RADAR

- Radio Detection and Ranging
- Mw technology

Advantages

- Radar can be seen through darkness, haze, fog and snow
- They can detect the range and angle i.e location of the target easily

limitations

- Radar cannot resolve in details like human eye as short distances
- They cannot recognize the color of the target

Application

- Civil Application
- Military Application

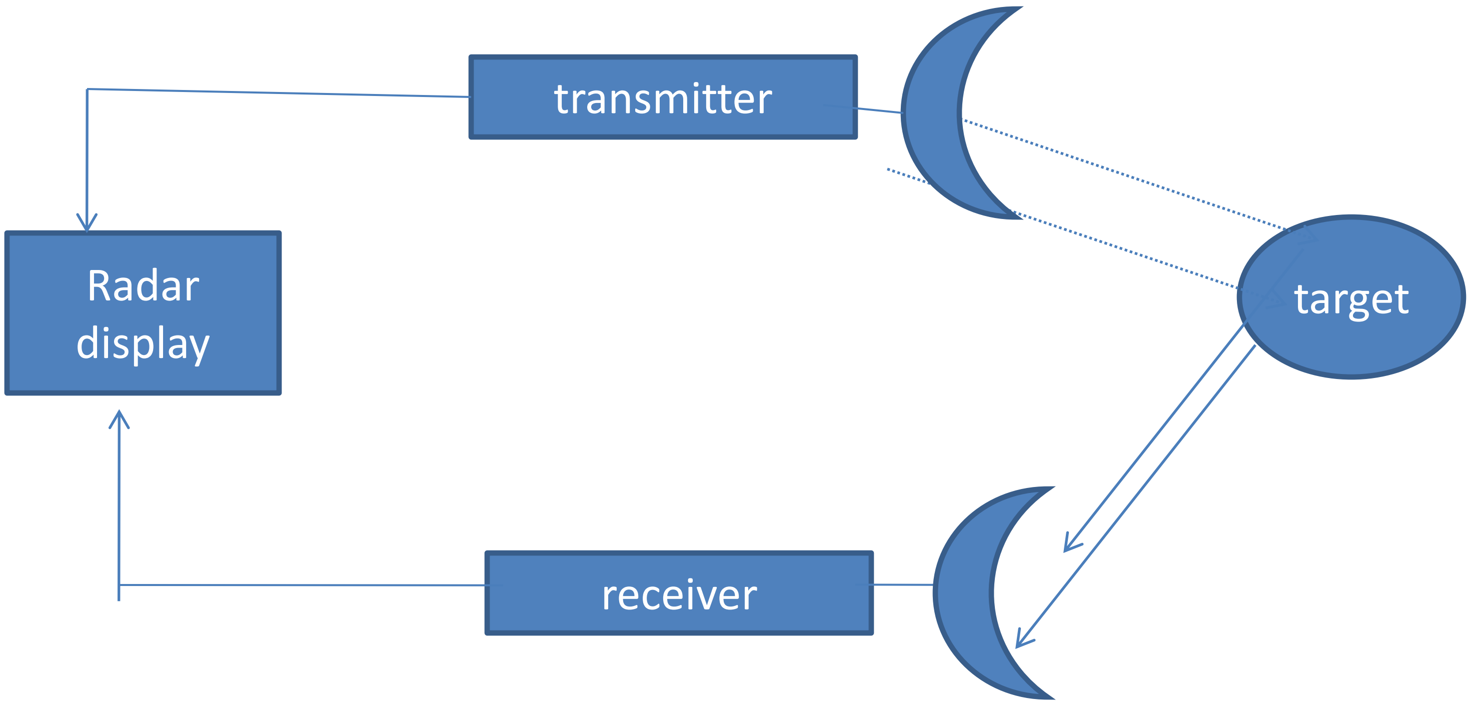
Civil application

- Navigational aid on ground and sea
- Radar altimeter for determining the height of plane above ground
- Airborne radar for satellite surveillance
- Police radar for directing and detecting speeding vehicles
- Radar for determining the speed of moving target

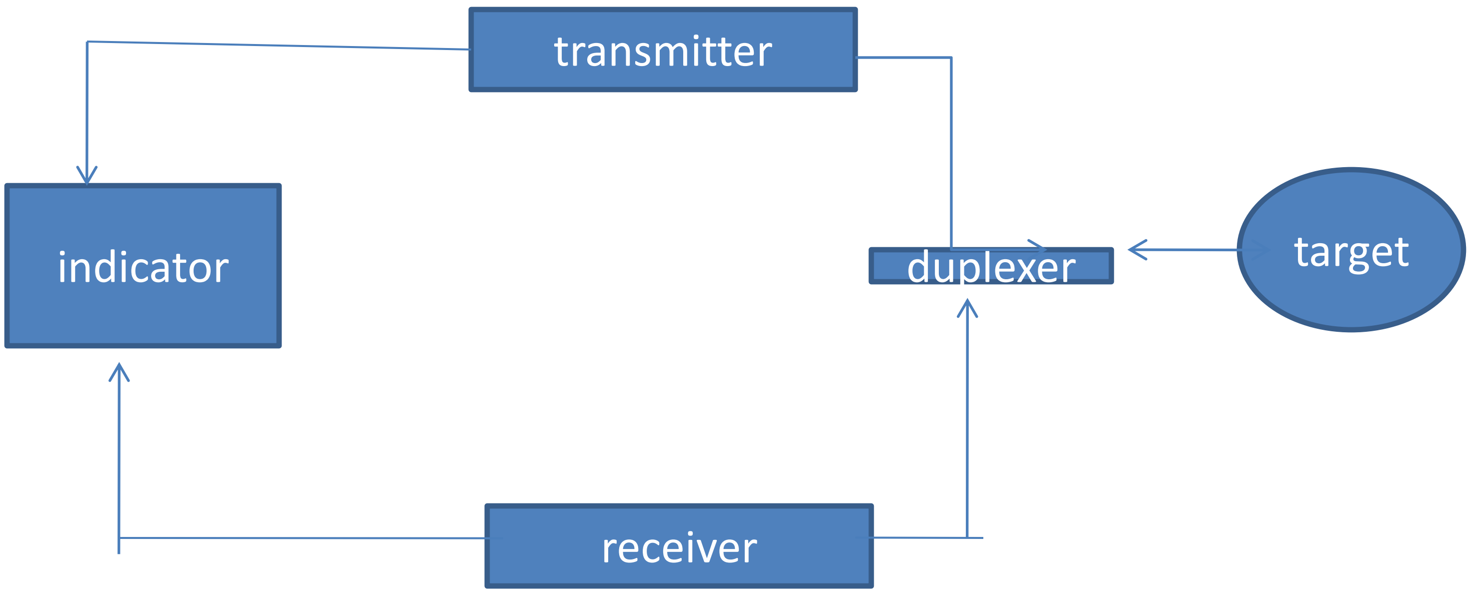
Military application

- Detecting and ranging of enemy target
- Aiming guns at aircraft and ships
- Early warning regarding approaching air craft or ships
- Searching for sub marine ,land masses
- Directing guided missiles

Block diagram of simple radar bistatic radar



Block diagram of simple radar monostatic



duplexer

- To isolate transmitter and receiver
- Protect receiver from high power transmitter
- Single transmitter/receiver
- Mono static radar(single antenna)

Standard Radar Frequency band designations

Band Designation	Nominal frequency range	Specific radar band assignment(Ghz)
L	1-2	1.215-1.4
S	2-4	2.3-2.5
C	4-8	5.2-5.925
X	8-12.5	8.5-10.68
KU	12.5-18	13.4-14,15.70-17.70
K	18-26.5	24.05-24.25
Ka	26.5-40	33.40-36

Classification

- Continous Wave (Cw)/doppler radars
- Pulsed radar

Free space radar range equation

power density

$$\frac{P_t}{4\pi R^2} \text{ watts/m}^2$$

power density (directive antenna)

$$\frac{P_t G}{4\pi R^2}$$

radar cross section of target σ

power intercepted by a target

$$\frac{P_t G}{4\pi R^2}.\sigma$$

power density of echo signal at the radar station is

$$\frac{P_t G}{4\pi R^2}.\sigma * \frac{1}{4\pi R^2}$$

effective area of recieving by antenna is denoted by A_e

$$P_r = \frac{P_t G A_e \sigma}{\left(4\pi R^2\right)^2}.watt$$

Maximum Radar range

- Distance beyond which target cannot be detected
- Received echo signal power pr is just equals the minimum detectable signals(Smin)
- Pr=Smin, R=Rmax

$$S_{\min} = \frac{P_t G A_e \sigma}{\left(4\pi R^2\right)^2} .watt$$

$$R_{\max} = \left[\frac{P_t G A_e \sigma}{\left(4\pi\right)^2 .S_{\min}} \right]^{\frac{1}{4}}$$

$$G = \frac{4\pi A_e}{\lambda^2}$$

Ae capture area of recieving antenna

, G transmitter gain,

$\lambda = wavelength$ of recieving antenna

$$R_{\max} = \left[\frac{P_t \dfrac{4\pi A_e}{\lambda^2} A_e \sigma}{(4\pi)^2 . S_{\min}} \right]^{\frac{1}{4}}$$

$$R_{\max} = \left[\frac{P_t (A_e)^2 \sigma}{4\pi\lambda^2 S_{\min}} \right]^{\frac{1}{4}}$$

$$A_e = \frac{G\lambda^2}{4\pi}$$

$$R_{max} = \left[\frac{P_t \left(\frac{G\lambda^2}{4\pi} \right)^2 \sigma}{4\pi\lambda^2 S_{min}} \right]^{\frac{1}{4}}$$

$$R_{max} = \left[\frac{P_t G^2 \lambda^2 \sigma}{(4\pi)^3 S_{min}} \right]^{\frac{1}{4}}$$