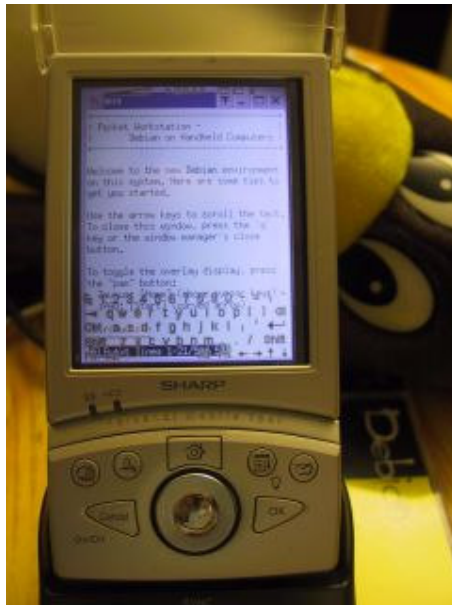


Debian on Handheld Computers The Pocket Workstation Project



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- Limitations of the platform
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Introduction

- The goal of the project: running a full Debian environment on a handheld computer
- Supported platforms:
 - Sharp Zaurus 5x00 and SL-C7x0
 - HP/Compaq iPAQ handhelds
- **WARNING:** inflammatory subjects ahead – this is all from a very subjective point of view, and many other solutions are possible

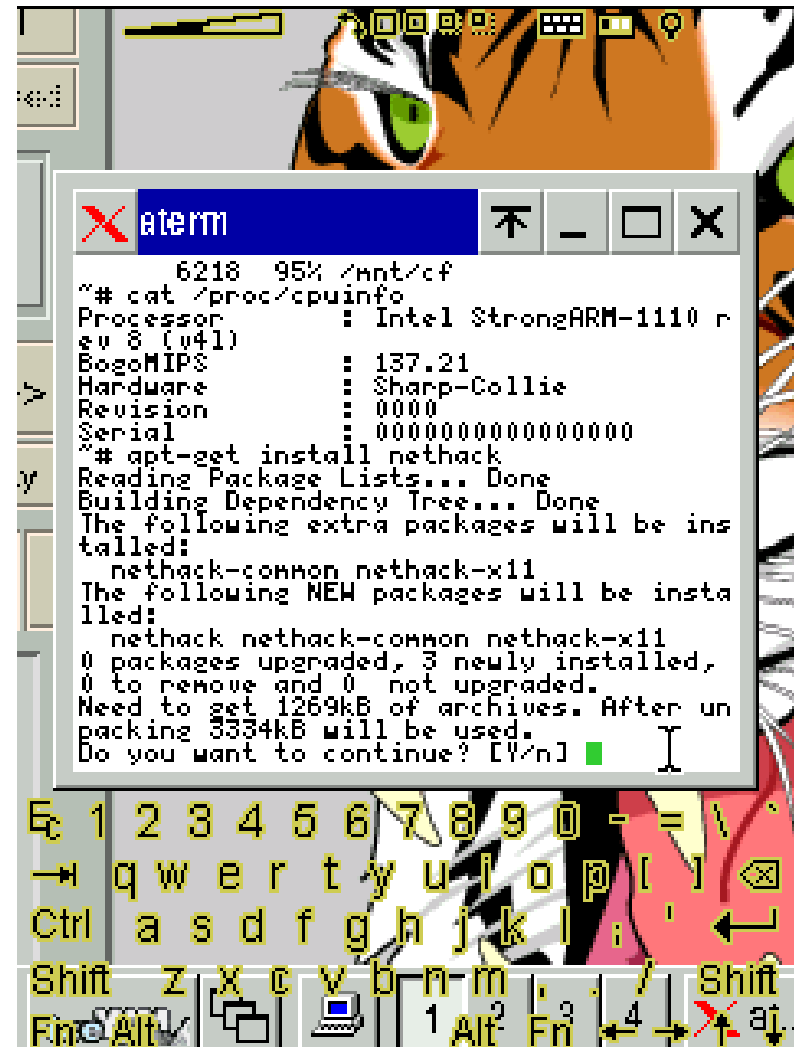
Why??

- Handheld environment should resemble desktop OS
 - My first handheld:
The dos-based HP 200LX
- Large selection of programs available
 - not limited to those designed for handheld
- Why Debian?
 - Huge archive of pre-compiled software for ARM
 - Excellent package management
- Is it something for everyone – not really...



Current status

- Requires SD/MMC card
 - at least 128 MB storage
 - chroot / pivot-root
- Uses Xvnc / fbvnc client
 - native X (TinyX) optional
- Most Debian apps work
- Problems
 - resource limitations
 - ported apps not working



The screenshot shows a terminal window titled 'aterm' with a blue header bar. The terminal output displays system information and the progress of installing the 'nethack' package. The background of the terminal window features a colorful, stylized illustration of a character's face.

```
6218 95% /mnt/cf
~# cat /proc/cpuinfo
Processor       : Intel StrongARM-1110 r
sv 8 (v4l)
BogoMIPS       : 137.21
Hardware       : Sharp-Collie
Revision       : 0000
Serial         : 0000000000000000
~# apt-get install nethack
Reading Package Lists... Done
Building Dependency Tree... Done
The following extra packages will be ins
talled:
  nethack-common nethack-x11
The following NEW packages will be insta
lled:
  nethack nethack-common nethack-x11
0 packages upgraded, 3 newly installed,
0 to remove and 0 not upgraded.
Need to get 1269kB of archives. After un
packing 3334kB will be used.
Do you want to continue? [Y/n]
```

Limitations of the platform

- Low screen resolution
 - 240x320 not sufficient for 80-column text
 - most apps work better on landscape display
- Keyboard missing or incomplete
- Touch screen as primary input
 - One button mouse only
 - Hard to do drags or complex maneuvers

Solved limitations

- Disk space
 - SD/MMC cards available up to 512 MB (but expensive)
- Main memory
 - current models have 64 MB RAM (but no swap space)
- CPU speed
 - StrongARM CPUs fast enough for most apps (but no FPU)

Handheld Zoology

- No expansion slots at all
 - All apps and data must fit in limited flash ROM (16 – 32 MB)
 - Example: original Compaq iPAQ 3630
- One expansion slot only
 - can't use network and storage card together
- Two expansion slots or built-in networking
 - One slot (MMC/SD or CF) can be dedicated to storage
 - Example: Sharp Zaurus, new HP iPAQs

Target platform for Debian port

- Sufficient storage capacity is available
 - at least 128 MB SD/MMC card
- Separate networking capability
 - free CF slot for expansion cards
 - builtin WiFi / Bluetooth
 - Infrared, serial, USB networking

Bootstrapping Debian

- Goal: get *apt-get* working
- Starting point: a working Linux system
 - can be minimal, not many tools needed
 - not usable for WinCE-only handhelds
- Option A: use *debootstrap*
 - ... but I didn't know about that at the time
- Option B: reinvent the wheel
 - shell script using *sed* and *grep* to solve dependencies

Bootstrapping continued

- Use a *chroot* environment for the Debian FS
 - avoid conflicts with native Linux system
- Run Debian inside *chroot*
 - hardware independent, uses drivers of native OS
 - can be annoying to use
 - wasted resources (two copies of C library)
- Dual-boot using *pivot_root*
 - needs more configuration work to support hardware

Choosing applications

```
# apt-get install galeon
Reading Package Lists... Done
Building Dependency Tree... Done
The following NEW packages will be installed:
 docbook-xml esound-common galeon galeon-common gconf gdk-imlib1 gnome-bin
 gnome-libs-data gnome-mime-data libart2 libaudiofile0 libcdparanoia0
 libesd0 libgconf11 libglade-gnome0 libglade0 libgnome-vfs-common
 libgnome-vfs0 libgnome32 libgnomesupport0 libgnomeui32 libgnorba27
 libgnorbagtk0 libnspr4 liboaf0 liborbit0 libscrollkeeper0 libxml1 libxml2
 libxslt1 mozilla-browser oaf scrollkeeper sgml-base sgml-data
0 packages upgraded, 35 newly installed, 0 to remove and 163 not upgraded.
Need to get 17.1MB of archives. After unpacking 51.3MB will be used.
```

```
# apt-get install konqueror
Reading Package Lists... Done
Building Dependency Tree... Done
The following NEW packages will be installed:
 gcc-3.3-base kdebases-libs kdelibs3 kdelibs3-bin konqueror lesstif1
 libdb4.1 libfam0c102 libkonq3 liblcms libmng1 libpcre3 libqt2 libssl0.9.7
 libstdc++5 libxml2 libxslt1 python python2.2
0 packages upgraded, 19 newly installed, 0 to remove and 163 not upgraded.
Need to get 17.6MB of archives. After unpacking 56.7MB will be used.
```

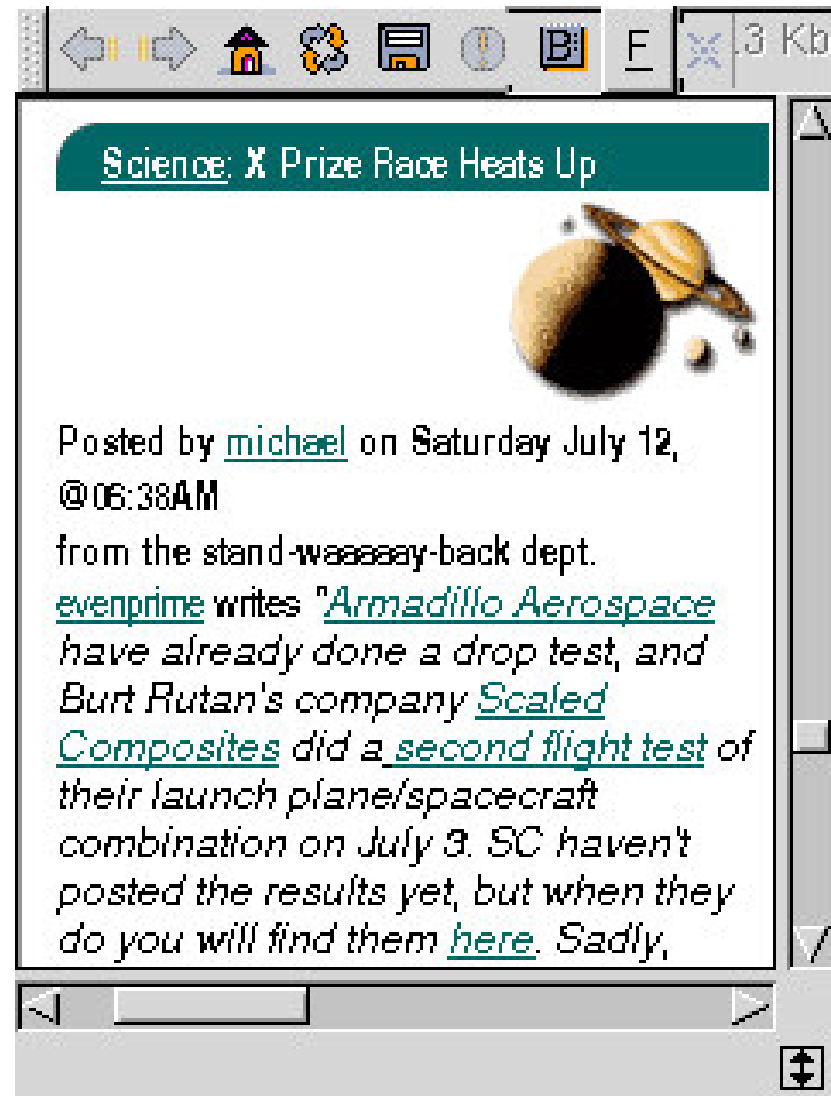
Web browser: *links -g*

- built-in anti-aliased fonts
- some JavaScript support
- handles SSL, tables, frames, downloads
- bookmark management



Web browser: *dillo*

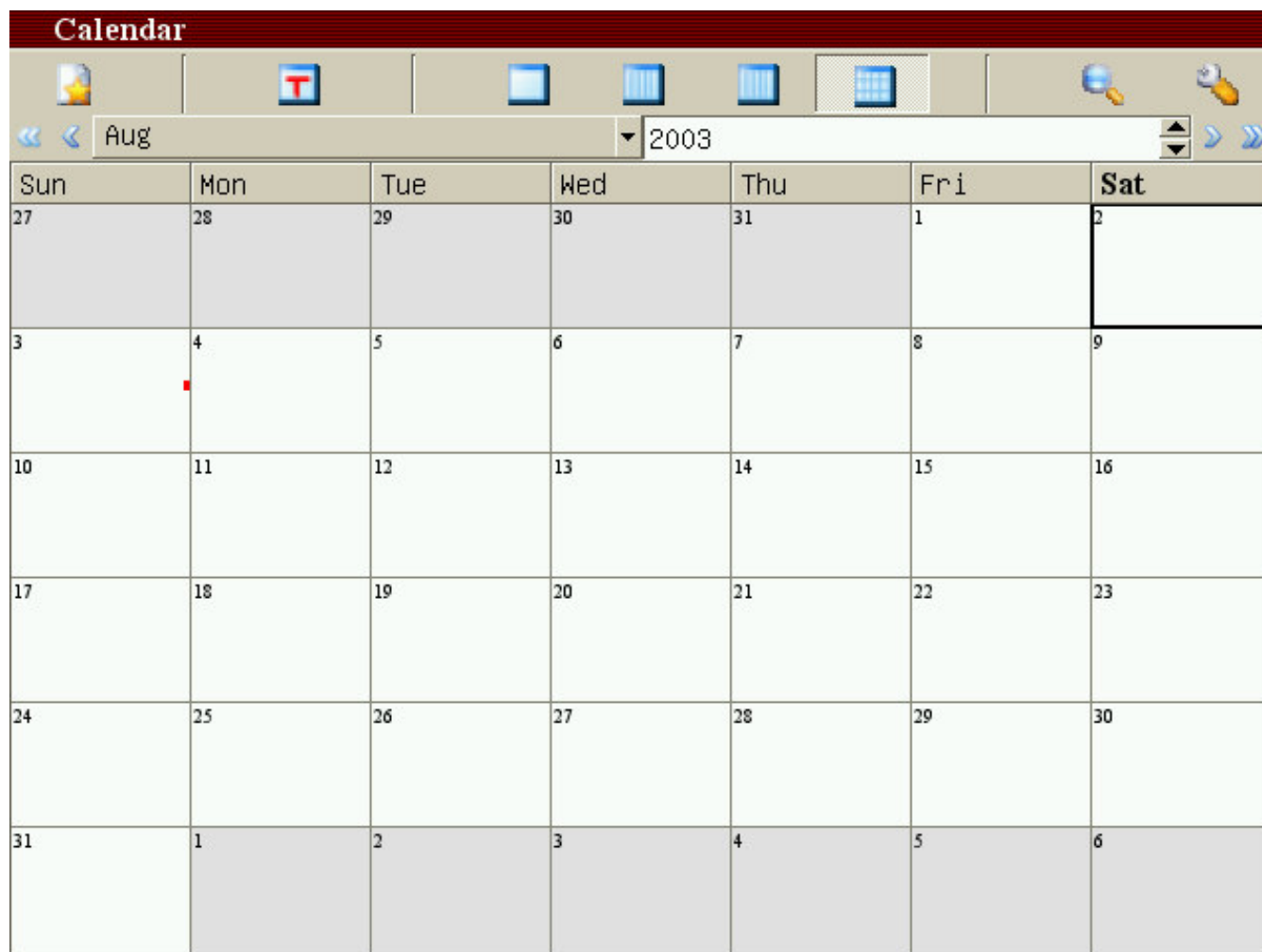
- key features missing
 - SSL
 - file download
- Advantage: being able to read the text on web pages
 - limit text line length to display width when reformatting paragraphs



Design decisions

- What to do if the application requirements and the platform's features don't match?
- The *Procrustes* method
 - chop off bits until what's left fits the space available
 - painful for developers and users
- The *Matrix* method
 - virtual platform simulates that expected by apps
 - painful for users

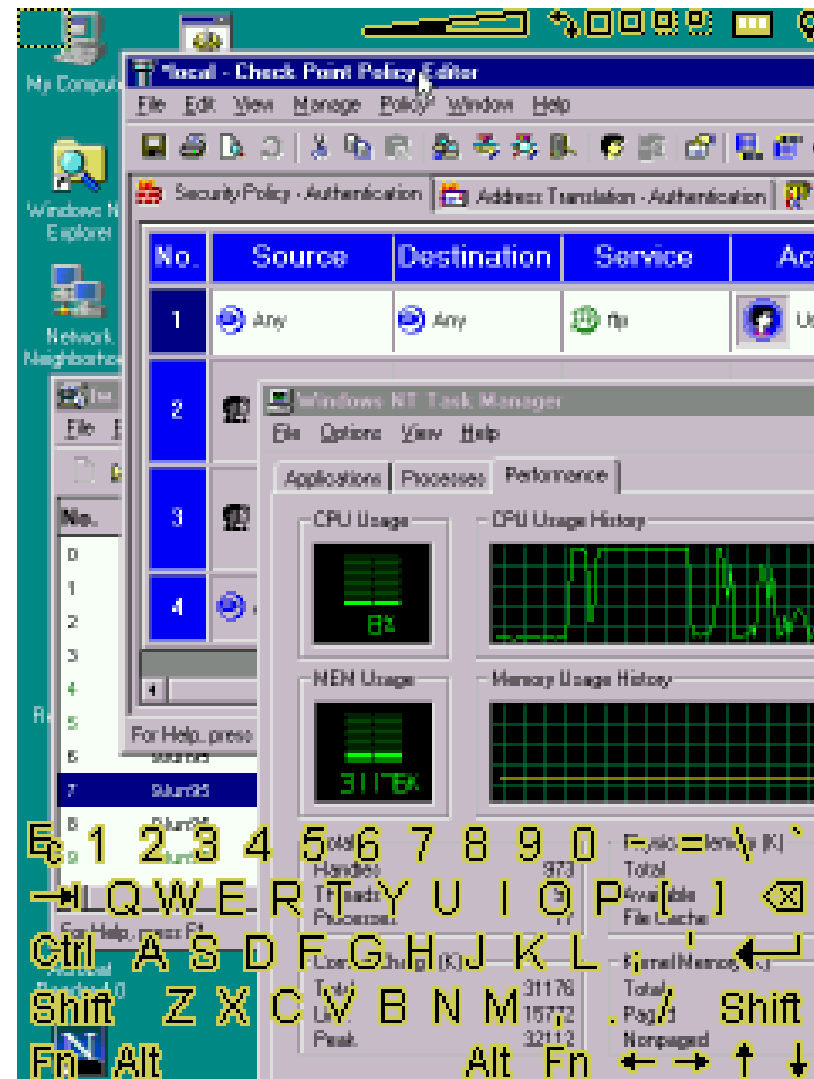
Qtopia, GPE and TinyX



- What's wrong with this picture?

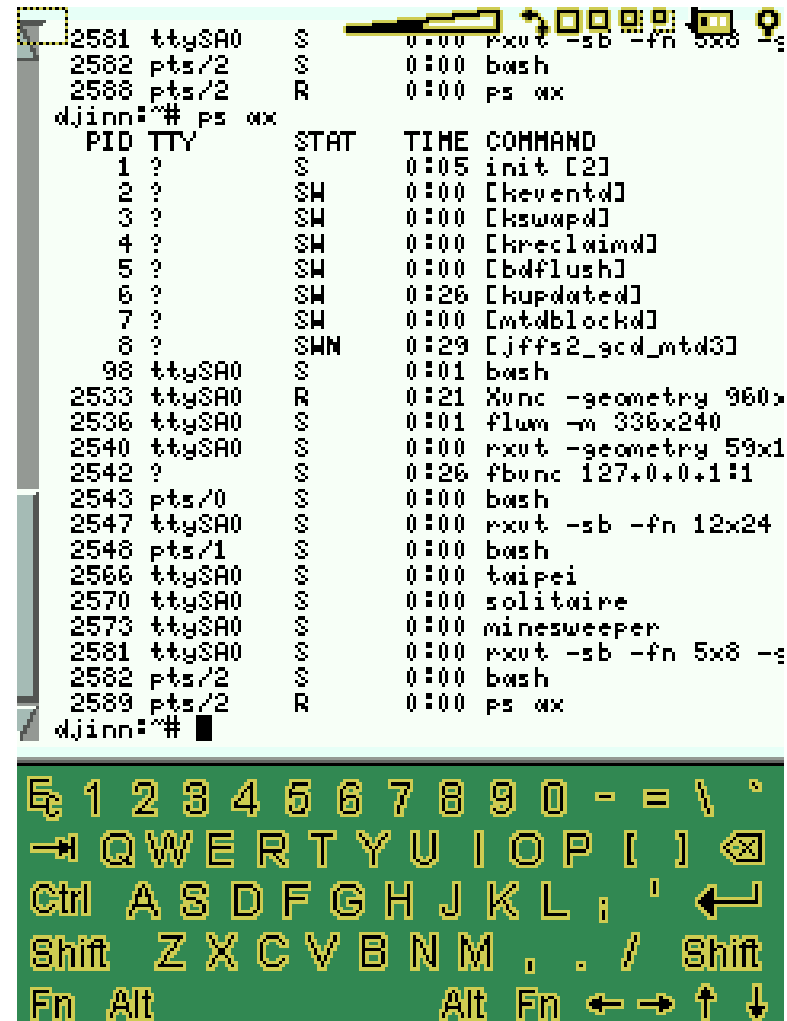
The virtual environment

- Based on VNC client
 - simple thin client
 - virtual display
- *fbvnc* client
 - Anti-aliased rescaling and rotation
 - Virtual keyboard overlay
 - 3 mouse button emulation
 - fast



Xvnc configuration

- Run Xvnc with virtual screen larger than physical display
- rotate and resize to fit the current app on-screen
- surprisingly fast, but not suitable for video and games
 - run those on framebuffer directly
 - use shared memory ?



```
2581 ttySA0 S 0:00 rxvt -sb -fn 5x8 -c
2582 pts/2 S 0:00 bash
2588 pts/2 R 0:00 ps ax
djinn:~# ps ax
PID TTY STAT TIME COMMAND
1 ? S 0:05 init [2]
2 ? SH 0:00 [keventd]
3 ? SH 0:00 [kswapd]
4 ? SH 0:00 [krcldwind]
5 ? SH 0:00 [bdflush]
6 ? SH 0:26 [kupdated]
7 ? SH 0:00 [mtdblockd]
8 ? SHN 0:29 [jffs2_gc_d_mtd3]
98 ttySA0 S 0:01 bash
2533 ttySA0 R 0:21 Xvnc -geometry 960x
2536 ttySA0 S 0:01 flwm -m 336x240
2540 ttySA0 S 0:00 rxvt -geometry 59x1
2542 ? S 0:26 fbvnc 127.0.0.1:1
2543 pts/0 S 0:00 bash
2547 ttySA0 S 0:00 rxvt -sb -fn 12x24
2548 pts/1 S 0:00 bash
2566 ttySA0 S 0:00 taipei
2570 ttySA0 S 0:00 solitaire
2573 ttySA0 S 0:00 minesweeper
2581 ttySA0 S 0:00 rxvt -sb -fn 5x8 -c
2582 pts/2 S 0:00 bash
2589 pts/2 R 0:00 ps ax
djinn:~#
```

⌘ 1 2 3 4 5 6 7 8 9 0 - = \ `
→ Q W E R T Y U I O P [] ↵
Ctrl A S D F G H J K L ; ' ←
Shift Z X C V B N M , . / Shift
Fn Alt Alt Fn ← → ↑ ↓

More virtual things

- Virtual Opie
 - Qt Embedded supports VNC server back-end
 - needs to be recompiled to support it
 - run: `QWS_DISPLAY=VNC:2 datebook -qws`
 - connect VNC client to localhost:2
- Virtual paper
 - pipe pixmaps to fbvnc client, and display them using built-in scaling and rotation
 - shell scripts use `gs` and `anytopnm`

Next-generation handhelds

- Sharp SL-C7x0
 - good keyboard
 - 640x480 landscape display
 - 64 MB RAM on C750 and C760
 - SD/MMC and CF expansion slots
 - IR, serial/USB port, stereo headphone / microphone connector
- Yopy, Sony Clie
 - keyboard and screen have wrong orientation



パーソナルモバイルツール
Zaurus <SL-C700>
(左)ビュースタイル (右)インプットスタイル

Where to go from here?

- PIM applications needed
 - Opie apps don't work well in X11 environment
 - GPE apps missing key features
 - sync with desktop difficult
 - Current favorite: *jpilot*
- Enhancements to *dpkg* and *apt*
 - space savings (three copies of *Packages* data?)
 - relocate apps across filesystems (*ipkg* does this)

Enhancements cont'd

- Use standard ways of doing things
 - *apm* for power management
 - *hwclock* for real-time clock management
- OpenZaurus handles much of this
 - should be merged in Debian distribution