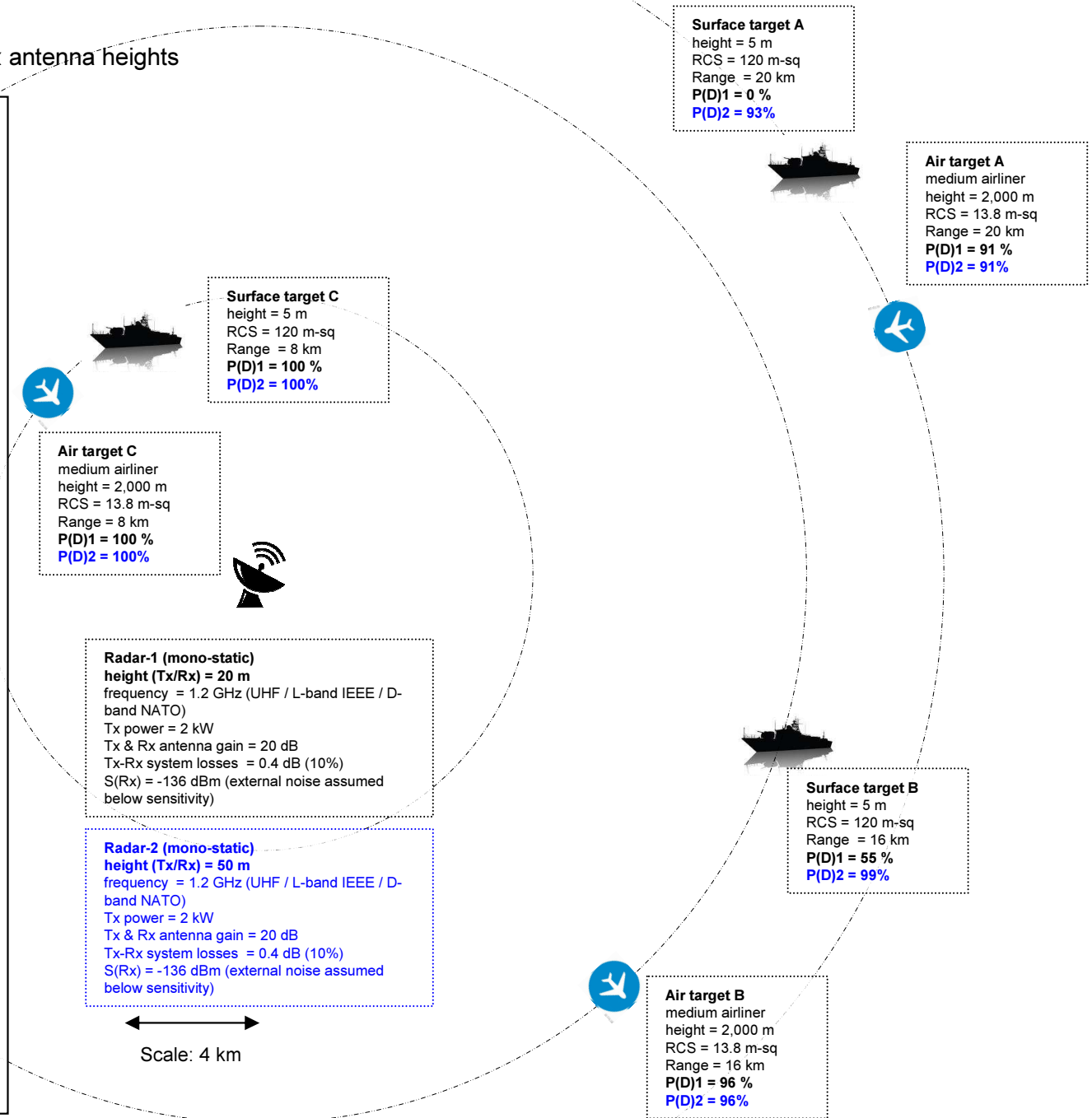


Radar: Basics – scenario 5a

Probability of Detection P(D): Effect of Tx and Rx antenna heights

- The height of the Tx and Rx antennas may be critical in determining the probability of detection, depending on the target height, particularly if it is near the surface.
- A higher antenna increases the radar horizon so targets at longer range may be observed. It also increases the Fresnel Zone so that propagation loss will be the lower free-space loss out to a greater range and where two-ray loss occurs it will be reduced.
- The horizon for Radar-1 with Tx/Rx height 20m, for the Surface targets is 27.7km and the Fresnel Zone is 5km. Hence all Surface Targets A, B and C are within the horizon but outside the Fresnel Zone and the higher two-ray loss applies. Hence Surface target A cannot be detected and B detected only with 55% probability.
- The horizon for Radar-1 for the Air targets is 203km and the Fresnel Zone is 2000km, so all Air targets are well within the horizon and the Fresnel Zone, suffering only the lower free space loss. Hence probability of detection is relatively high despite the air targets having a smaller RCS than the surface targets.
- The horizon for Radar-2, with Tx/Rx heights of 50m, for the Surface targets is 38.4km and the Fresnel Zone is 12.5km. So all Surface targets are within the horizon and target C is within the Fresnel Zone, suffering only free-space loss. The two-ray loss for targets A and B is also reduced.
- The horizon for Radar-2 for the Air targets is 213.8km and the Fresnel Zone is 5000km, so as for Radar-1 all Air targets are well within the horizon and the Fresnel Zone, suffering only the lower free space loss.
- It can be seen there is no change in the probability of detection for the air targets as there is no change in the free space loss. However even for the surface targets A and B outside the Fresnel Zone the probability of detection is greatly improved as the two-ray loss is greatly reduced.



Radar: Basics – scenario 5b

Probability of Detection P(D): Different Tx and Rx antenna heights (bi-static radar)

- As a case part way between the two examined in scenario 5a, the height of the Tx and Rx antennas may be different in a bi-static arrangement.
- Often for bi-static radars, the Tx and Rx antennas are separated in horizontal distance, but this vertical separation also constitutes a bi-static arrangement.
- The Tx antenna is at 20m height and the Rx antenna at 50m. Hence each antenna has a different horizon and Fresnel Zone as for these heights in the previous scenario.
- As expected the performance is part way between the two previous cases. The signals suffer a higher attenuation from the Tx antenna to the target and a lower one on the return to the Rx antenna.

