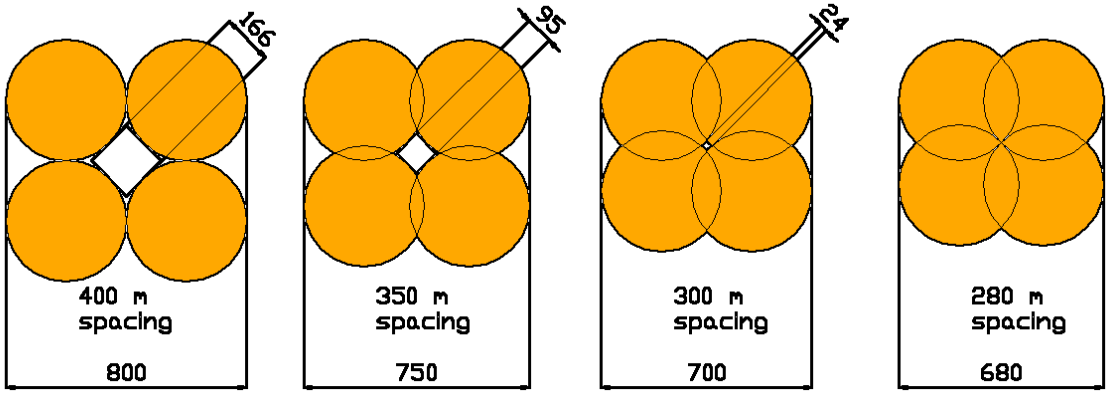
Application Note

Overlapping Detection Areas To Eliminate Dead Zones

First published: November 2022

This note describes how multiple radars can be arranged so that the detection areas overlap to eliminate any dead zones between radars.

The maximum radar range is 200 metres in all directions, covering a circular area. For protecting large sites, simple geometry shows that spacing the radars apart by 280 metres eliminates any central dead zones between these circular areas. Increased spacing covers a larger overall area but the dead zone increases, as shown below:



Radar spacing	Dead Zone
280 m	0 m
290 m	10 m
300 m	24.2 m
310 m	38.3 m
320 m	52.4 m
330 m	66.6 m
340 m	80.7 m
350 m	94.9 m
360 m	109 m
370 m	123.1 m
380 m	137.3 m
390 m	151.4 m
400 m	165.6 m

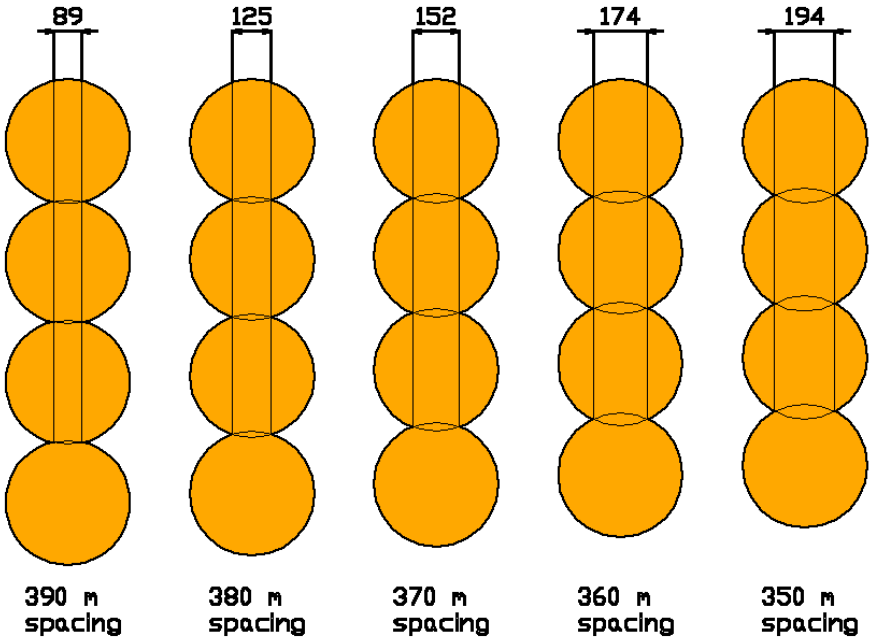
Note: we do not recommend using 400m spacing.

For some sites it may be possible to arrange the radars with wide separation so that a building is located in the central dead zone. This would increase the overall detection area with minimal impact on system performance because the area within the dead zone would not be usable anyway.

Radar spacing should also be arranged to prevent any targets passing through gaps between the detection areas.

The image to the right shows the length of overlapping detection areas when the radar spacing is decreased from 390 metres to 350 metres in 10 metre intervals.

We do not recommend using the theoretical maximum 400 m spacing as the overlap will be too small to guarantee a satisfactory detection probability.



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The following table shows the time it takes for different targets to cross the overlapping sections for a range of radar spacings.

Target type	Speed km/h	Time spent crossing overlapping detection zones				
		390 m	380 m	370 m	360 m	350 m
Walking	5	64 s	90 s	109 s	125 s	139 s
Sprinting / Bicycle	30	10 s	15 s	18 s	20 s	23 s
Car	50	6 s	9 s	10 s	12 s	13 s
Fast car	100	3 s	4 s	5 s	6 s	6 s

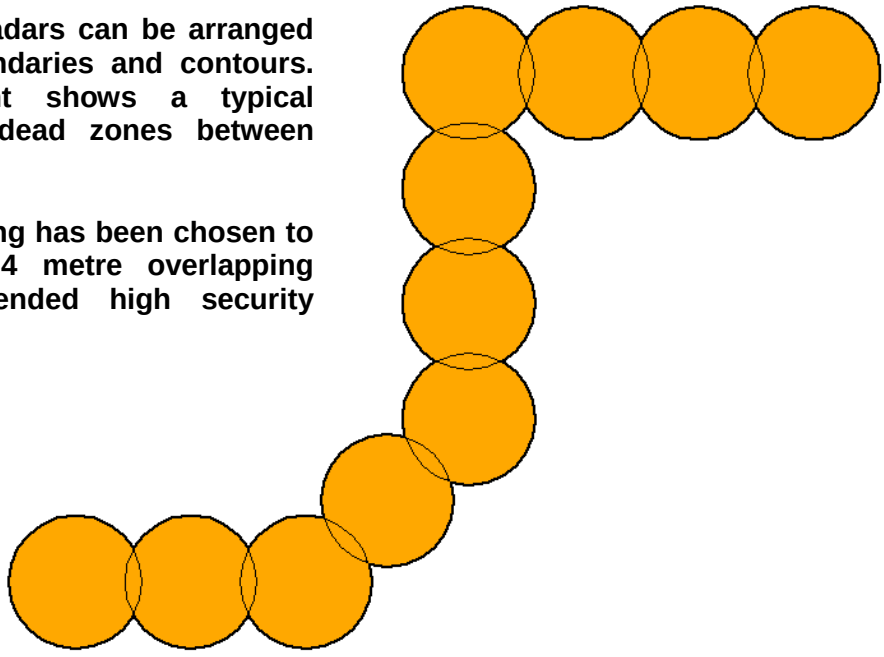
From the time the target spends in the overlapping section it is possible to determine a theoretical requirement for minimum detection probability (Pd) to guarantee the target is detected at least once:

Target type	Speed km/h	Required min. Pd % to detect at least once				
		390 m	380 m	370 m	360 m	350 m
Walking	5	0.7 %	0.5 %	0.4 %	0.3 %	0.3 %
Sprinting / Bicycle	30	4.6 %	3.3 %	2.7 %	2.3 %	2.1 %
Car	50	7.8 %	5.5 %	4.5 %	3.9 %	3.5 %
Fast car	100	15.6 %	11.1 %	9.1 %	7.9 %	7.1 %

In overlapped detection areas both radars are able to detect the target, effectively doubling the detection probability compared to non-overlapping areas. Although faster targets require higher detection probabilities, in reality this is not a problem. For example a running human is much slower than a car but the car is much bigger; the car spends less time in the detection area but is much easier to detect due to its larger size.

For long borders multiple radars can be arranged to follow the required boundaries and contours. The image on the right shows a typical arrangement to eliminate dead zones between radars.

In this case 350 metre spacing has been chosen to benefit from the large 194 metre overlapping sections to suit the intended high security application.



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