



Linux in home networks

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Sami Ruponen




Business from technology

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Outline

- § Benefits from using Linux
- § Using Linux in
 - Multimedia
 - Broadband router
 - Network storage
- § Example system for DVB streaming
- § Possible future applications
 - all-in-one solution
- § Conclusions
- § Links




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Benefits from using Linux

- § Linux can be used everywhere (almost)
 - scales from wrist watches to super computers
 - portability
 - wide peripheral support, even for older ones
- § Free software
 - development tools
 - no/low costs or license fees
- § Development
 - use of existing solutions (don't invent the wheel again!)
 - continuity
 - regardless of manufacturer support
 - future support




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Benefits from using Linux (continued)

- § Communities
 - lots of developers and experts worldwide
 - help and tips
 - everyone can participate in development
 - programmers
 - translators
 - ...
- § Experienced users can easily
 - add functionalities
 - modify for own needs



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Linux in multimedia use

- § Lot of improvement in recent years
- § Almost equal or even better compared to Windows-world
- § Things that slow down the development or restrict usage
 - DRM
 - in CD, DVD, Blu-ray Disc ...
 - e.g. CSS, AAC, HDCP ...
 - closed source softwares and drivers
 - not always bad thing, but what about the future?
- § Compatibility between (consumer) devices is important
 - various consortiums exist – even open ones
 - DLNA - Digital Living Network Alliance
 - UPnP Forum – Universal Plug and Play
 - lots of others

Linux-based set-top box Dreambox

- § Linux based
 - officially user-upgradeable and modifiable
- § Real digital TV set-top box
 - Linux doesn't show up to a regular user
 - not a Home Theatre PC
 - set-top box like interface
 - with Ethernet and USB interfaces and an optional HDD
 - NAS (Network Attached Storage) system can be used instead of internal HDD
- § Benefits from Linux and Ethernet interface
 - enables use of PC-like applications
 - ssh-terminal, file server, web browser, e-mail client, etc.
 - web-based control
 - program guides
 - scheduled recordings



Dream Multimedia GmbH

Linux-based set-top box Dreambox

- § What's under the hood
 - Linux operating system (2.6 series kernel) with shell access
 - closed source kernel modules for low-level access to hardware
 - graphical user interface on top of Linux
 - Enigma2 (Gemini2, Nemesis) ...
 - C++ for low-level stuff
 - Python for higher-level e.g. user interface, menu etc.
- § What user can do
 - download firmware upgrades from network
 - install plugins and additional softwares
 - manage the box through shell interface
 - execute regular Linux programs
 - even compile and install own firmware image

Linux-based broadband router Linksys WRT54GL

- § Hardware info
 - 200 MHz Broadcom 5352 (MIPS32)
 - 16MB RAM, 4MB Flash
 - 10/100Mbps Ethernet (4x LAN, 1x WAN)
 - 802.11b/g 54Mbps for wireless LAN
 - ships with modified Linux
- § Alternative open source firmwares
 - OpenWRT, DD-WRT
 - enables features not found in other consumer devices



www.linksys.com



Linux-based broadband router Linksys WRT54GL

§ Benefits

- possibility to run various servers and applications
 - web server, radius server for authentication ...
 - SIP proxy
 - firewall with content filtering
 - caching proxy server to speed up slow Internet connection
 - application-level gateway (ALG) to support applications with separate data and control channel
- build your own business using open source software
 - OpenWRT-based software
 - OpenSpark, FON

§ Other manufacturers have similar devices

- can be used with same open source firmwares
- check list of supported devices from projects' web pages

Linux-based Network Attached Storage Linksys NSLU2

§ Hardware info

- 266 MHz Intel XScale IXP420 (ARM)
- 32MB RAM, 8MB Flash
- 2x USB 2.0
- 10/100Mbps Ethernet
- ships with modified Linux



§ History

- originally run modified Linux
 - Linksys was required to release source codes
- communities started developing own firmwares
 - NSLU2-Linux project
 - alternate firmware images and operating systems
 - hardware modification (serial port etc.)

Linux-based Network Attached Storage Linksys NSLU2

§ Ability to run an unrestricted Linux OS

- with some memory restrictions
- wide range of applications besides NAS
 - web server
 - mail server
 - multimedia stream server
 - VoIP server

§ Similar devices from various manufacturers

- Iomega StorCentre devices
 - Open Protium project
- check list of supported devices from projects' web pages

Example system for DVB streaming

§ Building a test system

- as a proof of concept
- interesting subject

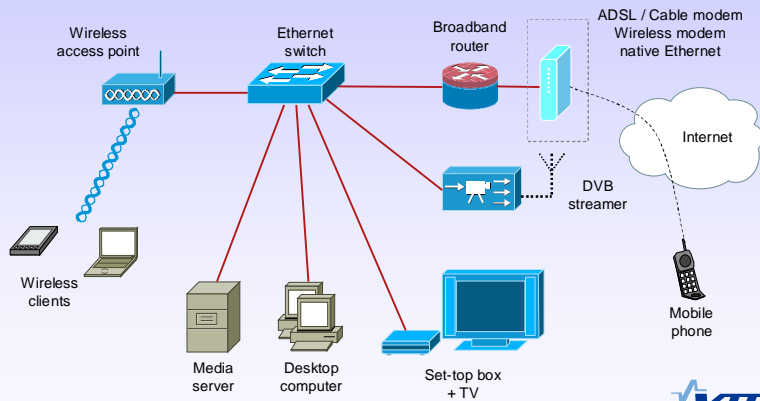
§ Only few components tested

§ Built using common PCs

§ Open software used

- VLC (a stream server and client)
- some DVB utilities for Linux (tuner interaction)

Example system for DVB streaming



Example system for DVB streaming Key components

§ DVB streamer

- Linux + VLC (as server)
- one tuner per DVB mux
 - commercial encrypted channels ???
- one multicast IP address per channel
- several possibilities to transport the stream
 - MPEG-TS over UDP/IP
 - RTP over UDP/IP
- use SAP and SDP to advertise channels
- minimal processing power needed
 - decapsulate streams from MPEG Transport Stream
 - no decoding of audio or video



Example system for DVB streaming Key components

§ Media server

- scheduled recording/storage of TV programs
- re-encode saved programs
 - to save storage space
 - to play in hand-held devices
 - real-time, on demand or idle time
- stream media over Internet
 - real-time streaming of selected channel
 - saved media
- file server for
 - documents
 - what ever files
- Linux + VLC (as client and server)
 - also web server, smb/nfs server, etc.



Example system for DVB streaming Key components

§ Ethernet switch

- combined bit rate of channels per DVB MUX ~20Mbit/s
 - thousands of multicast packets per second
- broadcast traffic throughout LAN (unnecessary)
 - chokes wireless links
 - chokes 10Mbps Ethernet (even 100Mbps in case of multiple MUXs)
 - every host has to process regardless of interest
- intelligent switch needed
 - only send a stream to a port with client listening
 - multicast and "IGMP snooping" support needed
 - exists only in few consumer products
- streams can/should be prioritised over other traffic
 - Ethernet priority tagging
 - IP DiffServ



Example system for DVB streaming pros

- § Software and hardware parts are easily available
- § Devices assembled from standard parts
 - good availability
 - low cost
 - good Linux support
- § Everything (almost) can be built on top of Linux
 - free software
 - ease of development
- § Support from Internet
 - help from forums
 - tips and examples

Example system for DVB streaming cons

- § Power consumption
 - § Heat dissipation and noise
 - § Space requirements
 - § Integration of pieces needed
 - increase compatibility
 - more user-friendly interface
- } Can be solved with more specialised hardware e.g. embedded devices

All-in-one solution?

- § How about putting it all together
 - An embedded-like system
 - small size, low noise, heat dissipation, power consumption
 - Powerful user interface
 - Could be used for
 - network storage
 - broadband router for
 - wire line access (Ethernet, ADSL)
 - wireless access (Wi-Fi, 3G/HSPA, Flash-OFDM, WiMAX)
 - advanced firewall
 - Wi-Fi access point, Ethernet switch
 - surveillance, home automation
 - general-purpose server
 - web, e-mail, file, backup, streaming, printing, VoIP, gaming etc.

Conclusions

- § Linux can be used everywhere
 - hardware and software exists
- § Important issues for future development and usage
 - software integration
 - user-friendly interface
- § Open issues / problems
 - DRM
 - closed source software and drivers
 - software patents

Links

- § Router
 - <http://openwrt.org/>
 - <http://www.dd-wrt.com/>
 - <https://open.sparknet.fi/>
- § NAS
 - <http://www.nslu2-linux.org/>
 - <http://www.openprotium.org/>
- § DVB streaming
 - <http://www.videolan.org/>
 - <http://www.linuxtv.org/>
- § Dreambox
 - http://www.dream-multimedia-tv.de/index_eng.php
 - <http://en.wikipedia.org/wiki/Dreambox>
 - <http://dreambox.wikidot.com/> (in Finnish)
- § Embedded Linux
 - <http://elinux.org/>
 - <http://www.openembedded.org/>
- § Compatibility
 - <http://www.dlna.org/>
 - http://elinux.org/DLNA_Open_Source_Projects
 - <http://www.upnp.org/>
 - <http://upnp.sourceforge.net/>

The background of the slide is dark blue with a pattern of white, semi-transparent, overlapping rectangular shapes that look like a network or data flow. There are also several small white arrows pointing in various directions.

THANK YOU

Sami Ruponen
VTT / Networks
sami.ruponen@vtt.fi

The VTT logo is displayed in white, featuring the letters 'VTT' and the stylized graphic element.

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