

RADAR COMMUNICATIONS

RADAR

- **RADAR** – Radio Detection & Ranging
- Radar is an Electromagnetic System for the detection and location of objects
- Radar operates in microwave region
 - 100MHz – 36 GHz, max up to 240GHz

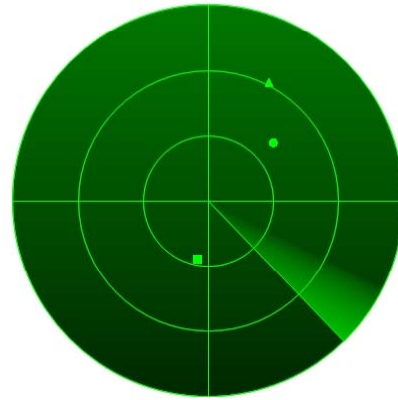
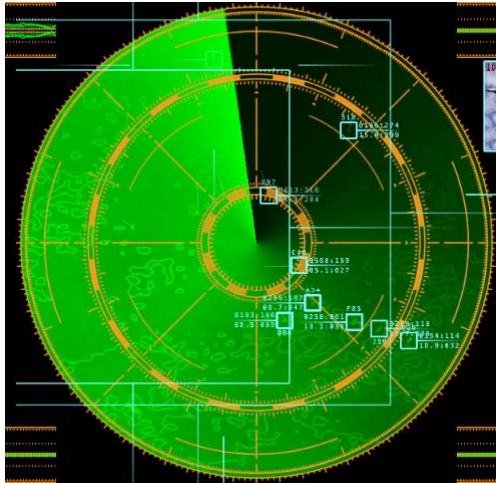
Operation of Radar

- Radar radiates energy into space and detect the echo signal reflected from an object/target.
- Location and presence of the object both are detected by comparing the received echo signal with the signal that was transmitted.

Radar Attributes

- It can operate in :
 - Darkness
 - Haze
 - Fog
 - Rain
 - Snow
- Its ability to measure distances with high accuracy and in all weather is one of the major attributes.

Radar Images



Radar Display

Cont'd



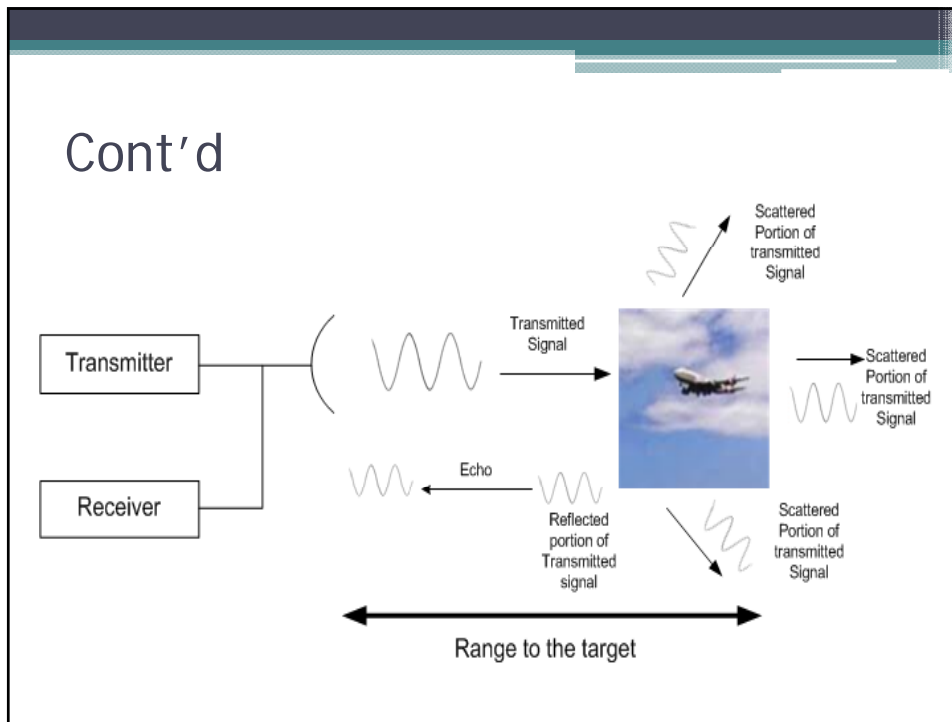
Basic Principle of Radar Communication

- Transmitter generates Electromagnetic signal (such as short pulse sine wave) radiated into space by an antenna.
- Portion of the transmitted energy is intercepted by the target and re-radiates in many directions
- The re-radiated directed back towards the radar is collected back by the radio antenna, which delivers it to the receiver.

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- If the target is in motion, there is a shift in the frequency of the echo signal due to Doppler effect.
- The frequency shift is proportional to the velocity of the target relative to the radar
- **Doppler Effect:**
 - A change in the observed frequency of a wave, as of sound or light, occurring when the source and observer are in motion relative to each other.
 - The frequency increases when the source and observer approach each other and decreases when they move apart.

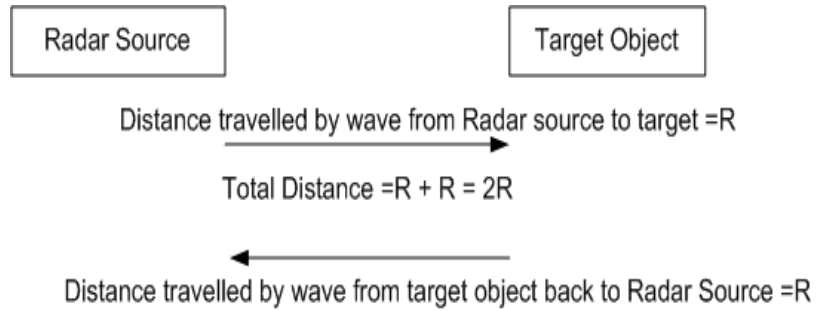
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Range to the Target

- Range to the target is determined by the time T_R it takes the Radar signal to travel to the target and back
- Electromagnetic energy in free space travels with the speed of light $c=3 \times 10^8$ m/s
- Time for the signal to travel to a target located at R distance.
- Total distance travelled by wave is $2R$, with wave travelling with speed of light
 - $T_R = 2R/c$
 - Or $R = c \times (T_R) / 2$

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Radar Applications

- Military
- Air Traffic Control
- Ship Safety
- Navigation