Traffic alert and collision avoidance system

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AIR TRAFFIC CONTROL

- ATC systems prevent aircraft collisions, organize and expedite the flow of traffic.
- It also provides weather and navigational information.
- Secondary surveillance radars are used for traffic control.
- Modern ATC use **air traffic control radar beacon system** (**ATCRBS**) surveillance radar monitoring and separation of air traffic.

Secondary Surveillance RADAR

- Primary RADAR measures position of targets by detection of reflected radio signals.
- SSR not only detects the aircraft but also gives its altitude and identity.
- SSR makes use of RADAR transponders that replies to interrogation by transmitting an encoded data.
- Transponder is a radio receiver and transmitter which receives request at **1090MHz** and transmits at **1030 MHz.**

Mid-Air Collision (MAC)

Worst MAC in History

- Saudi Arabian Airlines VS Kazakhstan Airlines , 1996 (349 people killed)

A mid-air collision is an aviation accident in which two or more aircraft come into contact during flight.

What is TCAS

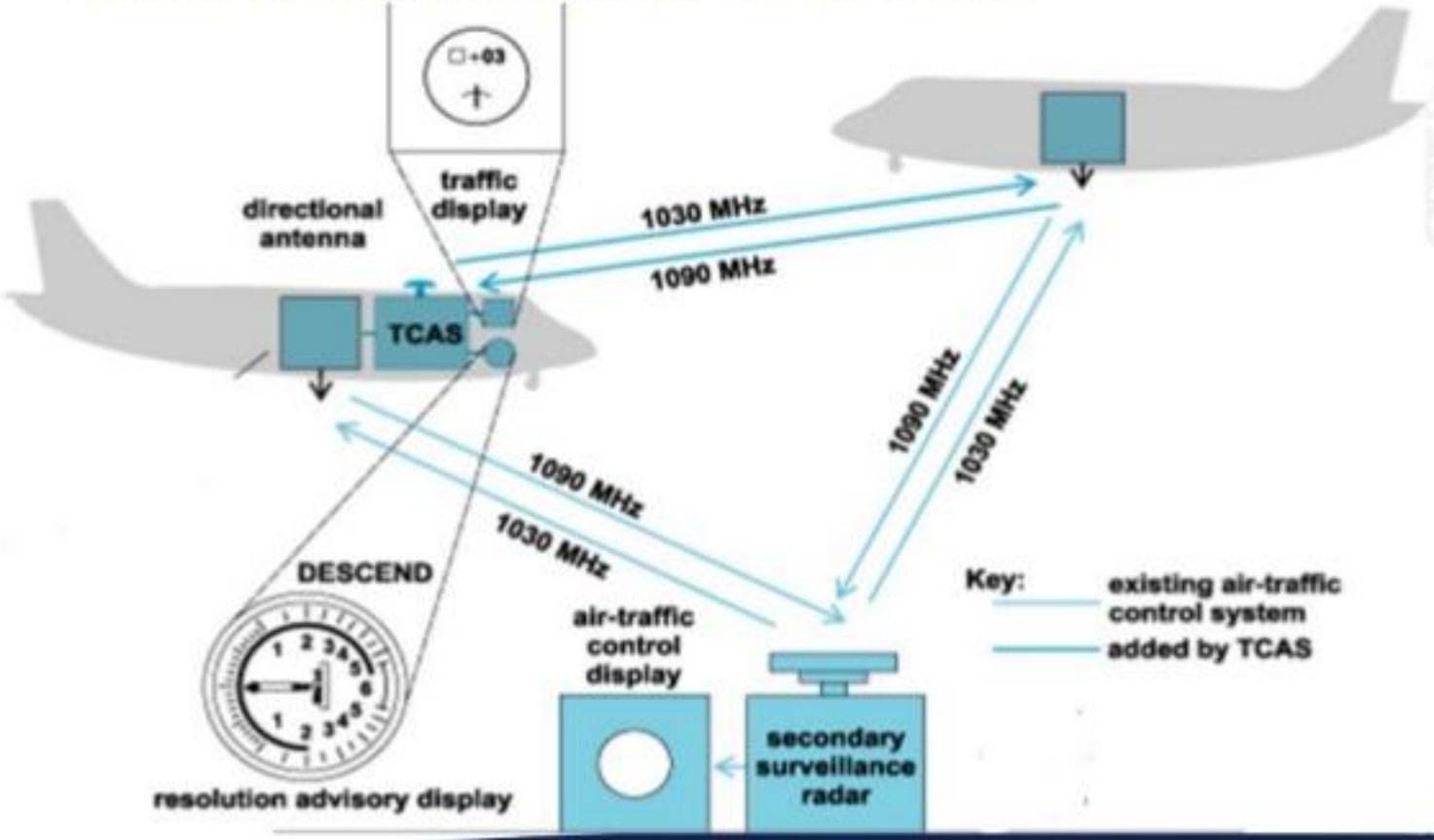
- TCAS stand for Traffic alert and Collision Avoidance System
- It is a transponder based interrogation system capable of displaying conflicting traffic and providing resolution advisory.
- Provides an extra level of protection against mid-air collisions.

HOW TCAS WORKS

- TCAS consists of antennas on aircraft body, computer processor & TCAS display inside cockpit.
- TCAS antenna continually surveys the airspace around an aircraft & transmit the signal.
- Other aircraft that also equipped with TCAS in the surrounding area will reply the signal.
- TCAS continuously calculates tracked aircraft position, therefore TCAS display constantly updated and provide real time position information.

HOW TCAS WORKS

- TCAS operates similar as Secondary Surveillance Radar (SSR), but in air to air role.



HOW TCAS WORKS

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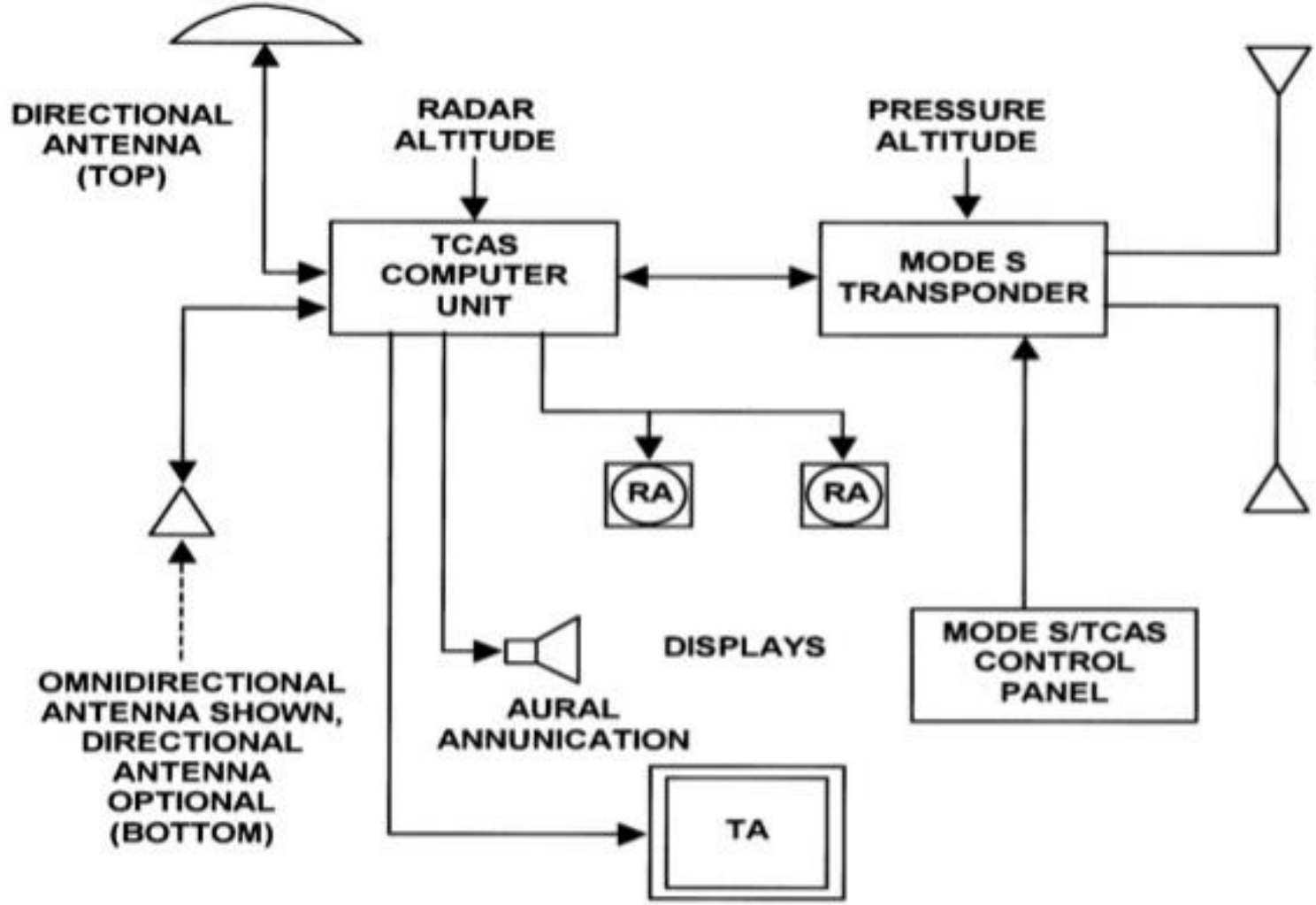
- Targets (other aircraft) are displayed on the TCAS screen as different symbols which show level of threat.
- Aircraft relative altitude also will be displayed.
  - Relative altitude is the targets altitude in relation to the aircraft. EX: -03↑ depicts a target 300 feet below and climbing.
- TCAS can not display aircraft without TCAS antenna/transponders.

TCAS BLOCK DIAGRAM

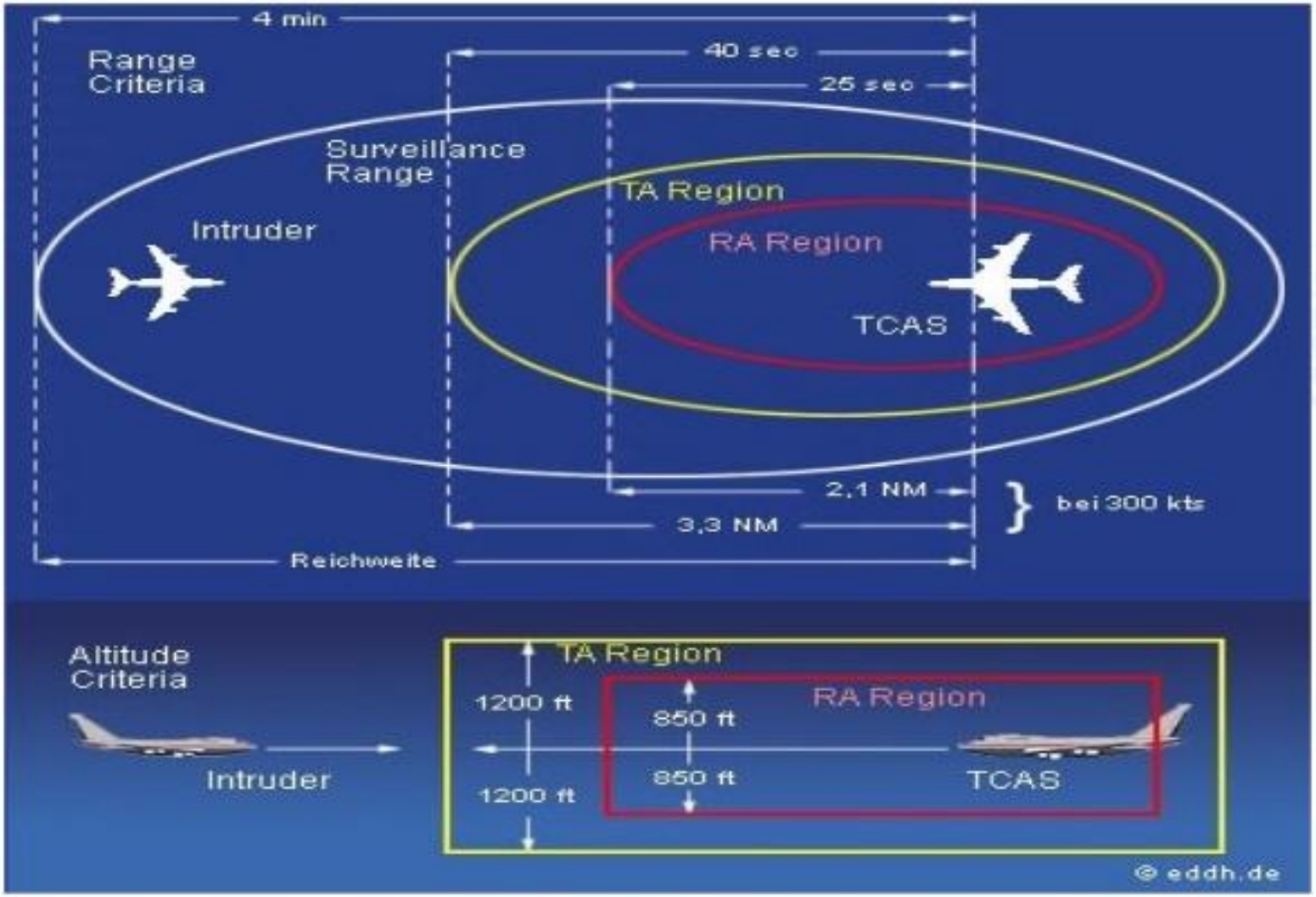


Traffic Advisory (TA) & Resolution Advisory (RA)

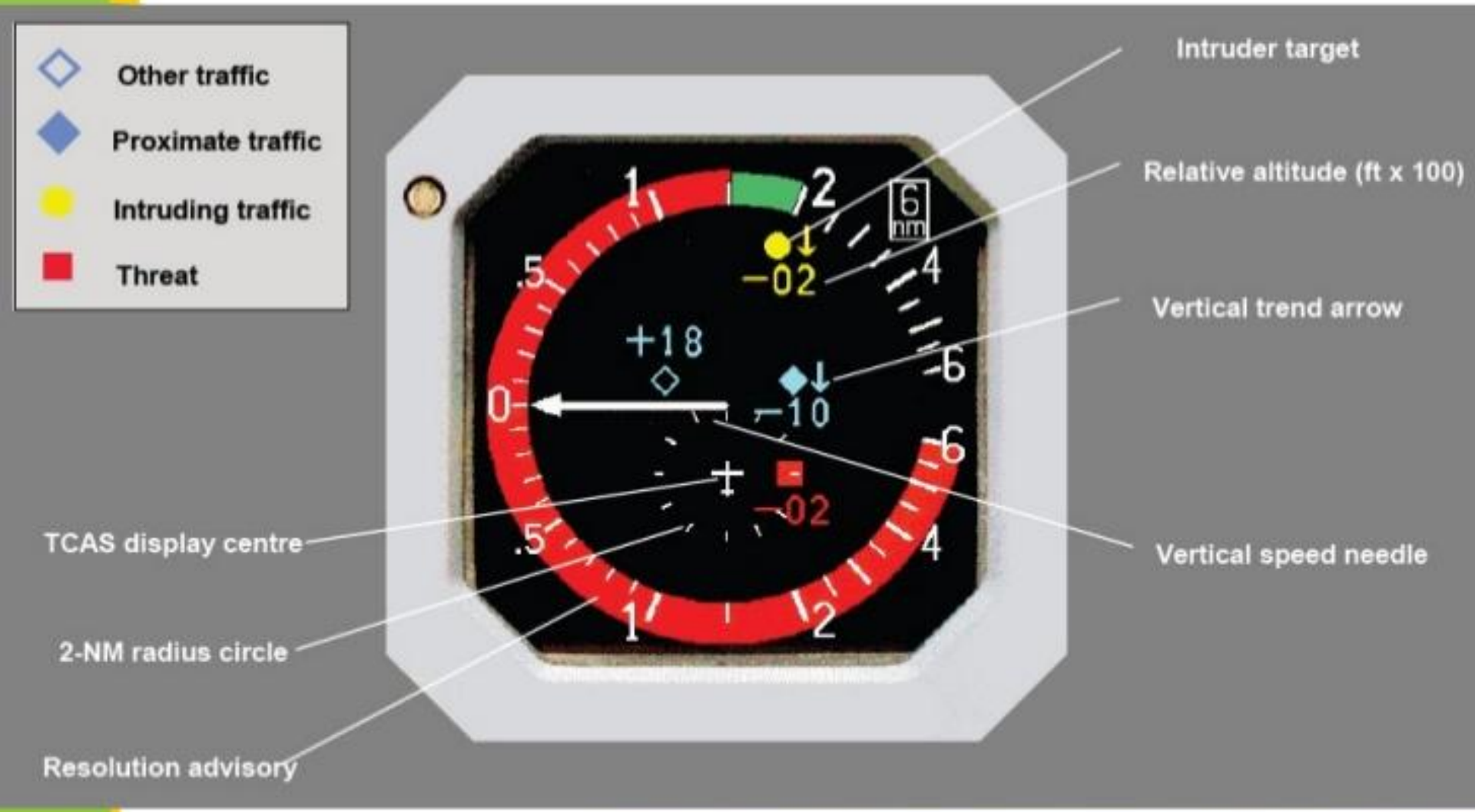
Determination of the alerts: TA & RA		AUDIO WARNING
Traffic Advisory (TA) help the pilots in the visual search for the intruder aircraft, and alert them to be ready for a potential resolution advisory	Intruder be at 45 and 35 seconds from the collision area.	"Traffic, Traffic"
Resolution Advisory (RA) avoidance maneuvers recommended to the pilot.	Intruder be at 30 and 20 seconds from the collision area.	"Climb, Climb" "Descent, Descent"

- Maximum number of aircraft processed = 30

PROTECTION THRESHOLDS



TYPICAL TCAS DISPLAY



TCAS Advantages and Disadvantages

ADVANTAGES

- All threats taken into account
- Detection of all transponding aircraft, including those which are not displayed on the air traffic controller's screen
- Independent system, which acts as a last resort measure to avoid mid-air collision when other safety precautions fail.
- TCAS reduced the risk of mid-air collision

DISADVANTAGES

- TCAS can not display aircraft without TCAS antenna/transponders.

TCAS Limitations

- No detection of aircraft without or not operating transponders .
- No knowledge of the pilot's intentions and of the ATC separation minima
- Basic display: no identification, no past positions, no speed vector
- Sometime generate **unnecessary alerts.**

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THANK YOU