NAVIGATIONAL EQUIPMENT

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LEARNING OBJECTIVES

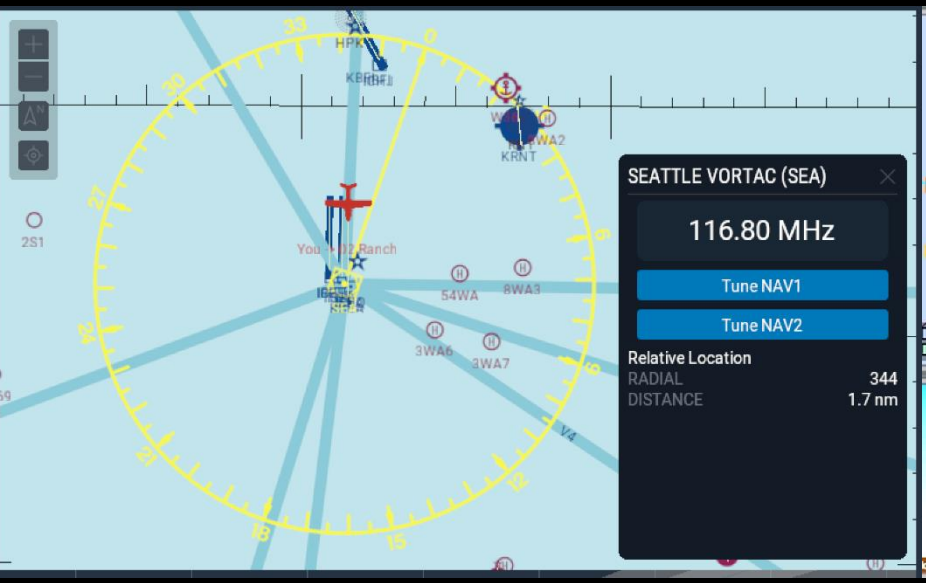
- To ascertain the knowledge on Navigational Equipment

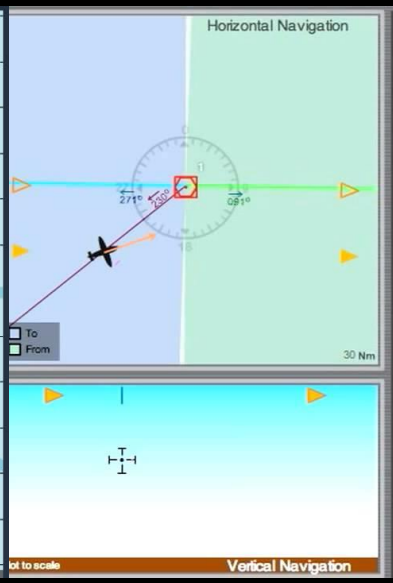
- To appreciate a situation with better knowledge of technical limitations

- To take strategic decisions on employment of airpower as a mean to reach the End State

NAVIGATION

➢ Navigation is the art and science of moving from point "A" to point "B" in the least possible time without losing your way





SEQUENCE

- Introduction
- Ground Based Navigation System
- Satellite Based Navigation System
- Other Navigation System

INTRODUCTION

- The techniques of Navigation depends on:
  - Visual Flight Rules (VFR)
  - Instrument Flight Rules (IFR

INTRODUCTION

VFR

- Navigation accomplished primarily by visual reference to the ground
- Requires at least 1000 ft. cloud ceiling and 3 miles of visibility
- Map reading
- Dead Reckoning
- Basic pilot training/certification

INTRODUCTION

IFR

- Navigation accomplished primarily by reference to onboard instruments, electronic navigation aids, and Air Traffic Control
- No weather minimums
- More advanced pilot training/certification required
- Radio Navigation

INTRODUCTION

RADIO NAVIGATION

- Radio Navigation is navigating an aircraft though application of radio
- The main principles
  - Direction - By bearing or radio phrases
  - Distance – By measuring of travel times

GROUND BASED NAVIGATION

- NDB – ADF
- VOR
- ILS
- DME

GROUND BASED NAVIGATION

NDB – ADF

- Ground Station is ‘Non Directional Beacon’
- Operating Frequency 190 kHz – 1750 kHz

GROUND BASED NAVIGATION

NDB – ADF

- Fixed ground station provides basic “bearing to” information
- Greater range but less precision than other methods
- Aircraft can use signal to “home” on the station

GROUND BASED NAVIGATION

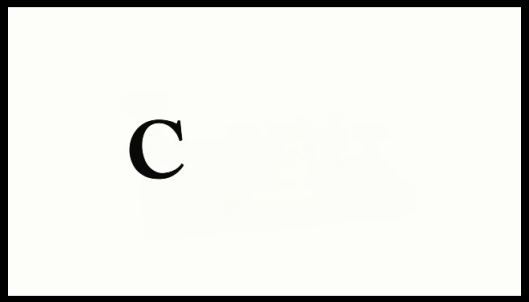
NDB – ADF

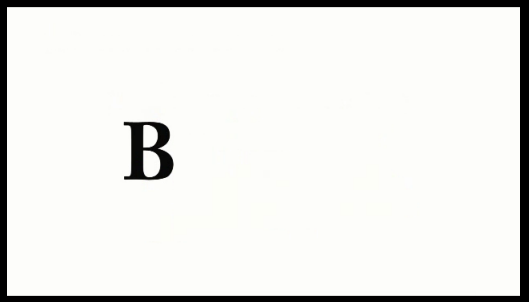
- ADF receive 2-3 digits Morse code Transmit by NDB

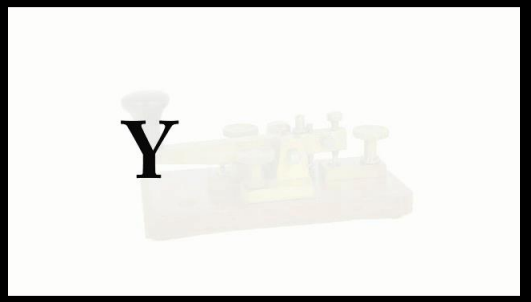
GROUND BASED NAVIGATION

NDB – ADF

- ADF receive 2-3 digits Morse code Transmit by NDB







GROUND BASED NAVIGATION

NDB – ADF

GROUND BASED NAVIGATION

VOR

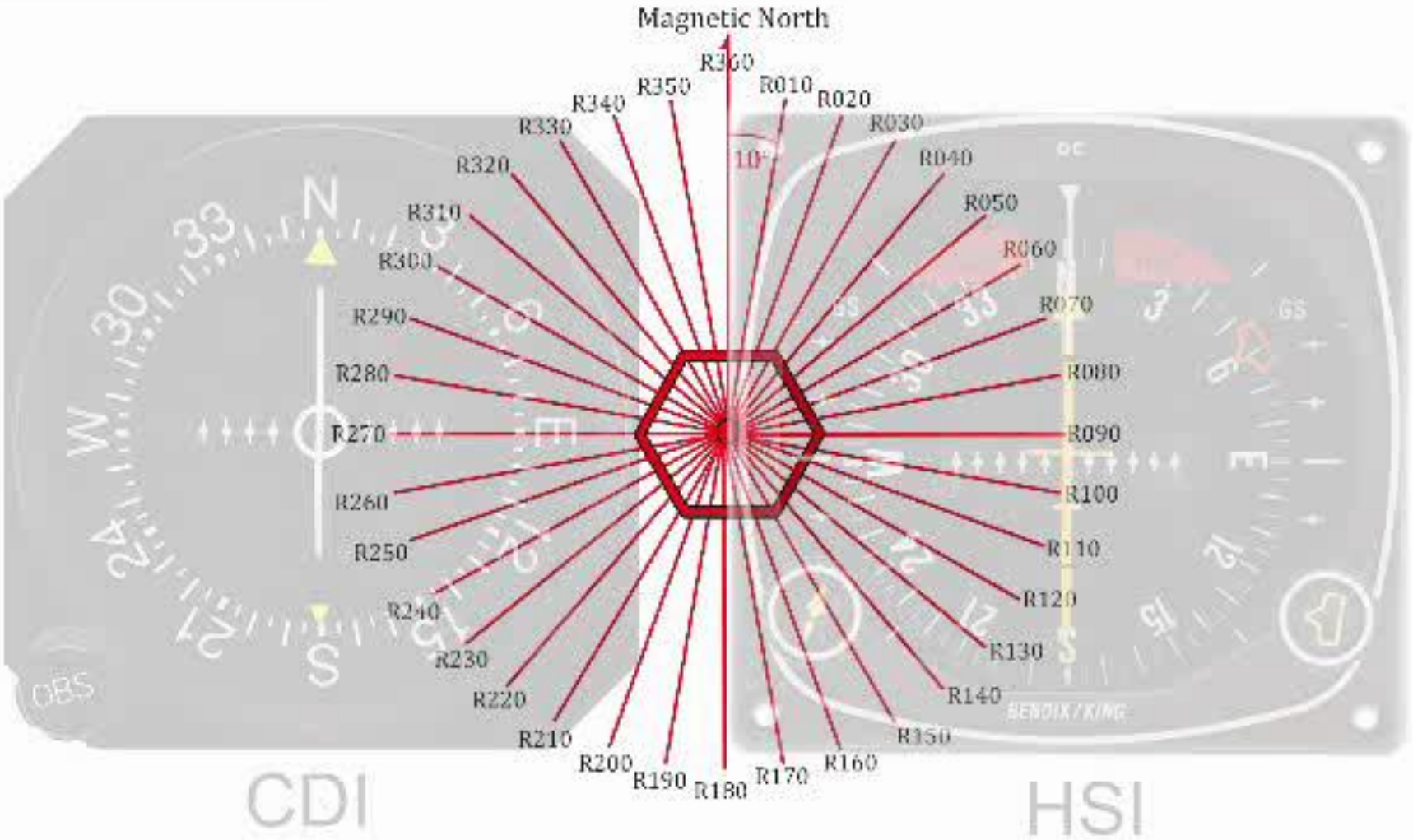
- VOR- VHF Omini directional Ranging
- Ground station is called ‘VOR Station’
- Allows aircraft to determine magnetic bearing from VOR station
- Operating Freq. 108.0MHz - 117.95MHz

GROUND BASED NAVIGATION

VOR

GROUND BASED NAVIGATION

VOR



GROUND BASED NAVIGATION

ILS

- Marker Beacons
- Localizer
- Glide Slope

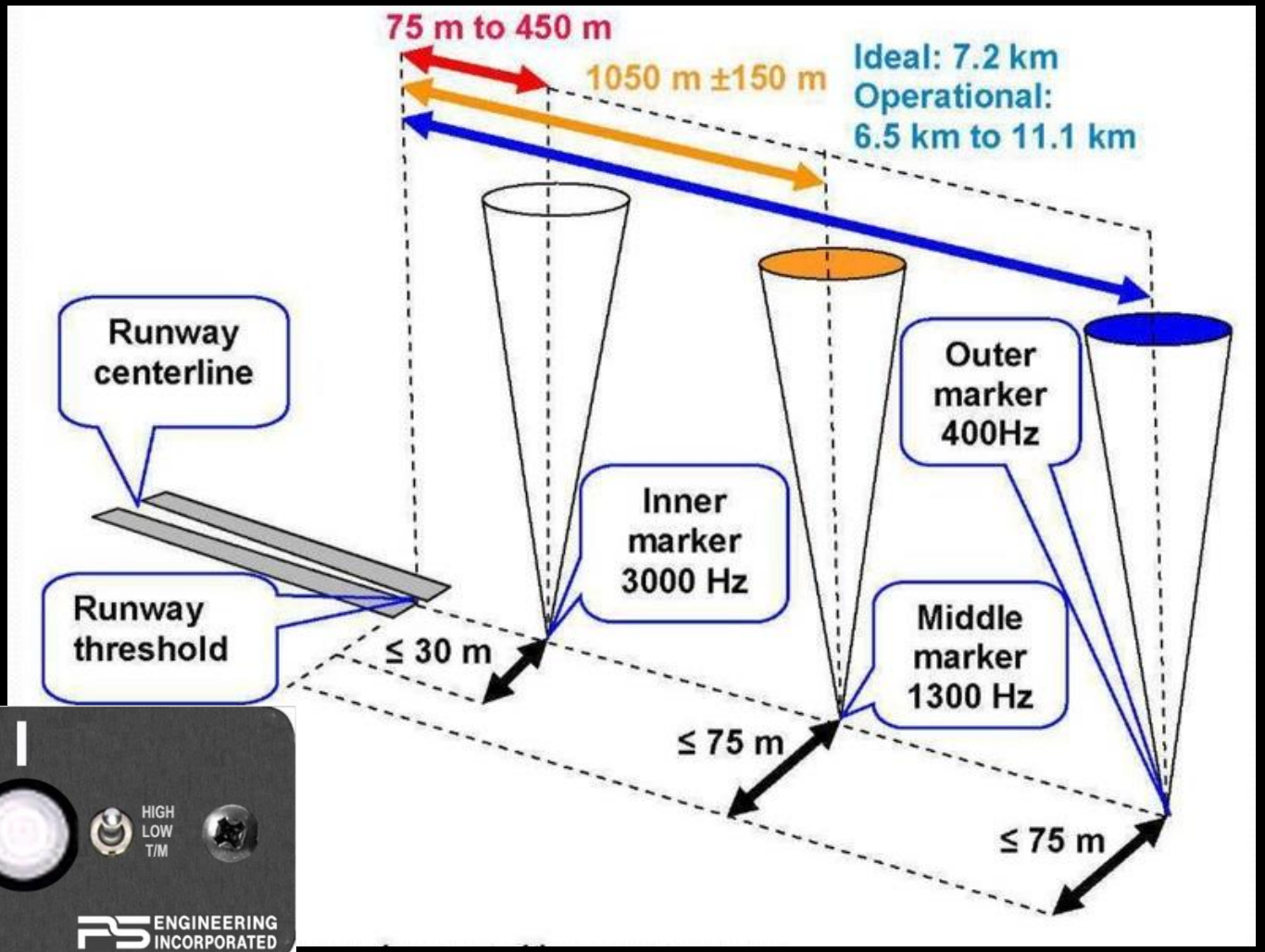
GROUND BASED NAVIGATION

ILS - Marker Beacons

- Operating Frequency 75MHz
- Outer Marker (4.5nm)
- Middle Marker (3000ft)
- Inner Marker (1500ft)

GROUND BASED NAVIGATION

ILS - Marker Beacons



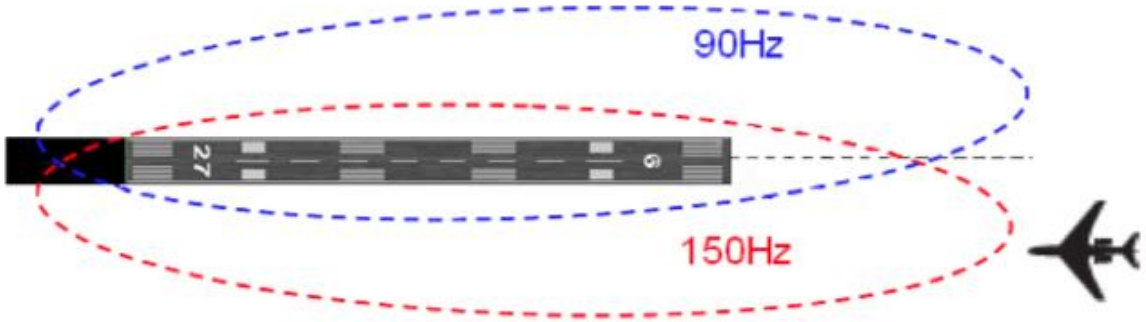
GROUND BASED NAVIGATION

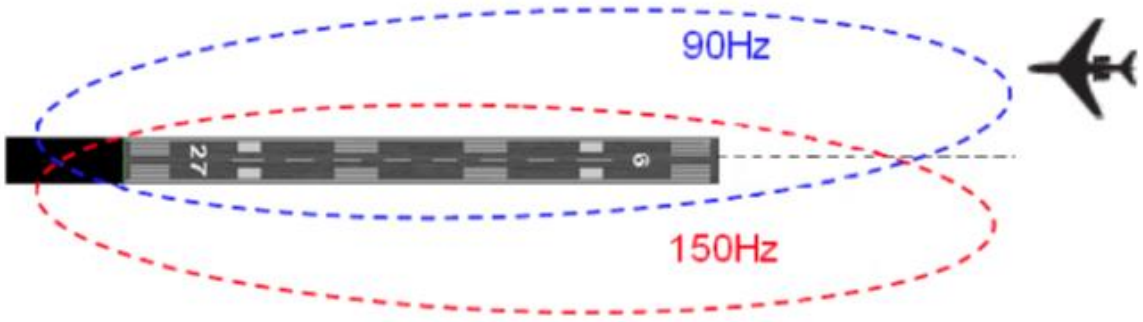
ILS - Localizer

- Operating Frequency 108MHz - 112 MHz (only on 100kHz Odd)
- “Lobe comparison” principle

GROUND BASED NAVIGATION

ILS - Localizer



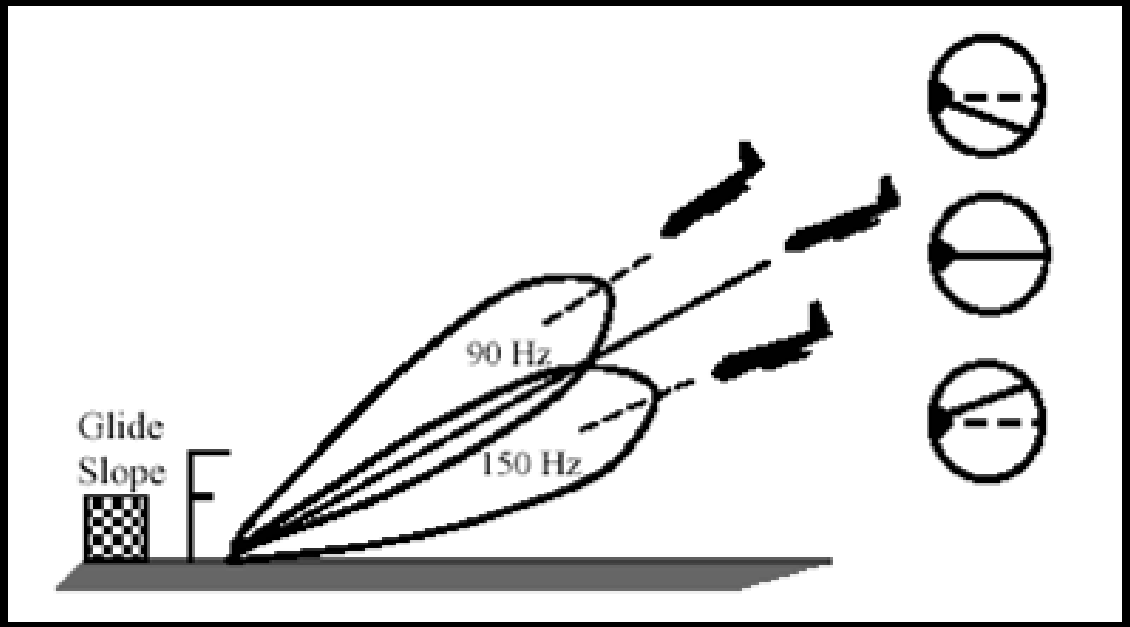


GROUND BASED NAVIGATION

ILS – Glide Slope

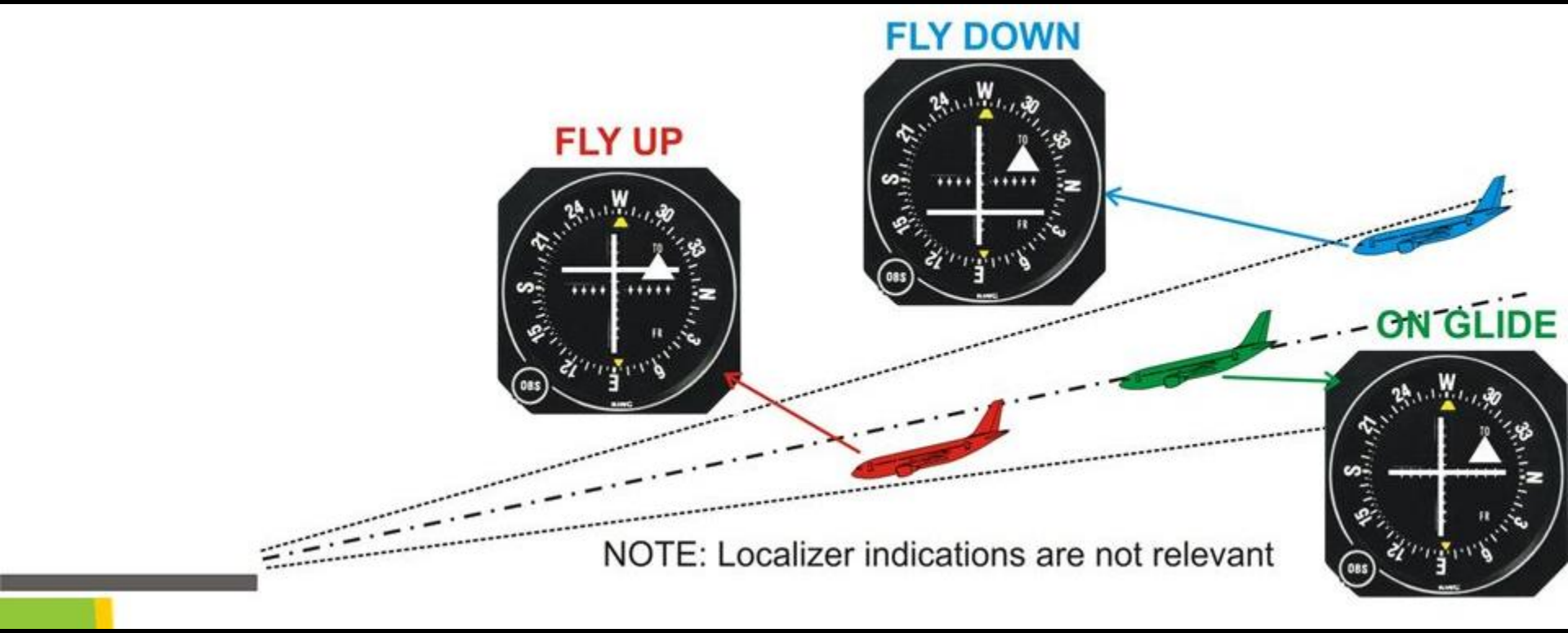
- Operating Frequency 328MHz – 335.4MHz

- Guide the pilot to correct touch down point



GROUND BASED NAVIGATION

ILS – Glide Slope



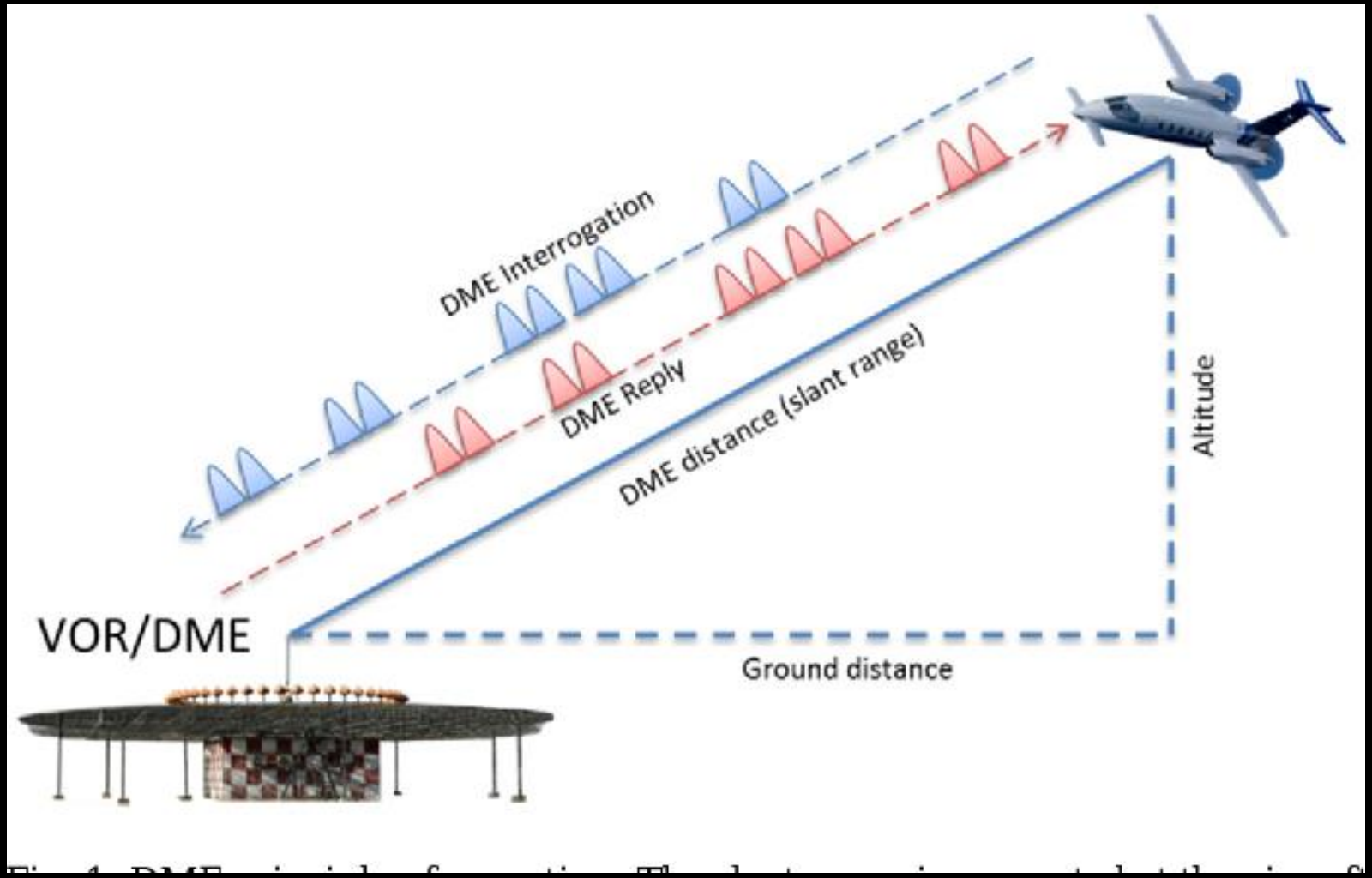
GROUND BASED NAVIGATION

DME

- Ground Station is called ‘DME Beacon’
- Operating Frequency 978 MHz – 1213MHz
- Airborne equipment called ‘DME Interrogator’
- TACAN is a military version of DME

GROUND BASED NAVIGATION

DME



SATELLITE BASED NAVIGATION

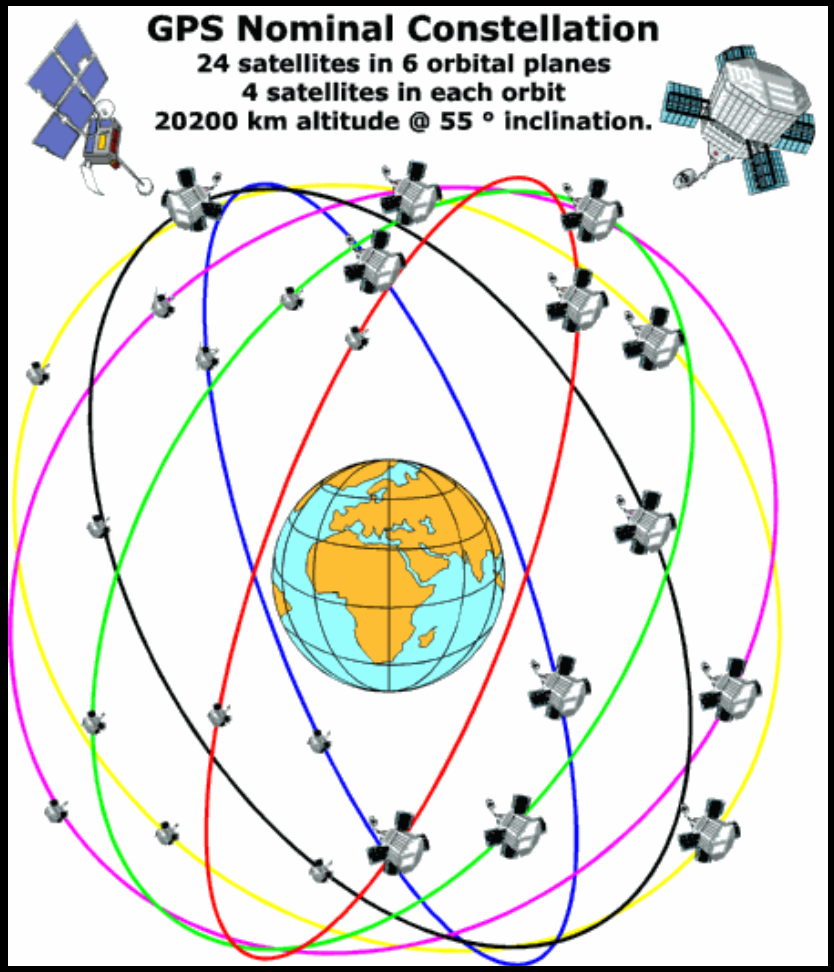
SATELLITE BASED NAVIGATION

- Global Positioning System (GPS)
- Global Navigation Satellite System (GLONASS)
- BeiDuo Navigation Satellite System (BDS)

SATELLITE BASED NAVIGATION

GPS

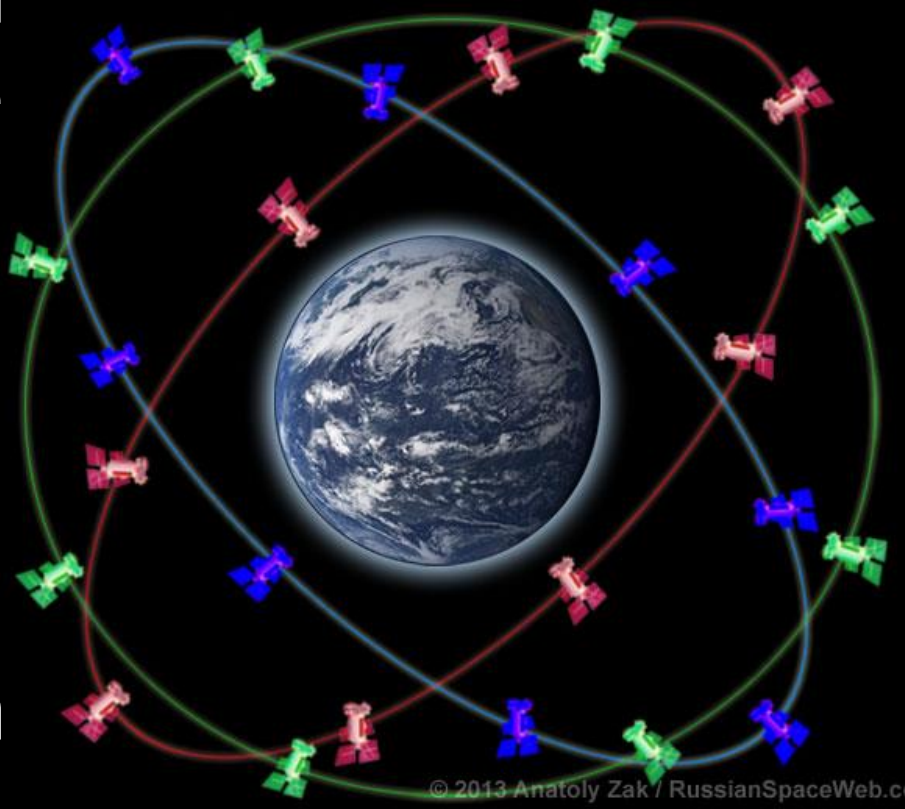
- Accurate 3D positioning (Lat, Lon, Alt)
- Precise time wrt UTC
- Continuous operation
- Usable in hostile environment
- Min of 5 Sat are observable in any where in world



SATELLITE BASED NAVIGATION

GLONASS

- Designed by Russian Aerospace Defence Force
- Precision Location
- All weather operation
- 3 Orbits, 8 SAT in each
- Continuous operation
- Used with Russian Aviation industry



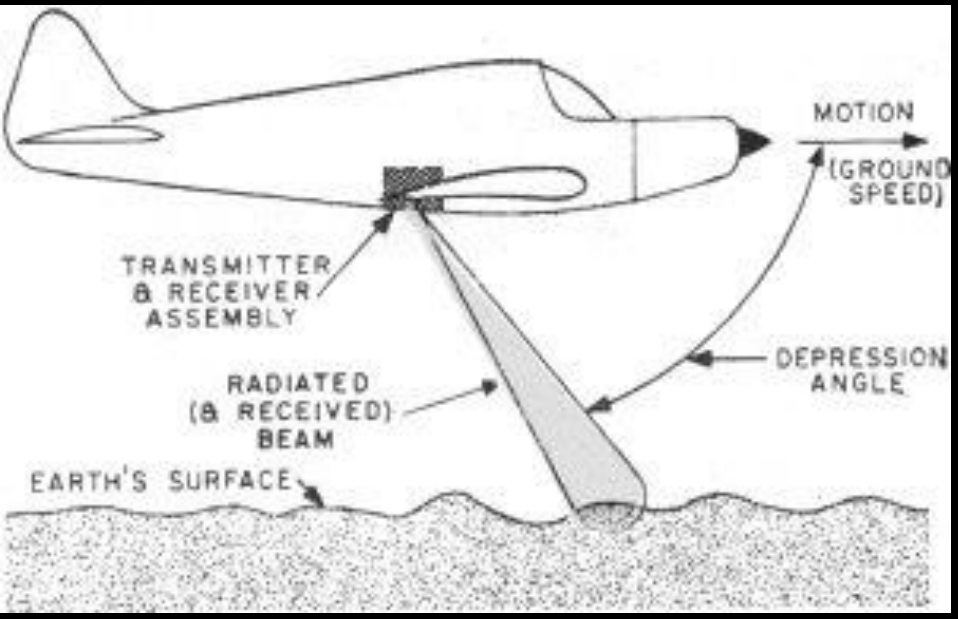
SATELLITE BASED NAVIGATION

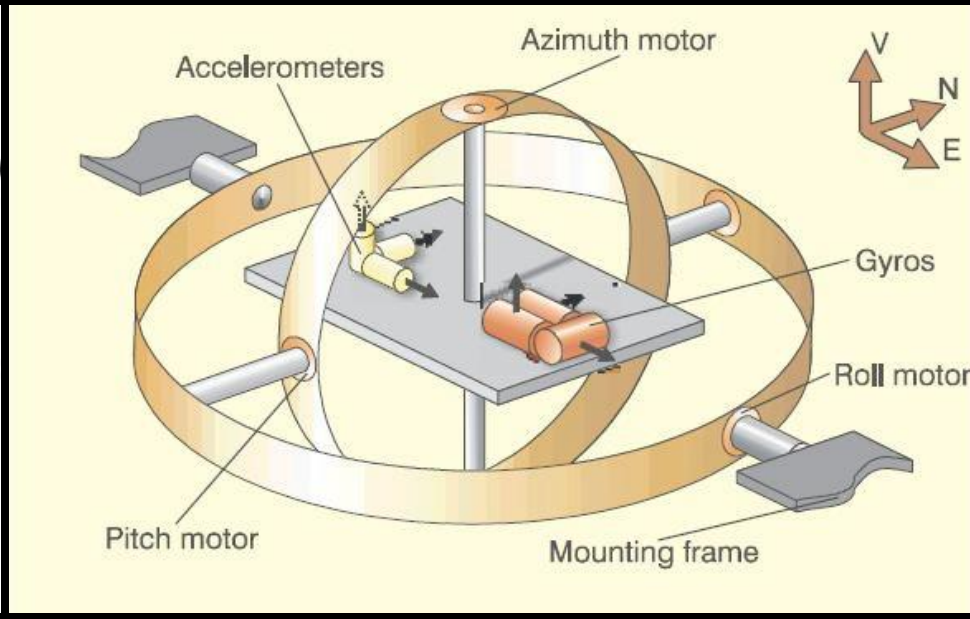
BDS

- Consist of 05 Geostationary Satellites (BeiDou -1)
- Complete project consist of 35 Satellites
- Location accuracy up to 10m
- Time accuracy up to 0.2 microsecond
- Two levels (Open and Restricted)
- Military version (Accuracy 10cm)

OTHER NAVIGATIONAL SYSTEMS

- Doppler Navigation System (DNS)
- Inertial Navigation System (INS)





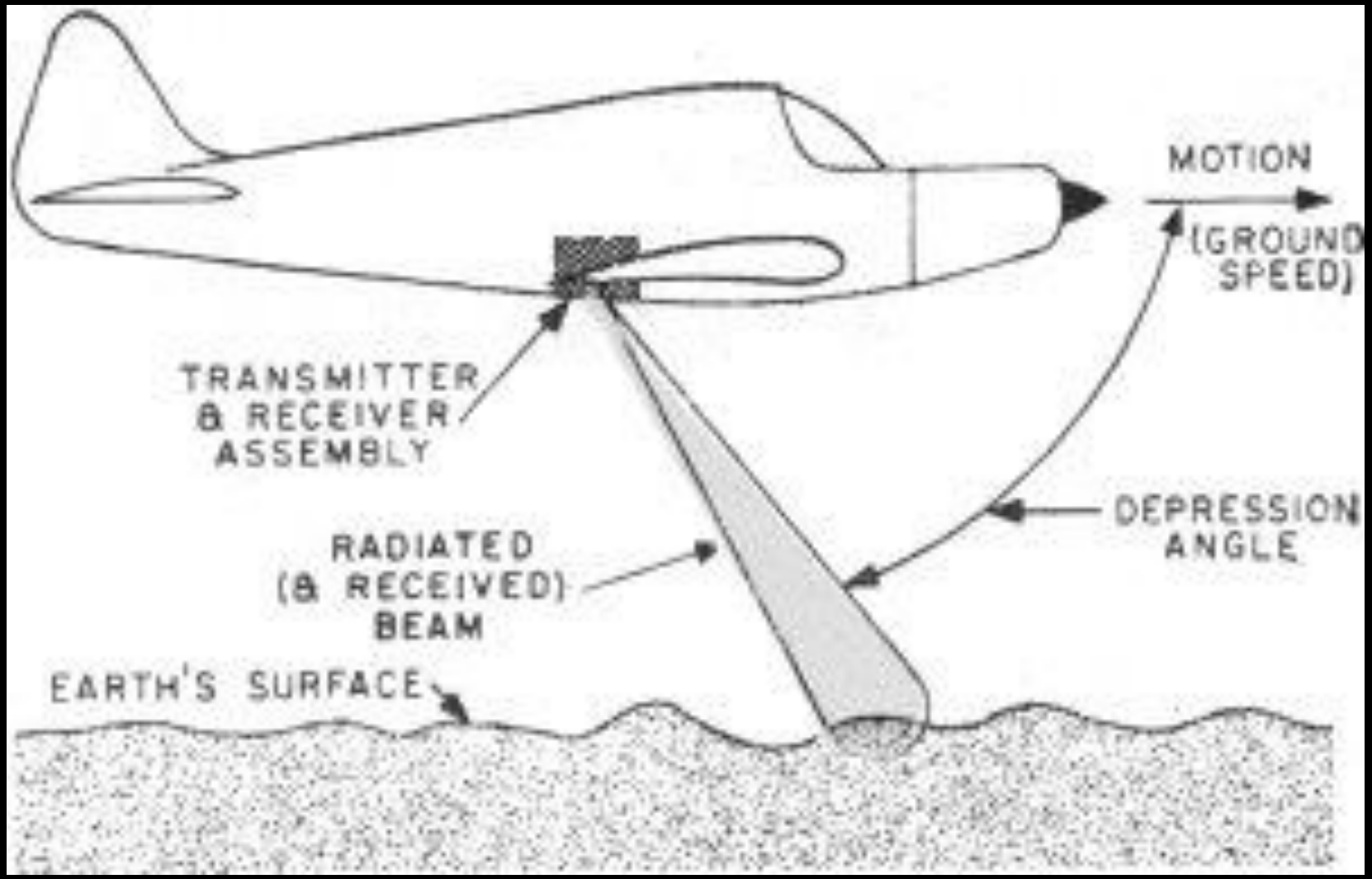
OTHER NAVIGATIONAL SYSTEMS

DNS

- Computes and displays ground speed and drift angle of an aircraft
- Not based on a ground station
- Utilizing the principle known as DOPPLER EFFECT

OTHER NAVIGATIONAL SYSTEMS

DNS



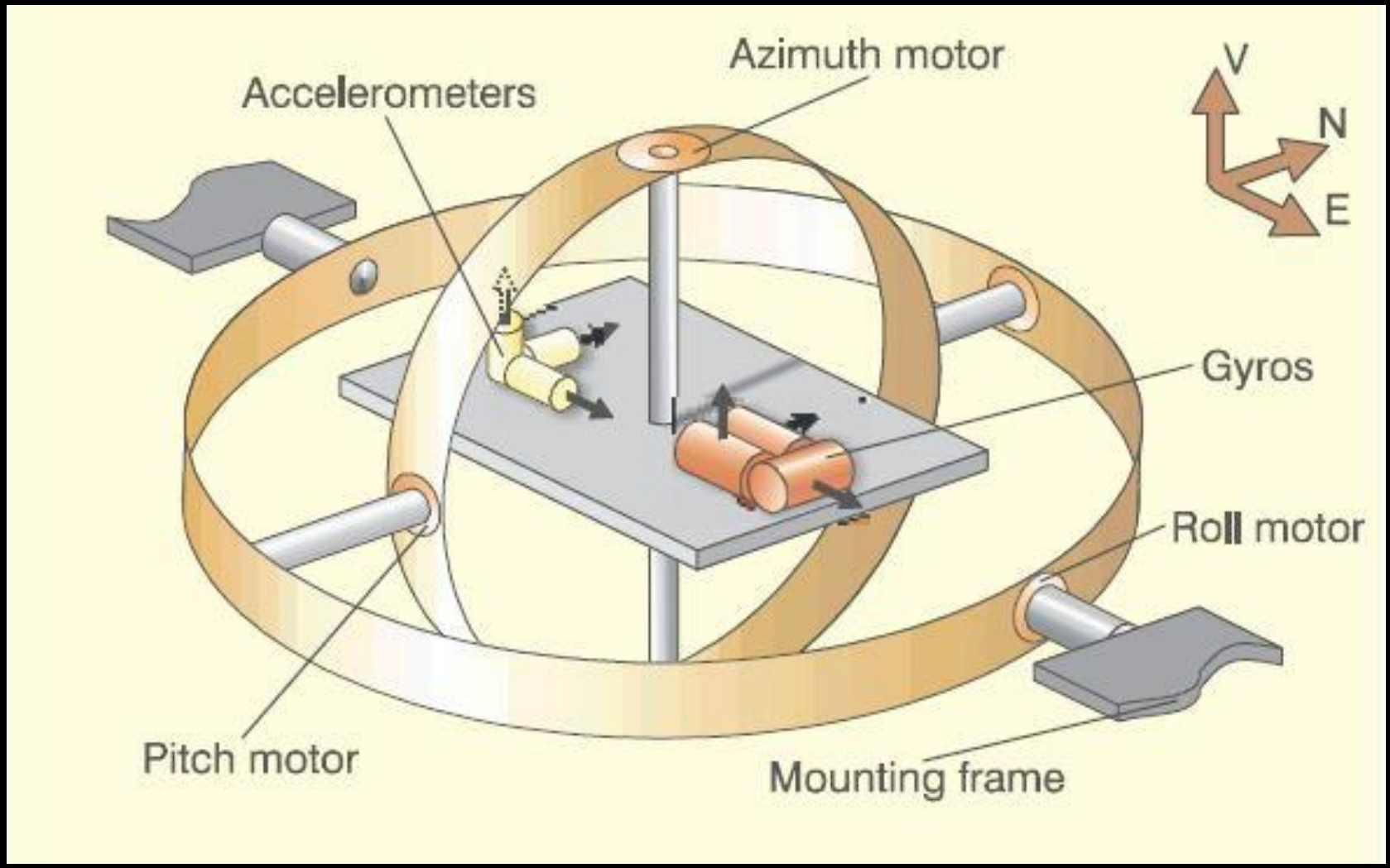
OTHER NAVIGATIONAL SYSTEMS

INS

- Self contained system
- Continuously measure the acceleration of aircraft
- All weather operation
- Consist with Three Gyros and Three accelerometers

OTHER NAVIGATIONAL SYSTEMS

INS

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