SYE 3803
Fundamentals of Avionics
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**VHF Omnidirectional Radio Range (VOR) and Distance Measuring Equipment**

- Short-range radio navigation; Typically less than 200 nm
- Developed in the 1930s; widely deployed after WWII (1946)
- Still in use today, but being replaced by RNAV (Area Navigation – Originally Random Navigation – revoked then reinstated with wide adoption of GPS)
- Used to establish Victor airways below 18,000 feet; Jetways, or Jet routes, above 18,000 feet
- VHF range: 108 to 117.95 MHz
  - 50 KHz frequency spacing
  - 108.0 to 111.95 MHz band (4 MHz) shared between ILS and VOR navigation
- Odd 100 KHz digit used for ILS
  - Ex. 108.10, 108.30, 108.55
- Even 100 KHz digit used for VOR navigation
  - Ex. 108.00, 108.05, 108.45

Omnidirectional Master Signal

Directional Variable Signal rotates 30 times a second
Demodulated VOR Navigational Signals

VOR bearings are aligned with magnetic north and increase in single degree increments clockwise.

Omnidirectional master signal

Directional variable signal
phase of transmitted signal changes with rotation angle

Aircraft is 90° east of the station

Aircraft is 90° From station
Aircraft is 270° To station
VOR Composite Signal and Symbols

- VOR composite signal includes navigational, station identifier, and voice signals
- Station identifier is usually a two- or three-letter Morse Code word
- Voice signal usually can be used for an audible version of the station identifier, in-flight service broadcasts, and HIWAS (Hazardous Inflight Weather Advisory Service) broadcasts

![VOR Symbol](image)

![VOR/DME Symbol](image)

![VORTAC Symbol](image)
# VOR Standard Service Volumes

<table>
<thead>
<tr>
<th>Service Class</th>
<th>Range</th>
<th>Altitude (feet AGL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal (T)</td>
<td>25 NM</td>
<td>1000 &lt; Alt &lt; 12,000</td>
</tr>
<tr>
<td>Low Altitude (L)</td>
<td>40 NM</td>
<td>1000 &lt; Alt &lt; 18,000</td>
</tr>
<tr>
<td>High Altitude (H)</td>
<td>40 NM</td>
<td>1000 &lt; Alt &lt; 14,500</td>
</tr>
<tr>
<td>High Altitude (H)</td>
<td>100 NM</td>
<td>14,500 &lt; Alt &lt; 60,000</td>
</tr>
<tr>
<td>High Altitude (H)</td>
<td>130 NM</td>
<td>18,000 &lt; Alt &lt; 45,000</td>
</tr>
</tbody>
</table>

*Service Volume for a High-Altitude Type (H) VOR/DME/TACAN Ground Station. Two other types are: (L) Low-Altitude, which covers up to 18,000 feet and 40 NM; and (T) Terminal, which covers up to 12,000 feet and out to 25 NM.*
VOR Display with CDI

OMNIBEARING

COURSE DEVIATION INDICATOR

OMNI BEARING SELECTOR

OBS

OMNI FLAG

OFF

33 0 3

21 18
VOR CDI Position and Aircraft Location
VOR Navigation from Jacksonville to Tampa
VOR: Multipath Signal
Doppler VOR provides more accurate bearing information and is less prone to signal reflection generated errors. By using a larger, circular antenna, such errors are greatly reduced.
Doppler VOR Station

VOR Tutorial: https://www.youtube.com/watch?v=iCCk2ch-xL4