DISTANCE MEASURING EQUIPMENT (DME)

Distance Measuring Equipment (DME) is defined as a combination of ground and airborne equipment which gives a continuous slant range distance-from-station readout by measuring time-lapse of a signal transmitted by the aircraft to the station and responded back. DMEs can also provide groundspeed and time-to-station readouts by differentiation.

➢ DISTANCE MEASURING EQUIPMENT (DME)

- ✓ Many VOR stations are co-located with the military version of the VOR station, which is known as T ACAN.
- ✓ When this occurs, the navigation station is known as a VORTAC station.
- ✓ Civilian aircraft make use of one of the TACAN features not originally installed at civilian VOR stations - distance measuring equipment (DME).
- ✓ A DME system calculates the distance from the aircraft to the DME unit at the VORTAC ground station and displays it on the flight deck.
- ✓ It can also display calculated aircraft speed and elapsed time for arrival when the aircraft is traveling to the station.
- ✓ DME ground stations have subsequently been

➢ DISTANCE MEASURING EQUIPMENT (DME)

- ✓ The latter aid in approach to the runway during landings.

➢ DISTANCE MEASURING EQUIPMENT (DME)

- ✓ The latter aid in approach to the runway during landings.
- ✓ The DME is useful because with the bearing (from the VOR) and the distance to a known point (the DME antenna at the VOR), a pilot can positively identify the location of the aircraft.
- ✓ DME operates in the UHF frequency range from 962 MHz to 1 213 MHz.
- ✓ A carrier signal transmitted from the aircraft is modulated with a string of integration pulses.
- ✓ The ground unit receives the pulses and returns a signal to the aircraft.
- ✓ The time that transpires for the signal to be sent and returned is calculated and converted into nautical

➢ DISTANCE MEASURING EQUIPMENT (DME)

✓ DME readout can be on a dedicated DME display or it

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➢ DISTANCE MEASURING EQUIPMENT (DME)

- ✓ The DME frequency is paired to the co-located VOR or VORTAC frequency. When the correct frequency is tuned for the VOR signal, the DME is tuned automatically. Tones are broadcast for the VOR station identification and then for the DME. The hold selector on a DME panel keeps the DME tuned in while the

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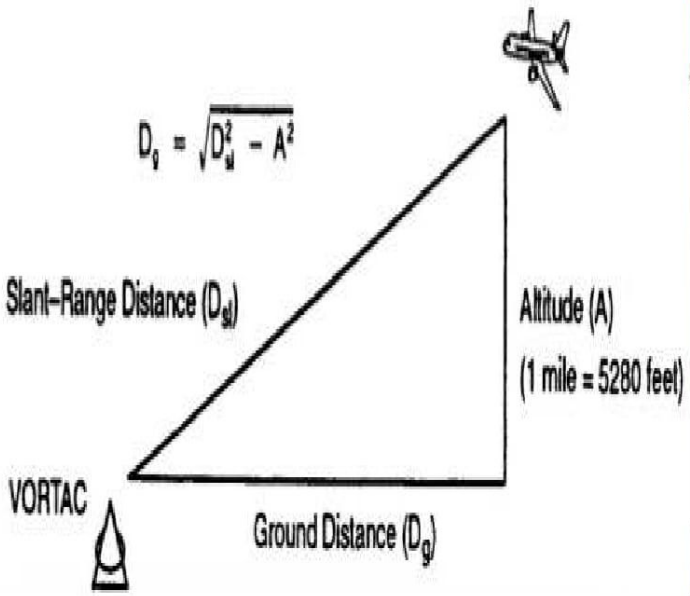
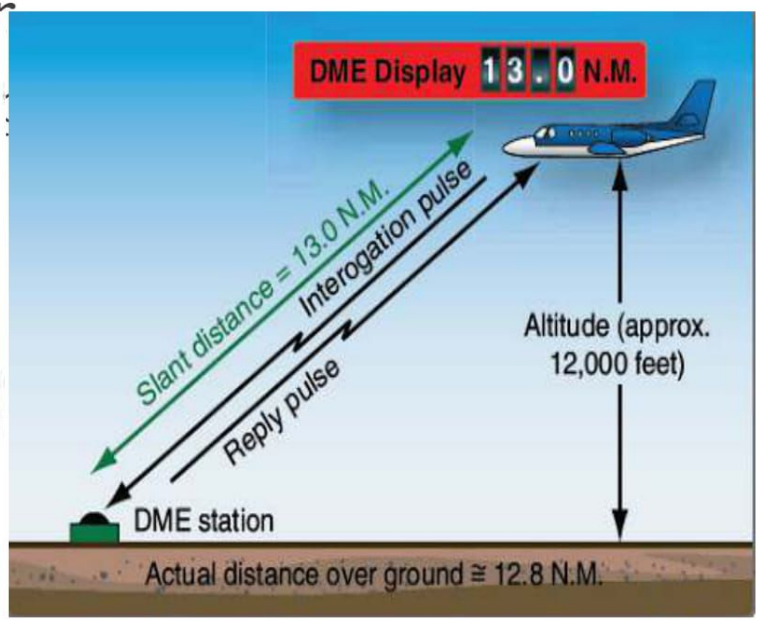
➢ DISTANCE MEASURING EQUIPMENT (DME)

- ✓ A traditional DME displays the distance from the DME transmitter antenna to the aircraft.
- ✓ This is called the slant distance. It is very accurate.
- ✓ However, since the aircraft is at altitude, the distance to the DME ground antenna from a point directly beneath the aircraft is shorter.
- ✓ Some r
  ground





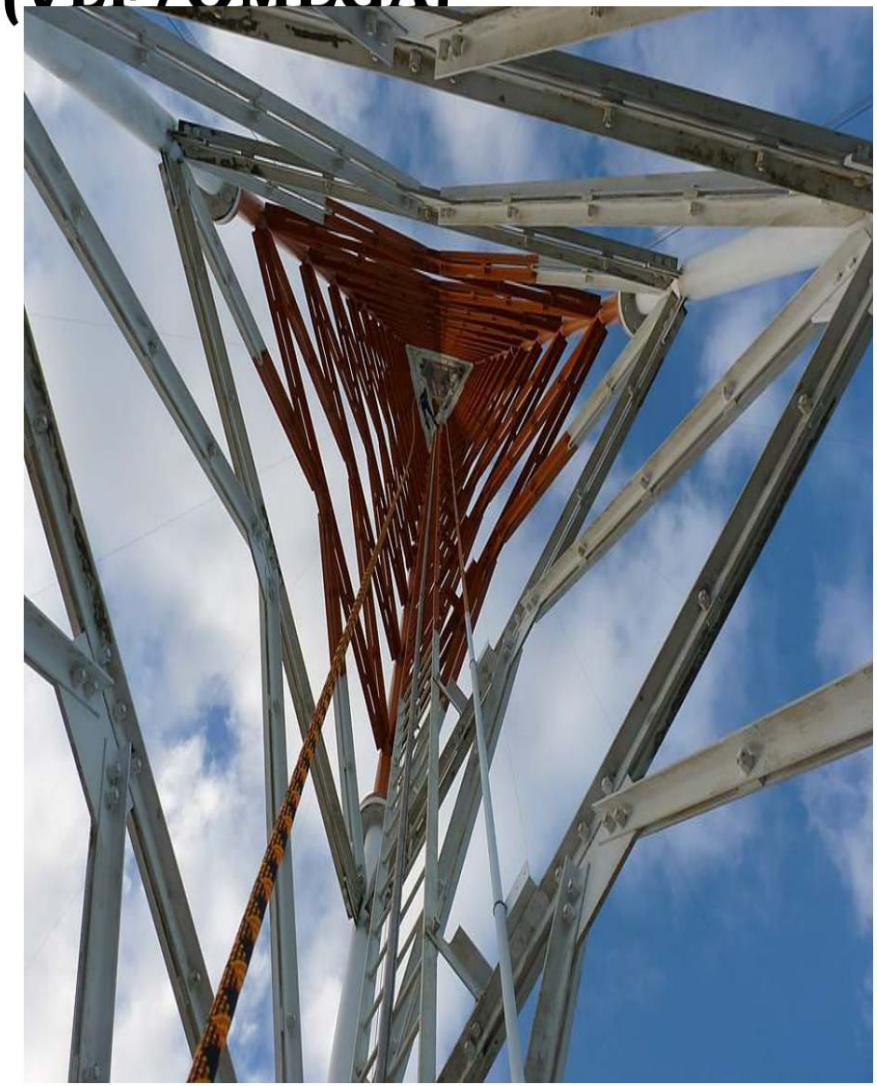
VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)

Omega was a worldwide, ground-based radio navigation system, operating in the very low frequency (VLF) band between 10 and 14 kilohertz (kHz). Its purpose was to provide a continuous, medium accuracy aid to navigation which was intended primarily for marine oceanic navigation and for both domestic and oceanic air navigation.

➢ VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)

- ✓ Omega is a worldwide, internationally operated radio navigation system.
- ✓ It operates in the Very Low Frequency (VLF) band between 10 and 14kHz.
- ✓ It provides an all-weather, medium-accuracy navigation service.
- ✓ OMEGA was originally developed by the United States Navy for military aviation users.
- ✓ It was approved for development in 1968 and promised a true worldwide oceanic coverage capability with only eight transmitters and the ability to achieve a four-mile accuracy when fixing a position.
- ✓ Each Omega station transmitted a very low frequency signal which consisted of a pattern of four tones unique to the station that was repeated every ten seconds.

➢ VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)



➢ VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)

- ✓ OMEGA employed hyperbolic radio navigation techniques and the chain operated in the VLF portion of the spectrum between 10 to 14kHz.
- ✓ Over time, it evolved into a system used primarily by the civil community.
- ✓ By receiving signals from three stations, an Omega receiver could locate a position to within 4 nautical miles using the principle of phase comparison of signals.
- ✓ Omega stations used very extensive antennas in order to transmit their extremely low frequencies.
- ✓ Specifically, they used grounded or insulated guyed masts with umbrella antennas.
- ✓ Some Omega antennas were the tallest constructions on the continent where they stood or still stand.

➢ VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)

- ✓ When six of the eight station chain became operational in 1971, day to day operations were managed by the United States Coast Guard in partnership with Argentina, Norway, Liberia, and France.
- ✓ The Japanese and Australian stations became operational several years later.
- ✓ Coast Guard personnel operated two US stations: one in LaMoure, North Dakota and the other in Kaneohe, Hawaii on the island of Oahu.
- ✓ Due to the success of the Global Positioning System, the use of Omega declined during the 1990s, to a point where the cost of operating Omega could no longer be justified.
- ✓ Omega was permanently terminated on September 30, 1997 and all stations ceased operation.
- ✓ Some of the stations, such as the La Moure station, are

- **VERY LOW FREQUENCY AND HYPERBOLIC NAVIGATION (VLF/OMEGA)**
  - **OMEGA Stations Worldwide and Frequencies.**

Station Location	Frequency (kHz)
A: Norway	12.1 kHz
B: Liberia	12.0 kHz
C: Hawaii	11.8 kHz
D: North Dakota	13.1 kHz
E: La Reunion	12.3 kHz
F: Argentina	12.9 kHz
G : Australia	13.0 kHz
H: Japan	12.8 kHz

AREA NAVIGATION (RNAV)

RNAV can be defined as a method of navigation that permits aircraft operation on any desired course within the coverage of station-referenced navigation signals or within the limits of a self-contained system capability, or a combination of these.

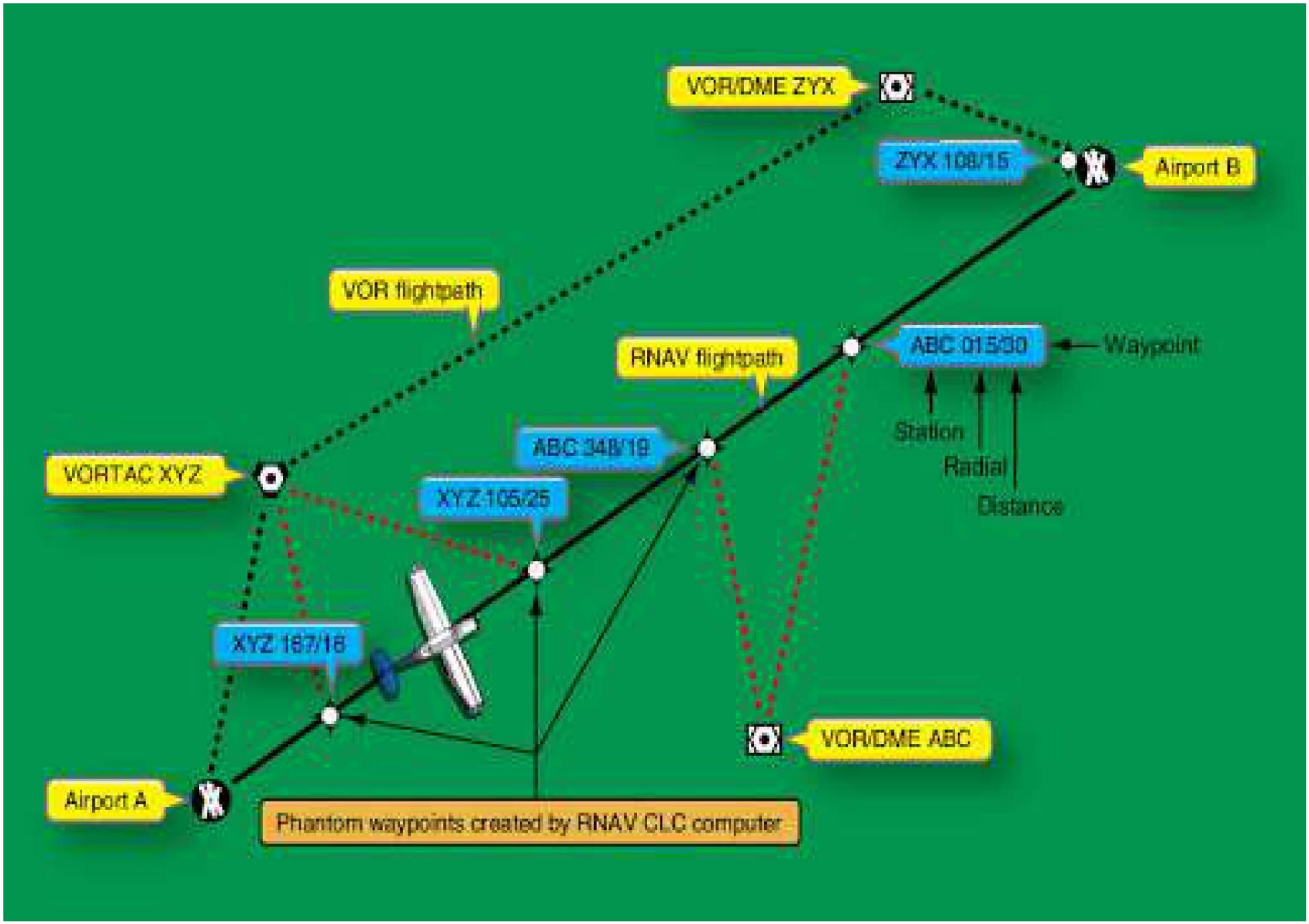
➢ AREA NAVIG ATION (RNAV)

- ✓ Area navigation (RNAV) is a general term used to describe the navigation from point A to point B without direct over flight of navigational aids, such as VOR stations or ADF non-directional beacons.
- ✓ It includes VORTAC and VOR/DME based systems, as well as systems of RNAV based around LORAN, GPS, INS, and the FMS of transport category aircraft.
- ✓ However, until recently, the term RNAV was most commonly used to describe the area navigation or the process of direct flight from point A to point Busing VORTAC and VOR/DME based references which are discussed in this section.
- ✓ All RNAV systems make use of waypoints. A waypoint is a designated geographical location or point used for route definition or progress-reporting purposes.

➢ AREA NAVIG ATION (RNAV)

- ✓ It can be defined or described by using latitude/longitude grid coordinates or, in the case of VOR based RNAV, described as a point on a VOR radial followed by that point is distance from the VOR station (i.e., 200/25 means a point 25 nautical miles from the VOR station on the 200° radial).
- ✓ The VOR/DME and VORTAC stations shown are used to create phantom waypoints that are overflown rather than the actual stations.
- ✓ This allows a more direct route to be taken.
- ✓ The phantom waypoints are entered into the RNAV course-line computer (CLC) as a radial and distance number pair.
- ✓ The computer creates the waypoints and causes the aircraft's CDI to operate as though they are actual VOR stations.

➢ AREA NAVIG ATION (RNAV)



➢ AREA NAVIG ATION (RNAV)

- ✓ VOR based RNAV uses the VOR receiver, antenna, and VOR display equipment, such as the CDI.
- ✓ The computer in the RNAV unit uses basic geometry and trigonometry calculations to produce heading, speed, and time readouts for each waypoint.
- ✓ VOR stations need to be within line-of sight and operational range from the aircraft for RNAV use.

➢ AREA NAVIG ATION (RNAV)

- ✓ RNAV has increased in flexibility with the development of GPS.
- ✓ Integration of GPS data into a planned VOR RNAV flight plan is possible as is GPS route planning without the u