KOMUNIKASI NIRKABEL BROADBAND

Arsitektur Sistem Komunikasi Nirkabel Broadband (Fix Broadband) – Wifi & Fix Wimax

By : Dwi Andi Nurmantris

IEEE 802.11 (Wifi)

- IEEE (Institute of Electrical and Electronics Engineers) established the 802.11 Group in 1990. Specifications for standard ratified in 1997.
- Founded by the Wireless Ethernet Communications Alliance (Wifi Alliance)
- Member companies such as 3COM, Cisco, Compaq etc.
- All WiFi products are 802.11➔ All 802.11 products are not necessarily WiFi.
- “Wi-Fi” adalah merek dagang Wi-Fi Alliance dan Dipatenkan oleh WI-FI Alliance pada Agustus 1999

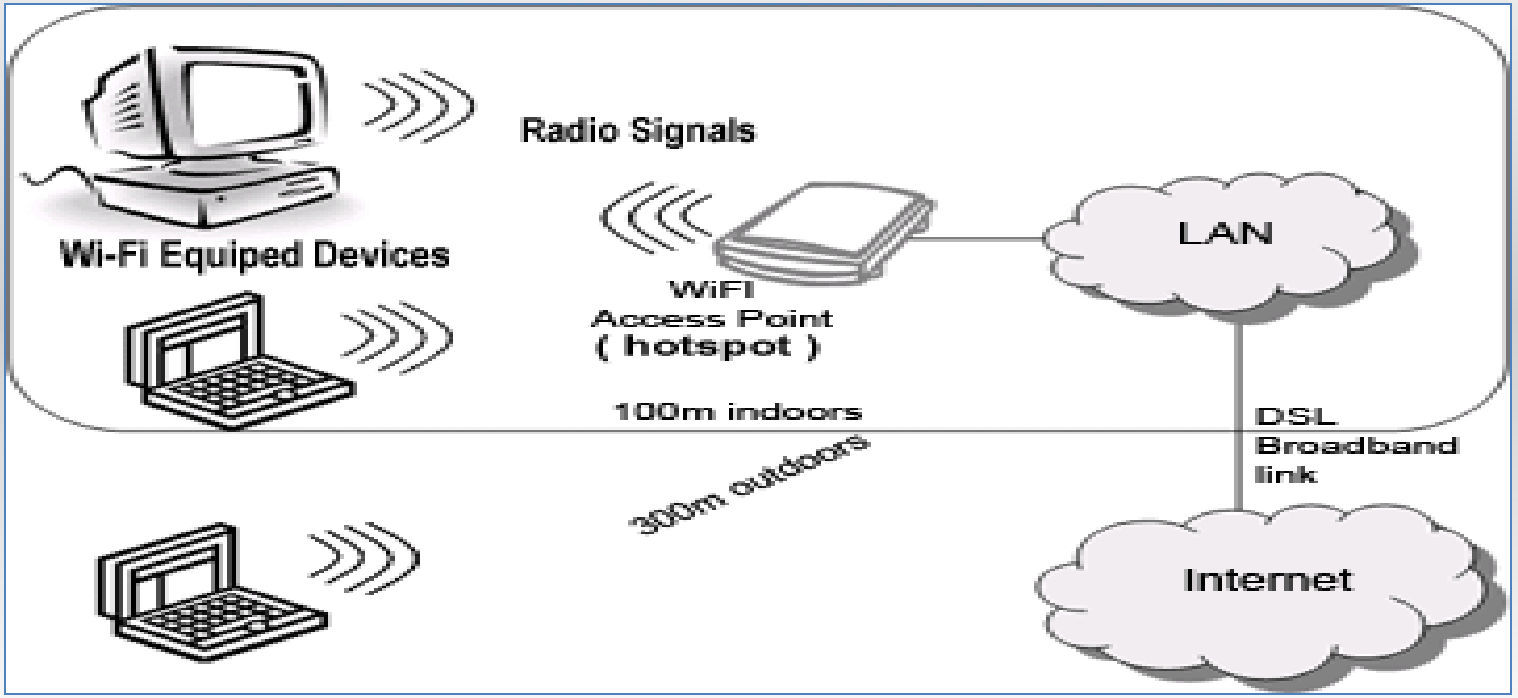
IEEE 802.11 (WiFi)

- Wi-Fi has grown from being just a LAN cable replacement technology to a public wireless access technology.
- Cheap and readily available equipment.
- WiFi has been viewed as complementary to 3G and other mobile standards as it has worked to enhance mobile services offered by operators.
- It’s coverage is not as great as that of 3G or 4G, but it gives a stable and higher transmission rate * than mobile technology.
- Handoff between WiFi access points is still not possible and, therefore, it is known more as a wireless access technology than a mobile technology.

How WiFi Work?

There are three most important items which makes Wi-Fi working in your laptop or desktop. These are,

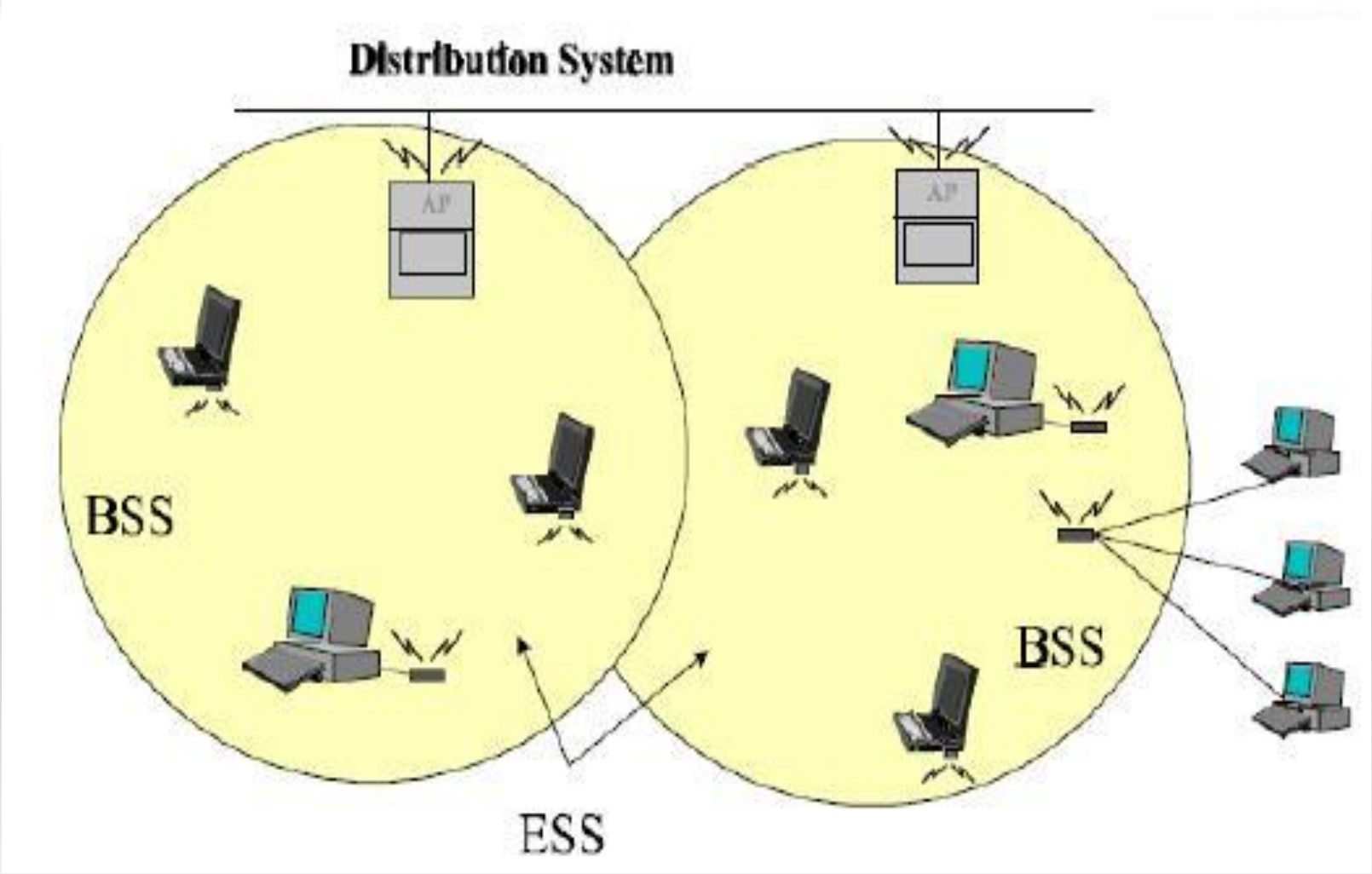
- ❖Radio Signals
- ❖Wi-Fi Card which fits in your laptop or computer.
- ❖Hotspots which create Wi-Fi Network.



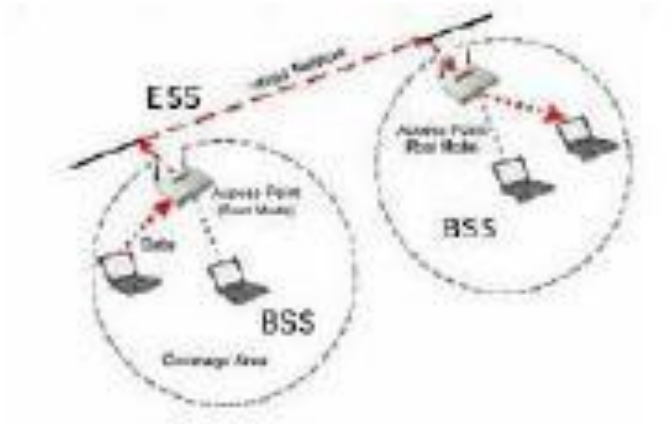
How to Connect WiFi Network?

- A Wi-Fi hotspot is created by installing an access point to an internet connection.
- An access point acts as a base station.
- When Wi-Fi enabled device encounters a hotspot the device can then connect to that network wirelessly.
- A single access point can support up to 30 users and can function within a range of 100 – 150 feet indoors and up to 300 feet outdoors.
- Many access points can be connected to each other via Ethernet cables to create a single large network.

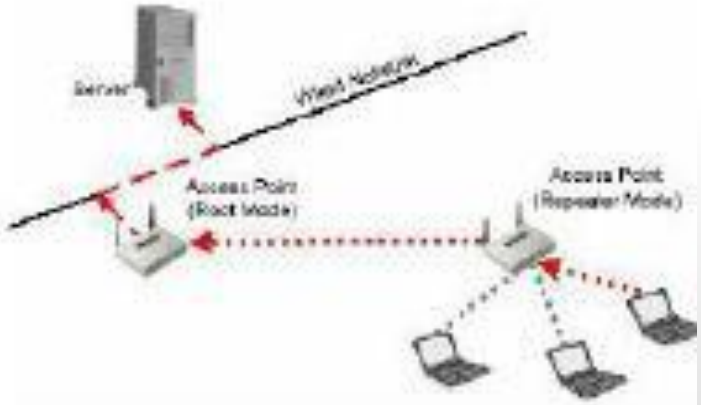
Arsitektur WiFi



Arsitektur WiFi



Infrastructure Mode

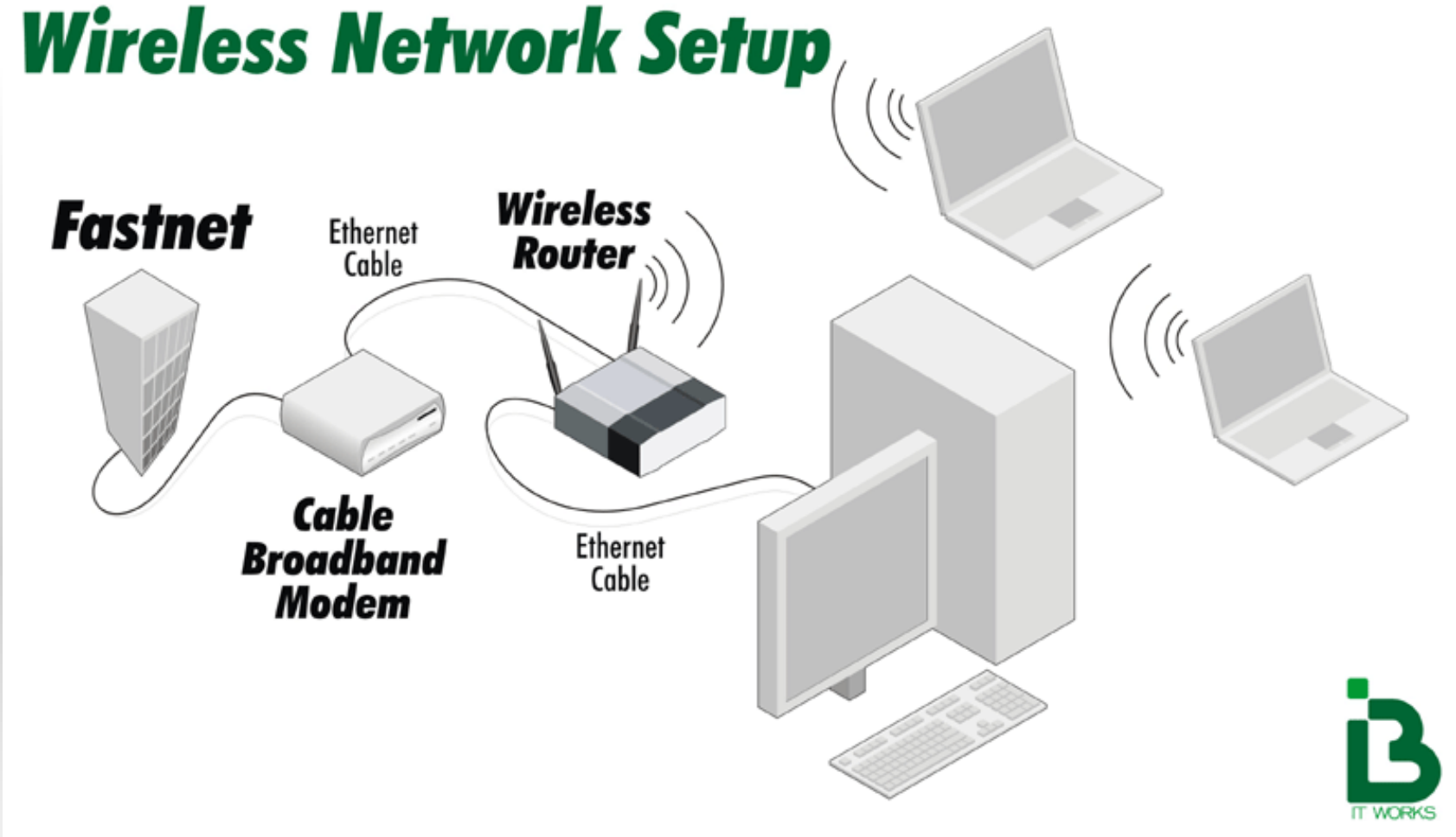


Repeater Mode

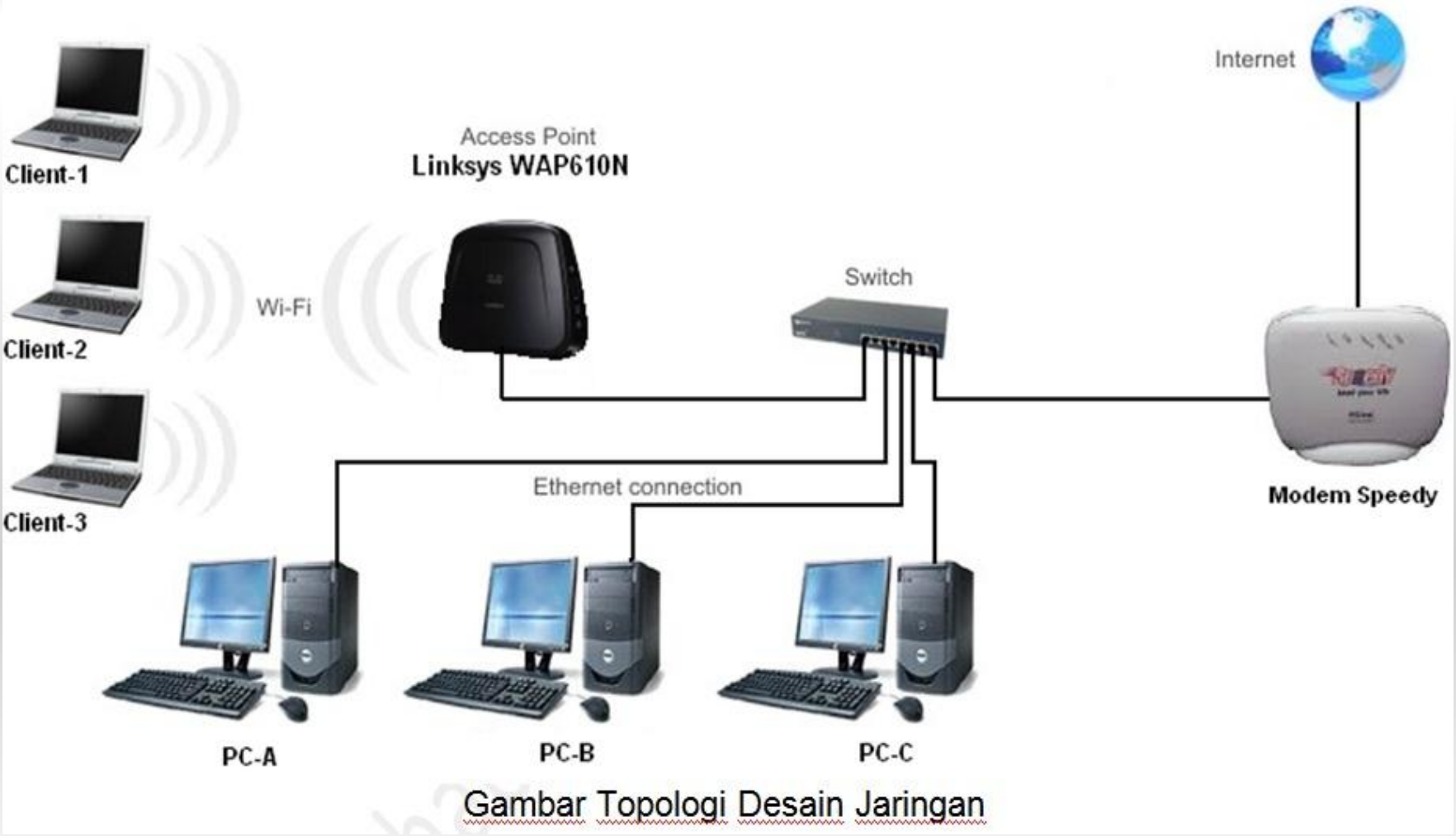
Bridge Mode

Ad-hoc Mode

Contoh Implementasi WiFi



Contoh Implementasi WiFi

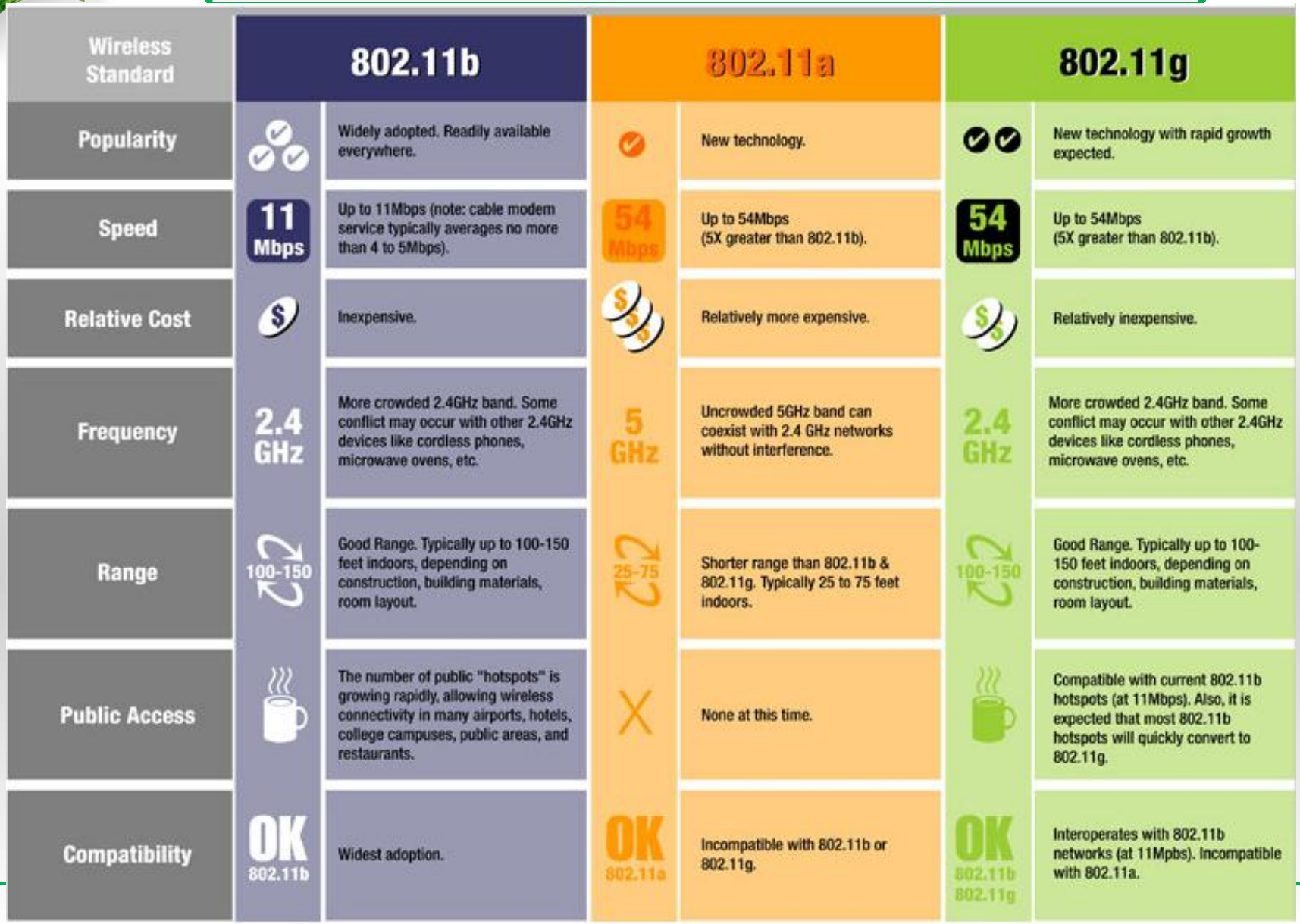


Gambar Topologi Desain Jaringan

IEEE 802.11 (WiFi)

Protocols	Release Date	Op. Frequency	Date Rate (Typ)	Date Rate (Max)	Range (indoor)
Legacy	1997	2.4 – 2.5 GHz	1 Mbit/s	2 Mbit/s	?
802.11a	1999	5.15-5.35/5.47-5.725/5.725-5.875 GHz	25 Mbit/s	54 Mbit/s	~30 meters (~100 feet)
802.11b	1999	2.4 – 2.5 GHz	6.5 Mbit/s	11 Mbit/s	~50 meters (~150 feet)
802.11g	2003	2.4 – 2.5 GHz	11 Mbit/s	54 Mbit/s	~30 meters (~100 feet)
802.11n	2006 (draft)	2.4 GHz or 5GHz bands	200 Mbit/s	540 Mbit/s	~50 meters (~160 feet)

IEEE 802.11 (WiFi)



IEEE 802.11 Specs. (WiFi)

	802.11b	802.11g	802.11a
Max. Speed	11 Mbps	54 Mbps	54 Mbps
Modulation	CCK	CCK & OFDM	OFDM
Frequency	2.4 – 2.497 Ghz	2.4 – 2.497 Ghz	5 Ghz
Approval	July 1999	June 2003	July 1999

IEEE 802.11 Specs. (WiFi)

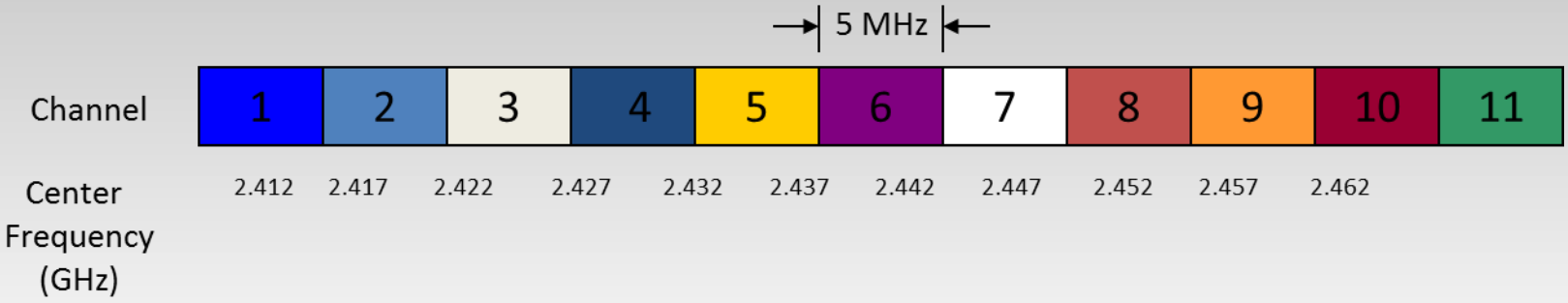
Frekuensi Kerja

- The 802.11 suite has been developed to enable wireless local area networking in either the 2.4 GHz or 5.2 GHz frequency bands.
- Specifically, the frequencies used by 802.11 fall in the unlicensed bands, these are frequency bands which anyone can use for radio communication (without a license) as long as their radio waves do not radiate too much power.
- The exact frequencies used (and how they are used) depends on whether the system follows 802.11b, 802.11a, or 802.11g.

IEEE 802.11 Specs. (WiFi)

802.11b

- The 802.11b standard defines a total of 14 frequency channels.
- FCC allows channels 1 through 11 within the U.S. Most of Europe can use channels 1 through 13. In Japan, only 1 choice: channel 14.
- Channel represents a center frequency. Only 5 MHz separation between center frequencies of channels.



IEEE 802.11 Specs. (WiFi)

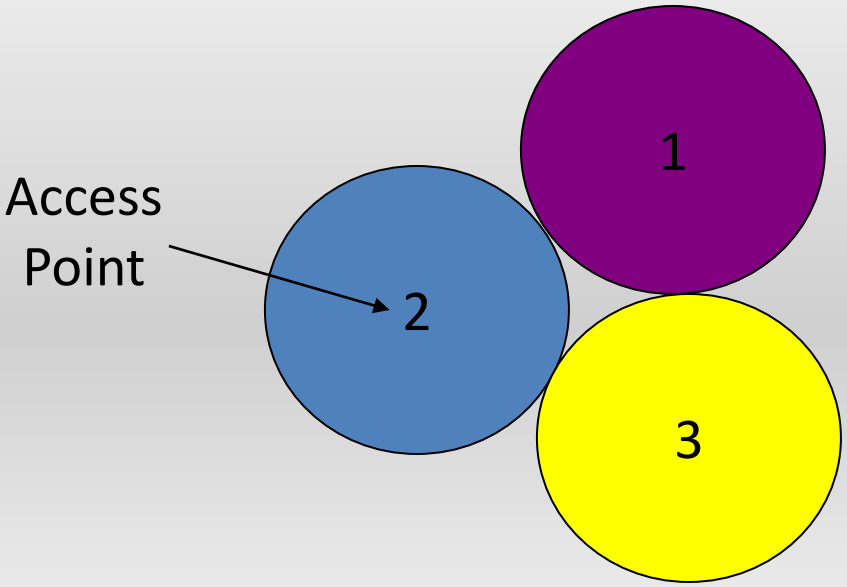
802.11b

- Any 802.11b signal occupies approximately 30 MHz.
- Thus, 802.11b signal overlaps with several adjacent channel frequencies.
- Only three channels (channels 1, 6, and 11 for the U.S.) that can be used without causing interference between access points.
- Any given area can therefore support at most 3 access points (operating on different channels) at once. Equivalently, it can at most support three local ad-hoc connections.

IEEE 802.11 Specs. (WiFi)

802.11b

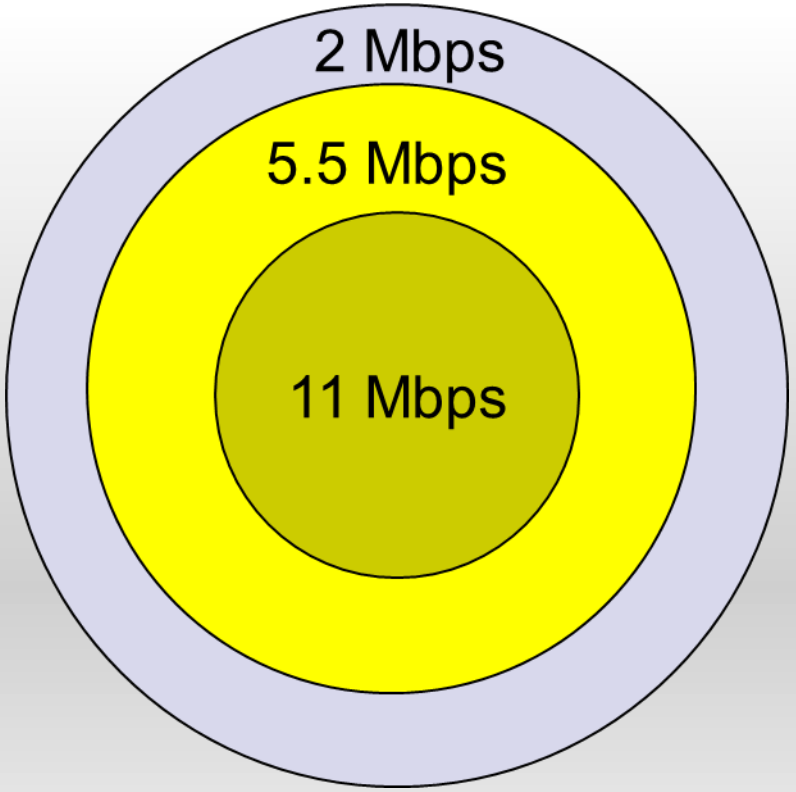
Neighboring AP's use different channels to reduce interference. "Reuse cluster" size is equal to 3.



IEEE 802.11 Specs. (WiFi)

802.11b

- Ideally, 802.11b supports wireless connections between an access point and a wireless device at four possible data rates: 1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps.
- Specifically, as terminal travels farther from its AP, the connection will remain intact but connection speed decreases (falls back).



IEEE 802.11 Specs. (WiFi)

802.11a

- 802.11a specification operates at radio frequencies between 5.15 and 5.825 GHz, i.e. 802.11a utilizes 300 MHz bandwidth
- The FCC has divided total 300 MHz in this band into three distinct 100 MHz bands: low, middle, and high, each with different legal maximum power.

	Band	Channel	Max Power
High band	5.725-5.825 GHz	9-12	1000 mW
Middle band	5.25-5.35 GHz	5-8	250 mW
Low band	5.15-5.25 GHz	1-4	50 mW

IEEE 802.11 Specs. (WiFi)

802.11a

- Because of high power output, high band used for building-to-building products. Lower two bands suitable for in-building wireless products
- In 802.11a, radio signals are generated using a method called Orthogonal Frequency Division Multiplexing (OFDM).
- OFDM is defined over the lower two bands (low and middle).

IEEE 802.11 Specs. (WiFi)

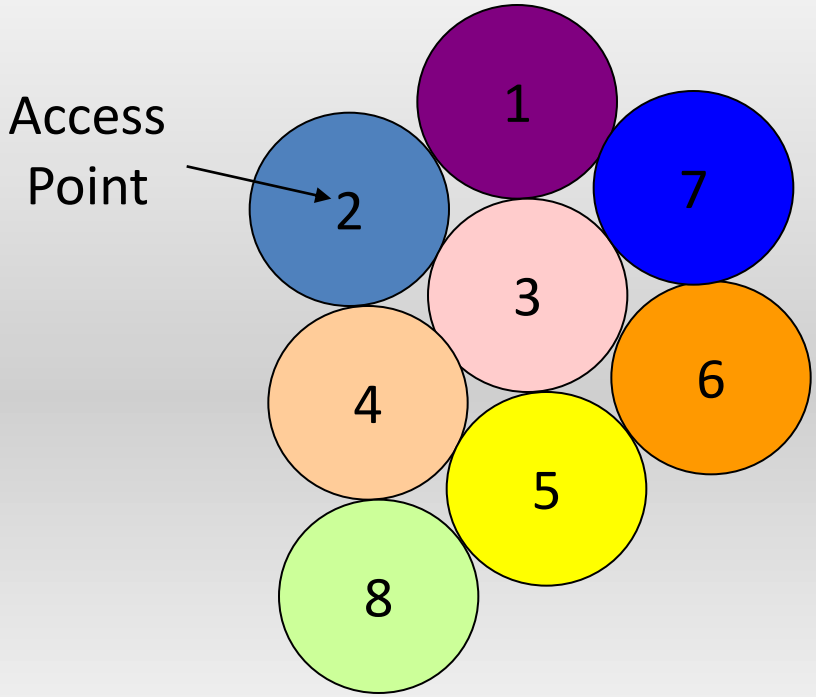
802.11a

- The low and middle bands have a total of 200 MHz of frequency.
- This 200 MHz supports 8 non-overlapping channels
- Depending on the number of subcarriers chosen, the transmitter can achieve transmission rates of 6, 9, 12,18, 24, 36, 48, or 54 Mbps.
- Since there are eight non-overlapping channels, 802.11a can support 8 different access-point to wireless device links in a given location. Or equivalently, it can support at most 8 ad hoc connections simultaneously.
- This is an improvement over 802.11b, where only 3 could be supported

IEEE 802.11 Specs. (WiFi)

802.11a

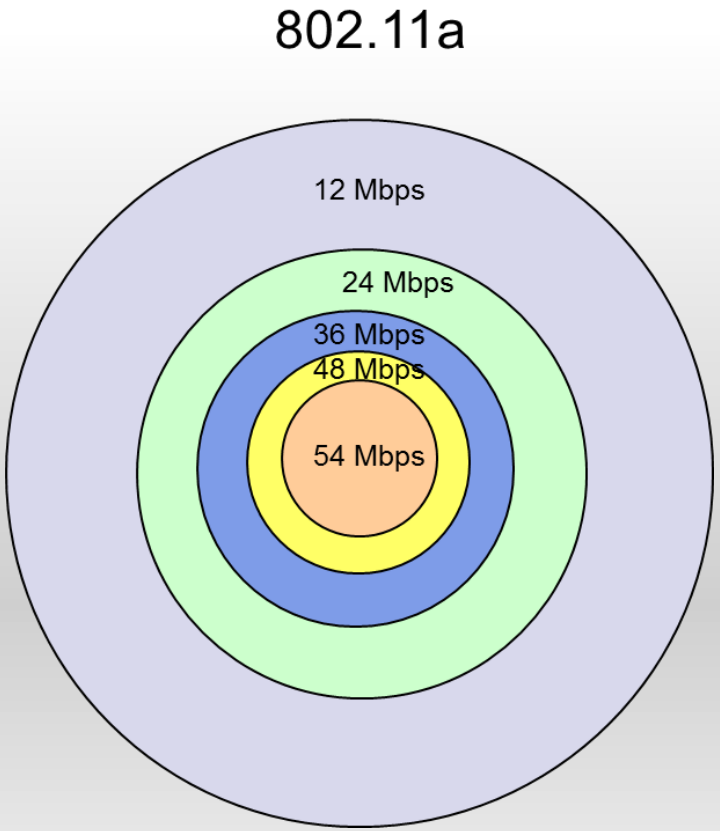
Neighboring AP's use different channels to reduce interference. "Reuse cluster" size is equal to 8.



IEEE 802.11 Specs. (WiFi)

802.11a

- The various data rates are supported in 802.11a by varying the number of subcarriers, the modulation scheme, etc.
- 802.11a (like 11b) has a rate fall back mechanism, i.e., as the distance between the transmitter and receiver increases, the supported data rate decreases.



IEEE 802.11 Specs. (WiFi)

802.11g

- 802.11g offers throughput of 802.11a with backward compatibility of 802.11b.
- 802.11g operates over 3 non-overlapping channels.
- 802.11g operates in 2.4 GHz band but it delivers data rates from 6 Mbps to 54 Mbps.
- 802.11g also uses OFDM but supports spread-spectrum capabilities if any one component of the system has older equipment, i.e., 802.11b equipment.
- Once again, 802.11g's "backward compatibility" with 802.11b means that when a mobile 802.11b device joins an 802.11g access point, all connections on that access point slow down to 802.11b speeds.

IEEE 802.11 Specs. (WiFi)

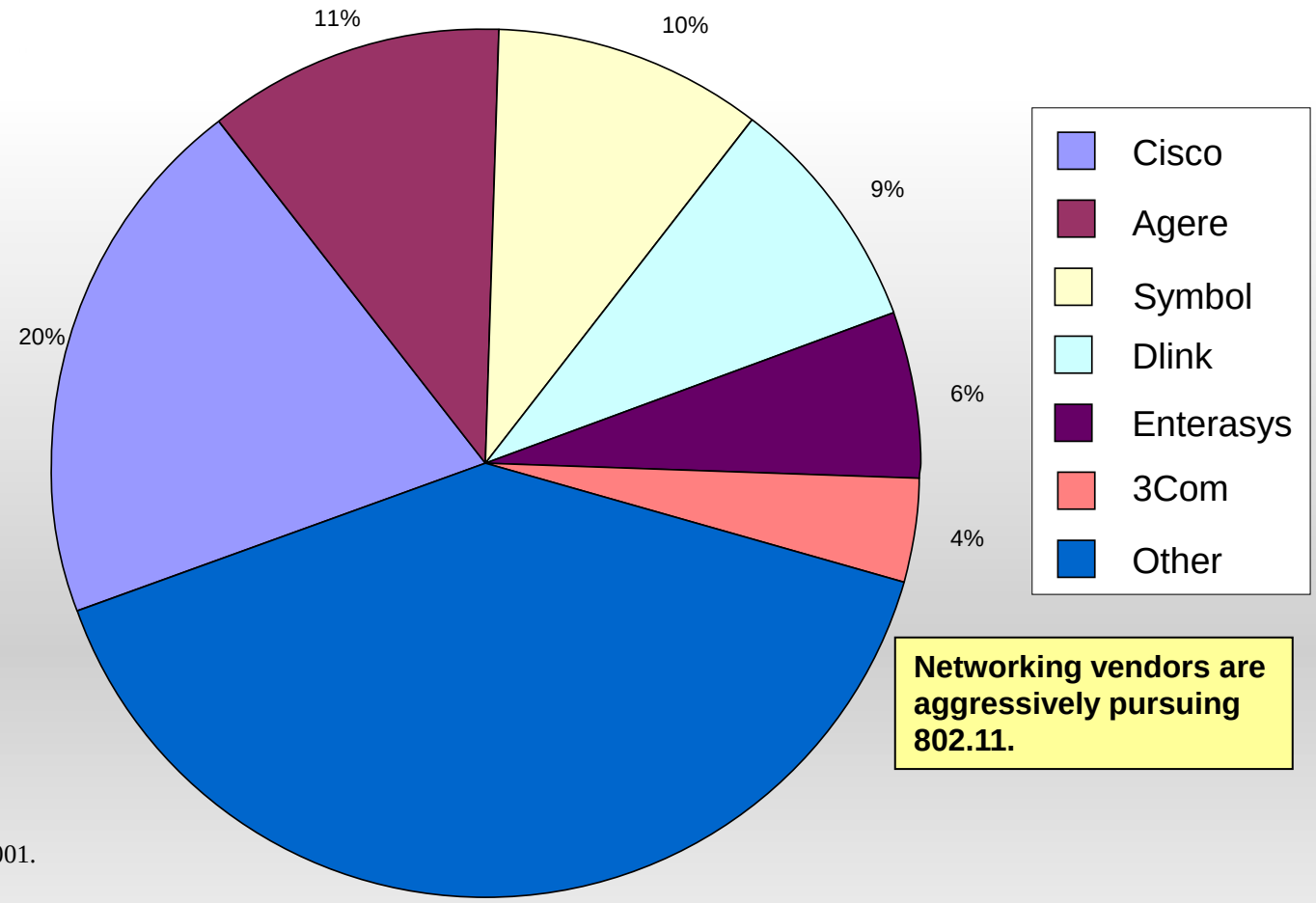
802.11a vs 802.11b vs 802.11g

- Higher number of channels in 11a allows more flexibility in avoiding interference.
- Range will depend on antenna gain, transmit power applied to the antenna, the receive sensitivity of the radio card and the obstacles between path ends.
- 802.11a has range 150-300 ft in practical scenarios. 11g has range comparable to 11b (approximately 1000 ft).
- 11a range is smaller than 11b and 11g. This is because 11a operates at a much higher frequency band.
- Generally, 802.11a is the most expensive of the three options.
- 802.11b is the cheapest and most popular WLAN option.
- 802.11g is more expensive than 11b but cheaper than 11a.
- Because of its smaller range, 11a requires more Access Points to a region, thereby increasing cost

IEEE 802.11 Specs. (WiFi)

802.11 network PHY standards										
802.11 Protocol	Release date	Frequency (Ghz)	Bandwidth (Mhz)	Stream Datarate min -- max (Mbps)	Allowable MIMO stream	Data Subcarrier Modulation	Modulation Antenna Tech	Beamforming Capability	Approx Range (meter)	
									indoor	outdoor
802.11	Jun-97	2.4	22	1 -- 2	1		DSSS, FHSS	No	20	100
802.11a	Sep-99	5	20	6 --54	1	BPSK,QPSK,16QAM,64QAM	OFDM (SISO)	No	35	120
		3.7								5K
802.11b	Sep-99	2.4	22	1 --11	1	DBPSK,DQPSK,CCK	DSSS (SISO)	No	35	140
802.11g	Jun-03	2.4	20	6 -- 54	1	BPSK,DBPSK,QPSK,DQPSK, CCK 16QAM,64QAM	OFDM, DSSS (SISO)	No	38	140
802.11n	Oct-09	2.4/5	20	7.2 -72.2 (6.5- 65)	4	BPSK, QPSK, 16-QAM, 64-QAM	OFDM (MIMO)	Yes	70	250
			40	15 - 150 (13.5 - 135					70	250
802.11ac	Dec-13	5	20	7.2 - 96.3 (6.5 - 86.7)	8	BPSK, QPSK, 16-QAM, 64-QAM 256-QAM optional	OFDM (MU-MIMO)	Yes	35	
			40	15 - 200 (13.5 - 180)					35	
			80	32.5 - 433.3 (29.2 - 390)					35	
			160	65 - 866.7 (58.5 - 780)					35	
802.11ax	next 2019	2.4/5	20/40/80/160	Up to 1134	8	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024- QAM	OFDM, OFDMA	Yes		

IEEE 802.11 (WiFi) -- vendor



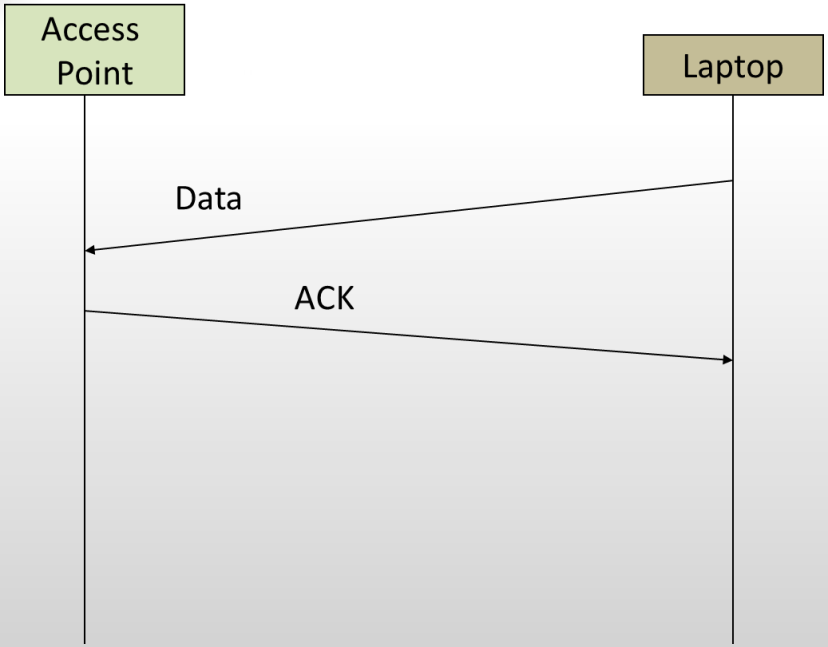
Networking vendors are aggressively pursuing 802.11.

Source: InStat, June 2001.

CSMA/CA

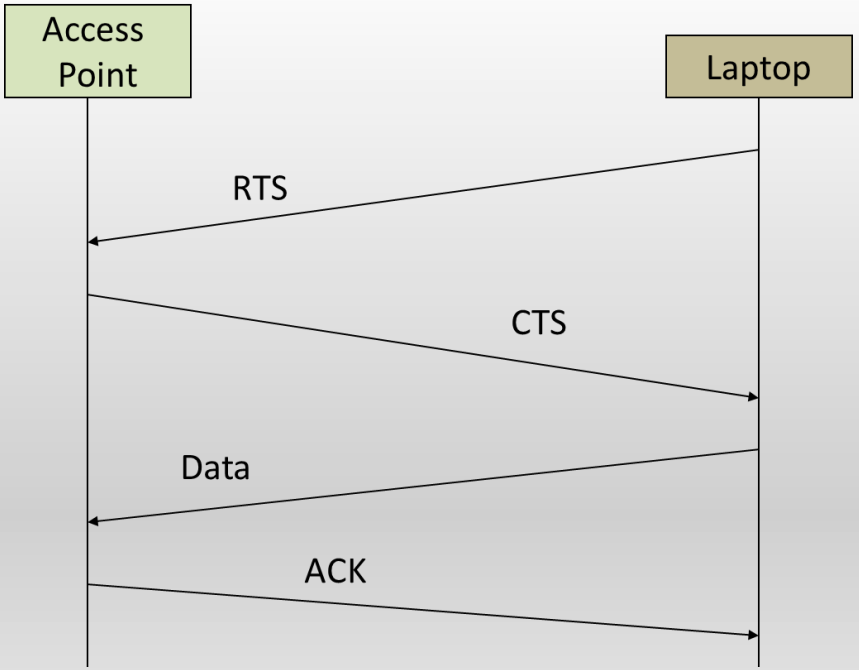
- only one user is allowed to communicate with a receiver at a time (cannot use another frequency channel support a second or third additional user).
- The way the one user is selected depends on the **carrier sense multiple access** with **collision avoidance (CSMA/CA)** random access method.

Collision Avoidance



2 Way Handshake

4 Way Handshake



WiFi Device

- Wireless Access Point (WAP)
- Wireless Routers
- Wireless Ethernet Bridge
- Range Extender

IEEE 802.11 (WiFi) -- advantages

- Simplicity and ease of deployment given that it uses unlicensed radio spectrum which does not require regulatory approval.
- Cost of rolling out this wireless solution is low.
- Users are able to be mobile for up to 300 feet (around 90 meter) from the access point.
- There are many Wi-Fi compatible products that are available at a low cost and can interoperate with other network technologies. Wi-Fi clients can work seamlessly in other countries with minimal configuration.

IEEE 802.11 (WiFi) -- Weaknesses

- Limited level of mobility.
- Susceptible to interference.
- Designed technically for short-range operations and basically an indoors technology.
- Security prolem

What is Wimax

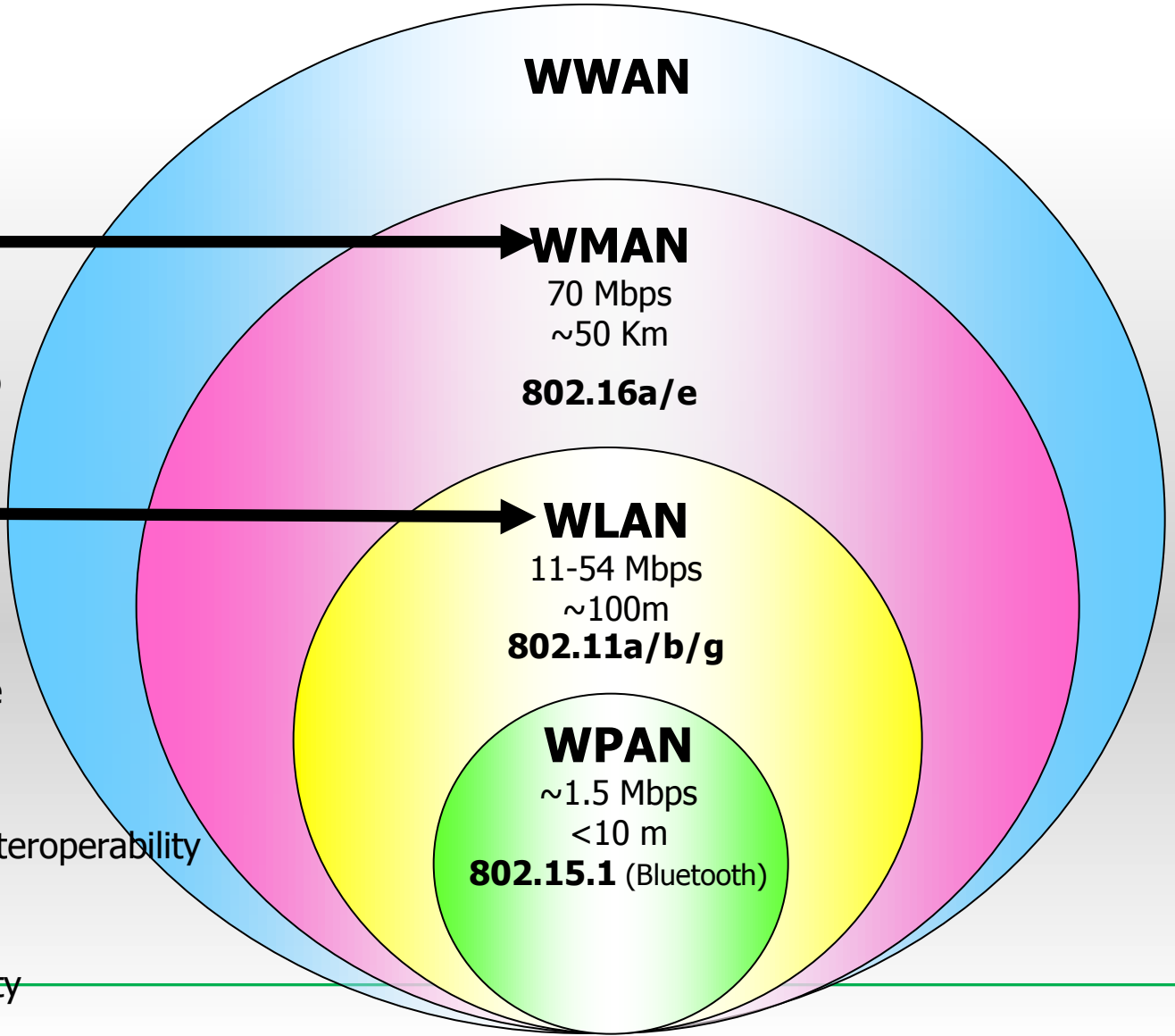
- WiMax, short for Worldwide Interoperability for Microwave Access, is the latest of the wireless "last mile" broadband technologies.
- WiMax is a radio technology that promises to deliver two-way Internet access at speeds of up to 75 Mbps at long range.
- WiMax will work with other shorter-range wireless standards, including Wi-Fi, Eventually, advocates hope to see the standard evolve into a mobile wireless Internet service similar to cellular data technologies. It may not ever be as wide-area as cellular but will offer higher data rates

WIMAX FORUM

- Didirikan pada bulan April 2001,terdiri dari pemimpin besar dari industri komunikasi dan komputasi untuk mendorong sebuah platform umum untuk penyebaran global dari layanan nirkabel pita lebar berbasis IP.
- WiMAX Forum akan mengeluarkan sertifikasi berbasis “conformance” dan interoperabilitas produk dalam standar kompatibel IEEE 802.16, ETSI HiperMAN dan lainnya

http://www.wimaxforum.org

Wireless Teknologi



WiMAX

New standard for Fixed broadband Wireless. Trying to do for MAN what Wi-Fi did for LAN.

Wi-Fi®

Includes 802.11a/b/g. Products must be Approved for Interoperability by the Wi-Fi Alliance.

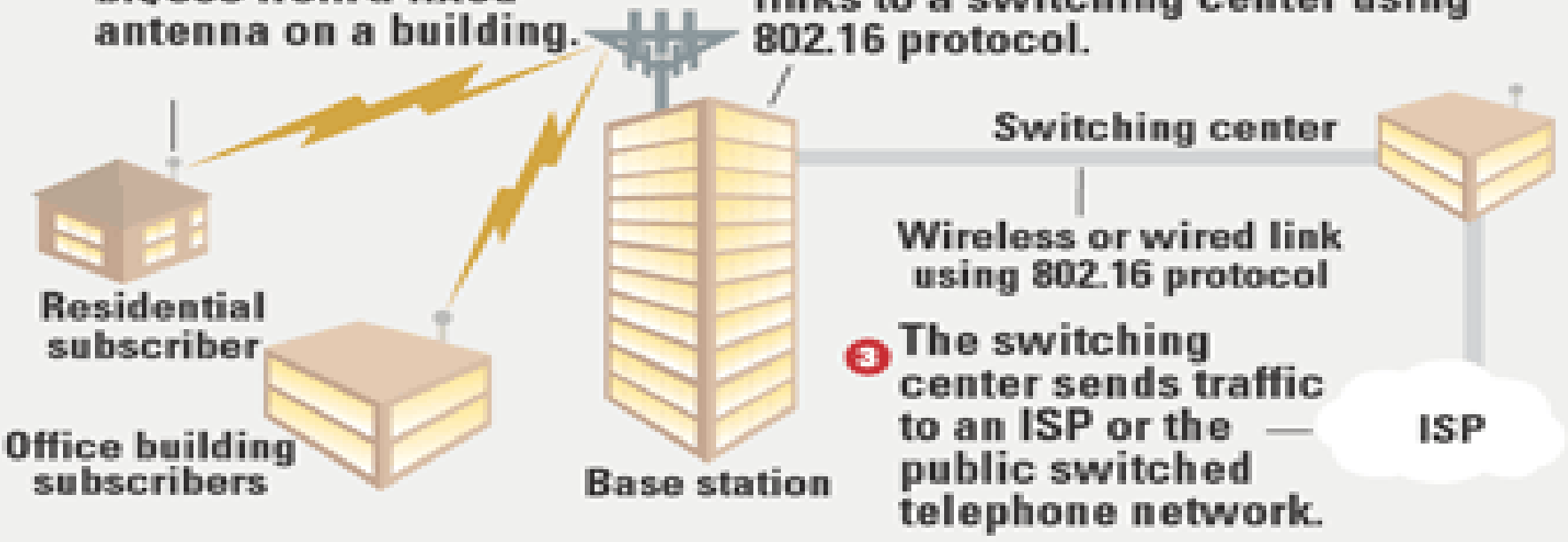
WiMAX: Worldwide Interoperability for Microwave Access

Wi-Fi : Wireless Fidelity

How Wimax Work

802.16

IEEE 802.16 standards define how wireless traffic will move between subscribers and core networks.



STANDARD WIMAX

802.16 network PHY standards												
802.16 Protocol	Release date	Frequency (Ghz)	Bandwidth (Mhz)	Operation	Duplexing Scheme	Stream Datarate min -- max (Mbps)	Allowable MIMO stream	Data Subcarrier Modula-tion	Modulation Antenna Tech	Beamforming Capability	Approx Range (Km)	
											indoor	outdoor
802.16	Dec-01	10-66 GHz	25 MHz in USA and 28 MHz Europe	LOS	TDD / FDD	32-134 Mbps		QPSK, 16-QAM or 64-QAM (Adaptive Modulation)	Single Carier	No		1 --5
802.16a	Jan-03	< 11 GHz	1.25 to 28 MHz	NLOS	TDD / FDD	Up to 75 Mbps		QPSK, 16-QAM or 64-QAM (Adaptive Modulation)	OFDM	No		8
802.16d /802.16-2004	Jun-04	< 11 GHz	1.25 to 28 MHz	NLOS / portable	TDD / FDD	Up to 75 Mbps		QPSK, 16-QAM or 64-QAM (Adaptive Modulation)	OFDM/OFDMA	yes		8
802.16e	Dec-05	< 6 GHz	1.25 to 20MHz	Non-LOS and Mobile	TDD / FDD	Up to 75 Mbps	4	QPSK, 16 QAM, 64 QAM (Adaptive modulation)	OFDM/OFDMA /SOFDMA (MIMO)	yes		5
802.16m	2011	< 6 GHz	5 to 40 MHz	Non-LOS and Mobile	TDD / FDD	100 Mbps mobile 1 Gbps for fix	8	BPSK, QPSK, 16 QAM, 64 QAM (Adaptive Modulation)	OFDM/OFDMA /SOFDMA (MIMO)	yes		3 , 5-30 and 30-100

Wimax for Fix and Mobile Access

IEEE 802.16-2004

Business, SME, SOHO Access

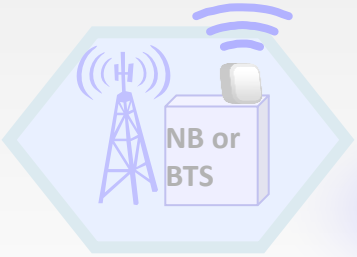
WiMAX
Base Station

Mobile PC/PAD

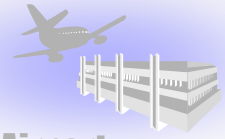
Residential Fixed
WDSL BB Access

Nomadic PC

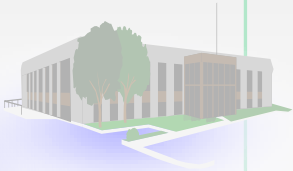
WiFi-Hotspot
Feeding



2G/3G Feeding



Airport



Campus
Hot Zones

Wimax for Fix and Mobile Access

Business, SME, SOHO Access

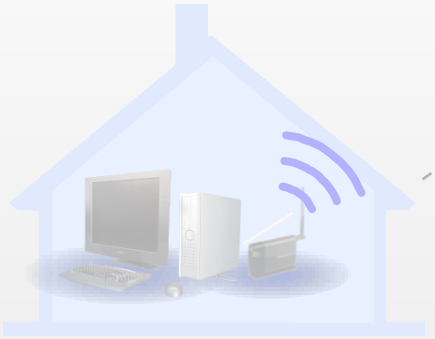
Mobile PC/PAD

WiMAX

Base Station

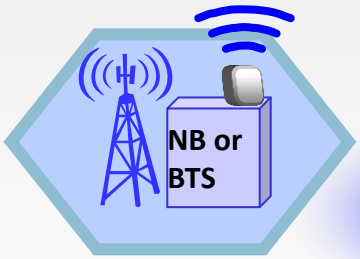
& IEEE 802.16e

Nomadic PC

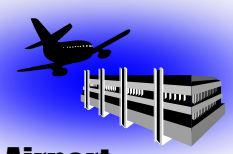


Residential Fixed
WDSL BB Access

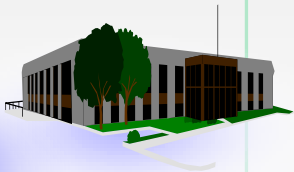
WiFi-Hotspot
Feeding



2G/3G Feeding

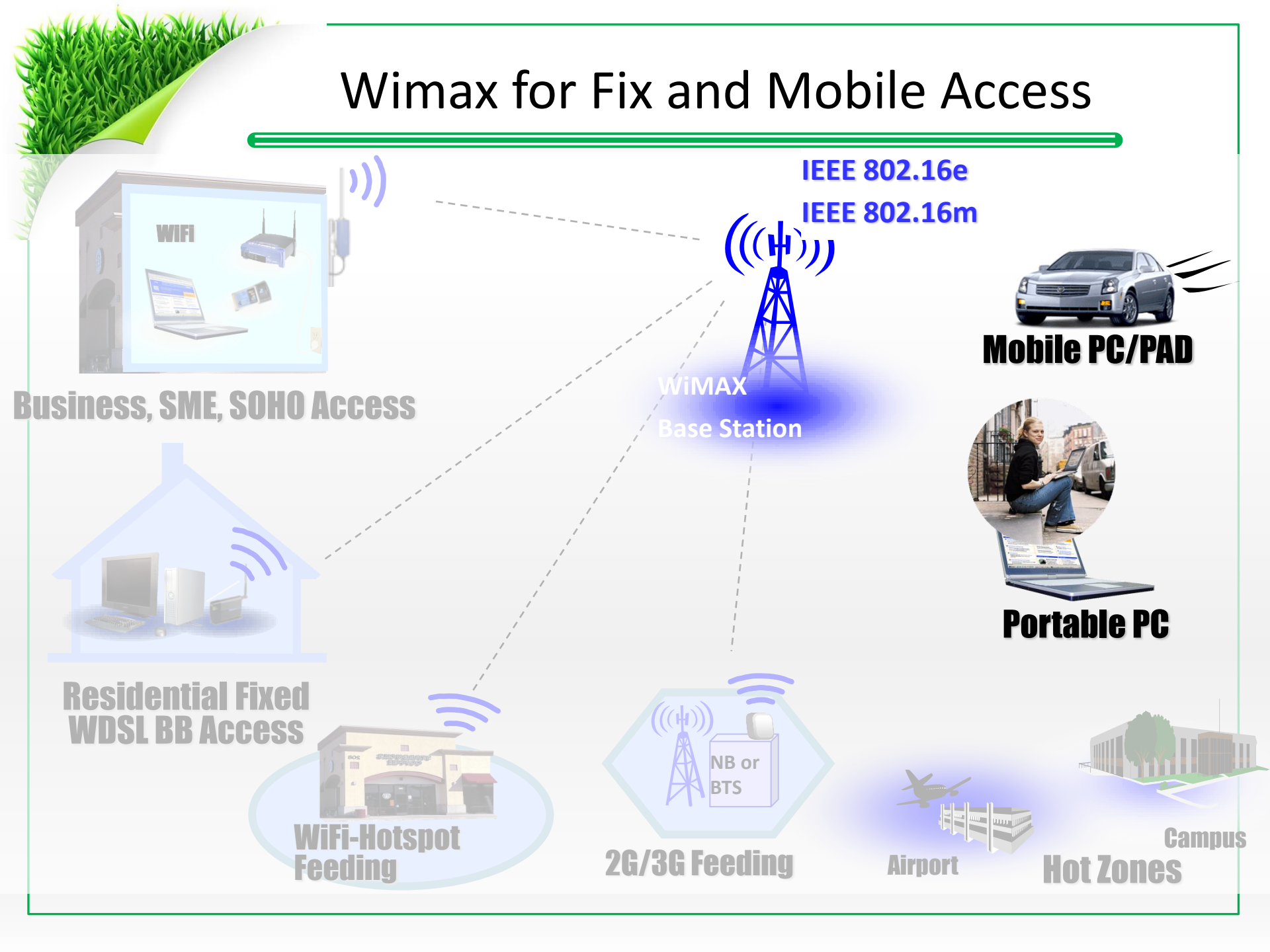


Airport

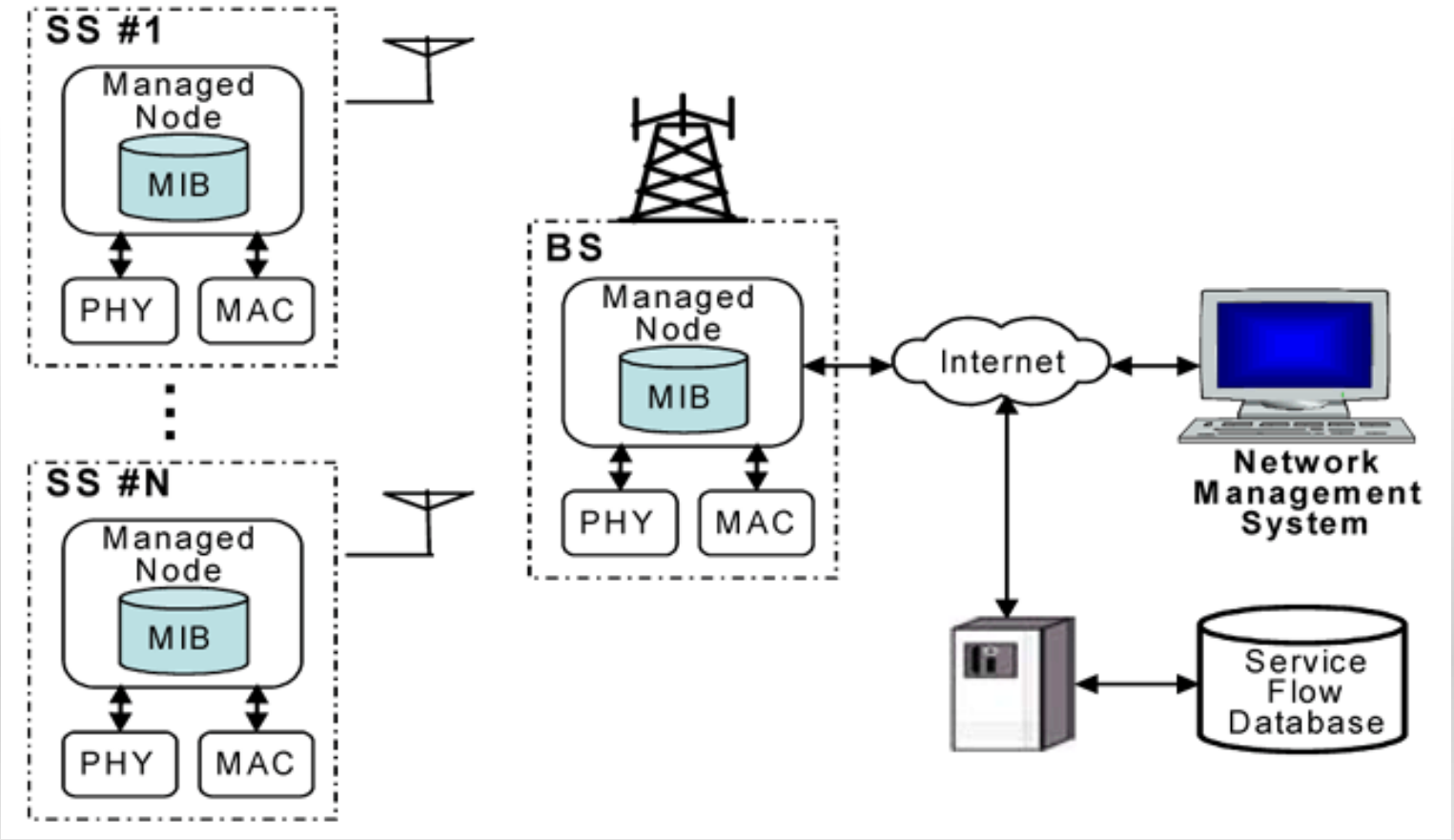


Campus
Hot Zones

Wimax for Fix and Mobile Access



Arsitektur Wimax



MIB – Management Information Base

Wimax Device

WIMAX TOWER

WIMAX RECEIVER

Wimax form of Services

- Non-LOS, Wi-Fi sort of service, where a small antenna on a computer connects to the tower. Uses lower frequency range (2 to 11 GHz).
- LOS, where a fixed antenna points straight at the WiMax tower from a rooftop or pole. The LOS connection is stronger and more stable, so it is able to send a lot of data with fewer errors. Uses higher frequencies, with ranges reaching a possible 66 GHz.

WiFI Vs Wimax

	IEEE 802.11	IEEE 802.16a
Max Speed	54Mbps (a&g)	10-100Mbps
Range	100m	40 km
QoS	none	yes
Coverage	Indoor	Outdoor
Users	Hundred	Thousand
Service Level	None	Yes

WiFI Vs Wimax

Scalability

802.11	802.16
■Wide, fixed (20MHz) frequency channels	■Channel bandwidths can be chosen by operator (e.g. for sectorization) ■1.5 MHz to 20 MHz width channels. MAC designed for scalability independent of channel bandwidth
■MAC designed to support 10's of users	■MAC designed to support thousands of users.

WiFI Vs Wimax

Bit Rate

	Channel Bandwidth	Maximum Data Rate	Maximum bps/Hz
802.11a	20 MHz	54 Mbps	~2.7 bps/Hz
802.16a	10, 20 MHz; 1.75, 3.5, 7, 14 MHz; 3, 6 MHz	**63 Mbps***	~5.0 bps/Hz

* Assuming a 14 MHz channel

WiFI Vs Wimax

Coverage

802.11	802.16
■ Optimized for indoor performance ■ Standard supports mesh network topology	■ Optimized for outdoor NLOS performance ■ Standard supports mesh network topology ■ Standard supports advanced antenna techniques

WiFI Vs Wimax

Range

802.11	802.16
■ Optimized for ~100 ***meters***	■ Optimized for up to 50 Km
■ No "near-far" compensation.	■ Designed to handle many users spread out over kilometers
■ Designed to handle indoor multi-path(delay spread of 0.8µ seconds).	■ Designed to tolerate greater multi-path delay spread (signal reflections) up to 10.0µ seconds
■ Optimization centers around PHY and MAC layer for 100m range.	■ PHY and MAC designed with multi-mile range in mind
■ Range can be extended by cranking up the power – but MAC may be non-standard.	■ StandardMAC;Sectoring/MIMO/AMC for Rate/Range dynamic tradeoff

WiFI Vs Wimax

QoS

802.11	802.16a
■ Contention-based MAC (CSMA/CA) => no guaranteed QoS	■ Grant-request MAC
■ Standard cannot currently guarantee latency for Voice, Video	■ Designed to support Voice and Video from ground up
■ Standard does not allow for differentiated levels of service on a per-user basis	■ Supports differentiated service levels: e.g. T1 for business customers; best effort for residential.
■ TDD only – asymmetric	■ TDD/FDD – symmetric or asymmetric
■ 802.11e (proposed) QoS is prioritization only	■ Centrally-enforced QoS

WiFI Vs Wimax

Security

802.11	802.16a
■ Existing standard is WPA + WEP ■ 802.11i in process of addressing security	■ Triple-DES (128-bit) and RSA (1024-bit)

PHY Layer Features of IEEE 802.16-2004

Feature	Benefit
256 point FFT OFDM waveform	Built in support for addressing multi-path in outdoor LOS and NLOS environments.
Adaptive Modulation and variable error correction encoding per RF burst	Ensures a robust RF link while maximizing the number of bits/second for each subscriber unit.
TDD and FDD support	Addresses varying worldwide regulations when one or both may be allowed

PHY Layer Features of IEEE 802.16-2004

Feature	Benefit
Flexible Channel Sizes (Can be an integer multiple of 1.25 MHz, 1.5 MHz, and 1.75 MHz with a maximum of 20 MHz.	Provides the flexibility to operate in many different frequency bands with varying channel requirements around the world.
Designed to support smart antenna systems.	Smart antennas can suppress interference and increase system gain. They are becoming important to BWA deployment as their costs come down.

WiFI Vs Wimax

- WiMax eliminates the constraints of Wi-Fi.
- Unlike Wi-Fi, WiMax is intended to work outdoors over long distances.
- WiMax is a more complex technology and has to handle issues of importance such as QoS guarantees, carrier-class reliability, NLOS.
- WiMax is not intended to replace Wi-Fi. Instead, the two technologies complement each other

TUGAS 1

Senin, 30 Apr 2012 09:10 WIB

Kolom Telematika

WiMAX Indonesia Sekarat!

- detikInet

0 komentar

1. Jelaskan dan gambarkan Arsitektur implementasi wifi di gedung Selaru
2. Jelaskan Perkemangan Wimax di Indonesia

TERIMAKASIH