Introduction of the ILS/VOR/DME

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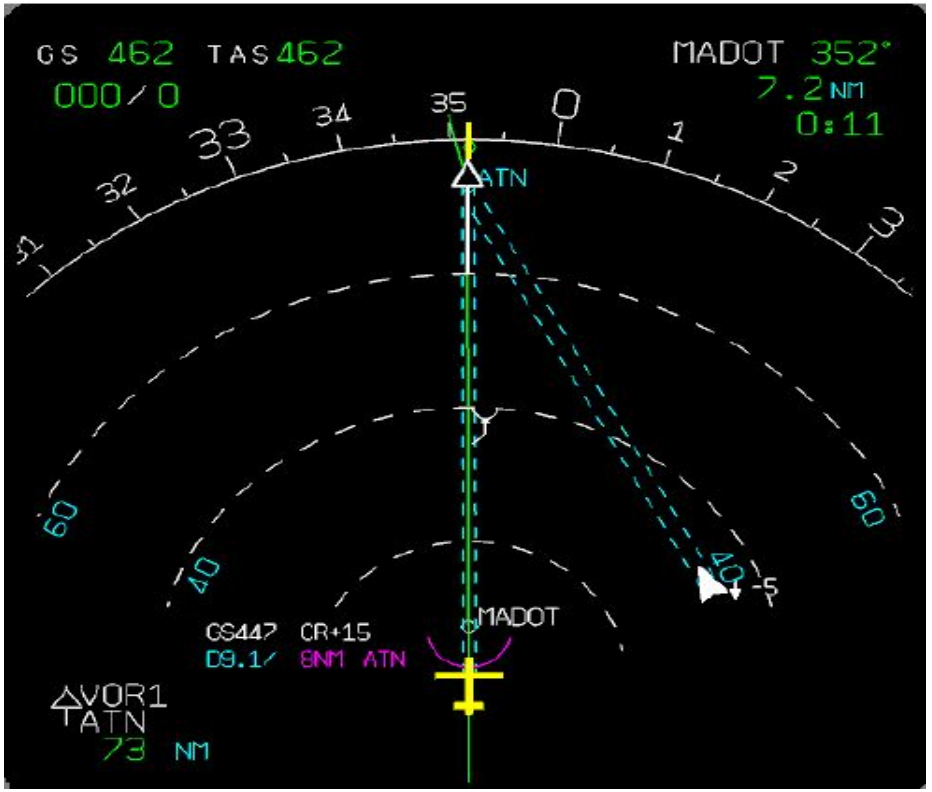
ЛЭ-4

Main ideas

- What is navigation?
- What is navigation used for?
- ILS ; VOR/DME

What is navigation?

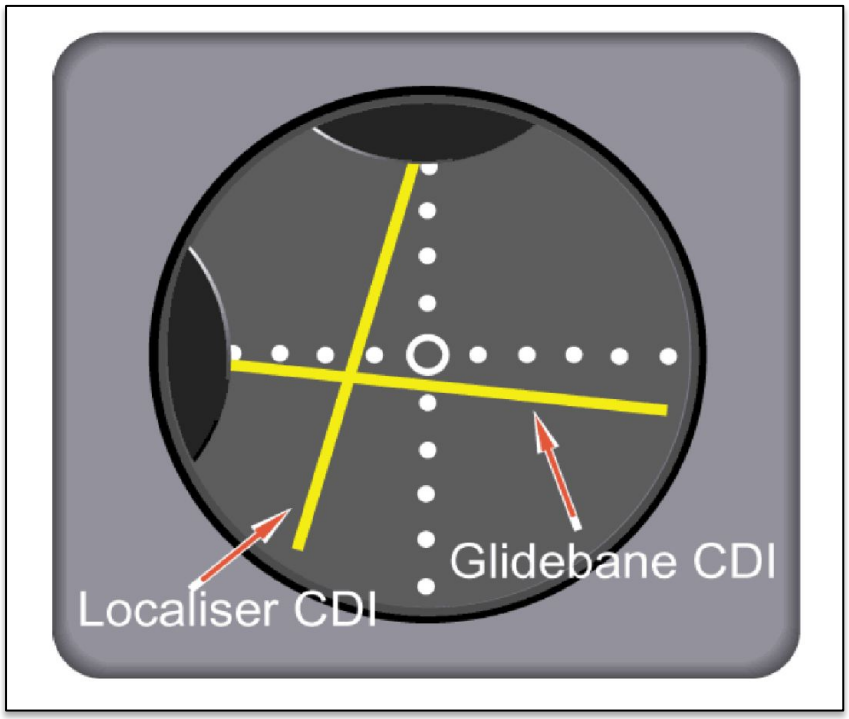
The process or activity of accurately ascertaining one's position and planning and following a route.

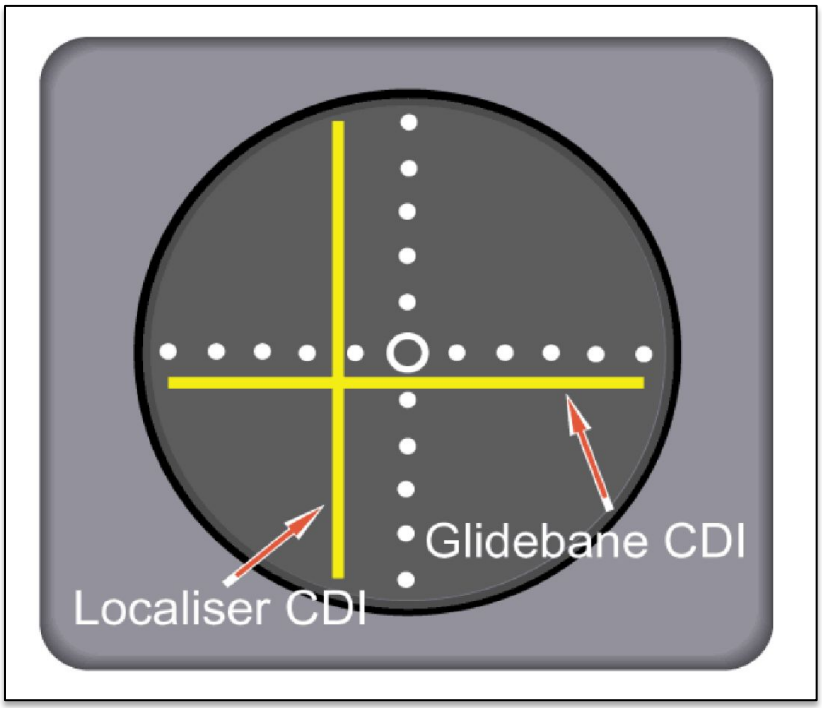


What is navigation used for?

Navigation is the **art and science of determining the position of a ship, plane or other vehicle, and guiding it to a specific destination**. Navigation requires a person to know the vehicle's relative location, or position compared to other known locations. Navigators measure distance on the globe in degrees

ILS Display at the Cockpit

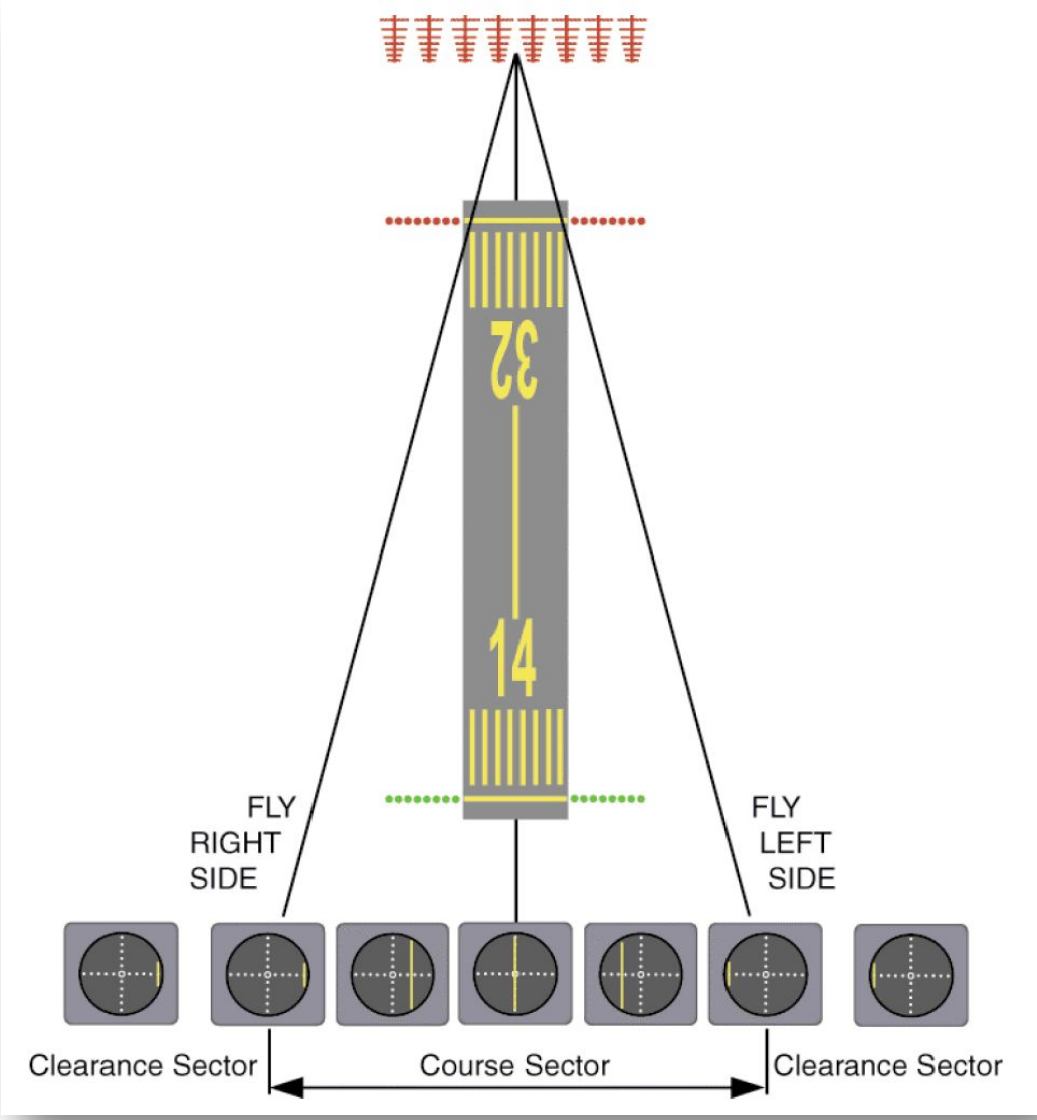


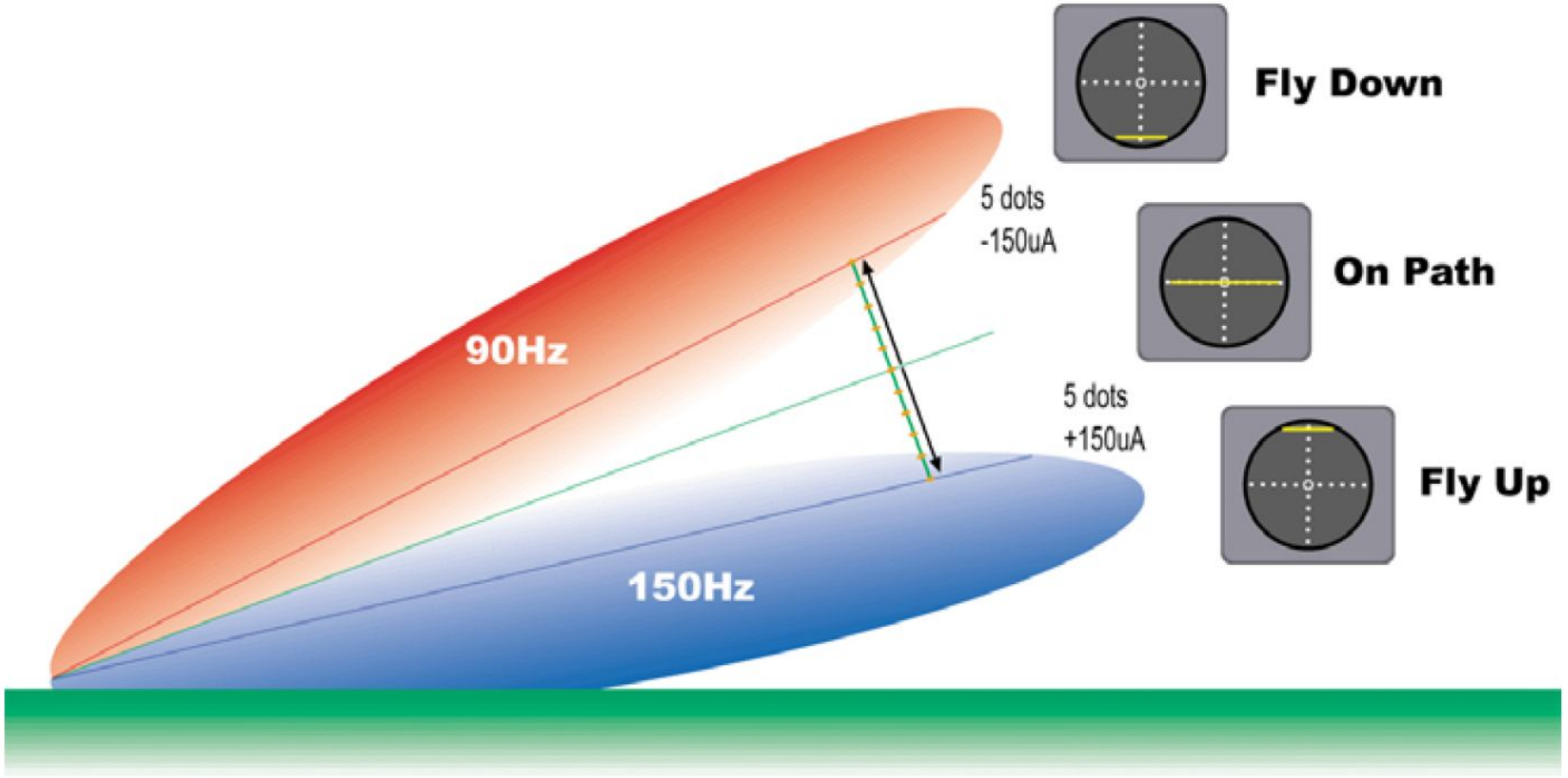


In aviation, the **instrument landing system** (**ILS**) is a radio navigation system that provides
short-range guidance to aircraft to allow them to approach a runway at night or in bad weather. In its original form, it allows an aircraft to approach until it is 200 feet (61 m) over the ground,
(800 m) of the runway.

ILS Display at the Cockpit

ILS uses two directional radio signals, the *localizer* (108 to 112 MHz frequency), which provides horizontal guidance, and the *glideslope* (329.15 to 335 MHz frequency) for vertical.

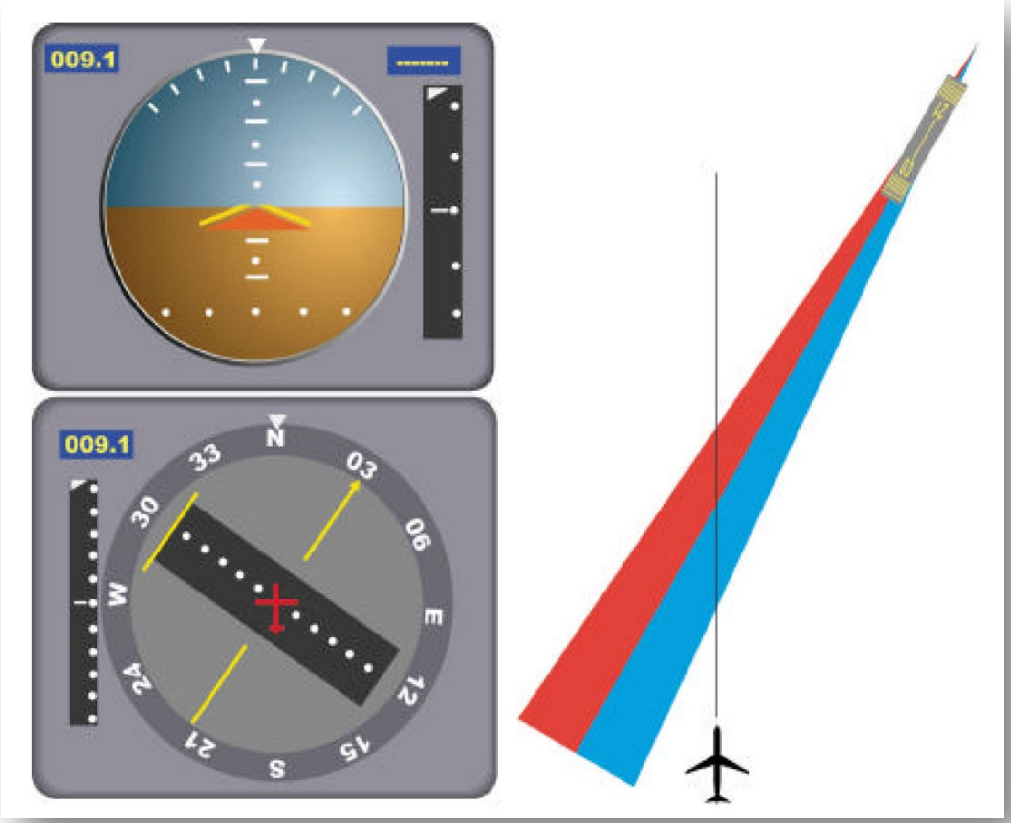




ILS Display at the Cockpit

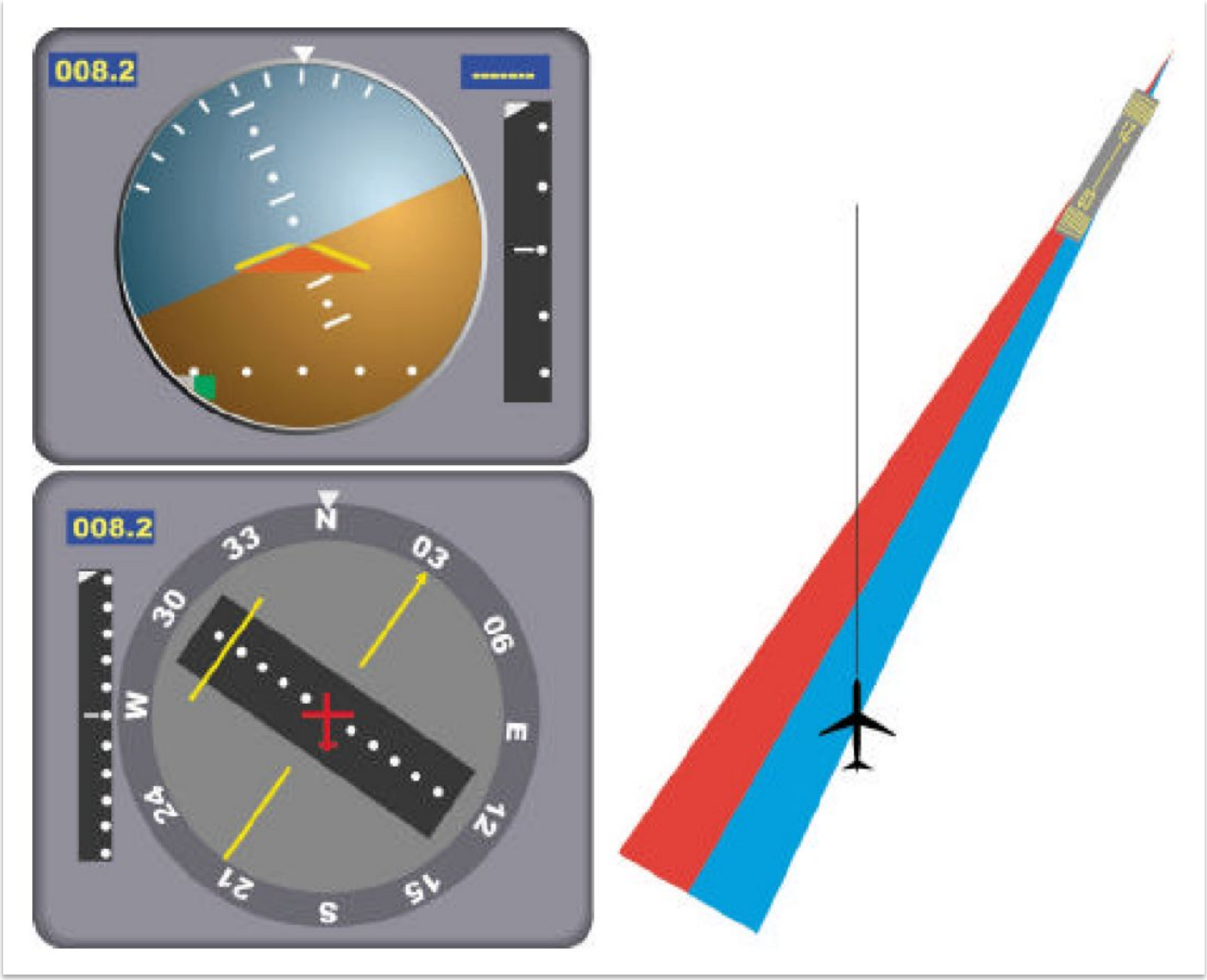
ILS Display at the Cockpit

The relationship between the aircraft's position and these signals is displayed on an aircraft instrument, often additional pointers in the attitude indicator.



The pilot attempts to maneuver the aircraft to keep these indicators centered while they approach the runway to the decision height. Optional *markers* provide distance information as the approach proceeds, including the *middle marker* placed close to the position of the decision height. Ils may also include high-intensity lighting at the end of the runways.

ILS Display at the Cockpit



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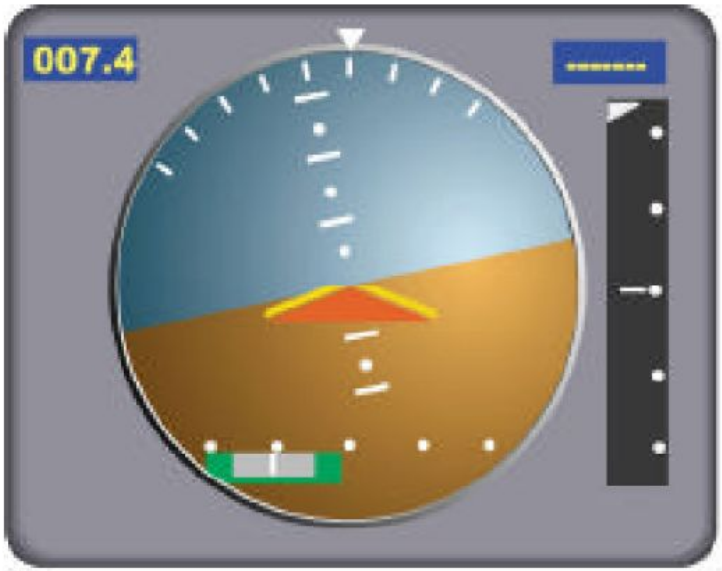
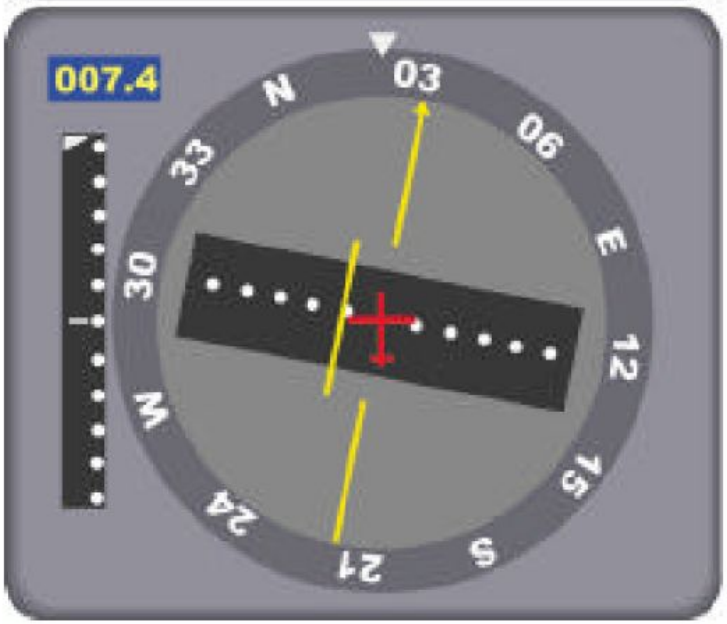
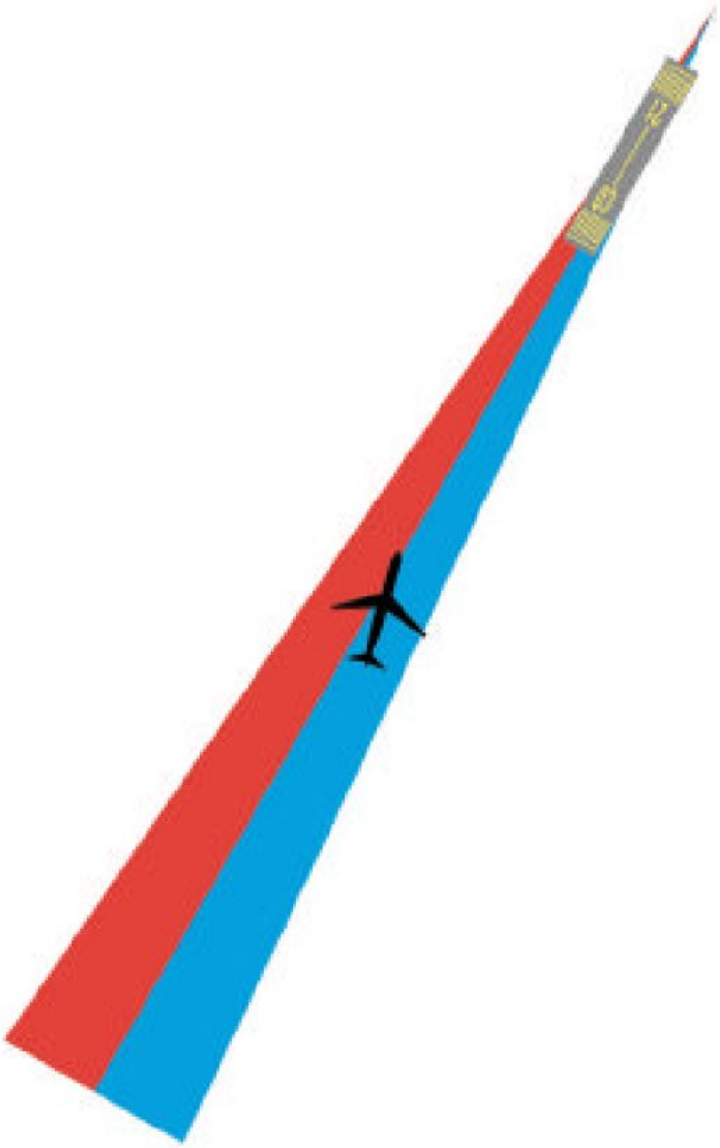
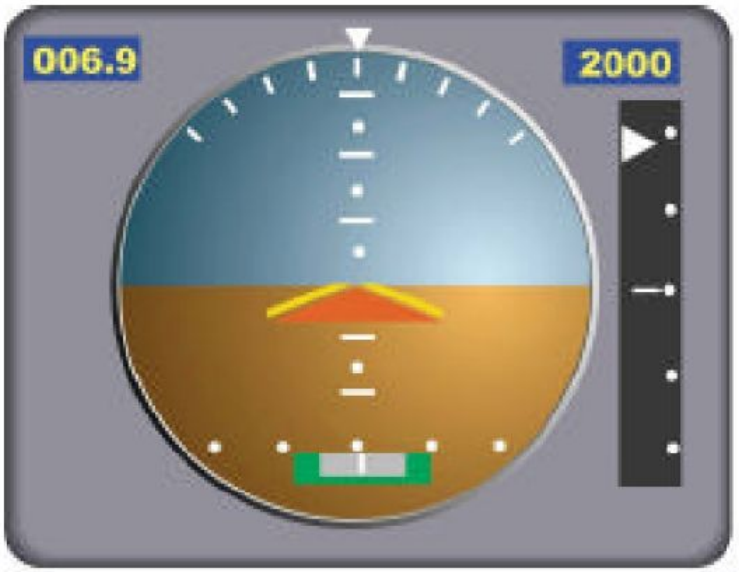
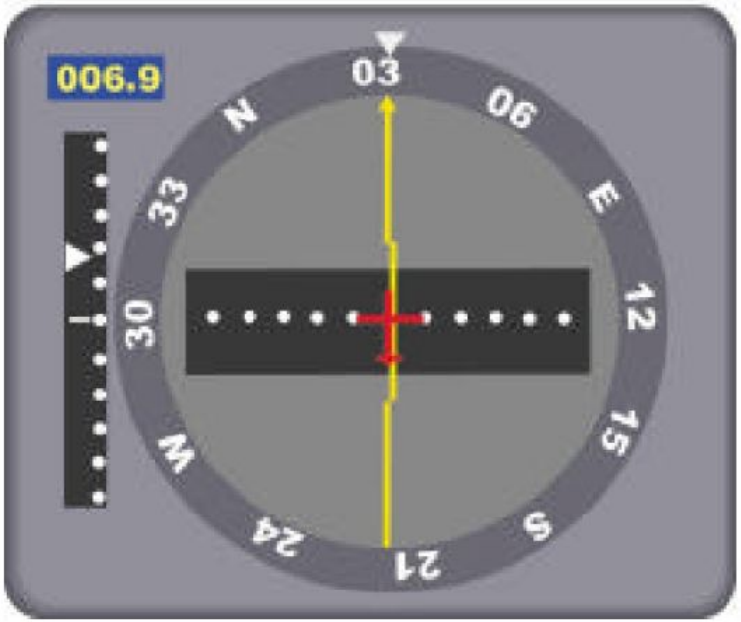


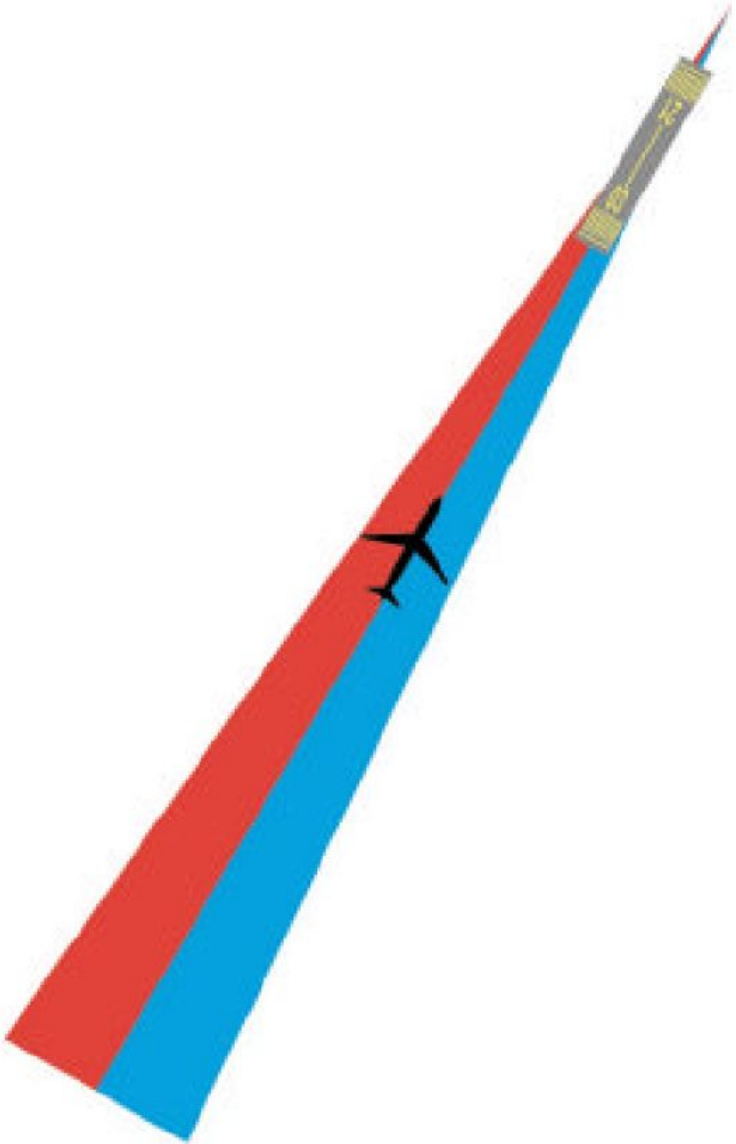




ILS Display at the Cockpit







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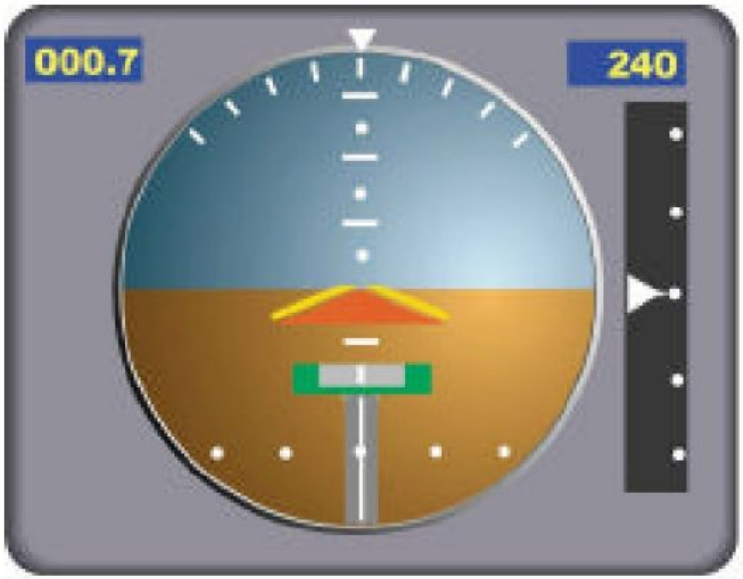
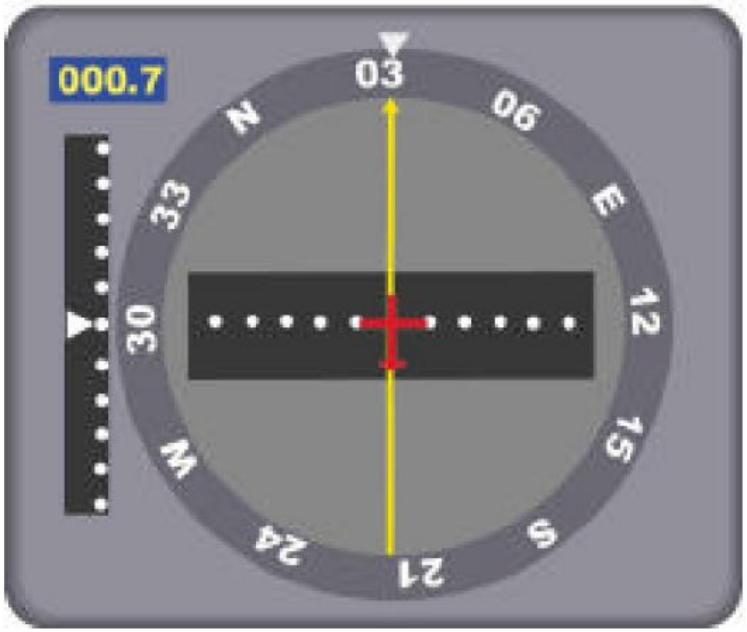
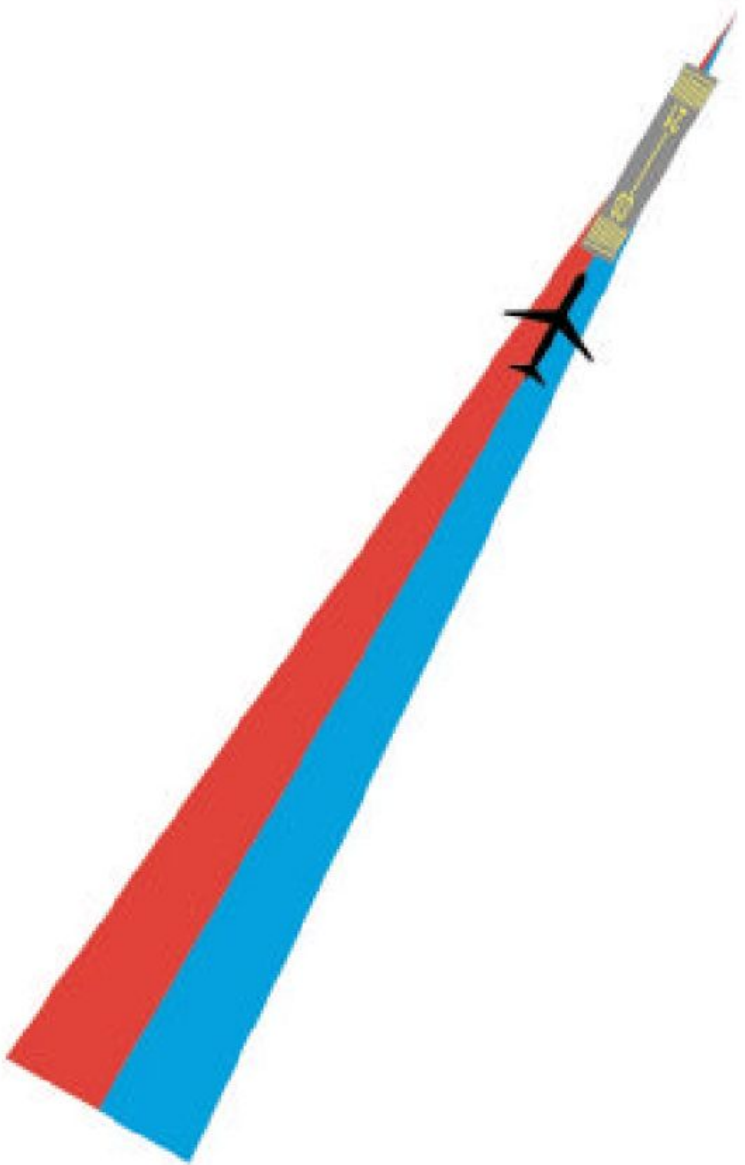
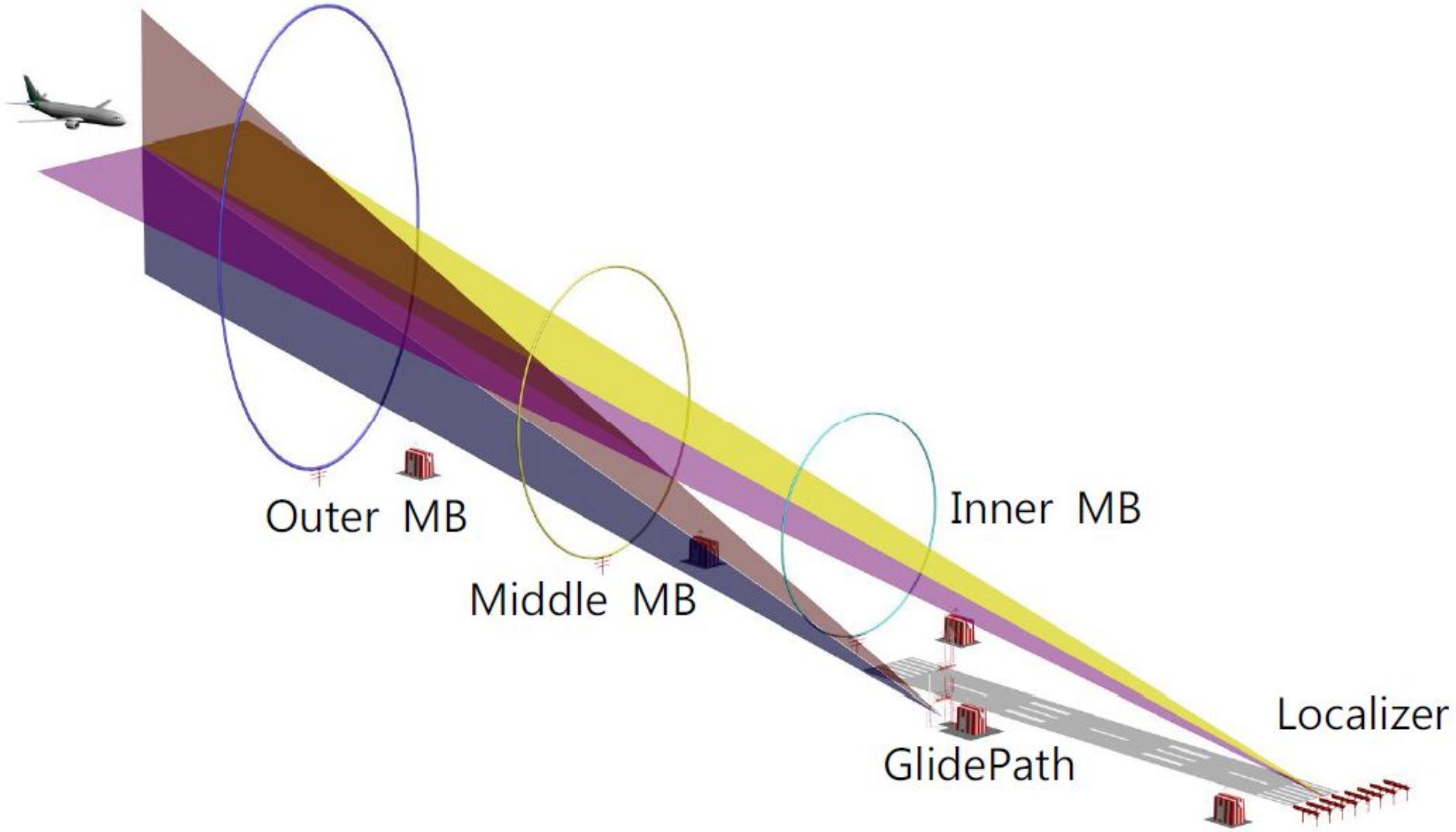






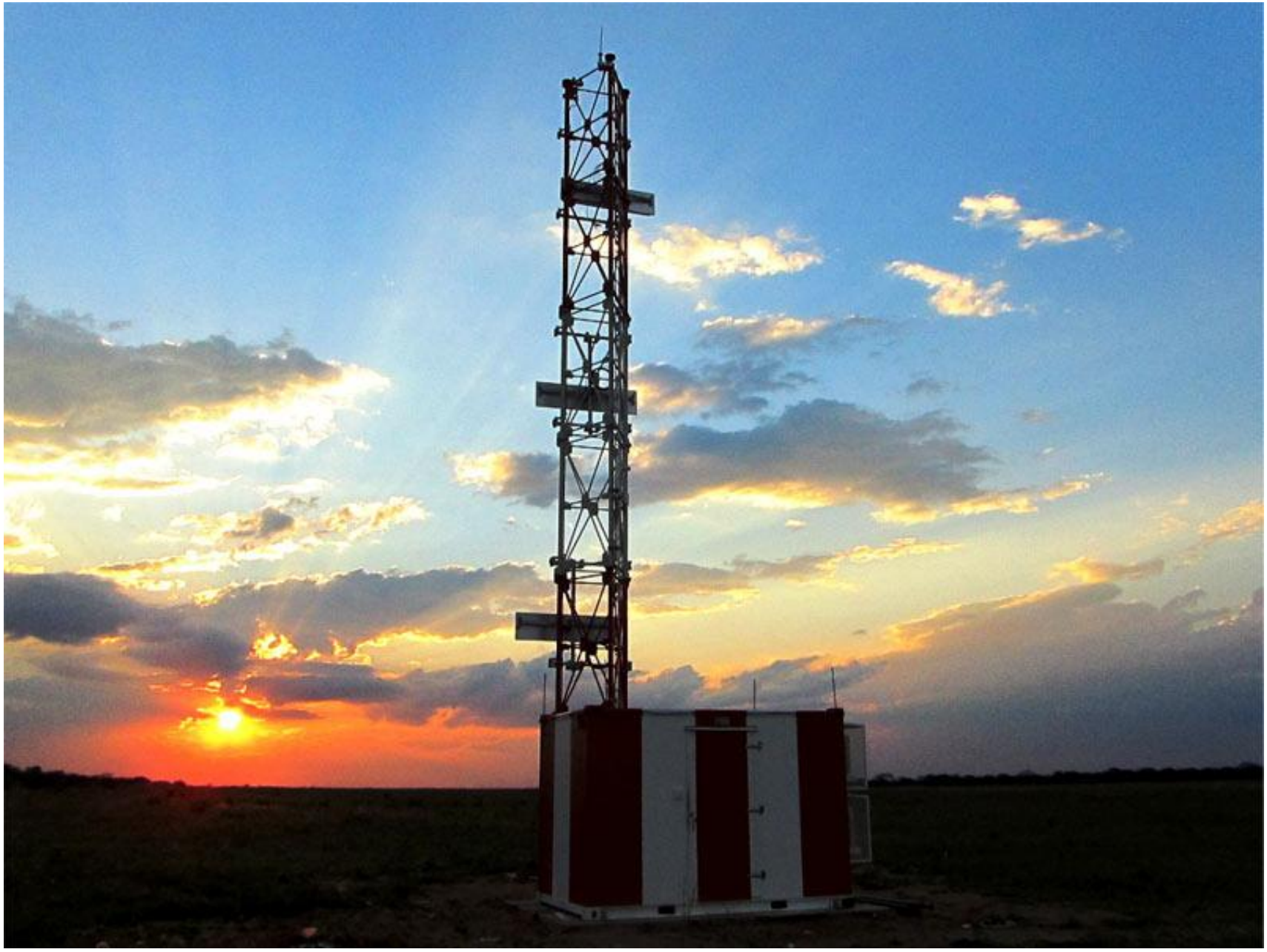
ILS (LLZ+GP+MB)



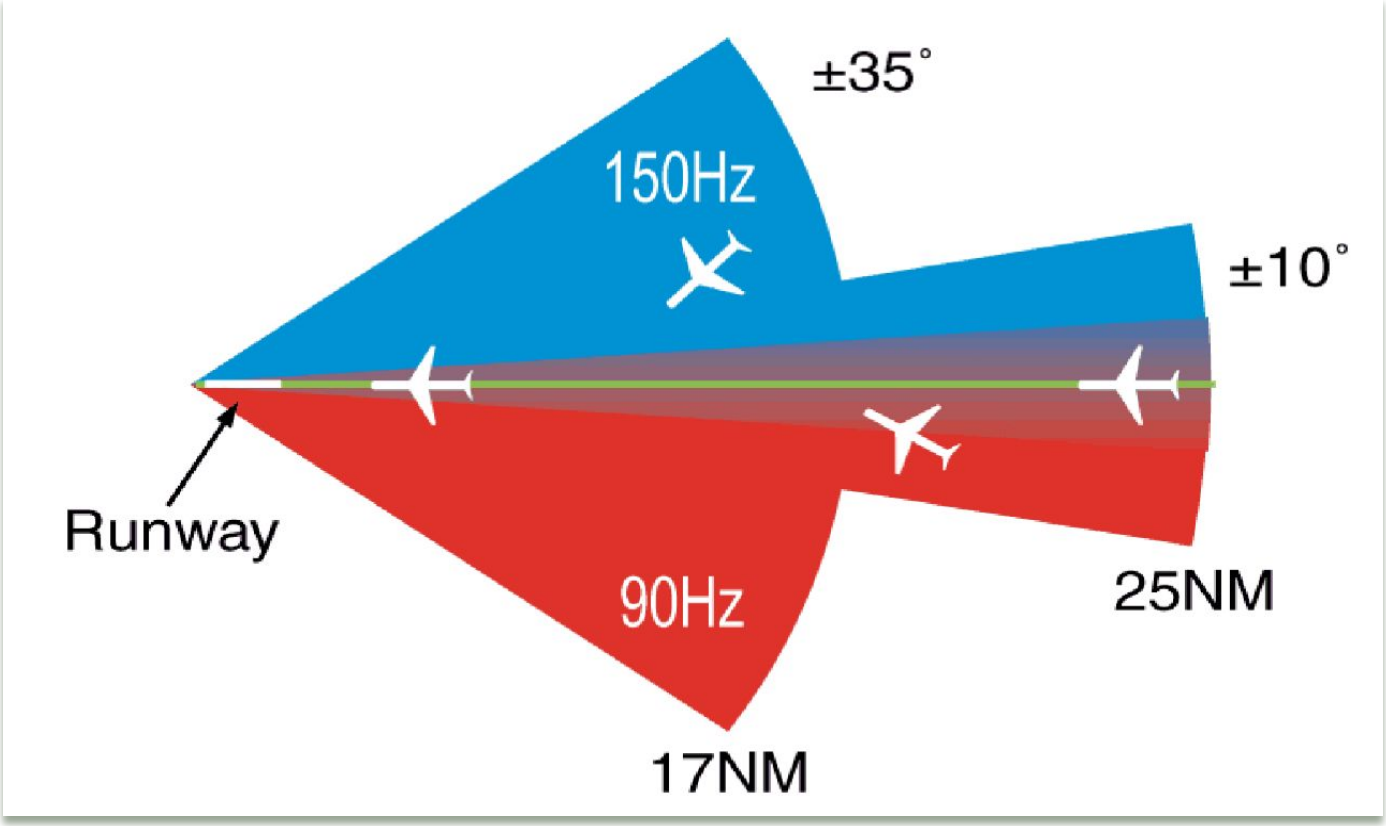
LLZ Antenna Array

An *instrument landing system* operates as a ground-based instrument approach
system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and,
in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions (IMC), such as low ceilings or reduced visibility due to fog, rain, or blowing snow.

GP Antenna Array



LLZ Coverage

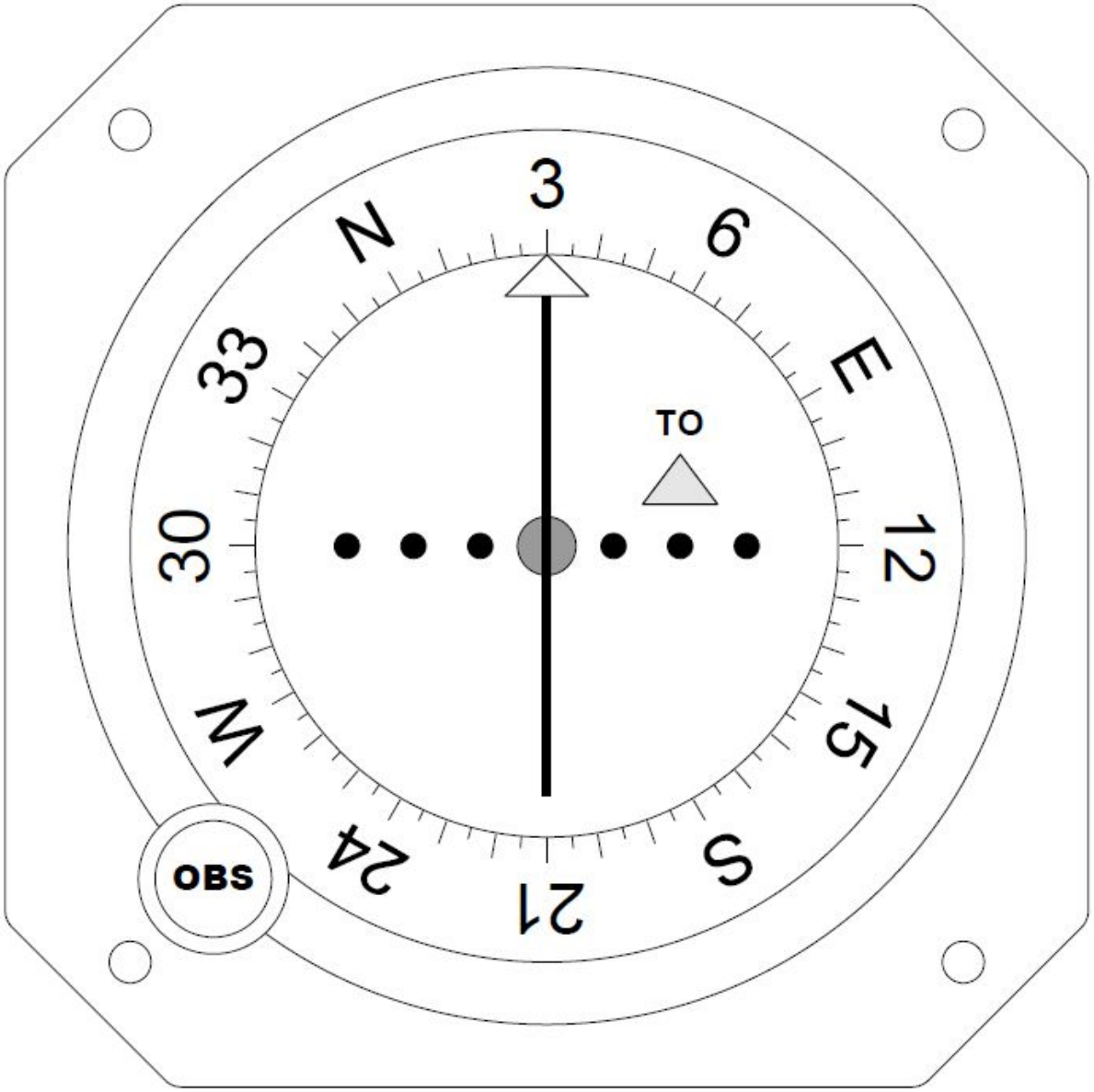


- Coverage
  - 25NM : 46.3 km within 10° from course line
  - 17NM : 31.5 km within 10° and 35° from course line
  - 10NM : 18.5 km outside 35° if coverage is required

DVOR/DME

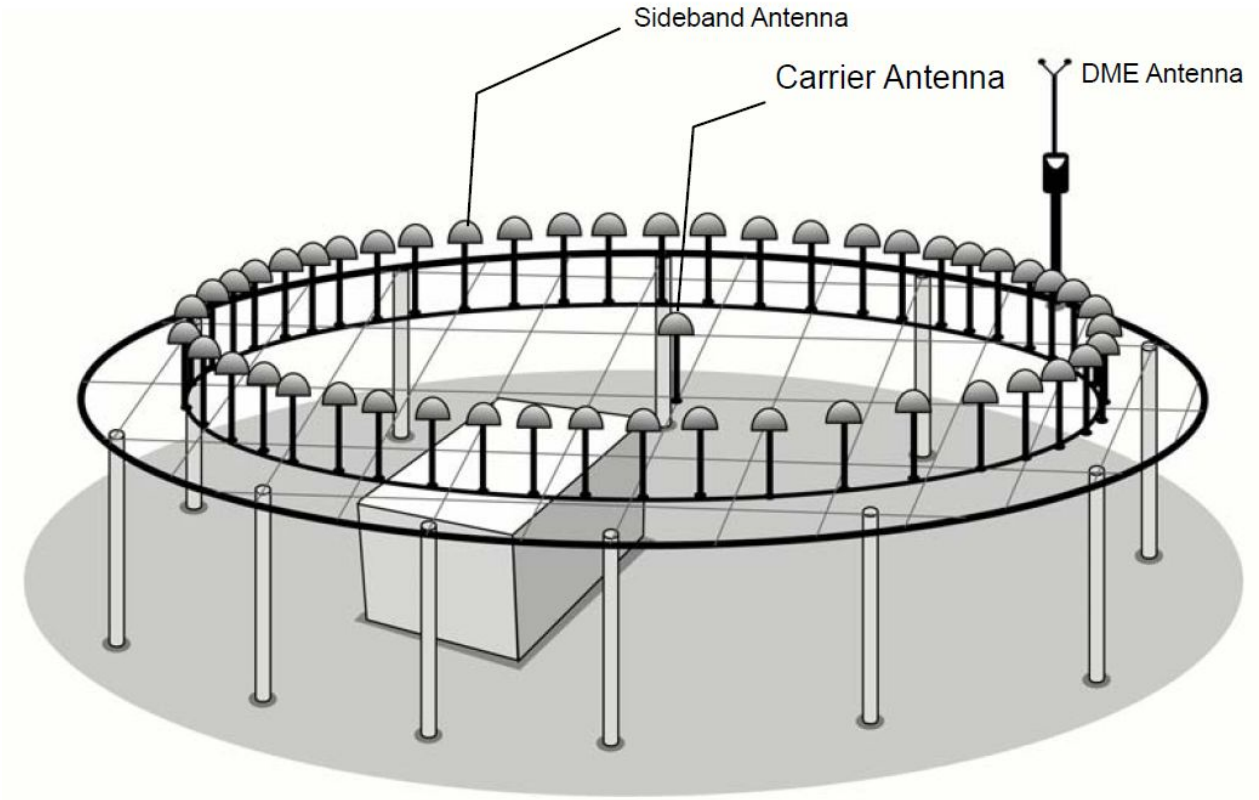
In radio navigation, a **VOR/DME** is a radio beacon that combines a VHF omnidirectional range (VOR) with a distance measuring equipment (DME). The VOR allows the receiver to measure its bearing to or from the beacon, while the DME provides the slant distance between the receiver and the station. Together, the two measurements allow the receiver to compute a position fix.

VOR Display at the Cockpit

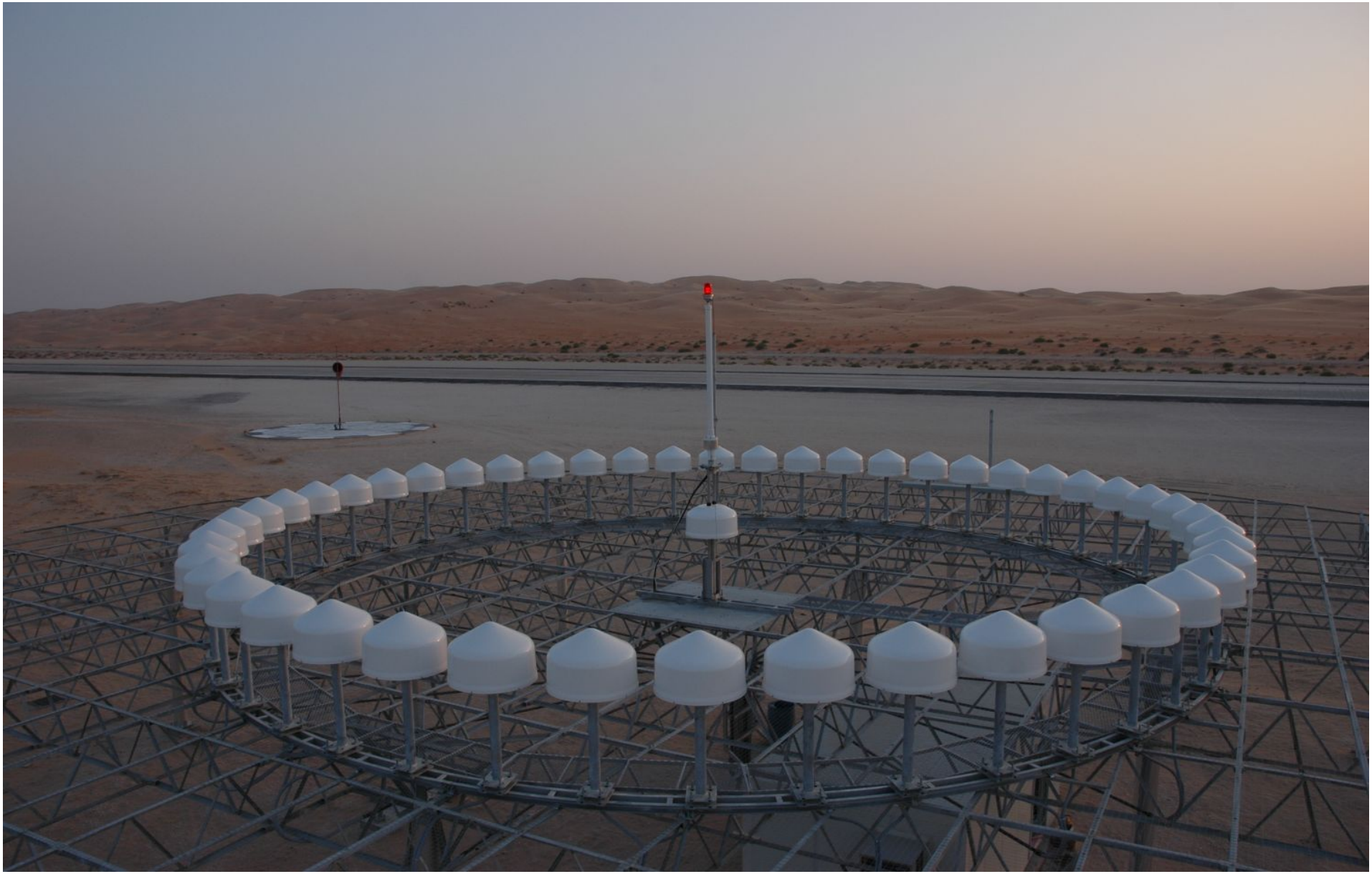


DVOR/DME

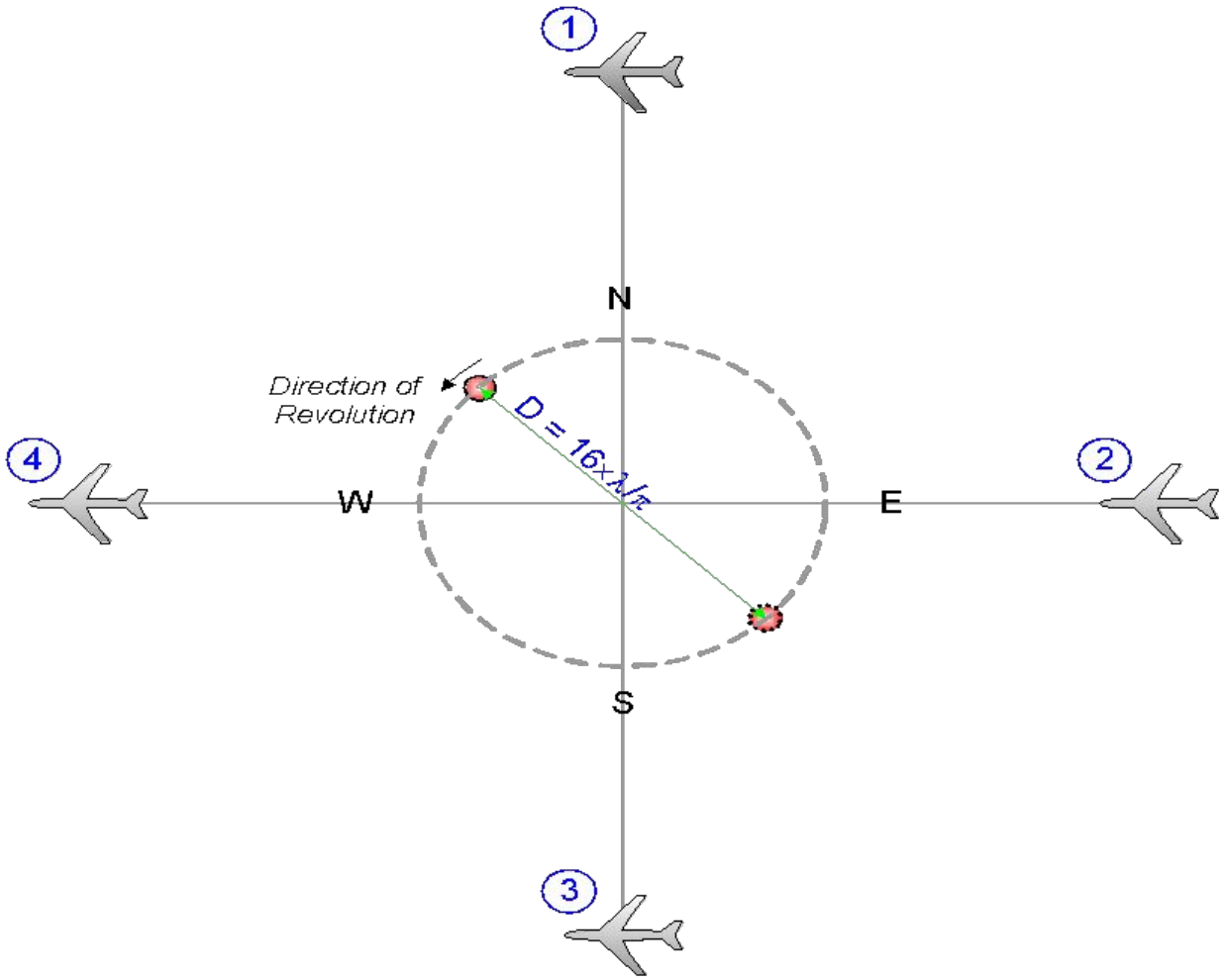
The VOR system was first introduced in the 1930s, but didn't enter significant commercial use until the early 1950s ([1]). It became much more practical with the introduction of low-cost solid state receivers in the 1960s. DME was a modification of World War II-era navigation systems like Gee-H, and began development in 1946. Like VOR, it only became practical with the introduction of solid state receivers during the 1960s.

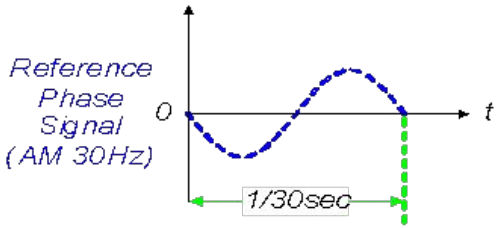


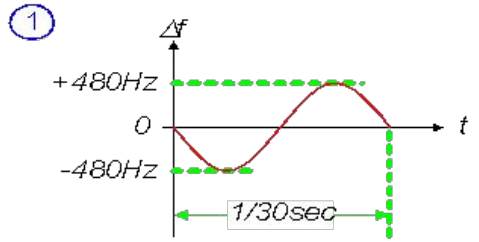
DVOR Antenna Array

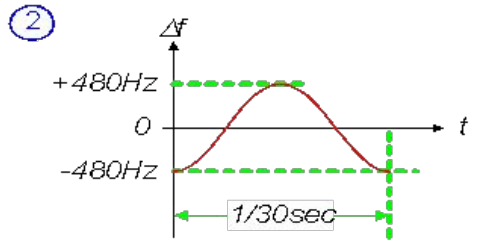


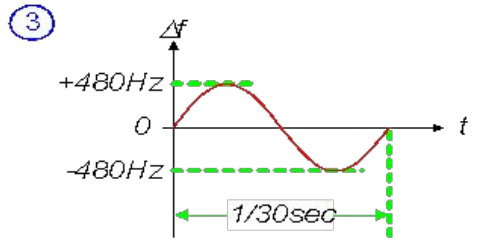
Phase Difference of each position

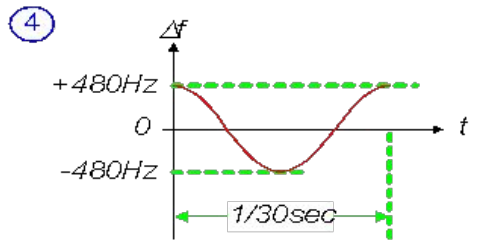












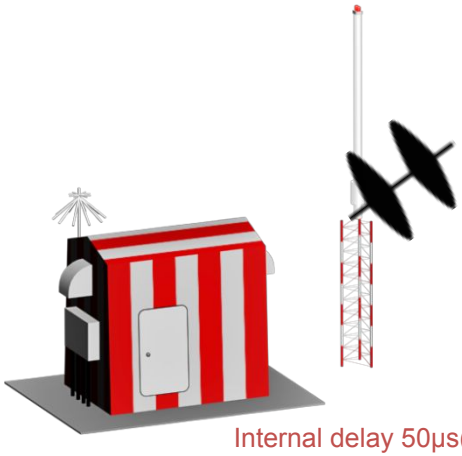
DME Antenna

Distance Calculation

The Aircraft Interrogator transmits an omnidirectional interrogation.

The Interrogation travels
At the speed of light.

The Replay travels
At the speed of light.



Internal delay 50μs(X CH)

$$\text{Distance (Slant)} = \frac{\text{Total travel time - 50μs}}{\text{12.36μs/NM}}$$