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, ss hd
- 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

- 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](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/](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
  - $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
    – 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](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](http://www.handhelds.org))
• Handhelds wiki ([www.handhelds.org/z/wiki](http://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](http://www.handhelds.org/email_lists.html))
  – ipaq@handhelds.org, linux@handhelds.org, familiar@handhelds.org, bootldr@handhelds.org