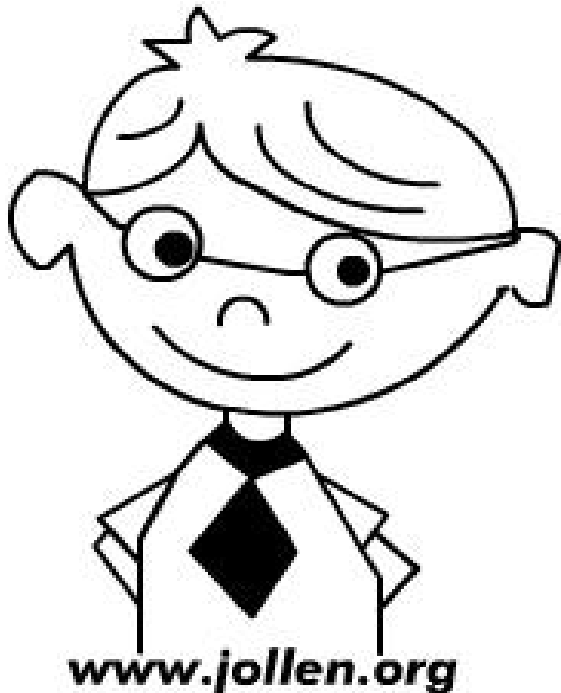


Embedded Linux + ARM

Embedded Linux on ARM

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Lecture 8: Mesh Router Project

Mesh WLAN Router, Root Filesystem,
Wireless Tools, libpcap, Quagga and
DEMO.



Mesh WLAN Router



Mesh Networking

- Multiple wireless networking system.
- Point to point, point to multipoint, multipoint to multipoint networking using 802.11a+g dual band wireless standard.
- Eliminate the need to connect to Wi-Fi “hot spots”.
- Reduce network deployment costs.

Developing a mesh wireless LAN router with ad-hoc embedded Linux technologies and open source solutions.

802.11x Protocols

- b and g have the longest range, at up to 150 feet indoors
- a is rated at 75 feet indoors. Outdoor ranges for all three are considerably longer, depending on the terrain. A good signal with a clear line-of-sight can travel a couple of miles
- b and g use the 2.4GHz band, which is crowded (cordless phones and microwaves also use this spectrum)
- a is on the 5GHz band, where there is less interference.
- b is rated at 11 megabits per second, while a and g deliver a theoretical 54 Mbps.
- a devices are the most expensive; b the least

<http://www.wi-fiplanet.com/tutorials/article.php/3066371>

功能規格

- 802.11a+g Dual Radio Mesh WLAN
- Router: 4*Fast Ethernet, LAN+1*WAN
- Firewall
- AutoIP (DHCP, zeroconf), StaticIP
- DHCP Server
- PPPoE
- Web Management
- MAC Masquerading
- NAT Gateway
- RSA/DSA private/public key

Root Filesystem



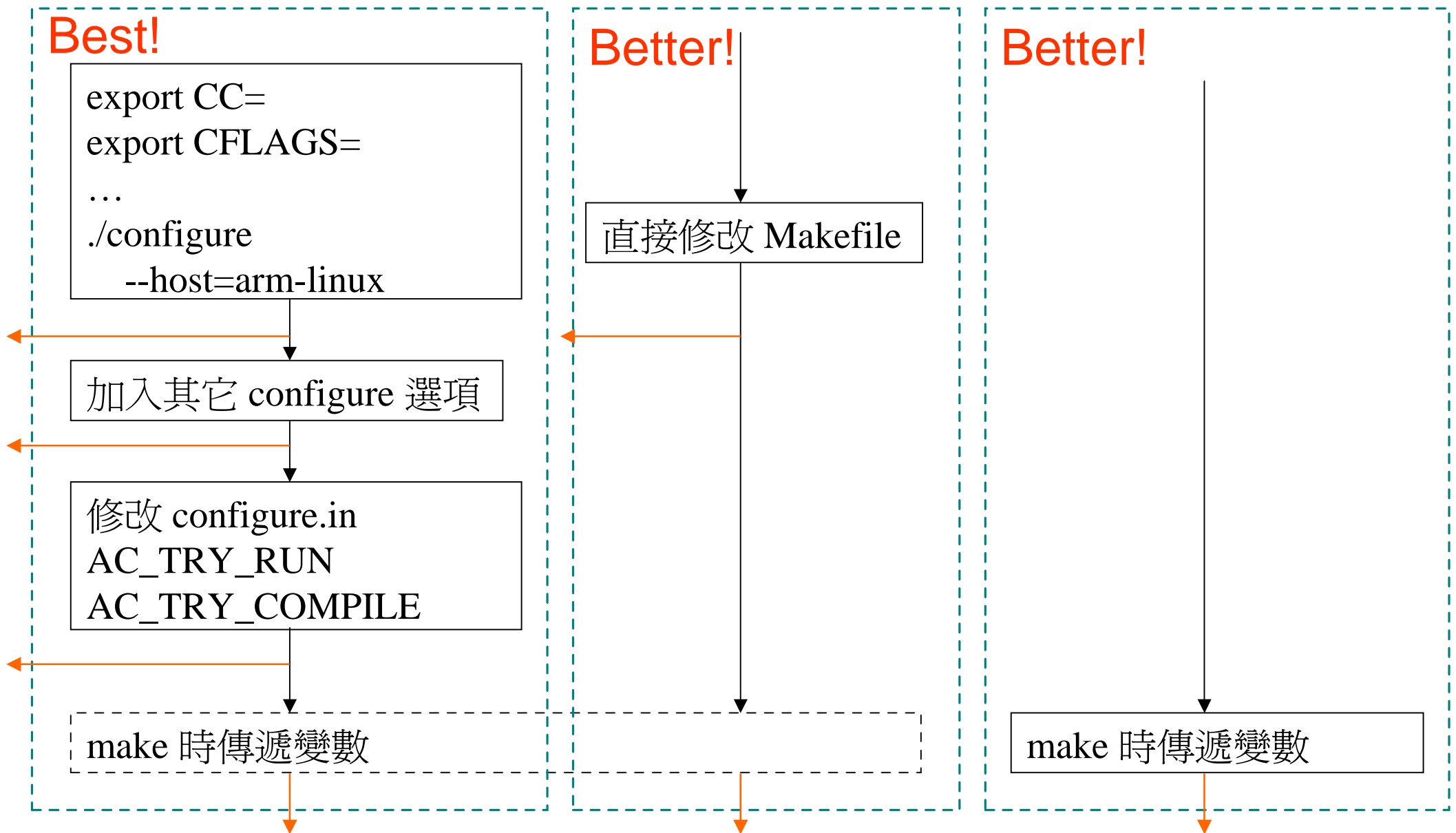
Open Source Solutions

- `busybox-1.00-rc3.tar.gz`
- `dproxy-0.5.tar.gz`
- `iptables-1.2.11.tar.bz2`
- `net-snmp-5.1.2.tar.gz`
- `net-tools-1.60.tar.bz2`
- `wireless_tools.26.tar.gz`
- `ntp-4.2.0.tar.gz`
- `openssh-3.9p1.tar.gz`
- `openssl-0.9.7d.tar.gz`
- `quagga-0.96.5.tar.gz`
- `rp-pppoe-3.5.tar.gz`
- `thttpd-2.25b.tar.gz`
- `zlib-1.2.1.tar.gz`
- `libdaemon-0.6.tar.gz`
- `libpcap-0.8.3.tar.gz`

Linux Wireless Solutions

- Kernel Drivers
 - ✓ Wi-Fi: madwifi. Atheros chip sets.
 - ✓ www.prism54.org: Intersil chip sets.
- User Applications
 - ✓ quagga: zebra, ospfd.
 - ✓ waproamd: Wireless roaming daemon.
 - ✓ wireless_tools: iwconfig, iwlist, iwspy...

Cross Compilation



Cross Compilation

套件	標準configure	額外configure	configure.in	傳遞make變數
busybox-1.00-rc3.tar.gz	—	—	—	—
dproxy-0.5.tar.gz	—	—	—	—
iptables-1.2.11.tar.bz2	×	×	×	●
libdaemon-0.6.tar.gz	●	●	×	×
libpcap-0.8.3.tar.gz	●	●	×	×
net-snmp-5.1.2.tar.gz	●	●	×	×
net-tools-1.60.tar.bz2	×	×	×	●
ntp-4.2.0.tar.gz	●	●	●	×
openssh-3.9p1.tar.gz	●	●	●	×
openssl-0.9.7d.tar.gz	●	●	×	●
quagga-0.96.5.tar.gz	●	●	×	×
rp-pppoe-3.5.tar.gz	●	×	●	●
thttpd-2.25b.tar.gz	●	×	×	×
wireless_tools.26.tar.gz	×	×	×	●
zlib-1.2.1.tar.gz	●	×	×	×

Adjustments

- OpenSSH 改用 Dropbear
- dproxy 改用 tmdns
- 將 services (daemons) 加到 inetd
- ...more

Wireless Tools



Wireless Tools for Linux

- http://www.hpl.hp.com/personal/Jean_Tourrilhes/Linux/Tools.html
- *iwconfig* manipulate the basic wireless parameters
- *iwlist* allow to initiate scanning and list frequencies, bit-rates, encryption keys...
- *iwspy* allow to get per node link quality
- *iwpriv* allow to manipulate the Wireless Extensions specific to a driver (private)
- *ifrename* allow to name interfaces based on various static criteria

Install wireless_tools

```
WIRELESS_TOOLS_DIR = wireless_tools.26
```

```
KERNEL_DIR = /home/xwire/linux-2.4.26-vrs1
```

```
.PHONY: install-wireless_tools wireless_tools clean-wireless_tools
```

```
wireless_tools:
```

```
    (export CC=$(CC); \
```

```
    export AR=$(AR); \
```

```
    export AS=$(AS); \
```

```
    export LD=$(LD); \
```

```
    export STRIP=$(STRIP); \
```

```
    export RANLIB=$(RANLIB); \
```

```
    make -C $(WIRELESS_TOOLS_DIR) KERNEL_SRC=$(KERNEL_DIR) all );
```

```
install-wireless_tools:
```

```
    make -C $(WIRELESS_TOOLS_DIR) install PREFIX=$(PREFIX)
```

```
clean-wireless_tools:
```

```
    make -C $(WIRELESS_TOOLS_DIR) clean
```

iwconfig

```
~ # iwconfig ath0
ath0 IEEE 802.11g ESSID:"xwire"
Mode:Managed Frequency:2.437GHz Access Point: 00:09:92:00:C4:CD
Bit Rate:36Mb/s Tx-Power:50 dBm Sensitivity=0/3
Retry:off RTS thr:off Fragment thr:off
Encryption key:off
Power Management:off
Link Quality:18/94 Signal level:-77 dBm Noise level:-95 dBm
Rx invalid nwid:63 Rx invalid crypt:0 Rx invalid frag:0
Tx excessive retries:0 Invalid misc:0 Missed beacon:0

~ # iwconfig eth2
eth2 IEEE 802.11b/g ESSID:"xwire"
Mode:Master Frequency:2.437GHz Access Point: 00:09:92:00:C4:CD
Bit Rate:54Mb/s Tx-Power=31 dBm Sensitivity=20/200
Retry min limit:8 RTS thr:2347 B Fragment thr:2346 B
Encryption key:off
Link Quality:80 Signal level:0 Noise level:176
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
Tx excessive retries:0 Invalid misc:0 Missed beacon:0

~ # _
```

iwconfig

```
~ # iwconfig ath0 mode ad-hoc channel 5
~ # iwconfig ath0
ath0 IEEE 802.11 ESSID:"xwire"
      Mode:Ad-Hoc Frequency:2.432GHz Cell: 02:60:B3:09:53:37
      Bit Rate:0kb/s Tx-Power:50 dBm Sensitivity=0/3
      Retry:off RTS thr:off Fragment thr:off
      Encryption key:off
      Power Management:off
      Link Quality:0/94 Signal level:-95 dBm Noise level:-95 dBm
      Rx invalid nwid:96 Rx invalid crypt:0 Rx invalid frag:0
      Tx excessive retries:0 Invalid misc:0 Missed beacon:0

~ #
```

iwlist

```
~ # iwlist ath0 channel|more
ath0      255 channels in total; available frequencies :
          Channel 01 : 2.412 GHz
          Channel 02 : 2.417 GHz
          Channel 03 : 2.422 GHz
          Channel 04 : 2.427 GHz
          Channel 05 : 2.432 GHz
          Channel 06 : 2.437 GHz
          Channel 07 : 2.442 GHz
          Channel 08 : 2.447 GHz
          Channel 09 : 2.452 GHz
          Channel 10 : 2.457 GHz
          Channel 11 : 2.462 GHz
          Channel 36 : 5.18 GHz
          Channel 40 : 5.2 GHz
          Channel 42 : 5.21 GHz
          Channel 44 : 5.22 GHz
          Channel 48 : 5.24 GHz
          Channel 50 : 5.25 GHz
          Channel 52 : 5.26 GHz
          Channel 56 : 5.28 GHz
          Channel 58 : 5.29 GHz
          Channel 60 : 5.3 GHz
--More--
```

iwlist

```
~ # iwlist eth2 scan
eth2      Scan completed :
          Cell 01 - Address: 00:09:92:00:C4:CD
            ESSID:"xwire"
            Mode:Master
            Encryption key:off
            Frequency:2.437GHz
            Quality:81  Signal level:0  Noise level:175
          Cell 02 - Address: 02:60:B3:09:53:37
            ESSID:"xwire"
            Mode:Ad-Hoc
            Encryption key:off
            Frequency:2.432GHz
            Quality:1/0  Signal level:-80 dBm  Noise level:-81 dBm

~ #
```

iwgetid

```
~ # iwgetid -a
eth2      Access Point/Cell: 00:09:92:00:C4:CD
~ # iwgetid -f
eth2      Frequency:2.437GHz
~ # iwgetid -m
eth2      Mode:Master
~ # iwgetid -f
eth2      Frequency:2.437GHz
~ # _
```

libpcap



libpcap

- <http://www.tcpdump.org/release/libpcap-0.8.3.tar.gz>
- Packet Capture library.
- Provides a high level interface to packet capture systems.
- Needed by tcpdump.

Install libpcap

```
LIBPCAP_DIR = libpcap-0.8.3
```

```
LIBPCAP_CFLAGS = -mtune=arm9tdmi -march=armv4 -mlittle-endian
```

```
libpcap: configure-libpcap
```

```
    make -C $(LIBPCAP_DIR)
```

```
configure-libpcap:
```

```
    (export CC=$(CC); \
```

```
    export LD=$(LD); \
```

```
    export STRIP=$(STRIP); \
```

```
    export RANLIB=$(RANLIB); \
```

```
    export CFLAGS="$(LIBPCAP_CFLAGS)"; \
```

```
    cd $(LIBPCAP_DIR); \
```

```
    ./configure \
```

```
        --prefix=$(ARMTOOLS_DIR) \
```

```
        --enable-ipv6 \
```

```
        --with-pcap=null \
```

```
        --with-linux=2.4.27 \
```

```
        --host=$(TARGET_ARCH) );
```

Quagga



Quagga

- <http://www.quagga.net/>
- IPv4/IPv6 routing software suite.
- Incoming Sun Solaris 10: SUNWzebra
- Support RIPv1, RIPv2, RIPvng, OSPFv2, OSPFv3, BGP-4, BGP-4+.

Install

```
quagga: configure-quagga
    make -C $(QUAGGA_DIR)
```

configure-quagga:

```
(export CC=$(CC)); \  
export AR=$(AR); \  
export AS=$(AS); \  
export LD=$(LD); \  
export STRIP=$(STRIP); \  
export RANLIB=$(RANLIB); \  
export CFLAGS="-O2 -Wall"; \  
export LDFLAGS="$(QUAGGA_LDFLAGS)"; \  
cd $(QUAGGA_DIR); \  
./configure \  
    --enable-user=root \  
    --enable-group=root \  
    --prefix=/ \  
    $(DISABLE_PKGS) \  
    --host=$(TARGET_ARCH) );
```

```
DISABLE_PKGS += #--disable-zebra  
DISABLE_PKGS += --disable-bgpd  
DISABLE_PKGS += --disable-ripd  
DISABLE_PKGS += --disable-ripngd  
DISABLE_PKGS += #--disable-ospfd  
DISABLE_PKGS += --disable-ospf6d  
DISABLE_PKGS += --disable-isisd
```

Zebra

```
Mem: 16872K used, 13712K free, 0K shrd, 172K buff, 11696K cached
Load average: 0.20, 0.12, 0.04 (State: S=sleeping R=running, W=waiting)
```

PID	USER	STATUS	RSS	PPID	%CPU	%MEM	COMMAND
129	root	R	336	128	5.8	1.0	top
112	root	S	992	1	0.0	3.2	snmpd
104	root	S	976	1	0.0	3.1	ospfd
94	root	S	660	1	0.0	2.1	zebra
105	root	S	444	1	0.0	1.4	thttpd
128	root	S	412	1	0.0	1.3	ash
62	root	S	324	1	0.0	1.0	inetd
72	root	S	320	1	0.0	1.0	udhcpd
1	root	S	316	0	0.0	1.0	init
107	root	S	240	1	0.0	0.7	dproxy
10	root	SW	0	1	0.0	0.0	mtdblockd
4	root	SW	0	1	0.0	0.0	kswapd
5	root	SW	0	1	0.0	0.0	bdflush
6	root	SW	0	1	0.0	0.0	kupdated
2	root	SW	0	1	0.0	0.0	keventd
3	root	SWN	0	1	0.0	0.0	ksoftirqd_CPU0

zebra is a routing manager that implements the zebra route engine. zebra supports RIPv1, RIPv2, RIPv6, OSPF, OSPF6, BGP4+, and BGP4-.

OSPF

```
Mem: 16872K used, 13712K free, 0K shrd, 172K buff, 11696K cached  
Load average: 0.20, 0.12, 0.04 (State: S=sleeping R=running, W=waiting)
```

PID	USER	STATUS	RSS	PPID	%CPU	%MEM	COMMAND
129	root	R	336	128	5.8	1.0	top
112	root	S	992	1	0.0	3.2	snmpd
104	root	S	976	1	0.0	3.1	ospfd
94	root	S	660	1	0.0	2.1	zebra
105	root	S	444	1	0.0	1.4	thttpd
128	root	S	412	1	0.0	1.3	ash
62	root	S	324	1	0.0	1.0	inetd
72	root	S	320	1	0.0	1.0	udhcpd
1	root	S	316	0	0.0	1.0	init
107	root	S	240	1	0.0	0.7	dproxy
10	root	SW	0	1	0.0	0.0	mtdblockd
4	root	SW	0	1	0.0	0.0	kswapd
5	root	SW	0	1	0.0	0.0	bdflood
6	root	SW	0	1	0.0	0.0	kupdated
2	root	SW	0	1	0.0	0.0	keventd
3	root	SWN	0	1	0.0	0.0	ksoftirqd_CPU0

ospfd is a routing component that works with the zebra routing engine.

DEMO



Xwire Mesh Router Product

- XBuilder: 近似 uClinux-dist 的套件整合環境。
- Wireless Access Point 示範
- 快速更改系統設定 (XBuilder 整合環境) 示範

References

1. Wireless on Linux, <http://www.wi-fiplanet.com/tutorials/article.php/3066371>.
2. A Linux Wireless Access Point HOWTO, <http://oob.freeshell.org/nzwireless/LWAP-HOWTO.html>.
3. Quagga Routing Suite, <http://www.quagga.net>