Typical Search Radar Loss Budget

Component	Symbol	Loss
Athmospheric loss	L_a	1.2 dB
Beamshape loss	L_{ant}	1.3 dB
Beamwidth factor	L_B	1.2 dB
Filter matching loss	L_n	0.8 dB
Fluctuation loss (for P_d=0.9)	L_f	8.4 dB
Integration loss	L_i	3.2 dB
Miscellaneous signal-processing loss	L_x	3.0 dB
Receive line loss	L_r	1.0 dB
Transmit line loss	L_t	1.0 dB
Total system loss	L_{total}	**21.1 dB**

Table 1: Typical Search Radar Loss Budget

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Every radar system has got miscellaneous losses. Some of these are preventible, or at least reducible by a well designed radar. Some losses can even minimized by maintenance.

But unfortunately most of these losses are inevitable. The sum of losses in Table 1 is declared very hard width the value of 21.1 Decibels. Well designed radars have a fairer loss of about 13 to 15 Decibels mostly.

Atmospheric Losses

These are losses due to atmospheric absorption by the atmosphere. They are dependent upon the radar operating frequency, the range to the target and the elevation angle of the target relative to the radar. These losses are insignificant at low frequencies less than 3 Gigahertzes by clear weather condition.

Beam shape Loss

This loss term accounts for the fact that, as the beam scans across the target, the signal amplitudes of the pulses coherently or non-coherently integrated varies. Because of the, the full integration gain of the integrator can’t be realized. From the Skolnik Radar Handbook typical values are:

- 1.6 dB for a scanning, fan beam radar
- 3.2 dB for a thinner beam, scanning radar
- 3.2 dB for a phased array radar wherein the beams of a search sector overlap at the 3-dB beam positions.

For phase array radars the beam doesn’t move continuously (in most cases) but in discrete steps. This means that the phased array radar may not point the beam directly at the target. This means, in turn, that the antenna gain used in the radar range equation will not be its maximum value. As with the other cases, this phenomena is accommodated through the inclusion of a loss term called, in this case, beam shape loss.

Beam width factor

The azimuth beam width of a radar antenna has not the same value in all elevation angles. This is summarized in an additional loss factor.

Fluctuation Loss

This relatively high loss is a result of the fluttering in the values of radar cross section. The gaps are frequency depending!

In order to overcome some of the target size fluctuations many radars use two or more different illumination frequencies. Frequency diversity typically uses two transmitters operating in tandem to illuminate the target with two separate frequencies.

Miscellaneous Signal Processing Loss

If the radar uses an MTI with a staggered PRF waveform, and a good MTI and PRF stagger design, it will suffer up to 3 dB signal processing loss.

Transmit Line Losses

Typically associated with the wave guides and other components between the power amplifier and the antenna. These are typically 1 to 2 dB in a well-designed radar.

Receive Losses

Typically associated with the wave guides and other components between the antenna and RF amplifier. These are also typically 1 to 2 dB for a well-designed radar. If the noise figure is referenced to the antenna terminals, receive losses are included in the noise figure.

Source:
http://www.radartutorial.eu/01.basics/Typical%20Search%20Radar%20Loss%20Budget.en.html