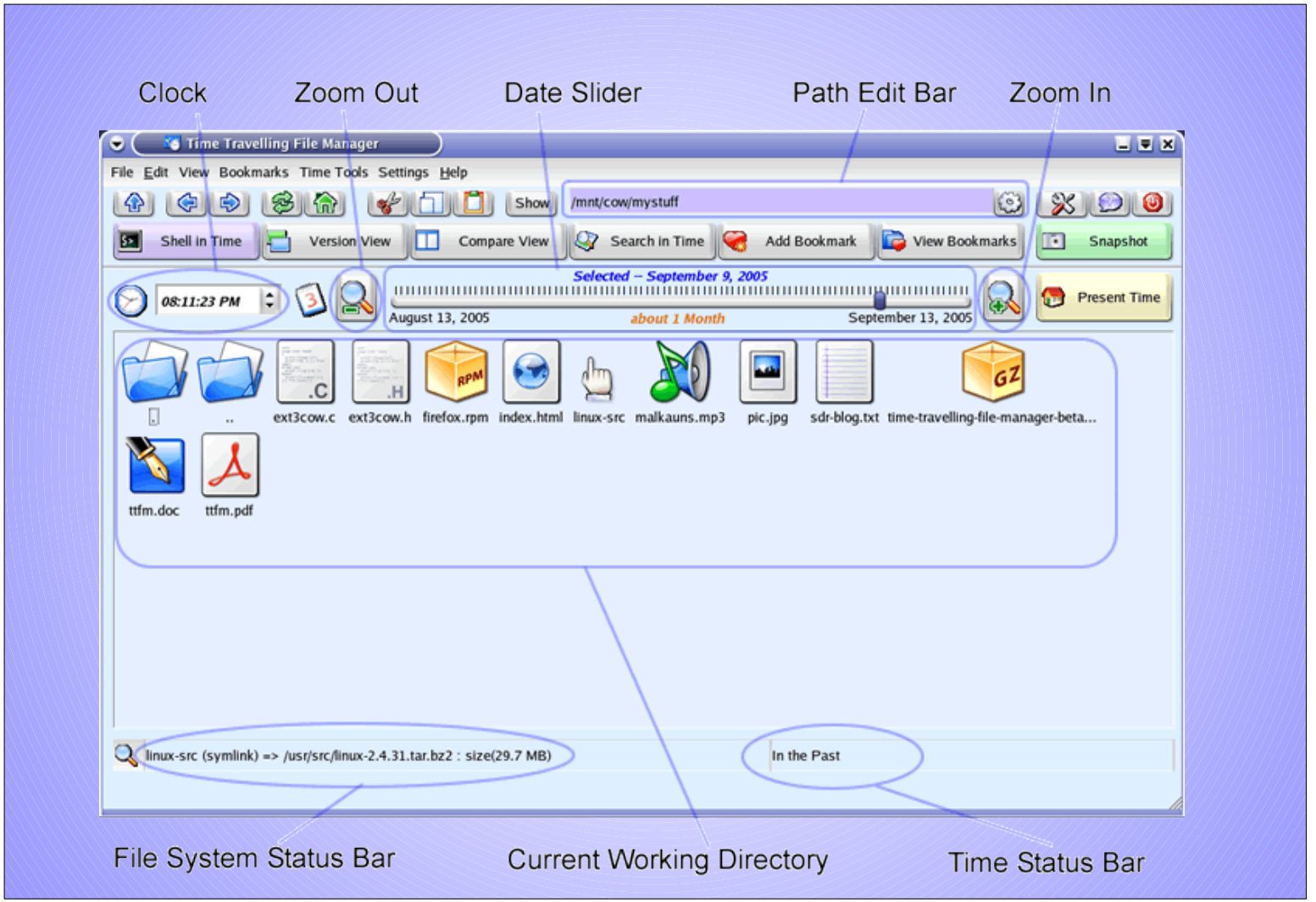
The olpcfs *filesystem*

- Transparent **versioning**
  - Reach back and study the past – then change it!
- Rich **metadata** via POSIX xattrs
  - Enhanced by mechanisms to treat metadata as 1st-class files
- Integrated metadata **indexing**
  - Unifies “Journal” and “files & folders” views

Demo

- http://wiki.laptop.org/go/Olpcfs has pointers to the source
- 2,500 lines of Python
  - Bdb and python-fuse packages
- First impressions:
  - I prefer managing directory objects, rather than being given full pathnames

Time-travelling file manager (an aside)



Journal integration

- All documents live in `~olpc/Documents`
- Sugar-aware activities add `action_id` xattrs for file grouping
- Add'l journal properties are directly implemented as xattrs

Journal, cont.

- Journal search built on native indexing
- Journal versions built on native versions
  - But additional attributes may be used for richer merge semantics, etc.
  - “Keep stars” in Journal correspond to landmark versions

Sync'ing & sharing

- All objects have “XUID”
  - Content-addressable
- Distributed indexes of various scopes on top of local index
- Not all local objects may appear in filesystem tree!
  - Some may be imported into index only

Sync'ing & sharing

- XUID encapsulates *object plus metadata*
  - “Who's got this XUID?”
  - “I'll tell you which XUIDs I don't have if you'll tell me your XUIDs.”
- Independently-modified documents may result in tagged versions in filesystem after import

Implementation scope

- Lots of fallback/alternative implementations possible
  - Currently writing proof-of-concept to test APIs and unblock journal & other work
  - Non-versioned implementations with look-aside metadata easy using FUSE, lufs, 9P, etc.
- Flash filesystems are hard.
  - But the datastructures used here are very flash-friendly!

Conclusions

- Even if it's not as ambitious as this, our datastore should look like a filesystem!
- Lots to learn from BeOS & the BSDs; they rock!
  - Even NTFS

Questions?