EEE116: Multimedia Systems

Dr Charith Abhayaratne

Tel: 25893
Email: c.abhayaratne@sheffield.ac.uk
Office: F176

- An introductory module to introduce computer, networking and multimedia content technologies.

- Course Delivery:
  - Lectures: 2 hours/week -Tuesday @ 9.00 am
    Friday @ 9.00 am (?)
  - Tutorials: 1 hour/week (Wednesday 9.00 am) – Start from week 2.

Electrical Engineering
The generation, transmission and application of electrical **power**

Control Engineering
The identification, management and prediction of systems

Electronic Engineering
The generation, transmission, processing and application of **information**

Communications
Transfer of **information** over a physical distance

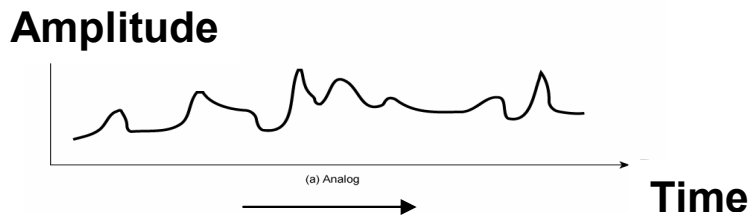
Mainly focus on 3 concepts:

Signal
Data
Information

Signal

Detectable transmitted energy that can be used to carry information.

A time/spatially-varying characteristic of a physical phenomenon, used to convey information.



Data

- Representation of
  - facts,
  - concepts, or instructions
- in a formalized manner suitable for
  - communication,
  - interpretation, or processing by
    - humans or by automatic means.
- E.g., any representations such as characters or analogue quantities to which meaning could be assigned.

Information

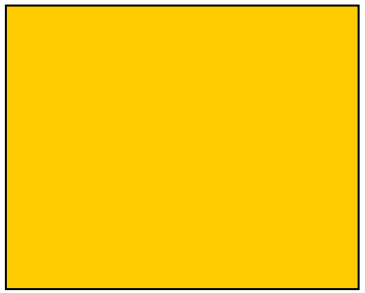
The meaning that a human assigns to data
by means of the known conventions used in their representation.
"Entropy" is a measure of information content.

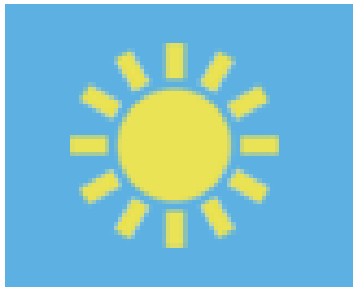
- Higher the entropy of a message, the more information it contains.
- The entropy is high if the uncertainty is high.

Information

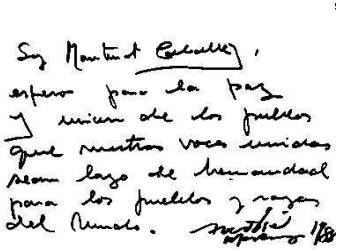
- The meaning that a human assigns to data
- by means of the known conventions used in their representation.

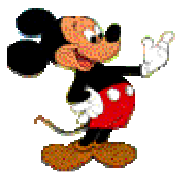
- “Entropy” is a measure of information content.



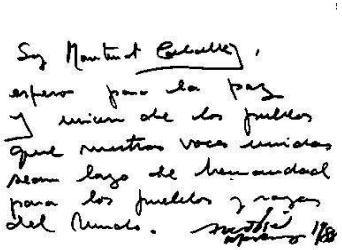


information





information



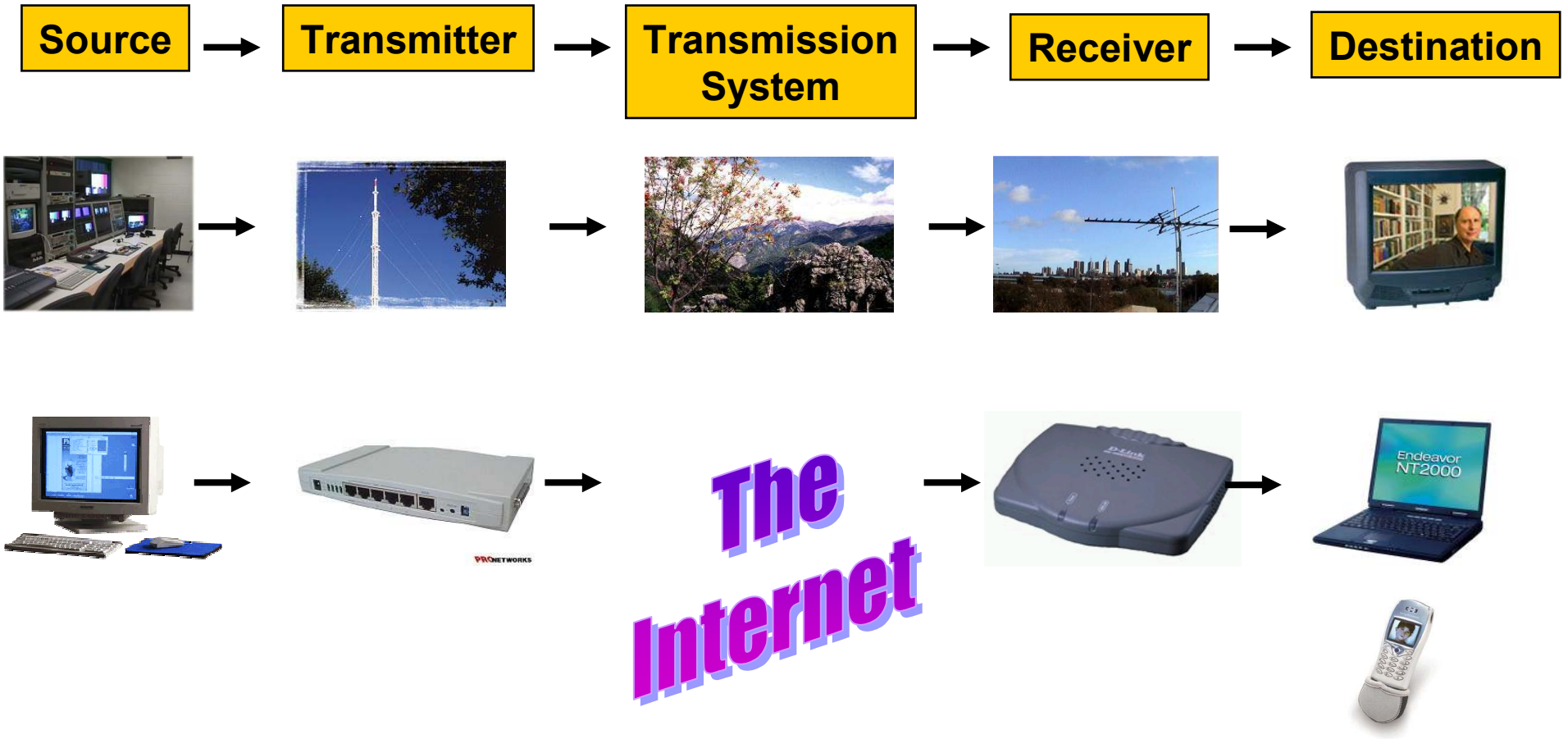
data

Telephone system

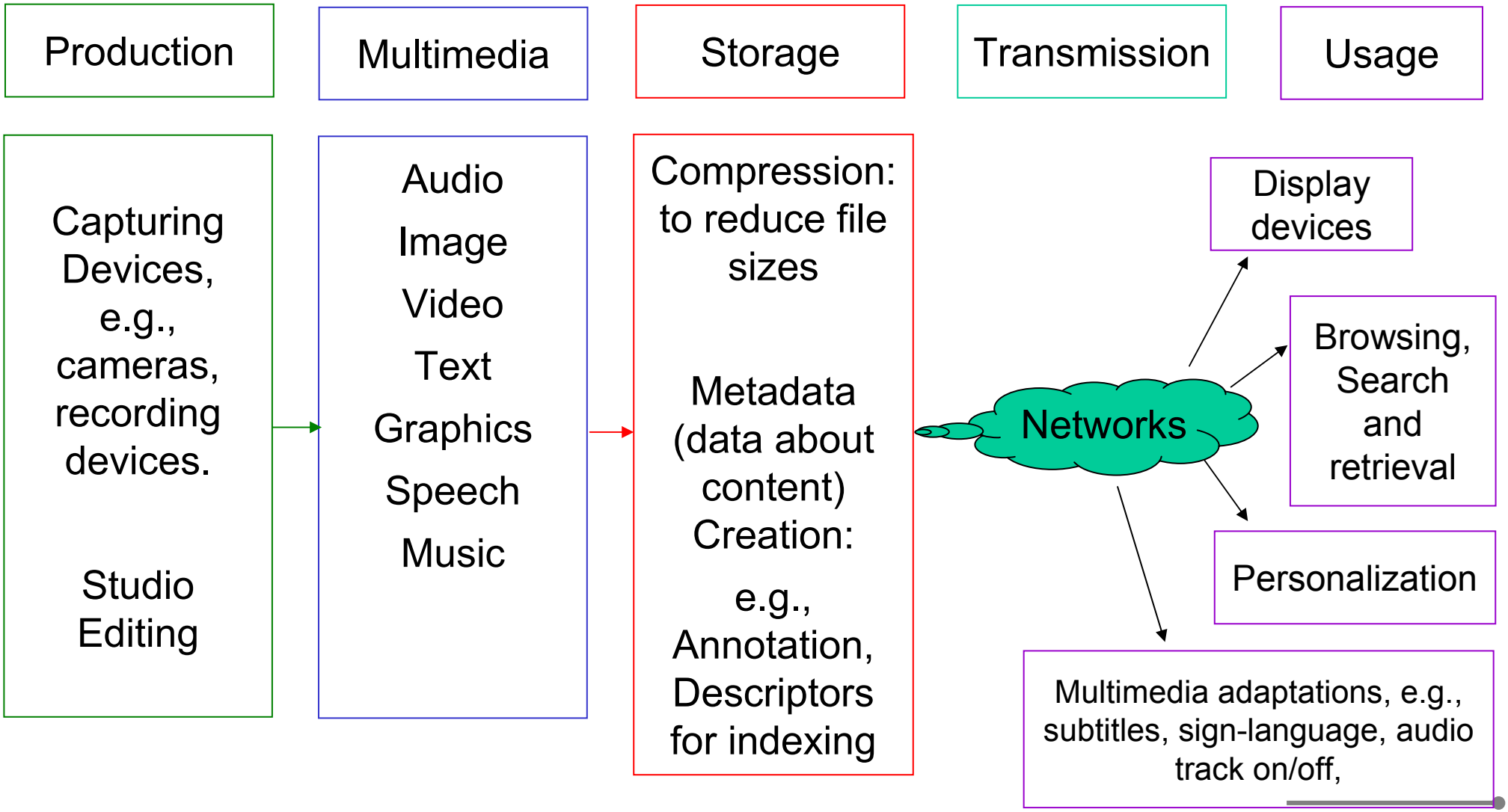
signal

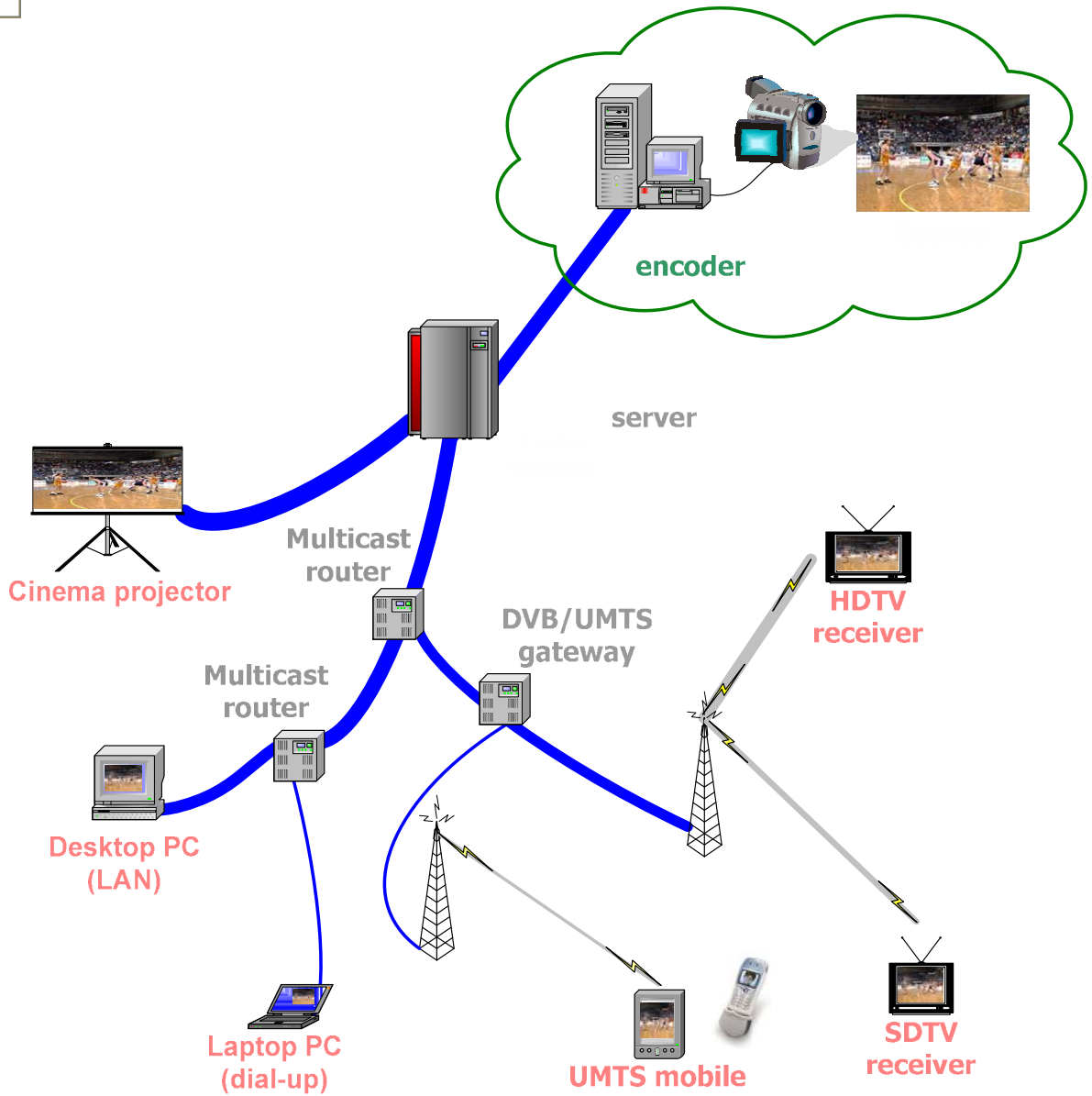
data

A Simplified Communication System



Multimedia Systems




encoder
server
Cinema projector
Multicast router
Multicast router
DVB/UMTS gateway
HDTV receiver
Desktop PC (LAN)
Laptop PC (dial-up)
UMTS mobile
SDTV receiver

EEE116 Multimedia Systems

- Aims:
  - To be familiar with the terminology associated with multimedia systems.
  - To understand concepts, applications and issues in networking in multimedia systems.
  - To understand media compression principles, techniques and relevant multimedia standards and their application in multimedia systems design.
  - To be able to analyse and determine the requirements, technological difficulties, costs and benefits of multimedia systems.

EEE116 Multimedia Systems

- Course Structure: 3 Parts
  - Communication Networks
    - Introduction to computer, basic communication concepts, networks.
    - Introduction to Internet, from a system viewpoint.
  - Content
    - Digital representation of content.
    - Image, video and audio basics.
    - Compression standards and formats (e.g., MPEG, JPEG, MP3).
  - Usage
    - Requirements, design and performance issues of multimedia systems.

EEE116 Multimedia Systems

- Course Organisation

Topic No.	Title	Lecture No.	Tutorial Questions
1	Introduction	L1	
2	Digital Representation	L2/L3	
3	Data Communications	L3 – L5	
4	Data Compression	L6/L7	
5	Digital Audio	L8 – L10	
6	Digital Imaging 1: Capture & Display	L11 – L13	
7	Digital Imaging 2: Coding	L14 – L15	
8	Internetworking	L16 – L19	

EEE116 Multimedia Systems

- Text Books (for background reading only)

- Multimedia and Communications Technology
  S. Heath (Focal Press).
- Computer networks and Internets
  D. Comer (Prentice Hall).

- The Protocols -TCP/IP Illustrated, Volume 1
  W. Stevens (Addison –Wesley)
- Digital image processing
  R. Gonzalez & R. Wood (Prentice Hall).
- Digital Television: MPEG-1, MPEG-2 and Principles of the DVB System
  H. Benoit (Focal Press).
- Digital Multimedia
  N. Chapman & J. Chapman (John Wiley).
- Multimedia Systems
  R. Steinmetz & K. Nahrstedt (Springer Verlag).

EEE116 Multimedia Systems

- Course delivery
  - 2 hours lecture / week
    - Printed handouts and/or online lecture notes
    - Class activities / Demos
  - 1 hour tutorial (problem solving sessions) / week
  - Relevant course material available in MOLE (My Online Learning Env.).
    - Login via MUSE
    - Module description / Handouts / lecture notes / tutorial problem sheets + solutions / past exams + solutions / revision questions / online tests.
- Assessment
  - Mid semester test (9.1%)
    - In week 7.
    - Material covered up to the end of week 5 (L10) and the tutorial of week 6.
  - End of Semester exam (90.9%)

Key Inventions in Communication

35,000 BC First paleolithic "writings."
8000 BC First objects used for accounting (clay cones)
4000-3000 BC Proto-Indo-European (PIE) language develops
2000 BC Earliest recorded postal system (Egypt)
2000 BC The Phoenician Alphabet is developed
900-700 BC Homer's Iliad and Odyssey are written
868 First surviving printed book (China)

1440 Guttenberg develops the Printing Press near Mainz, Germany
1700's George Murray develops the Optical Semaphore system

1831 Joseph Henry builds his first electric telegraph
1840 Alexander Bain connects telegraphs to pendulums and creates the first FAX machine.
1842 Samuel Morse gets $30,000 from the US Congress to build a trial telegraph
1854 George Boole publishes *The Laws of Thought* which outlines binary logic
1860 James Clark Maxwell invents four simple electromagnetic equations
1863 The first sounds are transmitted by electricity by Phillippe Reis in Germany
1866 The first Transatlantic telegraph cable is laid
1876 Alexander Graham Bell sends the message
"Mr. Watson, come here, I want to see you." - first message sent over his new telephone system
1887 The USA has 150,00 phones lines, the UK 26,000 and France 9,000
1899 Marconi transmits radio signals across the English Channel

1906 The first radio program is broadcast by Regina Fessenden. It includes violin music, a Bible reading, and Christmas wishes.
1925 John Logie Baird transmits first pictures in England.
1926 Transatlantic phone service is installed by shortwave relay.
1927 Car Radios are introduced.
1927 AT&T Labs transmits live television.
1928 The first television broadcasts.
1939 The first Silicon Valley garage start-up, Hewlett-Packard, is founded.
1947 Shockley, Bardeen, and Brattain at Bell Labs develops the transistor.
1949 Television sets pass the 1 million mark in the United States.
1949 Claude Shannon's *Mathematical Theory of Communication* is published.
1950 Bell Labs and Western Electric create the first telephone answering machine
1951 First commercial colour television broadcast (CBS)
1952 The Manchester Mark 1 computer used the first compiler.
1956 AT&T lays the first Transatlantic telephone cable (Scotland to Newfoundland)
1957 Sputnik, the first satellite is launched from the Soviet Union
1961 The first mass-produced monolithic integrated chips are produced.
1962 AT&T's Telstar satellite is launched (the first communications satellite)
1964 The first LAN Local Area Network (LAN) is developed
1965 ARPAnet is founded with the first experiments with Wide Area Networks (WANs).
1967 Nokia formed
1969 First commercial cellular radio system
1973 ARPAnet becomes operational with 25 computers.
1973 First handheld mobile phone by Motorola

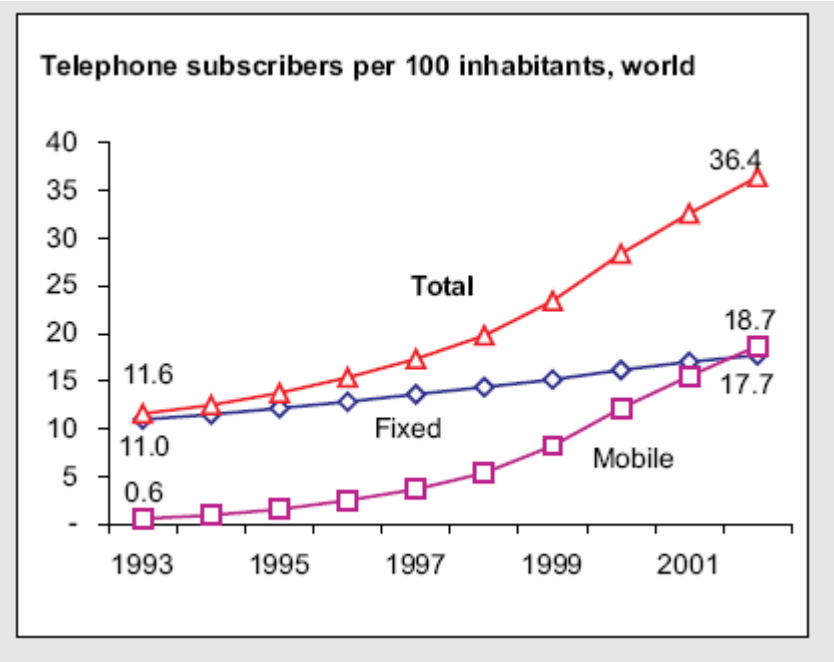
1974 The Xerox Alto becomes the first workstation computer.
1975 The Altair 8800 becomes the first microcomputer for sale
1977 Apple Computer is founded.
1981 The IBM PC debuts.
1981 First European mobile phone network(Norway)
1983 AT&T uses the first fiber optic phoneline
1985 First UK mobile phone network
1988 Internet consists of more than 33,000 computers .
1988 AT&T lays the first fiber optic transatlantic cable
1989 World wide web (WWW) proposal
1990 Microsoft ships Windows 3.0.
1991 First European GSM mobile network
1991 Internet consists of more than 500,000 computers .
1993 Internet consists of more than 1.8 million computers

Class Activity -1

Various types of usage of devices in multimedia systems

Telephone	Television	Computer

Telecommunication



Services:
- From voice communication to
- Visual and data communications.
- M-commerce

Mobile phone subscribers per 100 inhabitants

	US	Europe	UK
2001	**45.03**	**45.04**	**77.04**
2004	**60.97**	**75.10**	**102.81**

Source: http://www.itu.int/ITU-D/ict/statistics/

Television

Digital Video Broadcasting (DVB)
Digital Audio Broadcasting (DAB)

Digital television (Satellite/Cable/terrestrial)
- More Channels
- High picture quality

Interactive TV (view selection)
High definition resolutions.
TV-anytime
3D-TV
Digital Cinema

The Internet

The Internet
Complex collection of connected networks

Internet = Inter-network
I.e., communication between individual networks

Single network
- Owned by one organisation
- Occupies physical small area
- Uses common network software

ISP - Internet Service Provider
(e.g., AOL, BTbroadband)

The Internet

- Over 100 million people connected to the Internet in Europe - started life in 1970s
- 100 billion emails sent each day - first one sent 20 years ago
- World Wide Web - proposed in 1989

  Number of unique publicly accessible pages on WWW = 2.1 billion.

  Unique pages added per day = 7.3 million

- Note the The Web (WWW) and the Internet are not the same
- Internet traffic exceeds voice phone traffic
- New cellular wireless networks (GPRS and 3G) will integrate with the Internet
- Merging of computer and telecommunication technologies
- Global communications will be a major effect on business, society and politics

The most complex system made by man

1969 ARPANET commissioned by US DoD for research into networking

1971 15 nodes (23 hosts). Ray Tomlinson invents email program to send messages across a distributed network

1973 First international connections to the ARPANET: University College of London

1984 Domain Name System (DNS) introduced Number of hosts breaks 1,000

1989 Number of hosts breaks 100,000

1991 World-Wide Web (WWW) released by CERN ; Tim Berners-Lee

1992 Number of hosts breaks 1,000,000

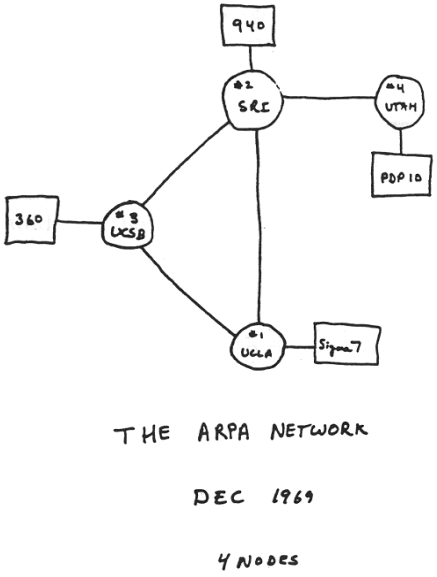
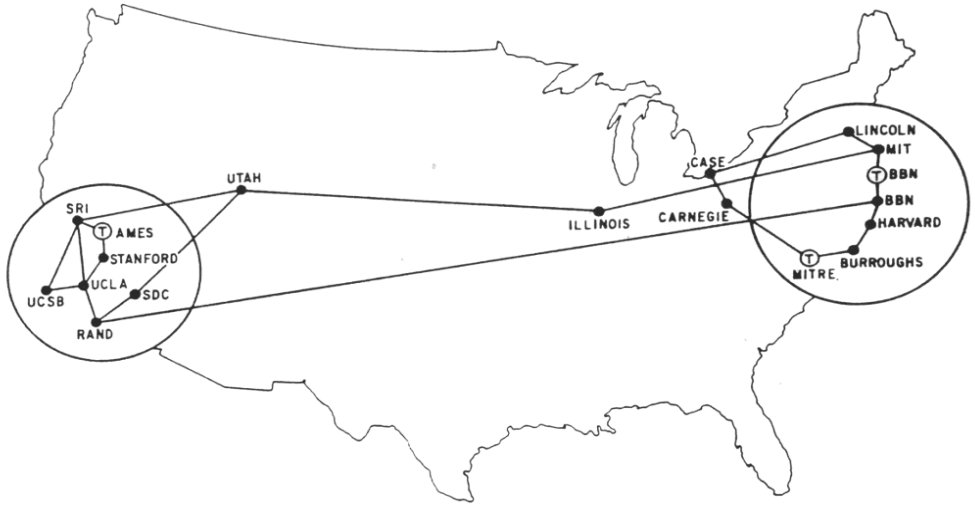


FIGURE 6.2 Drawing of 4 Node Network (Courtesy of Alex McKenzie)

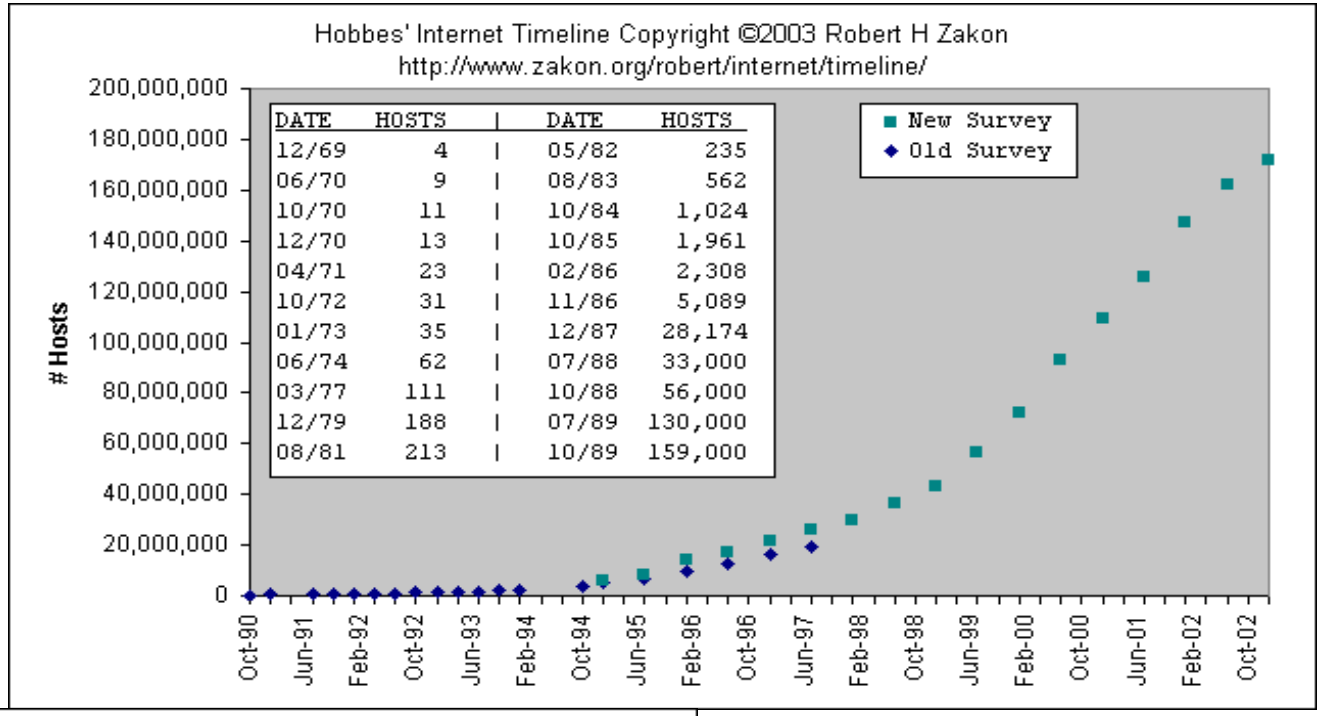
1969



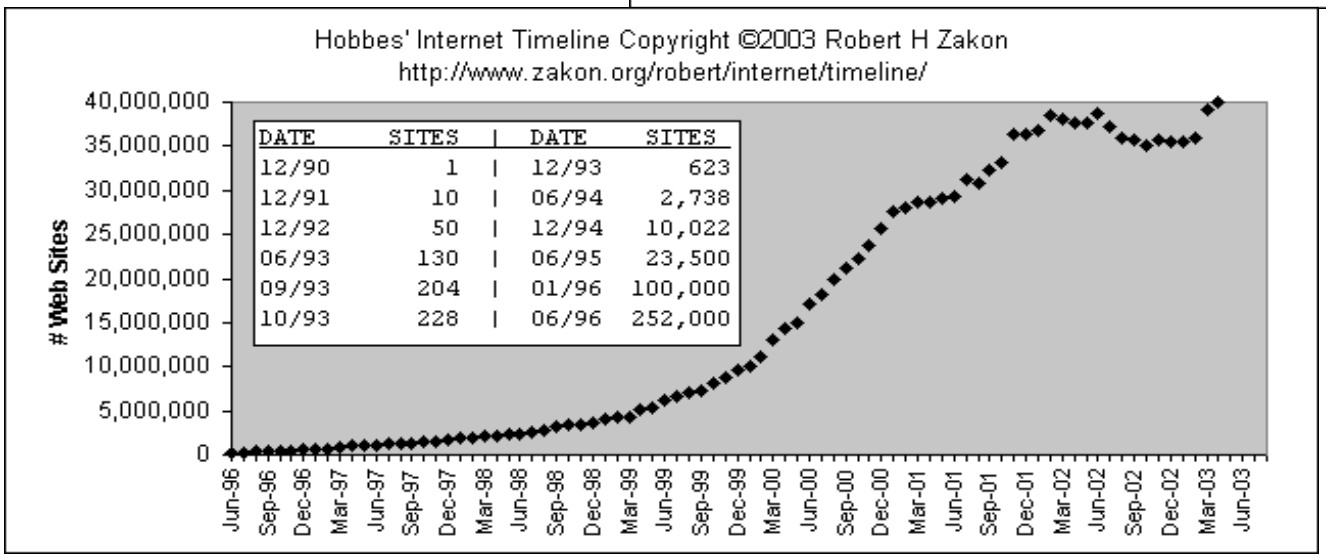
MAP 4 September 1971

1971

Number of Hosts

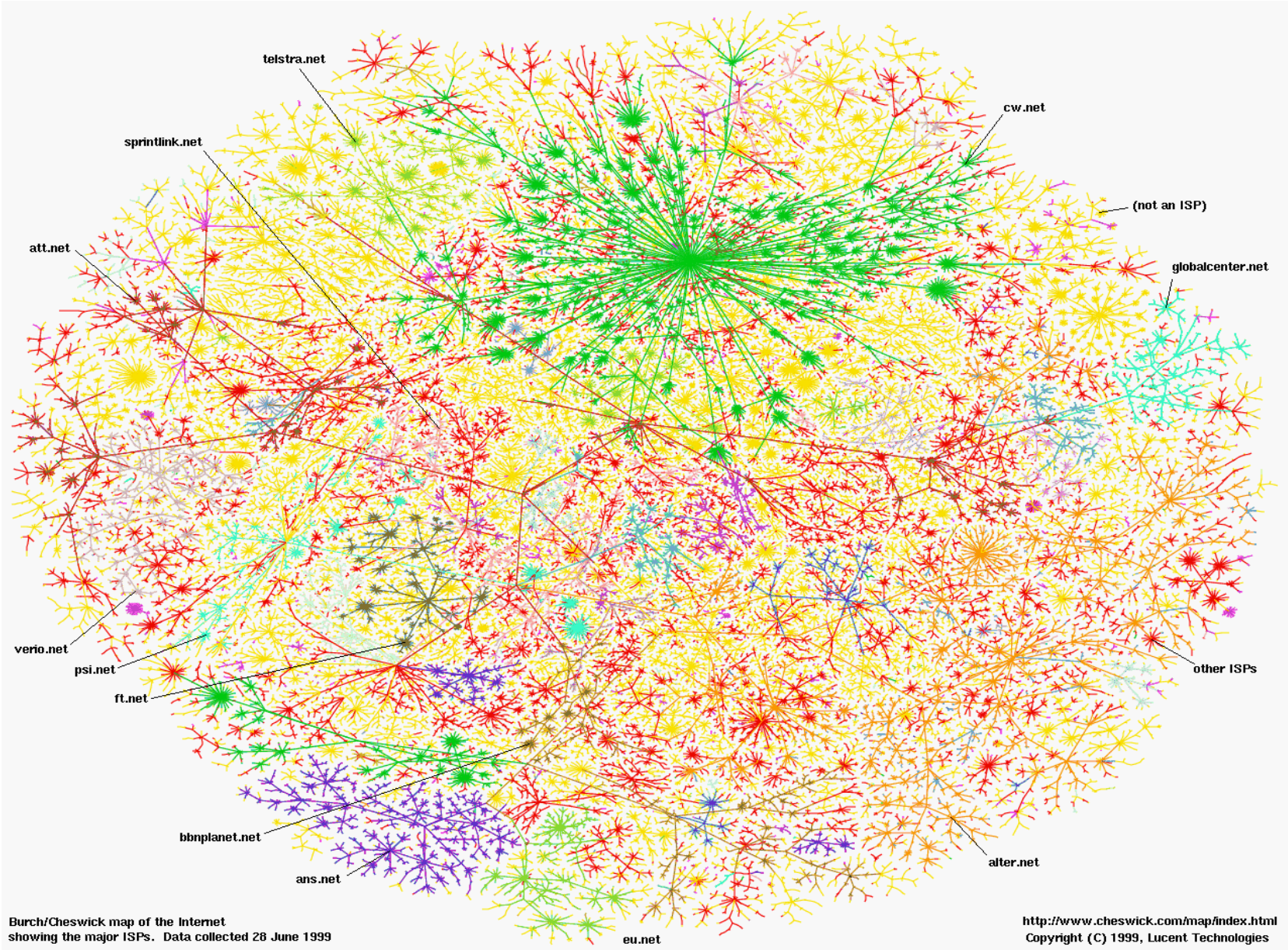


DATE	HOSTS	DATE	HOSTS
12/69	4	05/82	235
06/70	9	08/83	562
10/70	11	10/84	1,024
12/70	13	10/85	1,961
04/71	23	02/86	2,308
10/72	31	11/86	5,089
01/73	35	12/87	28,174
06/74	62	07/88	33,000
03/77	111	10/88	56,000
12/79	188	07/89	130,000
08/81	213	10/89	159,000

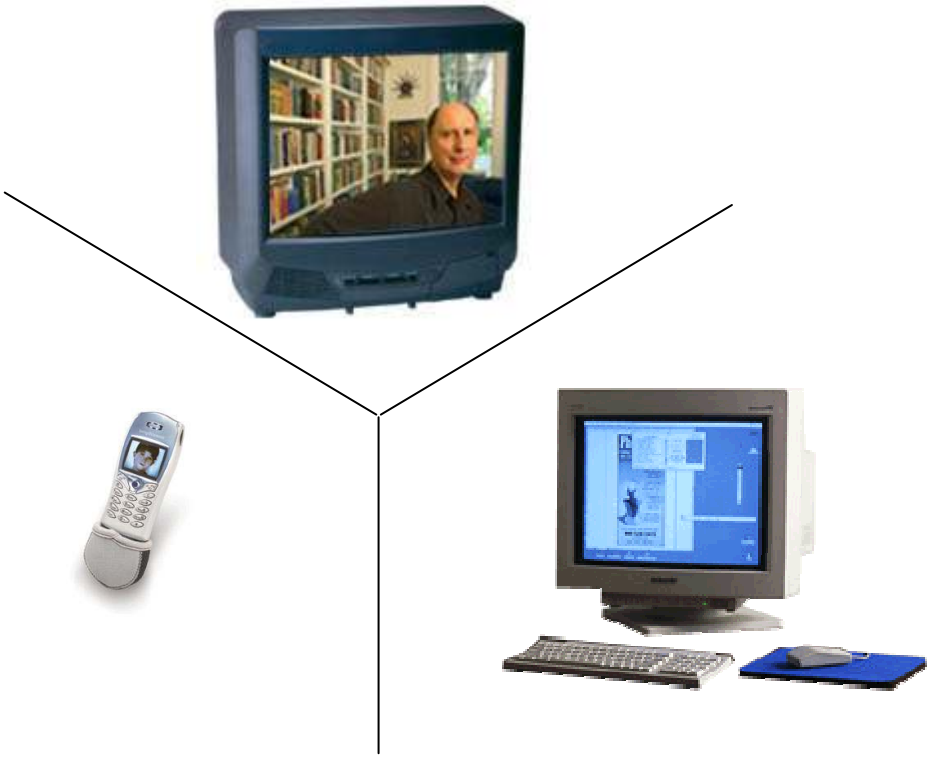


DATE	SITES	DATE	SITES
12/90	1	12/93	623
12/91	10	06/94	2,738
12/92	50	12/94	10,022
06/93	130	06/95	23,500
09/93	204	01/96	100,000
10/93	228	06/96	252,000

Number of Websites


telstra.net
cw.net
sprintlink.net
(not an ISP)
att.net
globalcenter.net
verio.net
other ISPs
psi.net
ft.net
bbnplanet.net
alter.net
ans.net
eu.net
Burch/Cheswick map of the Internet
showing the major ISPs. Data collected 28 June 1999
http://www.cheswick.com/map/index.html
Copyright (C) 1999, Lucent Technologies

Trend: convergence of three fields



Why is this convergence possible?