

:

:

**Networktheworld.org**

Network the World



-  
International Development  
Research Centre

:

*<http://www.lasilky.org/>* :

*<http://wndw.net/>*

2006

2008

( )



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209 .....

**223.....**

223 .....  
226 .....

228 .....

**237** .....

237 .....

241 ..... :

243 ..... :

247 ..... :

252 ..... :

260 ..... :

**269** ..... :

**276** ..... :

**278** ..... :

)

(DRM

- 
- 
- 
- 

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Association for Progressive Communications  
Abdus Salam International Center for Theoretical Physics  
<http://wireless.ictp.trieste.it/> <http://www.apc.org/wireless/>

International Network for the Availability of  
(<http://inasp.info/>) Scientific Publications

2005      WSFII      BookSprint  
(<http://www.wsfii.org/>)

Rob Flickenger

(<http://www.tawileh.net/anas/>) **Anas Tawileh** •

2002 /  
(<http://www.arabcommons.org/>)

VoIP

: " " " "

(<http://www.apc.org/wireless/>)

:

*anas@tawileh.net*

**Corina “Elektra” Aichele** " " •

( )

Slackware

/

*http://www.scii.nl/~elektra*

**Rob Flickenger** •

"

2002

"Building Wireless Community Networks

O’Reilly

"Wireless Hacks

Metrix Communication

.Media

*(http://metrix.net)* LLC

NoCat

SeattleWireless

*(http://nocat.net)*

*(http://seattlewireless.net)*

*http://constructiveinterference.net/* :

Radio

**Carlo Fonda** •

Abdus

Communications Unit

Salam International Center for Theoretical physics

**Jim Forester** •

.Cisco Systems

Silicon Valley

*jrforster@mac.com* :

**Ian Howard** •

Waterloo

" :



Geekcorps

Geekcorps

*wire.less.dk*

.Geekcorps

.**Tomas Krag**

.2002

Sebastian Büttrich

Tactical Technology Collective

(<http://www.tacticaltech.org/>)

Wireless Roadshow

(<http://www.thewirelessroadshow.org/>)

marcusgennaroz

.**Marco Zennaro**

ICTP

ham radios BBSes

Apple Newton

(<http://wire.less.dk/>) **Sebastian Büttrich**

IconMedialab

.2002 1997

Technical University

**Kyle Johnston** •

**Adam Messer** •

1995

11

**Ermanno Pietrosemoli** •

Escuela Latinoamericana de Redes “EsLaRed”

**Dana Spiegel** •

(<http://www.sociableDESIGN.com/>) sociableDESIGN

NYCwireless

(<http://www.nycwireless.net/>)

(<http://www.wirelesscommunity.info/>)

(<http://www.cowinanorange.com/>) **Lisa Chan** •

(<http://greenbits.net/~rlotz/>) **Richard Lotz** •

SeattleWireless

( )

**Casey Halverson** •

(<http://seattlewireless.net/~casey/>)

(<http://odessablue.com/>) **Catherine Sharp** •

(<http://seattlewireless.net/~mattw/>) **Matt Westervelt** •

SeattleWireless

(<http://seattlewireless.net/>)

Metrix

(<http://metrix.net/>) Communication LLC

Seasme Street

(! )

WSFII

Network the World

([www.idrc.ca](http://www.idrc.ca)) IDRC  
([www.networktheworld.org](http://www.networktheworld.org))

%50

( )

- - -

( - )

- - -

- - -



Network The

Jim Forster

World

—

**1**

:

.802.11

(

)

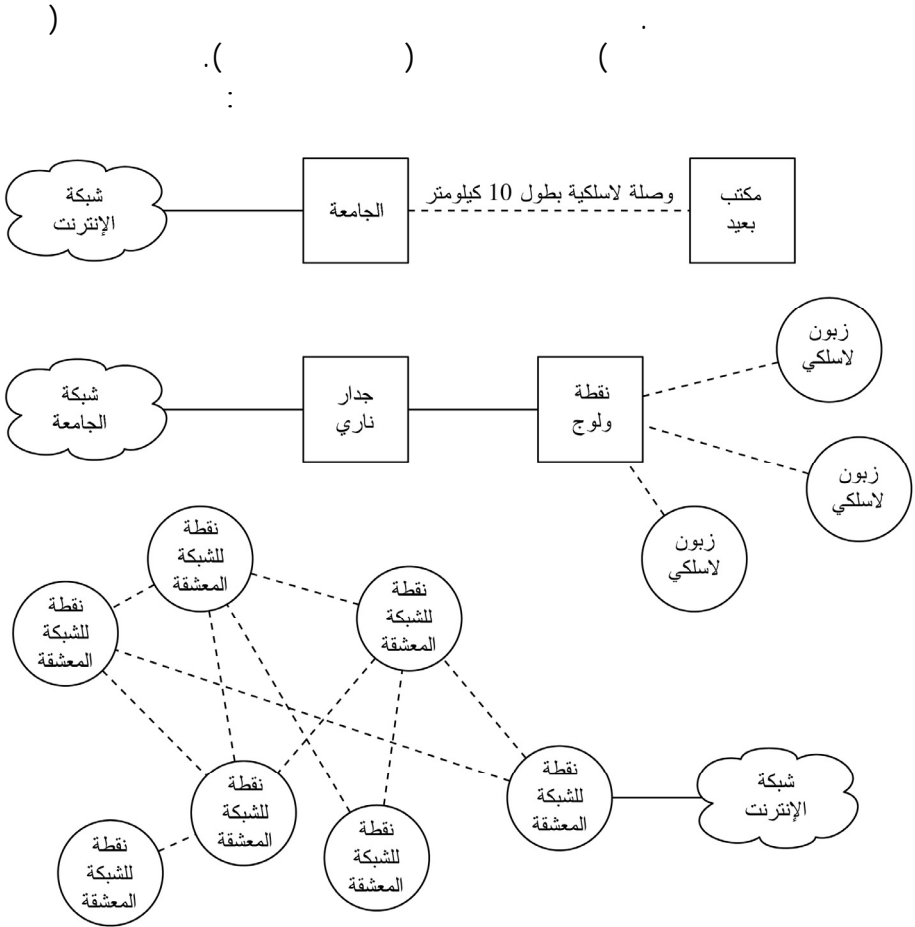
CDMA

GSM

)

(





:1.1

(Wi-Fi ) 802.11

(802.11a, 802.11b, 802.11g)

802.11

) 802.16

802.11

(WiMAX

.802.11

.802.11

802.11

:

IEEE

:802.11b •

1999 ( )

.1999

**Direct Sequence Spread**

"

**"Spectrum – DSSS**

2.282 2.412

ISM

11

.GHz

5

:802.11g •

.2003 ( )

802.11g

ISM

**Orthogonal Frequency**

"

5

:

54

**Division Multiplexing – OFDM**

(

25

)

11

DSSS

.802.11b

**:802.11a •**

1999

( )

IEEE

54

.OFDM

802.11a

27

ISM

5.805

5.745

5.320

5.170

UNII

.802.11g

802.11b

802.11g

802.11b

2.4

802.11a

.802.11b/g

108

802.11n )

(WiMAX MIMO 802.16

802.11b

802.11g

.(

2.4

ISM

)

				•
		209		
.205				•
			.209	•
.212				•
.188				•
	.226	189		•
				•
			.228	
	.60			•
				•
			.60	•
			.68	•
300				•
	.60			•
			.34	•
				•
	.117			•
	.32			•



		.74		•
			.87	•
.170				•
		.168		•
			.177	•
.187				•
				•
		.275		•
			.269	•
"	"			•

# 2

( )

.Ethernet

:

( )

( )

( )

$$\text{Speed} = \text{Frequency} \times \text{Wavelength}$$

(Lambda  $\lambda$  )

/ )

( / )

(Hz

Hertz

: 20

5

$$x \quad \backslash \quad 5 = \quad \backslash \quad 1$$

$$5 \backslash 1 =$$

$$20 = \quad 0.2 =$$

### Amplitude

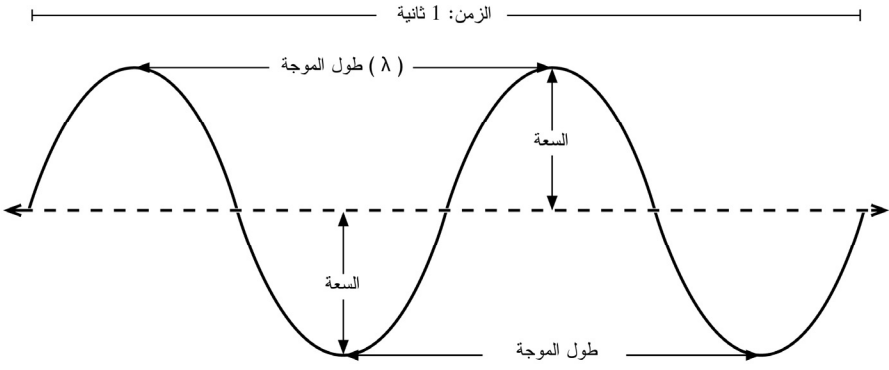
2.1

( )

"

" :





2

:2.1

( )

: (Dipole )

x =

:c

$$300 \cdot 000 \cdot 000 =$$

$$300 \cdot 000 = c$$

$$10^8 \times 3 =$$

$$f \times \lambda = c$$

( )

Centi-Meter (cm)

Giga-Hertz (GHz)

Micro-Seconds ( $\mu$ s)

n	1/1000000000	$10^{-9}$	-
$\mu$	1/1000000	$10^{-6}$	-
m	1/1000	$10^{-3}$	-
c	1/100	$10^{-2}$	-
k	1 000	$10^3$	-
M	1 000 000	$10^6$	-
G	1 000 000 000	$10^9$	-

802.11b

:

$$2.4 = (f)$$

$$\backslash \quad 2 \cdot 400 \cdot 000 \cdot 000 =$$

$$(f) \quad \backslash (c) \quad = \quad (\lambda)$$

$$10^9 \times 2.4 \quad \backslash \quad 10^8 \times 3 =$$

$$10^{-1} \times 1.25 =$$

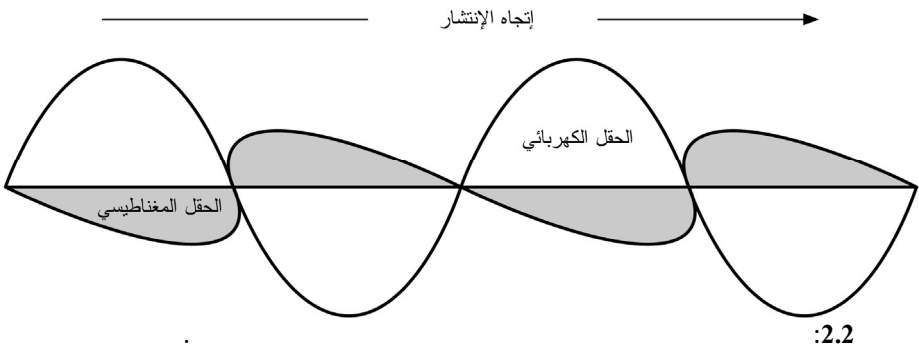
$$12.5 =$$

## Polarization

( )

( )

( )



( )

( )

.( )  
**electromagnetic**

**.spectrum**

400

$10^{14} \times 3.8$   
800 ( / )

$10^{14} \times 7.5$   
( / )

Alternating

( 60/50 )  
) Ultraviolet  
) Infrared  
Radio

Current (AC)  
X-Rays/ Roentgen  
(  
(

300  
1

3

( 100 ) FM

1

(Microwave )

30

300

1

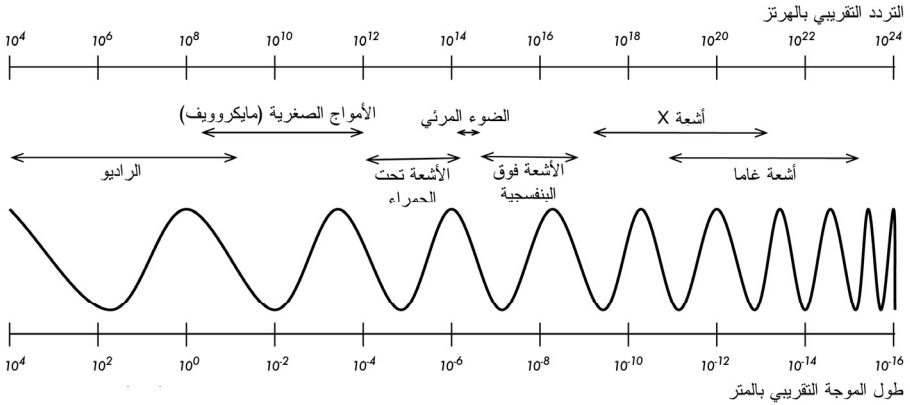
Microwave Oven

ISM

.band

( )

ISM



:2.3

2.412 – 2.484

) 802.11g 802.11b

.( 12.5

) 5.805 – 5.170

.( 6-5

### Bandwidth

80 )

0.08

2.48

2.40

.(

1

" :data rate

1

"

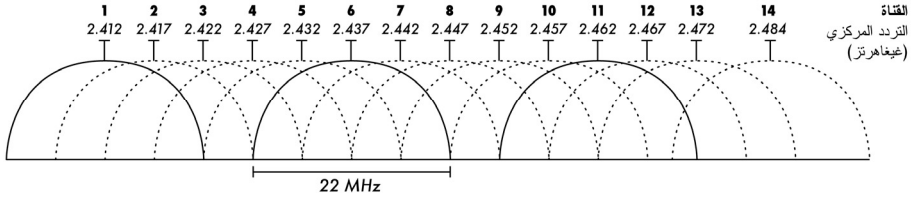
.802.11b

2.4

22

.channels  
5

.2.4



6 1

.802.11b

:2.4

11

802.11a 802.11b/g

:

- 
- 
- 

FM  
108

88

FM

5

5

50

( 88 )  
)  
)

FM

(  
(

( 1800 900

FM

( ) (1) (0)

. ( )

) **Huygens Principle**  
(1695-1629 Christiaan Huygens

:wikipedia.org

"

"

:

-

.( )

:( )

•

•

.1

:

)

.(

:

2.4



1

2.4



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)

(

2.4

)

:

(

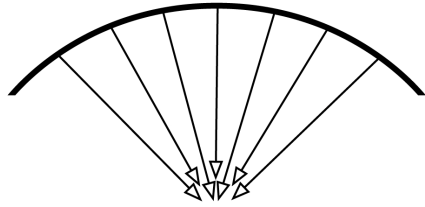
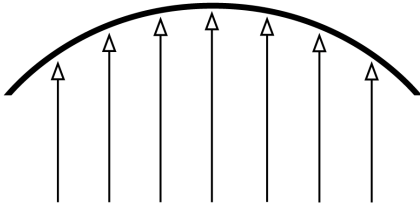
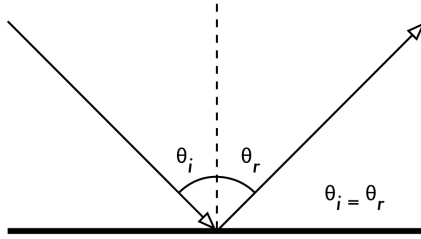
:

2.4

)

.(

1

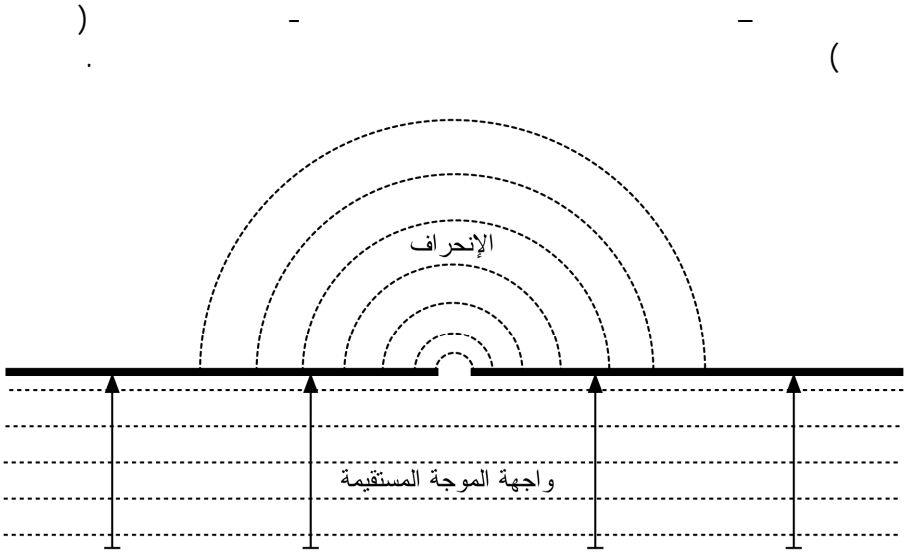


:2.5

multipath

) effects  
(

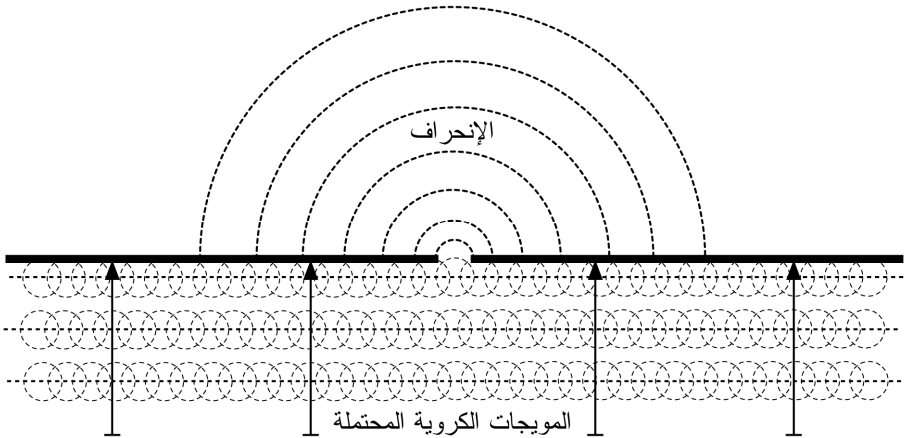
( )



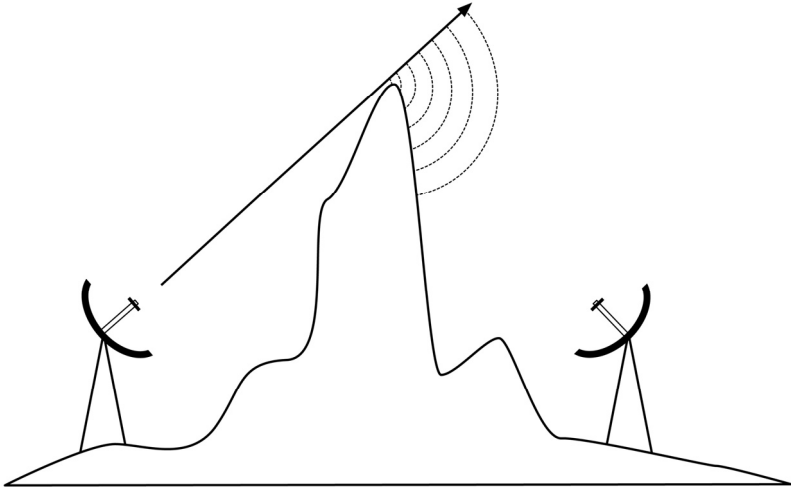
:2.6

( )

Fresnel



:2.7

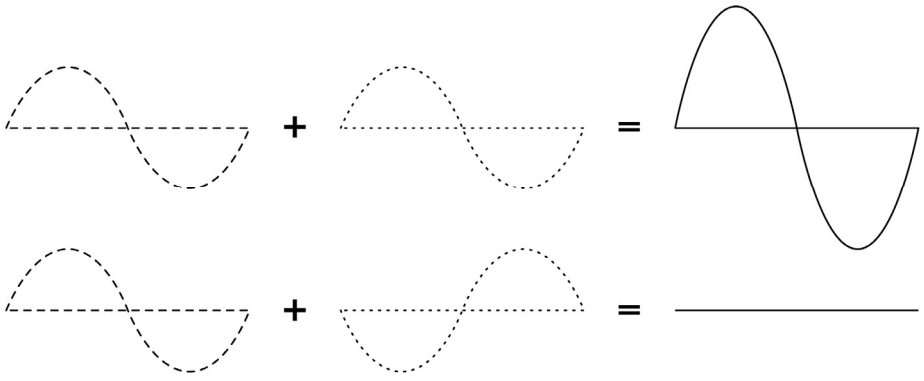


:2.8

:

!

+



:2.9

$(2=1+1)$

**destructive**

**constructive interference**

$(0=(1-)+1)$

**interference**

-

) phase shift

.(

Interference

)

.(

( )

: line of sight (LOS)

0.5

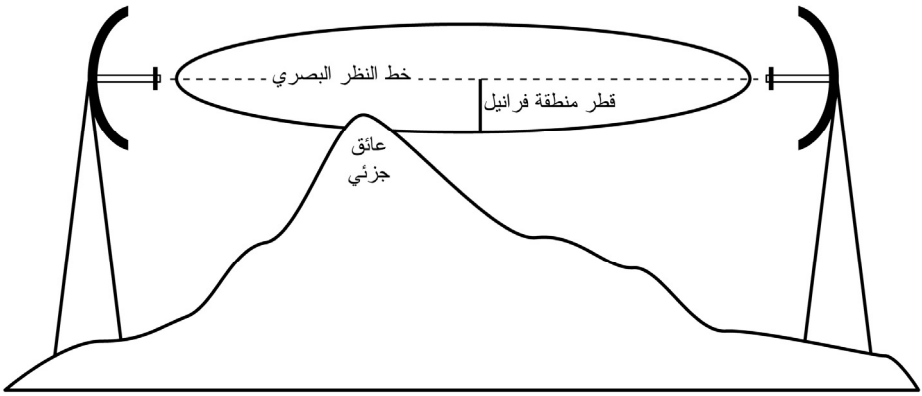
100

( )

.Fresnel zones

(Fresnel )

:



:2.10

.( )

60

:

$$r = 17.31 \times \sqrt{N(d_1 \times d_2)/(f \times d)}$$

$d_2$   $d_1$   
 $f$

$N$   
 $d$

$r$

:

2

:(802.11b 6 ) 2.437

r = 17.31 sqrt(1 x (1000 x 1000) / (2437 x 2000))

r = 17.31 sqrt(1000000 / 4874000)

r = 7.84 meters

10

2.16

%60

:

r = 17.31 sqrt(0.6 x(1000 \* 1000) / (2437 x 2000))

r = 17.31 sqrt(600000 / 4874000)

r = 6.07 meters

3.93

( 10)

%60

-

P

( )

:

.P

( ) V/m \

:

P ~ E<sup>2</sup>

.( )



decibels (dB)

2

:

$$dB = 10 \times \text{Log} (P1 / P0)$$

P0 P1

:

(	)	1 =	0
		1/2 =	1
		1/4 =	2
		1/8 =	3
		1/16 =	4
		$2^{-n} = 1/2^n =$	n

.exponential behaviour

logarithm (log)

.n

n

%

:

$$\begin{aligned}
 &= 3+ \\
 &= 3- \\
 &= 10+ \\
 &= 10-
 \end{aligned}$$

( )

dB

.P0

:

mW

$$1 = P0$$

dBm

dBi

**isotropic antenna**

(dipole )

( )

:

$$\begin{aligned}
 1 \text{ mW} &= 0 \text{ dBm} \\
 2 \text{ mW} &= 3 \text{ dBm} \\
 100 \text{ mW} &= 20 \text{ dBm} \\
 1 \text{ W} &= 30 \text{ dBm}
 \end{aligned}$$

.

.



# 3

TCP/IP

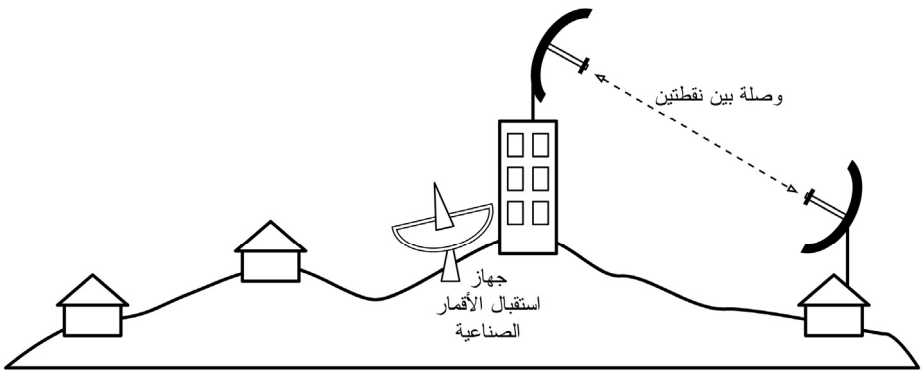
)  
(

- point-to-point •
- point-to-multipoint •
- multipoint-to-multipoint •

### Point-to-point

( )

30

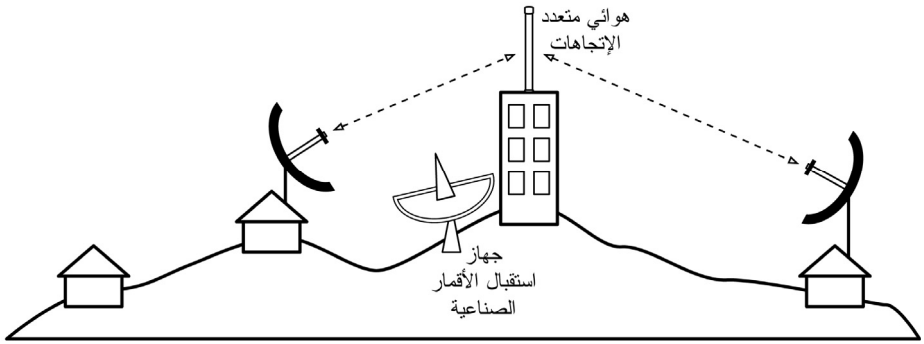


:3.1

( )

### Point-to-multipoint

3



VSAT

:3.2

) ( )  
( )

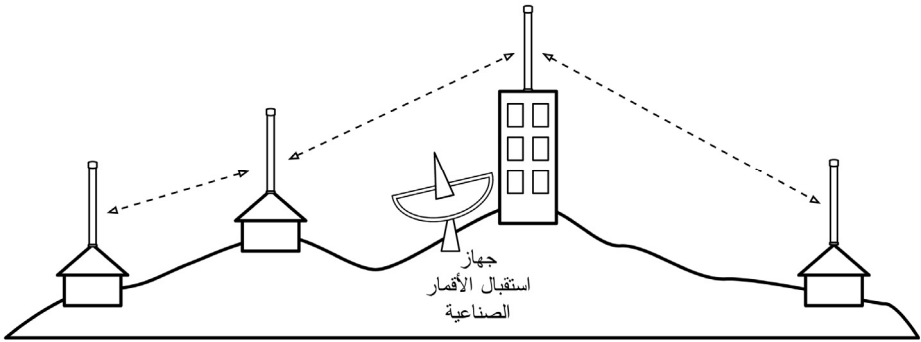
FM

### Multipoint-to-multipoint

ad-

.mesh

hoc



:3.3



.OLSR

## **The Logical Network**

:

TCP/IP

**TCP/IP**

4

TCP/IP

:

<i>Application</i>	التطبيقات
<i>Transport</i>	النقل
<i>Internet</i>	الإنترنت
<i>Data Link</i>	وصلة البيانات
<i>Physical</i>	الفيزيائية

TCP/IP :3.4

physical layer

TCP/IP

CAT5

**.data link**

Hub

)

:

(

Token Ring Ethernet

(802.11a/b/g)  
link local

ATM

48

MAC address

TCP/IP

**Internet**

Internet Protocol (IP)

Routers

IP

)

IP

**(Transport**

(TCP

)

UDP TCP

**Application**

HTTP

:

SMTP

FTP

TCP/IP

( )

( )

( )

( )

( )

Please Don't "

Physical / Data " :

"Look In The Attic  
Link / Internet / Transport / Application

### 802.11

.( ) ( )

802.11a

5

802.11b/g

2.4

802.11a

802.11b/g

2

802.11b

.11

:

802.11a/b/g

) :Master mode .1  
(infrastructure

(SSID

)

)

.( ..

.client mode

:Managed mode

.2

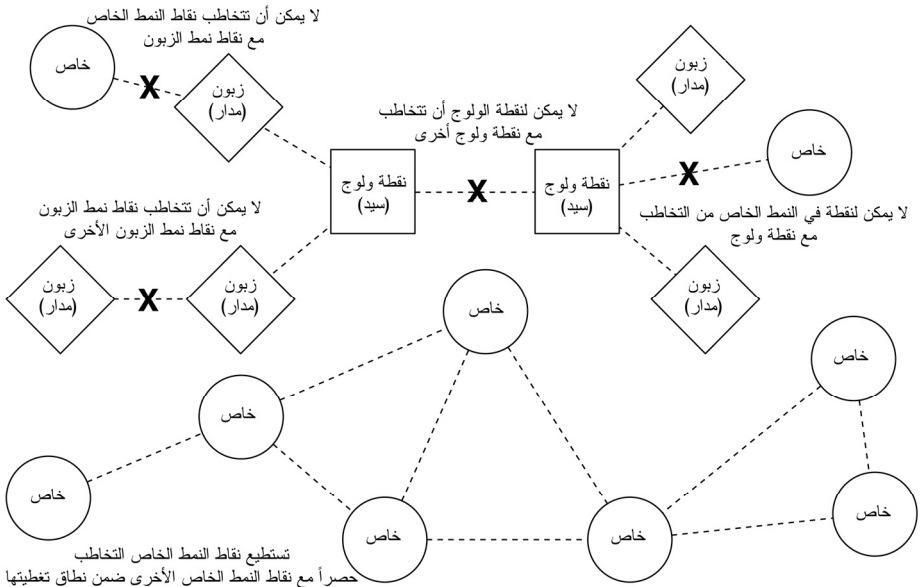
.3 :ad-hoc mode

( )

.4 :Monitor mode

(chapter six Kismet )

.passive



.IP

:

# Internet Networking

IP

IP Address

.( )

forwarding

.routing table

IP

32

IP<sup>5</sup>

8

.172.16.5.23 192.168.1.1 10.0.17.1 : IP

## Network Addressing

IP

IPv4

5

IPv6

address space

.subnets

sub-networks

globally

.routed IP addresses

( )

Network Address Translation (NAT)

)

.(

IP

.private addresses<sup>6</sup>

## Routing

**static routing**

**dynamic**

( )

**routing**

( )

**routing protocol**

.EIGRP RIP BGP OSPF

)

(

IETF

IEEE 802.11

Hazy Sighted

Ad-hoc On-

Link State (HLSL)

demand Distance Vector (AODV)

.Optimized Link State Routing (OLSR)

SrcRR

Roofnet

ETX DSR

.MIT

OLSR



## Forwarding

.( )

hop count

.prefix

time to live (TTL)

:

:

Destination	Gateway	Genmask	Flags	Metric	Iface
10.15.6.0	0.0.0.0	255.255.255.0	U	0	eth1
10.15.6.108	10.15.6.7	255.255.255.255	UG	1	eth1
216.231.38.0	0.0.0.0	255.255.255.0	U	0	eth0
0.0.0.0	216.231.38.	1 0.0.0.0	UG	0	eth0

10.15.6.23

.eth1

) 10.15.6.7

10.15.6.108

.(10.15.6.0

0.0.0.0

**.default gateway**

72.1.140.203

) 216.231.38.1

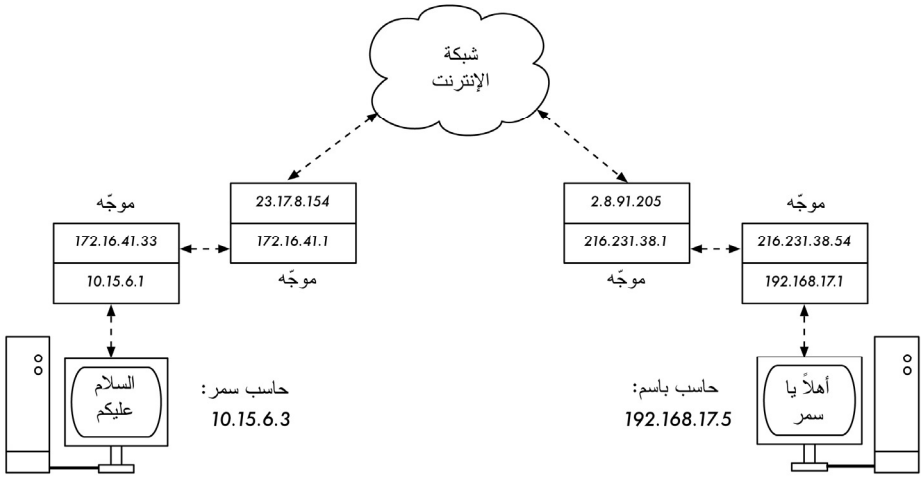
.(

)

(

time to live (TTL)

### IP



:3.6

.Instant Messaging

Ethernet

.IP

# OLSR

infrastructure

)

DSL  
hotspot  
)

(Master

GSM

.(managed

!

(

)

( )  
( )

:

( )

.( )

)

600

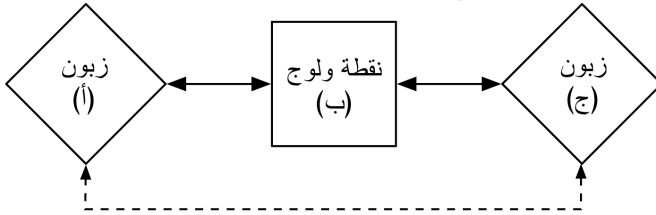
(802.11b

300

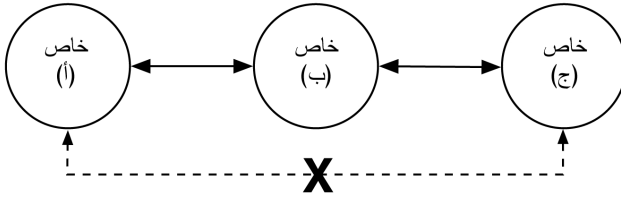
ad-hoc

( ) ( )

يقع كل من الزبونين (أ) و (ج) ضمن نطاق تغطية نقطة الولوج (ب)  
 ستقوم نقطة الولوج بإعادة توجيه البيانات المرسلة بين هاتين النقطتين



يمكن في نفس التشكيل أن تتخاطب النقط (أ) و (ج) التي تعمي ضمن النمط الخاص مع النقطة (ب)  
 لكنها لن تتمكن من الإتصال ببعضها مباشرة



( ) ( )  
 ( ) ( )

( )  
 ( )

:3.7

:

:( )

(OSPF )

### OLSRD

Optimized Link State

olsr.org Routing Daemon (OLSRD)

Windows 98, 2000, XP Mac OS X  
.NetBSD OpenBSD FreeBSD Linux /

Linksys WRT54G /  
Pocket PCs AccessCube Asus WI500g  
Metrix /

OLSRD .Metrix Pebble

IPv6

OLSR

INRIA

olsr.org .IETF

UniK Andreas Toennesen

OLSRD  
Link Quality Extension

.INRIA

olsr.org

Link Quality Extension

OLSRD

**.proactive routing**

**reactive routing**

100

OLSRD  
%30

Freifunk

200

Linksys WRT54G

OLSRD

“Hello”

Topology Control Messages – )

OLSRD

(TC Messages

.multipoint relays

.olsrd

olsrd

:

olsrd

(HNA )

(MID )

HNA

olsrd

olsrd

(

)

(

)

HNA

olsrd

HNA

olsrd

Debian GNU/Linux /  
.Metrix Pebble

/

Mac OS X

AccessCube

OpenWRT

Windows

IP

:

DHCP

DHCP

DHCP

IPv6

" )

MAC Address

IPv6

IPv6 Stateless Address Autoconfiguration in large mobile and  
(2002 M. Zitterbart K. Weniger "ad hoc networks

IPv4

Wiki

.olsrd

255.255.255.255

olsrd

olsrd

"

":

: /

wlan0

iwconfig wlan0 essid olsr.org mode ad-hoc channel 10 rts 250 frag 256

( )

Extended Service Set Identifier – ESSID

Cell-ID

Ad-hoc

802.11



Centrino

Intel

/

:

.iwconfig

```
wlan0 IEEE 802.11b ESSID:"olsr.org"
Mode:Ad-Hoc Frequency:2.457 GHz Cell: 02:00:81:1E:48:10
Bit Rate:2 Mb/s Sensitivity=1/3
Retry min limit:8 RTS thr=250 B Fragment thr=256 B
Encryption key:off
Power Management:off
Link Quality=1/70 Signal level=-92 dBm Noise level=-100 dBm
Rx invalid nwid:0 Rx invalid crypt:28 Rx invalid frag:0
Tx excessive retries:98024 Invalid misc:117503 Missed beacon:0
```

"Request to Send – RTS"

handshaking

RTS/CTS

-

( )

(!

IP

RTS

) "Fragmentation Threshold

(256

TCP

RTS

IP

Fragmentation

IP

:

.IP

netmask

IP  
olsrd

Mac OS

Windows

BSD /

/etc/olsrd.conf

**olsrd.conf**

:

```
UseHysteresis      no
TcRedundancy       2
MprCoverage        3
LinkQualityLevel   2
LinkQualityWinSize 20
```

```
LoadPlugin          "olsrd_dyn_gw.so.0.3"
{
    PIPParam          "Interval"      "60"
    PIPParam          "Ping"          "151.1.1.1"
    PIPParam          "Ping"          "194.25.2.129"
}
```

```
Interface "ath0" "wlan0" {
    Ip4Broadcast 255.255.255.255
}
```

olsrd.conf

:

olsrd

olsrd -d 2

:

-d 2

)

embedded

(

CPU

:

--- 19:27:45.51 ----- DIJKSTRA

192.168.120.1:1.00 (one-hop)  
192.168.120.3:1.00 (one-hop)

--- 19:27:45.51 ----- LINKS

IP address	hyst	LQ	lost	total	NLQ	ETX
192.168.120.1	0.000	1.000	0	20	1.000	1.00
192.168.120.3	0.000	1.000	0	20	1.000	1.00

--- 19:27:45.51 ----- NEIGHBORS

IP address	LQ	NLQ	SYM	MPR	MPRS	will
192.168.120.1	1.000	1.000	YES	NO	YES	3
192.168.120.3	1.000	1.000	YES	NO	YES	6

--- 19:27:45.51 ----- TOPOLOGY

Source IP addr	Dest IP addr	LQ	ILQ	ETX
192.168.120.1	192.168.120.17	1.000	1.000	1.00
192.168.120.3	192.168.120.17	1.000	1.000	1.00

### Ethernet

### OLSR

-

OLSR

!

ad-hoc

infrastructure

)

:

.(

olsrd

olsrd

olsr

olsr

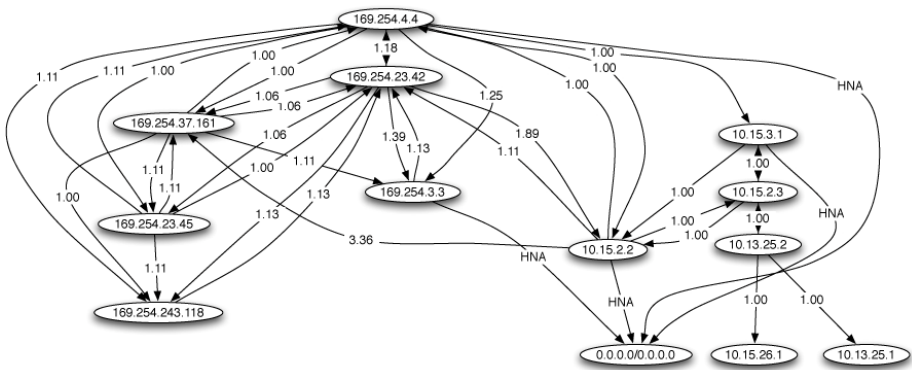
“Hello”

### Plugins

olsr.org

olsrd

.olsrd\_dot\_draw



:3.8

olsrd\_dot\_draw

graphviz .2004 TCP

## dot\_draw

olsrd  
:/etc/olsrd.conf

```
LoadPlugin "olsrd_dot_draw.so.0.3"
{
  PIPParam "accept" "192.168.0.5"
  PIPParam "port" "2004"
}
```

```
Topology "accept"
TCP "Port" ( "localhost" ) Information
```

.TCP 2004

telnet localhost 2004

neato dot

graphviz

Perl

Bruno Randolf

olsrd

.ImageMagick graphviz

:

<http://www.graphviz.org> Graphviz •

<http://www.imagemagick.org> ImageMagick •

:

<http://meshcube.org/nylon/utils/olsr-topology-view.pl>

:

./olsr-topology-view.pl :

### Troubleshooting

ping  
olsrd

ping

ping

olsrd

netmask

IP

Firewall

.UDP 698

!

**channel capacity**

**throughput**

.DSL

) **bandwidth**

(**data rate**

.(

)

54

802.11g

22

.802.11g

22

22

22

**queue**

**.lag**

**latency**

	< 1 Kbps	IM
Spam  ) (Hotmal                  Yahoo!	1-100 Kbps	
	50-100 Kbps	

<p>( )</p>		
<p>) streaming audio (</p>	<p>96-160 Kbps</p>	
	<p>24-100+ Kbps</p>	<p>VoIP</p>
	<p>64-200+ Kbps</p>	<p>( )</p>
	<p>Mbps - 0</p>	<p>BitTorrent) KaZaA Gnutella eDonkey (</p>



50  
 50 5 2.5  
 5 VoIP  
 802.11g ) half duplex 10  
 .( ) oversubscribe  
 .( 5 2

ICTP

:  
<http://wireless.ictp.trieste.it/simulator/>

# Link Planning

## link budget

(path loss )

: 802.11

200 TX power 30 **Transmit Power** dBm •

SeattleWirless

(<http://www.seattlewireless.net/HardwareComparison>)

**Antenna Gain** •

19- Omnidirectional 12-15 dBi Parabolic Sectoral dB 12 24 dBi 5-12 dBi

**Minimum Received Signal Level** •

(-dBm) dBm

( 1)

-95 dBm -75

:

**.Cable Losses**

•

Coaxial

.dB 3 - 2

**.scattering**

**attenuation**

**free space loss**

.( )

2.4

:

$$L_{fsl} = 40 + 20 \times \log(r)$$

r

L<sub>fsl</sub>

attenuation



multipath

.nulling  
antenna diversity

3

4

$$L \text{ (dB)} = 40 + 10 \times n \times \log(r) + L(\text{allowed})$$

)

:

.(

قدرة جهاز الإرسال  
+ ربح هوائي جهاز الإرسال  
- خسارة أسلاك جهاز الإرسال  
+ ربح هوائي جهاز الإستقبال  
- خسارة أسلاك جهاز الإستقبال

---

= الربح الكلي

:

:

الربح الكلي  
- خسارة المسار

= مستوى الإشارة في جهة الإستقبال

!

)  
-70dBm      -56dBm      (-dBm  
.  
( )

15 10

20

5

14      10  
(      20 )      100  
30      -82      (      -89      15 )  
2      (dBm)

:

(قدرة إرسال نقطة الولوج)      dBm 20  
(ربح هوائي نقطة الولوج)      dBm 10 +  
(خسارة الأسلاك في طرف نقطة الولوج)      dB 2 -  
(ربح هوائي الزبون)      dBm 14 +

:

$$\begin{array}{r} \text{(خسارة الأسلاك في طرف الزبون)} \\ \text{الرياح الكلي} \end{array} \quad \begin{array}{r} \text{dB } 2 - \\ \hline = \text{dB } 40 \end{array}$$

5

:

$$\text{dB } 113 = 20\log(5000) + 40 = \text{خسارة المسار}$$

:

$$40 \text{ dB} - 113 \text{ dB} = -73 \text{ dB}$$

$$-82 \quad ) \quad -73 \text{ dB} \quad (\text{dB}$$

$$82 \text{ dB} - 73 \quad ) \quad 9 \text{ dB} \quad (\text{dB}$$

:( )

$$\begin{array}{r} \text{(قدرة إرسال الزبون)} \\ \text{(رياح هوائي الزبون)} \\ \text{(خسارة الأسلاك في طرف الزبون)} \\ \text{(رياح هوائي نقطة الولوج)} \\ \text{(خسارة الأسلاك في طرف نقطة الولوج)} \end{array} \quad \begin{array}{r} \text{dBm } 15 \\ \text{dBi } 14 + \\ \text{dB } 2 - \\ \text{dBi } 10 + \\ \text{dB } 2 - \\ \hline \text{الرياح الكلي} \end{array} \quad \begin{array}{r} \\ \\ \\ \\ \\ \\ = \text{dB } 35 \end{array}$$

:

$$35 \text{ dB} - 113 \text{ dB} = -78 \text{ dB}$$

$$-89 \text{ dB} \quad ) \quad 11 \text{ dB} \\ \text{.(89 dB} - 78 \text{ dB}$$

$$\begin{array}{r} \text{(} \\ \text{24} \\ \text{14} \\ \text{)} \end{array} \quad \begin{array}{r} \text{dish} \\ \\ \end{array}$$

:

Green

Bay Professional Packet Radio's Wireless Network Link Analysis

*(<http://my.athenet.net/~multiplx/cgi-bin/wireless.main.cgi>)*

PDF

Super Edition

( )

Terabeam

*(<http://www.terabeam.com/support/calculations/index.php>)*

⋮

**2.4**

10,000	5,000	3,000	1,000	500	100	( )
120	113	110	100	94	80	( )

:

=	+	(dBi)	(dBi)

:

(dB)	=	+	+	(dB)

:

:( )

<	=	-	+	

:( )

<	=	-	+	

.RadioMobile

Green Bay Professional Packet Radio

Green Bay Professional Packet Radio (GBPPR)

*.http://www.qsl.net/n9zia/wireless/page09.html :*

:

**.Wireless Network Link Analysis**

*http://my.athenet.net/~multiplx/cgi-bin/wireless.main.cgi :*



( )

(Submit )

Super

GBPPR

PDF

Edition

Fresnel Zone Calculator

)

Decibel

Distance & Bearing Calculator

.( Conversion Calculator

# RadioMobile

/ Windows

.Wine

digital terrain

RadioMobile

elevation model

master/slave

.point-to-multipoint

point-to-point

Azimuth=340.1°	Elev. angle=-0.810°	Clearance at 5.51km	Worst Fresnel=2.4F1	Distance=5.54km
PathLoss=90.1dB	E. field=49.5dBμV/m	Rx level=-72.1dBm	Rx level=55.56μV	Rx Relative=37.4dB



:3.9

.RadioMobile

RadioMobile

Digital

200

20

elevation maps (DEM)

)

(

.DEM

)

(Mapquest

:

:

RadioMobile

<http://www.cplus.org/rmw/download.html>

RadioMobile

:

<http://www.cplus.org/rmw/english1.html>

/

### RadioMobile

/

RadioMobile

RadioMobile

.Wine

/

RadioMobile

:

IBM ThinkPad x31

•

Ubuntu Breezy (v5.10)

•

<http://www.ubuntu.com/>

Ubuntu Universe

20050725

Wine

•

RadioMobile

<http://www.cplus.org/rmw/download.html> :Windows

)

DLL

.(

VBRUN60SP6.EXE

MSVBVM60.DLL

)

Visual Basic 6

MSVBVM60.DLL

(Google

.MSVBVM60.DLL

:

Wine

# wine RMWDLX.exe

RadioMobile

U-NII ISM

Bluetooth

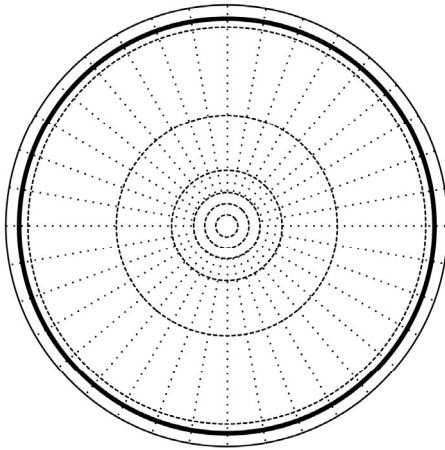
Microwave  
2.4

omnidirectional

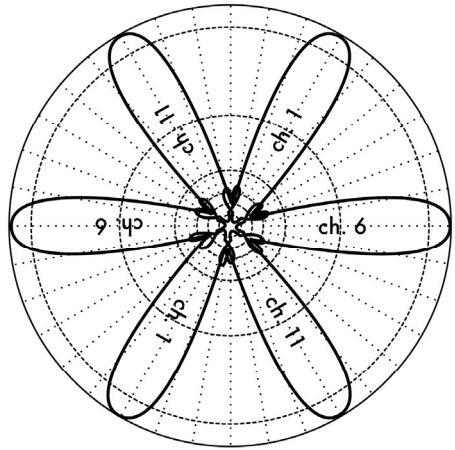
5

22

802.11b/g



يستقبل الهوائي متعدد الإتجاهات الضجيج من جميع الإتجاهات



يساعد استخدام عدة هوائيات قطاعية إلى تخفيف تأثير الضجيج وزيادة عرض الحزمة المتاح

:3.10

12

900

5.8

2.4

802.11a

2.4

5.8

Ronja

900

(<http://ronja.twibright.com/>)

2.4

### Repeaters

.LOS

line of sight

.repeaters

(one-arm repeater

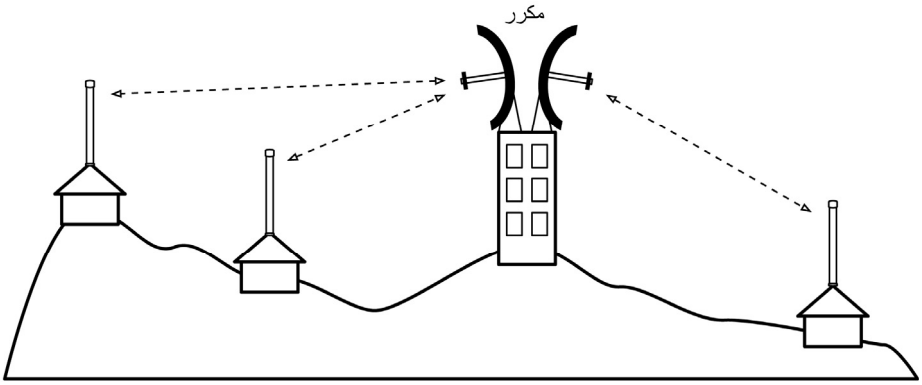
)

( )

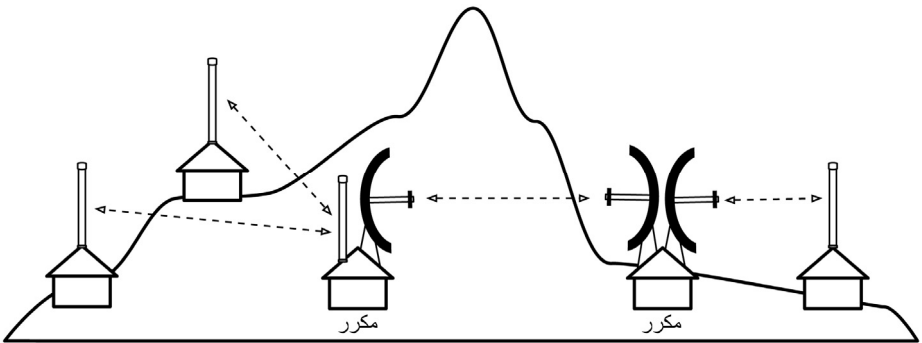
.Ethernet

802.11

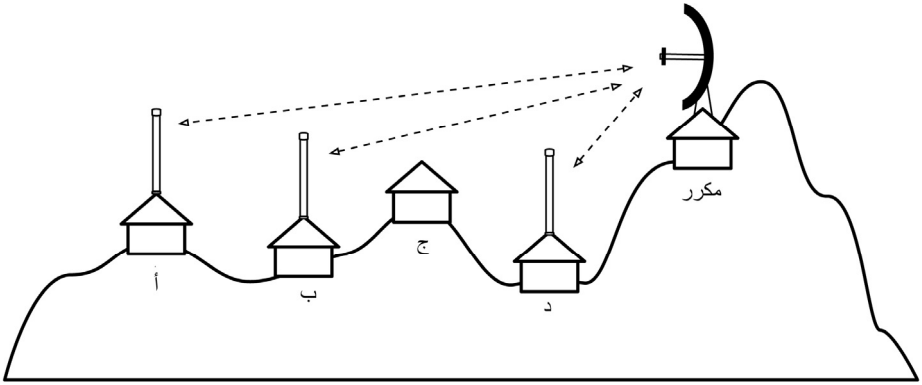
master



:3.11



:3.12



:3.13

" "

" "

## Traffic Optimization



### Web Caching

) proxy server (

) .(

30 ) .(

:

**.Squid** •

content )  
Squid .( filtering

Webalizer  
Squid Awstats

*http://www.squid-* : /

:

Debian / ) [cache.org/](http://cache.org/)  
Squid .(Squid FreeBSD

<http://squid-docs.sourceforge.net/> :

**Microsoft Proxy Server 2.0** •

Microsoft ISA Server

Microsoft

**Microsoft ISA Server** •

Sawmill

[\(http://www.sawmill.net/\)](http://www.sawmill.net/)

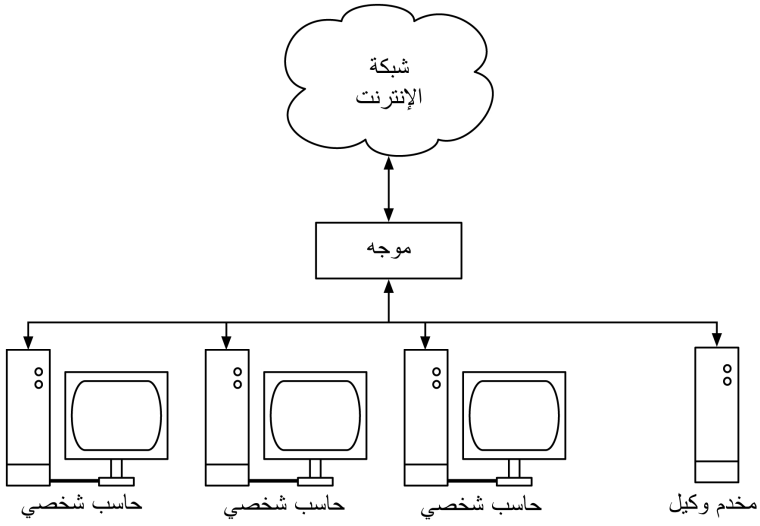
( )

Microsoft ISA Server

.WebSense

<http://www.isaserver.org/> <http://www.microsoft.com/isaserver/>

<http://www.antiproxy.com/>



:3.14

:

### .DHCP

Internet Explorer

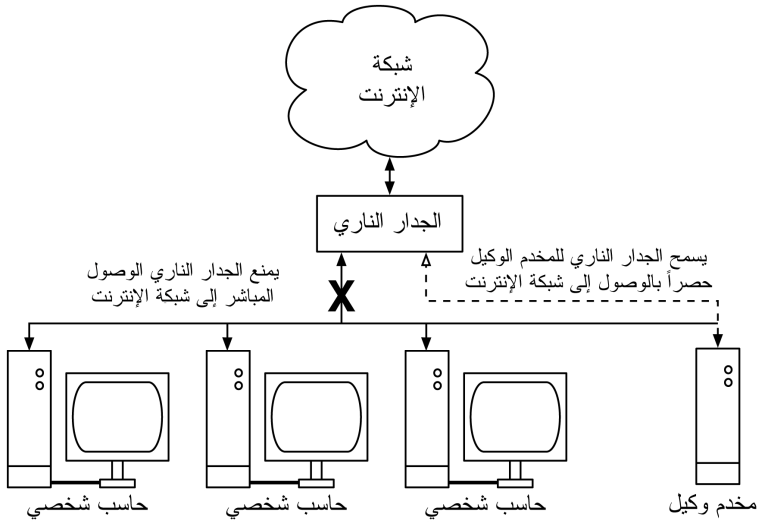
.NT domain

Windows 95/98/ME

Windows

NT/2000/XP

## Firewall



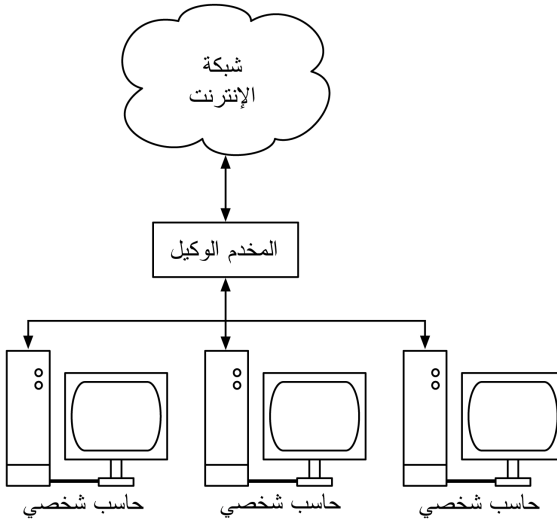
:3.15

( )

80

.KaZaA

## Two Network Cards



:3.16

IP

## transparent proxying

Squid

<http://www.squid-cache.org/Doc/FAQ/FAQ-17.html>  
<http://tldp.org/HOWTO/TransparentProxy-2.html>

## Policy-based routing

Cisco

Cisco

Makerere

### Mirroring a website

)

.(

-

.

(CGI )

-

.

(

)

.

rsync

.

rsync

wget

/

*http://xoomer.virgilio.it/hherold/ :*

*.http://www.cygwin.com/ :*

Cygwin

:

/var/www

:

•

C:\Inetpub\wwwroot

:

•

wget -cache=off -m http://www.python.org

. www.python.org

DNS

.name-based virtual host

)

.(

# wget

J. J.

CSIR J. P. L. Cloete Eksteen

Enhancing International World Wide Web In  
.Mozambique Through the Use of Mirroring and Caching Proxies

)

(<http://www.isoc.org/inet97/ans97/cloet.htm>)

HTML

( )

:( ( ) )

wget -proxy-on -cache=off -delete after -m <http://www.python.org>

HTML wget **:-m** • [www.python.org](http://www.python.org)

wget **--proxy-on** •

**--cache=off** •

:

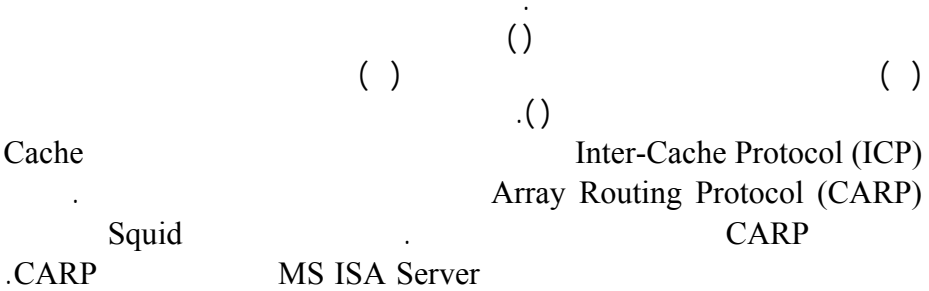
:--delete after •

wget

Squid

.Squid

### Cache Hierarchies



.CARP  
*http://squid-* :

*.docs.sourceforge.net/latest/html/c2075.html*

### Proxy Specifications

50

) SCSI

.(!

IDE

.RAID



RAM		Squid	
:	1		
(		) Squid	•
	1	10	
	500	50	
128		.RAM	•
		.X-Window	
		128	•
		256	•

### DNS Caching

DNS

time to live

(TTL)

IP

DNS

:

**Bind (named)**

Bind

Bind

.( )

RPM Debian

:Debian

apt-get install bind9

Bind

authoritative zones

split horizon

.DNS

**dnsmasq**

/

BSD

*.http://freshmeat.net/projects/dnsmasq/ :*

dnsmasq

DNS

**DHCP**

)

Bind

dnsmasq

( 200

**Windows NT**

: Windows NT

DNS

< Add

< Services

< Network

< Control Panel

Windows NT

.Microsoft DNS Server

Knowledge 167234

4

Base article

:

.Windows NT

DNS :DNS  
 .Domain Name System Manager  
 "New Server"  
 "

**Windows 2000**

< Settings < Start :DNS  
 .Add/Remove Software / < Control Panel  
 Add/Remove Windows Components /  
 < Networking Services < Components  
 .Domain Name System (DNS) < Details  
 < Start ) DNS MMC < Programs  
 < Administrative Tools .(DNS  
 Connect To " Action "Computer  
 The following " "computer:  
 "Select Target Computer"  
 ( )  
 !

**Mirrored Server**

**DNS**

) split DNS (split horizon  
 ( )

RFC 1918

IP

:

Makerere

172.16.16.21

*http://www.makerere.ac.ug/*

.195.171.16.31

makerere.ac.ug

DNS

makerere.ac.ug

www	CNAME	webserver.makerere.ac.ug
ftp	CNAME	ftpserver.makerere.ac.ug
mail	CNAME	exchange.makerere.ac.ug
mailserver	A	172.16.16.21
webserver	A	172.16.16.21
ftpserver	A	172.16.16.21

:

makerere.ac.ug

makerere.ac.ug\_

www	A	195.171.16.13
ftp	A	195.171.16.13
mail	A	16.132.33.21
MX		mail.makerere.ac.ug

IP

.RFC 1918

IP

IP

# Internet Link Optimization

22

802.11g

TCP/IP

.VSAT

**TCP/IP**

long fat pipe

network

520

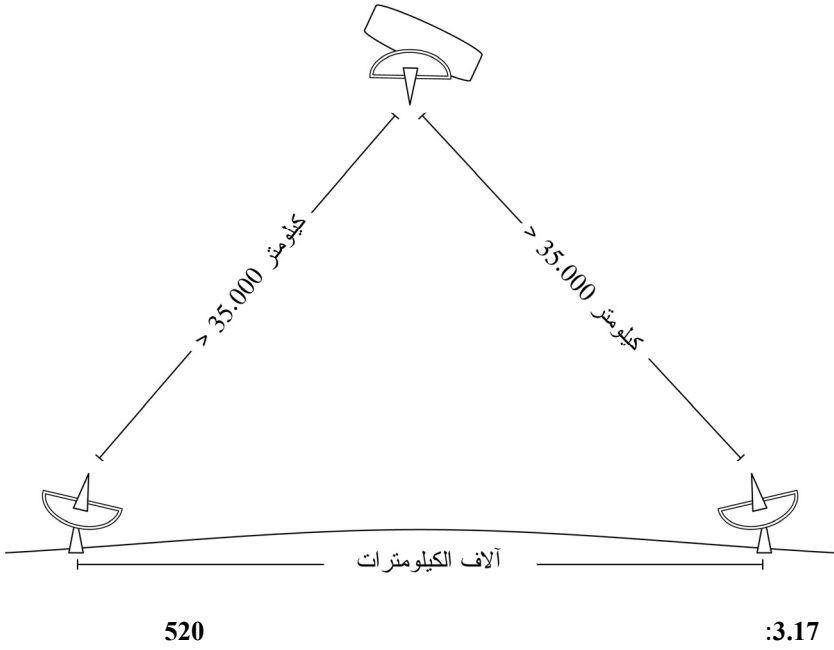
140

**RTT**

**transmission errors**

**large bandwidth delay product**

.TCP/IP



TCP/IP

:RFC 1323

) TCP

• window scale

• ( 64

• Selective acknowledgement (SACK)

• RTT

• timestamps

• timeout

• RTT

TCP

520

TCP/IP

RTT

TCP

TCP/IP

congestion control

TCP

mode

TCP

RTT

-

-

TCP/IP

TCP/IP

TCP Window Size TCP

64

TCP/IP

-

64

-

\

( 984 520 )

64

123

"

TCP

"advertised windows

64

TCP/IP

:

) TCP  
64 .(

( )  
TCP . TCP/IP  
congestion avoidance

TCP

TCP

**selective acknowledgement (SACK)**

2000

TCP/IP

:

Windows 2000

Selective Acknowledgement (SACK)

."TCP

SACK

BSD Linux

TCP/IP

512  
984  
984

64

"

"



:

VPN

.TCP/IP

)

(

:

*[http://www.psc.edu/networking/perf\\_tune.html](http://www.psc.edu/networking/perf_tune.html)*

**Performance-enhancing Proxy (PEP)**

) RFC 3135

*(<http://www.ietf.org/rfc/rfc3135>*

RFC

1323

TCP

PEP

TCP

TCP

.( TCP

) (

PEP

)

Squid



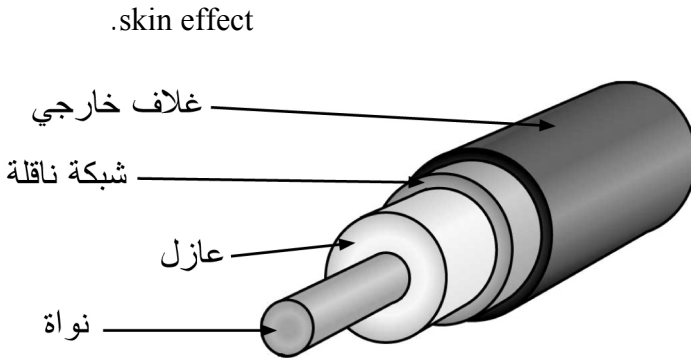
# 4

RF<sup>7</sup>

waveguides :  
2.4 :

" )  
.(of common axis  
dielectric

Coaxial  
HF " "coax  
.insulation  
PVC



:4.1

attenuation

.dB/m

. 1

. 2

.VHF

.dummy load<sup>8</sup>

<sup>8</sup> الحمل المبدد هو جهاز يبدد الإشارات اللاسلكية دون إرسالها، وكأنه بالوعة حرارية تعمل في امتصاص الترددات اللاسلكية.

:

	RG-58	Ethernet	.3
VHF	CB		
	RG-213		.4
	VHF	CB	
) Heliax		(foam	.5
LMR			
	LMR		
	LMR-600	LMR-400	
			.6
		)	
	(time domain reflectometer		.7

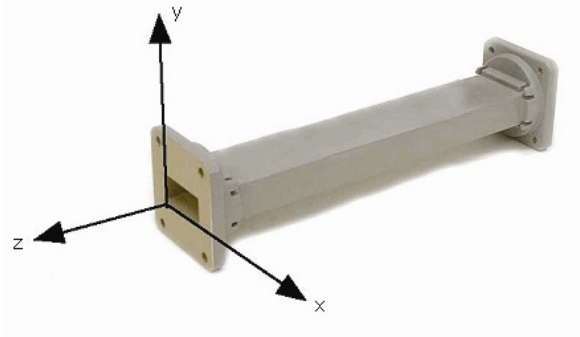
## Waveguide

2

Skin effect

:

z y x



Z Y X :4.2

.mode

(Transverse Magnetic ) TM

(Traverse Electrical ) TE

TE :

TM 11 10

Dominant Mode

$0.5\lambda$

Y

X

X

:

r

3.41r	2X	
3.2r	1.6X	
2.8r	1.1X	

:

( .loop ) probe

)

.(

		<b>Dielectric</b>		
4.95 mm	3.8 mm	2.95 mm	0.9 mm	RG-58
10.29 mm	8.64 mm	7.24 mm	2.26 mm	RG-213
10.29 mm	8.13 mm	7.24 mm	2.74 mm	LMR-400
11 mm	9.7 mm	8.12 mm	3.1 mm	3/8" LDF

:

:BNC

:

Banyonet Neill Concelman

.Carl Concelman

Paul Neill

( RG-316 RG-179 BNC RG-58 )  
10Base2

:TNC

BNC

12

.Threaded Neill Concelman

Neill

):N

(Navy

18

.SubMiniature version A

:SMA

18

SubMiniature version B  
SMA

:SMB

SubMiniature

4

:MCX

SMB

.%30

SMB



6

MCX

WiFi

Pigtail

:

TNC

:RP-TNC

) Linksys

.(WRT54G

U.FL

:(MHF  
MHF

) U.FL  
Hi-rose

MHF

U.FL

mini-PCI

.(TNC N )

MicroMate

MMCX

360

.Senao Cisco

PCMCIA

.MMCX

:MC-Card

.Avaya Orinoco Lucent

( )

.BNC

SMA

.( N )



N :4.3

- ( ) " .1
- ( ) .( )
- "! " .2
- dB )
- "! .(! " .3
- .MMCX U.FL
- 2.4 BNC .4
- .( TNC SMB SMA ) N .5
- .( )
- ) .6
- .( .7

**Reciprocity**

resonant

**radiation pattern**

:

**Input Impedence**

50

50

**Return Loss**

( )

:

$$\text{Return Loss (in dB)} = 20\log_{10} \frac{\text{SWR}}{\text{SWR} - 1}$$

### Bandwidth

( )

.2:1

SWR

$$\text{Bandwidth} = 100 \times \frac{(F_H - F_L)}{F_C}$$

$F_L$

$F_H$

$F_C$

### Directivity and Gain

.Omnidirectional

resonant half-wave dipole

isotropic

antenna

3  
(3dBi 3)

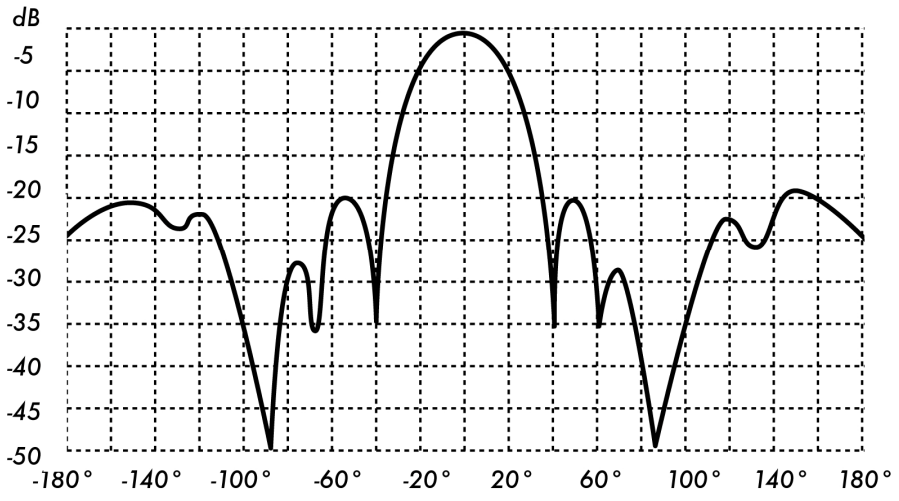
3  
(3dBd)

.gain transfer ( )

**Radiation Pattern**

Yagi

:



:4.4

( )

:

0

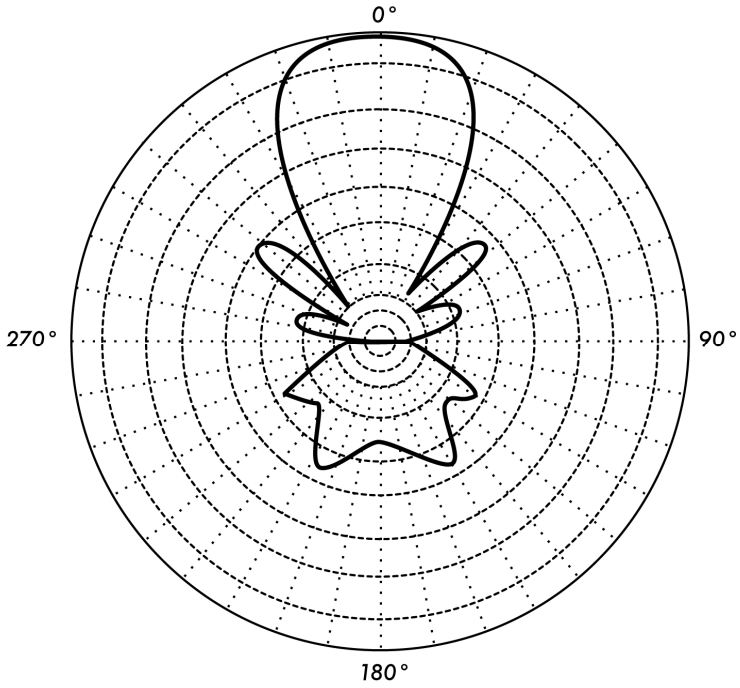
15

( )

)

(

:



:4.5

( )

0

40 - 30

3-

0

23-

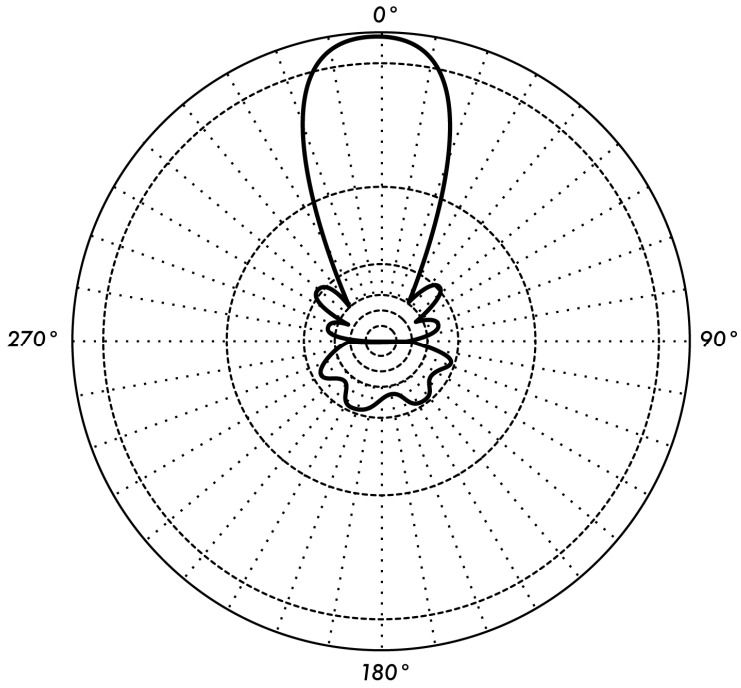
20-

53-

50-

( 30 )

:



:4.6

**relative**      **absolute**      :

(far-field      )  
(near-field      )



$$r_{\min} = \frac{2d^2}{\lambda}$$

$\lambda$

d

$r_{\min}$

### Beamwidth

3-

3

)

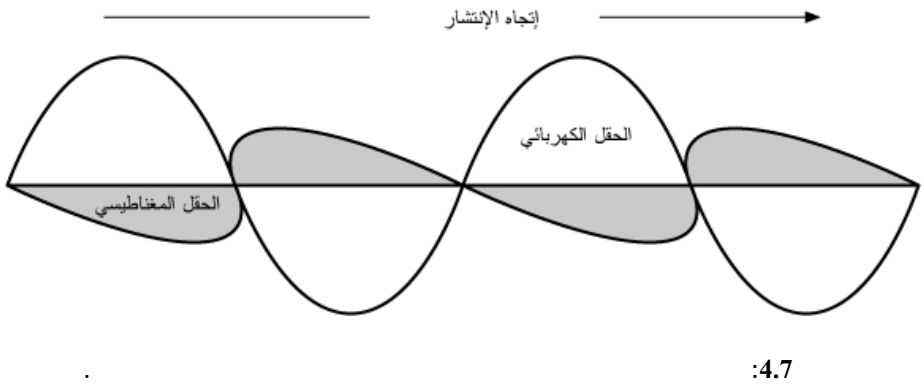
(

### Sidelobes

### Nulls

### Polarization

omnidirectional

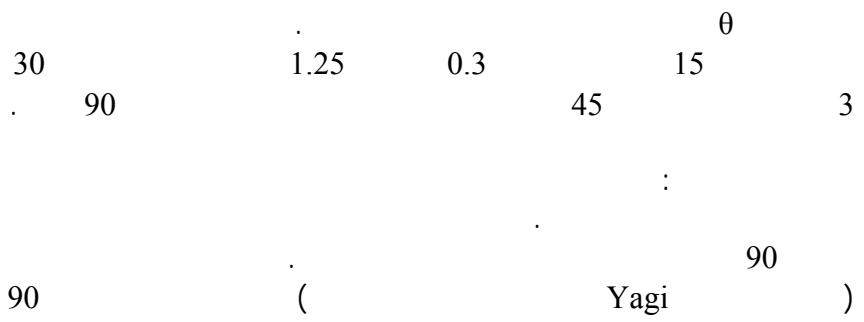


### Polarization Mismatch

.axial ratio

$$\text{Loss (dB)} = 20 \log (\cos \theta)$$

:



**Front-to-back ratio**

( )

180

VHF

5 6 5 2.4 12.5 2.4

:

dipole  
sectoral

omnidirectional

( 360)

ground plane

directional

180 60

horn

biquad

Yagi

:

the patch antenna

helicoidal

parabolic dish

2.4

:

2.4

### 1/4 wavelength ground plane

dipole

)

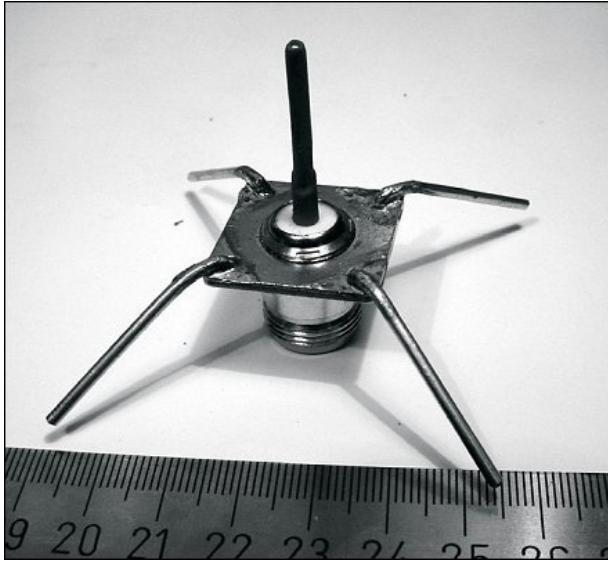
45 30

ground plane

(radial

2

4 -



:4.8

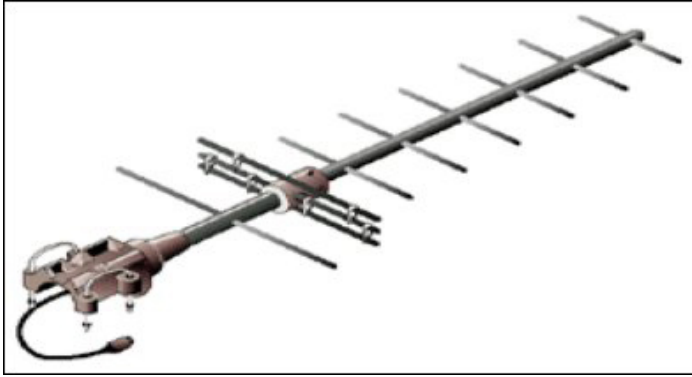
### Yagi

0.2

0.5

)  
)

(  
(



:4.9

10

20 10

20

### Horn

2.4

15-10



:4.10

# Parabolic dish

1

:

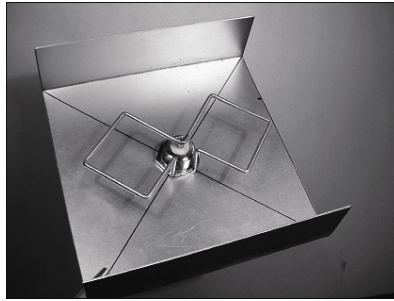


:4.11

## BiQuad

12-10

70



.BiQuad :4.12

( )  
180

:Sectoral

•

60

(multisectorial antenna )

:Panel or patch

20

•

### Reflector Theory

$$F = \frac{D^2}{16 \times c}$$

c

D



:

$$Gain = \frac{(\pi \times D)^2}{\lambda^2} \times n$$

$$Beamwidth = \frac{70\lambda}{D}$$

n

D

( 6 )

12

%50

(f/D)

0.25

.( )

### Amplifiers

.DC

2.4

2.4

•

•

•

•

•

2.4

2.4

.802.11b

**USB**

) USB

(USB Dongle

USB

( )  
)  
USB

.(

USB ( )

:

USB

Netstumbler

( 5 3 20 )

.( )

PVC

:

USB

*.http://www.usbwifi.orcon.net.nz/*

### Collinear omni

N

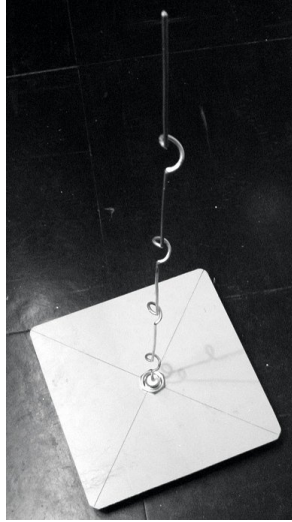
N

N

:

5

9 7



.Collinear Omni

:4.13

2 50 N  
10X10

- 
- 
- 



. 10X10

:4.14

- 
-

( 1.5 )

1

- 
- 
- 
- 
- 
- 
- 

.1



:4.15

2.5

90

.2



:4.16

:

3.6 90 .3

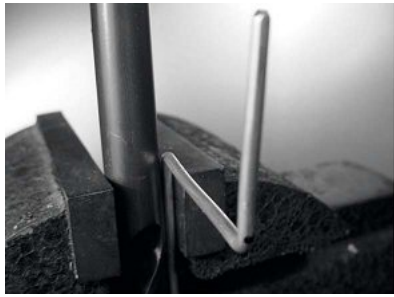
.Z



.Z

:4.17

1 Z .4



:4.18

:



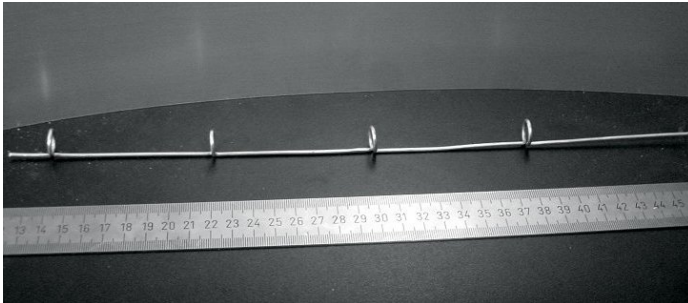
:4.19

7.8

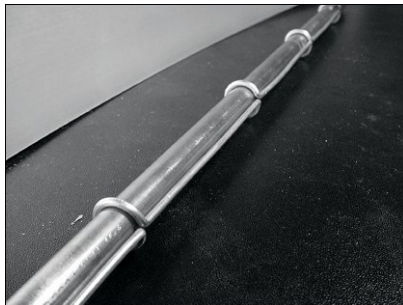
.5

7.8

8



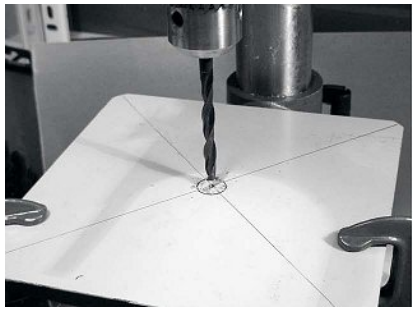
:4.20



:4.21



.6



:4.22

.N



.N

:4.23

( 0.5 50 ) N .7  
2



50

:4.24

N ( )

.8



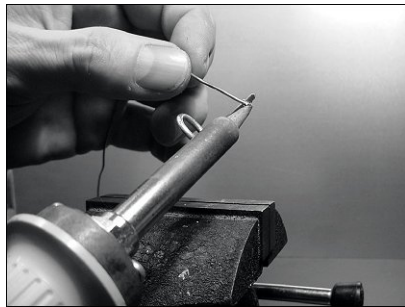
N

:4.25

2.5

.9

0.5

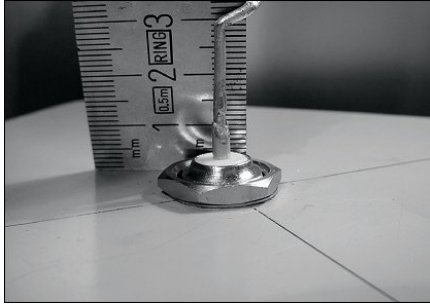


:4.26

.N

.10

3



3

:4.27

.11

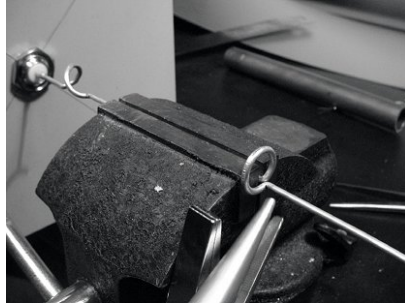
2



:4.28

2

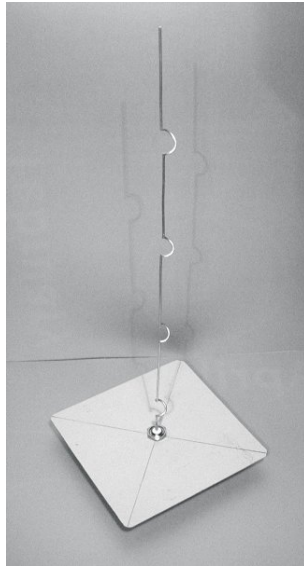
.12



:4.29

42.5

.13

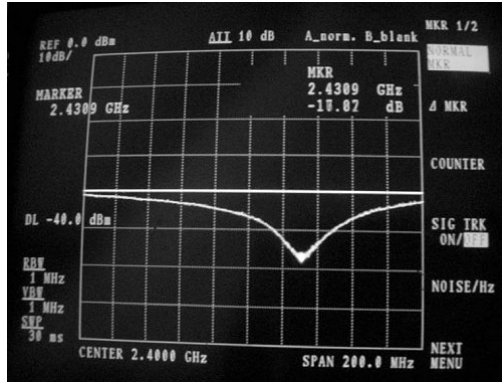


42.5

:4.30

.14

.Tracking Generator



.Collinear omni

:4.31

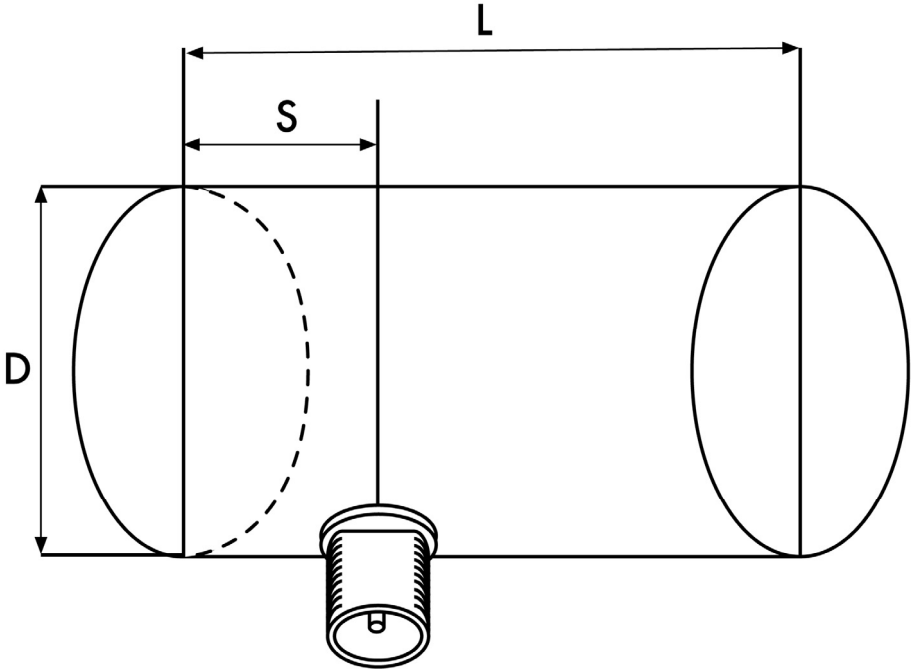
PVC

# Cantenna

N

N

:



:4.32

$$0.75 \quad 0.6 \quad D \quad .1$$

2.44  
- 7.3

12.2  
9.2

$$\lambda_G \quad (0.75\lambda_G) \quad L \quad .2$$

:

$$\lambda_G = \frac{\lambda}{\text{sqrt}(1 - (\lambda/1.706D)^2)}$$

56.4

D=7.3

14.8

D = 9.2

21

8.3

S

.3

:

$$S = 0.25 \lambda_G$$

(0.25 λ)

3.05

2.44

14 10

60



:4.33

		N	
2	4		•
21	8.3		•



:4.34

( 1.5 )

- 
- 
- 
- 
- 
- 
- 
- 
- 
- 

.1



:4.35

6.2

.2

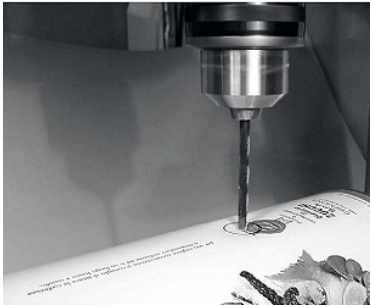




:4.36

.3

.N



:4.37

0.5

.4



:4.38

.N

.5

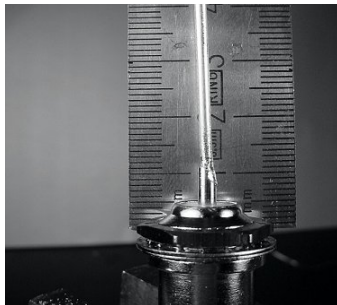


.N

:4.39

3.05

.6



:4.40

:

.7



:4.41

!

.8



:4.42

)

N

PVC (

) USB

(

30

2005

! 200

3.5

11

802.11b

:

*.http://www.wifi-shootout.com/*

**NEC2**

**Numerical Electromagnetic Code (version 2)**

NEC2

**structure**

:

NEC2

**.controls**

NEC

:

/

NEC2

NEC2

nec2 :

**xnecview**

:

.xnecview

NEC2

.Mac

Windows

NEC2

NEC2 .

Ray Anderson

NEC2

:

"NEC2

"

*.http://www.si-list.net/swindex2.html*

"

*.http://www.nittany-scientific.com/nec/ :*

"NEC2

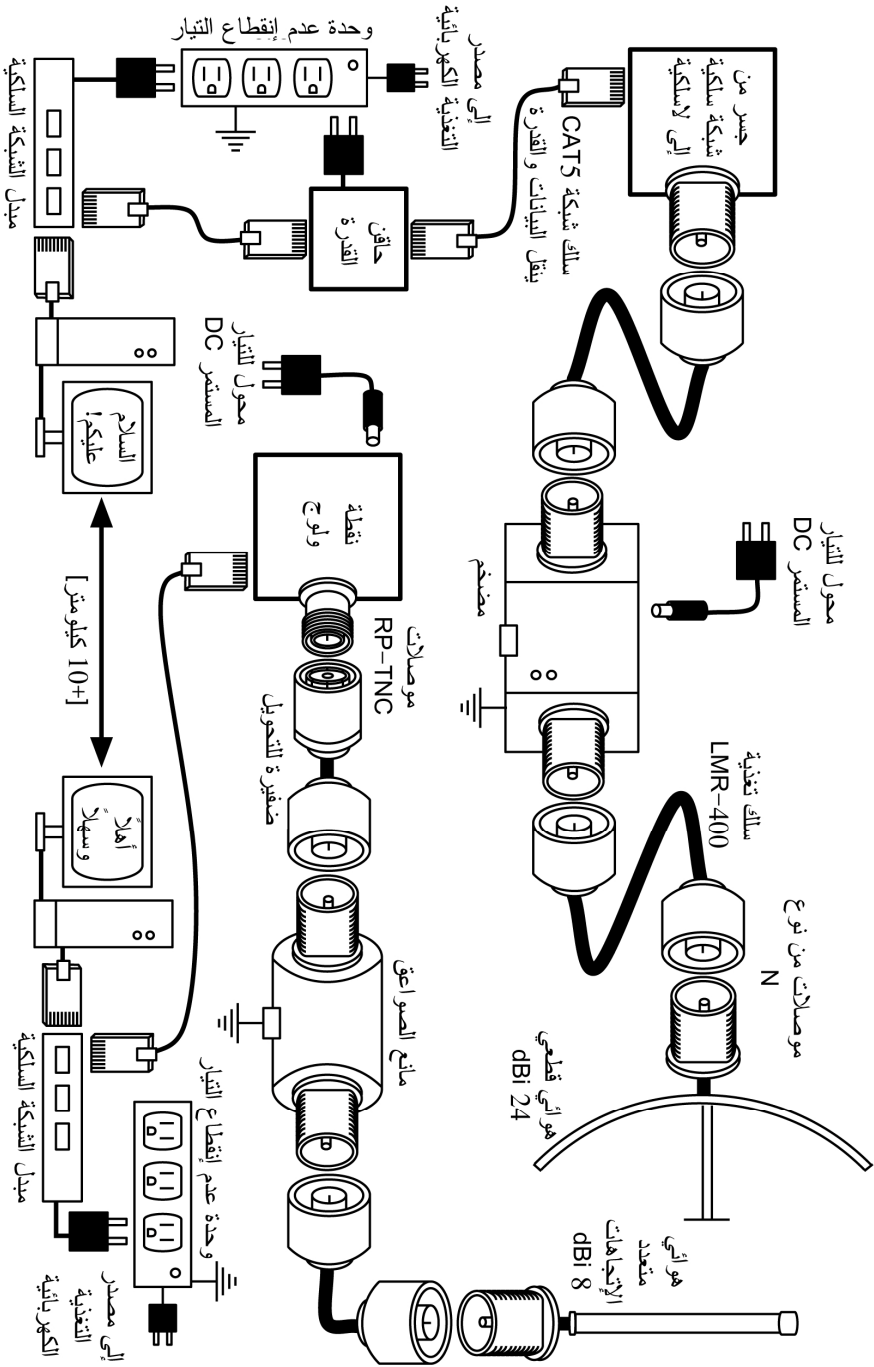


# 5

AC

.DC

!" "



:5.1



:

:

.Ethernet )  
(

- .1
- .2
- .3
- .4

)

.(

( )

"

"

:

(802.11b/g )

•

•

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.(

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)

**throughput.**

(

22

54)

)

.(802.11g

%20

DC

:

)

.(- 110-

**.Availability**

Power Over

Ethernet (POE)

NAT

**DIY**

)

.(

Motherboards

( )

" "

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( )

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.(802.11a/b/g

TCP/IP

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.(802.11a/b/g

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OFDM  
5.8 ISM

**Redline Communications**

AN-50

Redline

50

20

54

36

18

Redline

19

(1 U)

RG11

Beldon RG6

)

(Andrew Cosportation Heliac

Times Microwave LMR

:

Redline

General Alignment Mode

.Windows

.Test

Save

Save

AN-30  
 30 802.11a T1/E1 AN-100 Redline  
 .WiMAX RedMax

Redline Communications

:

*http://www.redlinecommunications.com/*

**Alvarion**

Alvarion

Alvarion

VL

.Link Blaster

VL

point-to-multipoint

24

VL

6

Redline AN-50

Link Blaster

Alvarion

Alvarion

AN-50

Redline

OEM

.Link Blaster

Link Blaster

Redline

Alvarion

Redline



2.4

Alvarion

Frequency Hopping Spread Spectrum (FHSS)

Direct Sequence Spread Spectrum (DSSS)

DSSS

FHSS

:

Alvarion

*http://www.alvarion.com/*

**Rad Data Communications**

Rad Airmux

48

Airmux 200

CAT5

Airmux

2005

19 )

12

(

19

Airmux

Rad Communications

:

*http://www.rad.com/*

**Cisco Systems**

:

Cisco

Cisco

:

802.11a/b/g Cisco

: Cisco

*<http://www.cisco.com/>*

Trango  
Waverider

:

*(<http://www.trangobroadband.com/>)* Broadband  
*(<http://www.waverider.com/>)* Communications

:



:5.2

American Wire Gauge (AWG)

#4

Stainless steel

.CAT5

) /  
(Microsoft Windows

data-link

.application

/  
VPN Concentrator

Ethernet

/

.Metrix

Linksys WRT54

: /

Masquarading  
)

.( NAT

- 
- 

.Transparent bridge

/

command line interface (terminal)

. /

.Ethernet

.Prism Atheros

Ubuntu Linux

5.10

(Breezy Badger )

.MADWiFi HostAP

.<http://madwifi.org/> <http://hostap.epitest.fi/> :

: /

Wireless Tools (iwconfig, iwlist commands)

iptables firewall

caching

) dnsmasq

(DHCP server

DNS server

- 
- 
-

CPU

133

486

.DNS

WEP

)  
- Squid )

(VPN  
(

NAT

.RAM  
64

- USB flash drive )  
- Compact Flash - USB

CF

CF

IDE

IDE

IDE

(-

### Masquarding Access

:

### Point

.1

/

.2

.3

)

.4

(

```

Fedora Core / Ubuntu
(Ethernet – eth0 )
(wlan0)

```

:Master

# iwconfig wlan0 mode Master

wlan0

ad-hoc

MADWiFi HostAP

dnsmasq

) Ubuntu

:(root

# apt-get install dnsmasq

eth0

root )

( :DHCP

154

:

# dhclient eth0

default

IP

Master

.gateway

mode

:

# iwconfig wlan0 essid "my network" mode Master enc off

)

enc off

.(WEP

:WEP

# iwconfig wlan0 essid "my network" mode Master enc 1A2B3C4D5E

"S:"

:

# iwconfig wlan0 essid "my network" mode Master enc "s:apple"

IP

:

# ifconfig wlan0 10.0.0.1 netmask 255.255.255.0 broadcast 10.0.0.255 up

### Masquearding

NAT

:

# modprobe ipt\_MASQUERADE

:

# iptables -F

:

NAT



:

```
# iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
```

:

```
# echo 1 > /proc/sys/net/ipv4/ip_forward
```

) Debian

:

/etc/network/options

(Ubuntu

```
ip_forward=no
```

:

```
ip_forward=yes
```

:

```
# /etc/init.d/network restart
```

:

```
# /etc/init.d/networking restart
```

### DHCP

IP  
10.0.0.0/24)

“my network”

WEP

.(

DHCP

.dnsmasq

caching DNS server

DHCP

:

.NAT  
DNS

VSAT

.dialup  
DNS

dnsmasq

*<http://thekelleys.org.uk/dnsmasq/doc.html>*

dnsmasq  
**./etc/dnsmasq.conf**

DHCP

:

interface=

:

interface=wlan0

wlan0 ...  
:

#dhcp-range=

#

:

dhcp-range=10.0.0.10,10.0.0.110,255.255.255.0,6h

:

:

# /etc/init.d/dnsmasq start

DHCP

IP

:

:

Gnome

- firestarter •

.Gnome

KDE

- knetfilter •

.KDE

- Shorewall •

.iptables

.webmin-shorewall

Shorewall

( )

- fwbuilder •

iptables

:

IP

DHCP

DHCP

.DHCP

dnsmasq

**bridge-utils**

Debian

Ubuntu

.Fedora Core

brctl

Debian

Ubuntu

**/etc/network/interfaces**

IP

IP

netmask

wlan0

.wlan1

wlan0 :

wlan1

“office”

.“repeater”

**:/etc/network/interfaces**

auto br0

iface br0 inet static

```

address 192.168.1.2
network 192.168.1.0
netmask 255.255.255.0
broadcast 192.168.1.255
gateway 192.168.1.1
pre-up ifconfig wlan0 0 0.0.0.0 up
pre-up ifconfig wlan1 0.0.0.0 up
pre-up iwconfig wlan0 essid "office" mode Managed
pre-up iwconfig wlan1 essid "repeater" mode Master
bridge_ports wlan0 wlan1
post-down ifconfig wlan1 down
post-down ifconfig wlan0 down

```

```

wlan0 # wlan1
.

```

```

interfaces

```

```

Debian /

```

```

/etc/network/if-pre-up.d/bridge :

```

```

/etc/network/if-post-down.d/bridge

```

```

./usr/share/doc/bridge-utils/ :

```

```

)

```

```

/etc/network/interfaces

```

```

( Fedora Core

```

```

:

```

```

iface br0 inet static
pre-up ifconfig wlan0 0 0.0.0.0
pre-up ifconfig wlan1 0.0.0.0
pre-up iwconfig wlan0 essid
pre-up iwconfig wlan1 essid
pre-up brctl addbr br0
pre-up brctl addif br0 wlan0
pre-up brctl addif br0 wlan1
post-down ifconfig wlan1 down
post-down ifconfig wlan0 down
post-down brctl delif br0 wlan0
post-down brctl delif br0 wlan1
post-down brctl delbr br0

```

```

:

```

# ifup -v br0

(verbose) "-v"

) Fedora Core  
IP (Debian

:

# ifconfig br0 192.168.1.2 netmask 255.255.255.0 broadcast 192.168.1.255  
# route add default gw 192.168.1.1

.( )

: brctl

# brctl show br0

2 1

/

.CD

"

"

/

Windows

)

.(RADIUS

domain server

.(

)

Chillispot

.phpMyPrePaid

Authentication

(

)

:

OpenWRT

.Freifunk •

OLSR

(<http://openwrt.org/>)

Linksys WRT54G /

MIPS

WRT54GS / WAP54G, Siemens SE505

Freifunk

Freifunk

.OLSR

Sven Ola

.x86

Freifunk

:

<http://www.freifunk.net/wiki/FreifunkFirmware>

/

.Metrix Pebble •

Terry Schmidt

.2002

NYCwireless group

Debian

Metrix Communication

2004

:

64

x86

Pebble  
Pebble

<http://metrix.net/howto/metrix-> :

[.pebble.html](#)

**.m0nowall** •

.FreeBSD

( 6 )

.XML

)

.(

:

.FreeBSD

<http://www.m0n0.ch/>

Ubuntu

)

(Debian

## Linksys WRT54G

Linksys WRT54G

RP-TNC

Ethernet

802.11b/g

60

WRT54G

2003

/

WRT54G



OpenWRT

*(http://openwrt.org/)*

*(http://www.freifunk.net/wiki/FreifunkFirmware)* Freifunk

Flash                      2005                      Linksys                      WRT54G  
 )                      /                      RAM                      VxWorks  
 .(                      WRT54GL                      Linksys                      WRT54G  
 /                      Linksys                      .WAP54G                      WRT54GS  
 Linksys                      /                      WRT54GL  
 WRT54GL                      WRT54G  
 OLSR

:

*http://linksysinfo.org* .1

*http://seattlewireless.net/LinksysWrt54g* .2



**6**

( )

) ) ( (

PVC

**Switches**

.( ) 30

UPS

!

UPS

30

shared medium

" "

)

(

(MAC

)

.MAC

denial of

.service (DoS)

2.4

ARP table

disassociation flooding  
.overflows

:

:

"

.1983

.war drivers

"War Games

GPS

( )

NetStumbler

.Kismet

<http://www.nodedb.com/> <http://www.wifimaps.com/> :

[.http://www.netstumbler.com/](http://www.netstumbler.com/)

:

ESSID

(Kismet )

(<http://www.etherpeg.org/>) Etherpeg

(<http://www.ex-parrot.com/~chris/driftnet/>) Driftnet

GIF

.JPG

## Authentication

MAC

( 48 )

.Ethernet

**MAC filtering**

MAC



MAC

" "

MAC

MAC

**.closed network**  
ESSID

)

(Netstumbler

ESSID

ESSID

Netstumbler

ESSID )

(Kismet

**Wired Equivilant Privacy**  
802.11a/b/g

WEP

40

WEP

MAC

WEP

)

(

WEP

)

WEP  
(

:

WEP

WEP

)

(

WEP

WEP

WEP

"

"

WEP

WEP

WEP

:

WEP

- <http://www.isaac.cs.berkeley.edu/isaac/wep-faq.html>* •
- <http://www.cs.umd.edu/~waa/wireless.pdf>* •
- [http://www.crypto.com/papers/others/rc4\\_ksaproc.ps](http://www.crypto.com/papers/others/rc4_ksaproc.ps)* •

WPA **Wi-Fi Protected Access**

WPA WEP

SSL Certificates

802.1X

WPA

.RADIUS

Temporal Key Integrity

WPA

Protocol (TKIP)

.WEP

( ) WPA

WPA

WPA .WEP

WEP

)

.(!

### Captive Portals

)

(

)

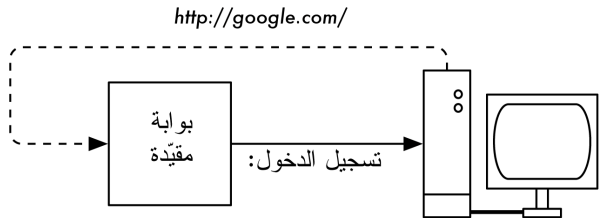
.( MAC

WEP

IP

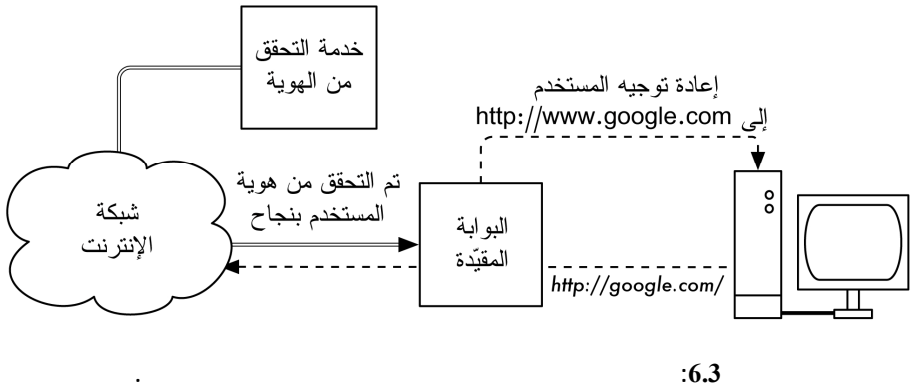
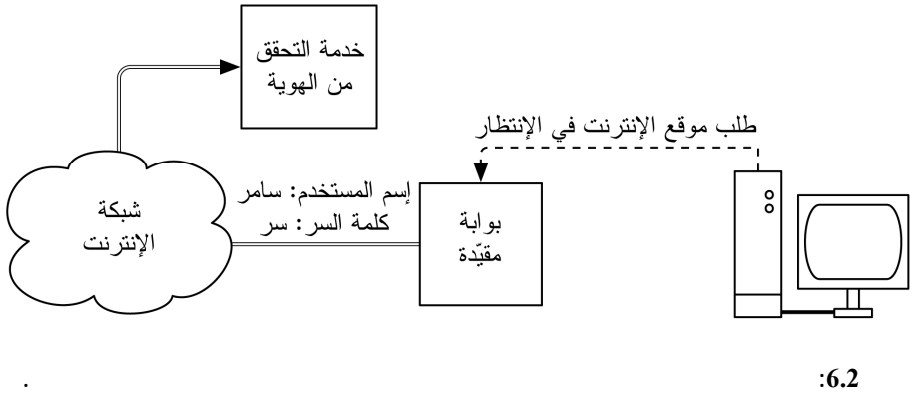
IP

.DHCP



:6.1

"Login"



IP

MAC

:

WPA WEP

NoCatSplash :

.Chillispot

**NoCatSplash**

*.http://nocat.net/download/NoCatSplash/*

NoCatSplash

"Login"

C NoCatSplash  
BSD GNU/Linux /

.OpenWRT  
HTML

*.http://nocat.net/ :*

NoCatSplash

:

*.(http://www.chillispot.org) Chillispot •*

.RADIUS

phpMyPrePaid

phpMyPrePaid

<http://sourceforge.net/projects/phpmyprepaid/> :

[\(http://www.wifidog.org/\)](http://www.wifidog.org/) WiFi Dog •

( 30 )

pop-up Javascript

) [\(http://m0n0.ch/wall/\)](http://m0n0.ch/wall/) m0n0wall •

FreeBSD (

RADIUS

.PHP

## Privacy

( )

**end-to-end**

**encryption**

WPA WEP

( )

)

(SMTP POP

WEP

- 
- 
- **Public key cryptography**
- (
- **Data encapsulation**
- IP
- DNS



# SSL

## ) Secure Sockets Layer

(SSL

public key

public key cryptography  
infrastructure (PKI)

.SSL

https

certificate

SSL  
)

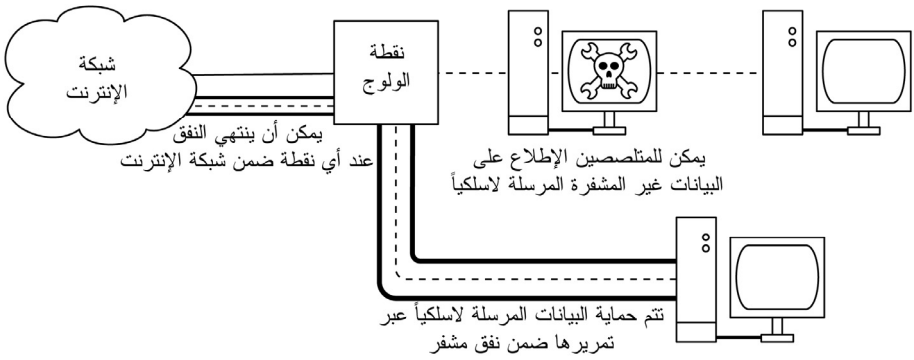
(authorities – CA

SSL

DNS

master session key

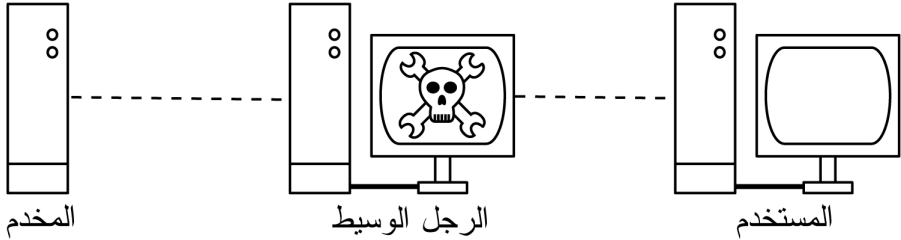
.tunnel



:6.4

PKI

.man-in-the-middle (MITM)



:6.5

PKI

.PKI

( )

"

"Ignore

SSL

POP IMAP )

.SSL (SMTP

SMTP

POPS IMAPS

)

.SSL/TLS

.(http://www.stunnel.org/) Stunnel

(SSL

.TCP

SSL

**SSH**

telnet

SSH

SSH (SSL

.ftp rcp

sftp scp

)

181

:

key

PKI

fingerprint cache  
SSH

SSH

SSH

( )

SSH

TCP

SSH

(<http://openssh.org/>) OpenSSH

.Unix

(<http://www.putty.nl/>) Putty

Windows

OpenSSH

(<http://winscp.net/>) WinSCP

(<http://www.cygwin.com/>) Cygwin

.OpenSSH

.-L

.squid.example.net

Squid

:

(

) 3128

ssh -fN -g -L3128:squid.example.net:3128 squid.example.net

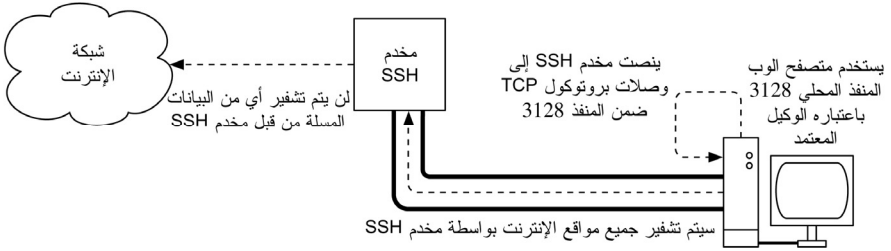
-g

SSH

-fN

OpenSSH

3128



SSH SSH :6.6

SOCKS5 SOCKS4 SSH  
.Squid

ssh -fN -D 8080 remote.example.net

SOCKS5 SOCKS4

.8080

SSH

SSH

TCP

ssh -fNCg -L110:localhost:110 -L25:localhost:25 mailhost.example.net

-C

.-L

.1024

root

.SSH

SSH

**OpenVPN**

VPN

OpenVPN

.SSL

Windows GNU/Linux /  
Mac OS X NetBSD FreeBSD OpenBSD 2000/XP  
TCP .Solaris  
( DNS )

.IPSEC

OpenVPN

OpenVPN  
SSL

OpenVPN

(RSA SSL)

- 
- 
- 
- 
- 

TCP SSL SSH OpenVPN

( )

VPN

VPN

OpenVPN

<http://www.linuxjournal.com/article/7949> :Linux Journal

[.http://openvpn.net/howto.html](http://openvpn.net/howto.html) :

# Tor & Anonymizers

anonymizing

Privoxy

(<http://tor.eff.org/>) Tor

(<http://www.privoxy.org/>)

GNU/Linux / Tor / Mac OS / Windows

BSD

Privoxy Tor  
(Linksys WRT54G )

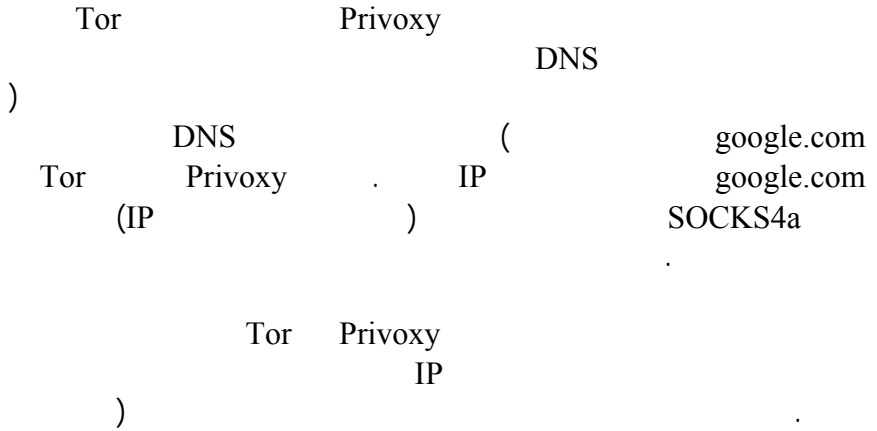
TCP

Tor

onion

)

(routing



### Monitoring

( )

### Network Detection

.( )

*(http://www.netstumbler.com/)* **Netstumbler** •

.Windows

Netstumbler

GPS

Netstumbler

*(http://www.netstumbler.com/)* **Ministumbler** •

Netstumbler

Windows

PDA

Pocket PC

*(http://www.macstumbler.com/)* **Macstumbler** •

) Netstumbler

Mac OS X (

.Apple Airport

*(http://sourceforge.net/projects/wellenreiter/)* **Wellenreiter** •

Perl

.GNU/Linux /

Prism2, Lucent :

GTK

.Cisco



### Protocol Analyzers

.802.11

: ( )

*(http://www.ethereal.com/)* **Ethereal** •

GNU/Linux /

.BSD

Mac OS X Windows

750

Ethereal

.HTTP

802.11

TCP

Ethereal

*(http://www.kismetwireless.net/)* **Kismet** •

Mac OS X GNU/Linux /

OpenWRT

/

PCAP

Kismet

.Ethereal

Netstumbler

.GPS

Kismet

*(http://kismac.binaervarianz.de/)* **KisMAC** •

Mac OS X

Kismet

PCAP

.Ethereal

(

) AirportExtreme

.USB

)

.Etherpeg Driftnet •

(JPG GIF

*http://www.etherpeg.org/*

Etherpeg

*http://www.ex-parrot.com/~chris/driftnet*

Driftnet

### Bandwidth Monitoring

:

#### SPAM

*(http://people.ee.ethz.ch/~oetiker/webtools/mrtg/)* **MRTG** •

1995

Perl C

MRTG

*(http://people.ee.ethz.ch/~oetiker/webtools/rrdtool/)* **RRDtool** •

MRTG

rrdtool

)

RRD

(Round-Robin Database

RRDtool

ntop [\(http://www.ntop.org/\)](http://www.ntop.org/) ntop •

rddtool

Mac OS BSD GNU/Linux /

.Windows X

[\(http://iptraf.seul.org/\)](http://iptraf.seul.org/) iptraf •

/

command line

.GNU/Linux

## Troubleshooting

Mac OS X Windows )

.ping (BSD GNU/Linux /

ICMP

.ping •

ping

[\(http://www.yahoo.com/\)](http://www.yahoo.com/)

: ping

```
$ ping yahoo.com
```

```
PING yahoo.com (66.94.234.13): 56 data bytes
```

```
64 bytes from 66.94.234.13: icmp_seq=0 ttl=57 time=29.375 ms
```

```
64 bytes from 66.94.234.13: icmp_seq=1 ttl=56 time=35.467 ms
```

```
64 bytes from 66.94.234.13: icmp_seq=2 ttl=56 time=34.158 ms
```

```
^C
```

```

--- yahoo.com ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 29.375/33.000/35.467/2.618 ms

```

control-C

ttl

ping

DNS

.DNS

IP

```

$ ping 216.231.38.1
PING 216.231.38.1 (216.231.38.1): 56 data bytes
64 bytes from 216.231.38.1: icmp_seq=0 ttl=126 time=12.991 ms
64 bytes from 216.231.38.1: icmp_seq=1 ttl=126 time=14.869 ms
64 bytes from 216.231.38.1: icmp_seq=2 ttl=126 time=13.897 ms
^C
--- 216.231.38.1 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 12.991/13.919/14.869/0.767 ms

```

IP

ping

```

.(http://www.bitwizard.nl/mtr/) mtr traceroute •
tracert ) ping traceroute
traceroute .(Windows
:

```

```

$ traceroute -n google.com
traceroute to google.com (72.14.207.99), 64 hops max, 40 byte packets

```

```

1 10.15.6.1 4.322 ms 1.763 ms 1.731 ms
2 216.231.38.1 36.187 ms 14.648 ms 13.561 ms
3 69.17.83.233 14.197 ms 13.256 ms 13.267 ms
4 69.17.83.150 32.478 ms 29.545 ms 27.494 ms
5 198.32.176.31 40.788 ms 28.160 ms 28.115 ms
6 66.249.94.14 28.601 ms 29.913 ms 28.811 ms
7 172.16.236.8 2328.809 ms 2528.944 ms 2428.719 ms
8 * * *

```

DNS

traceroute

-n

traceroute ping (mtr) My TraceRoute

.traceroute ping

My traceroute [v0.69]

tesla.rob.swn (0.0.0.0) (tos=0x0 psize=64 bitpatSun Jan 8 20:01:26 2006

Keys: Help Display mode Restart statistics Order of fields quit

Packets Pings

Host Loss% Snt Last Avg Best Wrst StDev

- 1. gremlin.rob.swn 0.0% 4 1.9 2.0 1.7 2.6 0.4
- 2. er1.sea1.speakeasy.net 0.0% 4 15.5 14.0 12.7 15.5 1.3
- 3. 220.ge-0-1-0.cr2.sea1.speakeasy. 0.0% 4 11.0 11.7 10.7 14.0 1.6
- 4. fe-0-3-0.cr2.sfo1.speakeasy.net 0.0% 4 36.0 34.7 28.7 38.1 4.1
- 5. bas1-m.pao.yahoo.com 0.0% 4 27.9 29.6 27.9 33.0 2.4
- 6. so-1-1-0.pat1.dce.yahoo.com 0.0% 4 89.7 91.0 89.7 93.0 1.4
- 7. ae1.p400.msr1.dcn.yahoo.com 0.0% 4 91.2 93.1 90.8 99.2 4.1
- 8. ge5-2.bas1-m.dcn.yahoo.com 0.0% 4 89.3 91.0 89.3 93.4 1.9
- 9. w2.rc.vip.dcn.yahoo.com 0.0% 3 91.2 93.1 90.8 99.2 4.1

control-C

.mtr

root

# Throughput Testing

)

(<http://www.dslreports.com/stest>)

(<http://ftp.arl.mil/pub/ttcp/>) **ttcp** •

.Unix

:

```

node_a$ ttcp -r -s
node_b$ ttcp -t -s node_a
ttcp-t: buflen=8192, nbuf=2048, align=16384/0, port=5001 tcp -> node_a
ttcp-t: socket
ttcp-t: connect
ttcp-t: 16777216 bytes in 249.14 real seconds = 65.76 KB/sec +++
ttcp-t: 2048 I/O calls, msec/call = 124.57, calls/sec = 8.22
ttcp-t: 0.0user 0.2sys 4:09real 0% Oi+0d 0maxrss 0+0pf 7533+0csw

```

TCP

TCP UDP

kilobyte

8

kilobit

ttcp

(tracert ping )

(<http://dast.nlanr.net/Projects/Iperf/>) **iperf** •

ttcp

iperf . tcp

node\_a\$ iperf -s  
node\_b\$ iperf -c node\_a

-----  
Client connecting to node\_a, TCP port 5001  
TCP window size: 16.0 KByte (default)  
-----

[ 5] local 10.15.6.1 port 1212 connected with 10.15.6.23 port 5001  
[ ID] Interval Transfer Bandwidth  
[ 5] 0.0-11.3 sec 768 KBytes 558 Kbits/sec

control-C 5001

) iperf tcp  
( IPv6

### Network Health

.(<http://www.cacti.net/>) cacti •

RRDtool

PHP

Cacti

MySQL

SNMP

Cacti

)

(

**SmokePing** •

*(<http://people.ee.ethz.ch/~oetiker/webtools/smokeping/>)*

Perl Tobias Oetiker

SmokePing

Cacti MRTG

SmokePing

SmokePing

Nagios *(<http://www.nagios.org/>)* **Nagios** •

)  
ping

(SmokePing

Nagios

SMS

( )

Nagios

.IM

Nagios



# 7

National Electrical

Manufacturers Association (NEMA)

NEMA 3

NEMA 6

NEMA 4X

ingress

( )

:

IP7 IP6

.protection (IP)

UV

NEMA

gaskets

DC

( )

:

**.Power over Ethernet (POE)**

802.3af

13

CAT5

end

) 802.11af

2-1 )

(span injector

(8-7 5-4 )  
mid span injector

(6-3

802.11af  
(Cisco )

POE

CAT5  
**passive POE injector**  
DC

20

:CAT5

*<http://www.gweep.net/~sfoskett/tech/poecalc.html>*

5-4

CAT5

( / ) 8-7 ( / )  
(6-3 2-1 )

*<http://www.nycwireless.net/poe> :*

.( ( )



:7.1

(gin pole )



:7.2



:7.3

AM  
FM

FM

.Ethernet



:7.4



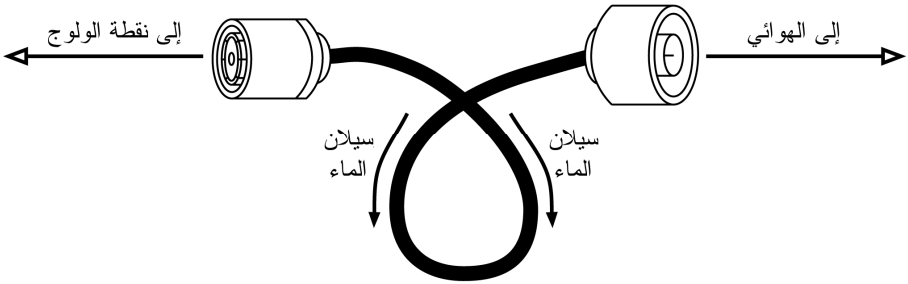


:7.5

)

(Zinc)

( )



:7.6

.UV

( )

:

:

.1

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.2

.GMRS FRS

amateur radio

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.3

GPS	.4
( GPS )	.5
	.6
Netstumbler Kismet )	.7
(	.8
	.9
	.10

( )

VSAT

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.(gauge 8

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UPS

.1

( 30)

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.3

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plomb

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500

220            110 240 220  
                  )

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.DC

.polarity

.flooded cell acid

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%60

CPU

24 12  
12 DC

AC

20-8



12 5

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) inductor

25 16

25

24

5

Linksys WRT54G

6

(DC

)

20

.Ethernet

Linksys

3

WAP54G

6

4G Systems Accesscube

.Freifunk

OpenWRT

Orinoco

mini-PCI

802.11b

DC

11 ( )  
 .( ) 14.5 ( )

ampere-meter

DC

:

$$P = U \times I$$

I

U

P

:

$$6 \text{ Watts} = 12 \text{ Volts} \times 0.5 \text{ Ampere}$$

6  
 12                    144                    (Ah)                    0.5                    (Wh)

Ah

170

.100%

340

-

12

100%

12.8

:

12.6 ( 12.6 )

11.6  
95%

0% 12.6 100%  
11.6

12.5 70% 12.3 90%

50% ( 150-50 ) 0%

11

0

low voltage disconnect circuit

(LVD)

70%

80%  
170

51 34

!

12.3

100%

/

( IU IU1a )

50% )

(

maintenance-free

!

**Battery buffered**

**system**

230

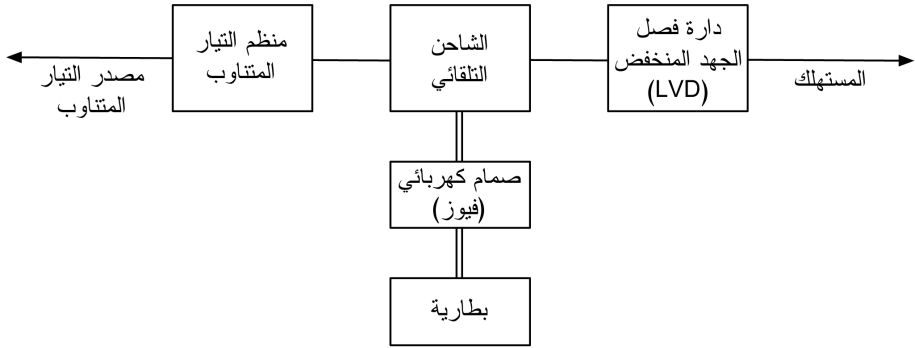
( )

200

( )

-

:



:7.7

$$12 \text{ : } 7 - 24$$

$$168 \text{ Wh} = 24\text{h} \times 7 \text{ W}$$

$$\text{ : } 12$$

$$14 \text{ Ah} = 168 \text{ Wh} / 12 \text{ Volt}$$

$$98 \text{ Ah} = 14 \text{ Ah/day} \times 7 \text{ days}$$

$$1176 \text{ Wh} = 98 \text{ Ah} \times 12 \text{ Volt}$$

$$\text{ ) } 30\% \quad 100\%$$

$$\text{ : } \quad ( \quad 70\%$$

$$140 \text{ Ah} = 98 \text{ ah} / 0.7$$

5

19

$$133 \text{ Wh} = 19\text{h} \times 7 \text{ Watt}$$

:

100%

.75% /

$$177.4 \text{ Wh} = 133 \text{ Wh} / 0.75$$

5

:

$$166 \text{ Wh} = 148 \text{ Wh} / 0.75$$

:Ah

$$14.8 \text{ Ah} = 177.4 \text{ Wh} / 12 \text{ Volt}$$

:

$$2.96\text{A} = 14.8 \text{ Ah} / 5\text{h}$$

$$0.6 \quad 7 .$$

: 12

$$3.56 \text{ A} = 2.96 \text{ A} + 0.6 \text{ A}$$

.100%

8 IU Ia

.( 5)

5

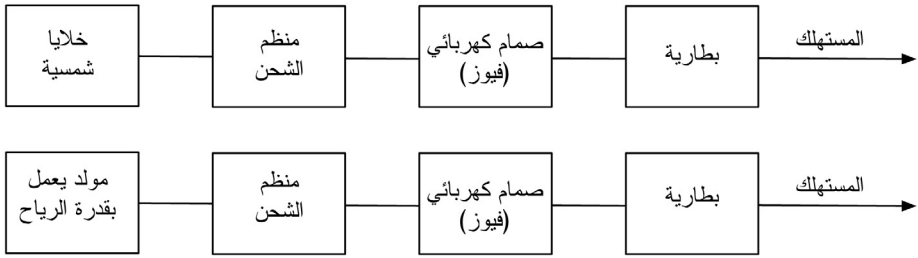
) PVSOL

.(

10%

- 25  
!

:



:7.8

4-3

6



( )

!

( )

**Maximum Power Point Tracking**

1000

20

1000

220

:

30

300

1

-

18

.Maximum Power Point – MPP

:

$$18 \text{ Watt} = 18 \text{ Volt} \times 1 \text{ Ampere}$$

$$\begin{matrix} 12.3 \\ ( 1.1 ) \text{ MPP} \\ : \end{matrix}$$

$$13.5 \text{ Watt} = 12.3 \text{ Volt} \times 1.1 \text{ Ampere}$$

75%

90%

70%

- ( )

### Low Voltage Disconnect Circuit

( )

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8

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( )

( )

decision trees

:

IP

SSID

( )

**.backup**

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•



:

)

.(

.known good

•

Ethernet

CD-ROM

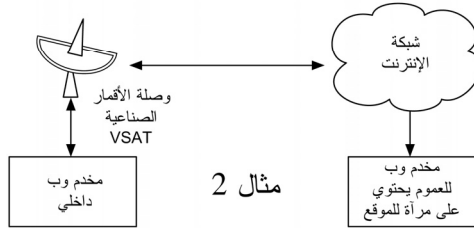
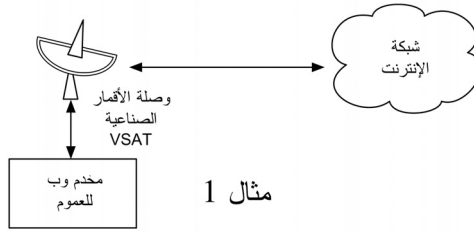
•

•

.LMR-400

DNS

Split DNS



## Open Proxies

```

squid.conf
.Squid
IP

```

## Open relay hosts

```

.spam
)
SMTP
) 25 telnet .(
set telnet Windows :( local_echo

```

telnet mail.uzz.ac.zz 25

) command-line

```

MAIL FROM: spammer@waste.com
250 OK - mail from <spammer@waste.com>
RCPT TO: innocent@university.ac.zz
250 OK - rcpt to spammer@waste.com

```

MAIL FROM

550 Relaying is prohibited.

*. http://www.ordb.org/*

Exim Postfix Sendmail ) MTA  
IP

(Exchange

### Peer-to-peer networking

(peer-to-peer)

: BearShare WinMX Morpheus KaZaa

.KaZaa

Drive Image Pro (*http://www.partimage.org/*) Partition Magic  
.*(http://www.powerquest.com/)*

)

.(

KaZaa

KaZaa

1214

.4000 1000

80

.( )

:

( )

SSH Microsoft NetMeeting

VPN

( )

)

(

( )

-

Microsoft Network Bonzi-Buddy

.worms

Ad-Aware (<http://www.spychecker.com/>) Spychecker

(<http://www.xp-antispay.org/>) xp-antispay (<http://www.lavasoft.de/>)

## Windows Updates

Windows

.Microsoft

:

•

**Software Update Server**

Microsoft

•

DNS

*windowsupdate.microsoft.com*

Microsoft

Automatic )

(Updates

.Microsoft cabinet (.cab)

(Squid)

:

```

2003.4.2 13:24:17 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:18 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:18 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab HEAD 0
2003.4.2 13:24:19 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:19 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:20 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:21 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:21 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab GET 0
2003.4.2 13:24:21 192.168.1.21 http://windowsupdate.microsoft.com/ident.cab
*DENIED* Banned extension .cab HEAD 0

```

(Windows

)

Norton Anti- )

(Virus

RealNetwork

Konfabulator )

(Dashboard

( )

.( )

Mac OS X Windows

### Windows

Windows

.Server Message Block (SMB) NetBIOS

TCP/IP

elections

.master browser

.My Network Places

Network Neighbourhood

LANs

SMB

Windows

### SMB/NetBIOS



SMB

:

**ZoneAlarm** •

( )

<http://www.zonelabs.com/>

Internet Explorer

.ZoneAlarm

Windows Explorer

•

SoftPerfect Network

(<http://www.softperfect.com/>

) Scanner

W32/Opaserv

Windows

Unix

Windows

### Email forwarding loops

:

.Yahoo!



SMTP

650

.( : )

University of Moratuwa

URL

**ftp://**

)

(

URL

.cron job

Windows

:(c:\ftpscript.txt

)

FTP

FTP

open ftp.ed.ac.uk  
gventer  
mysecretword  
delete data.zip  
binary  
put data.zip  
quit

:

ftp -s:c:\ftpscript.txt

Windows NT, 2000, XP

Start )

**transfer.cmd**

.(> Settings > Control Panel > Scheduled Tasks

.cron at

Unix

Windows / Samba / Web / Novell

HTML

URL

University of Bristol

(FLUFF)

FLUFF

*.http://www.bristol.ac.uk/fluff/*

CGI

.Apache

Python

9

)

(

( )

PVC

200

90

200

Routerboard 500

25

30

120

:

:

" "

.Windows XP

Pentium 4

)

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parasitic

( )

wireless model

( )

8  
Ikatel SOTELMA

X.25

:

OpenWRT

1

Linksys

bridge mode

SSID

14

dBi

*(<http://hyperlinktech.com/>)*

)

(

(

)



:

:

-  
Ian Howard -

:

CD-ROM

8

( )

.VSAT

(Ku

) C

64

128

400

:

140

( )

245

:

( )

25

WDS

3000

( )

3

.802.11b

5-2

90

Fast Ethernet )  
)

FM

.(100BT  
( 500

246

:

10

20

WDS

400

( )

:anchor clients

( )

:

:

( )

Ian Howard -

:

2004  
WiFi

2003

NYCwireless  
Spectropolis

" " " "

)

(

NYCwireless

2003  
NYCwireless  
SUNY

Dana Spiegel  
Brooke Singer

.Purchase

:

City Hall

Bluetooth WiFi

GPS Radio

/

( )

( )

WiFi

:

" " " "

WiFi ( )  
:  
( .. )

Dana Spiegel

NYCwireless

2001

NYCwireless

Alliance for Downtown New York  
Business Improvement

(DTA)  
District (BID)

City Park

The Lower Manhattan Cultural Council (LMCC)

(LMCC ) Wayne Ashley :

( ) Jordan Silbert

( ) Yury Gitman

( ) Jordan Schuster

:

( )

Parsons New School

SUNY

NYC

WiFi

NYCwireless

)

.(

WiFi

Sonic Interface

Akitsugu Maebayashi



251

:

Upper Air )

(DSP Music Syndicate

Eric John

Jabberwocky  
Elizabeth Goodman

Paulos

Jabberwocky

GPS drawings

Jeremy Wood

:

Julian Bleecker  
Jonah Brucker-Cohen

**WiFi Epherma Cache** •  
**UMBRELLA.net** •  
Katherine Moriwaki

free103point9 Transmission

**Microradio Sound Walk** •  
Artists

Carlos J. Gomez de Liarena

**Urballoon** •

:

- Naomi Joshua Kinberg **Bikes Against Bush** •
- Jeff Knowlton **InterUrban** •
- Karen Lee Spellman
- Akitsugu Maebayashi **Hotspot Bloom** •
- Eric John Paulos **Sonic Interface** •
- Elizabeth Goodman **Jabberwocky** •
- DSP Music Syndicate **Upper Air** •
- Trebor Scholz **Twenty-Four Dollar Island** •
- Following 'The Main of the Crowd'** **Text Messaging Service** •
- Dodgeball + Glowlab

DTA LMCC NYCwireless

11,000

2004

*http://www.spectropolis.info/ :*

:

*.http://www.wirelesscommunity.info/spectropolis*

Dana Spiegel -

:

:

2004

8

VSAT

:

5

24

802.11b

) )

( (

20

FM

8 Omni

(<http://hyperlinktech.com/> Hyperlinktech ) dBi

15

1

panel

.trigonometry

tan(x) =

+

-

\

$$\tan(x) = \frac{5m + 20m - 3m}{400m}$$

$$x = \tan^{-1}(22m / 400m)$$

$$x \approx 3 \text{ degrees}$$

GNU/Linux /

16

4

5

Ethernet

Mikrotik RB220

VSAT

(Hyperlink Technologies ) dBi 8

Mikrotik version 2.8.27 BB220

DHCP /

DNS-caching firewall

VSAT

Mikrotik .NAT

x86

mini-

) CF

POE  
PCMCIA pci

.x86

Mikrotik

Mikrotik

RB220

Altheros a/b/g mini-pci

461 POE

:

<http://www.mikrotik.com/routers.php#linx1part0>

24 subnets

.IP

tcpdump

MAC

imaps pops https

	C-band	VSAT
12,000	)	2.2
64		(
		700

Ku-band  
)  
(

Windows

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)  
(C-band  
UPS  
)  
(

2  
Powernoc 802.11b CPE  
dBi  
CPE  
7  
SuperPass  
POE

POE

( 12)

:

.( )

PowerNOC CPE

IP

) 249

.([http://powernoc.us/outdoor\\_bridge.html](http://powernoc.us/outdoor_bridge.html))

20

40

20

.( 2

)

$$= ( \quad ) + \quad + \quad +$$

300 200

1050  
100

150

100  
750

700 :

150



:

:

$$= \quad + \quad +$$

)

(

)

$$100 \left( \frac{150}{24} + \frac{3000}{1380} \right) \cdot 10\%$$

( 80)

:

Ku-band

C-band

) 450  
(

) 700

( 450

Ian Howard -

:

%99.5

CyberTwiga  
1996

Bill Sangiwa

1995

9.6

(

4000

) SITA

( )

2.4

2.4

2.4

2000

)

(

)

.( ..

(Alvarion

) Breezecom

(Tele2)

3.8/3.9

E1

2000

omindirectional

Point to Multi Point (PMP)

IP

100

)

64

(2000

)  
(ERP

3000-2000

SNMP

.UNIX

UPS

C-band

42

3.5/3.4

)

3000

100

(

2002

Access Kenya

2003

(

3.5/3.4)

1000

3.5/3.4

10,000

1

12

120

5.8/5.7

IP

VPN  
.IP  
NOC

VirtualIT  
Netscreen

VPN

(Juniper )

.VPN

2003

( )  
100

256 128  
Canopy

Motorola

"

Broadband Access Ltd.  
.2003

"Blue

Canopy

Motorola

)

24

(

%95.5

(

)

:

Canopy

Canopy  
UTP

) VPN

(  
VPN

:

2500

600-500

128-64  
VPN

( )

10 1

Mombasa

( )

(VPN )

( )

) Cacti MRTG

(



.( )

.( )

VPN

3-2

( )

( )

VPN

(CCTV )

%80

(WiMax )

!

- http://www.blue.co.ke/* Broadband Access, Ltd. •
- http://www.accesskenya.com/* AccessKenya, Ltd. •
- http://www.virtualit.biz/* VirtualIT •

:

•  
•

*.http://wndw.net/ :*

Cushcraft

•

*http://www.cushcraft.com/comm/support/technical-  
papers.htm*

*http://www.freeantennas.com*

•

*http://hyperlinktech.com* Hyperlink Tech

•

Psanada Networks LLC

•

*http://www.wlanparts.com*

*http://www.superpass.com* SuperPass

•

*http://www.si-* NEC-2

•

*list.org/swindex2.html*

NEC-2

•

*http://www.nittany-scientific.com/nec*

USB

•

*http://www.usbwifi.orcon.net.nz*

*http://www.cacti.net*

Cacti

•

*http://www.dslreports.com/stest*

•

*http://www.ethereal.com* Ethereal

•

*http://dast.nlanr.net/Projects/Iperf* Iperf

•

- <http://iptraf.seul.org> iptraf •
- MRTG •
- <http://people.ee.ethz.ch/~oetiker/webtools/mrtg>
- <http://www.bitwizard.nl/mtr> My TraceRoute •
- <http://www.nagios.org> Nagios •
- <http://www.ntop.org> Ntop •
- RRDtool •
- <http://people.ee.ethz.ch/~oetiker/webtools/rrdtool>
- SmokePing •
- <http://people.ee.ethz.ch/~oetiker/webtools/smokeping>
- <http://www.softperfect.com> SoftPerfect •
- Squid •
- <http://en.tldp.org/HOWTO/mini/TransparentProxy-2.html>
- <http://ftp.arl.mil/ftp/pub/tcp> tcp •
- 
- <http://www.antiproxy.com> AntiProxy •
- Anti-spyware •
- <http://www.spychecker.com>
- <http://www.ex-parrot.com/~chris/driftnet> Driftnet •
- <http://www.etherpeg.org> Etherpeg •
- OpenVPN •
- <http://www.linuxjournal.com/article/7949>
- <http://www.lavasoft.de> Lavasoft Ad-Aware •
- <http://openssh.org> OpenSSH •
- OpenVPN •
- <http://openvpn.net/howto.html>
- <http://www.privoxy.org> Privoxy •
- Windows PuTTY SSH •
- <http://www.putty.nl>
- <http://www.sawmill.net> Sawmill •
- WEP •
- <http://www.isaac.cs.berkeley.edu/isaac/wep-faq.html>

- ) Windows XP •
- <http://www.xp-antispy.de> ( •
- <http://www.stunnel.org> Stunnel Universal SSL Wrapper •
- <http://tor.eff.org> TOR •
- RC4 •
- [http://www.crypto.com/papers/others/rc4\\_ksaproc.ps](http://www.crypto.com/papers/others/rc4_ksaproc.ps) •
- <http://winscp.net> Windows SCP •
- <http://www.cs.umd.edu/~waa/wireless.pdf> " " •
- Windows ZoneAlarm •
- <http://www.zonelabs.com> •
- 
- <http://squid-> Squid •
- [docs.sourceforge.net/latest/html/c2075.html](http://docs.sourceforge.net/latest/html/c2075.html) •
- DHCP DNS Dnsmasq •
- <http://thekelleys.org.uk/dnsmasq/doc.html> •
- 
- <http://www.isoc.org/inet97/ans97/cloet.htm> •
- <http://www.bristol.ac.uk/fluff> FLUFF •
- Microsoft Internet Security and Acceleration Server •
- <http://www.microsoft.com/isaserver> •
- Microsoft ISA •
- <http://www.isaserver.org> Server and Firewall •
- 
- [http://www.psc.edu/networking/perf\\_tune.html](http://www.psc.edu/networking/perf_tune.html) •
- 
- <http://www.ietf.org/rfc/rfc3135> •
- <http://squid-cache.org> Squid •
- 
- Champaign-Urbana •
- <http://cuwireless.net/download> •
- WRT54G Freifunk OLSR •
- <http://www.freifunk.net/wiki/FreifunkFirmware> •

- <http://pdos.csail.mit.edu/roofnet/doku.php> MIT Roofnet •
- <http://www.olsr.org> OLSR •
- <http://meshcube.org/nylon/utils/olsr-topology-view.pl> •
  
- Prism 2.5 •
- HostAP •
- <http://hostap.epitest.fi> •
- <http://m0n0.ch/wall> m0nowall •
- <http://madwifi.org> Atheros MadWiFi •
- Metrix •
- <http://metrix.net/metrix/howto/metrix-pebble.html> •
- Linksys OpenWRT •
- <http://openwrt.org> •
- <http://nycwireless.net/pebble> Pebble Linux •
  
- <http://www.chillispot.org> Chillispot •
- 
- <http://www.qsl.net/n9zia/wireless/page09.html> •
- Mac OS X KisMAC •
- <http://kismac.binaervarianz.de> •
- <http://www.kismetwireless.net> Kismet •
- Mac OS X MacStumbler •
- <http://www.macstumbler.com> •
- Windows NetStumbler •
- <http://www.netstumbler.com> Pocket PC •
- NoCatSplash •
- <http://nocat.net/download/NoCatSplash> •
- PHPMyPrePaid •
- <http://sourceforge.net/projects/phpmy prepaid> •
- RadioMobile •
- <http://www.cplus.org/rmw> •

- Terabeam •
- <http://www.terabeam.com/support/calculations/index.php>
- / Wellenreiter •
- <http://www.wellenreiter.net>
- <http://www.wifidog.org> WiFiDog •
- GBPRR •
- <http://my.athenet.net/~multiplx/cgi-bin/wireless.main.cgi>
- 
- <http://www.wifi-> DefCon •
- <http://www.wifi-shootout.com>
- <http://www.wlghz.org> •
- <http://linksysinfo.org> Linksys •
- Linksys WRT54G •
- <http://seattlewireless.net/index.cgi/LinksysWrt54g>
- <http://nocat.net> NoCat •
- <http://nycwireless.net/poe> POE •
- <http://ronja.twibright.com> Ronja •
- <http://seattlewireless.net> •
- 
- <http://www.seattlewireless.net/HardwareComparison>
- Stephen Foskett •
- <http://www.gweep.net/~sfoskett/tech/poecalc.html> POE
- 
- <http://www.alvarion.com> Alvarion •
- <http://www.cisco.com> Cisco •
- <http://metrix.net> Metrix •
- 
- Mikrotik •
- <http://www.mikrotik.com/routers.php#linx1part0>
- PowerNOC •
- [http://powernoc.us/outdoor\\_bridge.html](http://powernoc.us/outdoor_bridge.html)
- <http://www.rad.com> RAD •







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.802.11b/g 802.11a

U-NII

20 802.11b/g

22

.802.11a

802.11b / g			
(GHz )		(GHz )	
2.447	8	2.412	1
2.452	9	2.417	2
2.457	10	2.422	3
2.462	11	2.427	4
2.467	12	2.432	5
2.472	13	2.437	6
2.484	14	2.442	7

802.11a	
(GHz )	
5.170	34
5.180	36
5.190	38
5.200	40
5.210	42
5.220	44
5.230	46
5.240	48
5.260	52
5.280	56
5.300	60
5.320	64
5.745	149
5.765	153
5.785	157
5.805	161

•  
•

AD HOC

ANTENNA

ACCESS POINT (AP)

AWG

AZIMUTH

BEAMWIDTH

CHANNEL

DECIBEL (dB)

$$dB = 10 \times \text{Log}(P1 / P0)$$

DHCP

( )  
 ( )  
 .(

DIFFRACTION

DIPOLE

( )

DIRECTIVITY

DRIVER

CD

DSL

Direct-Sequence Spread Spectrum  
:DSSS

DSSS

EFFICIENCY

:Extended Service Set Identifier  
(.SSID )

ESSID

ETHERNET

Xerox  
Intel DEC  
.1976  
Star Bus  
10

IEEE 802.3

CSMA/CD

( ) Base-T100  
100

( 1000) 1

Frequency Hopping Spread  
:Spectrum

FHSS

FRONT TO BACK  
RATIO

.( )

FTP

GAIN

GROUND

5

HARNESS

HOTSPOT

.802.11x

HUB

ICMP

.IP

Institute of Electrical and  
:Electronics Engineers

IEEE

Internet Engineering Task Force

IETF

INFRASTRUCTURE  
MODE

INTERFERENCE



IP

.IP

LATENCY

.Line of sight

LOS

MAC

48

MAC

MESH NETWORK

MRTG

IP

NAT

IP

NOISE

NTOP

Orthogonal Frequency Division  
:Multiplexing  
.HiperLAN2 IEEE 802.11a

OFDM

OMNIDIRECTIONAL

:Operating System

OS

,2000 ,98)

(XP, CE

UNIX, MAC )

.(OS, IOS, JUNOS

ICMP

PING

POLARIZATION

( )

:Post Office Protocol

POP

.Point-to-point	PTP
.Point-to-multipoint	PTMP
.Quality of Service	QOS
	RADIATION PATTERN
	SIDELOBES
( )	
	SIMPLE NETWORK MANAGEMENT PROTOCOL
.Signal to Noise Ratio	SNR
	SSH
rlogin, telnet, ftp	
32	SSID

:Secured Sockets Layer

SSL

TCP/IP

TCP

:Time Division Multiple Access

TDMA

:User Datagram Protocol

UDP

:Ultra Violet radiation

UV

:Virtual Private Network

VPN

( )

.( )

:Wide Area Network

WAN

:Wired Equivalent Privacy  
IEEE 802.11

WEP

.Wireless Fidelity

WIFI

.IEEE 802.16

WIMAX

.Wireless Internet Service Provider

WISP

: Wi-Fi Protected Access

WPA

.WEP

:



([www.idrc.ca](http://www.idrc.ca)) IDRC –

**Networktheworld.org**