Plan 9

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Synchronization

Survey

How many have installed *nix on a box?

Windows?

How many have done an upgrade?

How many have a personally owned box with multiple users?

Done an upgrade?

What does "PC" stand for?

Today: Plan 9 from Bell Labs

Synchronization

Friday

"Review session"

Your chance to "review" me

Overview

What style of computing?

    The death of timesharing

    The "Unix workstation problem"

Design principles

Runtime environment

File servers (TCP file system)

Name spaces

Timesharing

One computer per ...

    City: Multics

    Campus: IBM mainframe

    Department: minicomputer

Sharing, protection easy inside "the community"

Administration amortized across user base

    Printers, too...

The *Personal Computing* Revolution

Consequence of the microprocessor

Get *your own* machine!

No more "disk quota"

You decide which software is on the box

    Upgrade whenever *you* want

Great!

The Rallying Cry

One of the Alto's most attractive features is that it does not run faster at night.

Butler Lampson?

The Personal Computing Disaster

You do your own backups

    Probably not!

You do emergency security upgrades

    Day or night!

Sharing files is hard, risky

    machine:/usr/... (until it retires)

Every machine you use has different software

Hybrid Approach

Centralize "the right" resources

  Backed-up, easily-shared file systems

  Complex (licensed) software packages

  Version management / bug patches

Access those resources from a fast local machine

Which OS on the servers?

  Don't care – black boxes

Which OS on the workstation?

Workstation Operating Systems

Unix?

Good: It's the system you're used to using

Bad: Administer it yourself

/etc/passwd, /etc/group, anti-relay your sendmail...

Windows

Your very own copy of VMS!

Support for organization-wide user directory

Firm central control over machine

"install software" is a privilege

Workstation Operating Systems

Mac OS 9

Your own ... whatever it was

Mac OS X

Your own Unix system! (see above)

VM/CMS or MVS!!!

IBM PC XT/370

Your own *mainframe*!

You and your *whole family* can (must) administer it

The "Network Computer"

Your own display, keyboard, mouse

Log in to a real computer for your real computing

Every keystroke, every mouse click over the net

Every font glyph...

Also known as

Thin client, X terminal, Windows Terminal Services

Once "The Next Big Thing"

Thud

The Core Issues

Who defines and administers resources?

What goes across the network?

    X terminal: keystrokes, bitmaps

    AFS: files

Are legacy OSs right for this job?

The Plan 9 Approach

"Build a UNIX out of little systems"

  ...not "a system out of little Unices"

Compatibility of essence

  Not real portability

Take the good things

  Tree-structured file system

  "Everything is a file"

Toss the rest (ttys, *signals*!!!)

Design principles

Everything is a file

   Standard naming system for all resources

"Remote access" is the common case

   Standard resource access protocol, 9P

Personal namespaces

   Naming *conventions* keep it sane

A practical issue: Open Source

   Unix source not available at the birthplace!

System Architecture

Shared-memory multiprocessor *cycle servers*

Reliable machine-room *file servers*

Plan 9's eternal versioned file system

Remote-access workstation *terminals*

Access your *view* of the environment

Don't *contain* your environment

rsc   /dev/n   jmk   skipt   tklopp   john   brucee   lorenz
12:17   11:47   11:16   02:50   02:05   02:03   Jun 10   Jun 10

Germany

olive(4)   anna   achille
load con
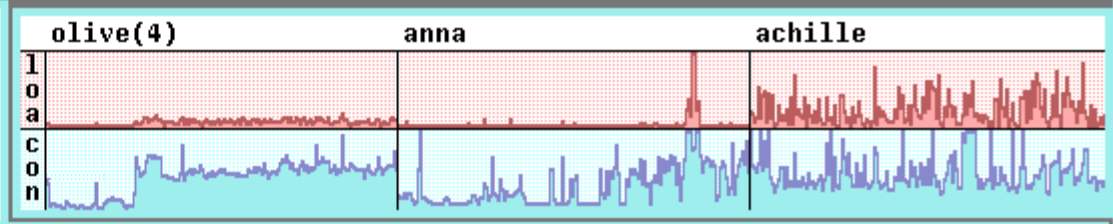
Mail Newcol Kill Putall Dump Exit

New Cut Paste Snarf Sort Zerox Delcol
/mail/fs/mbox/34/ Del Snarf | Look Reply all Delmesg Save

===> 3/ (multipart/mixed) [inline]

jmk@plan9.bell-labs.com rsc@plan9.bel

ody.jpg /usr/rob/plan9bunnysm.jpg

New Cut Paste Snarf Sort Zerox Delcol
/acme/mail/guide Del Snarf | Look
Mail stored
plumb /mail/box/$user/names
mail –'x' someaddress
mkbox /mail/box/$user/new_box

/mail/fs/mbox/ Del Snarf | Look Put Mail
34/ Russ Cox <rsc@plan9.bell-labs.com>   Sun 11 Jun 12:17
        34/1/   (text/plain)
        34/2/   rob pike <rob>   (text/plain)
        34/3/   renee french <cornelia@world.std.com>
            34/3/1/   (text/plain)
            34/3/2/   (image/jpeg)
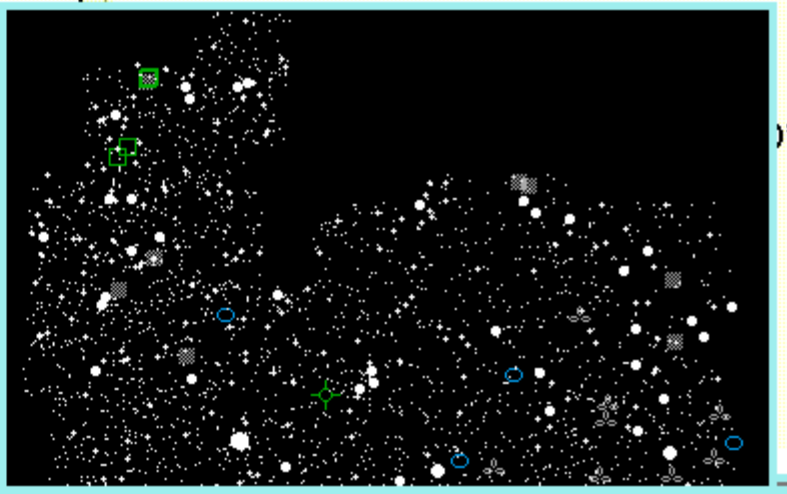   34/3/3/   (text/plain)
33/ /dev/null Sun 11 Jun 11:47
32/ jmk Sun 11 Jun 11:16
        32/1/   (text/plain)
        32/2/   DAGwyn@aol.com   (text/pl

/usr/rob/lib/plumbing Del Snarf | Look
to update: cp /usr/$user/lib/plumbing /mnt/plumb/rules

editor = acme

%g scat
ori
638 items
plot nogr

Plan 9 from Bell Labs

. 3–6 augrim, 4 –ym, 5 –ime,
–ime, 7 agrum, algrim. β. 4–6
algorism, algorithm. [a. OFr. augorisme, algorisme, augorime;
7–9 algorism, algorithm. [a. OFr. augorisme, algorisme, augorime;
ad. med.L. algorism-us (cf. Sp. guarismo cipher), f. Arab. al-Khowāra
the native of Khwārazm (Khiva), surname of the Arab mathematician
Abu Ja'far Mohammed Ben Musa, who flourished early in the 9th
c., and through the translation of whose work on Algebra, the
Arabic numerals became generally known in Europe. (Cf. 'Euclid'
= plane geometry.) Algorisme being popularly reduced in OFr.
to augorime, English also shows two forms, the popular augrime,
ending in agrim, agrum, and the learned algorism which passed

window
x
x.gif
y
日本語
%g ech
%g

Custom Namespaces

/bin/date means *your architecture*'s binary

/dev/cons means *your* terminal

Per-*window* devices

/mail/fs/mbox/25 is the 25th message in your box

The /bin File System

Look, Ma, no $PATH!

```
% bind /sparc/bin /bin
% bind -a /rc/bin /bin
% bind -a /usr/davide/sparc/bin /bin
```

/bin is a *union* directory

Each backing directory searched in order

/dev/tty vs. /dev/cons

```
% (process_foo <foo >bar ) >&errs
```

What if process_foo wants to talk *to the user?*

Unix – magic device "/dev/tty"

When you open it, you actually open /dev/ttyXX

Plan 9 – *correct namespace* contains /dev/cons

The right device is *mounted as* /dev/cons

By whoever runs you (window manager, login, ...)

Per-Window Devices

X: a complex monolithic server somewhere

House of a thousand mysteries

Not on the 15-410 reading list: ICCCM

Plan 9: Per-*window* devices

/dev/screen, /dev/mouse, /dev/cons

/dev/label - window title

/dev/wdir – working directory

% echo top > /dev/wctl

The Serial-Port File System

Look, Ma, no ioctl()!

```
% bind -a '#t' /dev
% echo b9600 > /dev/eia1ctl
% echo "foo" > /dev/eia1
```

The TCP File System

Look, Ma, no finger command!

```
% cat /net/tcp/clone/ctl
44
% cd /net/tcp/44
% echo "connect 128.2.194.80!79" > ctl
% echo davide > data
% cat data
```

Look, Ma, no NAT proxy setup!

```
% import gateway.srv /net/tcp
```

The /tmp Problem

Unix /tmp: security hole generator

Programs write /tmp/program.3802398

Or /tmp/program.$USER.3432432

No name collision "in practice"

Unless *an adversary* is doing the practicing

ln -s /tmp/program.3802398 /.cshrc

Suggest a command line to a setuid root program...

Fixing /tmp

No inter-user security problem if *only one user*!

Plan 9 /tmp is per-user

Matches (sloppy) programmer mental model

Plan 9 3-Level File Store

Exports one tree spanning many disks

   Users bind parts of the tree into namespaces

3-level store

   RAM caches disks, disks cache WORM jukebox

Daily snapshots, available forever

   /n/dump/1995/0315 is 1995-03-15 snapshot

   Time travel without "restoring from tape"

   Public files are *eternally* public – be careful!

Plan 9 Process Model

New-process model

    fork()/mount()/exec()

System calls block

Task/thread continuum via rfork()

    Resources are shared/copied/new

        Name space, environment strings

        File descriptor table, memory segments, notes

    rfork() w/o "new process" bit edits current process

Process Synchronization

rendezvous(tag, value)

    Sleeps until a 2nd process presents matching tag

    Two processes swap values

    "Tag space" sharing via rfork() like other resources

Shared-memory spin-locks

Summary

Files, files, files

    "Plumber" paper

        Programmable file server

        Parses strings, extracts filenames

        Sends filenames to programs

        File, file, blah, blah, ho hum?

    Isn't it cleaner than

        Signals, sockets, RPC program numbers, CORBA?

Not just another reimplementation of 1970

More Information

http://www.cs.bell-labs.com/plan9dist/

Disclaimer

A distributed system is a system in which I can't do my work because some computer has failed that I've never even heard of.

Leslie Lamport