

UEC747: ANTENNA AND WAVE PROPAGATION

Jan-May 2021

Lecture 2: History of Antennas

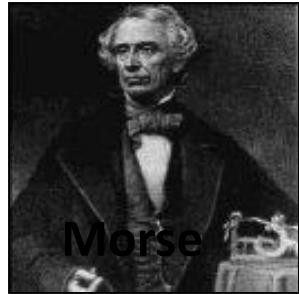
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and

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Introduction ➔ A little Histroy.....

1832



Wired Transmission

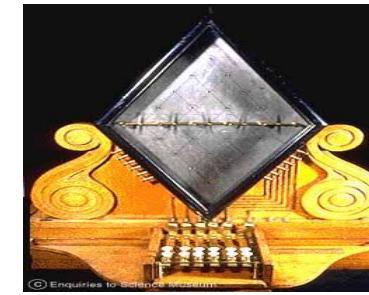
Morse develops the telegraph



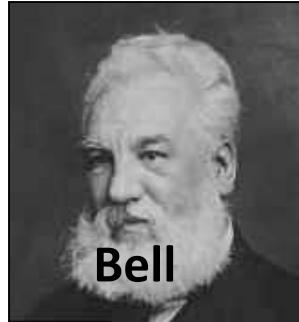
1839



Cooke develops the first electric telegraph



1876



Bell discovers the phone



1851: 1st cross-channel link (Siemens)
1866: 1st Trans-Atlantic link

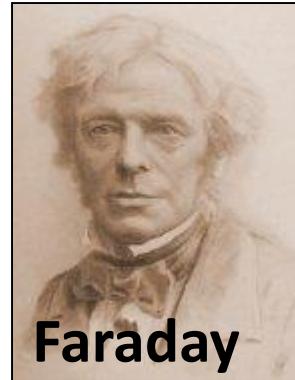


Introduction

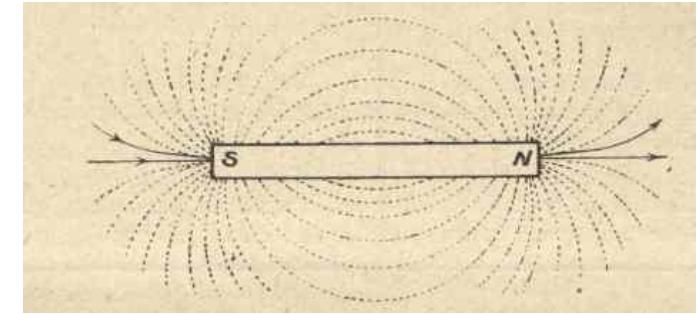


Hertzian transmissions

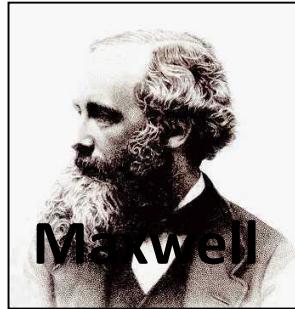
1831



Faraday
hypothesizes
electric and
magnetic fields



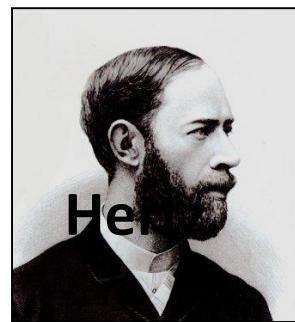
1864



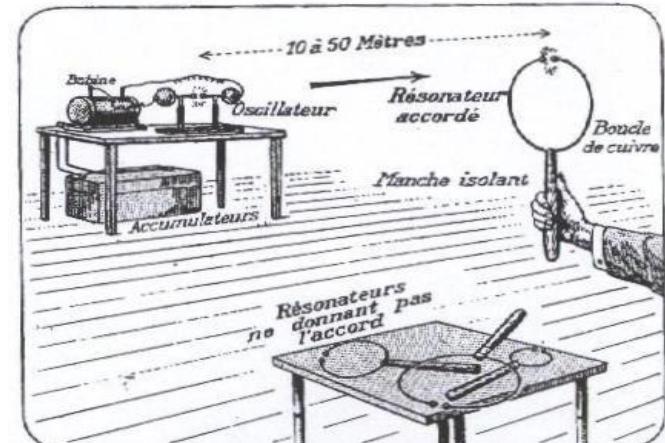
Maxwell
establishes his
famous theory of
electromagnetism

$$\begin{cases} \nabla \cdot \mathbf{E} = \rho/\epsilon_0 \\ \nabla \wedge \mathbf{E} = -\partial \mathbf{B}/\partial t \\ \nabla \wedge \mathbf{B} = \mu_0 \mathbf{j} + \epsilon_0 \mu_0 \partial \mathbf{E}/\partial t \\ \nabla \cdot \mathbf{B} = 0 \end{cases}$$

1887

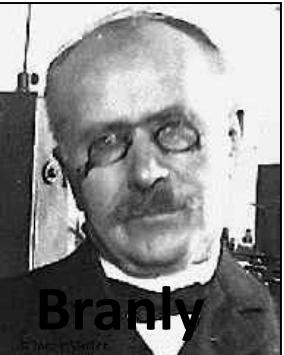


Hertz highlights the
spread of
electromagnetic
waves



Radio communications begins

1890



Branly develops its "coherer" to receive electromagnetic waves



1895

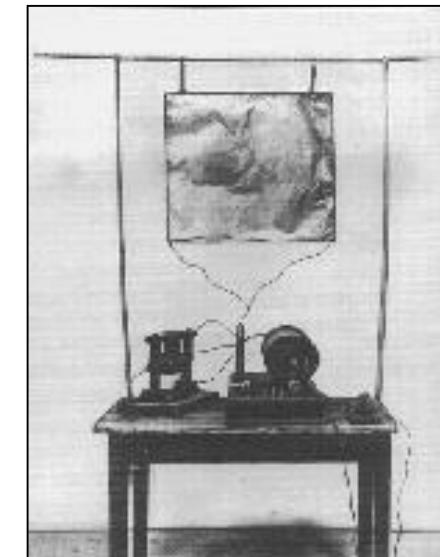


Popov invents the first antenna for weather observation

1895



Based on the work of Hertz, Branly and Popov, Marconi produces the first radio transmission (>2 km)



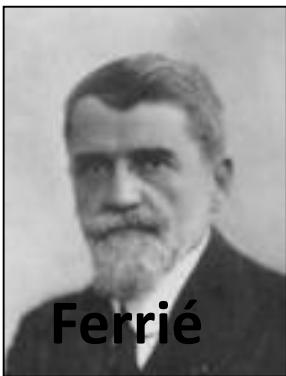
First Deployments.....

1899 First cross-channel transmission

1901 First Antibes-Corse transmission (175 km)

1903 Transmission Ireland-Newfoundland (3400km)

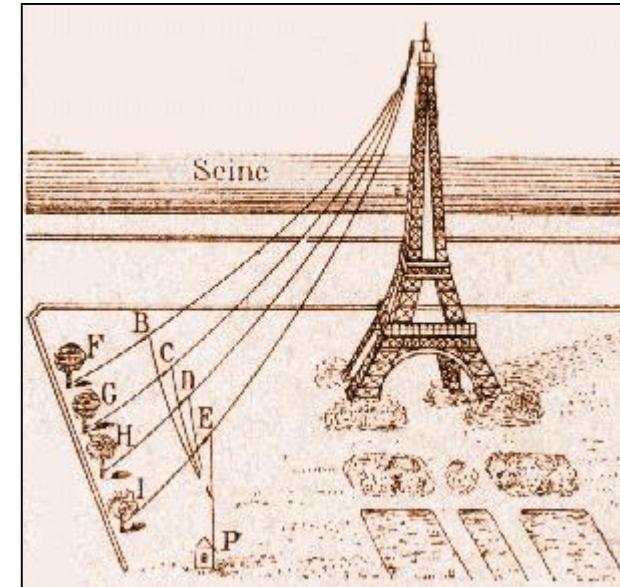
1905



Gustave Ferrié installs the first antenna on the Eiffel Tower for military communications (range of several hundred km)

1908

Range of 6000 km



The Lyon transmitter - la Doua



← 1914: 8 120-metre pylons(Towers)



1917: 2 pylons of 200
meters and 6 pylons
of 180 meters →

Facilities transferred
to Ain in 1960

Network deployment

- 1912** Titanic's SOS is captured by the ship Carpathia and rescues 800 people
- 1916** Requirement to equipp ships on radio
- 1920** 1st France-America radio link open to the public
- 1927** 1st London-New York radio link
- 1939** Start of multiplexing
- 1955** 1st radio-mobile network in France (taxis, doctors)
- 1956** 1st trans-Atlantic telephone cable TAT1 (48 lanes)

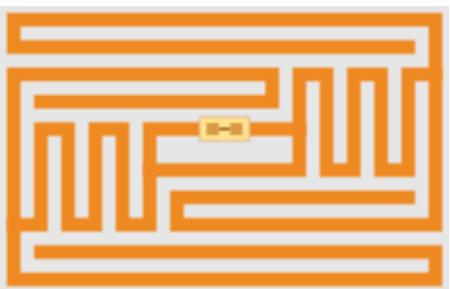
Applications



SonyEricsson T68, 2001



VLA in New Mexico [4]



RFID-TAG [3]

- | Communication
Radio, TV, mobile phone, Satellite
 - | Radar (RAdio Detection And Ranging),
Ground-penetrating radar (GPR), Microwave
tomography
 - | RFID (Radio-frequency identification)
 - | Positioning, e.g., GPS
 - | Radio astronomy
 - | Optics, nano antennas
-

Wireless communications



Base station in Nattavaara by.

Base stations:

- | High efficiency
- | Directivity

Terminal antennas:

- | Many small antennas in modern mobile phones.
- | MIMO (many antennas), RFID, TV...
- | Co-exist with camera, battery, ..., user
- | Must be cost efficient.

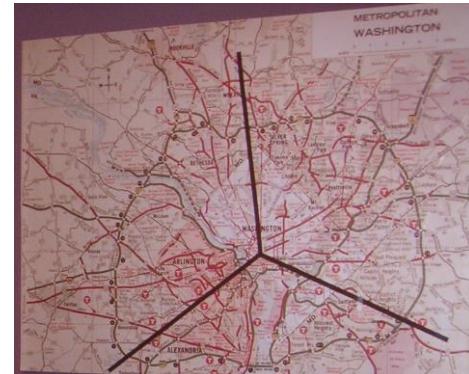


SonyEricsson T68, 2001 [7]



Radio astronomy

- | Often large reflector antennas.
- | Often large arrays.
- | [The VLA \(Very Large Array\) in Socorro, New Mexico has 27](#)
antennas that together offer a
resolution of approximately
 $0.2 \text{ arcsec} \approx 1 \mu\text{rad}$ at
 $\lambda = 3 \text{ cm}$.



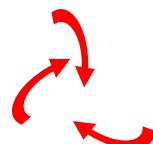
The VLA and Washington DC



Antennas in everyday life



GSM 900 MHz
DCS 1800 MHz
UMTS 2 GHz
LTE 800 MHz, 2.6 GHz

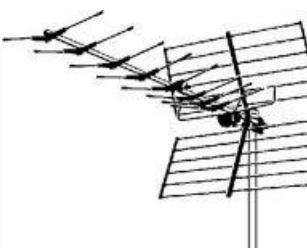


Wifi / Bluetooth / UWB
2.4 à 6 GHz



Analog 800 MHz
DECT ~1900 MHz

Collision avoidance Radar ~80 GHz
Remote Toll ~6 GHz
Lock Remote control 433 MHz



TV terrestrial
500 MHz

Satellite systems 1 to 45 GHz (Ex :
Television 12 GHz, GPS 1.5 GHz)



Military boat

Wideband antennas for
« Electronic war »: listening to
foe's transmissions (radars and
comms) for identification and
jamming



Communication antennas
(HF, VHF, etc.)

Radar antenna
for fire control

Radar antennas for missile-
launching system

Array antenna for aerial and
surface surveillance radar



Assignment

Find which types of antennas are required in 5G communication?

THANKS