北京航空航天大學
BEIHANG UNIVERSITY

Avionics Technology

B31353551

— *Aero Communication*

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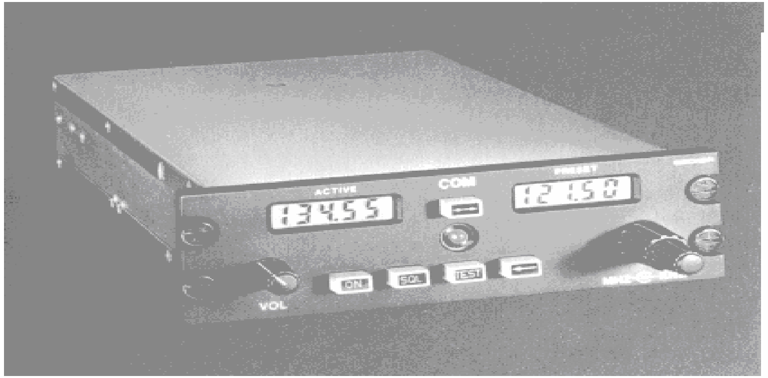
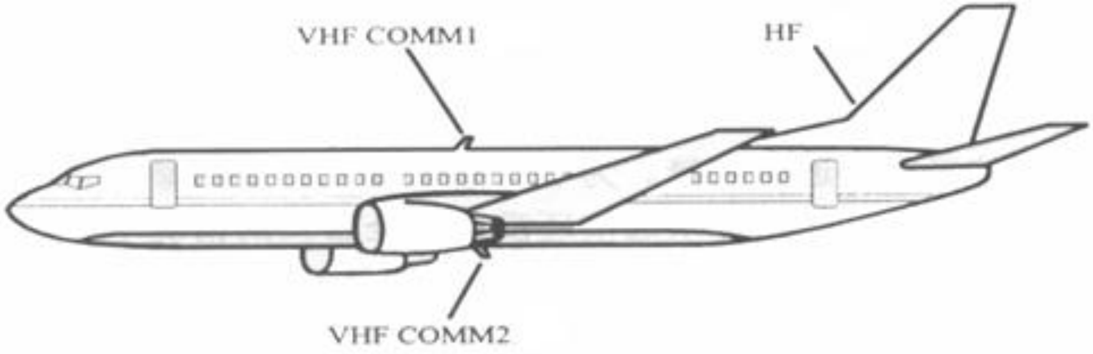
V. Aero Communication

References and further readings —

D. Stacey, Chapter 3: VHF Communication, *Aeronautical Radio Communication Systems and Networks*.



Airborne radio station for communication



Radio antennas mounted on aircraft fuselage

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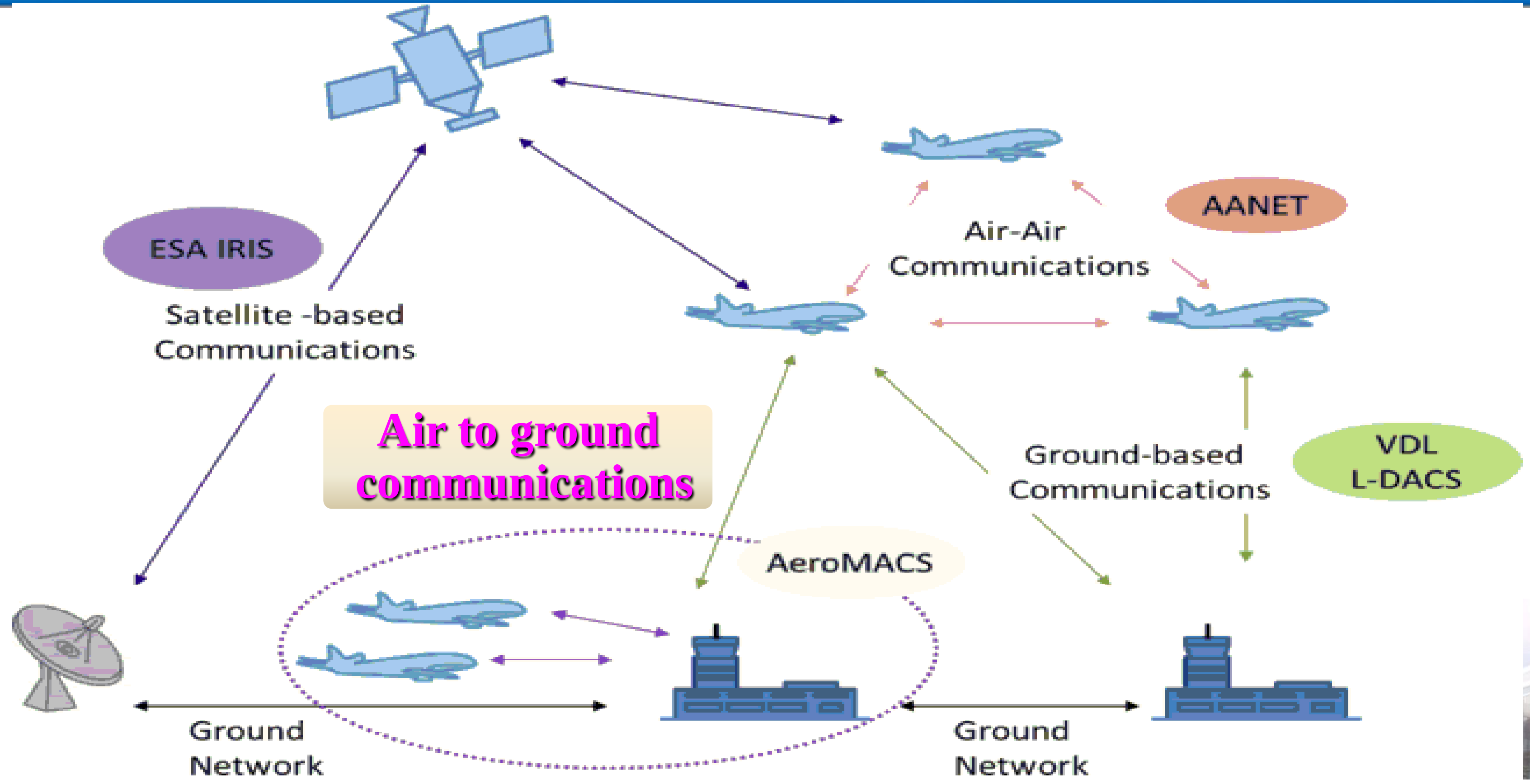

Aero communication network

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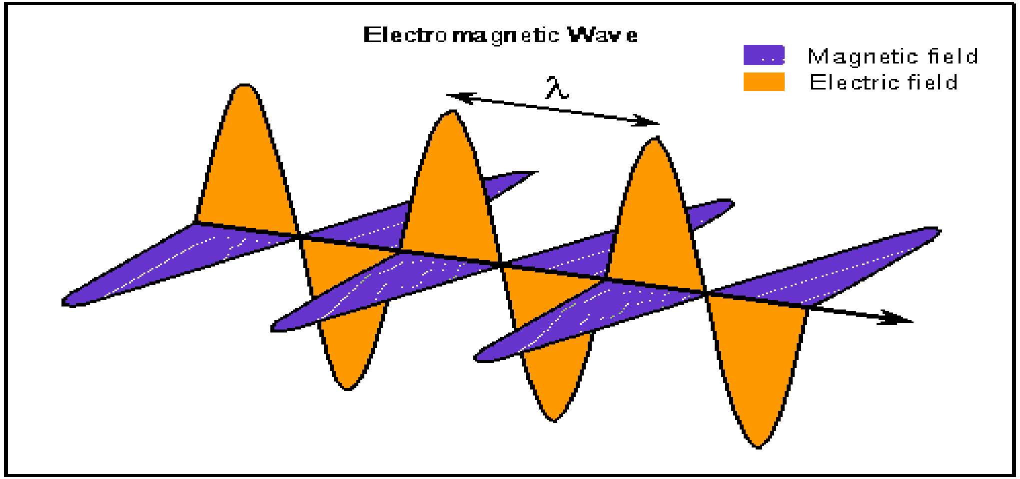

Radio waves are electromagnetic waves of frequency between 30 Hz and 300 GHz

Variety of radio antennas located on mountain peaks to give maximum transmission ranges

V. Aero Communication

（1）Some concepts

（2）VHF Communication

（3）Long-distance Communications

（1）Some concepts

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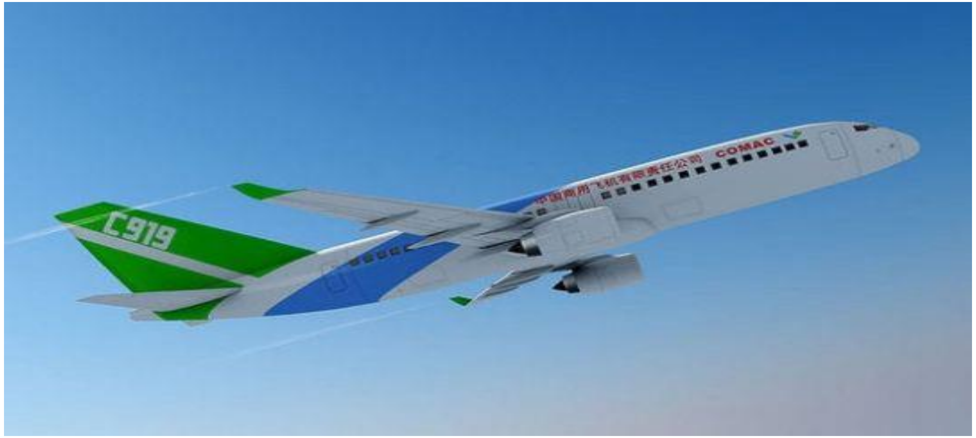
- *Air to ground communication* was first made possible by the development of two-way aerial telegraphy in 1912 sending messages in Morse code, and soon followed by two-way radio. In June 1915 the world's first air-to-ground voice transmission took place at Brooklands over about 20miles.

The earliest communication with aircraft was by visual signalling

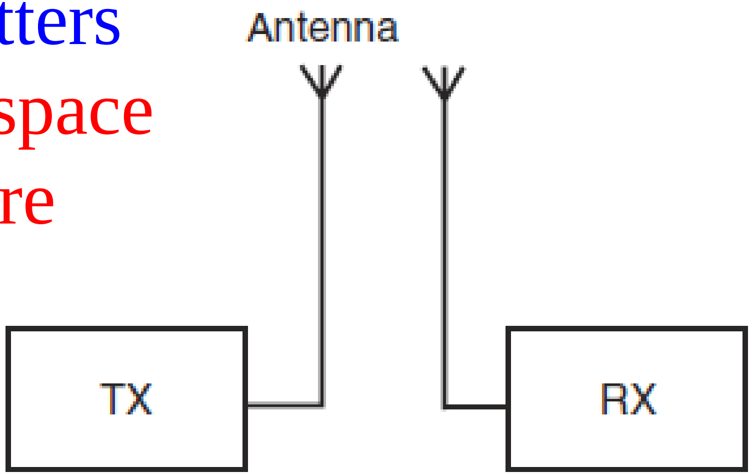
(1) Some concepts

- Today radio waves can carry messages across significant distances from a transmitter to a receiver. Despite nearly a century of innovation in communications, many of the original techniques (e.g. voice communications) used to communicate with the ground are used by today's aircraft.



（1）Some concepts

- *Radio waves* are often described as having the properties of light and can be described by traditional ‘wave’ physics. Another important facet is the geometry and the relationship between the transmitters and receivers, and the earth and space through which the radio waves are propagating.



Transmitter: a device that converts electrical signals into emitted RF energy

Receiver: a device that receives RF energy and converts it back into electrical signals

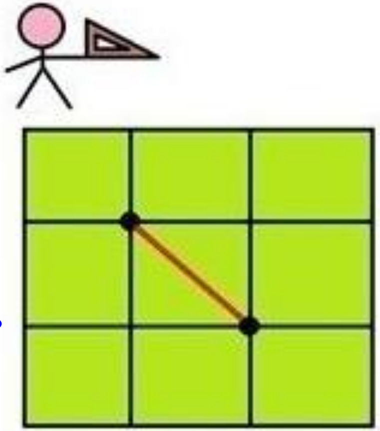
Transmitter, antenna, air propagation and receiver

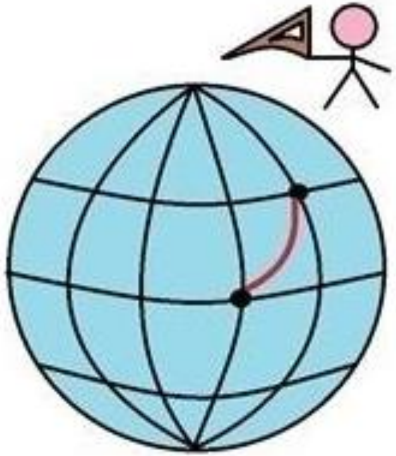
（1）Some concepts

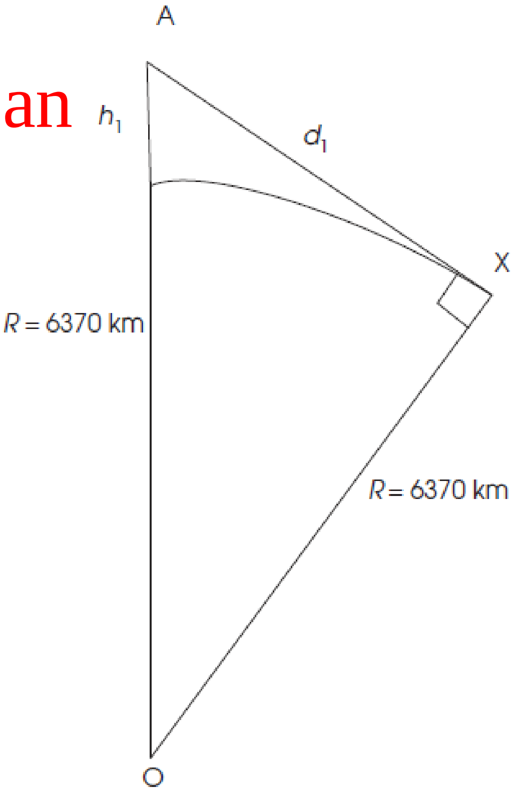
- *Antenna* can be considered as a part of the transmitter or receiver system (or it can be in both). It is usually a passive device that converts electrical signals straight into radio waves.
- *Propagation* is the ability of a radio wave to travel between a transmitter and a receiver in free space or in another medium such as air.
- *Radio frequency* (*RF*) : the number of cycles per second (Hz) of a radio wave.

(1) Some concepts

- *Radio Geometry* is often involved in radio horizon calculations. Consider an aircraft antenna located at a point A, at a height above mean sea level of h_1, the radio horizon distance from this aircraft is d_1 and the horizon point of point X can be determined.







(1) Some concepts

- By definition, AXO is a right-angle triangle. So using Pythagoras theorem

$$(h_1 + R)^2 = d_1^2 + R^2$$

This can be rearranged to

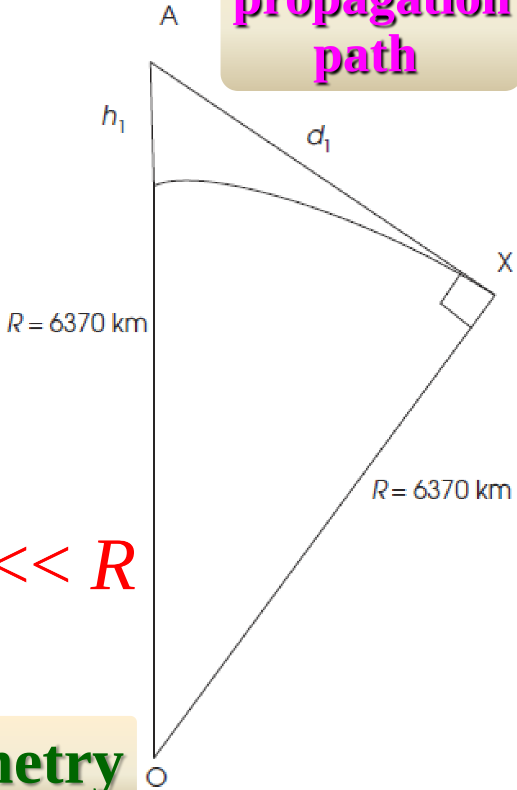
$$h_1(2R + h_1) = d_1^2$$

$$d_1 = (h_1(2R + h_1))^{0.5}$$

$(2R + h)$ is approximated by $2R$ due to $h << R$

Therefore $d_1 \approx (2Rh_1)^{0.5}$

Straight line propagation path

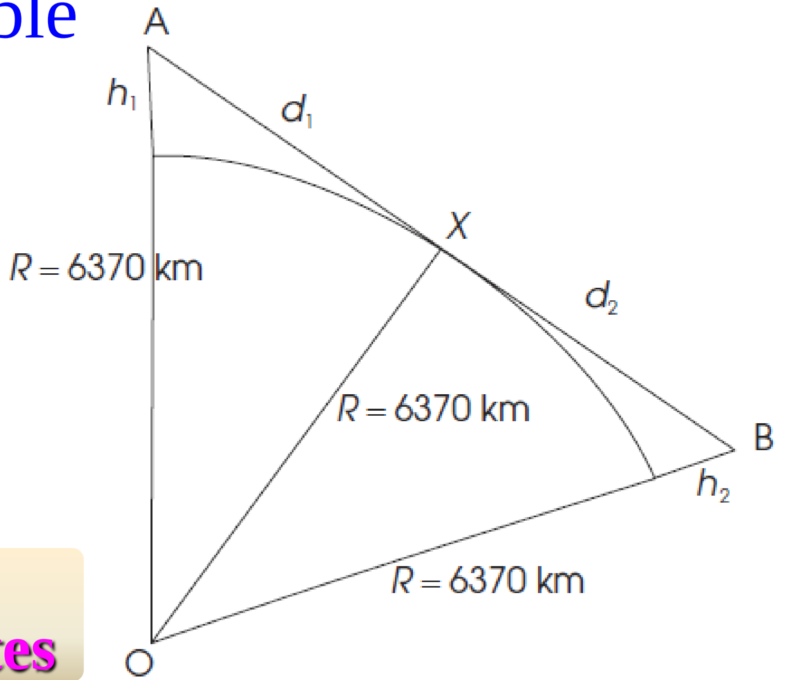


Radio horizon geometry

(1) Some concepts

- Extending this argument to another airborne antenna at a point at B or a high-tower mast h_2 above the mean sea level, the LOS distance achievable between two points (i.e. the limit where the communication ray grazes the horizon) can be defined by

$$D \approx d_1 + d_2 = (2Rh_1)^{0.5} + (2Rh_2)^{0.5}$$



Radio horizon geometry for two aircraft or two 'high'-elevation sites