Plan 9 from Bell Labs Unix, Only Moreso

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Unics: Designed in a distant era

- Ken Thompson and friends started to simplify the original Multics system in 1969
- The known Unix ecosystem developed as needs grew
 - Original inclusions: an editor (ed), PDP-7 assembler, and shell
 - Word processing (roff), Thompson shell, PDP-11 port (1971)
 - Rewritten in C (Version 4, 1973)
 - Bourne Shell (sh) (Version 7, 1977)
- Unix released to educational markets in 1975 and commercially in 1982

Unics: Designed in a distant era

- It is the 1980's.
- Unix entrenched in a text- and keyboard-centric user interface
- Networking and graphics incohesive to original Unix design
- Computers were becoming cheaper and more sophisticated
- Ken Thompson and friends were ready to start fresh
- What will change this time around?

Design of Plan 9

9P: a universal communication protocol

- Client-server model (server responds to client's requests)
- Used for local and remote services
- Byte-oriented, little-endian
- 9P file servers for communication of programs and hardware

The file system: a universal communication interface

- Files are exposed by hardware to invoke behavior
- Files are exposed by programs to send/receive messages
- I/O achieved with regular reads and writes of text streams
- Sharing files means sharing data and resources

8 1/2: an unsophisticated windowing system

- A stacking window manager everything is a window
- Windows are unaware of surrounding environment by design of the OS
- Files for graphics, tty, etc. are served for programs to interact with
- Mouse alone is used to interact with UI

The mouse: for everything other than typing

- Closely integrated with the window system
- Each button has a general purpose
 - Left button: selecting text
 - Middle button: operations within a window
 - Right button: operations with windows
- Buttons can be overridden with a graphical program in a conventional way

Private name spaces: processes have a unique view of the file system

- The window system creates a new name space for each terminal
- Files are created and brought into familiar places
- ► For the console I/O file, /dev/cons
 - It is privately "mounted" (via bind) to /dev/cons
 - Consequently, programs always expect to read/write text to /dev/cons

Feature orthogonality: measure twice, awk -F once

- Plan 9 takes the Unix philosophy without compromise
- Common actions need not be rewritten in every core utility:
 - ► Walking through a file tree (--recursive is omitted)
 - ► Formatting a field-separated list into N columns (use mc)
- For the sake of size and simplicity, at the expense of convenience

Plumbing: Associate file and functionality

- ► The plumber is a file server to communicate data between pertinent programs
- How processes use it
 - Writing to: process has data that needs to be handled
 - Reading from: process(es) read file for data it conventionally handles
- If no program open is eligible to handle this data, a rule file matches the file with a program to run

Consequence of encapsulation and ubiquity

- Components of a system can be shared by exposing file systems!
- The user is to use a diskless terminal, while connecting to:
 - A CPU server which has many processors on tap
 - A file server which has plentiful working and static storage
- This distributed system was the original vision of Plan 9

U-nixed

GNU

Unruly

ioctl syscall

► File I/O a sufficient abstraction

Superuser

- hard,sym}links 'host owner' the closest parallel, only has resource control hard,sym}links
 - bind + private name spaces work similarly

Usage

One who computes

- 'I want to '{'write text','view documents',
 'process text'}' in Plan 9!'
 - Sorry, you can't brace expand in Plan 9
- 'I want to '^('write text' 'view documents'
 'process text')!^' in Plan 9!'
 - Yes, good.

Userspace: The Final Frontier

- Everything you could possibly use a computer for:
 - write text (sam, acme)
 - view documents (page)
 - process text (sed, awk, regexp)
 - format text (troff)
 - browse the web (mothra)
 - compile and link C code (e.g. 8c, 81)
 - shell (rc)

The Shell - rc

- Simplified syntax for sake of writability
- Canonical Bourne Shell features retained, like file redirection and piping
- Not too many surprises here

Sam

- Similar to ed in spirit
- Two windows:
 - Text editing window: WYSIWYG
 - Command language window: ed-like
- Operates on a selection of text, called a 'dot'
 - i/foo for inserting 'foo' before dot
 - c/foo for changing contents of dot to 'foo'
 - a/foo for appending 'foo' after dot

Acme

- Culminates Plan 9's design choices into a pleasant interface
- Consists of columns which contain vertically-stacked windows
- The mouse facilitates UI interaction and manipulating text
- Exposes a file system for the layout and contents of windows
- Borrows the command language from sam
- Like Emacs in spirit, where users may spend most of their time in Acme

Plan 9 C Compiler

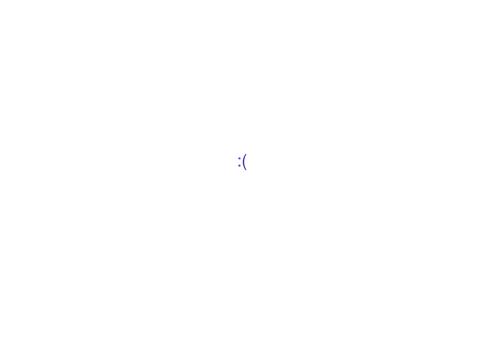
- Plan 9 has its own flavor style of C, similar to C99
- Compiler and linker distinct programs for each architecture
- The process may be automated with mk
- Trivial cross-compilation just set objtype to the target
- An interpreter exists for all targets (for MIPS: vi)

Plan 9 C Compiler

```
void
main(int argc, char *argv[])
    print("hello, world\n");
    exits("");
 To run in the shell (386 architecture):
% 8c foo.c
8 81 foo.8
% 8.out
hello, world
```

Text Processing

- sed, awk, and a regular expression language are all there
- Some Unix commands deemed superfluous as these accomplish the same thing
 - Example: head is omitted as sed 10q works too
 - Want any of them back? Make an rc script with the same name in \$home/bin/rc/, which is bound to /bin
- Have fun!



Where in the World is Plan 9 Users Group?

- Plan 9 didn't catch on
- Plan 9 wasn't better enough than Unix
- Plan 9 had a commercial license and cost money for most of its lifespan
- Plan 9 needed a kick-start to fix issues with documentation and sparse drivers, but never got one
- Plan 9 died in 2015

Dead, but not forgotten

- Forks of direct successors or inspirations to Plan 9 exist
- 9front: Plan 9 but with more drivers and programs
- Harvey OS: Plan 9 rewritten to build in GCC or Clang
- Akaros: An research operating system oriented for HPC/parallel applications
- /proc, a virtual file system exposing functionality with the kernel, was borrowed by the Linux kernel