BROADBAND NETWORKS

Komunikasi Data

Definisi Broadband

- Biasanya broadband services didefinisikan sebagai “pelayanan telekomunikasi yang membutuhkan kanal transmisi lebih besar dari 2 Mbps (E1)”
- Atau: Jaringan digital yang dapat melayani apa saja: jasa data kecepatan tinggi, videophone, videoconference, transmisi grafis resolusi tinggi, CATV, termasuk juga jasa sebelumnya seperti telepon, data, telemetri dan faksimile
- Belum ada standar global ttg definisi “Broadband”

Mengapa Broadband

- Konvergensi / Digitalisasi
- Komputer dan aplikasi
- Bandwidth suara, data, image dan video
  - Drivers - advancing technology, profitable services, regulation
    - Digital imaging and software download applications
    - Faster PCs and larger hard drive storage media
    - Growth of broadband services in hotels, airports, campuses
    - Competition by MSOs for ILECs voice & data services
    - A profitable carrier business model & capital availability
    - Municipal government economic development
    - Federal government support for favorable broadband policies
    - Homeland security systems installed in all public places
  - Dampening effects - difficult business model
    - Limited availability of capital for building infrastructure
    - Long payback periods - economics of revenue vs costs
    - Regulatory uncertainty about future competition

Teknologi Akses Broadband

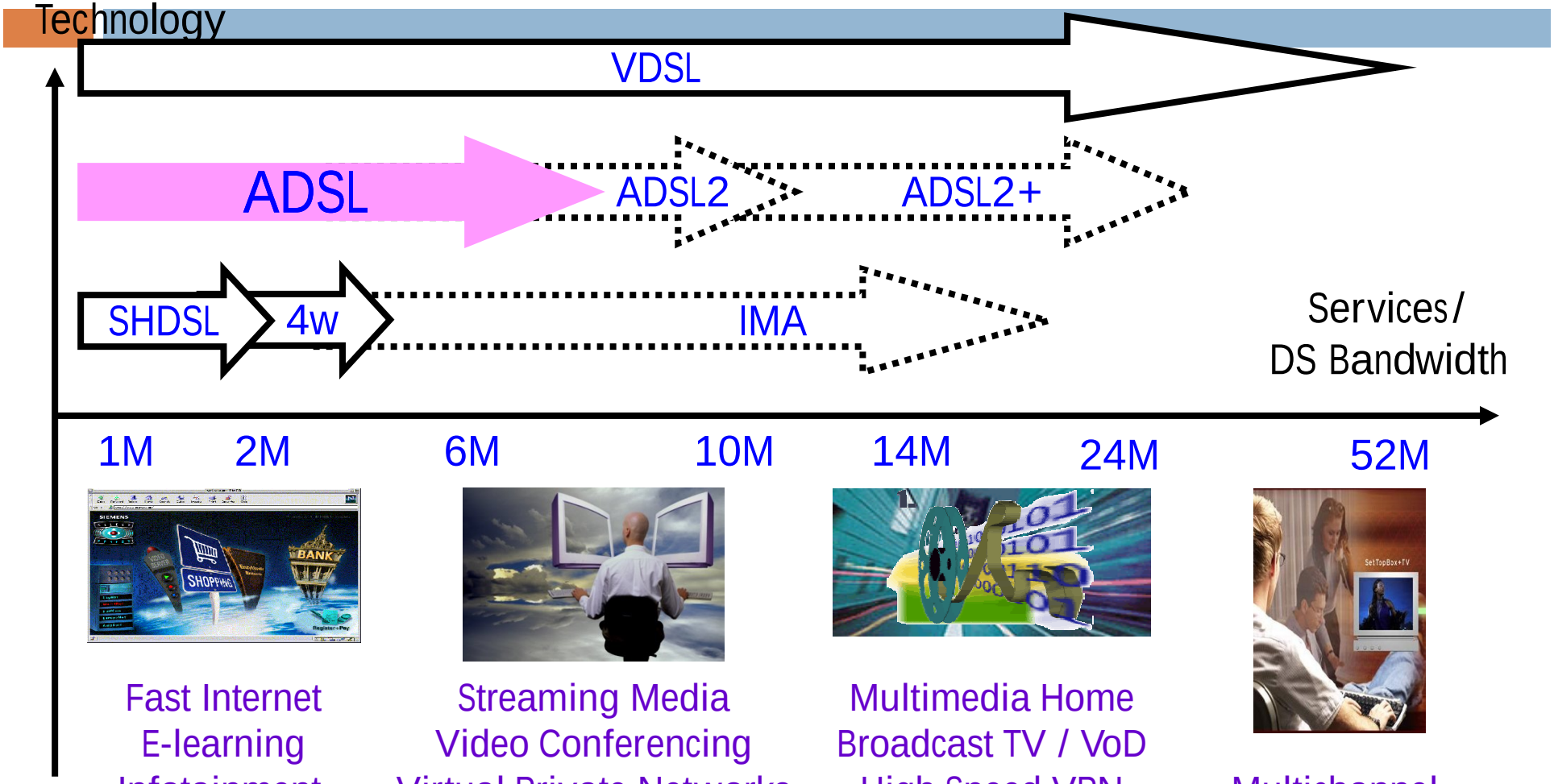
- Wireline Broadband Access
  - xDSL (incl. ADSL)
  - FTTx / HFC
- Wireless Broadband Access
  - Wireless LAN (WiFi)
  - WiMAX

xDSL

- x Type Digital Subscriber Line (xDSL)
- Teknologi yang mengoptimalisasi saluran telepon biasa (POTS) menjadi saluran digital kecepatan tinggi untuk memberikan layanan Broadband
- xDSL memungkinkan terjadinya komunikasi data dan voice secara bersamaan menggunakan jaringan akses kabel tembaga (line telepon)

xDSL	Kepanjangan	Rate	Mode	Aplikasi
HDSL	High-Speed Digital Subscriber Line (2 pair)	1,544 Mbps	Symmetric	Pair Gain (12 kanal), Internet, Pengganti T1 / E1
SHDSL	Single Line HDSL	1,544 Mbps	Symmetric	Idem HDSL, tapi pair gain 24 kanal
ADSL (G-Lite)	Asymmetric DSL	s/d 1,5 Mbps s/d 512 Kbps	Downstream Upstream	Internet, Video Phone
ADSL (G.DMT)	Asymmetric DSL	s/d 10 Mbps s/d 1 Mbps	Downstream Upstream	Internet, Video Conference, Remote LAN
SDSL	Symmetrical DSL	s/d 2 Mbps	Symmetric	Internet, Video Conference, LAN, VPN, Video Streaming
VDSL	Very High Speed DSL	s/d 8 Mbps	Symmetric	

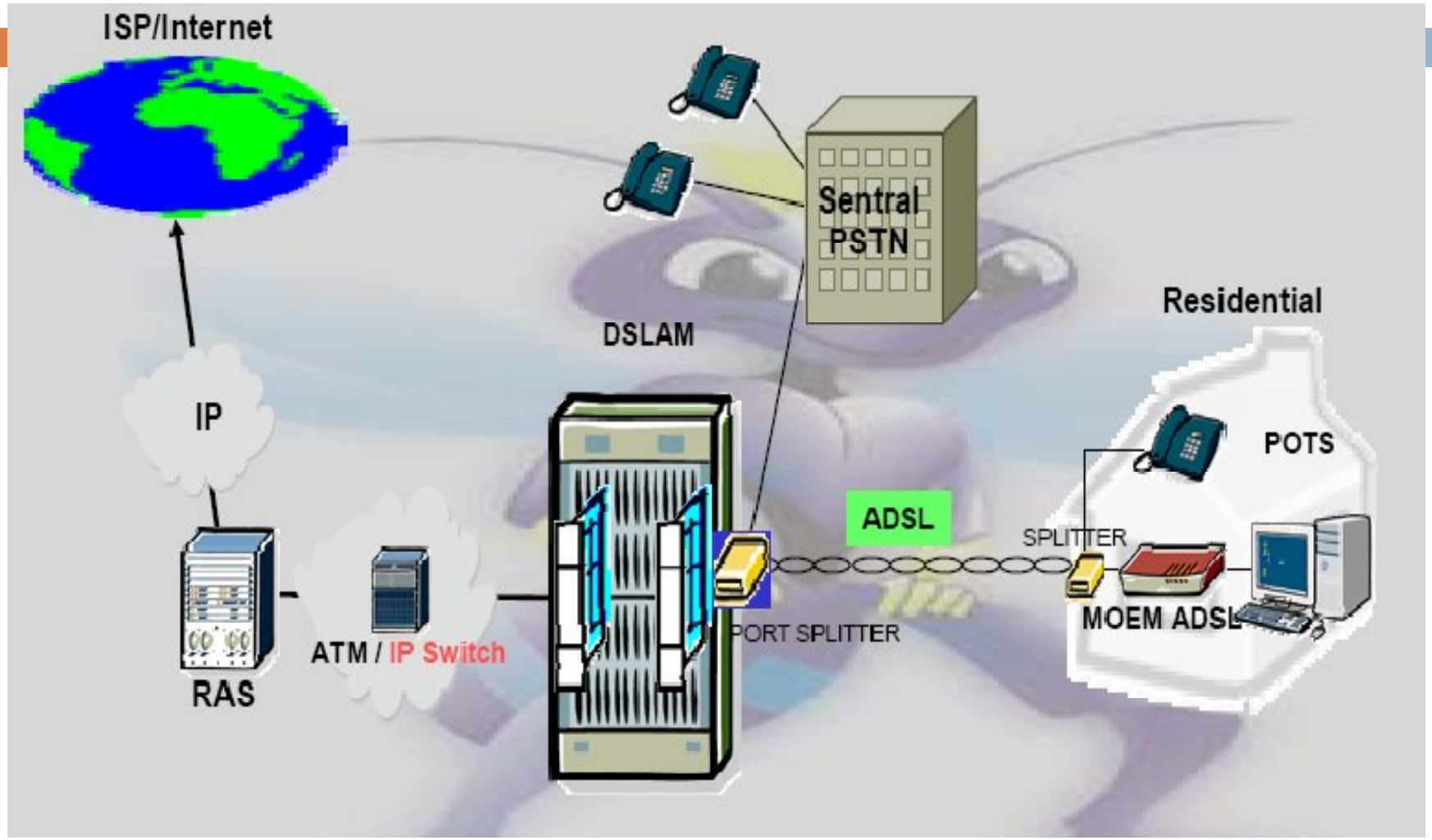
DSL Technologies & Services



ADSL

- ADSL (Asymmetric Digital Subscriber Line): teknologi akses, yang memungkinkan terjadinya komunikasidata, voice dan video secara bersamaan, menggunakan media jaringan akses kabel tembaga 1 pair.
  - Disebut asimetrik karena rate / kecepatan transmisi dari sentral ke pelanggan (downstream) tidak sama dengan rate transmisi dari arah pelanggan ke sentral (upstream)
  - Aplikasi ini digunakan untuk menyalurkan layanan broadband
  - Bit rate downstream s.d. 8 Mb/s, upstream s.d. 640 kb/s
- Hardware ADSL
  - Modem ADSL
  - DSLAM (Digital Subscriber Line Access Multiplexer)
    - Filter Voice & Data
    - Modulator/Demodulator DSL
    - Multiplexer
  - ATM/IP Switch : titik penyambungan antara DSLAM dgn RAS
  - RAS (Remote Access Server) : routing dari user ke ISP tujuan

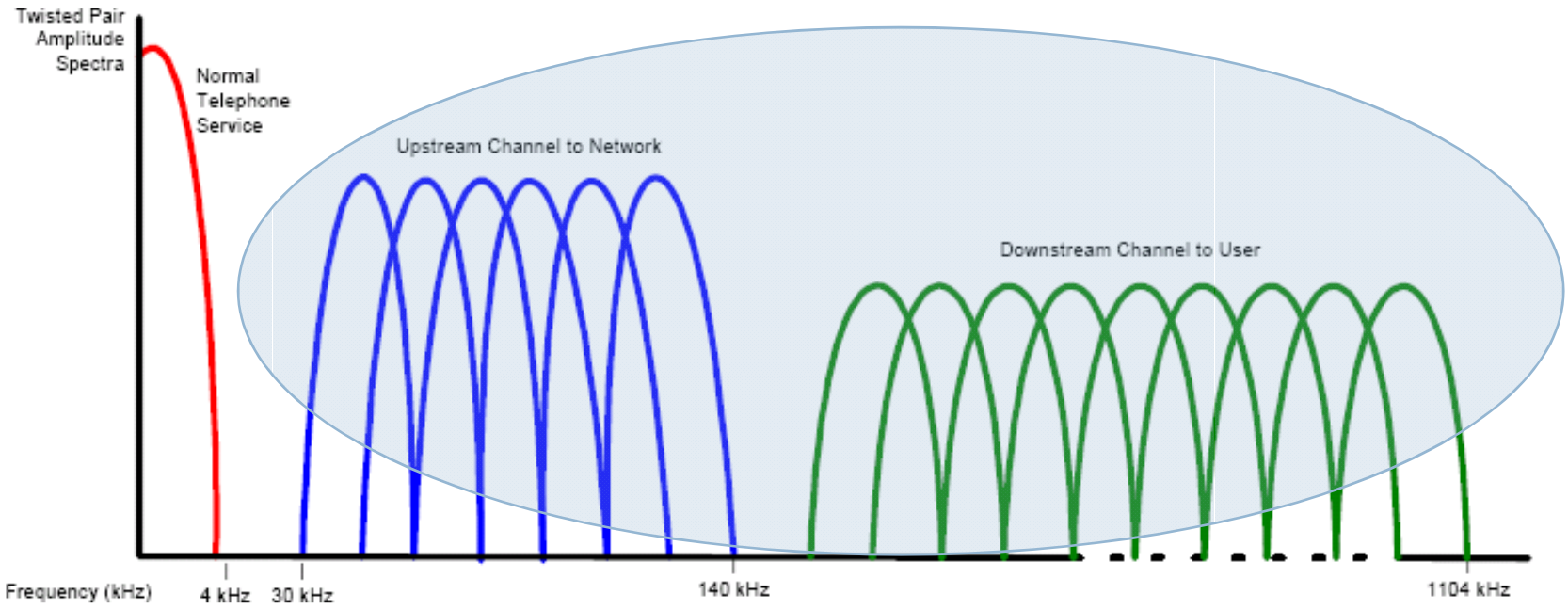
Konfigurasi Jaringan ADSL



Kelebihan/keunggulanTeknologi ADSL

- Satu saluran telepon dapat digunakan untuk pembicaraan telepon dan akses data (internet, file transfer, e-mail, dll) pada saat bersamaan
- Koneksi ke internet lebih cepat dibanding menggunakan analog modem
- Sifat hubungan: dedicated connection
- Jasa ADLS
  - Internet akses
  - Video on Demand
  - Remote LAN Access
  - Interactive Multimedia
  - Untuk HDTV: perlu Very High Data Rate DSL : VDSL

Bagaimana Voice & Data dapat ditransmisikan secara bersamaan

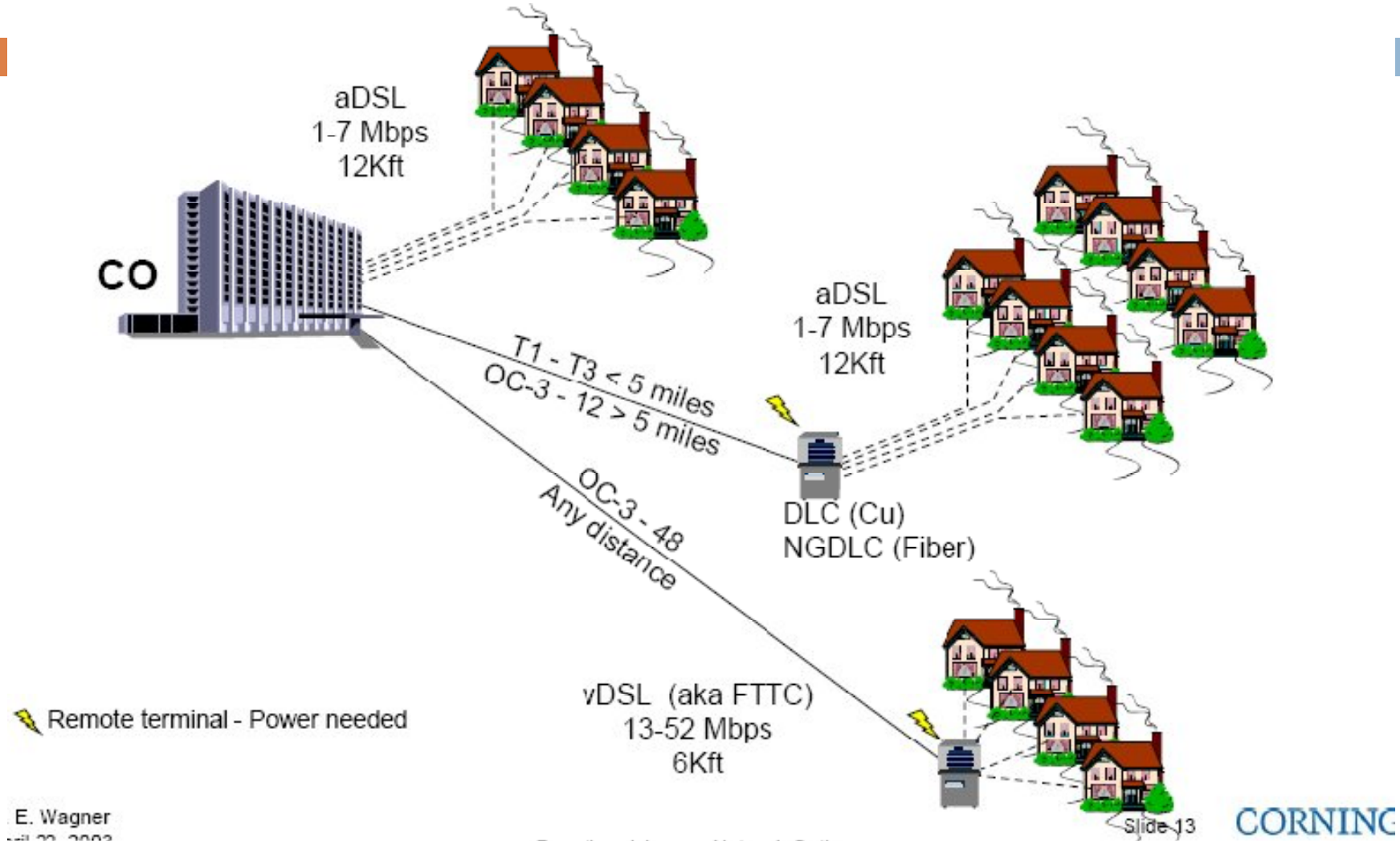


- teknik modulasi discrete multitone → Modem ADSL

FTTx / HFC

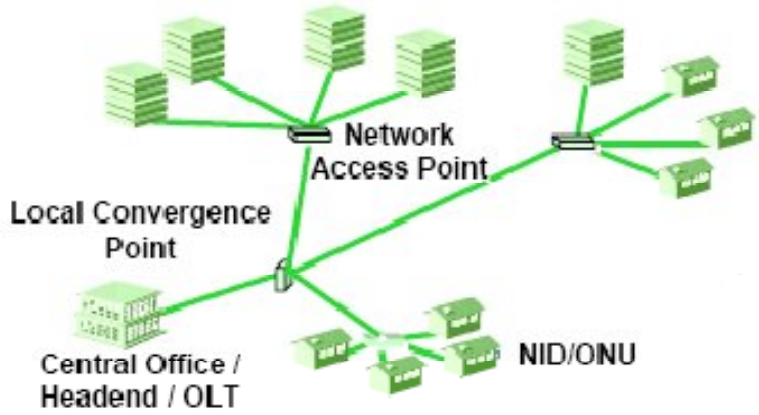
- Fiber to the Building (FTTB)
- Fiber to the Curb (FTTC)
- Fiber to the Home (FTTH)
- Hybrid System (Hybrid Fiber Coax)

FTTC

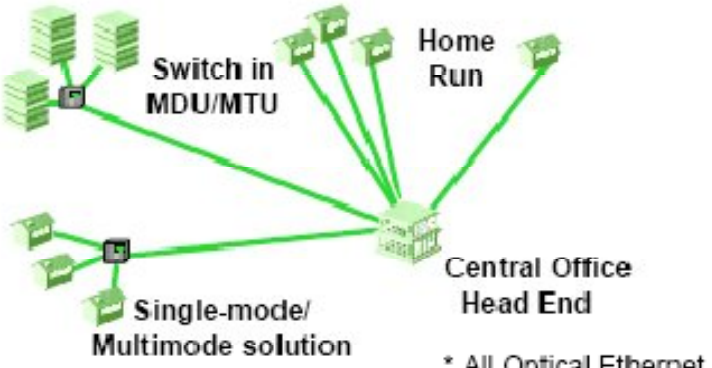

aDSL
1-7 Mbps
12Kft
CO
T1 - T3 < 5 miles
OC-3 - 12 > 5 miles
OC-3 - 48
Any distance
aDSL
1-7 Mbps
12Kft
DLC (Cu)
NGDLC (Fiber)
vDSL (aka FTTC)
13-52 Mbps
6Kft
Remote terminal - Power needed

FTTH Networks

Passive Optical Network



Point to Point (AOEN*)



* All Optical Ethernet Network

Characteristics:

- No electronics in field
- Typically shared among 16-32 subscribers
- Standards exist
- Many vendors have equipment
- Most widely deployed architecture in US

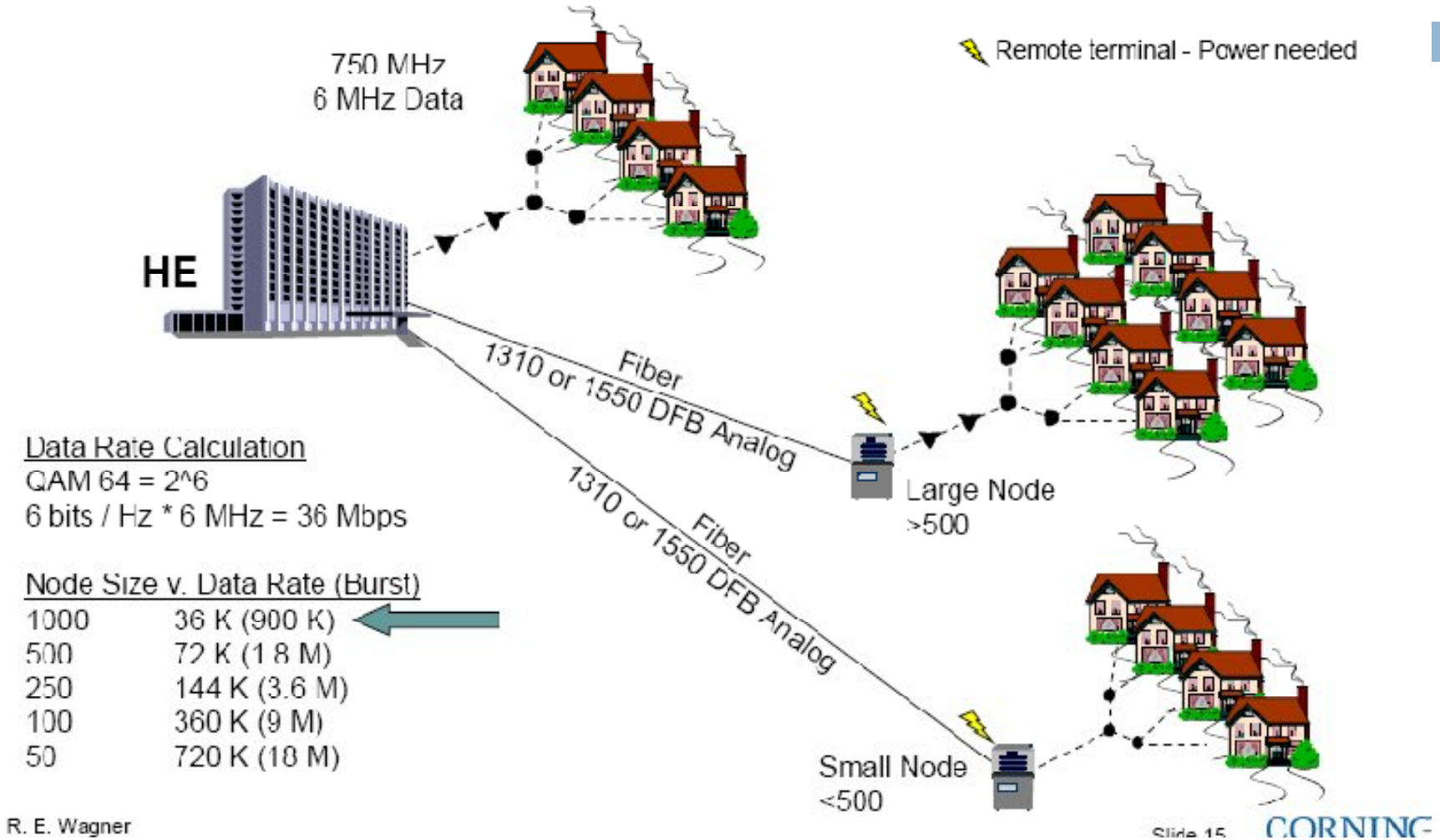
Characteristics:

- Actives in the field
- Simple
- Fiber rich
- No sharing
- Most widely deployed architecture in EU

FTTH

- Single-pair voice-grade copper running to residences is limited in the speed it can provide for data transmission
- Fiber to the home (FTTH) will bring optical fiber to each home
- Higher speeds for data transmission, video, etc.
- Being held back by high installation costs, which require provable strong demand

Hybrid Fiber Coax (HFC)



HFC

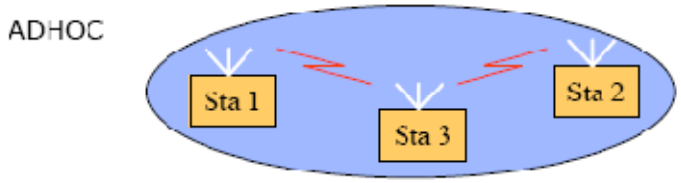
- Cable Modem
  - Delivered by cable television operator
  - Cable modems follow the Data-Over-Cable Interface Specification (DOCIS) standard
    - Up to 10 Mbps downstream
    - 128 kbps to 512 kbps upstream
    - Heavy users get throttled back by operator
  - Speed is shared in a neighborhood
  - Only users sending and receiving simultaneously
  - In practice, medium ADSL speed or higher

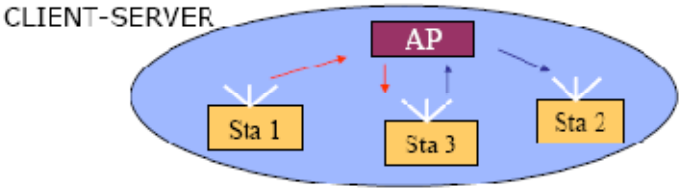
Wireless LAN

- Wireless LAN menggunakan gelombang radio electromagnetic untuk berkomunikasi dari suatu tempat ke tempat yang lain dalam model :
  - Peer to Peer
  - LAN to LAN
- Umumnya diimplementasikan sebagai jaringan Extension atau Alternative dari jaringan Wired LAN
- Menggunakan frekuensi ISM (Industrial, Scientific and Medical) – tidak butuh lisensi
  - 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

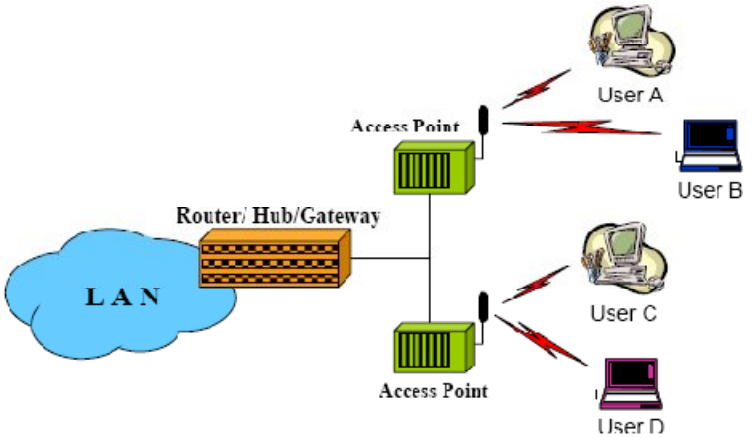
Konfigurasi dan Arsitektur WLAN

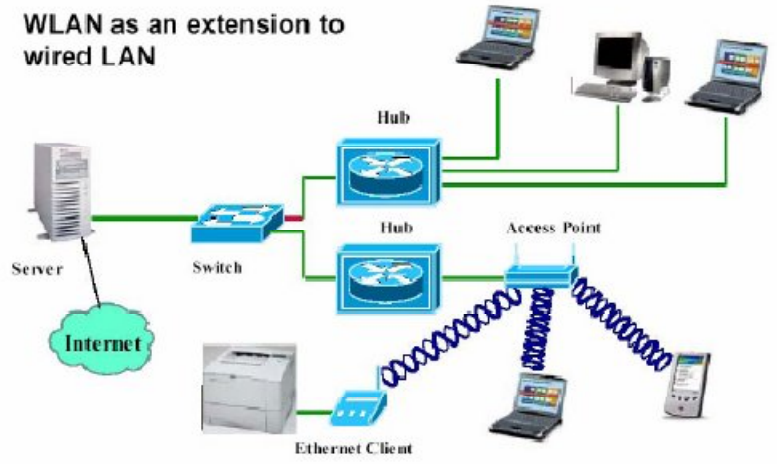
Konfigurasi WLAN





Arsitektur Jaringan WLAN





Standar WLAN

	802.11a	802.11b	802.11g
Speed	54 Mbps	11 Mbps	54 Mbps
Frequency	5.150 – 5.850 GHz	2.4 – 2.4835 GHz	2.4 – 2.4835 GHz
Range	50 meters	100 meters	100 meters
N.O. Channels	13	3	3
Data Rates	54, 48, 36, 24, 18, 12, 9, 6 Mbps	11, 5.5, 2, 1 Mbps	54, 48, 36, 24, 18, 12, 9, 6 Mbps
Modulation	OFDM	DSSS	DSSS and OFDM
Media Access	CSMA/CA	CSMA/CA	CSMA/CA
Tx Power	50 mW	1 to 100 mW	1 to 100 mW
Rx Sensitivity	-90 to -72 dBm	-94 to -88 dBm	-92 to -72 dBm

Kelebihan Wireless LAN dibandingkan Wired LAN

- Plug and play : dapat digunakan secara langsung
- Meningkatkan produktivitas and Layanan :
  - Akses informasi secara Real-Time
  - Dapat mengakses darimana pun dalam area organisasi/kantor
- Kecepatan instalasi : dibandingkan penggelaran jaringan kabel yang membutuhkan waktu yang lama
- Flexibel : Dapat digelar dimana saja bahkan di tempat dimana kabel tidak mungkin diimplementasikan
- Reduksi biaya : Dalam kasus pengembangan,pemindahan maupun perubahan konfigurasi LAN

Hotspot

- Public Wireless LAN (PWLAN)
- Restricted to indoor usage
- Using Wi-Fi technology or 802.11a/b/g
- Speed ranging from 11 Mbps to 54 Mbps
- Installed in public gathering places or ‘hotspots’
  - Coffe shop, restaurants, hotel, airport, train stations, convention center and residential
- Provides Internet access for mobile users
- Future apps: gaming, voice



WiMAX

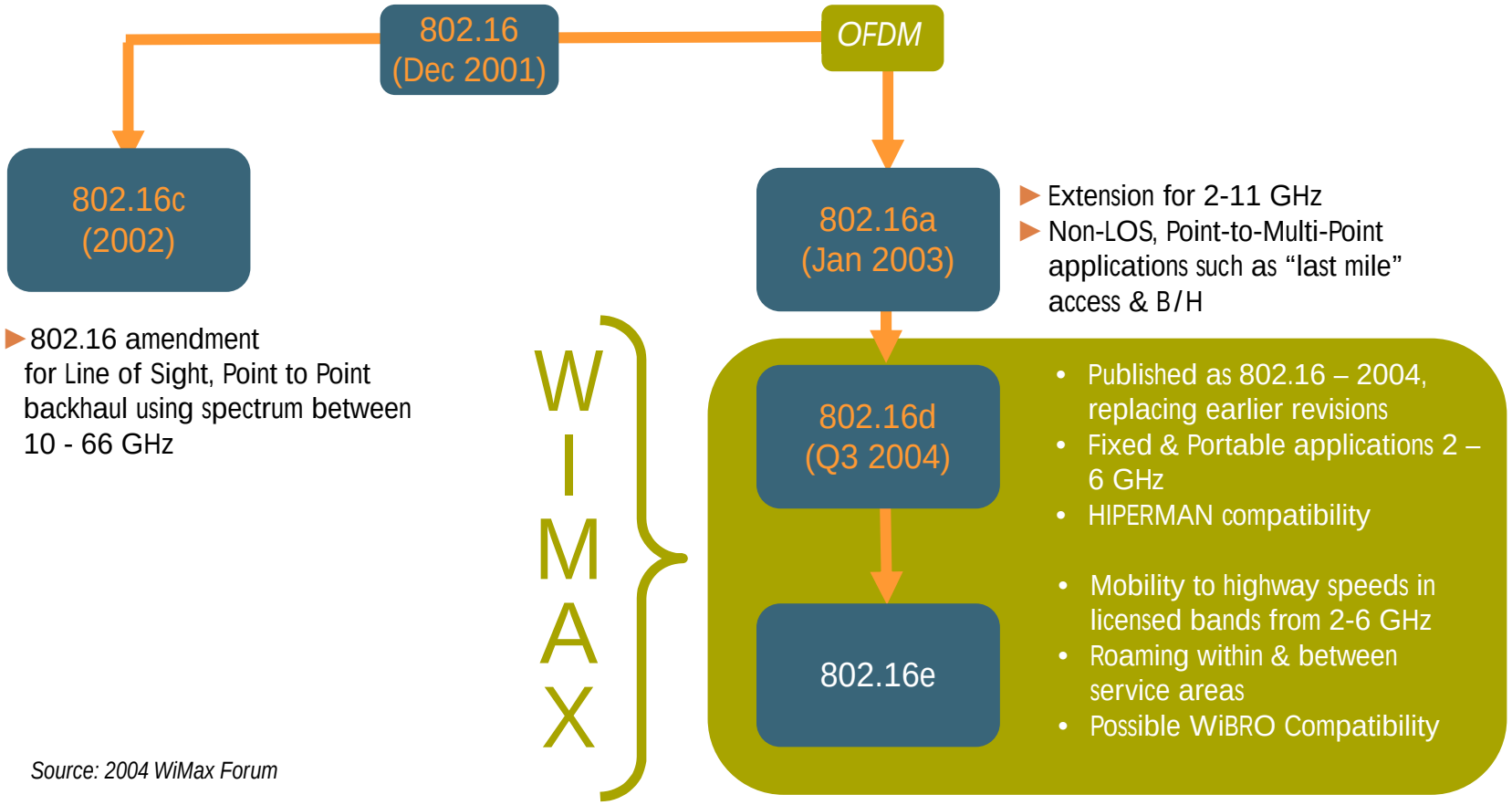
- What is WiMax
  - It is a wireless broadband access technology based on the IEEE 802.16 standard.
  - WiMAX is “Worldwide Interoperability for Microwave Access”.
  - WiMAX is a broadband wireless access standard.
  - WiMAX is developed and standarized by the WiMAX Forum, to certify equipment that conforms to the IEEE 802.16* standard with
  - focus in sub 6 GHz radio bands.
- 802.16 WiMAX
  - One of several terrestrial wireless access standards under development
  - Fixed version being standardized first
    - 20 Mbps up to 50 km (30 miles)
  - Mobile version under development (802.16e)
    - 3 Mbps to 16 Mbps for mobile users

WiMAX Key Issues

- Supports Triple Play, WiFi & Mobile backhauling applications on one infrastructure
- High speed mobile capability
- Multi form CPE with WiFi/WiMAX enabled
- The technology basis for 4G

Standar WiMAX

- Original fixed wireless broadband air Interface for 10 – 66 GHz
- Line-of-sight only, Point-to-Point applications



- 802.16 amendment for Line of Sight, Point to Point backhaul using spectrum between 10 - 66 GHz

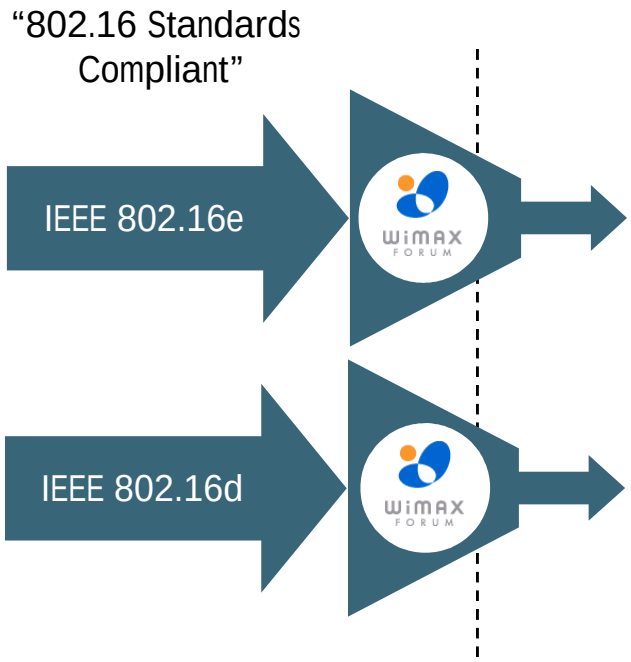
- Extension for 2-11 GHz
- Non-LOS, Point-to-Multi-Point applications such as “last mile” access & B/H

- Published as 802.16 – 2004, replacing earlier revisions
- Fixed & Portable applications 2 – 6 GHz
- HIPERMAN compatibility

- Mobility to highway speeds in licensed bands from 2-6 GHz
- Roaming within & between service areas
- Possible WiBRO Compatibility

Source: 2004 WiMax Forum

WiMAX Profile (from WiMAX Forum)



WiMAX Forum Certified™

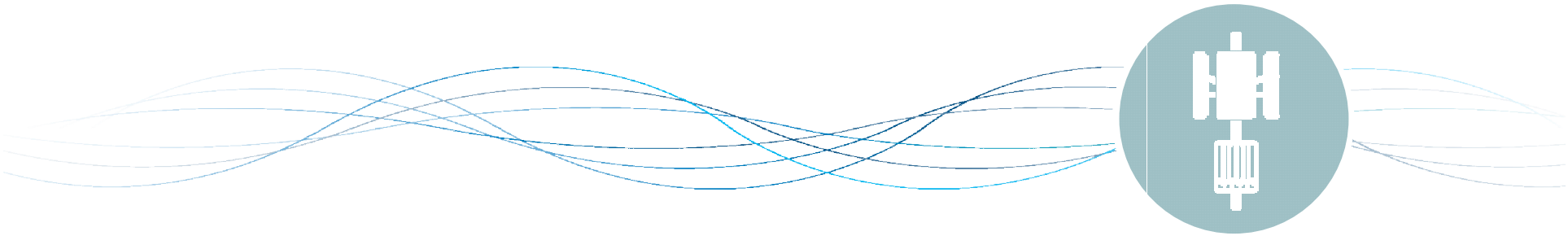
Fixed / Mobile WiMAX Profiles
(To be finalized in 2H 2006)
128-2048 FFT Scaleable OFDMA
Focus on 2.3, 2.5, 3.5, 5.8 GHz

Fixed WiMAX Profiles
256 FFT OFDM
3.5 GHz with 4 Variations:
FDD: 3.5 MHz, 7.0 MHz Channels
TDD: 3.5 MHz, 7.0 MHz Channels
5.8 GHz: 10 MHz Ch; TDD

By conforming to the WiMAX profile a vendor benefits by…

- Receiving certification from an independent testing lab
- Ensuring interoperability with certified products from other vendors

WiMAX Technology Improvement



High Performing

Spectrally efficient OFDM interface, advanced antenna techniques, reduced latencies

Flexible Install

Zero-footprint base sites and all outdoor design for flexible, unobtrusive installations

Truly Mobile

Provides full cellular-like capability and seamless inter-technology handovers

Reduced CAPEX

Integrated design avoids supporting real estate, no-touch software upgrades, simple fiber implementation

Reduced OPEX

Elimination of high cost centralized boxes, simplified management, reduced core transport costs

All IP Architecture

Flexible core network integration and inter-working, end-to-end session QoS, flexible service deployment

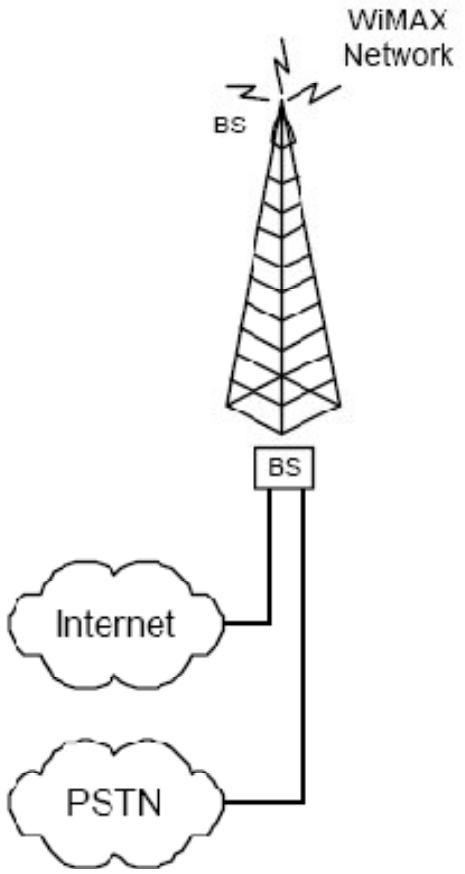
Opsi Frekuensi WiMAX

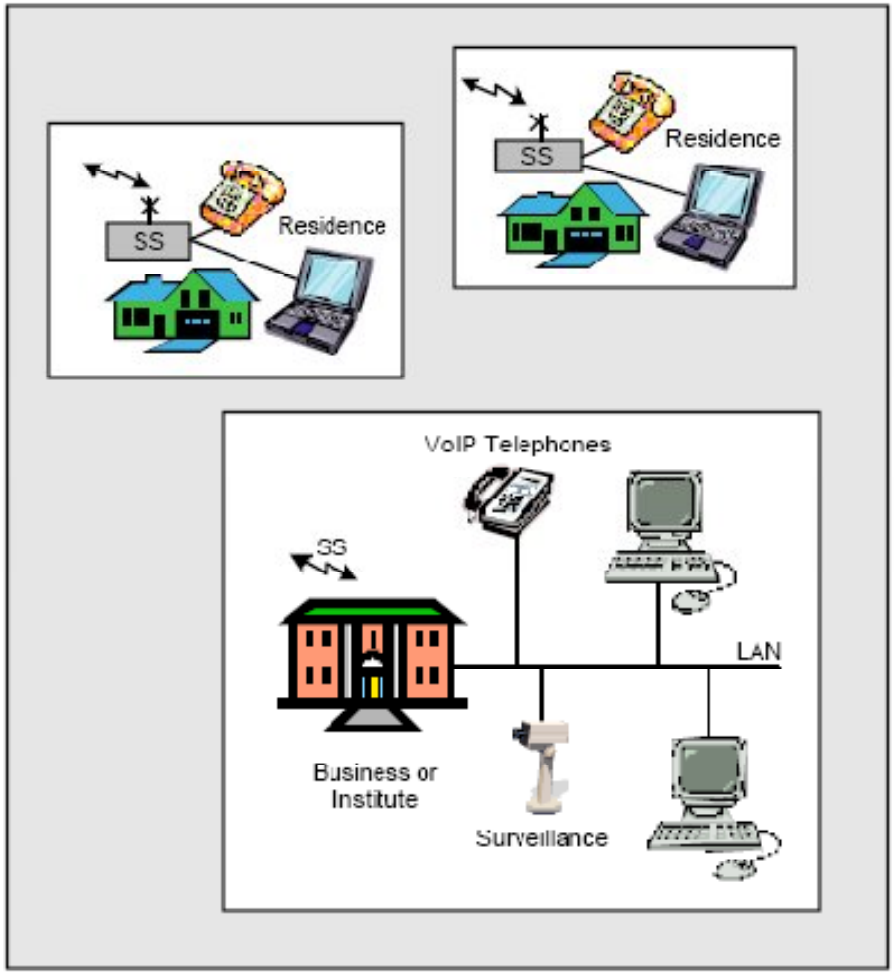
- 2.3 GHz band
- 2.5 GHz band
- 3.4 – 3.6 GHz band
- 5.8 GHz band
- Optional : 4.9 – 5.0 GHz
- Optional : 700 MHz (in US case)
- Optional : 3.3 GHz band

Case Study :

- Singapore : 2.3 GHz and 2.5GHz
- EU: 3.4 – 3.6GHz band
- Australia: 3.5GHz band
- USA & Canada : 700MHz, 2.5GHz band
- Indonesia : seems to use the 2.3GHz band (for mobile) and 3.3GHz band (for fixed), other bands are already utilized.

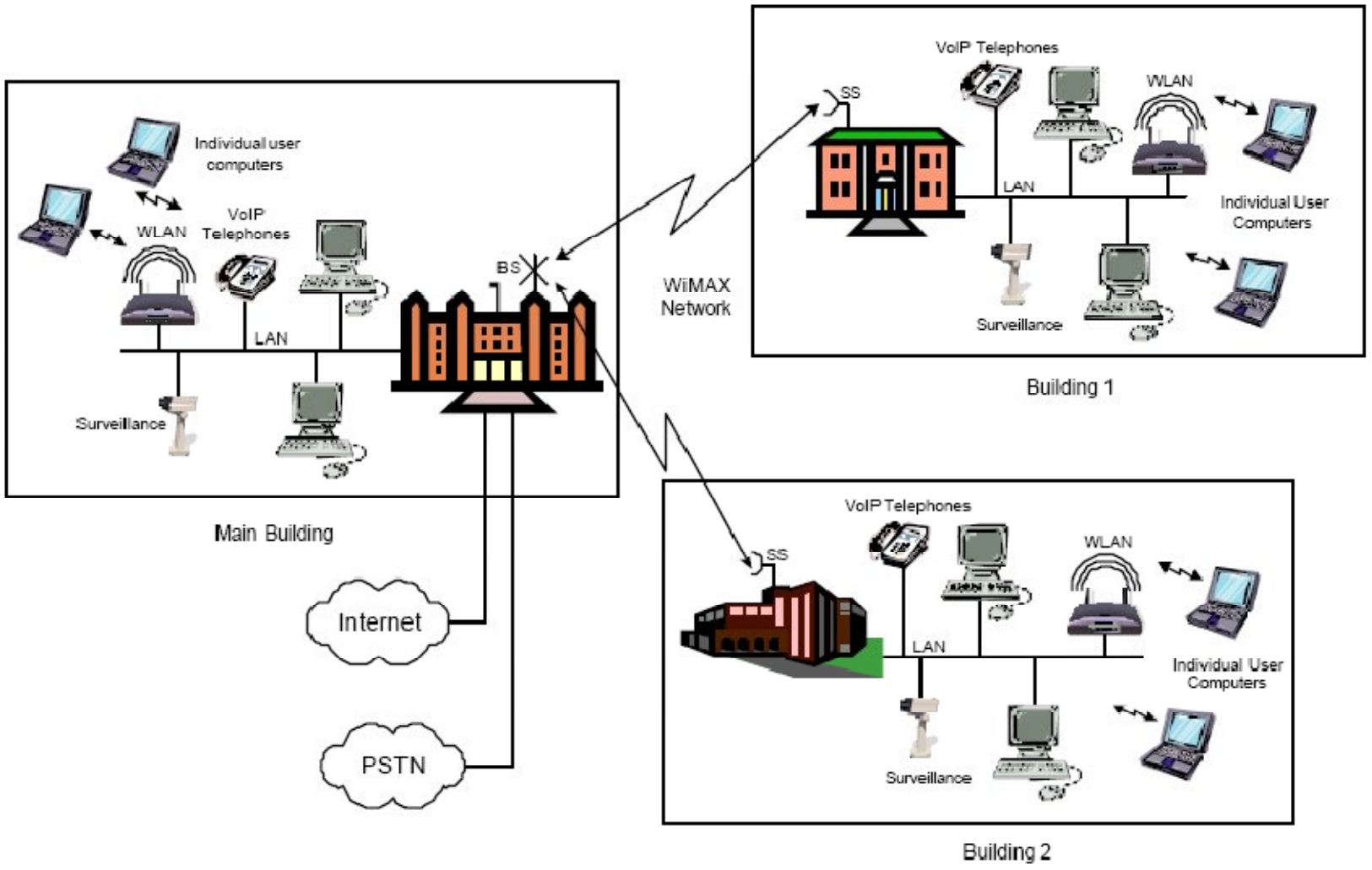
WiMAX untuk Rural Community



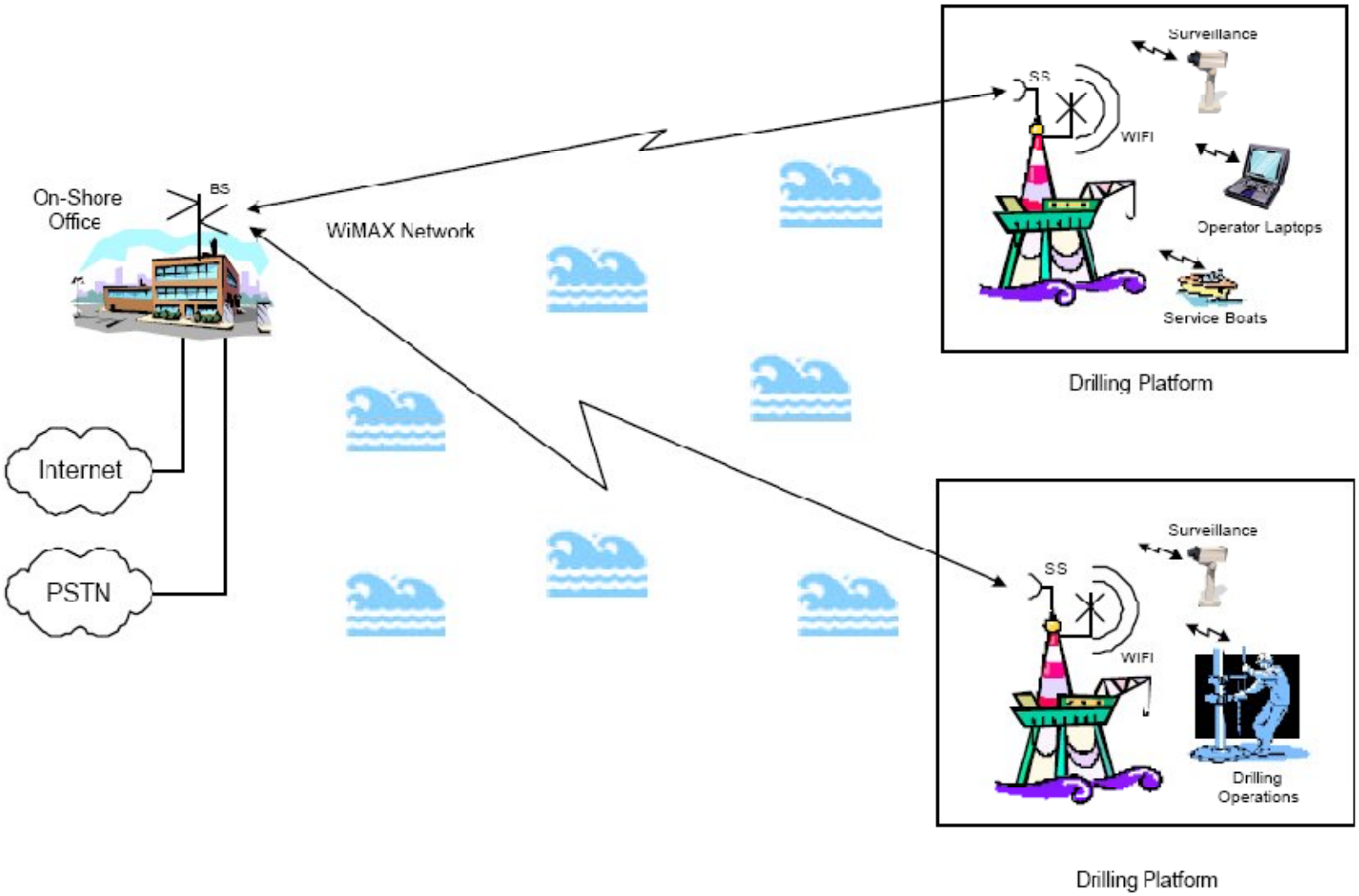


Rural Community

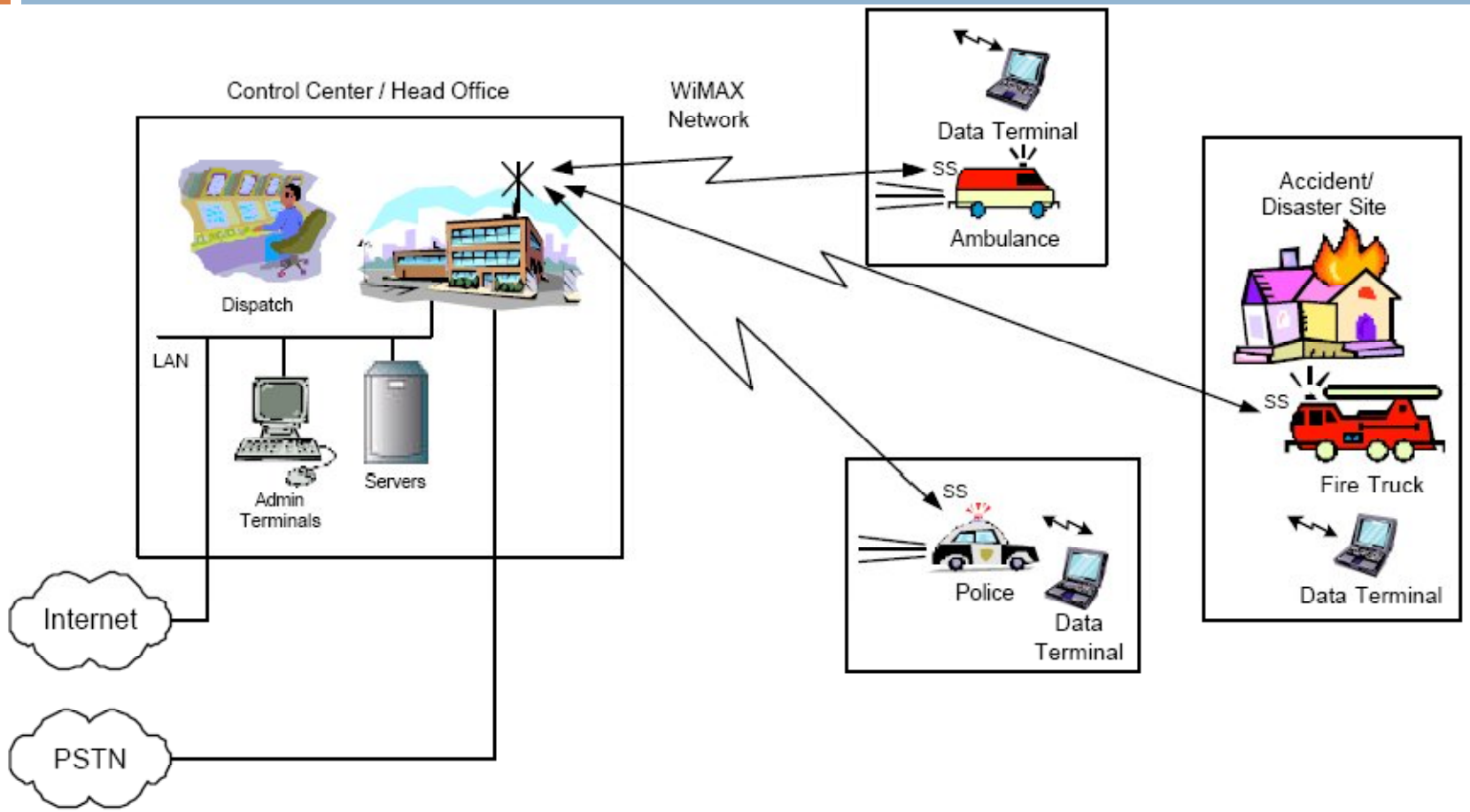
WiMAX untuk Konektivitas Kampus



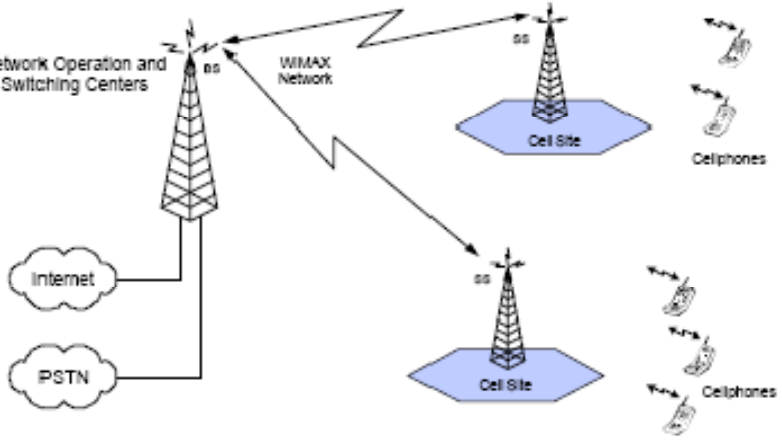
WiMAX untuk Komunikasi Lepas Pantai



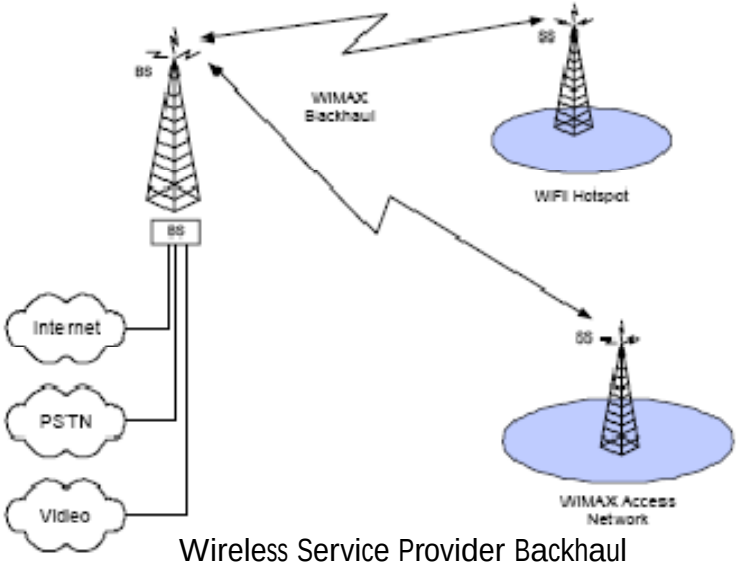
WiMAX untuk Keamanan Umum



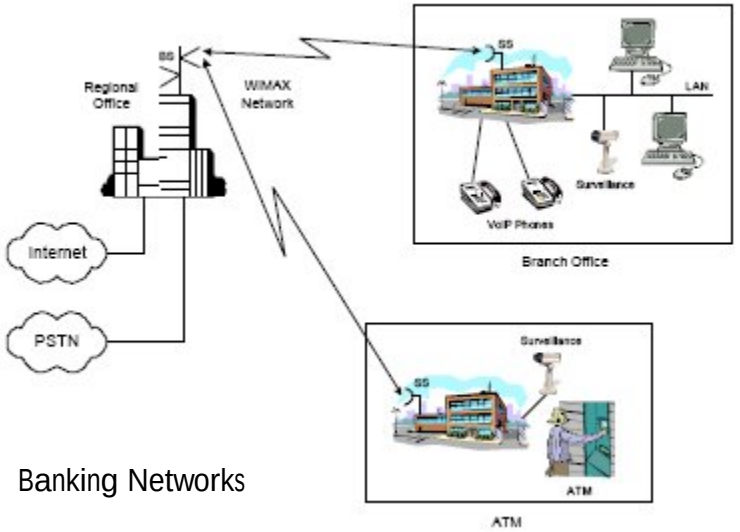
WiMAX untuk Private Networks



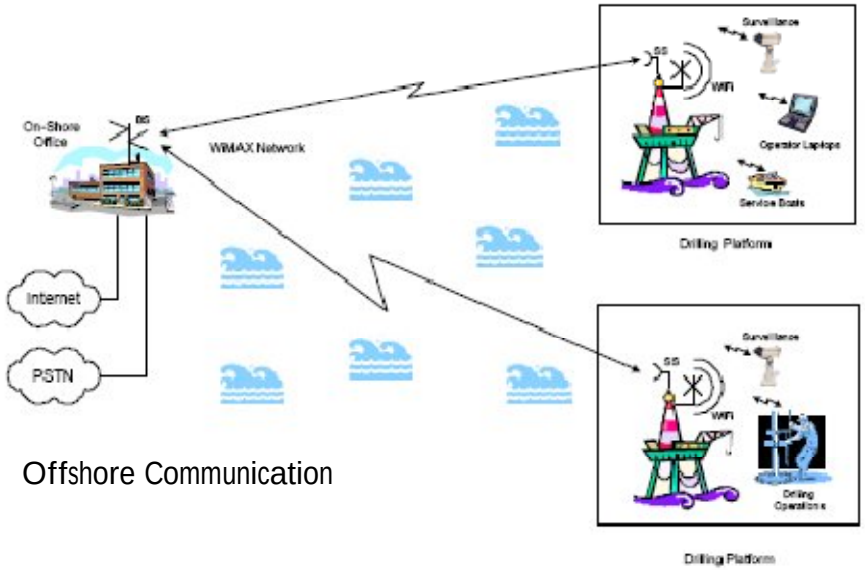
Cellular Backhaul



Wireless Service Provider Backhaul

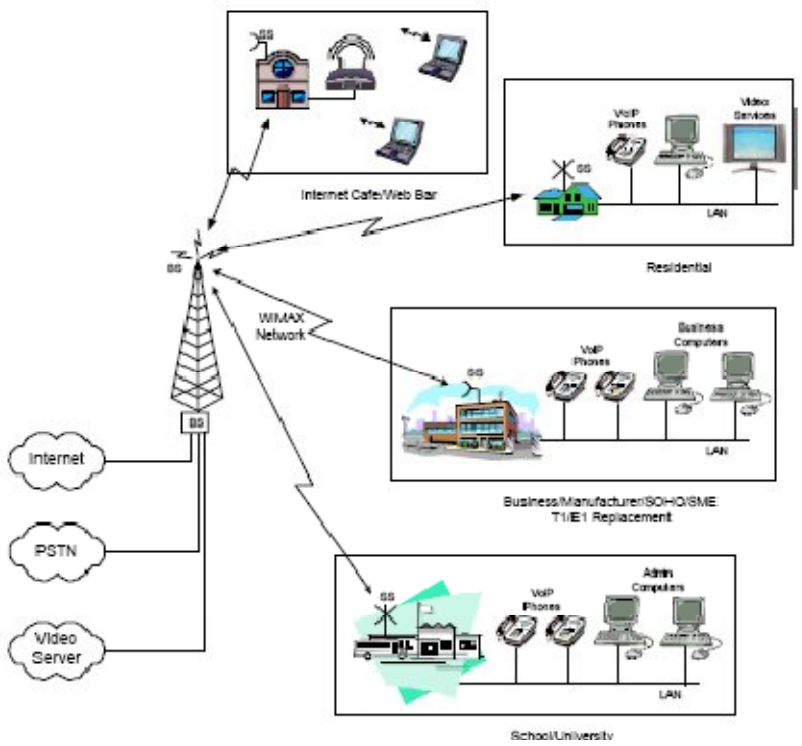


Banking Networks



Offshore Communication

WiMAX untuk Public Network



Wireless Service Provider Access Network

Perbandingan 2G/3G, WiFi, WiMAX

