Technical challenges to spectrum sharing between radars and non-radar (communication) systems

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Abstract. To partially satisfy a voracious worldwide appetite for additional spectrum allocations for data and voice communication systems, a variety of proposals have been put forth for such systems to share spectrum with radars by operating in bands that have previously been allocated on a primary or co-primary basis for radars alone. The impetus behind these proposals may be the relatively wide spectrum bands that have been allocated worldwide for radar operations. The technical justifications for the sharing proposals typically includes the following claims: Radar systems make little use of existing spectrum allocations, and so there is much radar spectrum available for other uses; radar receiver performance is inherently robust against interference from signals of other services, and therefore radar receivers can operate co-channel with, or at least in the same band as, communication signals; to the extent that interference to radars might occur from non-radar services, it can in principle be limited on some acceptable statistical basis; and finally, if interference to radar receivers due to spectrum sharing is in fact found to be intolerable, it is possible in principle to design and deploy communication systems that will mitigate interference by detecting locally utilized radar frequencies and avoiding operations on those frequencies. Unfortunately, all of the above statements contain either technical flaws or implementation challenges that need to be understood by decision makers who must grapple with the radar spectrum sharing issues. This paper discusses the technical challenges of allowing non-radar communication systems to operate in radar spectrum.

Data are presented which show that, when properly measured, radar spectrum is in fact observed to be heavily utilized by radar emissions. Additional data are presented demonstrating that radar receiver performance is usually measurably degraded when interference levels are as low as 6 decibels below the nominal internal noise floor limit of those receivers. The same data effectively show that radar receivers are not as robust against interference as is often assumed, and that co-channel operation of non-radar systems and radar systems is therefore not generally technically feasible. The physical reasons for this are discussed. Finally, the technical challenges associated with operating non-radar systems in radar spectrum by deploying radar-signal-sensing and frequency-avoidance (so-called dynamic frequency selection, or DFS) systems is discussed. This approach is found to be theoretically possible but difficult to implement in real-world systems. Ultimately, the general feasibility of allowing non-radar systems to use radar spectrum is found to be theoretically possible under some circumstances, but technically difficult from any practical standpoint, primarily because the performance of radar receivers is usually noise-limited.