The History of Telecommunications

Part II:
The Telephone and its Several Inventors

by

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

Most valuable patent ever issued!
Bell’s first experiments

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

Alexander Graham Bell’s first telephone
Bell’s first telephone designs
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)

- left Boston University to spent more time to experiments
- 2 important deaf-mute pupils left:
  Georgie Sanders and Mabel Hubbard
- use basement of Sander’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 Brasil: “My God – it talks.”
- 1877: series of lectures and demo’s
1877 patent of 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
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 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
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 microphone.
- **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 “supercloon”
- Italian immigrant who started a candle factory in the US
- owned several patents in different areas,
  
  \[\text{but none on electrical equipment whatsoever}\]
- filed a caveat on telephone invention in 1871; renewed in 1872 and 1873
- too many suspicious events:
  \[\begin{align*}
  \& \text{no money for telephone patent, in the meantime applied for 5 others (1872-1876)} \\
  \& \text{newspaper that reported on his experiments in 1871 could not be traced} \\
  \& \text{no working equipment could be shown in court} \\
  \& \text{his wife sold equipment to pay hospital bills; equipment could not be retraced} \\
  \& \text{his journal contained impossible dates}
  \end{align*}\]
- in 2002 the US House of Representatives adopted a resolution stating:
  \[\text{“.. that … his work in the invention of the telephone should be recognized”}\]
• 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>government owned – private – government owned</td>
</tr>
<tr>
<td>Germany</td>
<td>government owned; mix of different local systems</td>
</tr>
<tr>
<td>France</td>
<td>mess; different rates and equipment; no plan; no standardization</td>
</tr>
<tr>
<td>Belgium</td>
<td>government owned; unity, but bureaucracy</td>
</tr>
</tbody>
</table>

**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 Rijktelefoondienst (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
## Worldwide distribution of telephony at the end of the 19-th century

<table>
<thead>
<tr>
<th>Year</th>
<th>US</th>
<th>Europe</th>
<th>Rest of world</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1880</td>
<td>47,900</td>
<td>1,900</td>
<td>-</td>
<td>49,800</td>
</tr>
<tr>
<td>1885</td>
<td>147,700</td>
<td>58,000</td>
<td>11,800</td>
<td>217,500</td>
</tr>
<tr>
<td>1890</td>
<td>227,000</td>
<td>177,000</td>
<td>31,500</td>
<td>435,500</td>
</tr>
<tr>
<td>1900</td>
<td>1,355,00</td>
<td>800,000</td>
<td>100,000</td>
<td>2,255,000</td>
</tr>
</tbody>
</table>
Old-time telephones 1

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

Danish desk phone (Ericsson design 1904)

Compact wall phone (Western Electric 1910)

1907 MAGNETO WALL SET
This is a more modern version of the telephone with a built-in generator mechanism to provide current for signalling the operator. Almost exactly similar telephones were in general use from the late '90s through the '30s. Some are in service in rural areas. Note enclosed receiver terminals, an improvement of 1907.
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
In 1956 the first transatlantic telephone cable was laid; until then telegraphy was the only fixed line transatlantic telecommunication service.
### Data of transatlantic telephone cables

<table>
<thead>
<tr>
<th>name</th>
<th>year</th>
<th># voice channels</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAT-1</td>
<td>1956</td>
<td>36</td>
<td>1\textsuperscript{st} transatlant. telephone cable</td>
</tr>
<tr>
<td>TAT-7</td>
<td>1985</td>
<td>4,000</td>
<td>last transatl. copper cable</td>
</tr>
<tr>
<td>TAT-8</td>
<td>1989</td>
<td>15,000</td>
<td>1\textsuperscript{st} transatl. fiber cable</td>
</tr>
<tr>
<td>TAT-13</td>
<td>1996</td>
<td>130,000</td>
<td>optical repeaters</td>
</tr>
<tr>
<td>Parameter</td>
<td>Specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budget</td>
<td>$750 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life cycle</td>
<td>25 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>14,000 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeater distance</td>
<td>45 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibers</td>
<td>4 in ring (2 each direction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitrate</td>
<td>5 Gb/s per fiber</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(bi-directional capacity 10 Gb/s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voice channels</td>
<td>130,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Telephone switching 1

Manual switchboard

Manual exchange office
Automatic dialing

Strowger selector
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
Pioneers of Radio

James Clerk Maxwell (1831-1879)
Heinrich Hertz (1857-1894)
Guglielmo Marconi (1874-1937)
Mobile telephony

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

First mobile radio (Marconi 1901)
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 History of the Telephone, by H. Casson, McClurg & Co., 1910
THE END

Thank you for your attention