Linux on iPAQ

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Outline

- Why Linux?
- iPAQ Linux
- Handheld Linux Products
- Developing for ARM Linux
- CRL Mercury BackPAQ

Why Linux?

- Full source/binary availability
- Freedom to change any part of the system
- Advanced networking
  - IPv6, MIPv6, IPSEC
- Advanced security
  - ssh, sshd
- Complete GUI flexibility
  - GTK and Qt
  - Microwindows, picogui, ...
- Java 2 SE and ME

it's a full-fledged computer

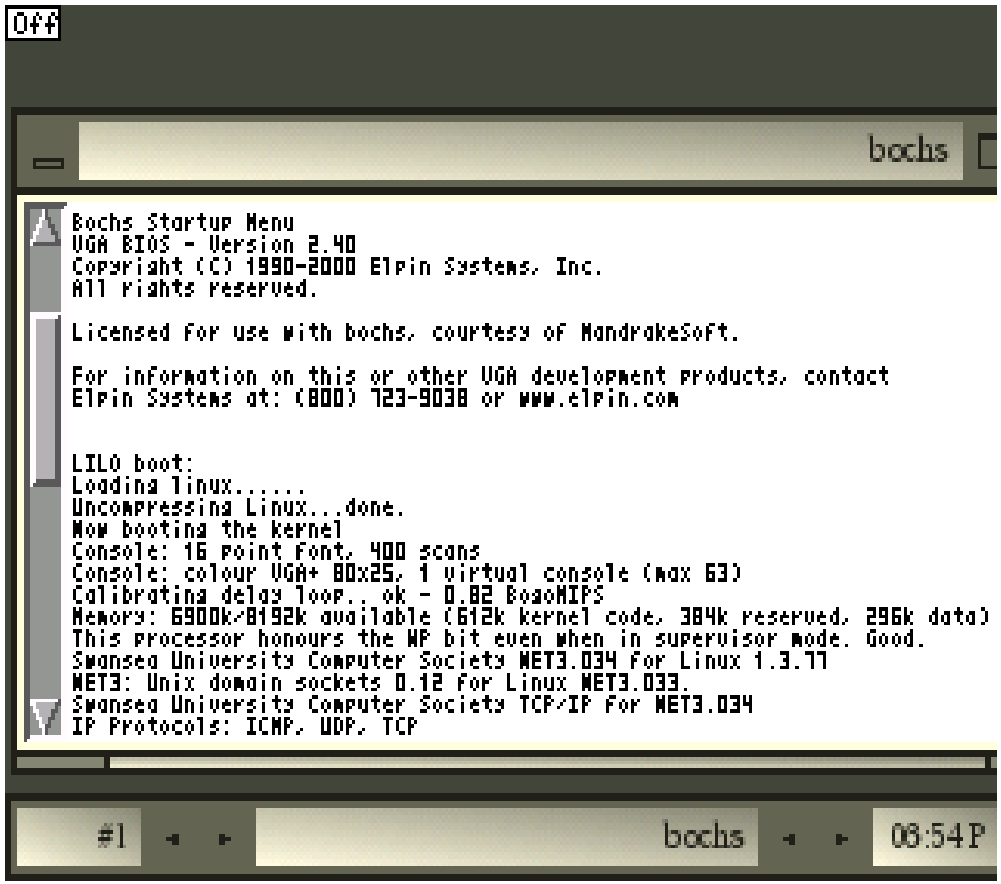
Why Linux?

- More stable operating system
  - Protected process environment
  - User/kernel separation
    - Yields uptimes of 6-9 months when we last surveyed
- Same software as laptop or server
  - Same kernel
    - Supports all protocols, filesystems
    - Subset of IO devices, though
  - Same API's
    - Not subset/superset
  - Same tools and utilities, python, perl, ruby, ...

iPAQ Linux Constraints

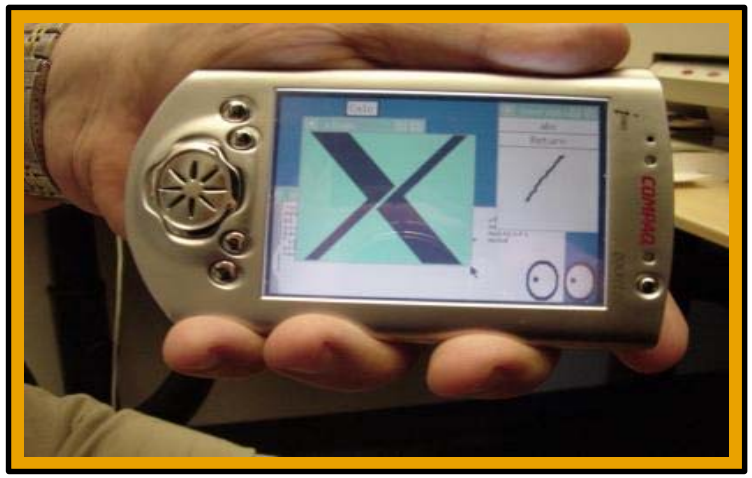
- Adjust for storage space (32MB)
  - This can be a problem
  - Can be helped by CF storage cards
- Adjust for screen size (320x240 12 to 16 bit color)
  - GUI's need to be refactored
- Adjust for lack of keyboard
- Input methods: stylus, xkbd, xstroke, serial cable, remote input via X, ssh

Linux on Linux on iPAQ



- Bochs x86 emulator running on iPAQ

Linux Capabilities



- Linux 2.4.19 and 2.6.1
- Networking
  - WLAN, WWAN
  - IPSEC and other VPN
  - IPv6, Mobile IP
- Filesystems
  - JFFS2: compressed journaling flash filesystem
  - EXT3 on conventional drives

Not just a zippy PDA, but a pocket workstation

Hardware Support (February, 2004)

- iPAQ H31xx, H36xx, H37xx, H38xx, H39xx, H5xxx
  - H22xx, H19[34]x in progress
- Dell Axim
- Toshiba e74x
- Siemens Simpad
- Jornada 560/720
- Keyboards: Stowaway, MicroKeyboard, etc.
- CF, single/dual PCMCIA sleeves
  - Various ethernet CF/PCMCIA cards
  - 802.11b interfaces, BlueTooth
  - CF, Microdrive, IDE interface to larger drives
- Barcode scanner, various serial GPS's, etc.

iPAQ Linux Distributions

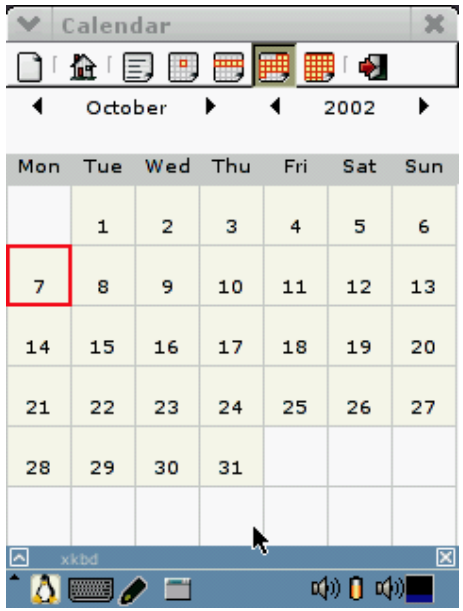
Handhelds.org Linux Distributions

- Handhelds.org project started March 2000
- Familiar Linux (familiar.handhelds.org)
  - jffs2 root, python scripting, ipkg, X & window manager
- Opie distribution
  - Open source version of Qtopia (www.trolltech.com)
- Intimate Linux (intimate.handhelds.org)
  - ARM Debian with disk or net, boot via WinCE or Familiar

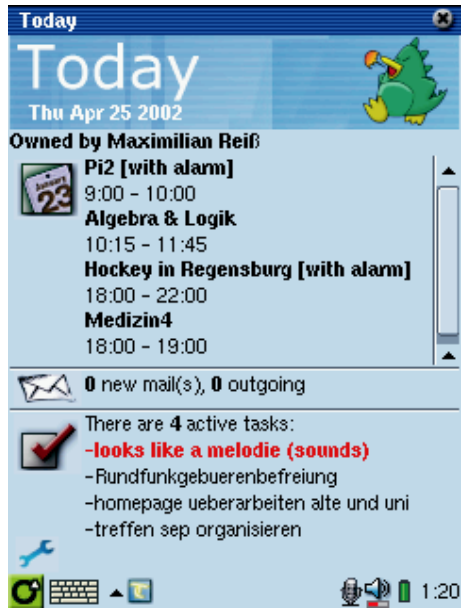
Linux on the iPAQ: Familiar distribution

- JFFS2 root
- X Window System
  - Anti-aliased fonts
  - Landscape or Portrait mode
- Full networking
- sshd
- Distributed as ipkgs

GPE

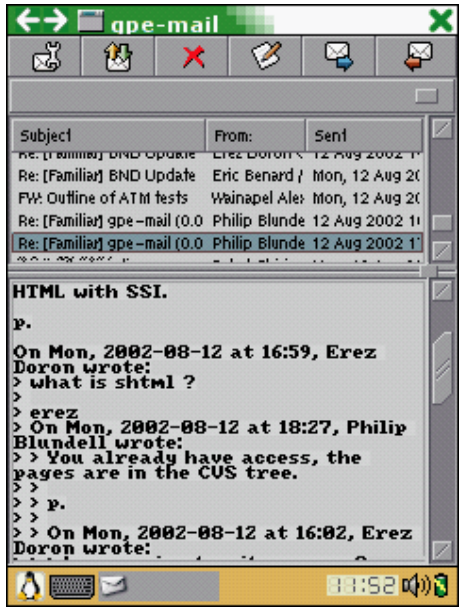


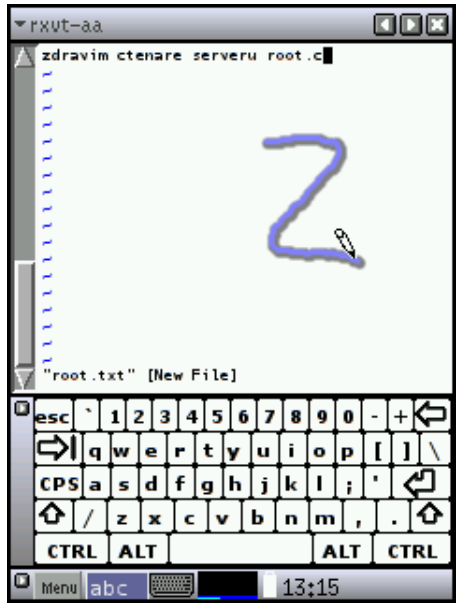
OPIE



GPE

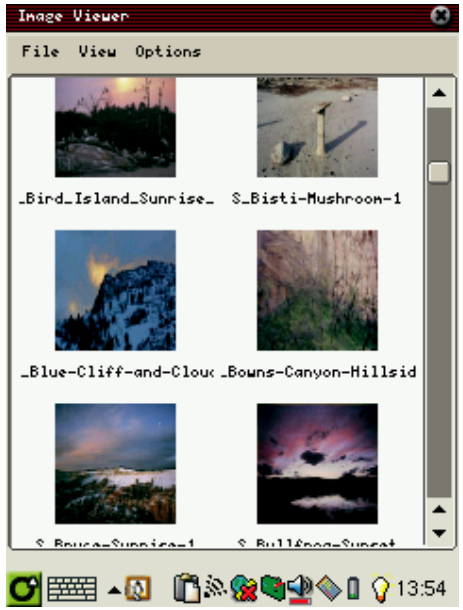
- X window system
  - with render extension
  - with rotate and resize
  - choose landscape/portrait on the fly
- GTK 2.2 toolkit
- Full screen handwriting input
- sqlite for pim data
- Available in Familiar distribution
- http://gpe.handhelds.org

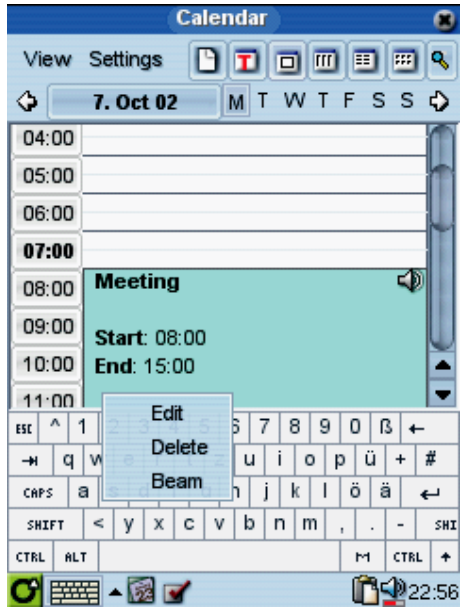




OPIE

- QT/Embedded
- full open source PIM suite
  - derived from Qtopia
- without X
  - (soon with X too…)
- distributed as ipkg's
- PDA-oriented
- compatible with Sharp Zaurus
- http://www.opie.info/

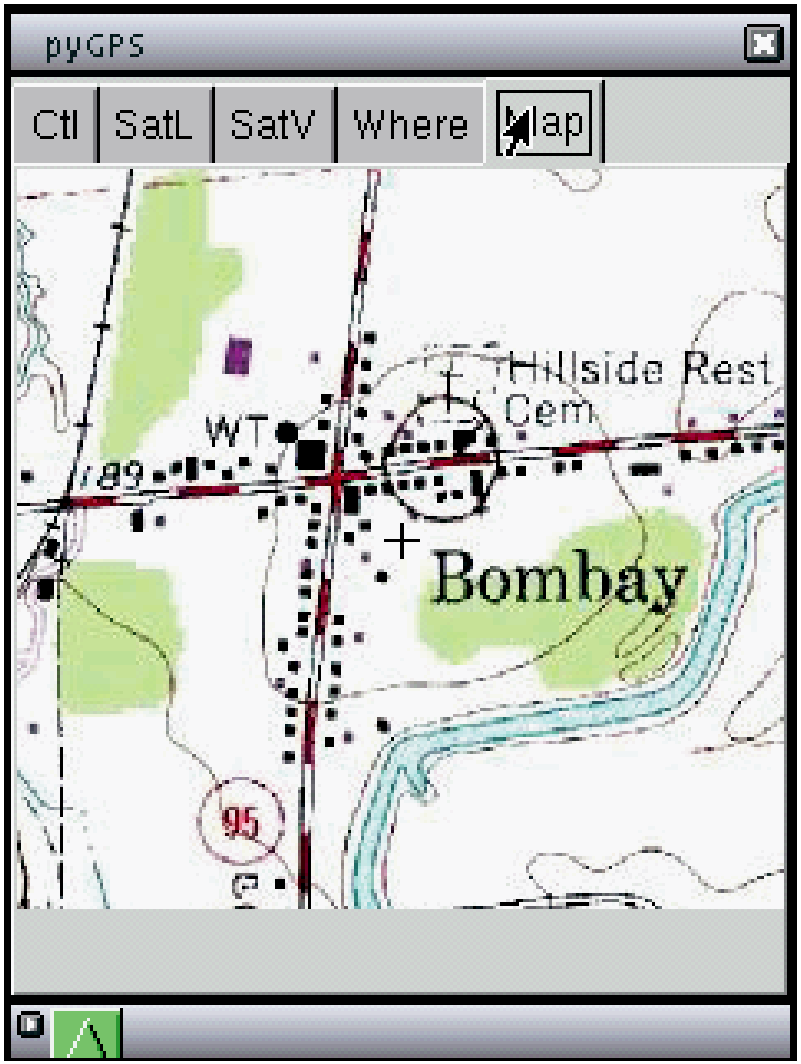




Debian (Intimate) Linux

- Full blown linux on the Compaq iPAQ!
- Installed on CF, PCMCIA, IDE or NFS root
- Supports native development

IPAQ Linux Community



- 2700 mailing list members
- 1300 guest developers
- 209 registered developers
- 76 projects hosted on handhelds.org
- 1900 software packages listed on ipkgfind.handhelds.org
- native development cluster
- multiple distributions

iPAQ Linux in Products

- Fluke Networks WaveRunner
  - Enterprise network tester
  - Commercial product
  - H3800 iPAQ
  - Linux-based
  - Single PCMCIA sleeve
  - Fluke 802.11b card
  - http://www.flukenetworks.com/us/LAN/Handheld+Testers/WaveRunner/Overview.htm
  - $4000

Handheld Linux Products

- Qtopia from trolltech.com
  - commercial Qt based PDA software
- Hancom Mobile Office
- Lycoris Pocket PC Edition
  - Based on Opie
  - Demonstrated January 2004, available soon for iPAQ and Zaurus
- Many software packages available for Zaurus

Linux cellphones

- Motorola A760 cellphone (Asia)
- E28's E2800 (China)
- Samsung linux-based cellphone (China)

CRL Mercury Project

Mercury BackPAQ

- BackPAQ: prototyping platform
  - IPAQ extension pack
    - VGA CMOS camera
    - 32MB Flash
    - Xilinx Virtex 200E FPGA
    - external expansion connector
    - 2 PC Card slots
    - 2 axis and 3 axis accelerometers
    - audio codec and headset connector
  - WLAN and WWAN via PC Cards
- Developed by Compaq Research / HP Labs for MIT Oxygen project

iPAQ H3600/BackPAQ

iPAQ H3600/BackPAQ

Developing for iPAQ Linux

Compiling for ARM Linux

- Cross compilation
  - E.g., x86 linux host -> ARM linux target
  - Faster than native compilation
  - Often requires Makefile modification
- Cross-toolchain
  - ftp://ftp.handhelds.org/pub/linux/arm/toolchain/
  - Unpack in root directory
  - Add /usr/local/arm/3.2.3/bin to PATH
  - Prepend “arm-linux-” to gcc, g++, ld, strip, nm, ranlib, ar
  - Generally: make CC=arm-linux-gcc all
- To watch out for:
  - Segv from ld usually indicates attempt to link x86 object file into arm binary
  - “Capture” of headers from /usr/include and libs from /usr/lib

Full Native Development and Compilation

- No Makefile issues, but slower
- Use Debian on iPAQ, netwinder, skiff, shark
- iPAQ/skiff Cluster
  - 8 iPAQ's (40Gig local disks), 2 iPAQs (9 Gig local disks), 6 skiffs, 2 sharks
  - iPAQ 1-10, skiff[1-6].handhelds.org, reefshark, tigershark
  - rlogin, telnet, ssh -l guest, no password
  - Use ftp, scp, etc. from the machines to transfer files to them
  - Create a directory in /home2/guest/<emailaddress>
  - Or get your own accounts
  - Maintained by Nick Duffek, George France

iPKG Software Packages

- iPKG (Carl Worth)
  - Structure derived from Debian packages
  - Provides apt-get style network installation
  - Small ipkg implementation
  - http://www.handhelds.org/z/wiki/iPKG
- Usage
  - ipkg update — downloads list of avail packages
  - ipkg install foo — (re)installs package foo, its deps
  - ipkg upgrade foo — upgrades to latest version of foo
  - ipkg remove foo — removes foo
  - Ipkg info foo — describes foo package

iPKG Metadata (in control.tar.gz)

- control file (required)
  - Package: dtmfdial
  - Version: 0.2-rjr2
  - Depends: libc6, python
  - Architecture: arm
  - Maintainer: Ross Reedstrom <reedstrm@rice.edu>
  - MD5Sum: 3636114a4e31c690933a99ebc3422525
  - Size: 6303
  - Filename: dtmfdial_0.2-rjr2_arm.ipk
  - Description: A command line DTMF tone dialer, with defaults tweaked for use on the Ipaq, and a python-gtk graphical interface
- preinst, postinst, prerm, postrm
  - Scripts to run before/after install/removal

iPKG Feeds

- A feed is a collection of ipkgs
- Packages file
  - summarizes control files for latest version of each ipkg
  - Created by "`ipkg-make-index . > Packages`"
- Feeds accessible via
  - Local filesystem
  - HTTP
  - FTP
  - NFS

References

- Handhelds.org
  - http://www.handhelds.org/
  - http://www.handhelds.org/handhelds-faq/handhelds-faq.html
- Familiar Linux Distribution
  - http://familiar.handhelds.org/

- http://www.hpl.hp.com/personal/Jamey_Hicks/

iPAQ Linux Resources

- Handhelds.org website (www.handhelds.org)
- Handhelds wiki (www.handhelds.org/z/wiki)
  - Includes search interface
  - World writable – please use and contribute
- Chat (IRC on irc.openprojects.net)
  - #handhelds.org mostly ipaq linux discussion
  - #familiar Familiar distribution discussion
  - #ipaq lightly populated, installation support
  - #opie Opie developers
- Email: (www.handhelds.org/email_lists.html)
  - ipaq@handhelds.org, linux@handhelds.org, familiar@handhelds.org, bootldr@handhelds.org

invent