Sistem Komunikasi Nirkabel

WIRELESS LAN

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Materi

- Pengenalan Jaringan Wireless
- Arsitektur IEEE 802.11
- Physical Layer IEEE 802.11
- Data Encryption Wireless
- Survei Lokasi

Wireless?

- Wireless LAN atau WLAN adalah jaringan area lokal nirkabel yang menggunakan gelombang radio sebagai pembawanya.
- Link ke pengguna adalah nirkabel, untuk memberikan koneksi jaringan ke seluruh pengguna di suatu gedung atau kampus.
- Jaringan backbone biasanya menggunakan kabel

Bagaimana cara kerja Wireless LAN?

LAN nirkabel beroperasi dengan cara yang hampir sama seperti LAN kabel, menggunakan protokol jaringan yang sama dan mendukung sebagian besar hal yang sama di level aplikasi.

Apa keuntungan WLAN?

- Menggunakan protokol physical dan data link yang khusus
- Integrasi ke dalam jaringan yang ada melalui Access Point yang menyediakan fungsi penghubung
- Memungkinkan tetap terhubung saat kita menjelajah dari satu jangkauan area ke jangkauan area lainnya
- Memiliki keamanan yang baik
- Memiliki persyaratan interoperabilitas tertentu
- Menawarkan kinerja yang berbeda dari LAN kabel.

Physical dan Data Link Layers

Physical Layer:

- NIC nirkabel mengambil frame data dari Link Layer, mengacak data dengan cara yang telah ditentukan, kemudian menggunakan aliran data yang dimodifikasi untuk memodulasi sinyal pembawa radio.

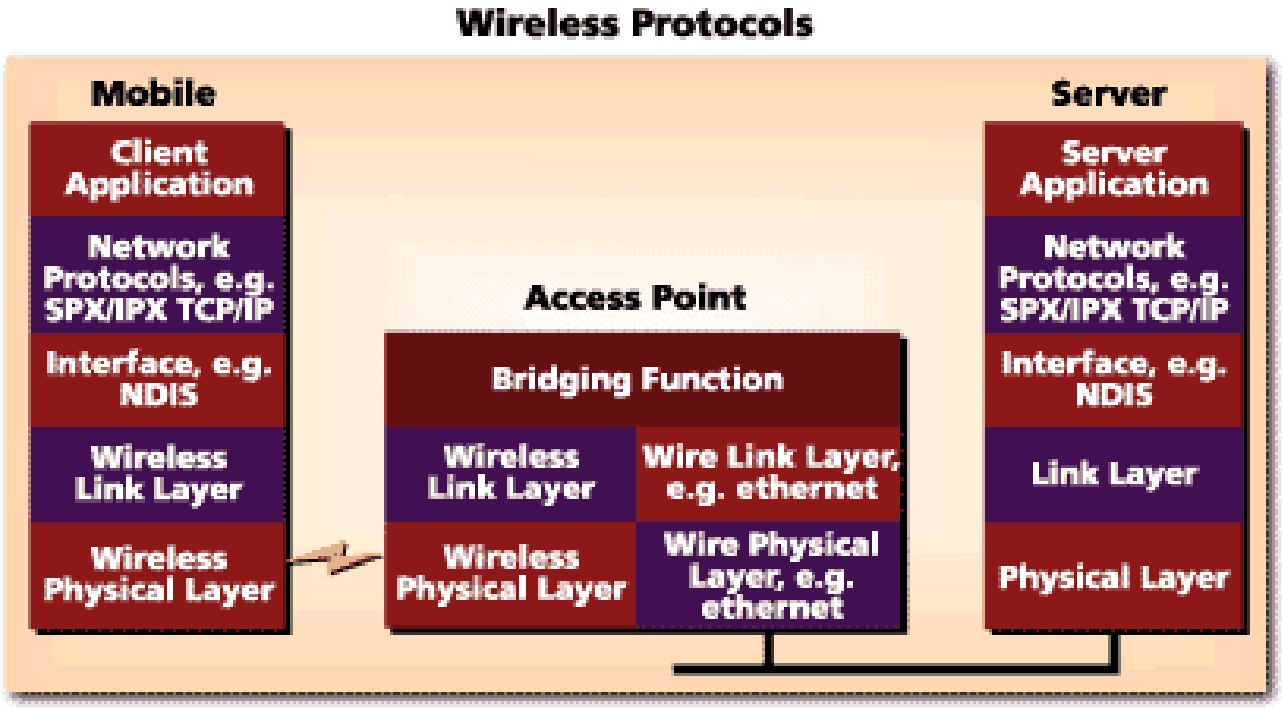
Data Link Layer:

- Menggunakan **C**arriers-**S**ense-**M**ultiple-**A**ccess with **C**ollision **A**voidance (CSMA/CA).

Integrasi dengan Existing Networks

- Wireless Access Points (APs) - perangkat kecil yang menjembatani lalu lintas nirkabel ke jaringan user.
- Kebanyakan access point menjembatani LAN nirkabel ke jaringan Ethernet.

Integrasi dengan Existing Networks

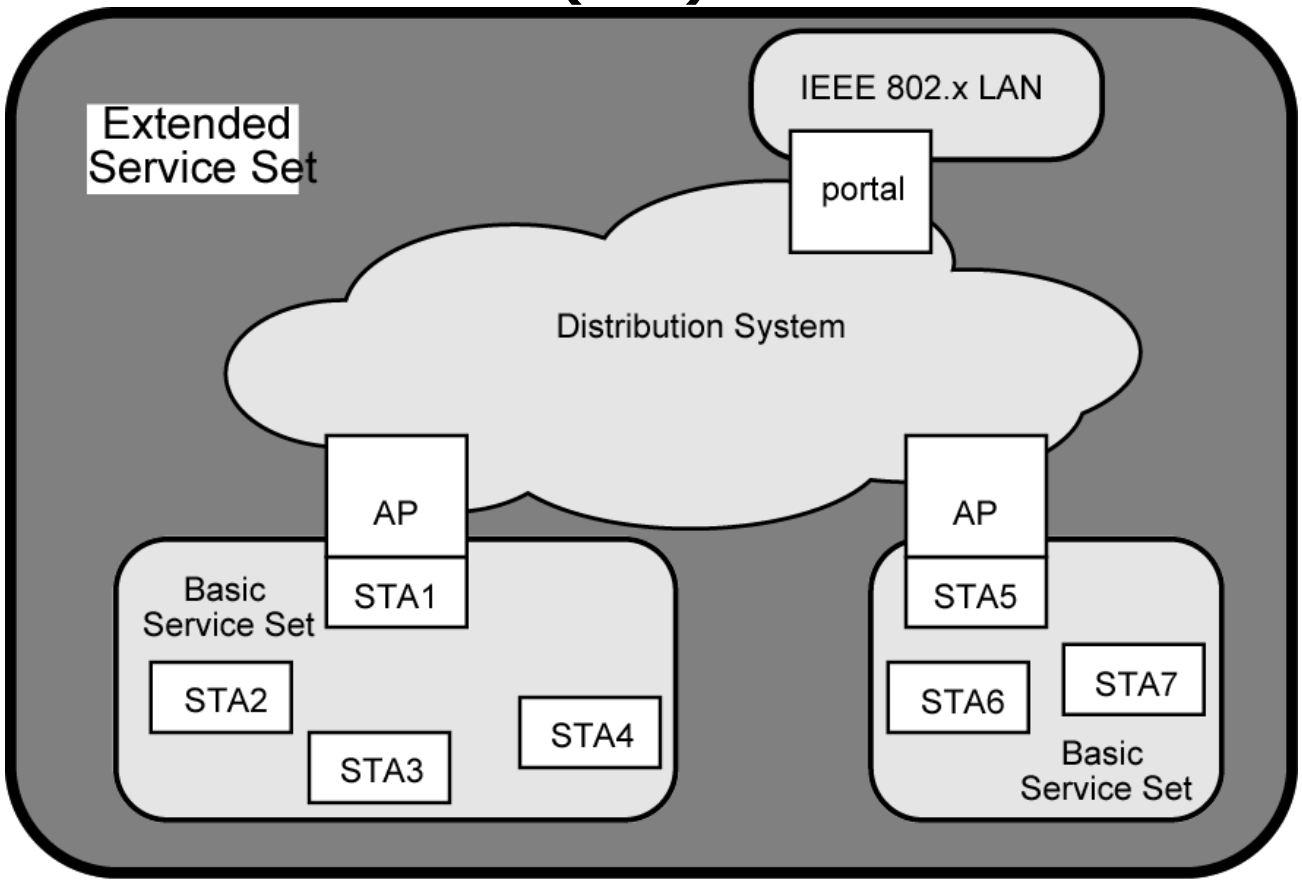


Arsitektur Jaringan IEEE 802.11

Arsitektur Jaringan Wirelss:

1. Basic Service Set (BSS)

2. Extended Service Set (ESS)

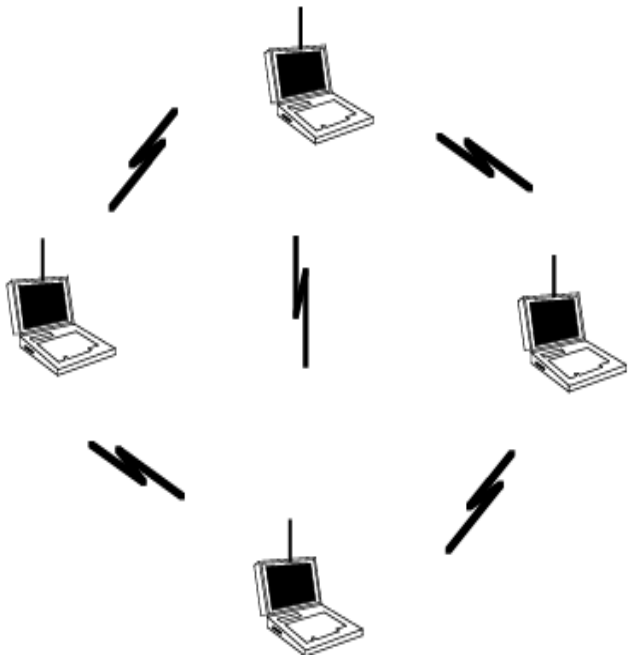


STA = station
AP = access point

Jaringan Ad Hoc

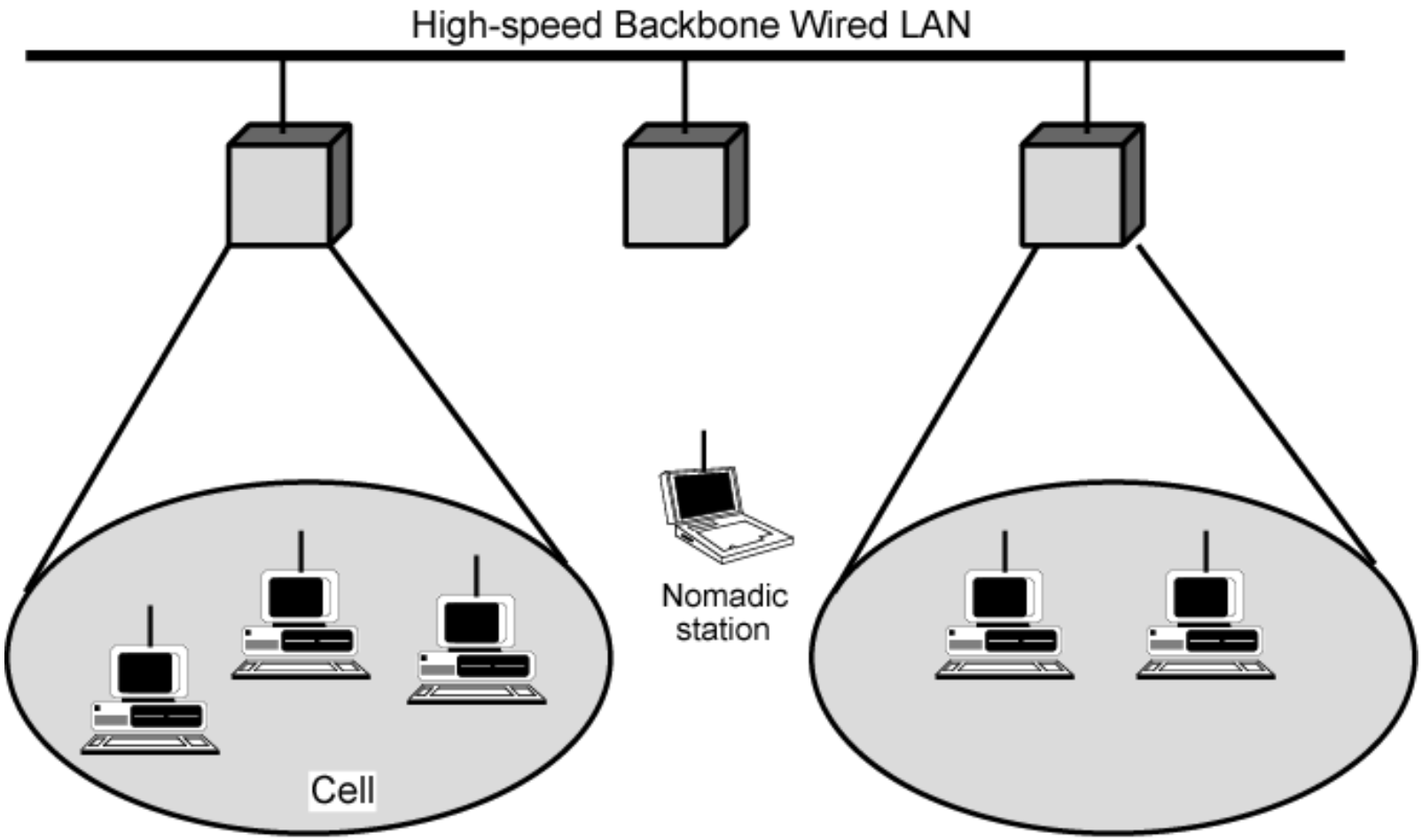
- Jaringan peer-to-peer
- Disiapkan untuk memenuhi beberapa kebutuhan yang mendesak
- Misalnya. sekelompok karyawan, masing-masing dengan laptop atau smartphone, dalam pertemuan bisnis atau kelas
- Jaringan selama pertemuan tersebut

Add Hoc LAN



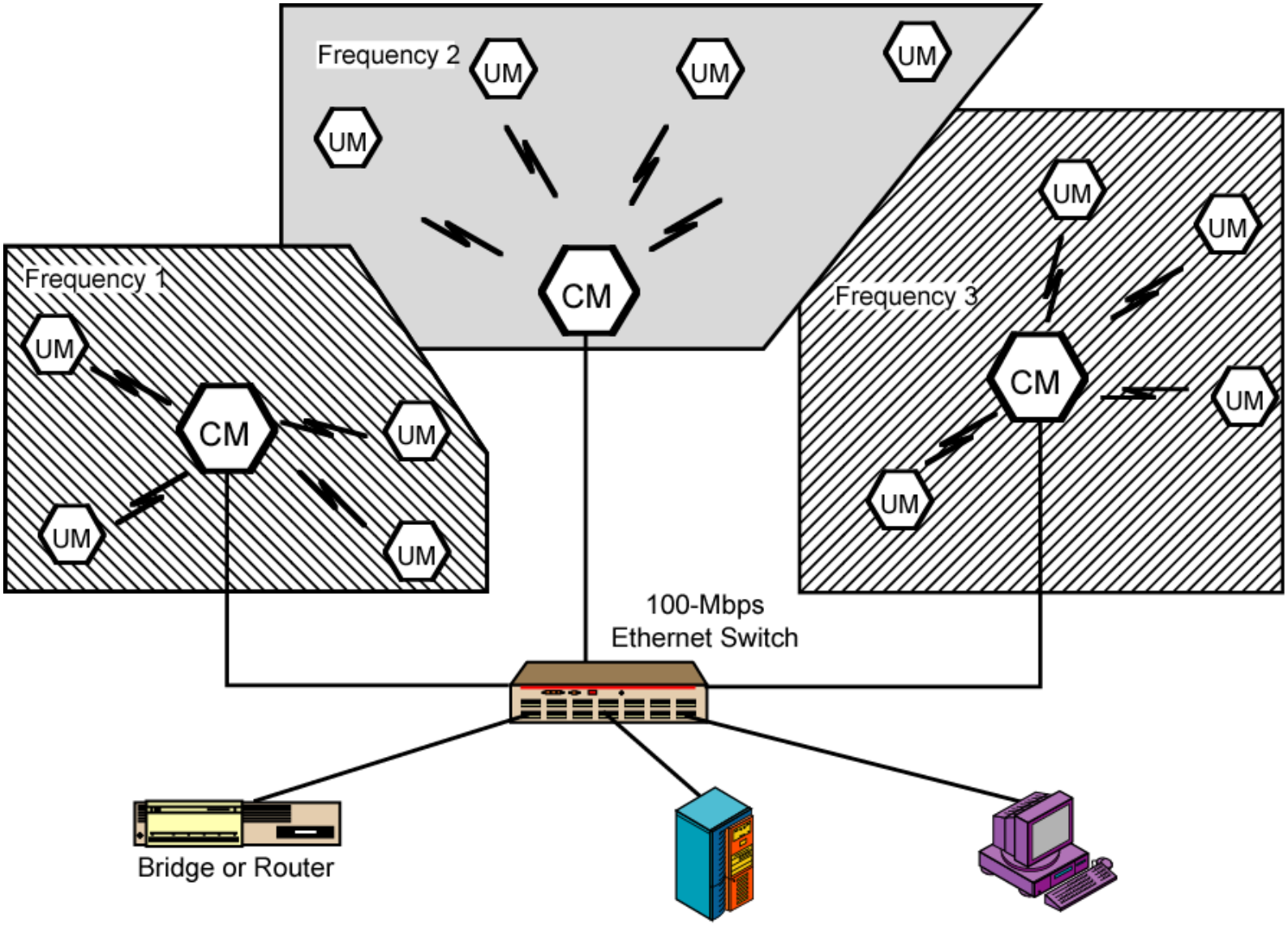
- Sekelompok stasiun yang menggunakan frekuensi radio yang sama – Basic Service Set

Infrastructure Wireless LAN

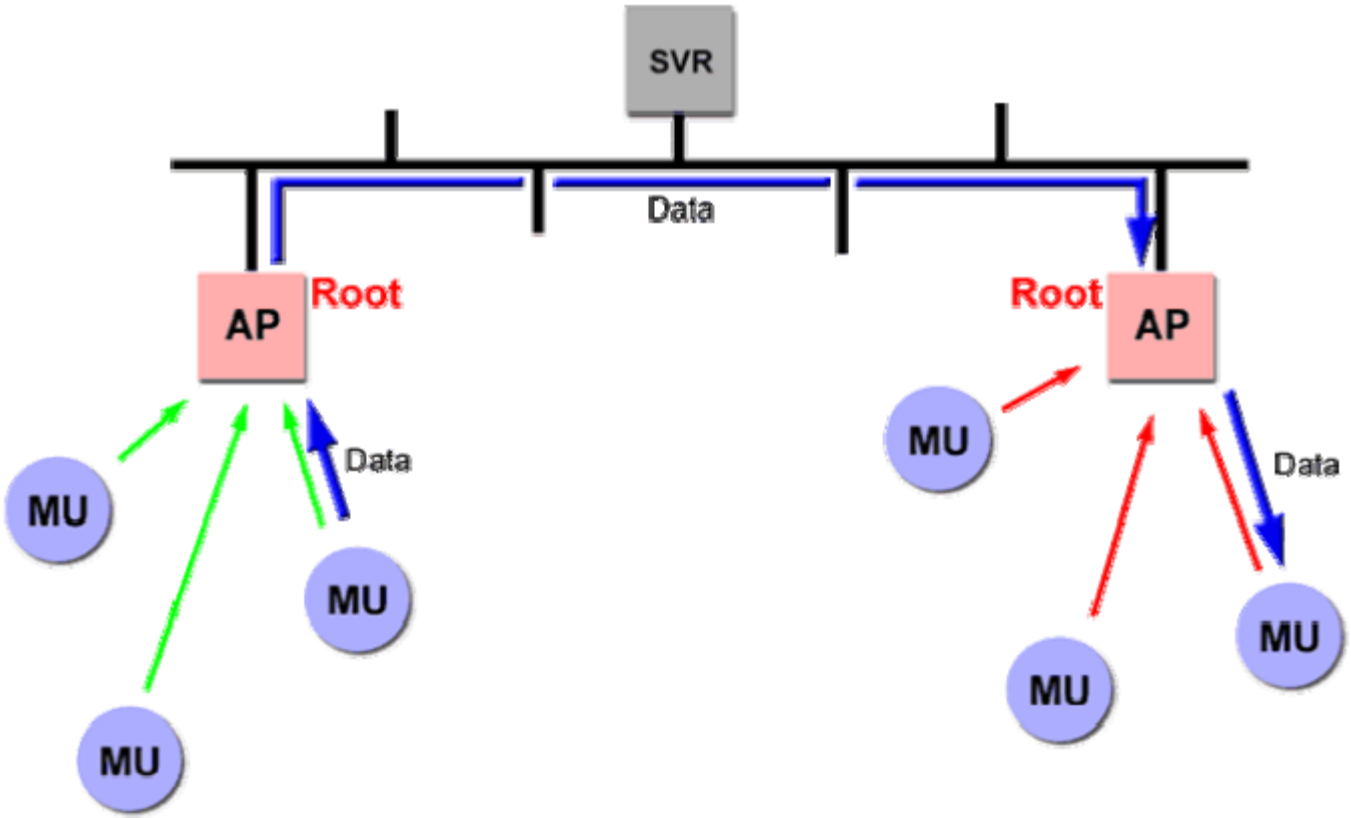


(a) Infrastructure Wireless LAN

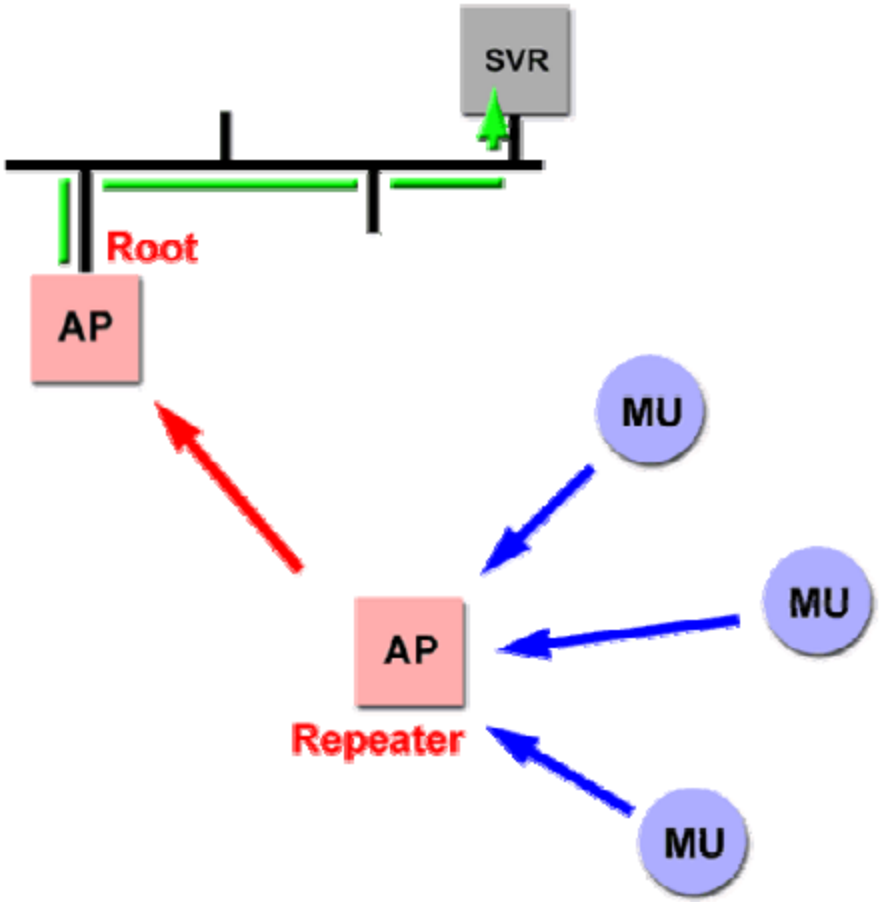
Multi-Cell Wireless LAN Configuration (Infrastructure Network)



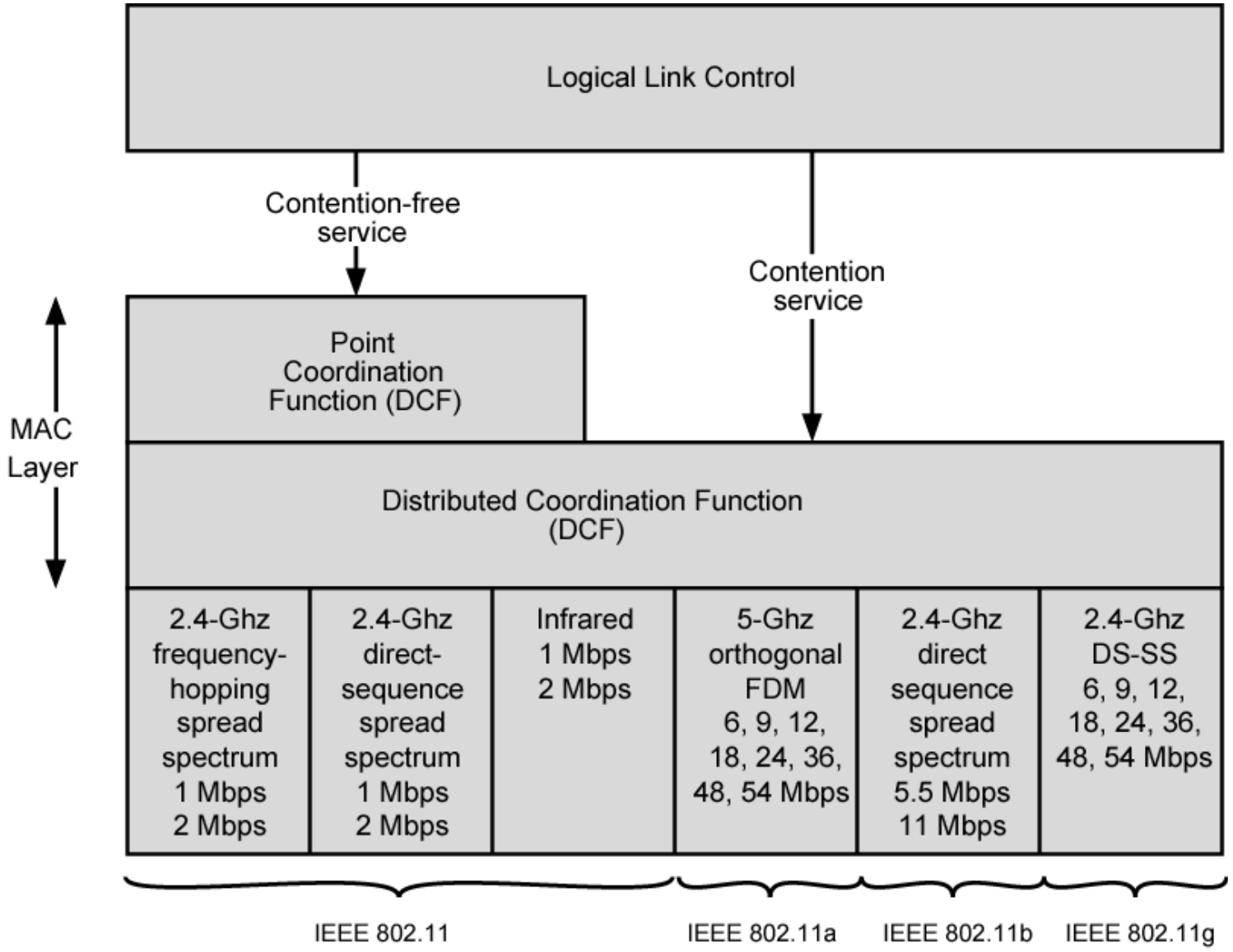
Access Point dalam “Root Mode”



Access Point dalam “Repeater Mode”



IEEE 802.11 Protocol Architecture



Why Choose? A vs B vs G

Wireless Technology Comparison Chart

Wireless Standard	802.11b	802.11a	802.11g
Popularity	Widely adopted. Readily available everywhere.	New technology.	New technology with rapid growth expected.
Speed	11 Mbps — Up to 11Mbps (note: cable modem service typically averages no more than 4 to 5Mbps).	54 Mbps — Up to 54Mbps (5X greater than 802.11b).	54 Mbps — Up to 54Mbps (5X greater than 802.11b).
Relative Cost	Inexpensive.	Relatively more expensive.	Relatively inexpensive.
Frequency	2.4 GHz — More crowded 2.4GHz band. Some conflict may occur with other 2.4GHz devices like cordless phones, microwave ovens, etc.	5 GHz — Uncrowded 5GHz band can coexist with 2.4 GHz networks without interference.	2.4 GHz — More crowded 2.4GHz band. Some conflict may occur with other 2.4GHz devices like cordless phones, microwave ovens, etc.
Range	100-150 — Good Range. Typically up to 100-150 feet indoors, depending on construction, building materials, room layout.	25-75 — Shorter range than 802.11b & 802.11g. Typically 25 to 75 feet indoors.	100-150 — Good Range. Typically up to 100-150 feet indoors, depending on construction, building materials, room layout.
Public Access	The number of public "hotspots" is growing rapidly, allowing wireless connectivity in many airports, hotels, college campuses, public areas, and restaurants.	None at this time.	Compatible with current 802.11b hotspots (at 11Mbps). Also, it is expected that most 802.11b hotspots will quickly convert to 802.11g.
Compatibility	OK 802.11b — Widest adoption.	OK 802.11a — Incompatible with 802.11b or 802.11g.	OK 802.11b 802.11g — Interoperates with 802.11b networks (at 11Mpbs). Incompatible with 802.11a.

Kecepatan WiFi

Protokol	Frekuensi	Lebar Kanal	MIMO	Kecepatan data maksimum (teoretis)
802.11ax	2,4 atau 5 GHz	20, 40, 80, 160 MHz	Multi Pengguna (MU-MIMO)	2,4 Gbps[1]
802.11ac wave2	5 GHz	20, 40, 80, 160 MHz	Multi Pengguna (MU-MIMO)	1,73 Gbps[2]
802.11ac wave1	5 GHz	20, 40, 80 MHz	Pengguna Tunggal (SU-MIMO)	866,7 Mbps[2]
802.11n	2,4 atau 5 GHz	20, 40 MHz	Pengguna Tunggal (SU-MIMO)	450 Mbps[3]
802.11g	2,4 GHz	20 MHz	N/A	54 Mbps
802.11a	5 GHz	20 MHz	N/A	54 Mbps
802.11b	2,4 GHz	20 MHz	N/A	11 Mbps
Lama 802.11	2,4 GHz	20 MHz	N/A	2 Mbps

[1] 2 Aliran spasial dengan modulasi 1024-QAM.
[2] 2 Aliran spasial dengan modulasi 256-QAM.
[3] 3 Aliran spasial dengan modulasi 64-QAM.

Benefits of A vs B vs G

802.11b
Wireless-B

- Lowest price
- Excellent signal range
- Coverage penetrates most walls
- Works with public hotspots

802.11a
Wireless-A

- Supports more users per room
- Unaffected by interference from 2.4GHz devices
- Can co-exist with B and G networks
- Coverage limited To one room

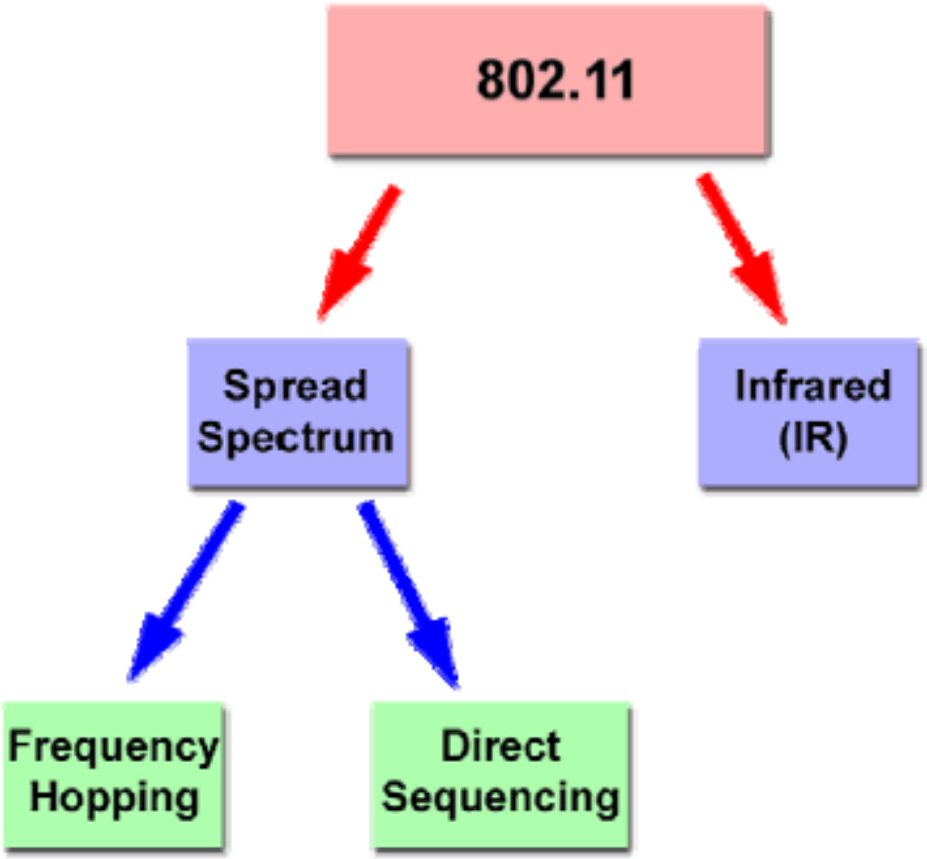
802.11g
Wireless-G

- Best value - only 10% premium for 5 times the speed of Wireless-B
- Compatible with Wireless-B networks and hotspots
- Excellent signal range
- Coverage penetrates most walls

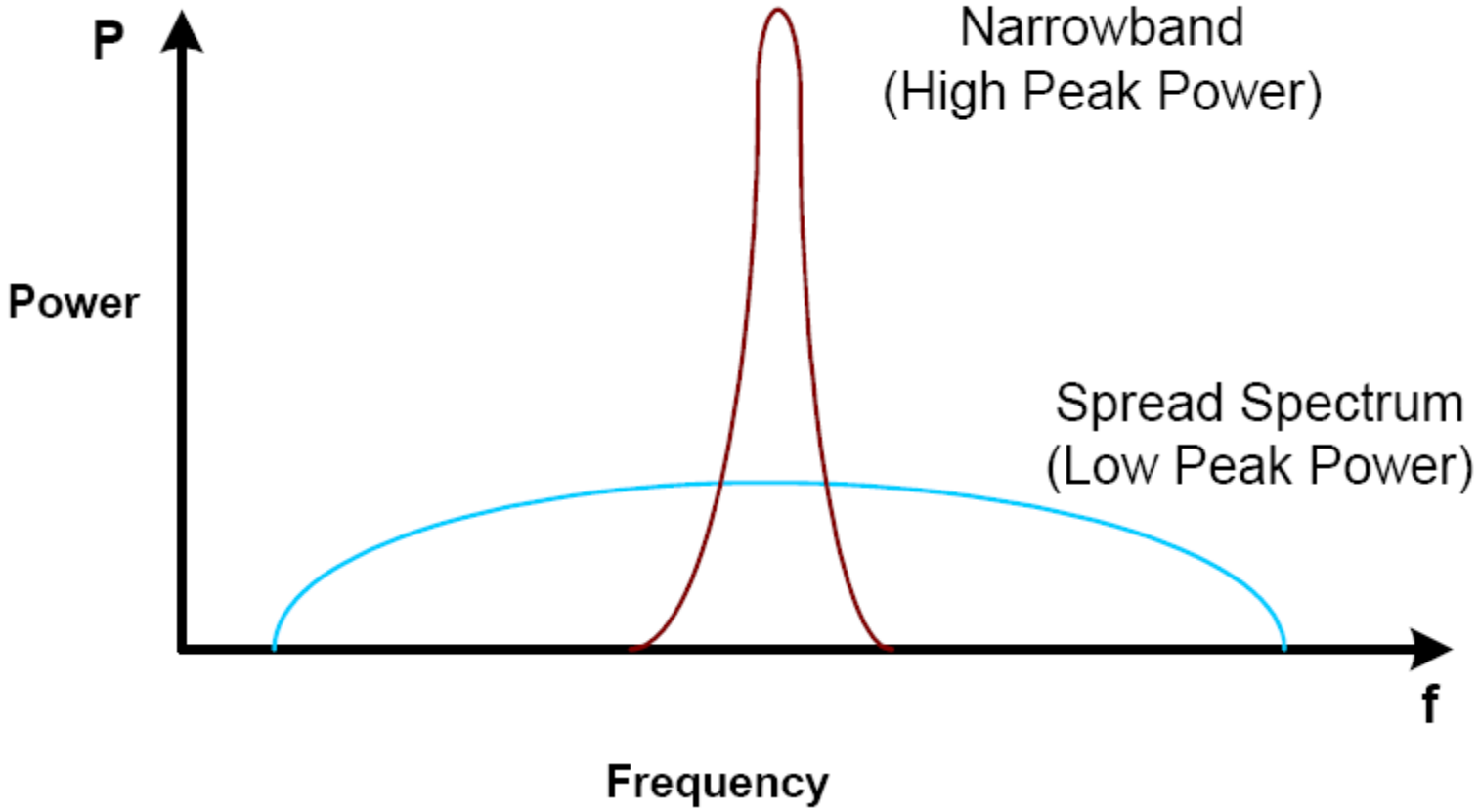
Table 1. IEEE 802.11 WLAN standards.

Standard	Spectrum	Maximum physical rate	Layer 3 data rate	Transmission	Compatible with	Major disadvantage	Major advantage(s)
802.11	2.4 GHz	2 Mbps	1.2 Mbps	FHSS/DSSS	None	Limited bit rate	Higher range
802.11a	5.0 GHz	54 Mbps	32 Mbps	OFDM	None	Smallest range of all 802.11 standards	Higher bit rate in less-crowded spectrum
802.11b	2.4 GHz	11 Mbps	6-7 Mbps	DSSS	802.11	Bit rate too low for many emerging applications	Widely deployed; higher range
802.11g	2.4 GHz	54 Mbps	32 Mbps	OFDM	802.11/ 802.11b due to narrow spectrum	Limited number of colocated WLANs higher range than 802.11a	Higher bit rate in 2.4-GHz spectrum

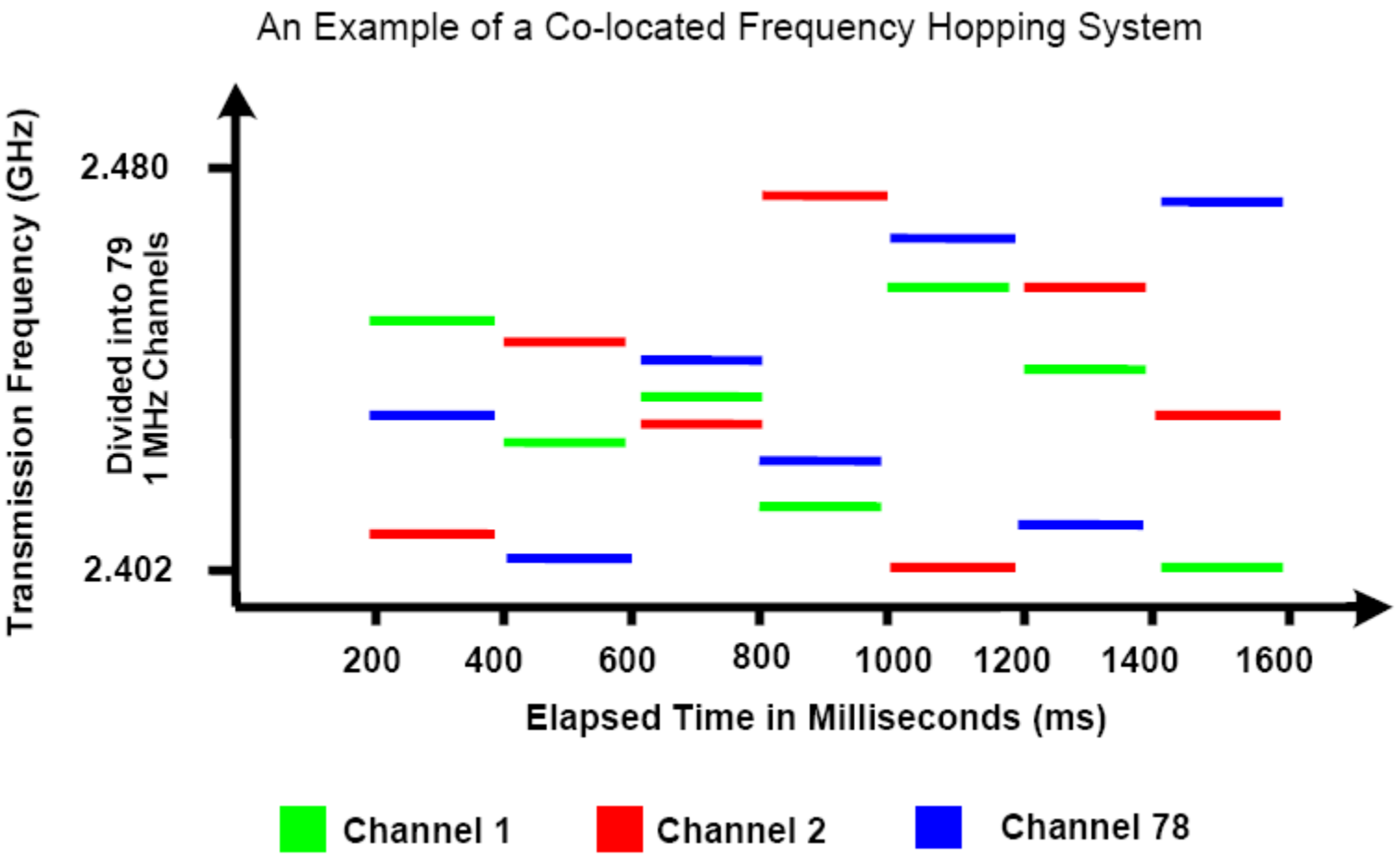
802.11 Physical Layer



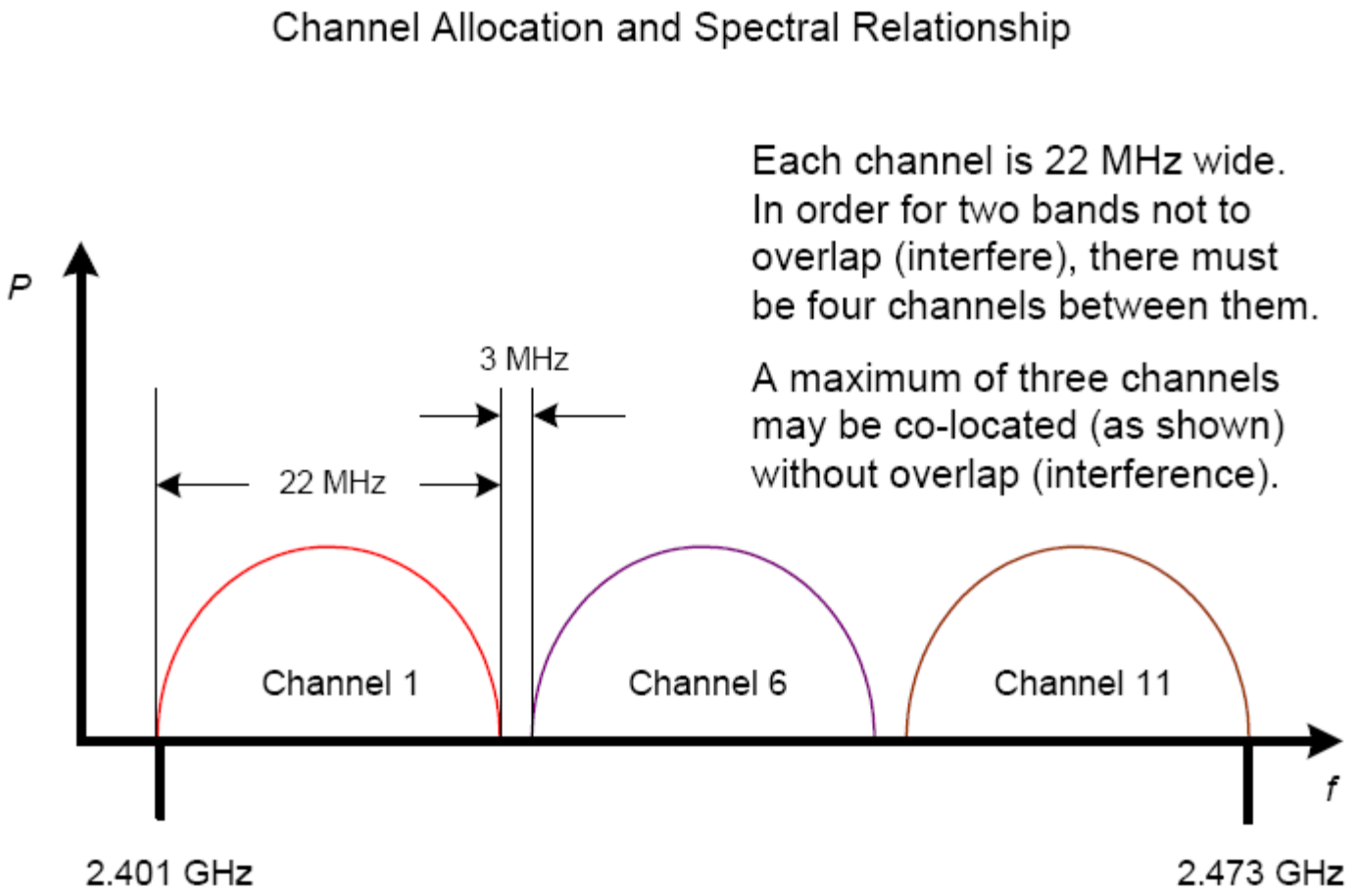
Spread Spectrum



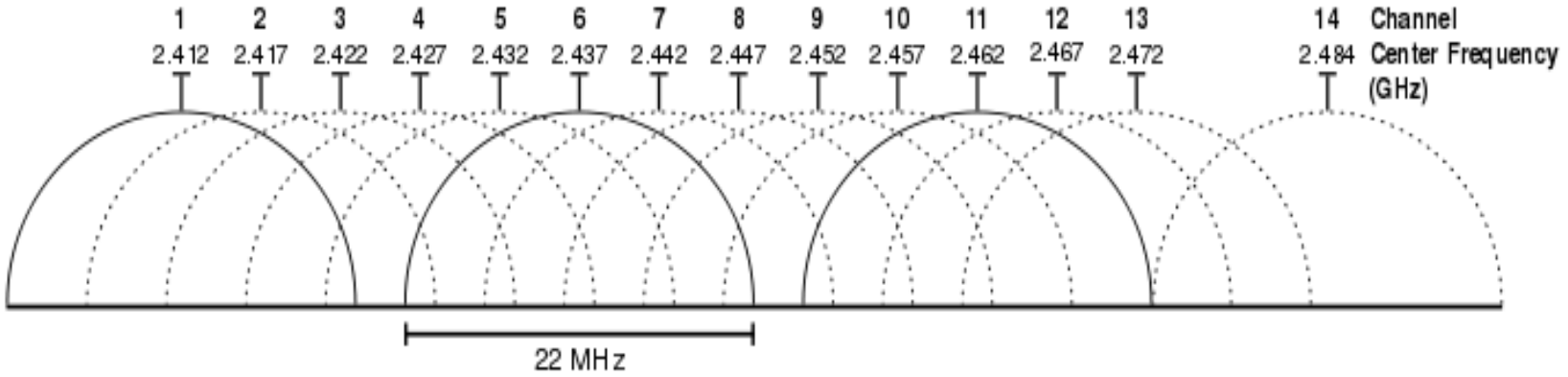
Frequency Hopping Spread Spectrum



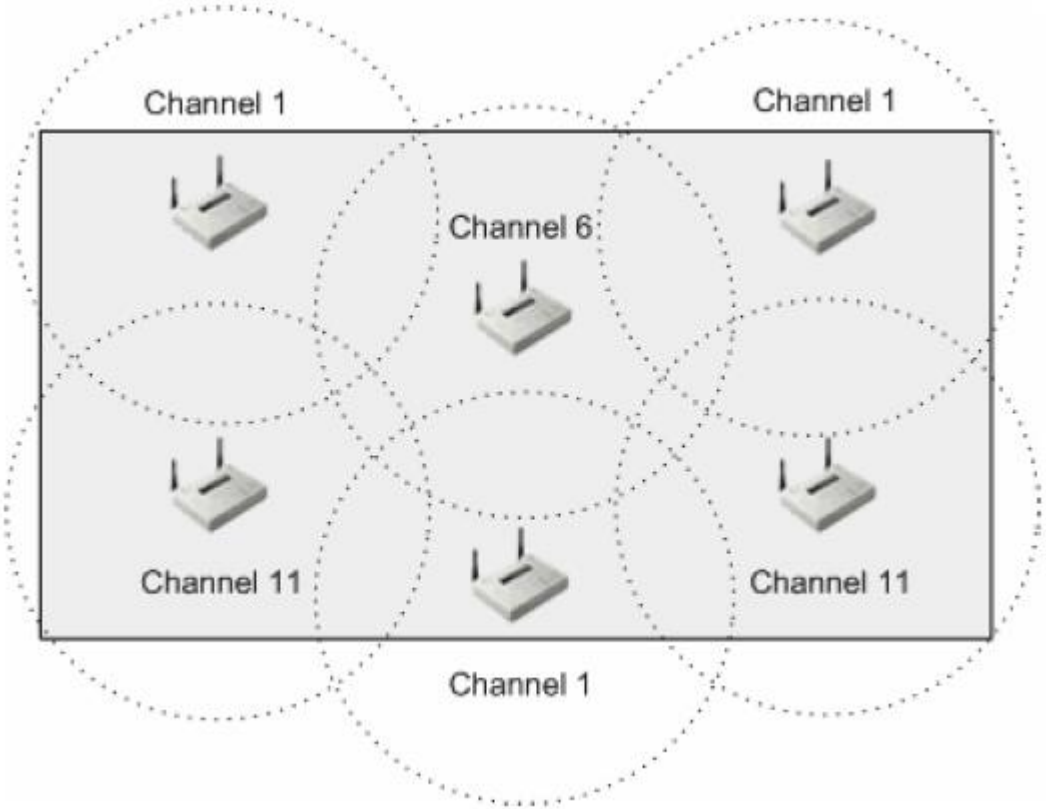
Direct Sequencing Spread Spectrum



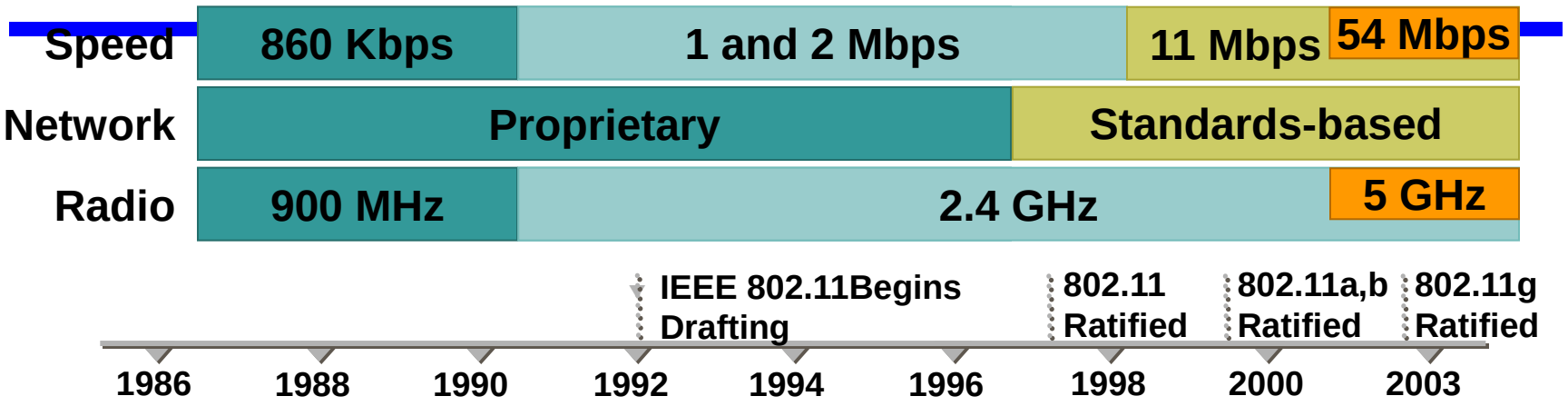
Representasi Grafis Wi-Fi channels di 2.4 GHz band



Channel Reuse



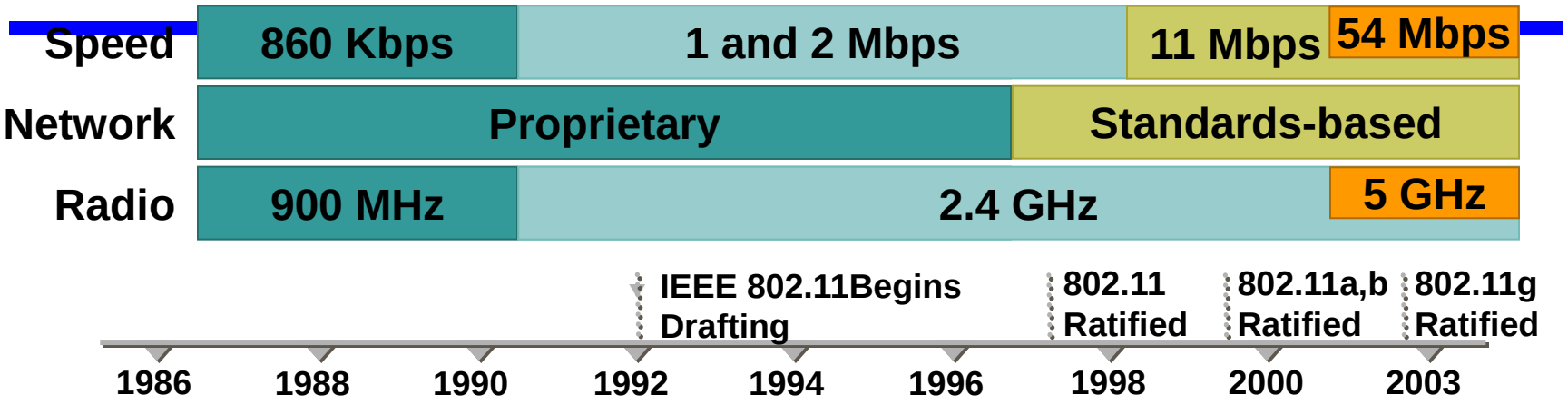
Standards – a, b, g



- **802.11a**
  - Up to 54 Mbps
  - 5 GHz
  - Not compatible with either 802.11b or 802.11g
- **802.11b**
  - Up to 11 Mbps
  - 2.4 GHz
- **802.11g**
  - Up to 54 Mbps
  - 2.4 GHz

802.11g is backwards compatible with 802.11b, but with a drawback (later)

Teknologi 802.11 PHY (Physical Layer)



- Tiga jenis transmisi radio dalam pita frekuensi 2,4 GHz unlicensed:
  - Frequency hopping spread spectrum (FHSS) 802.11b (not used)
  - Direct sequence spread spectrum (DSSS) 802.11b
  - Orthogonal frequency-division multiplexing (OFDM) 802.11g
- Salah satu jenis transmisi radio dalam pita frekuensi 5 GHz unlicensed:
  - Orthogonal frequency-division multiplexing (OFDM) 802.11a

WLAN Devices: Access Points

Infrastruktur Dalam Gedung

- **1200 Series (802.11a and 802.11b)**
- **1100 Series (802.11b)**

Wireless LAN Devices: Client Adapters

Clients (NICs)

- **350 Series (802.11b)**
- **5 GHz client adapter (802.11a)**

Driver didukung untuk semua sistem operasi.

Wireless LAN Devices: Antennas

Antenna

- **2.4GHz Antennas**
- **5 GHz Antennas**

Indoor Vs Outdoor

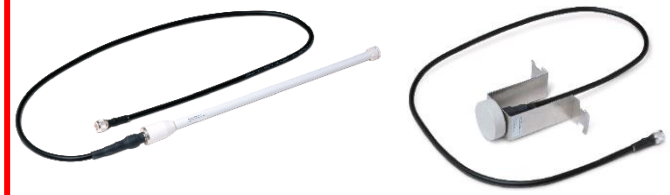
Antennas

- **Indoor and Outdoor**
- **WLAN and Bridging**

- 2.4 GHz

- **Outdoor**
- **Bridging**

- 5 GHz



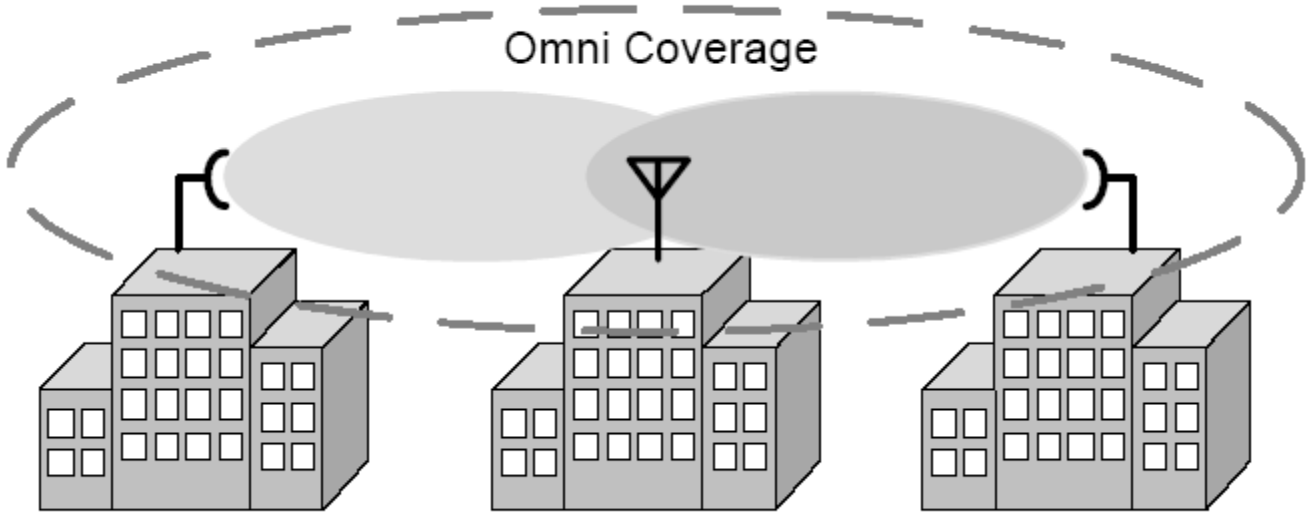
Dipole / Omni Antenna

Omni Ceiling Mount Antenna

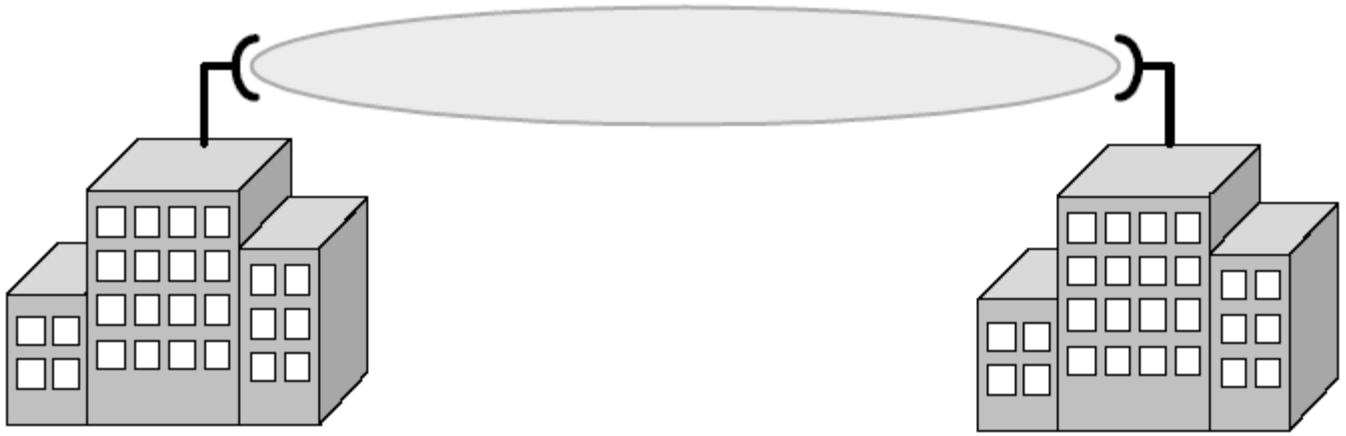
Omni Ground Plane Antenna

Omni Pillar Mount Antenna

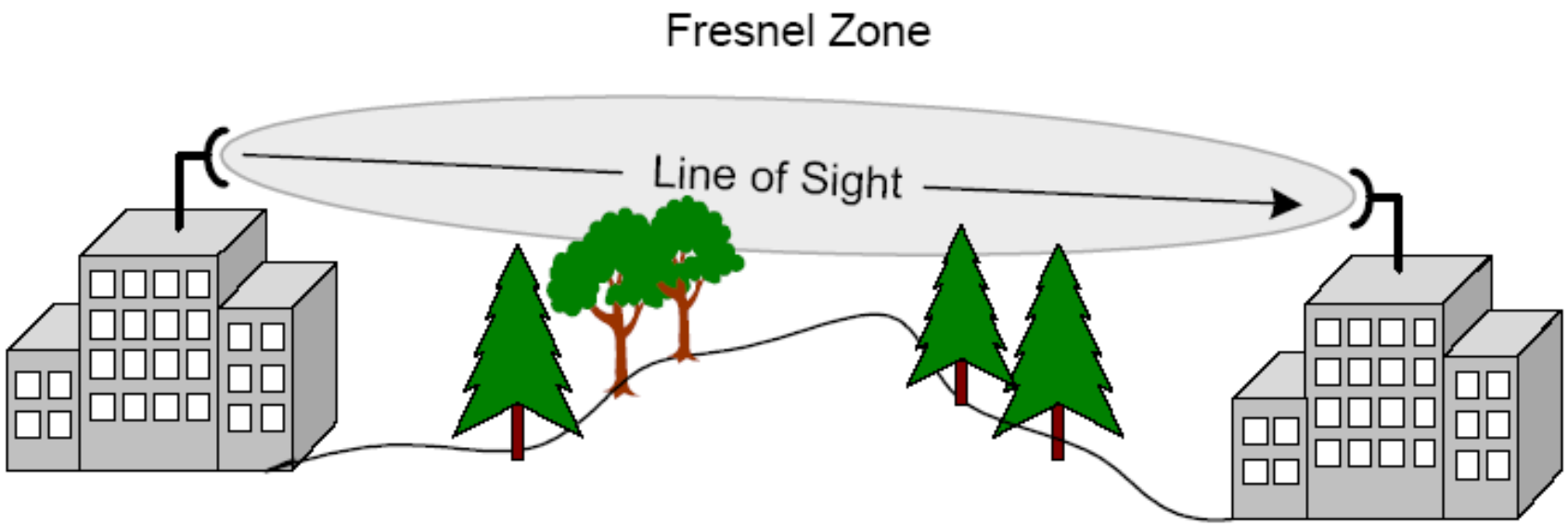
Point to Multipoint Link



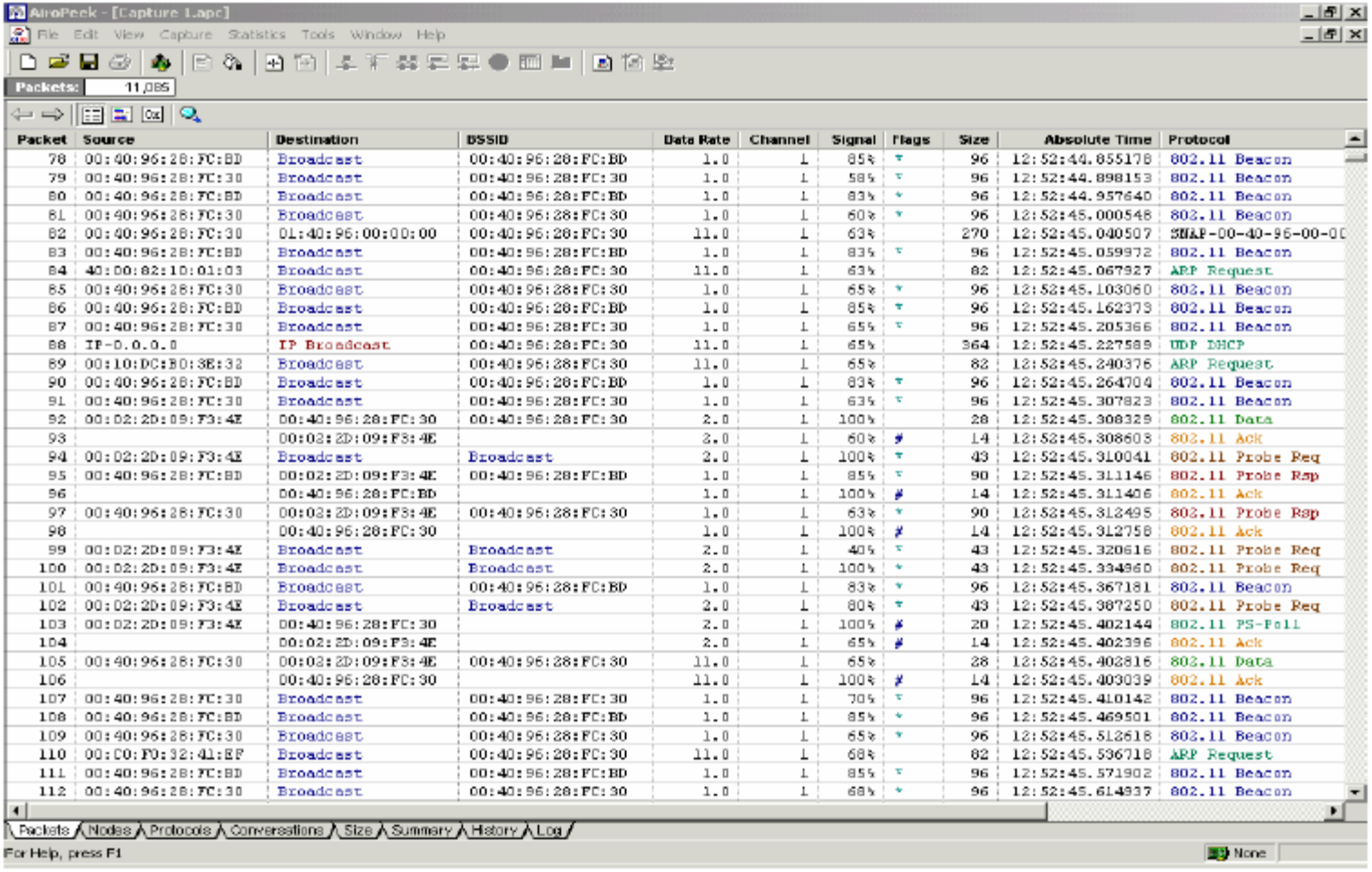
Point-to-point Wireless Link



Antenna



Packet Analysis



Data Encryption

Transmisi Informasi yang Aman

- Physical layer
  - Keamanan fisik transmisi data diperoleh dengan menggunakan teknologi spektrum tersebar yang membuatnya tahan terhadap gangguan
- MAC (Medium Access Control) layer
  - Algoritma enkripsi disebut Wired Equivalent Privacy (WEP)
    Gunakan kunci enkripsi statis.
  - Wi-Fi Protected Access (WPA)
    WPA menggunakan Temporal Key Integrity Protocol (TKIP), yang mengubah kunci dengan setiap paket data.

Survei Lokasi

- Membantu menentukan cakupan area, kecepatan data, penempatan Access Point yang tepat.
- Kumpulkan informasi: membuat diagram area cakupan dan mengukur kekuatan sinyal, SNR (signal to noise ratio), tingkat interferensi RF

Survei Lokasi