Wireless Telegraphy, Amateur and Broadcast Radio

Global Information Network – National Broadcasting Corporation
Marconi – Sarnoff and Armstrong

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Computers for NOTETAKING ONLY
Please - NO Cell Phones, Texting, Internet use
Electrons in hot carbon (soot) radiate X-rays, UV, visible light, IR, radio (due to random electron motion).
Electrons in antenna radiate waves when forced at single frequency (due to sinusoidal electron motion).

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The Electric Field of an Oscillating Charge

Economics and Politics

Marconi wireless telegraphy
RMS Titanic with Marconi Antenna

Electricity

Morse - Intelligence at a distance
Edison - Lighting a city
Westinghouse - Power at a distance
Marconi - Wireless messages at sea
Heinrich Hertz’s Experiment - 1888

- Spark in transmitter initiates radio burst
- Spark in receiver ring detects radio burst

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- Spark in receiver ring detects radio burst

Roughly 5 cycles of electrical oscillation after each spark

* One-meter long wire legs separated by spark gap
* Radio waves generated at ~50,000,000 cycles/second
Electromagnetic Wave

\[ \nu \lambda = c \]

- \( \nu \): frequency
- \( \lambda \): wavelength
- \( c \): wave-speed

Time or Length

Pan Pipe

Length determines frequency

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Electromagnetic Wave

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wireless telegraph

Hertz Discovery
Marconi Patents
Marconi Demonstrations
Marconi’s Wireless Telegraph

Wireless Telegraph

Hertz Discovery

Marconi Patents

Marconi Demonstrations
Marconi’s Wireless Telegraph

AERIAL WIRE OR ELEVATED TERMINAL

SPARK GAP

INDUCTION COIL

KEY

BATTERY

GROUND
Marconi’s 7777 Patent tuning circuits used for transmitter and receiver

Coherer resistance drops when hit with radio burst – causes click in ear phones – then a tap returns it to high resistance
Tuning Circuit
(sensitive and selective)

\[ L \quad C \]

Adjust resonant frequency by changing \( C \)

Marconi’s 7777 Patent
tuning circuits used for transmitter and receiver

Coherer resistance drops when hit with radio burst – causes click in ear phones – then a tap returns it to high resistance
Inverted Pyramid Transmitting Antenna

Marconi’s 7777 Patent tuning circuits used for transmitter and receiver

Coherer resistance drops when hit with radio burst – causes click in ear phones – then a tap returns it to high resistance
Saint John’s (Newfoundland)

Cornwall (England)

Receiving antenna

KITE

Inverted Pyramid Transmitting Antenna

December 12, 1901
Crossing the Atlantic

1856  Morse  telegraph
1901  Marconi  wireless
1927  Lindberg  airplane

Marconi gets Physics Nobel Prize in 1909
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World Wide Wireless Plan in 1912

Transmitter in New Brunswick NJ
Receiver in Belmar NJ

Each location to be a station pair, …
World Wide Wireless Plan in 1912

Each location to be a station pair, …

Transmitter in New Brunswick NJ
Receiver in Belmar NJ
RMS Titanic sinks April 15, 1912
(1912 Radio Act – 24 hour watch)
In later years Marconi rejects idea to send voice by radio

Inflexible Pioneer (with a dark side)
Theories of Innovation

applied science
social process
individual genius
Theories of Innovation

applied science
social process
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EE Prof. Reginald Fessenden
University of Pittsburgh - 1906
Amplitude Modulated (AM) Carrier Wave

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Amplitude Modulated (AM) Carrier Wave

- 550 – 1600 KHz (Carrier Freq.) example – 1010 KHz (WINS)

- 20 – 10,000 Hz (Audio Freq.) example – 440 Hz (musical note A₄)

- Combined Wave
Amplitude Modulated (AM) Carrier Wave

550 – 1600 KHz (Carrier Freq.)
example – 1010 KHz (WINS)

20 – 10,000 Hz (Audio Freq.)
example – 440 Hz (musical note A₄)

Combined Wave

Demonstration Amplitude Modulation and Detection
Amplitude Modulated (AM) Carrier Wave
Cat’s Whisker Crystal Radio

Crystal Diode as One-Way Valve
Cat’s Whisker Crystal Radio

Vacuum Tube Radio

Crystal Diode as One-Way Valve

Light Bulb Triode as both One-Way Valve and Amplifier
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David Sarnoff
early (before WWI)

Telegrapher and office boy
American Marconi Company

Meets Columbia Univ. Student
Edwin Armstrong

Commercial Manager of
American Marconi Company
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“I have in mind a plan of development which would make radio a ‘household utility’ in the same sense as the piano or phonograph. The idea is to bring music into the house by wireless.”

- Sarnoff in 1915

"The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?"

- Sarnoff's associates in response to his urgings for investment in the radio in the 1920s
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Edwin Howard Armstrong

Regeneration Circuit
First IRE Medal of Honor
SUPERHET Circuit
FM Radio Circuit
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Radio Corporation of America

RCA founded out of American Marconi with GE executive as CEO
RCA buys AT&T’s patents
RCA buys Westinghouse’s patents

… and then dominates American Radio
After WWI …

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Listening to KDKA (Pittsburgh) - 1921
After WWI...

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New Brunswick NJ – 1921
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Newlyweds - Edwin and Marion Armstrong in December 1922
First Broadcasting Network - 1926

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Entrepreneur

First Broadcasting Network - 1926

David Sarnoff
President of RCA in 1929
President Franklin D. Roosevelt

Presidential Fireside Chats with US Citizens 1933 - 1944

David Sarnoff
President of RCA in 1929
Radio Drama: Mercury Theatre on the Air with Orson Wells

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President of RCA in 1929
Radio Drama: Mercury Theatre on the Air with Orson Wells
Ladies and gentlemen, we interrupt our program of dance music to bring you a special bulletin from the Intercontinental Radio News.

At twenty minutes before eight, central time, Professor Farrell of the Mount Jennings Observatory, Chicago, Illinois, reports observing several explosions of incandescent gas, occurring at regular intervals on the planet Mars. The spectroscope indicates the gas to be hydrogen and moving towards the earth with enormous velocity.

Professor Pierson of the Observatory at Princeton confirms Farrell's observation, and describes the phenomenon as, quote, "like a jet of blue flame shot from a gun," unquote.

We now return you to the music of Ramón Raquello, playing for you in the Meridian Room of the Park Plaza Hotel, situated in downtown New York.
Halloween Prank in 1938

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Grover’s Mill, West Windsor NJ

W2XMN & W2XEA
Maj. Armstrong Leaps to Death; FM Inventor, 63

Note Blames Estrangement

Maj. Edwin Howard Armstrong, 63, the electronic genius who invented FM radio, leaped to his death today from his 13th-floor apartment at River House, 430 E. 52nd St. A note found by the police in the empty Armstrong apartment indicated that Maj. Armstrong had sought death because of a recent estrangement from his wife, Mrs. Esther Marian Armstrong, now visiting a sister in Gransby, Conn.

Maj. Armstrong, professor of electrical engineering at Columbia University, who won the Medal of Merit and a Presidential citation for his contribution to military communications by radio, was remembered as having done more than any other man toward improving radio in the past 30 years. His newest development was a system for multiplexing FM radio so that more than one program could be sent out simultaneously on the same wavelength.

Body Found on Roof.

Maj. Armstrong’s body, fully clothed, was found on the roof.

Maj. Armstrong, Genius of Radio, Dies in Plunge

(Continued From Page One)

E. A. Lawrence, of 191 E. 89th St., told reporters that the major had no “immediate illness” when he examined him recently.

The police learned that Mrs. Armstrong left for New York immediately upon hearing of her husband’s death. A friend made arrangements to have the body taken to Campbell’s Funeral Home at 51 St. and Madison Ave.

No Motive Known.

Associates at Columbia could not ascribe any motive for suicide. So far as they know, they said, Maj. Armstrong had not complained of illness and had shown no indications of mental depression. He had been at the Macclesfield Hartley Laboratories, of which he had charge, within the last few days.

Major Armstrong was credited with having made the four most important contributions to radio. First, he devised the regenerative circuit which took radio out of the crystal detector stage and made possible the loudspeaker. Second came the super-heterodyne circuit, which ever since its invention has been the basis of radio reception. Third came the super-regenerative circuit, and finally, in 1930, FM (frequency modulation) radio, which permits reception without static interference of any kind. The audio reception accompanying television is frequency-modulated.

Served in Two Wars.

Maj. Armstrong served in the Army Signal Corps in World War I and in World War II.

February 1, 1954

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His newest development was a system for multiplexing FM radio so that more than one program could be sent out simultaneously on the same wavelength.

Body Found on Roof. Maj. Armstrong’s body, fully clothed, was found on the roof. He might have access to the laboratories. He became a full professor at the university in 1934.

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Maj. Armstrong, Genius Of Radio, Dies in Plunge

(Continued From Page One.)

July 23, 1951

February 1, 1954

W2XMN & W2XEA
Ham Radio Operators become Electronics Industry Pioneers

David Packard
9DRV

Frederick Terman
6AE

Jack St. Clair Kilby
W9GTY

Steve Wozniak
6A6BND

W2XMN & W2XEA
Ham Radio Operators become Electronics Industry Pioneers

Key Ideas

Scientific:
- Marconi’s Tuning Circuit
- Armstrong’s Many Circuits

Social:
- Sarnoff’s Broadcast System
- Federal Control of Airwaves

Symbolic:
- FDR speaks to the Nation

David Packard
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Frederick Terman
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