

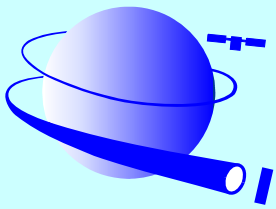
The History of Telecommunications

Part II:

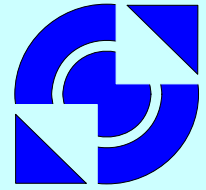
The Telephone and its Several Inventors

by

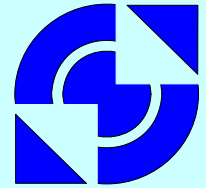
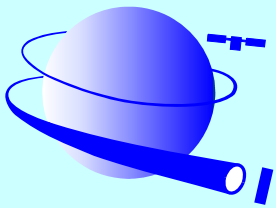
Wim van Etten



Contents

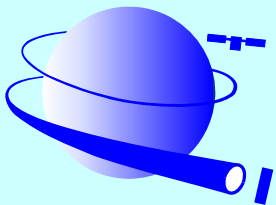


1. Introduction
2. Bell and his invention
3. Bell Telephone Company (BTC)
4. Lawsuits
5. Developments in Europe and the Netherlands
6. Telephone sets
7. Telephone cables
8. Telephone switching
9. Radio telephony (mobile telephony)
10. Liberalization
11. Conclusion

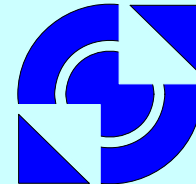


Johann Philipp Reis
1834-1874

- German physicist and school master
- 1861: vibrating membrane touched needle; reproduction of sound by needle connected to electromagnet hitting wooden box
- several great scientists witnessed his results
- could not be demonstrated transmission of articulated speech in court
- submitted publication to *Annalen der Physik*: refused
- later on he was invited to publish; then he refused
- ended his physical experiments as a poor, disappointed man
- invention not patented

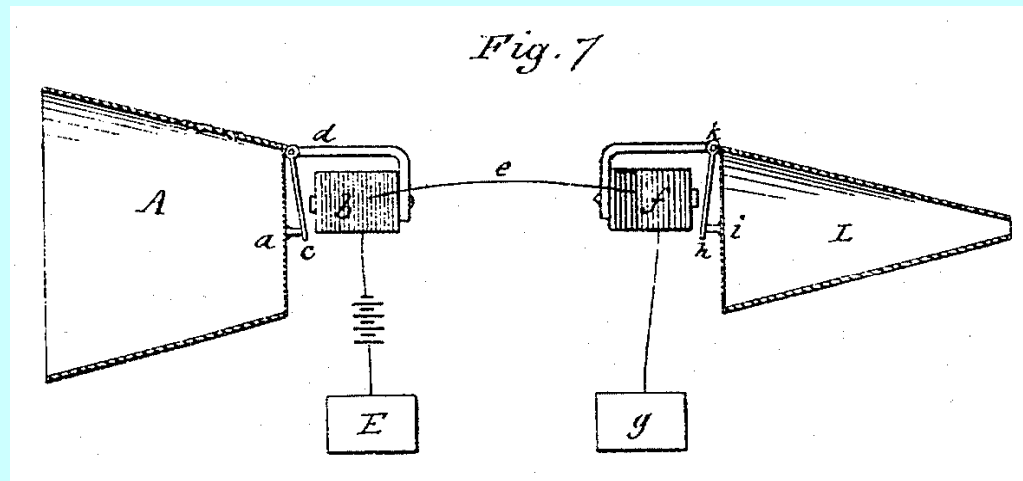
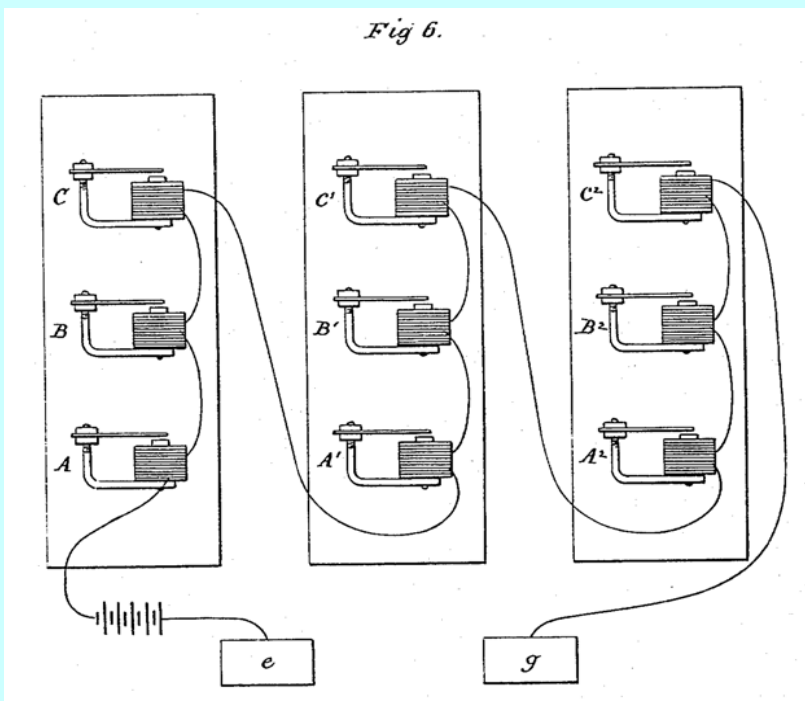


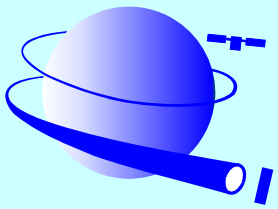
The telephone patent



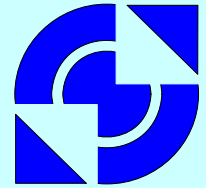
1876: February 14, Alexander Graham Bell applies patent
“Improvement in Telegraphy”; patented March 7, 1876

Most valuable patent ever issued !



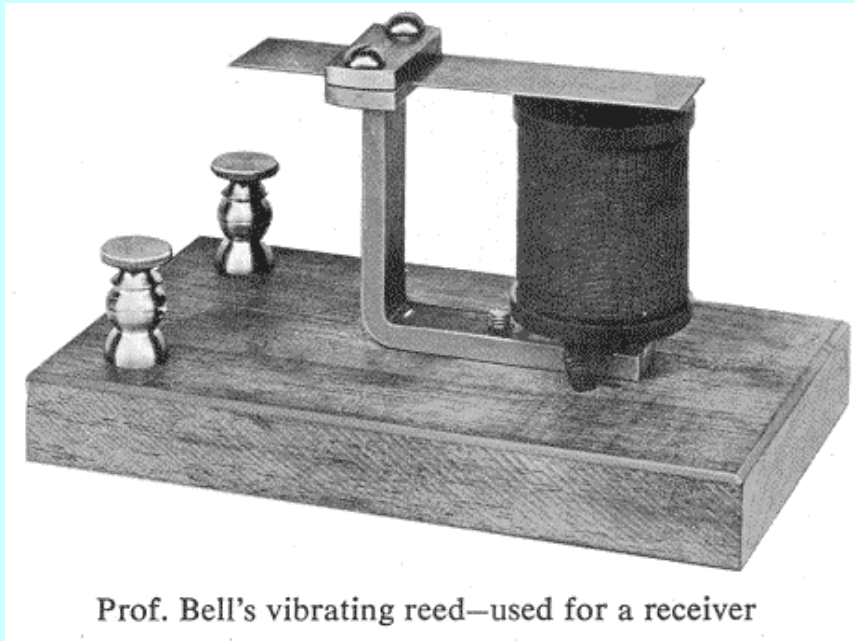


Bell's first experiments

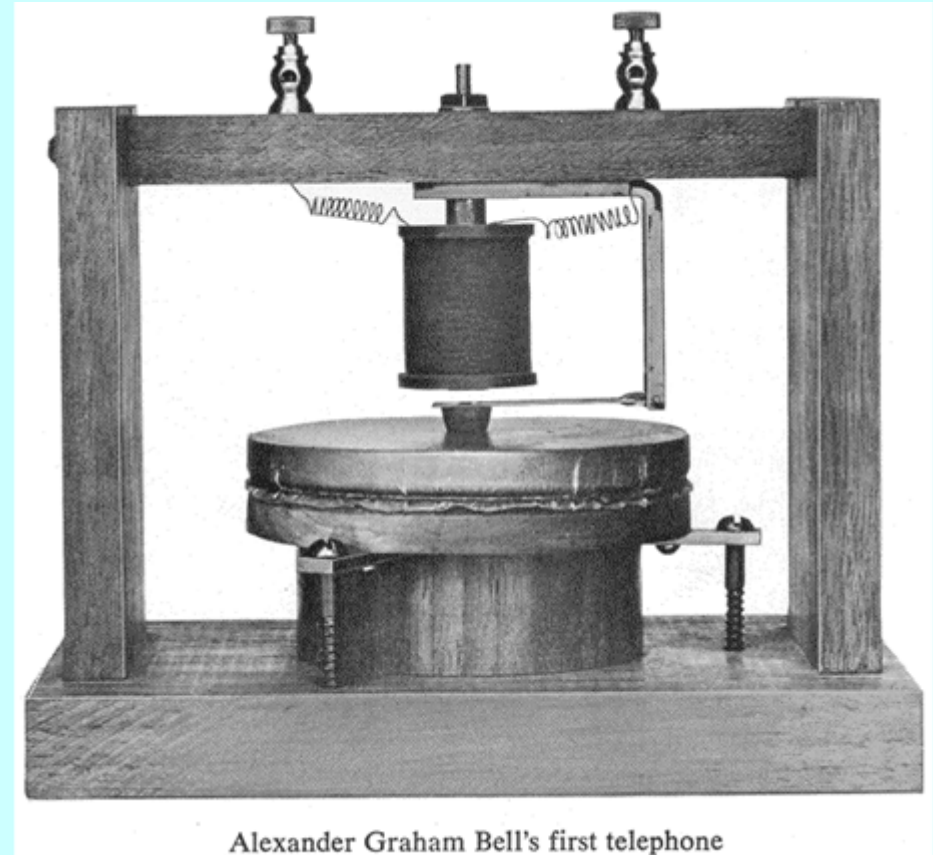


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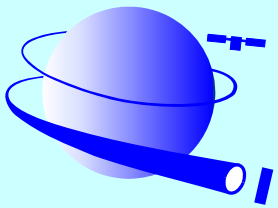
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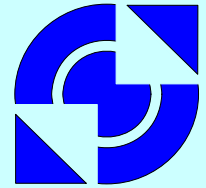
Prof. Bell's vibrating reed—used for a receiver



Alexander Graham Bell's first telephone

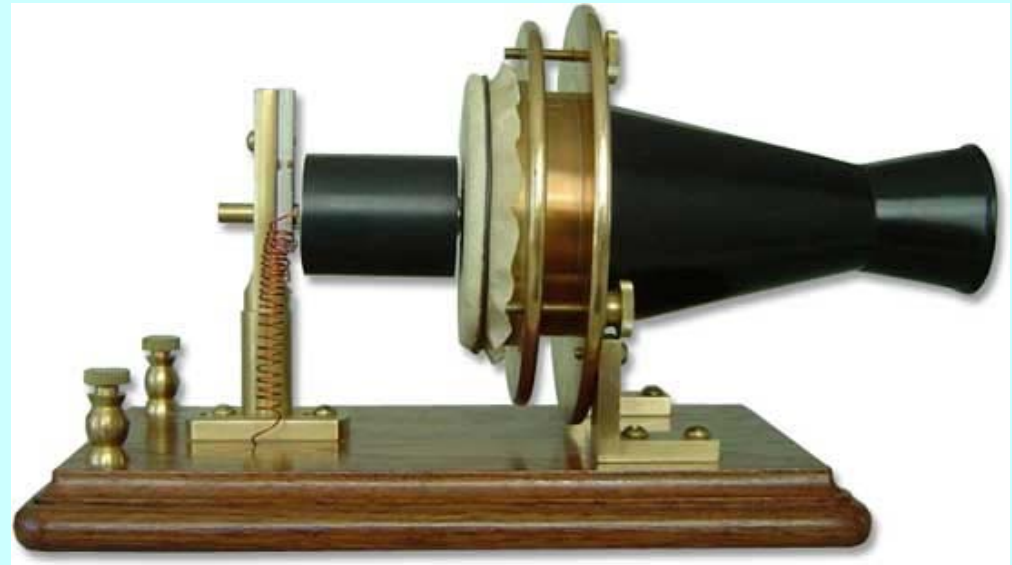


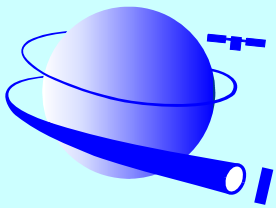
Bell's first telephone designs



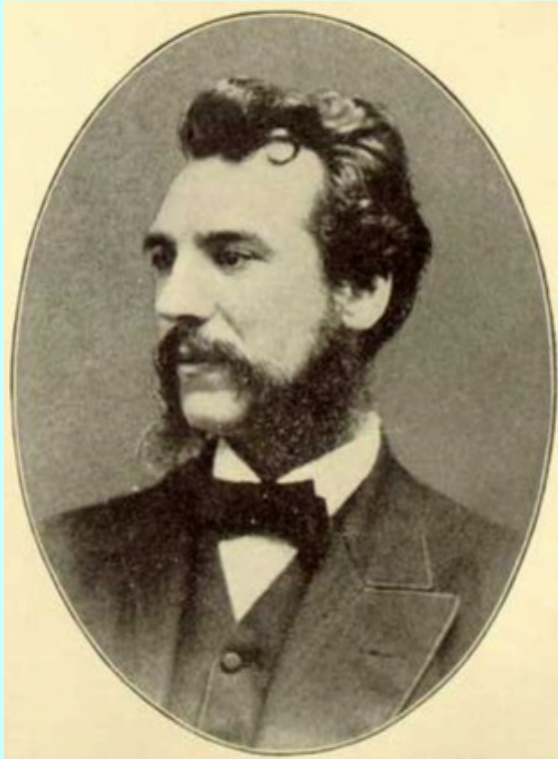
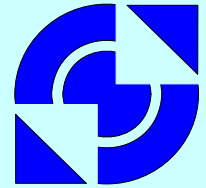
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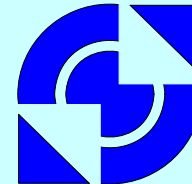
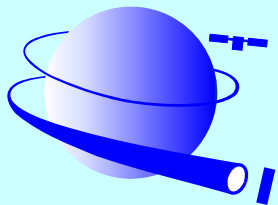


Bell

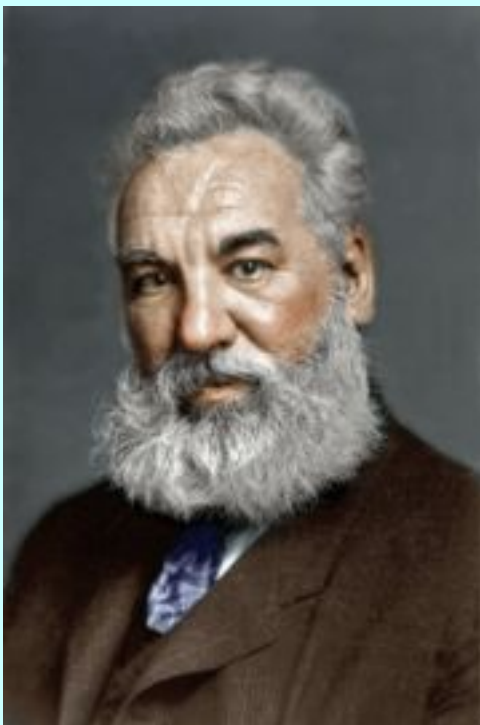


Alexander Graham Bell
(1847-1922)

- born in Scotland 1847
- father, grandfather and brother had all been associated with work on elocution and speech
- his father developed a system of “Visible Speech”
- was an expert in learning deaf-mute to “speak”
- met Wheatstone and Helmholtz
- when 2 brothers died of tuberculosis parents emigrated to Canada
- 1873: professor of Vocal Physiology and Elocution at the Boston University School of Oratory: US citizen
- 1875: started experimenting with “musical” telegraphy
- had a vision to transmit voice over telegraph wires

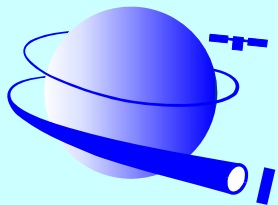


Bell (continued)

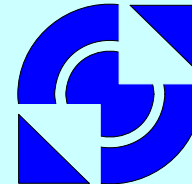


Alexander Graham Bell
(1847-1922)

- left Boston University to spend more time on experiments
- 2 important deaf-mute pupils left:
Georgie Sanders and Mabel Hubbard
- use basement of Sanders's house for experiments
- Sanders and Hubbard gave financial support, provided he would abandon telephone experiments
- Henry encouraged to go on with it
- Thomas Watson became his assistant
- March 10, 1876: "Mr. Watson, come here, I want you."
- June 1876: Centennial Exposition in Philadelphia;
Dom Pedro, emperor of Brazil: "My God – it talks."
- 1877: series of lectures and demos

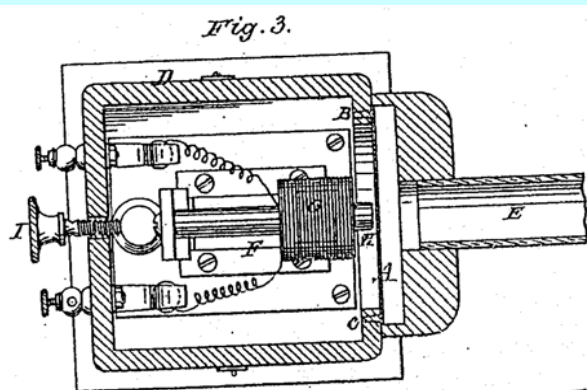
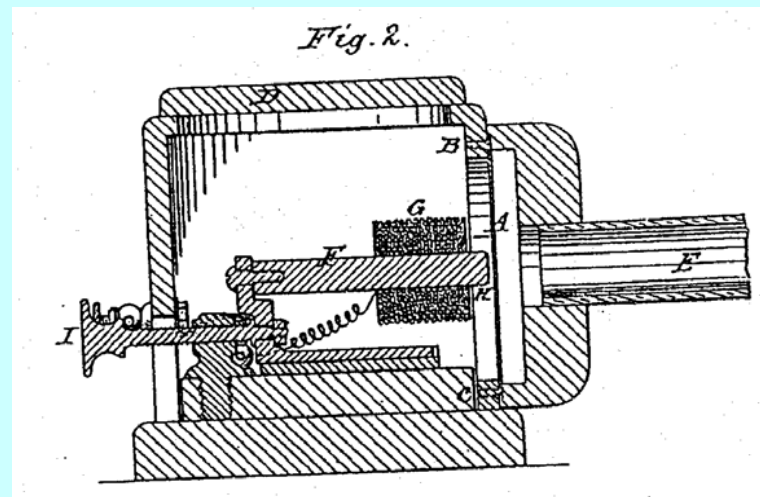
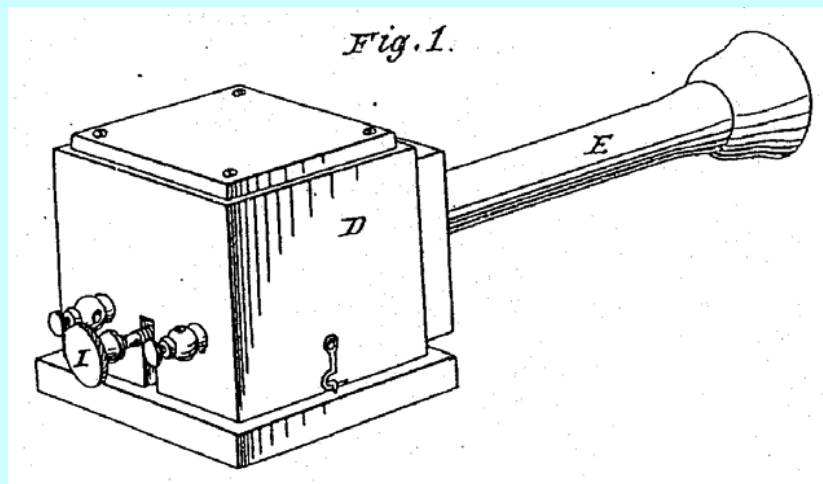


1877 patent of Bell



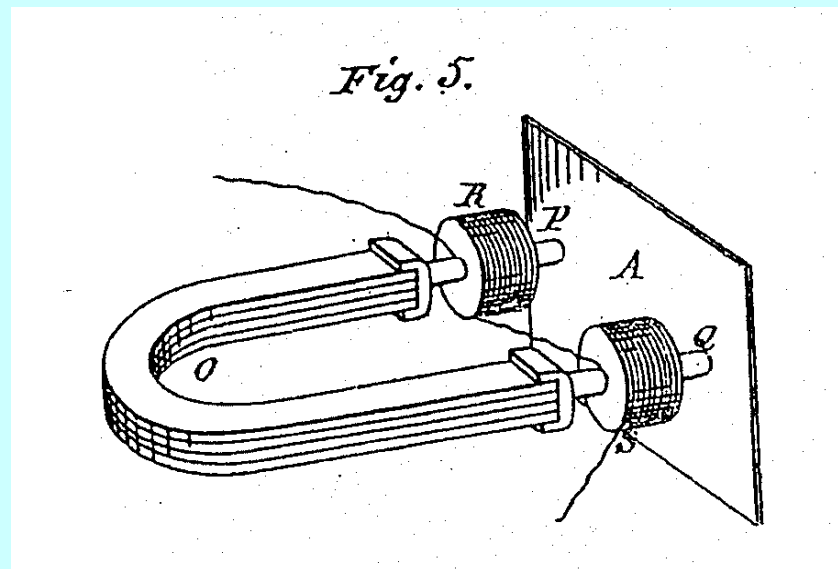
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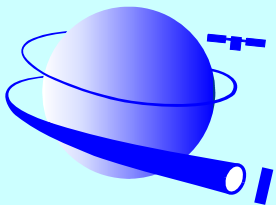
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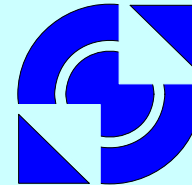
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A. Folger
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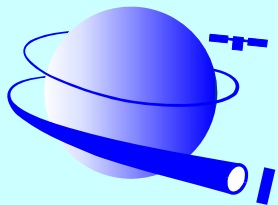
Inventor:
Alexander Graham Bell



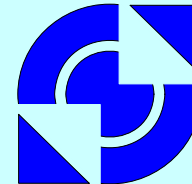


Bell's butterstamp models

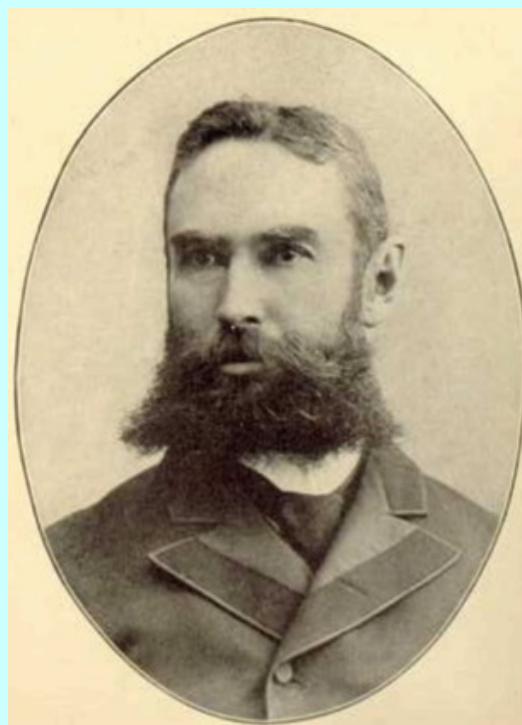




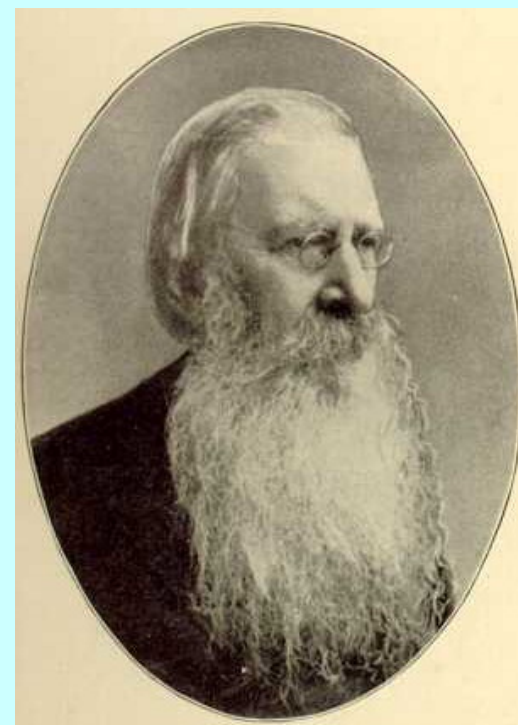
Godfathers of telephony



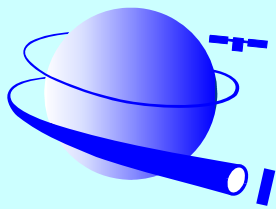
Thomas Watson



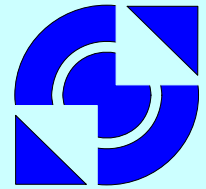
Thomas Sanders



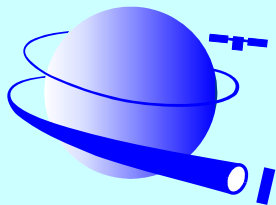
Gardiner Hubbard



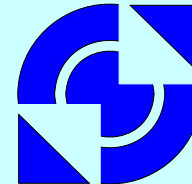
Bell Telephone Company (BTC)



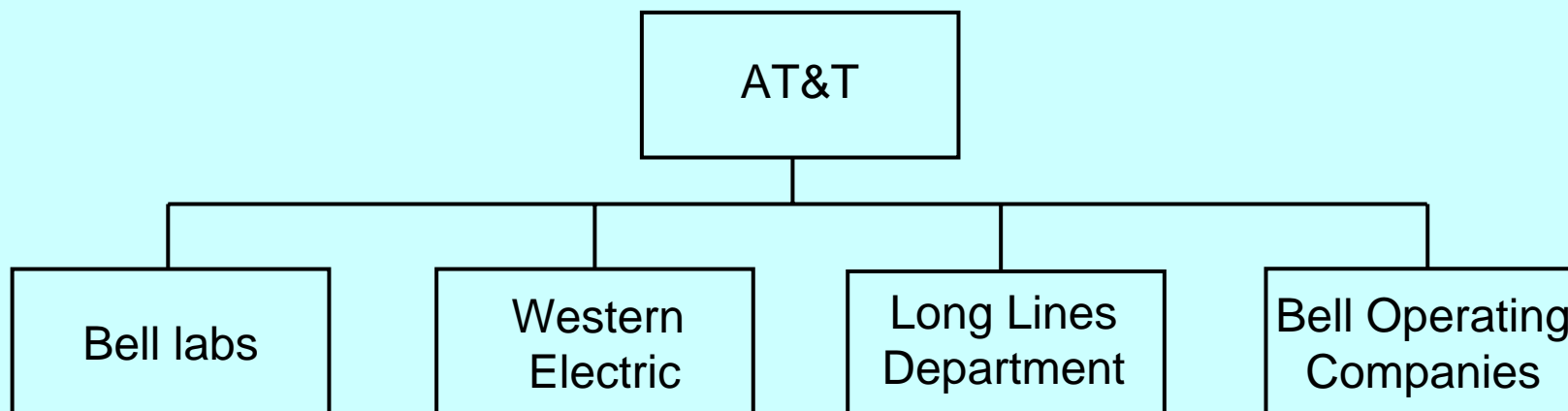
- July 9, 1877: “Bell Telephone Company” (BTC) established;
Shares: Bell 30%, Sanders 30%, Hubbard 30%, Watson 10%
- July 11, 1877: Bell marries Mabel Hubbard
- On honeymoon trip to Europe Bell presents his invention. No contract from UK
- BTC doesn't run well. Returning from honeymoon Bell asks BTC for money
- BTC in crisis
- All telephone rights offered to Western Union for \$ 100,000. Refused by WU (toy!)
- Blake offers his transmitter to BTC (as good as Edison's of WU)
- September 1878: WU starts lawsuit on Bell's telephone patents
- November 1879: WU stops the lawsuit. Agreement between BTC and WU

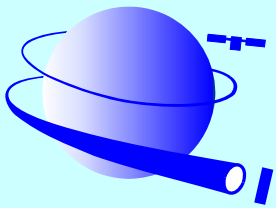


BTC (continued)

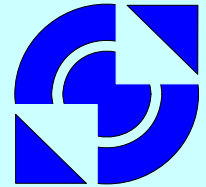


- 1882:
- Sanders, Hubbard and Watson sell their shares for lots of money (millions); Bell offers his shares to his bride
 - Bell is offered position of chief inventor
He refuses: “I can not invent on command”
 - 125 telephone companies in operation
- 1885: Foundation of AT&T (American Telephone and Telegraph Company)



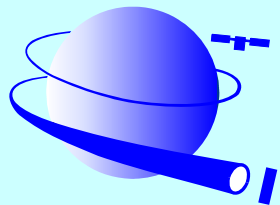


BTC business model



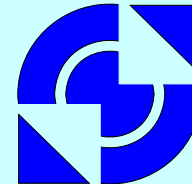
BTC business model introduced by Theodore Vail (first president)

- BTC partner in entire telephone business
- no equipment sold, only leasing
- only BTC produced equipment is allowed to be connected to BTC network
- local telephone companies under BTC umbrella
- every agent had to report on infringement of Bell's patents (expired 1893-1894)
- new inventions (patents) in the field of telephony are bought or a lawsuit is started against the inventor
- standardized telephone equipment by control of production

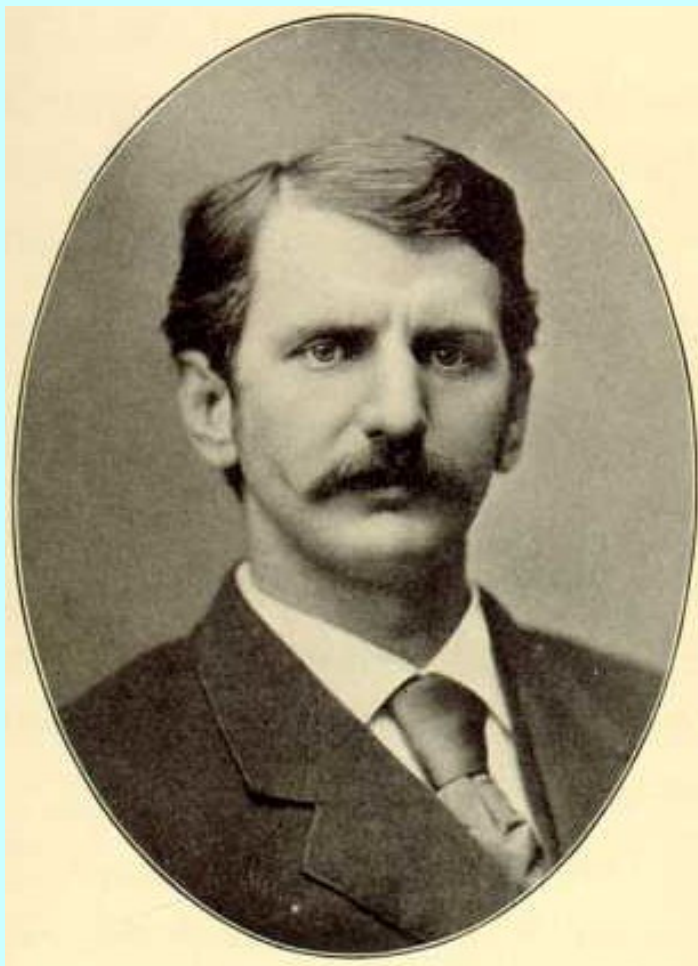


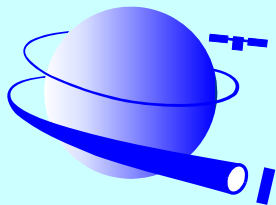
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Theodore Vail

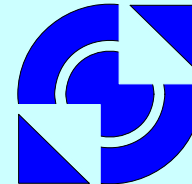


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Lawsuits 1

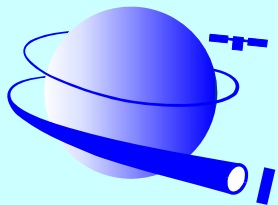


1878: WU starts lawsuit: Elisha Gray, Amos Dolbear, Thomas Edison

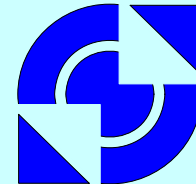
1879: Agreement:

- Bell was confirmed as the inventor of the telephone
- WU sold his telephone network to BTC
- BTC will not operate a telegraph network in the US
- WU gave BTC use of its telephone patents

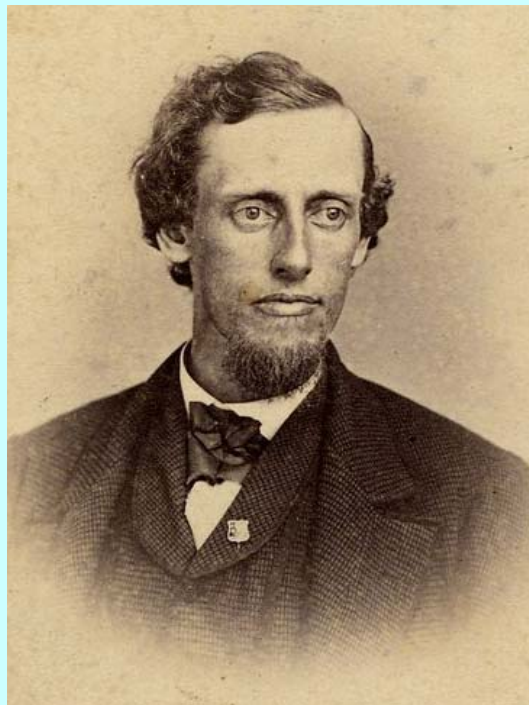
David won the battle against Goliath,
and became a Goliath itself within a few years



Lawsuits 2



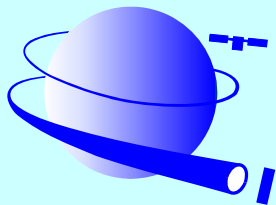
Elisha Gray



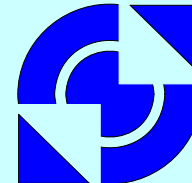
Amos Dolbear



Thomas Edison



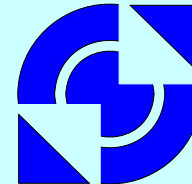
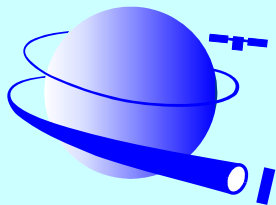
Lawsuits 3



- Edison invented a.o. the carbon microphone, which was superior to Bell's micro
- Dolbear invented a.o. the "tin can telephone", static telephone

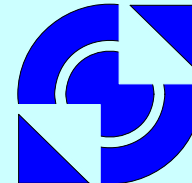
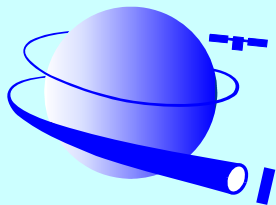
Gray:

- co-founder of Gray & Barton, which later became Western Electric
- invented the liquid microphone, initially used by Bell
- filed a caveat similar to Bell's patent on February 14, 1876, the same day as Bell applied for his famous patent; Gray was 2 hours later
(“Of all the men who did not invent the telephone, Gray was the nearest”)



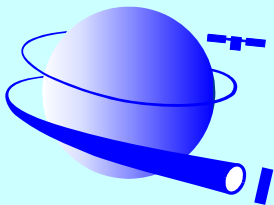
Daniel Drawbaugh

- eccentric person
- blacksmith in a small village
- subscriber of Scientific American, he imitated more than 40 inventions claiming them as his own
- started experimenting with telephones in 1863
- group of investors decided to challenge BTC on his behalf
- many witnesses testified that they heard speech from his telephone before Bell's patent was issued
- Drawbaugh was not a very good witness in his own behalf
- BTC faction labeled him as a "clown"
- BTC won the battle, but it was a close call

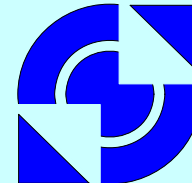


Antonio Meucci

- if Drawbaugh was a clown, Meucci can be entitled as a “superclown”
- Italian immigrant who started a candle factory in the US
- owned several patents in different areas,
 - but none on electrical equipment whatsoever
- filed a caveat on telephone invention in 1871; renewed in 1872 and 1873
- too many suspicious events:
 - no money for telephone patent, in the meantime applied for 5 others (1872-1876)
 - newspaper that reported on his experiments in 1871 could not be traced
 - no working equipment could be shown in court
 - his wife sold equipment to pay hospital bills; equipment could not be retraced
 - his journal contained impossible dates
- in 2002 the US House of Representatives adopted a resolution stating:
 - “.. that ... his work in the invention of the telephone should be recognized”



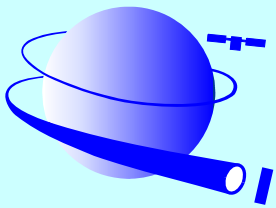
Lawsuits 6



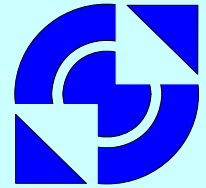
- for 11 years a real battle was fought against Bell's patents
- Bell had to defend his patents in 13 lawsuits of national interest
- 5 were carried to the Supreme Court
- 587 other lawsuits of various nature
- with the exception of 2 trivial contract suits BTC won them all

Why was BTC so successful in the lawsuits?

- the patents were very well written by Bell himself
- they had a team of eminent lawyers (a.o. Hubbard)
- Bell was BTC's main witness; he was well-spoken
- Bell made an honest impression
- Bell well documented his daily achievements in a journal



Developments in Europe



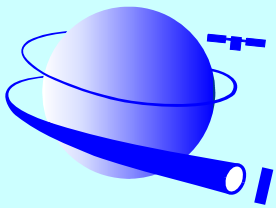
- UK: government owned – private – government owned
- Germany: government owned; mix of different local systems
- France: mess; different rates and equipment; no plan; no standardization
- Belgium: government owned; unity, but bureaucracy

The Netherlands:

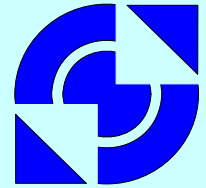
- 1879 First public networks
- 1881 Nederlansche Bell Telephoon Maatschappij (NBTM)
- 1887 NBTM installs long distance lines
- 1896 Local governments take over local networks
- 1897 Rijkstelefoondienst (later PTT)
- 1904 Law on Telegraph and Telephone services. Gradually taking over of local networks by PTT. Last ones in 1940 (A'dam, R'dam, the Hague)

Europe in general:

Lots of bureaucracy; lack of standardization; lack of consistent plans

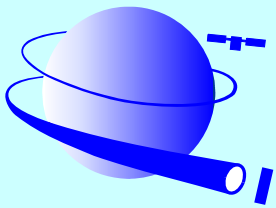


Distribution worldwide

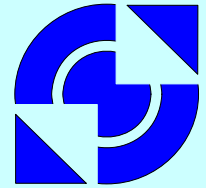


Worldwide distribution of telephony at the end of the 19-th century

Year	US	Europe	Rest of world	Total
1880	47,900	1,900	-	49,800
1885	147,700	58,000	11,800	217,500
1890	227,000	177,000	31,500	435,500
1900	1,355,00	800,000	100,000	2,255,000

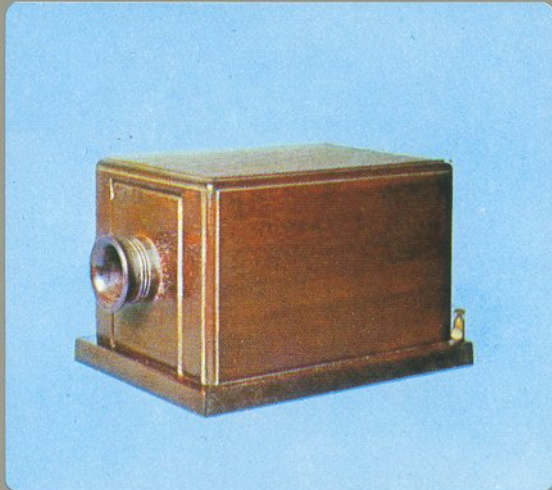


Old-time telephones 1



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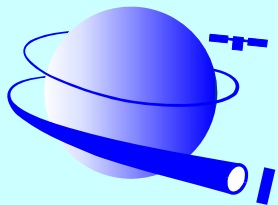
1877 **FIRST COMMERCIAL TELEPHONE**
The round, camera-like opening on this box instrument served as transmitter and receiver, needed mouth-to-ear shifts. Developed by Bell in the fall of 1876, it went into service in 1877 when a Boston banker leased two instruments which were attached to a line between his office and his home in Somerville, Mass.



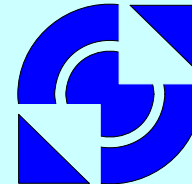
Skeleton (Ericsson 1892)



French desk phone
(1902)



Old-time telephones 2



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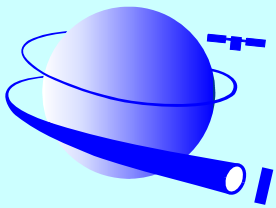
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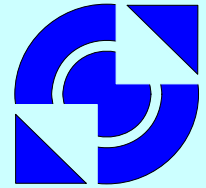
Danish desk phone
(Ericsson design 1904)



Compact wall phone
(Western Electric 1910)



Old-time telephones 3



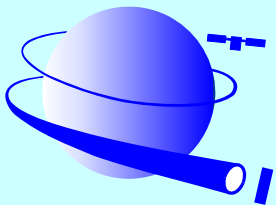
Wooden wall phone
(Ericsson 1911)



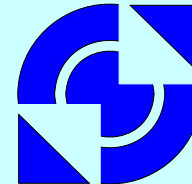
Candlestick (1920)



Round base
(Western Electric 1930)



Old-time telephones 4



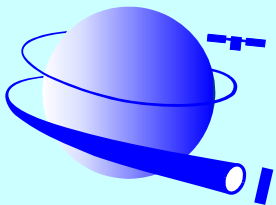
Ericofon
(1950)



Bakelite phone
(Ericsson 1969)



Electronic phone
(Philips 1989)



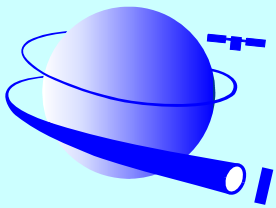
Telephone cables 1

- copper wires as overhead lines on poles
- later on cables buried in the ground

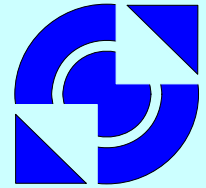


Broadway, New York, 1890

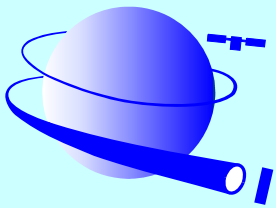




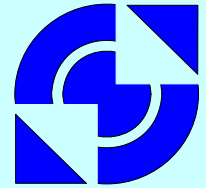
Telephone cables 2



In 1956 the first transatlantic telephone cable was laid;
until then telegraphy was the only fixed line
transatlantic telecommunication service

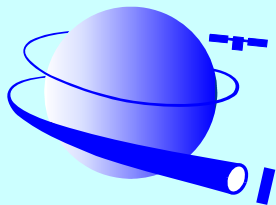


Telephone cables 3

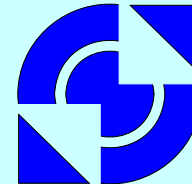


Data of transatlantic telephone cables

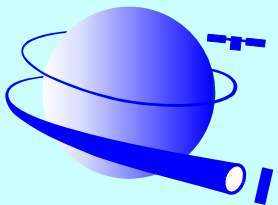
name	year	# voice channels	remarks
TAT-1	1956	36	1 st transatlant. telephone cable
TAT-7	1985	4,000	last transatl. copper cable
TAT-8	1989	15,000	1 st transatl. fiber cable
TAT-13	1996	130,000	optical repeaters



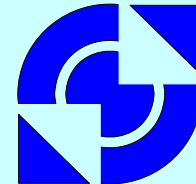
TAT 12/13



Budget:	\$ 750 million
Life cycle:	25 years
Total length:	14,000 km
Repeater distance:	45 km
Fibers:	4 in ring (2 each direction)
Bitrate:	5 Gb/s per fiber (bi-directional capacity 10 Gb/s)
Voice channels:	130,000



Telephone switching 1



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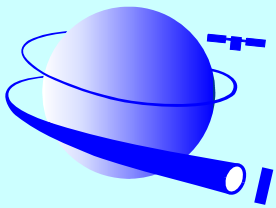
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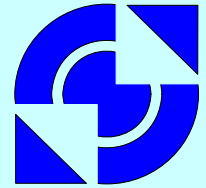
Manual switchboard



Manual exchange office



Telephone switching 2



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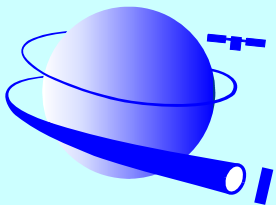
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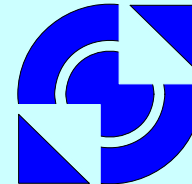
Automatic dialing



Strowger selector

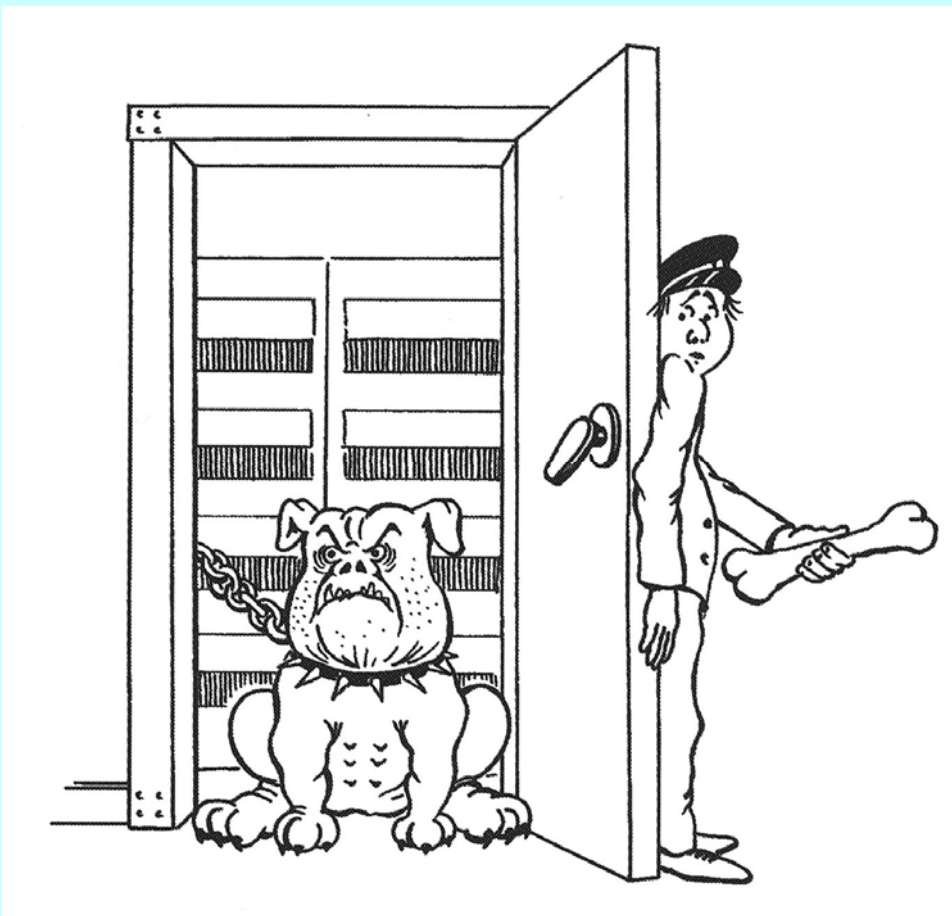


Telephone switching 3

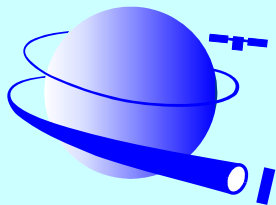


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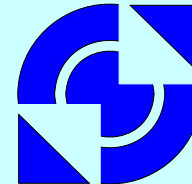
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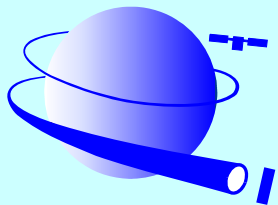
What staff is required for an exchange?



Radio telephony

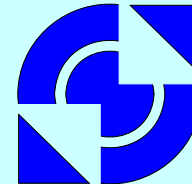


- 1873 James Clerk Maxwell: EM theory
- 1888 Heinrich Hertz: experimental proof of EM theory
- 1896 Guglielmo Marconi: first patent on radio telegraphy
- 1897 Marconi founded
“Wireless Telegraph and Signal Company”, later named
“Marconi Wireless Telegraph Company” (1900)
- 1900 First radio telegraphy service in Europe (mainly maritime)
- 1902 First transatlantic radio telegraphy message
- 1907 First radiotelephony transmission
- 1927 First transatlantic radiotelephony service

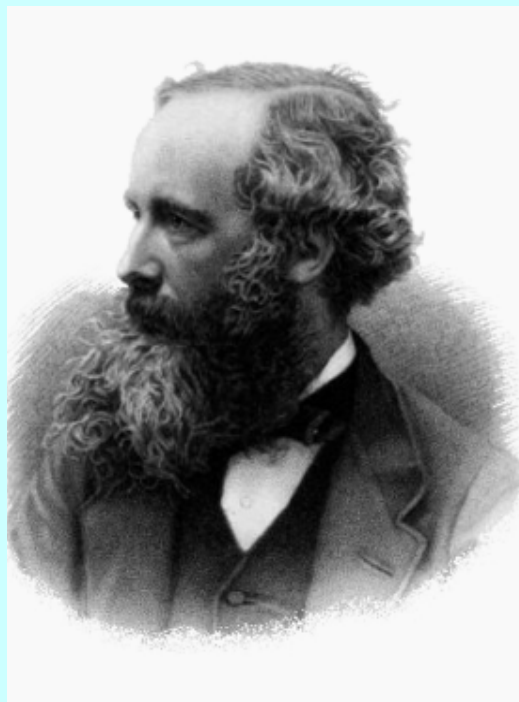


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Pioneers of Radio



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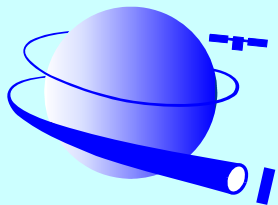
James Clerk Maxwell
(1831-1879)



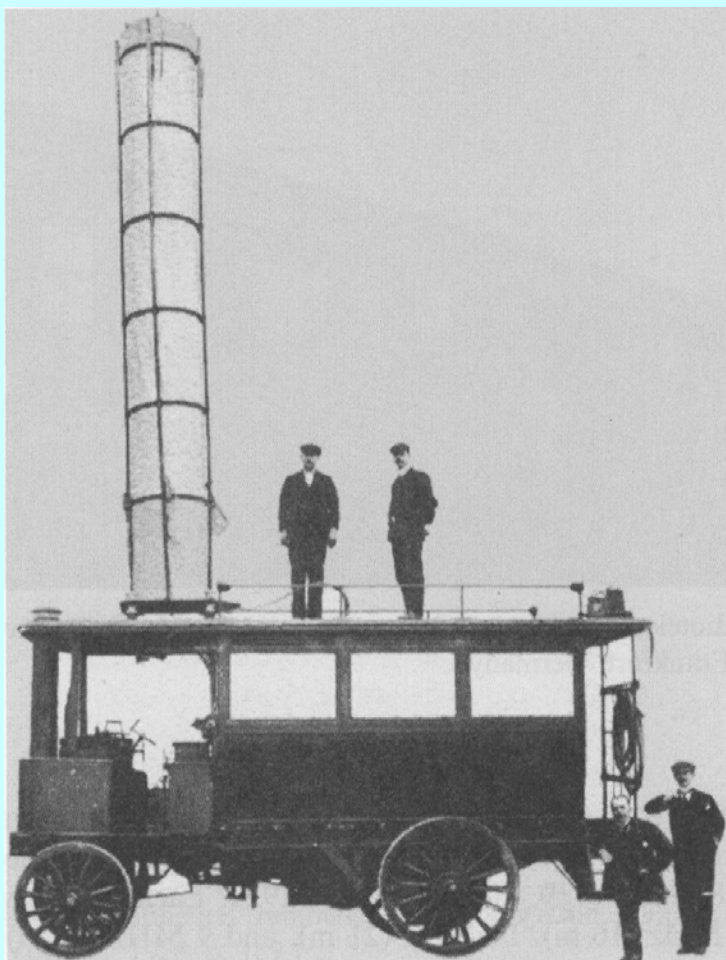
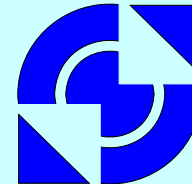
Heinrich Hertz
(1857-1894)



Guglielmo Marconi
(1874-1937)



Mobile telephony

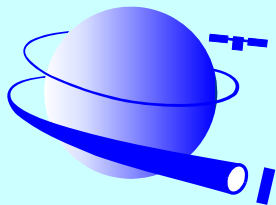


First mobile radio (Marconi 1901)

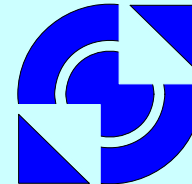


- NMT: 1982
- GSM: 1991
- DECT: 1993
- UMTS: 2004





Deregulation in US



- AT&T was the biggest company in the world
- had virtually a monopoly in US for many years

Under pressure of competitors and government it slowly gave up

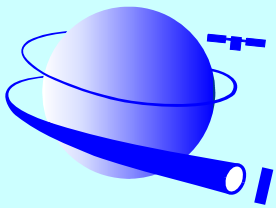
1981 MCI wins a lawsuit against AT&T on exploitation of private lines

1984 Divestiture of AT&T:

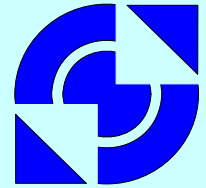
- 7 RBOC's
- AT&T (Long Lines, Western Electric, Bell Labs)

1996 Further break up of AT&T

- AT&T (communication services, part of Bell Labs)
- Lucent (previous Western Electric and major part of Bell Labs)



Deregulation in Europe



In Europe the monopoly was with the governments (PTT's)

1987 Commission of the EU publishes a plan on liberalization telecom market

1992 Evaluation of the impact

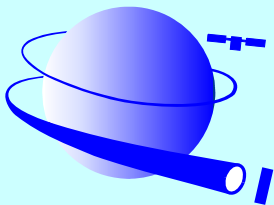
1997 Full liberalization in all EU countries

- Charges went down by 35 % on average
- 500,000 jobs extra
- Volume increased significantly

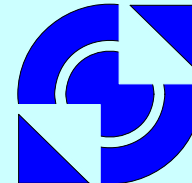
Independent authorities to control the market (in the Netherlands: OPTA)

Problem:

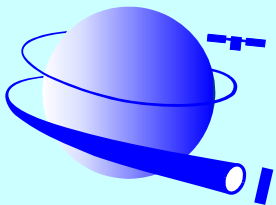
Reluctance of incumbent operators to open the local loop for competitors



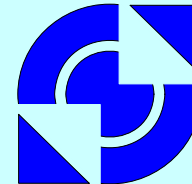
Concluding remarks



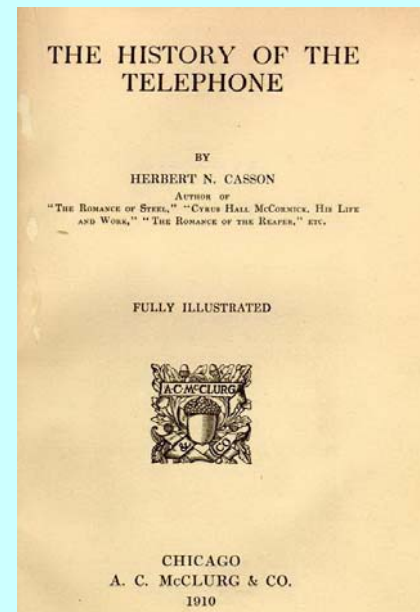
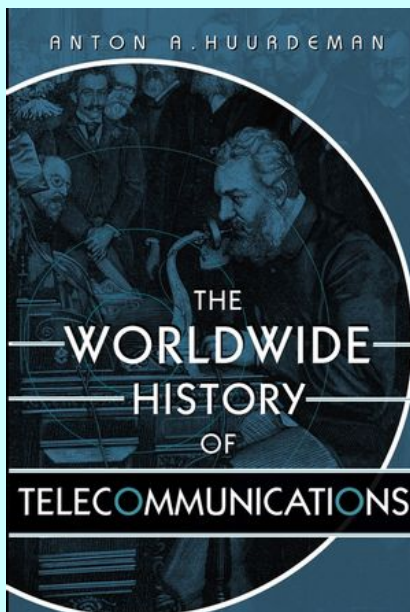
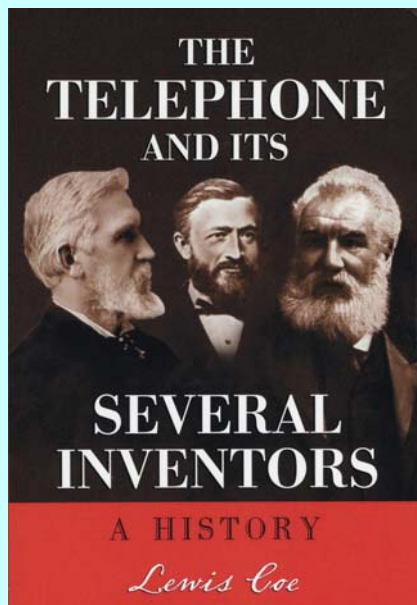
- not all aspects of telephony were covered (a.o. satellite telephony)
- Bell should be considered as the inventor of the telephone
- until a few years ago the telephony network was the major telecom network; data was transferred via this network;
- nowadays it is the other way around:
 - the data network (Internet) is the most important network (all IP)
 - telephony lost the lead and now uses the Internet as transport medium (VoIP)
- liberalization gave a new impetus to telecom services and lowered rates
- the speeds and services now available on the fixed line networks will soon be available via the mobile network as well

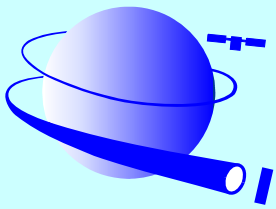


References

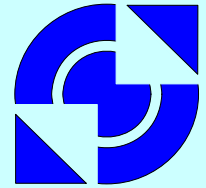


- *Wikipedia*
- *The Telephone and its Several Inventors*, by Lewis Coe, McFarland & Co., 1995
- *The Worldwide History of Telecommunications*, by Anton Huurdeman, Wiley, 2003
- *The History of the Telephone*, by H. Casson, McClurg & Co., 1910





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THE END

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