

Webhosting and Networking

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Agenda

- What is a Network?
- Elements of a Network
 - Hardware
 - Software
- Ethernet Technology
- World Wide Web
- Setting up a Network
- Conclusion

What is a Network?

- An interconnected system of things or people
- Purpose of a Network?
 - Resource Sharing
 - Communication
- LANs have become the most popular form of Computer Networks

Principle of Locality of Reference

- Temporal Locality of Reference

If a pair of computers communicates once, the pair is likely to communicate again in the near future and periodically

- Physical Locality of Reference

A computer tends to communicate most often with other computers that are nearby

Elements of a Network (cont.)

- Computers (Clients & Server(s))
- NICs
- Cables & Connectors
- Hub/Switches
- Router

Elements of a Network (cont.)



NIC



Switch



Router



cables



Elements of a Network (cont.)



**A rack of
Network
switches and
routers**

Software Components

- Protocol Stack
TCP/IP
- Application Software

Client

Browser, E-mail Client, Chat Client

Server

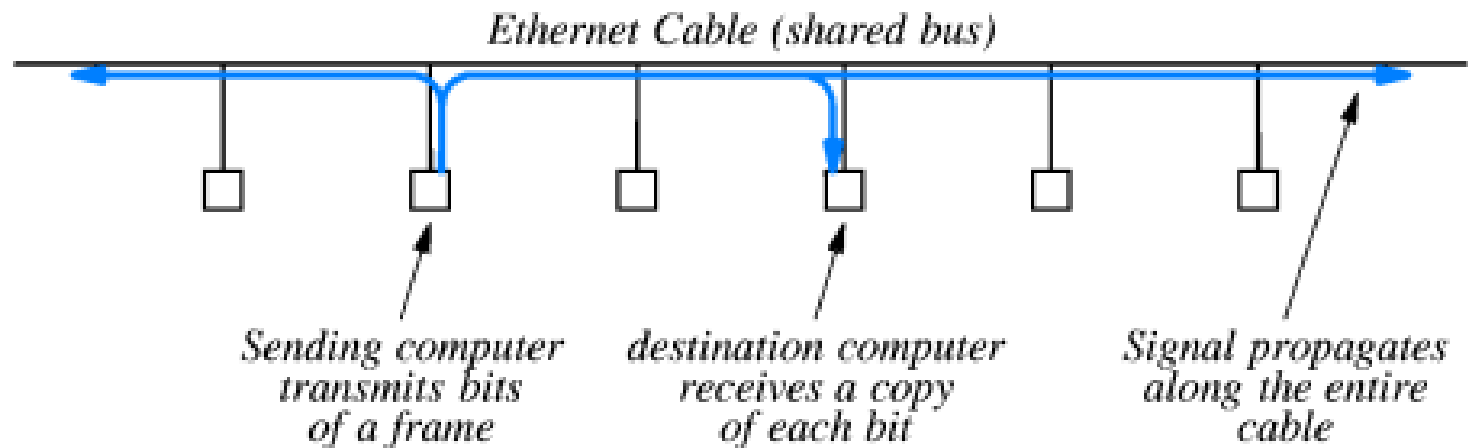
Web Server, Mail Server, File Server

What is a Protocol?

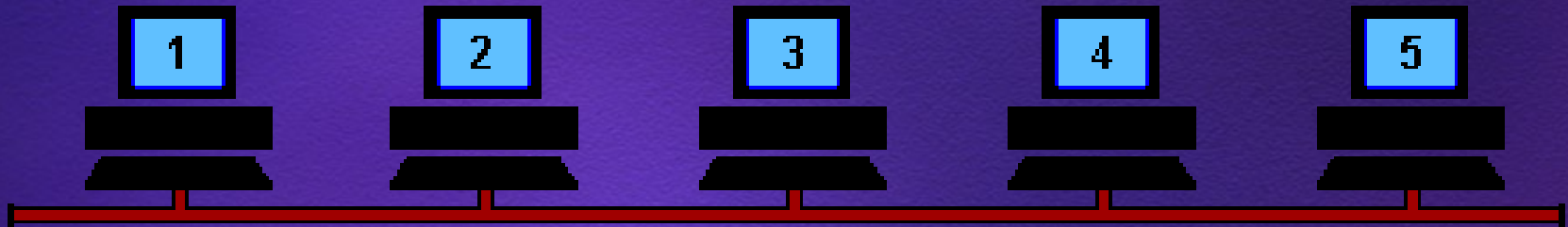
- Set of Rules
- Described by international standard bodies
- TCP – Transmission Control Protocol
- IP – Internet Protocol
- HTTP, FTP, SMTP, POP, SNMP and a lot..

Ethernet

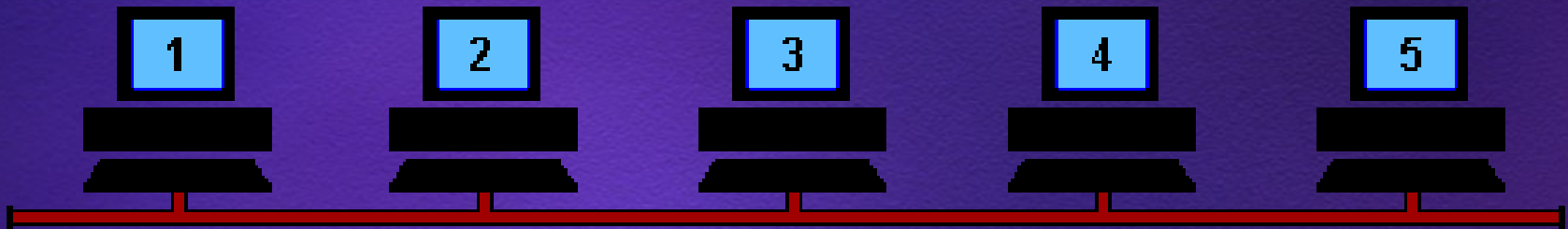
- Local Area Network Standard
- CSMA/CD



Ethernet

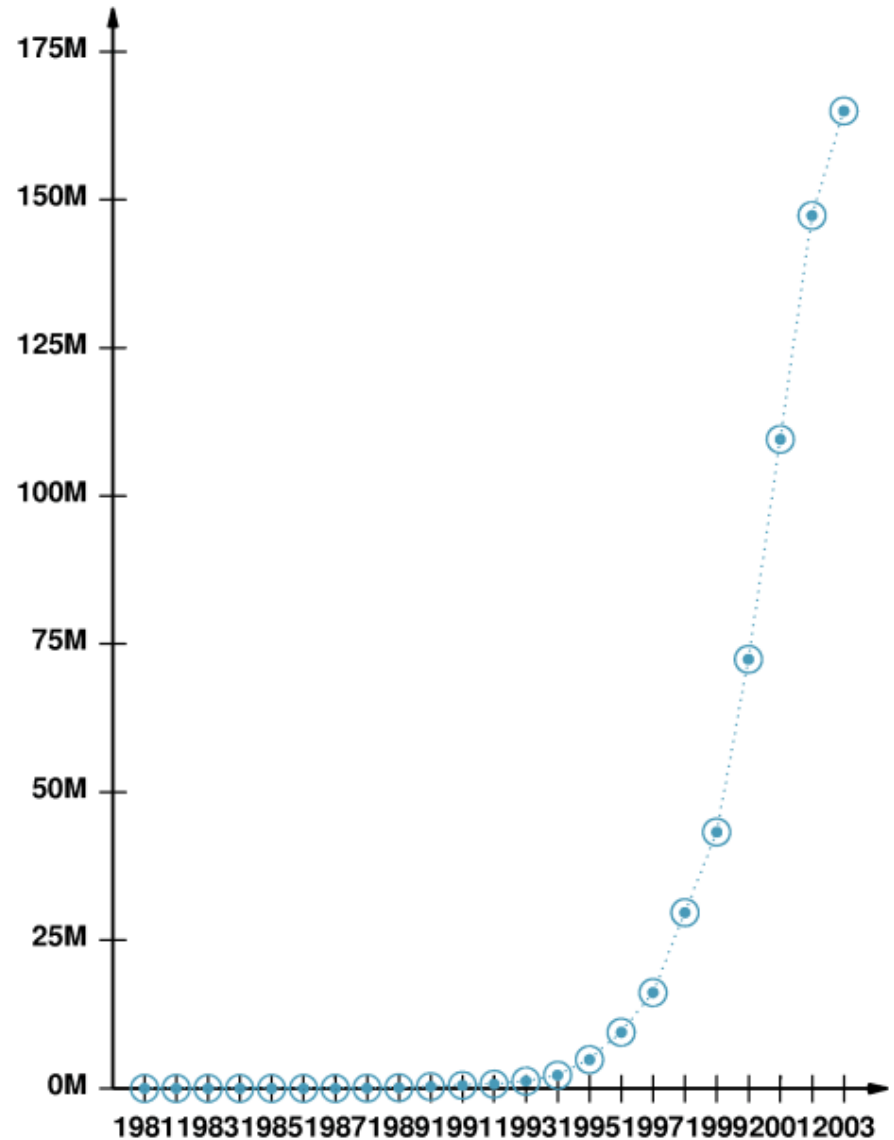


Ethernet (CSMA/CD)



Internetworking

- Connecting two LANs
- Network of Networks – Internet
- Grows @ of 50% per year

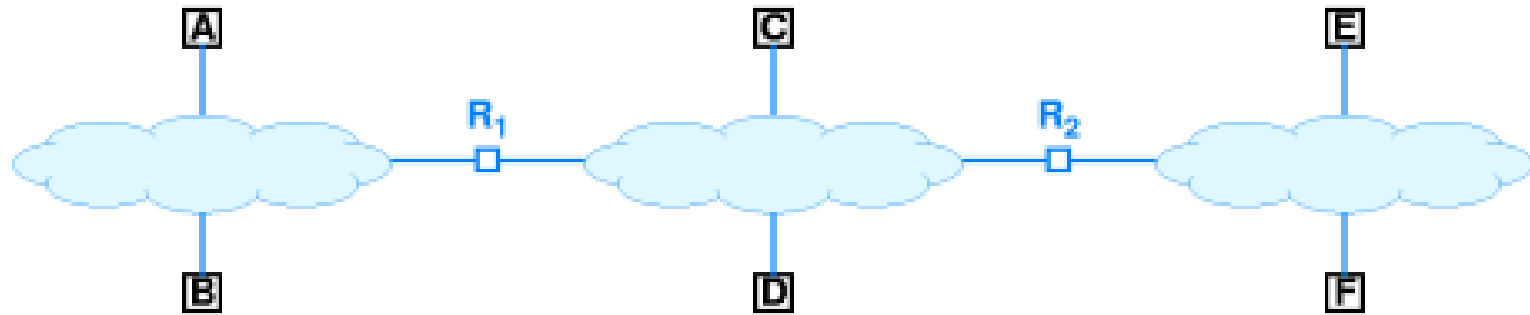


Internet – What is important?

- Routing
- IP addressing
- Data Rate
- Bandwidth support for Next Gen applications
- Seamless integration of existing technologies
- Semantic Web

Routing

- **Routing** is the process of moving packets through an internetwork



- **Routers R1 and R2 use Routing Tables to route the packets**

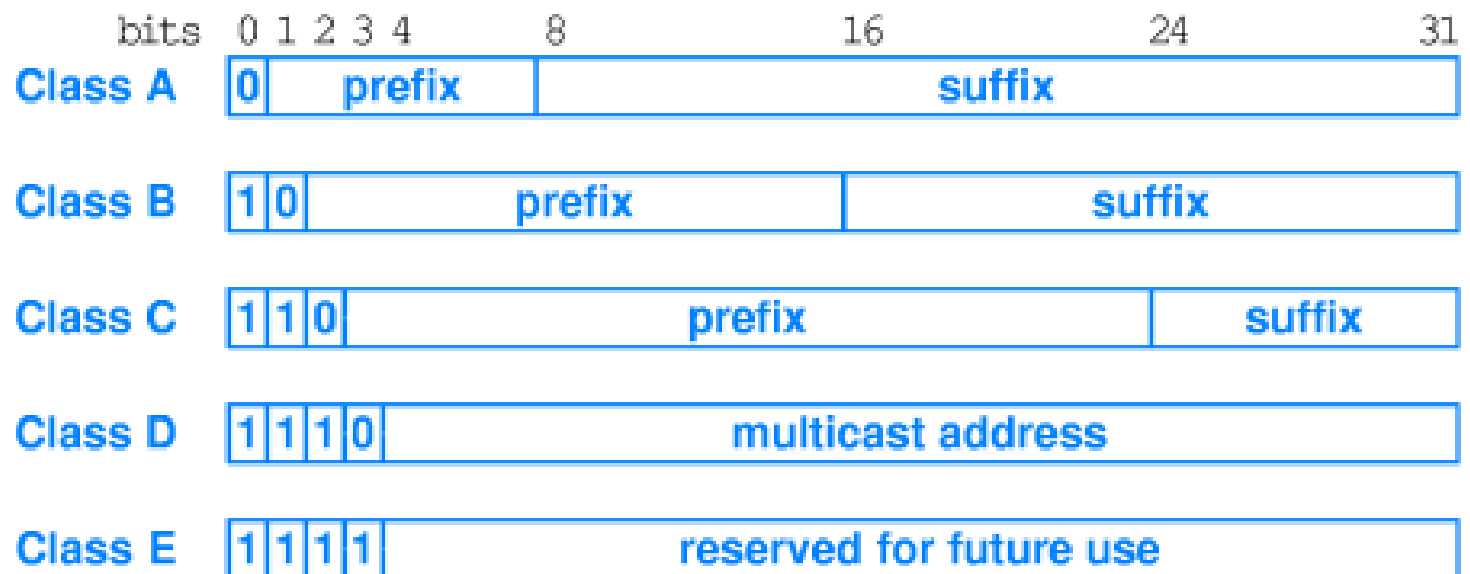
Addressing

- IP V4 addressing – 32 bit
- IP V6 addressing – 128 bit

IP Address = Network part + Host part

192.168.72.22

Different Classes of IP address



Addressing

- IP Address is hard to remember
- Human readable URLs
- <http://www.google.com>
- Mapping is done by DNS

How to connect to Internet

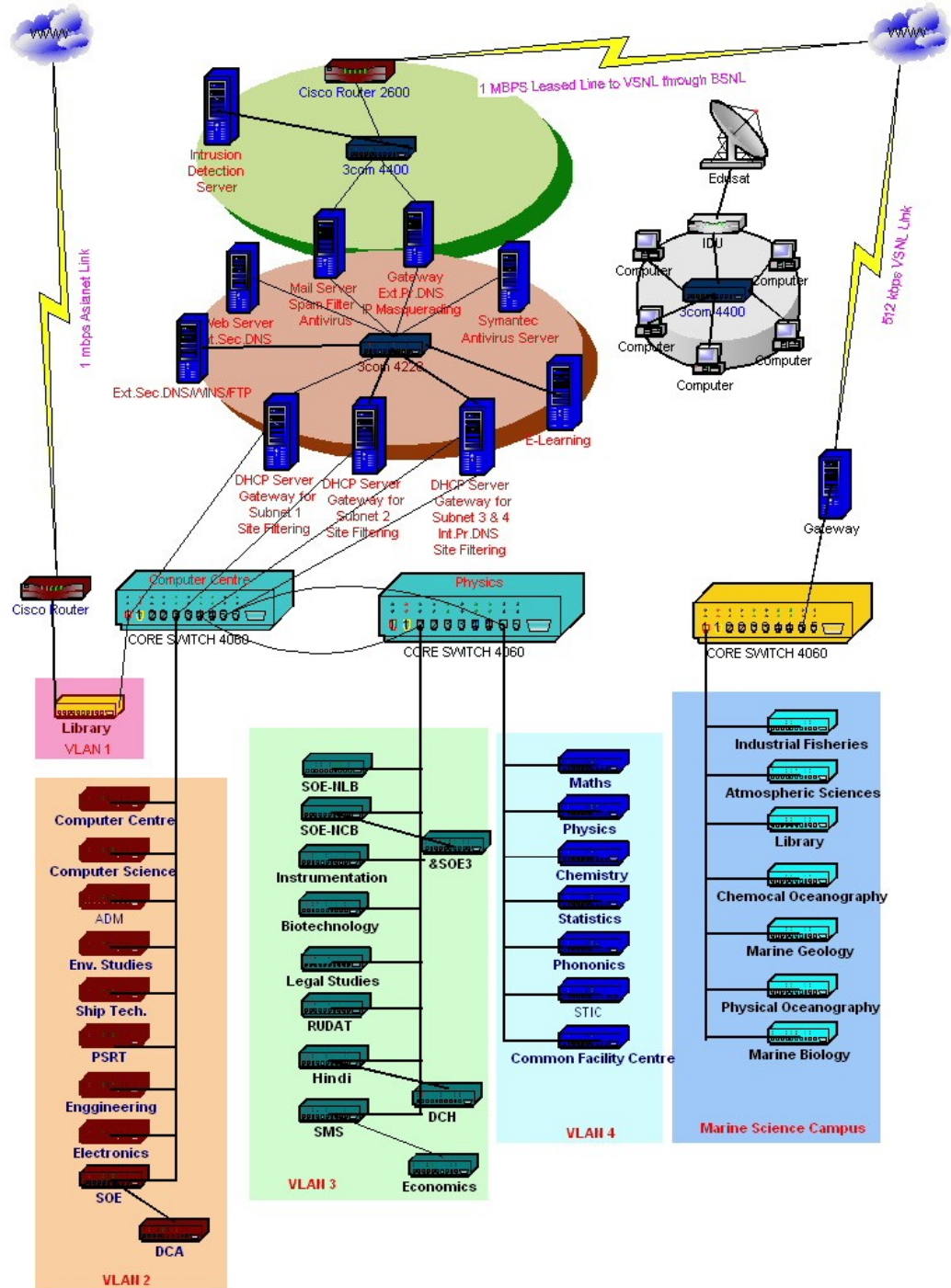
- Dial-Up (28 – 56 Kbps)
- DSL (90 Kbps)
- ISDN(64-128 Kbps)
- Leased Line (T1 line – 1.5 Mbps)
(T3 line – 44 Mbps)
- Satellite (500 Mbps)
- Wireless (128 Kbps)

ADSL (512 – 8 Mbps)

- ADSL Speed 512Kbps
- Typical Download 460 Kbps
- Typical Upload 200-240 Kbps

CUSAT network

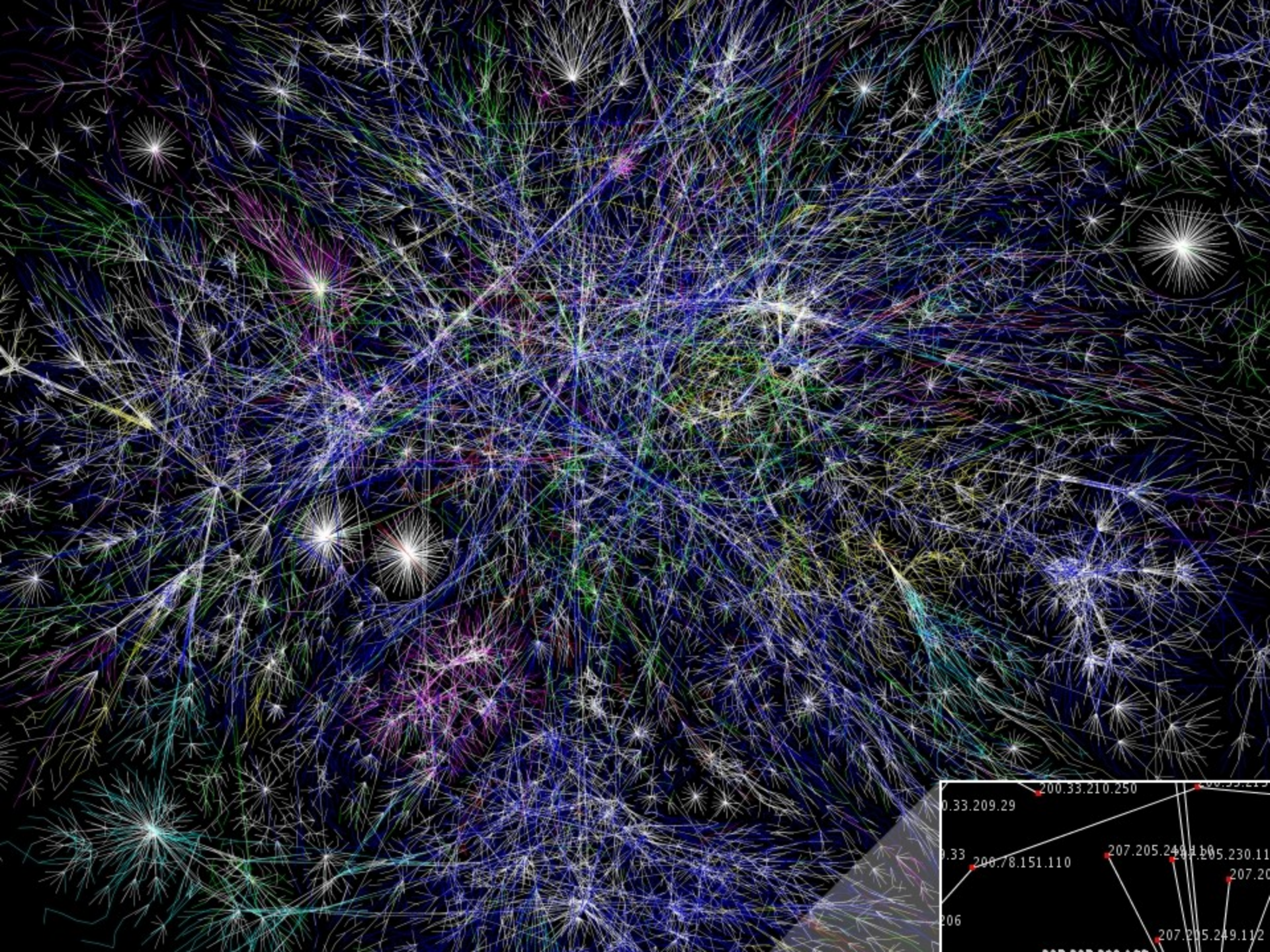
- 14 Mbps leased line
- Mail Server
- Web Server
- E-learning
- Streaming
- Edusat
- VPN
- Anti-virus
- IDS



Network Utilities

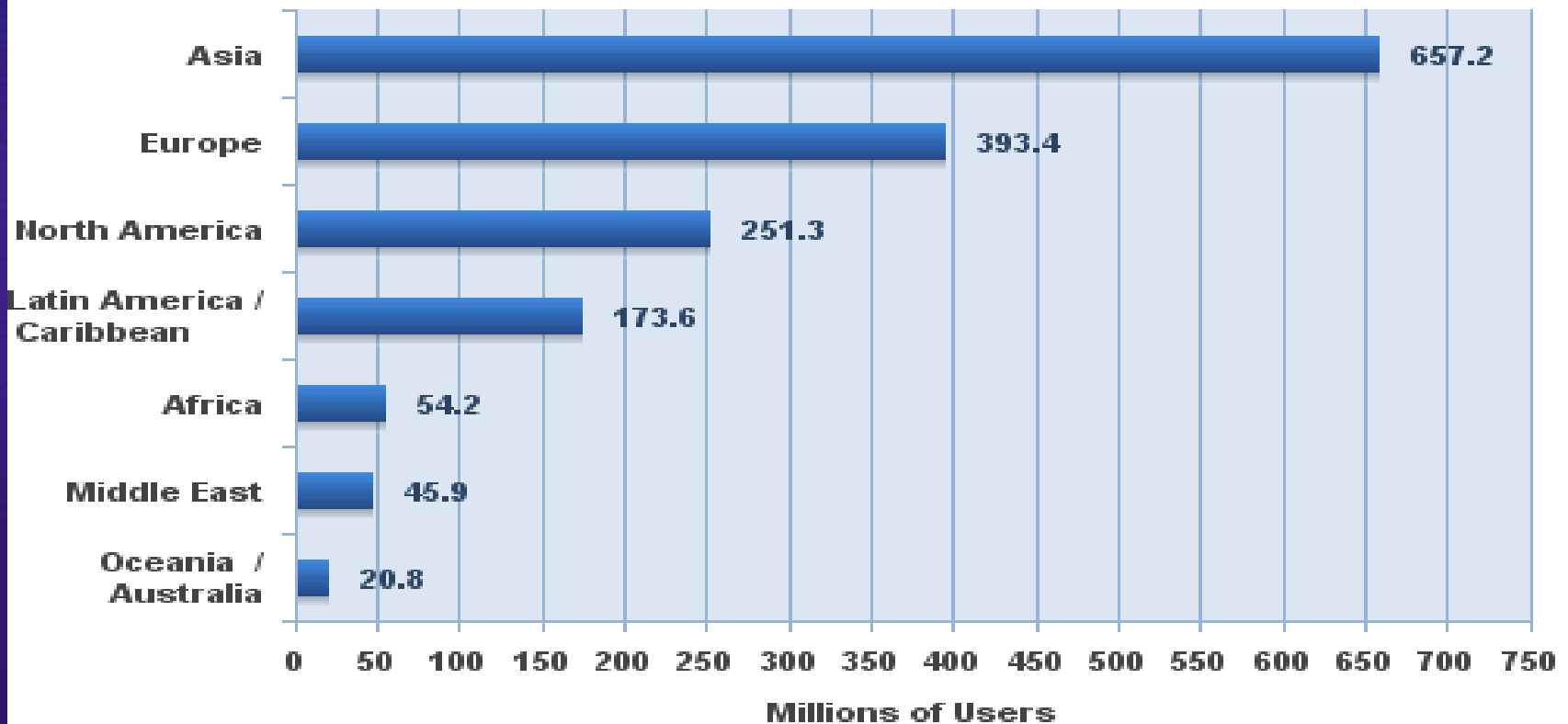
- Ping
- Traceroute
- ftp
- telnet
- ssh

How Big is Internet?



Internet Usage as of now

Internet Users in the World by Geographic Regions



Source: Internet World Stats - www.internetworldstats.com/stats.htm

Estimated Internet users are 1,596,270,108 for March 31, 2009

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India?

- 1,147,995,898 population - Area: 3,166,944 sq km
- 81,000,000 Internet users as of March/09, 7.1% penetration
- 2,520,000 broadband Internet connections as of June/07
- USE GROWTH 1,520.0 % (2000-2009)

Dawn of the Net

Web Services



Consumer-Oriented Web Services

- Stock Quotes
- JIT Calendar



Business-Oriented Web Services



- Credit Authorization
- JIT Productivity Apps

Programmatic-Access



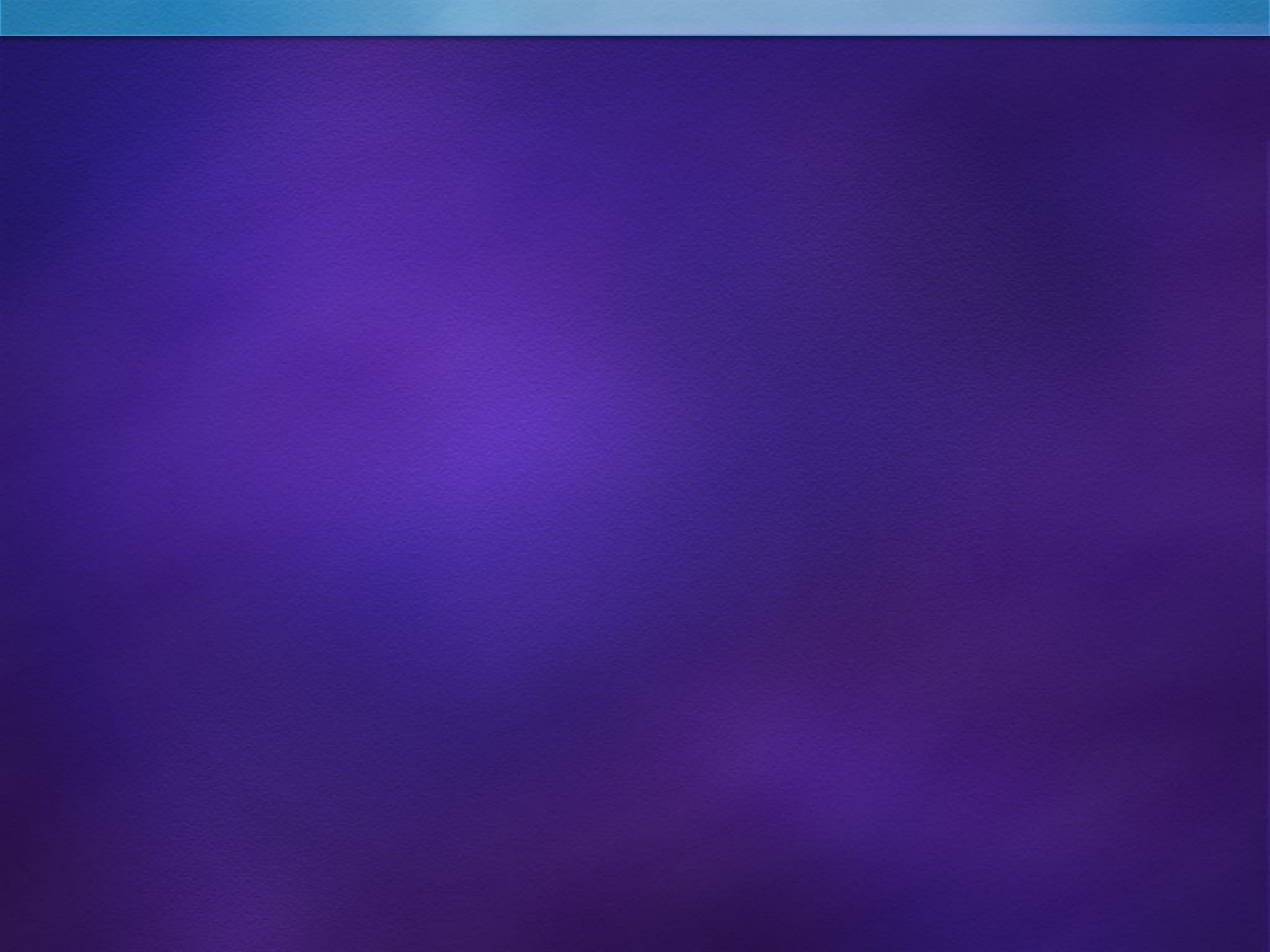
Device-Oriented Web Services



How to setup a Network?

Private IP

- Address range Subnet mask Provides
Addresses per LAN
- 10.0.0.0 - 10.255.255.255 255.0.0.0 1 class A
LAN 16,777,216
- 172.16.0.0 - 172.31.255.255 255.255.0.0
16 class B LANs 65,536
- 192.168.0.0 - 192.168.255.255 255.255.255.0
256 class C LANs 256



HAVE A BREAK



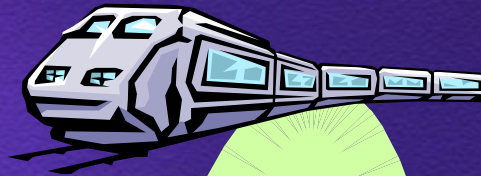
Mobile and wireless services – Always Best Connected

LAN, WLAN
780 kbit/s

GSM 53 kbit/s
Bluetooth 500 kbit/s

UMTS, GSM
115 kbit/s

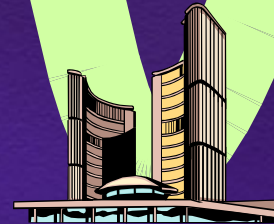
LAN
100 Mbit/s,
WLAN
54 Mbit/s



GSM/EDGE 384 kbit/s,
WLAN 780 kbit/s



GSM 115 kbit/s,
WLAN 11 Mbit/s



UMTS, GSM
384 kbit/s



UMTS,
DECT
2 Mbit/s

Mobile devices

Pager

- receive only
- tiny displays
- simple text messages

PDA

- simpler graphical displays
- character recognition
- simplified WWW

Laptop

- fully functional
- standard applications

Sensors,
embedded
controllers



Mobile phones

- voice, data
- simple graphical displays

Palmtop

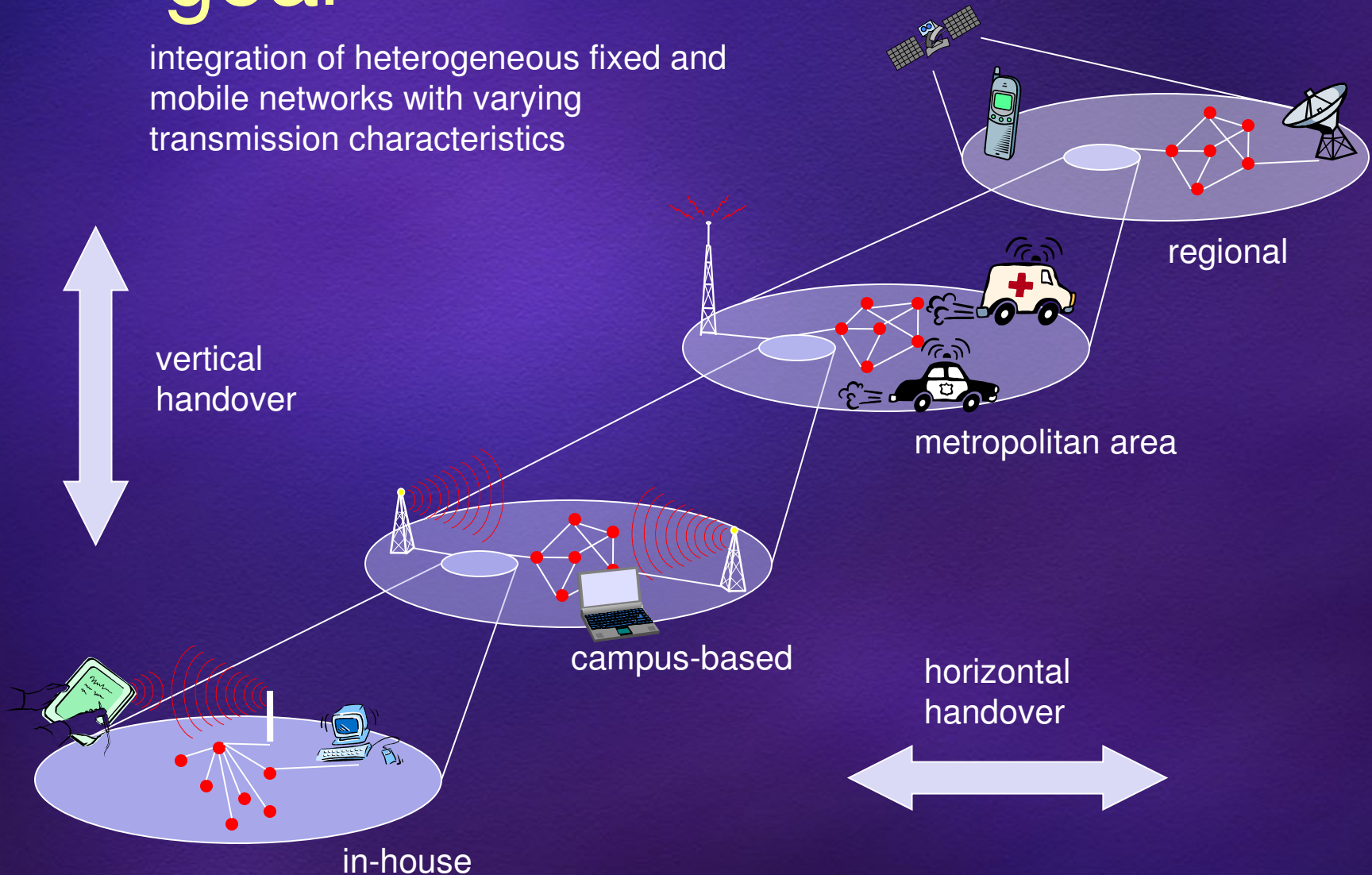
- tiny keyboard
- simple versions of standard applications



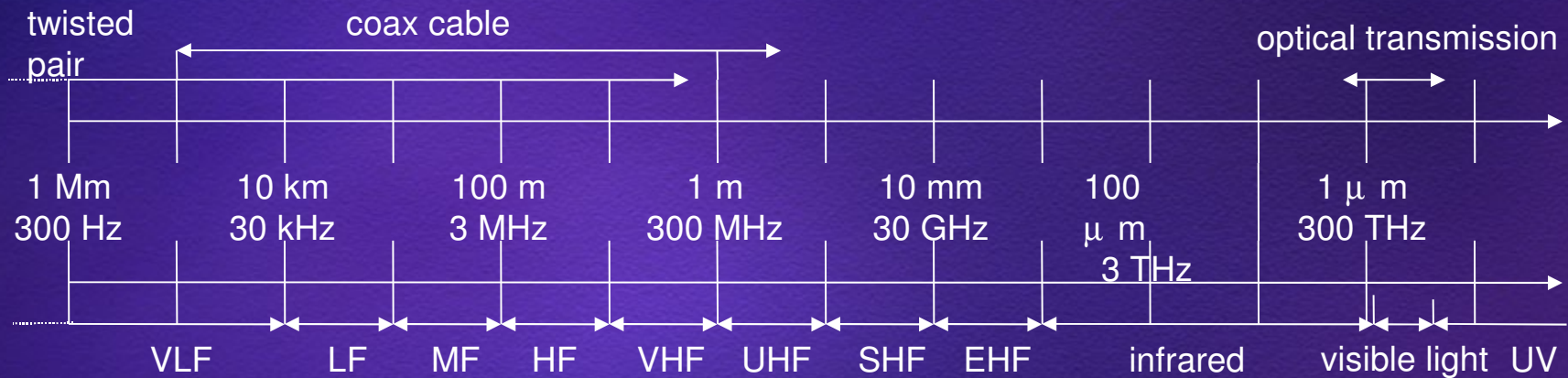
performance

Overlay Networks - the global goal

integration of heterogeneous fixed and mobile networks with varying transmission characteristics



Frequencies for communication



- VLF = Very Low Frequency Frequency
- LF = Low Frequency
- MF = Medium Frequency Frequency
- HF = High Frequency
- VHF = Very High Frequency

UHF = Ultra High

SHF = Super High Frequency

EHF = Extra High

UV = Ultraviolet Light

- Frequency and wave length:

- $\lambda = c/f$

- wave length λ , speed of light $c \cong 3 \times 10^8 \text{m/s}$, frequency f

Frequencies and regulations

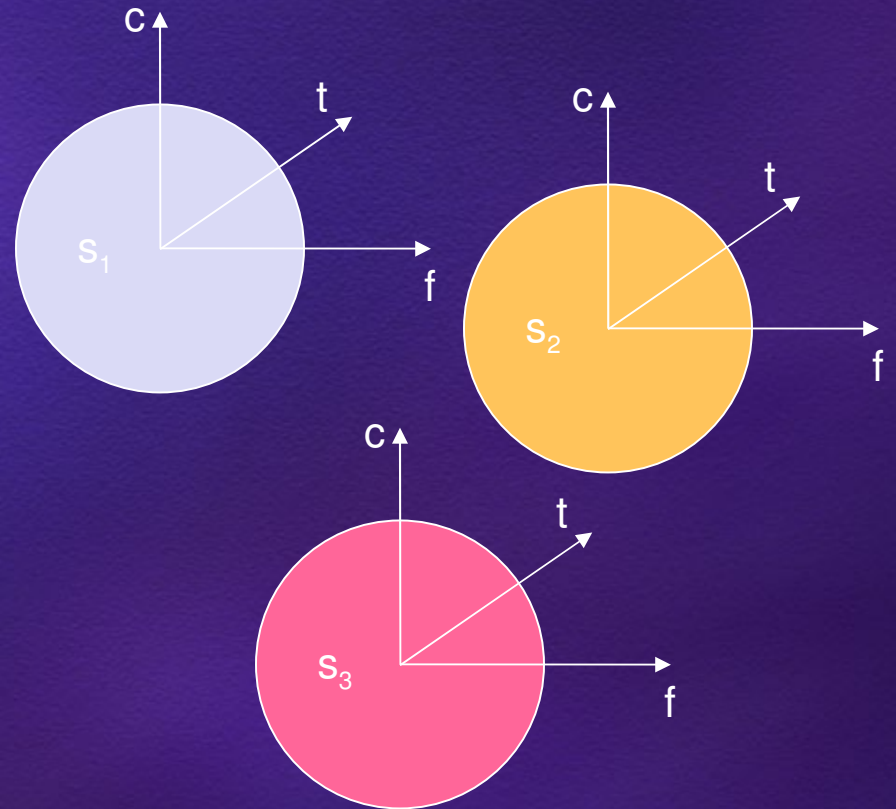
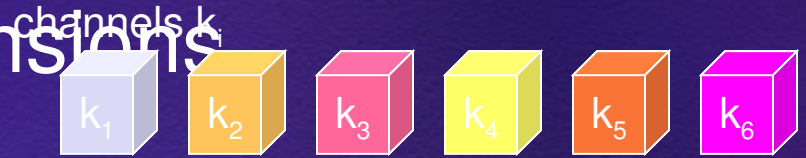
- ITU-R holds auctions for new frequencies, manages frequency bands worldwide (WRC, World Radio Conferences)

	Europe	USA	Japan
Cellular Phones	GSM 450-457, 479-486/460-467,489-496, 890-915/935-960, 1710-1785/1805-1880 UMTS (FDD) 1920-1980, 2110-2190 UMTS (TDD) 1900-1920, 2020-2025	AMPS, TDMA, CDMA 824-849, 869-894 TDMA, CDMA, GSM 1850-1910, 1930-1990	PDC 810-826, 940-956, 1429-1465, 1477-1513
Cordless Phones	CT1+ 885-887, 930-932 CT2 864-868 DECT 1880-1900	PACS 1850-1910, 1930-1990 PACS-UB 1910-1930	PHS 1895-1918 JCT 254-380
Wireless LANs	IEEE 802.11 2400-2483 HIPERLAN 2 5150-5250	902-928 IEEE 802.11 2400-2483 5150-5250, 5725-5825	IEEE 802.11 2471-2497 5150-5250

Multiplexing

- Multiplexing in 4 dimensions

- space (s)
- time (t)
- frequency (f)
- code (c)

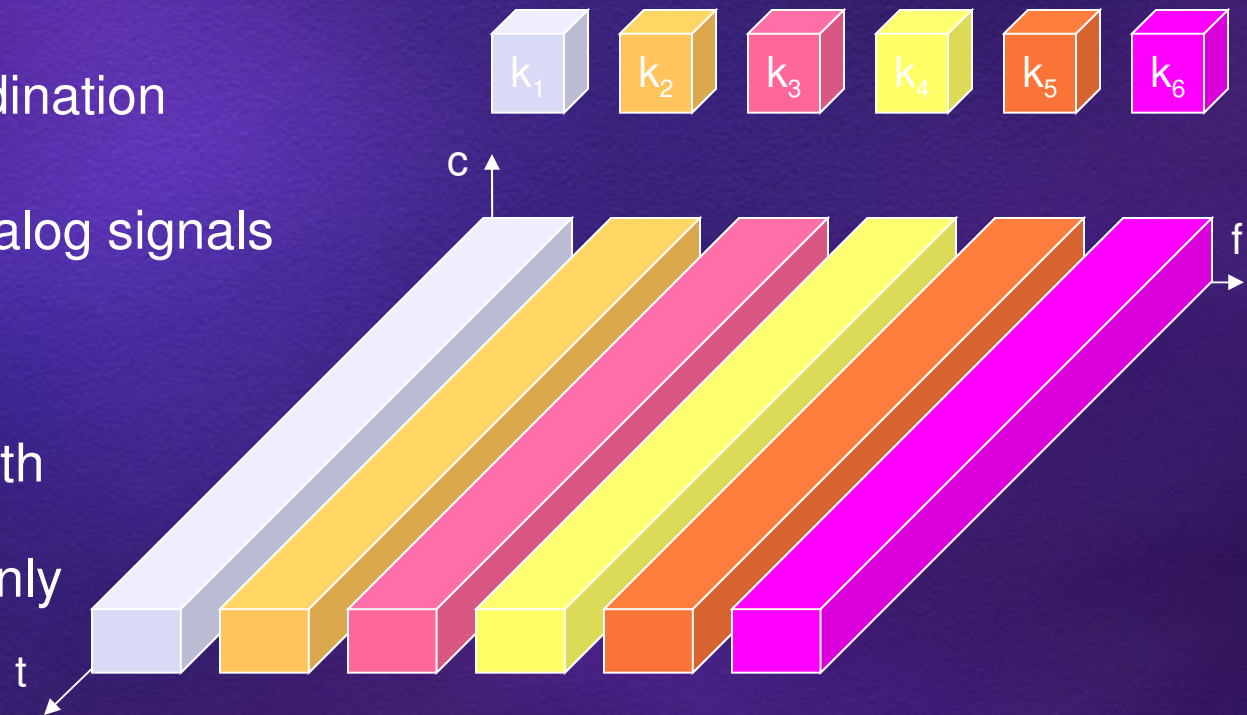


- Goal: multiple use of a shared medium

- Important: guard spaces needed!

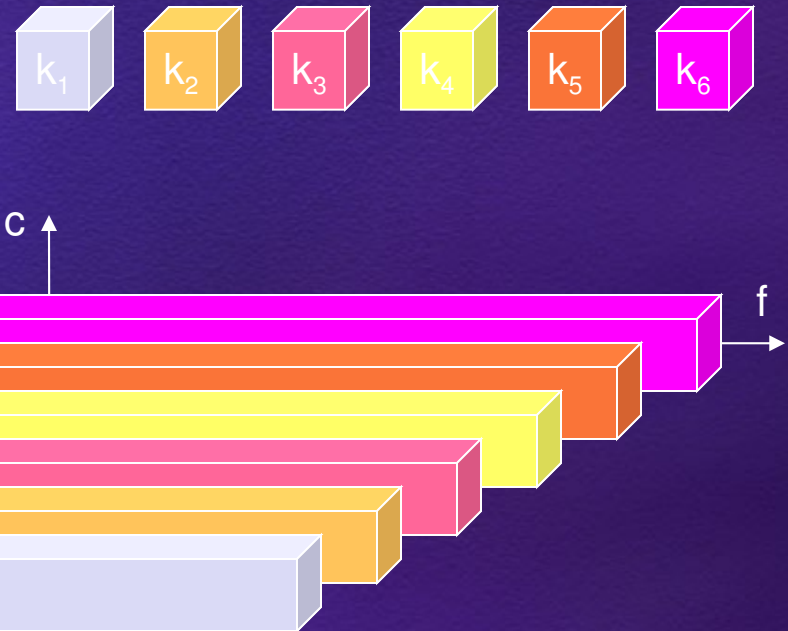
Frequency multiplex

- Separation of the whole spectrum into smaller frequency bands
- A channel gets a certain band of the spectrum for the whole time
- Advantages:
 - no dynamic coordination necessary
 - works also for analog signals
- Disadvantages:
 - waste of bandwidth if the traffic is distributed unevenly
 - inflexible
 - guard spaces



Time multiplex

- A channel gets the whole spectrum for a certain amount of time
- Advantages:
 - only one carrier in the medium at any time
 - throughput high even for many users
- Disadvantages:
 - precise synchronization necessary



Time and frequency multiplex

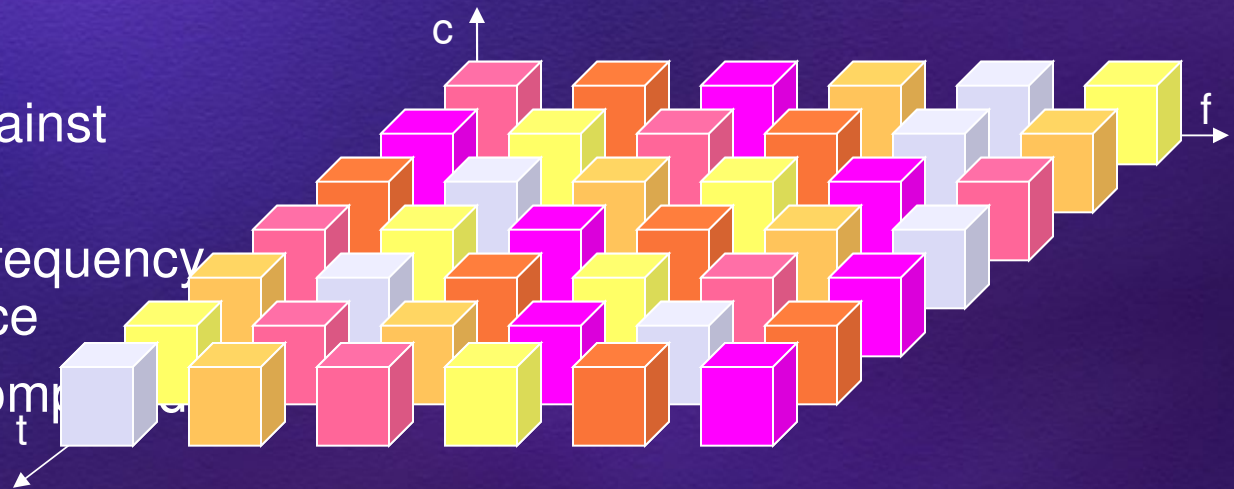
- Combination of both methods
- A channel gets a certain frequency band for a certain amount of time

- Example: GSM

- Advantages:

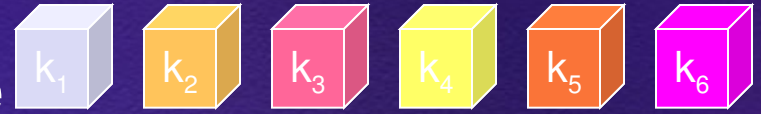
- better protection against tapping
- protection against frequency selective interference
- higher data rates compared to code multiplex

- but: precise coordination required



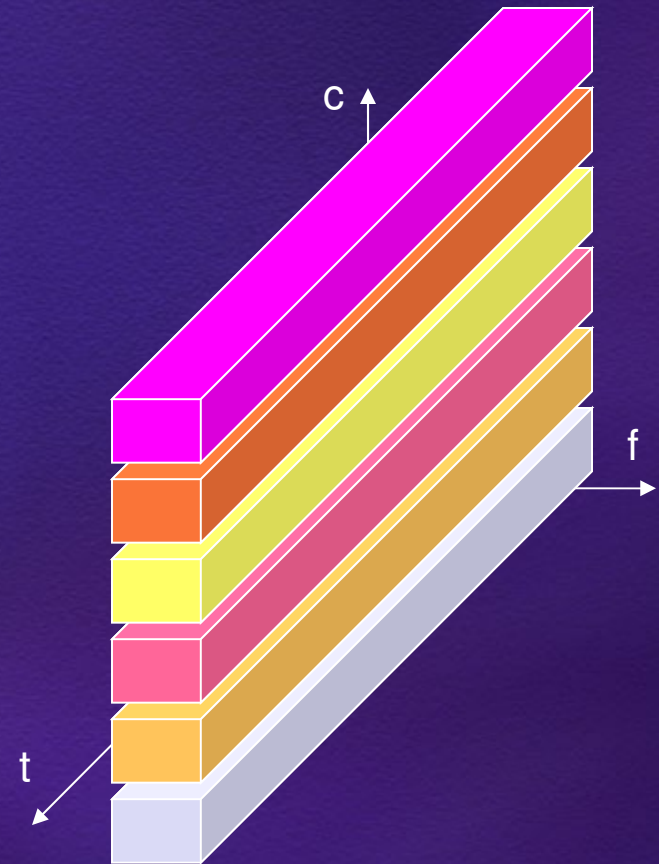
Code multiplex

- Each channel has a unique code



All channels use the same spectrum at the same time

- Advantages:
 - bandwidth efficient
 - no coordination and synchronization necessary
 - good protection against interference and tapping
- Disadvantages:
 - lower user data rates
 - more complex signal regeneration
- Implemented using spread spectrum technology



GSM & CDMA

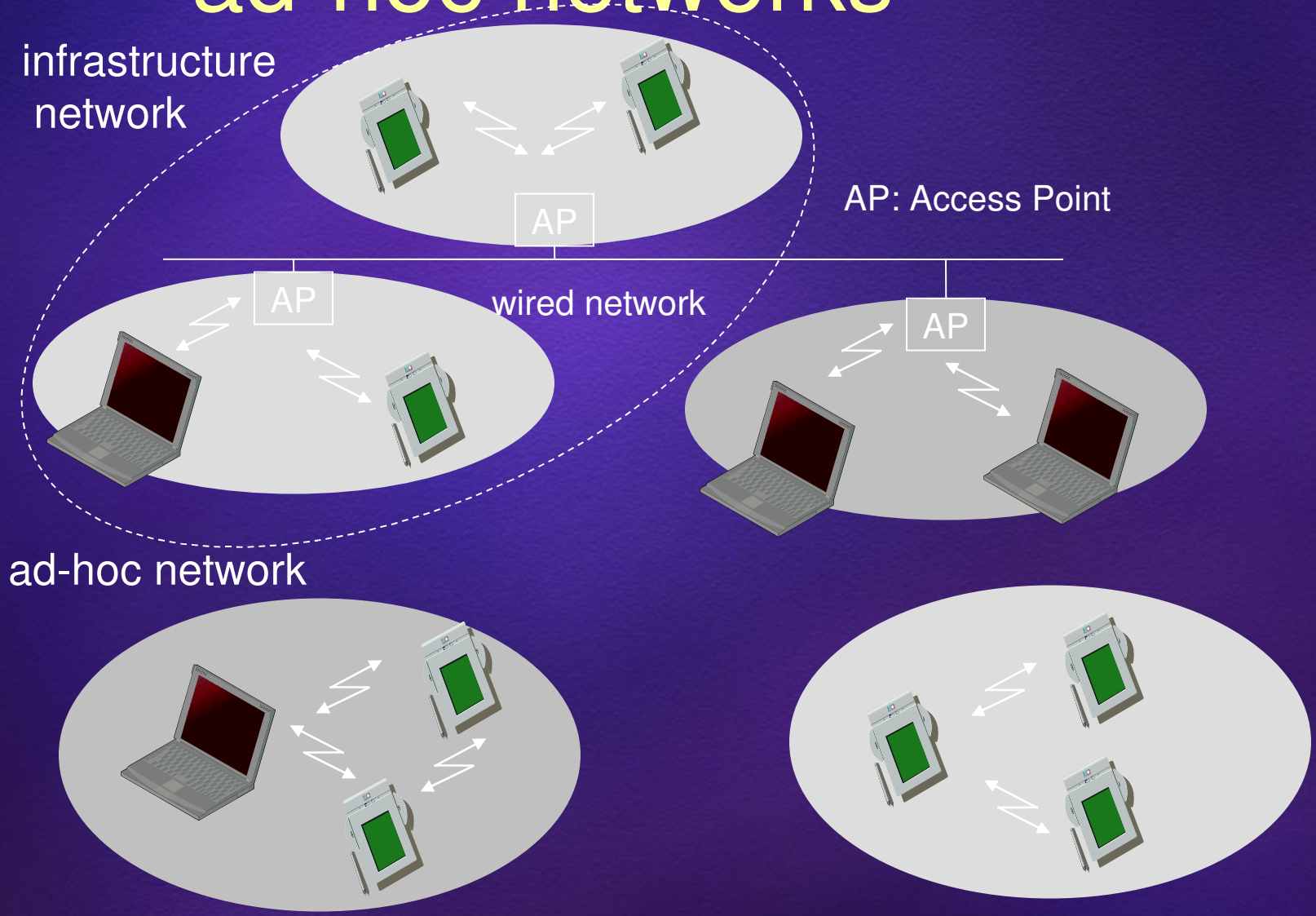
- Global System for Mobile Communications (GSM)
- Code Division Multiple Access (CDMA)
- GSM requires frequency planning
- CDMA uses spread spectrum technique



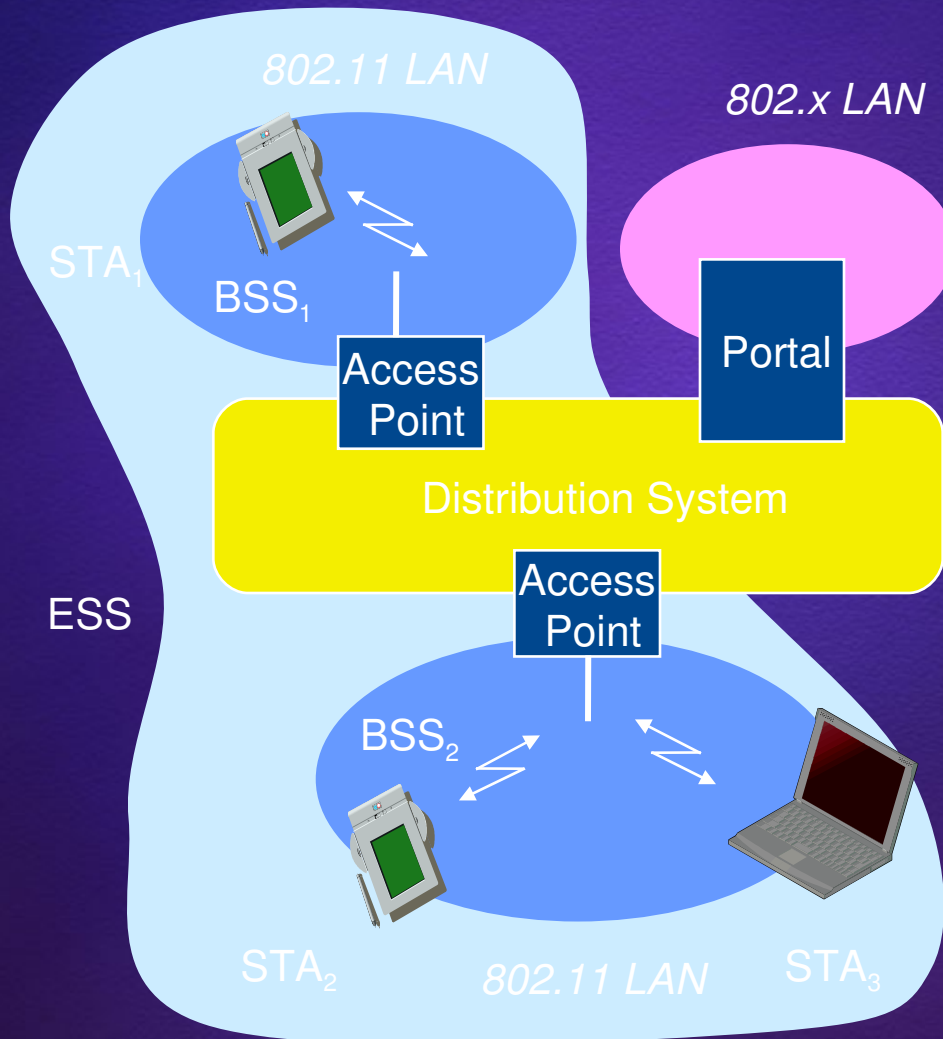
Wireless and Mobile Networks

- Wireless Networking
 - Infrastructure based
 - Ad-hoc (peer-to-peer)

Comparison: infrastructure vs. ad-hoc networks



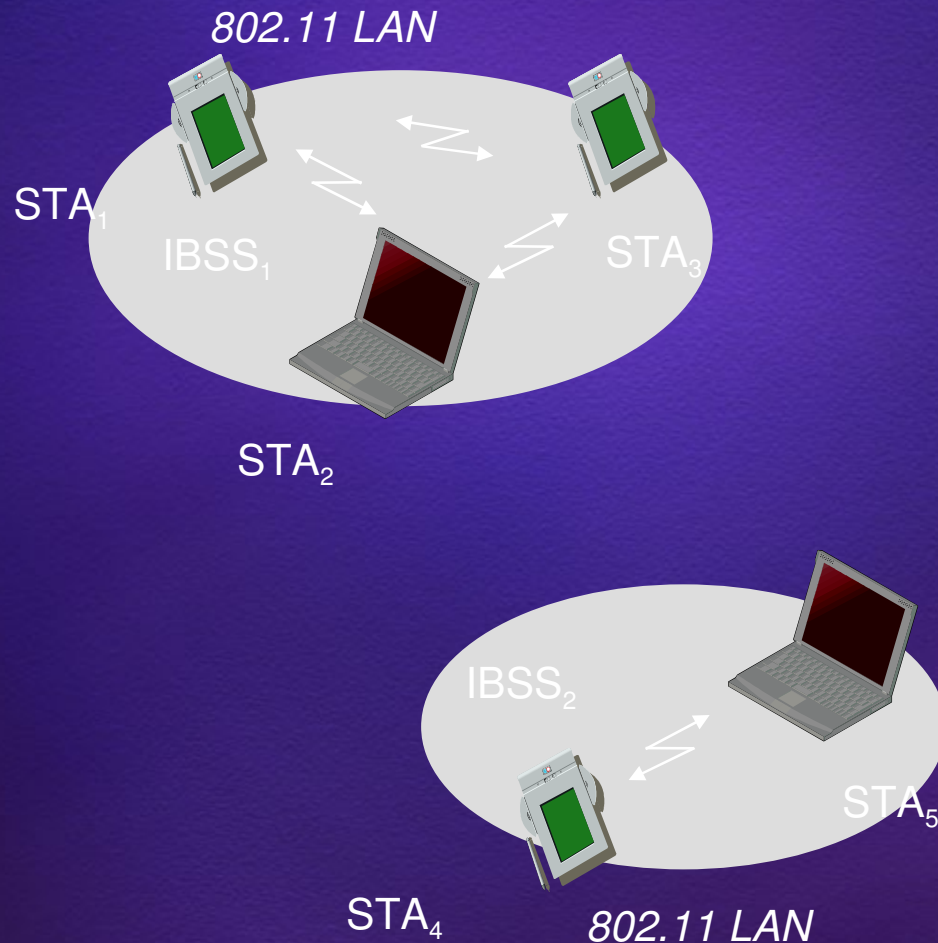
802.11 - Architecture of an infrastructure network



- Station (STA)
 - terminal with access mechanisms to the wireless medium and radio contact to the access point
- Basic Service Set (BSS)
 - group of stations using the same radio frequency
- Access Point
 - station integrated into the wireless LAN and the distribution system
- Portal
 - bridge to other (wired) networks
- Distribution System
 - interconnection network to form one logical network (EES: Extended Service Set) based

802.11 - Architecture of an ad-hoc network

- Direct communication within a limited range

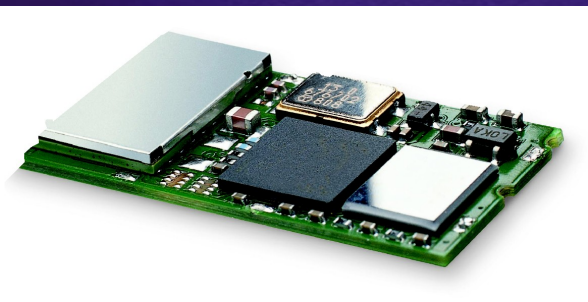


- Station (STA): terminal with access mechanisms to the wireless medium
- Independent Basic Service Set (IBSS): group of stations using the same radio frequency

Bluetooth

- Idea

- Universal radio interface for ad-hoc wireless connectivity
- Interconnecting computer and peripherals, handheld devices, PDAs, cell phones – replacement of IrDA
- Embedded in other devices, goal: 5€/device (2002: 50€/USB bluetooth)
- Short range (10 m), low power consumption, license-free 2.45 GHz ISM
- Voice and data transmission, approx. 1 Mbit/s gross data rate

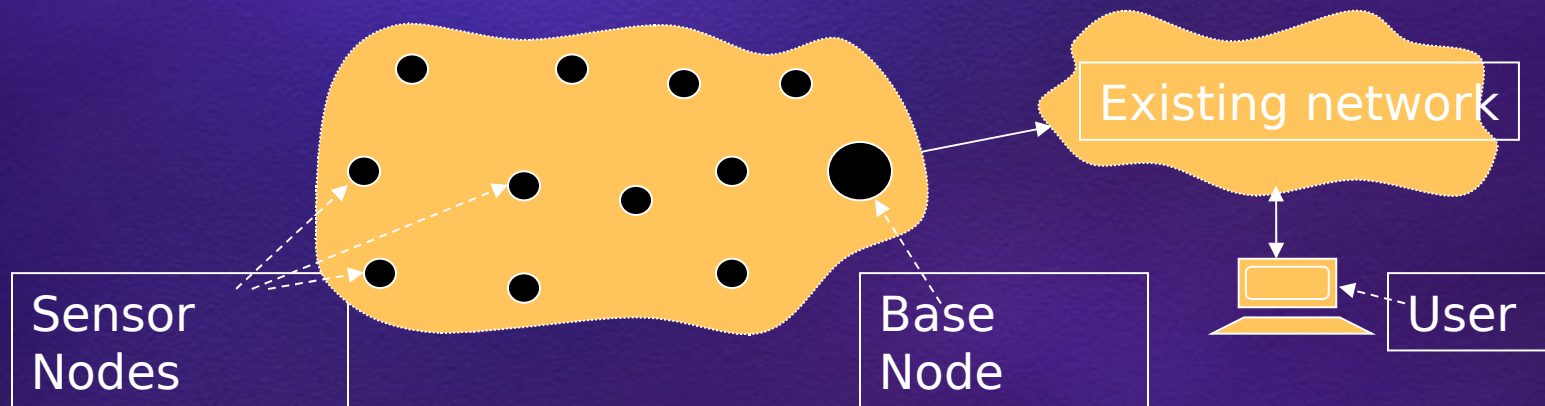


WPAN

- IEEE 802.15 standard equivalent to Bluetooth

Wireless Sensor Networks

- recently emerging technology
- composed of a large no. of very small sensors



WSN Projects

CitySense Project April 2007

- Harvard University, BBN Technologies, and the City of Cambridge have begun a four-year project to install 100 wireless sensors atop streetlights in Cambridge, Mass., creating the world's first city-wide network of wireless sensors.
- will measure **temperature**, **wind speed**, **rainfall**, **barometric pressure**, and **air quality**, but the possibilities are endless

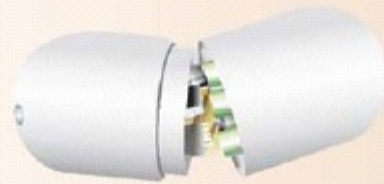
SUN initiative

- A world full of sensors is a world in which, for instance, building climates are micro-controlled, rooms come alive with lights and music when people enter them, and the health of elderly family members is monitored from a distance

Sensor Nodes?



large nodes
>0.1m



'envinode'
≈0.1m



'smart dust'
<0.001m

What we can sense?

- Oceanographic & Meteorological data
- Snow thickness
- UV
- Weather, pH, conductivity
- River flow, quality, precipitation
- Temperature, light, humidity
- Light levels, air temperature and humidity, soil temperature and soil moisture
- And a Lot...

More Examples

- Global Seismographic Network

<http://www.iris.edu>

- Deep Ocean Assessment and reporting of Tsunamis

<http://www.ndbc.noaa.gov/dart.shtml>

- Tropical Atmosphere Ocean Project

<http://www.pmel.noaa.gov/tao/index.shtml>

- King County Lake Data

<http://dnr.metrokc.gov/wlr/waterres/lakedata/index.htm>

- Orion Project

<http://orion.lookingtosea.ucsd.edu/>

- Seismic Project

<http://www.cens.ucla.edu>

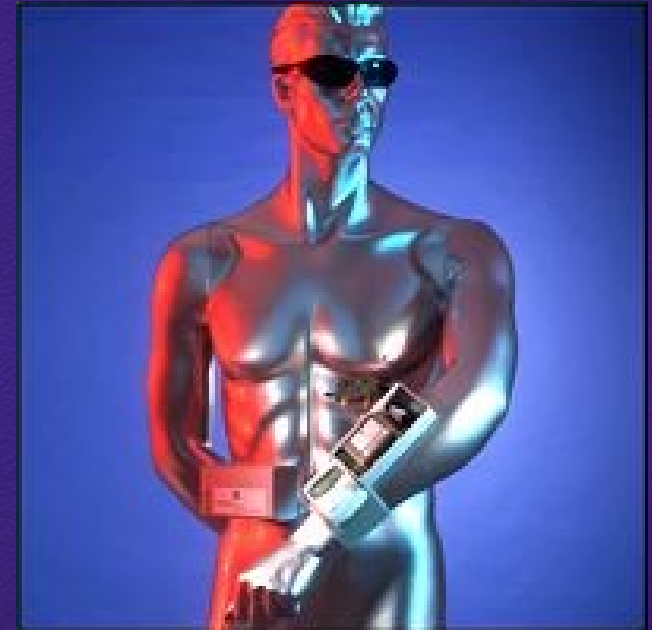
- Habitat Monitoring

<http://www.greatduckisland.net/>

BAN

- Body Area Network

The basic concept of BAN is the fusion of both ideas: a set of mobile, compact units which enable transfer of vital parameters between the patient's location and the clinic or the doctor in charge.



Wi-Fi & Wi-Max

- Wi-Fi broad name for WLAN technology
- Wi-Max – Wireless MAN standard will be used for Mobile Internet

4G Networks

- Mobility is great challenge
- Speed is 100 Mbps – 1 Gbps
- Multimedia Messaging Services, Video Chat, MobileTV, High Definition TV



Thank You