Radar Systems

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Basics of Radar Technology

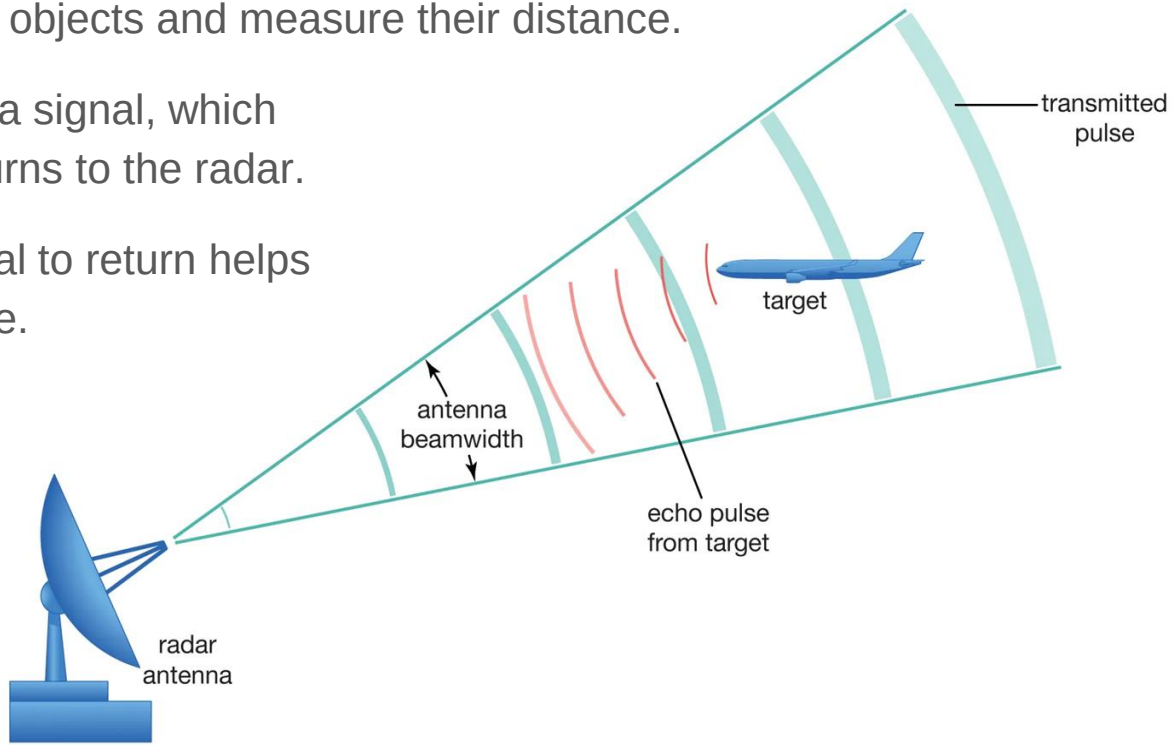
- Radar stands for Radio Detection and Ranging.

- It uses radio waves to detect objects and measure their distance.

- The radar system sends out a signal, which bounces off an object and returns to the radar.

- The time it takes for the signal to return helps determine the object's distance.

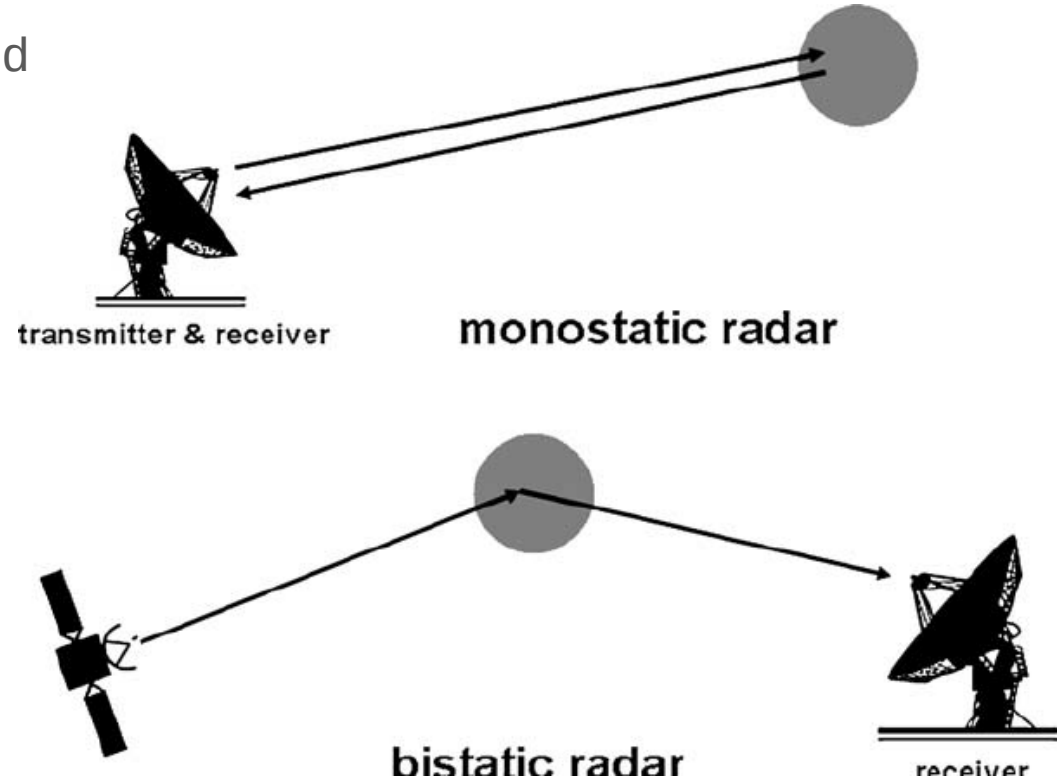
It is important to understand at what distance radar is effective



Types of Radar Systems

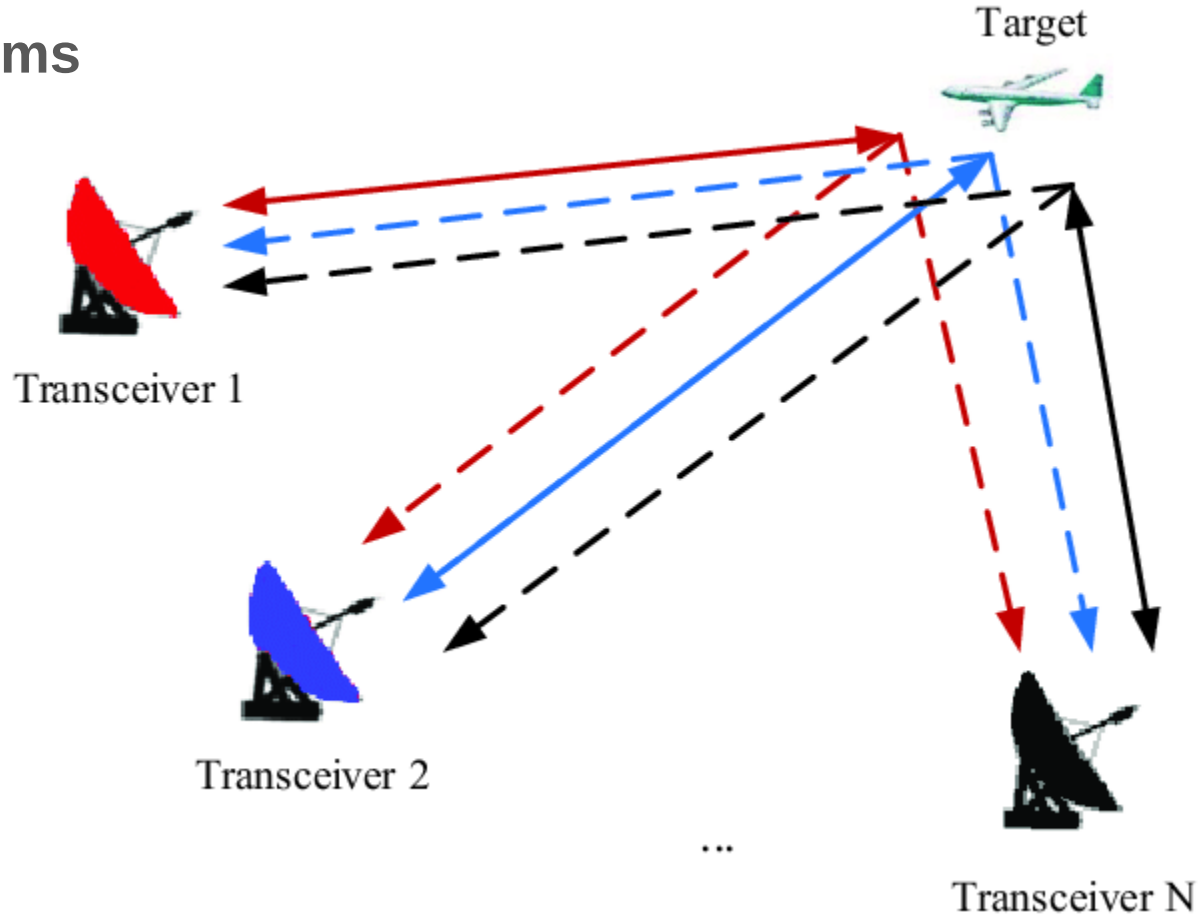
- Monostatic Radar: Transmitter and receiver are in the same location.

- Bistatic Radar: Transmitter and receiver are in different locations.



Types of Radar Systems

- Multistatic Radar: Multiple transmitters and receivers in different locations, working together.



Buran A-140 Radar System

Type: Monostatic Radar

Manufacturer: Ukraine

Functions:

- Weather monitoring
- Navigation support
- Air traffic control

Features:

- High accuracy
- Long-range detection
- Advanced signal processing

Using the example of this radar, let's calculate the range of the radar.

Calculation Part

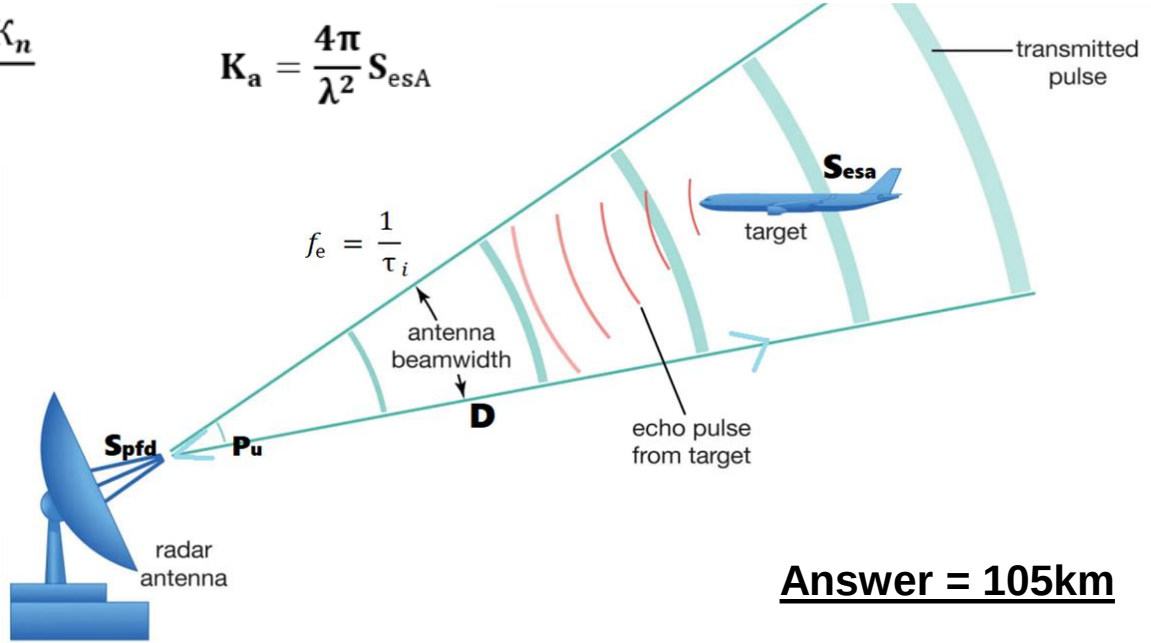
$$P_c = S_{pfd} \times S_{esa} = \frac{P_u K_a S_{esa} S_{esA}}{(4\pi)^2 D^4}$$ *is the basic equation of radar.*

$$P_{cmin} = m_p k T_0 K_n \Delta f_e = \frac{m_p k T_0 K_n}{\tau_i}$$

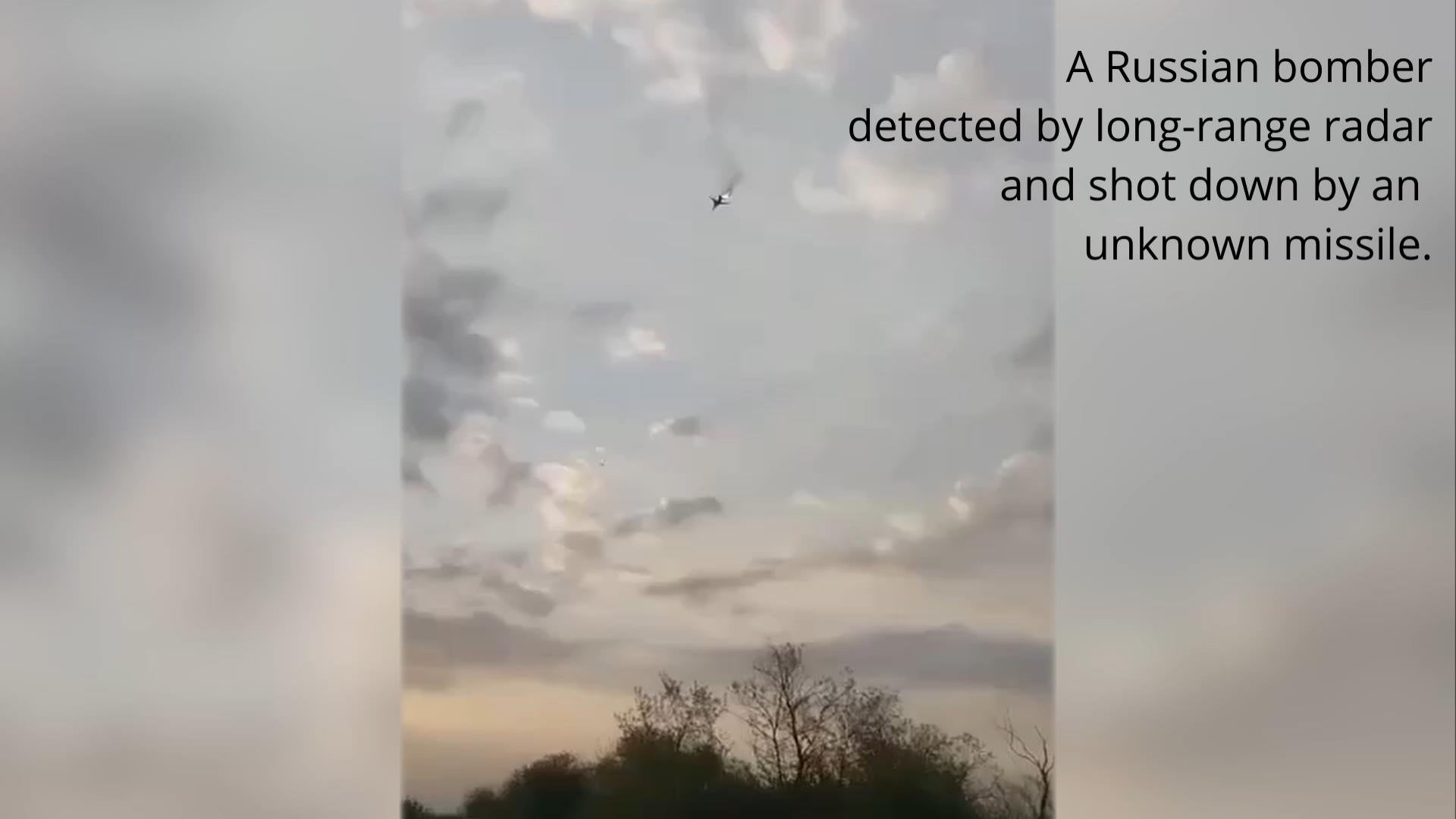
$$K_a = \frac{4\pi}{\lambda^2} S_{esA}$$

after calculations

$$D = \sqrt[4]{\frac{\tau_i P_u K_a{}^2 S_{esa} \lambda^2}{(4\pi)^3 m_p k T_0 K_n}}$$



Answer = 105km


A Russian bomber
detected by long-range radar
and shot down by an
unknown missile.

Thank you for attention!

D-?
P_u-5× 10^3B
τ_i- 0.1 c
S_{esa}- 2 m^2
K_a – 33dB
m_p- 1 dB
k-1,38 × 10^{-23} $\frac{Дж}{К}$
T_0- 290 K
K_n-1 dB
λ-0.03 m

τ_i- pulse duration

P_u- radiated power

S_{esa}- effective radiated area

K_a – directivity coefficient

m_p- resolution coefficient

k-1,38 × 10^{-23}- Boltzmann constant

T_0- 290 K

K_n- receiver noise figure

λ - wavelength

S_{esA}- effective area

S_{pfd}- power flux density

$$D = \sqrt[4]{\frac{\tau_i P_u K_a{}^2 S_{esa}}{(4\pi)^3 m_p k T_0 K}}$$

$$= \sqrt[4]{\frac{0,1}{(4\pi)^3 \cdot 1 \cdot 1,38 \times 10^{-23} \cdot 290}}$$

$$= \sqrt[4]{\frac{81675 \cdot 10^{21}}{21344\pi^3}} \approx 105400,07m$$

$$\approx 105,4km$$