

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R M.1638-1
(01/2015)

**Characteristics of and protection criteria
for sharing studies for radiolocation
(except ground based meteorological
radars) and aeronautical radionavigation
radars operating in the frequency bands
between 5 250 and 5 850 MHz**

M Series
**Mobile, radiodetermination, amateur
and related satellite services**

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Recommendations

(Also available online at <http://www.itu.int/publ/R-REC/en>)

Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

Electronic Publication
Geneva, 2015

© ITU 2015

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

RECOMMENDATION ITU-R M.1638-1

Characteristics of and protection criteria for sharing studies for radiolocation (except ground based meteorological radars) and aeronautical radionavigation radars operating in the frequency bands between 5 250 and 5 850 MHz

(2003-2015)

Scope

This Recommendation describes the technical and operational characteristics of, and protection criteria for, radars operating in the frequency band 5 250-5 850 MHz, except ground based meteorological radars which are contained in Recommendation ITU-R M.1849. These characteristics are intended for use when assessing the compatibility of these systems with other services.

Keywords

Radar, shipborne, land-based, aeronautical, protection, multi-function

Abbreviations/Glossary

ARNS Aeronautical radionavigation service

ECCM Electronic counter-measures

The ITU Radiocommunication Assembly,

considering

- a) that antenna, signal propagation, target detection, and large necessary bandwidth characteristics of radar to achieve their functions are optimum in certain frequency bands;
- b) that the technical characteristics of radiolocation (except ground based meteorological radars) and radionavigation radars are determined by the mission of the system and vary widely even within a band;
- c) that the radionavigation service is a safety service as specified by No. **4.10** of the Radio Regulations (RR) and requires special measures to ensure its freedom from harmful interference;
- d) that representative technical and operational characteristics of radiolocation (except ground based meteorological radars) and radionavigation radars are required to address sharing and compatibility with these systems as necessary;
- e) that procedures and methodologies to analyse compatibility between radars and systems in other services are provided in Recommendation ITU-R M.1461;
- f) that radiolocation, radionavigation and meteorological radars operate in the frequency bands between 5 250-5 850 MHz;
- g) that ground-based radars used for meteorological purposes are authorized to operate in the frequency band 5 600-5 650 MHz on a basis of equality with stations in the aeronautical radionavigation service (ARNS) (see RR No. **5.452**);
- h) that Recommendation ITU-R M.1849 contains technical and operational aspects of ground based meteorological radars and can be used as a guideline in analysing sharing and compatibility between ground based meteorological radars with systems in other services,

recommends

- 1 that the technical and operational characteristics of the radiolocation (except ground based meteorological radars) and radionavigation radars described in Annex 1 should be considered representative of those operating in the frequency bands between 5 250 and 5 850 MHz;
- 2 that Recommendation ITU-R M.1461 should be used as a guideline in analysing sharing and compatibility between radiolocation (except ground based meteorological radars) and radionavigation radars with systems in other services;
- 3 that the criterion of interfering signal power to radar (except to ground based meteorological radars) receiver noise power level I/N , of -6 dB should be used as the required protection trigger level for the radiodetermination sharing studies with other services. This protection criterion represents the net protection level if multiple interferers are present.

Annex 1

Characteristics of radiolocation (except ground based meteorological radars) and aeronautical radionavigation radars

1 Introduction

The frequency bands between 5 250 and 5 850 MHz that are allocated to the ARNS, radionavigation and radiolocation services on a primary basis as shown in Table 1.

TABLE 1

Band (MHz)	Allocation
5 250-5 255	Radiolocation
5 255-5 350	Radiolocation
5 350-5 460	Aeronautical radionavigation Radiolocation
5 460-5 470	Radiolocation Radionavigation
5 470-5 570	Maritime radionavigation Radiolocation ⁽¹⁾
5 570-5 650	Maritime radionavigation Radiolocation
5 650-5 725	Radiolocation
5 725-5 850	Radiolocation

⁽¹⁾ In accordance with RR No. 5.452, between 5 600 and 5 650 MHz, ground-based radars for meteorological purposes are authorized to operate on a basis of equality with stations in the maritime radionavigation service. Recommendation ITU-R M.1849 contains characteristics of ground based meteorological radars.

The radiolocation radars perform a variety of functions, such as:

- tracking space launch vehicles and aeronautical vehicles undergoing developmental and operational testing;
- sea and air surveillance;
- environmental measurements (e.g. study of ocean water cycles and weather phenomena such as hurricanes);
- Earth imaging; and
- national defense and multinational peacekeeping.

The aeronautical radionavigation radars are used primarily for airborne weather avoidance and windshear detection, and perform a safety service (see RR No. **4.10**).

In Table 2, there are multifunction radars.

Multifunction radar can perform search, tracking, radionavigation including weather detection, functions with the same antenna in a single frequency band. For example in airborne applications, mechanically steered antennas or phase array antennas are commonly used, and the functions typically include search and tracking of aerial and surface target search, and terrain and weather avoidance.

In shipborne applications mechanically steered antennas or phase array antennas are commonly used, and the functions typically include search and tracking of aerial and surface target search and weather avoidance. These multifunction radars provide space and weight (essential in the airborne applications) saving, and adaptable operating modes base on changing requirements.

2 Technical characteristics

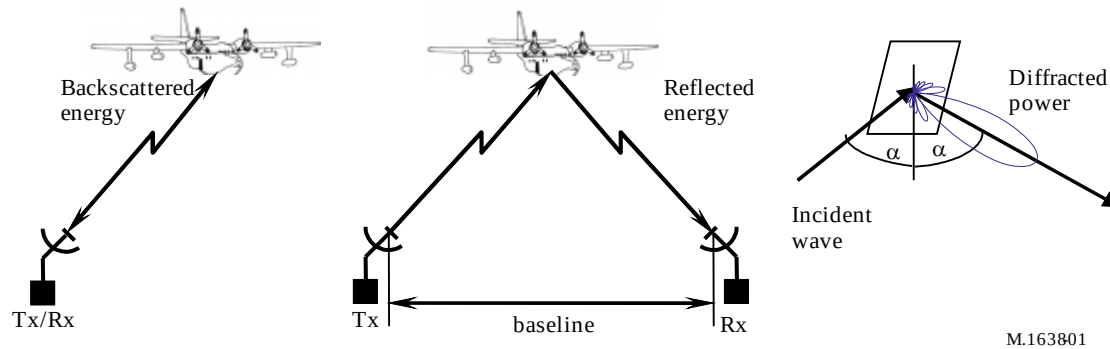
The frequency bands between 5 250 and 5 850 MHz are used by many different types of radars on land-based fixed, shipborne, airborne, and transportable platforms. Table 2 contains technical characteristics of representative systems deployed in these bands. This information is generally sufficient for general calculations to assess the compatibility between these radars and other systems. These radars are conventionally operated as monostatic radar with transmitter and receiver at the same location (Fig. 1a). However, Radars 10A and 14A of Table 2 are additionally operated as bistatic radar where the transmitter and receiver are spatially separated (Fig. 1b).

The advantage of the separation of transmitter and receiver is the possible enhancement of the radar cross-section of an object. The effect is exemplarily shown in Fig. 1c for a square plane. This is especially important if the object to be detected does not reflect much energy in the direction of the incident radar signal.

The distance between the transmitter and receiver (baseline) is typically in the range of 30-50 km. Synchronization of the transmitter and receiver can be achieved by a radio link or global navigation satellite service or by time standards. This operation mode with passive receiver at a different location than the transmitter should be taken into account in compatibility studies. Since the receivers are not changed, the protection criteria of the mono-static and bi-static radar receiver are equal.

FIGURE 1

1a: Monostatic radar; 1b: Bi-static radar; 1c: Diffracted power of a simple square plane



This Table contains characteristics of some frequency-hopping radars which are operating in this frequency range. Frequency hopping is one of the most common electronic-counter-counter-measures (ECCM). Radar systems that are designed to operate in hostile electronic attack environments use frequency hopping as one of its ECCM techniques. This type of radar typically divides its allocated frequency band into channels. The radar then randomly selects a channel from all available channels for transmission. This random occupation of a channel can occur on a per beam position basis where many pulses on the same channel are transmitted, or on a per pulse basis. This important aspect of radar systems should be considered and the potential impact of frequency hopping radars should be taken into account in sharing studies.

TABLE 2

Characteristics of radiolocation (except ground based meteorological radars) and aeronautical radionavigation radars

Characteristics	Units	Radar 1	Radar 2	Radar 3	Radar 4	Radar 5	Radar 6	Radar 7	Radar 8	Radar 9
Function		Instrumentation	Instrumentation	Instrumentation	Instrumentation	Instrumentation	Surface and air search	Multifunction Surface and air search	Research and Earth imaging	Search
Platform type (airborne, shipborne, ground)		Ground	Ground	Ground	Ground	Ground	Ship	Ship	Airborne	Airborne
Tuning range	MHz	5 300	5 350-5 850	5 350-5 850	5 400-5 900	5 400-5 900	5 300	5 450-5 825	5 300	5 250-5 725
Modulation		N/A	None	None	Pulse/chirp pulse	Chirp pulse	Linear FM	None	Non-linear/linear FM	CW pulse
Tx power into antenna	kW	250	2 800	1 200	1 000	165	360	285	1 or 16	0.1-0.4
Pulse width	µs	1.0	0.25, 1.0, 5.0	0.25, 0.5, 1.0	0.25-1 (unmodulated) 3.1-50 (chirp)	100	20.0	0.1/0.25/1.0	7 or 8	1.0
Pulse rise/fall time	µs	0.1/0.2	0.02-0.5	0.02-0.05	0.02-0.1	0.5	0.5	0.03/0.05/0.1	0.5	0.05
Pulse repetition rate	pps	3 000	160, 640	160, 640	20-1 280	320	500	2 400/1 200/750	1 000-4 000	200-1 500
Chirp bandwidth	MHz	N/A	N/A	N/A	4.0	8.33	1.5	N/A	62, 124	N/A
RF emission bandwidth -3 dB -20 dB	MHz	4.0 10.0	0.5-5	0.9-3.6 6.4-18	0.9-3.6 6.4-18	8.33 9.9	1.5 1.8	5.0/4.0/1.2 16.5/12.5/7.0	62, 124 65, 130	4.0 10.0
Antenna pattern type (pencil, fan, cosecant-squared, etc.)		Pencil	Pencil	Pencil	Pencil	Pencil	Cosecant-squared	Fan	Fan	Pencil
Antenna type (reflector, phased array, slotted array, etc.)		Parabolic reflector	Parabolic	Parabolic	Phased array	Phased array	Parabolic	Travelling wave feed horn array	Two dual polarized horns on single pedestal	Slotted array

TABLE 2 (cont.)

Characteristics	Units	Radar 1	Radar 2	Radar 3	Radar 4	Radar 5	Radar 6	Radar 7	Radar 8	Radar 9
Antenna polarization		Vertical/left-hand circular	Vertical/left-hand circular	Vertical/left-hand circular	Vertical/left-hand circular	Vertical/left-hand circular	Horizontal	Horizontal	Horizontal and vertical	Circular
Antenna main beam gain	dBi	38.3	54	47	45.9	42	28.0	30.0	26	30-40
Antenna elevation beamwidth	degrees	2.5	0.4	0.8	1.0	1.0	24.8	28.0	28.0	2-4
Antenna azimuthal beamwidth	degrees	2.5	0.4	0.8	1.0	1.0	2.6	1.6	3.0	2-4
Antenna horizontal scan rate	degrees/s	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	36, 72	90	N/A	20
Antenna horizontal scan type (continuous, random, 360°, sector, etc.)	degrees	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	Continuous 360	30-270 Sector	Fixed to left or right of flight path	Continuous
Antenna vertical scan rate	degrees/s	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A	N/A	N/A	N/A
Antenna vertical scan type (continuous, random, 360°, sector, etc.)	degrees	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A (Tracking)	N/A	Fixed	Fixed in elevation (–20 to –70)	N/A
Antenna side-lobe (SL) levels (1 st SLs and remote SLs)	dB	–20	–20	–20	–22	–22	–20	–25	–22	–25
Antenna height	m	20	20	8-20	20	20	40	40	To 8 000	9 000
Receiver IF 3 dB bandwidth	MHz	1	4.8, 2.4, 0.25	4, 2, 1	2-8	8	1.5	1.2, 10	90, 147	1
Receiver noise figure	dB	6	5	5	11	5	5	10	4.9	3.5
Minimum discernable signal	dBm	–105	–107	–100	–107, –117	–100	–107	–94 (short/medium pulse) –102 (wide pulse)	–90, –87	–110

TABLE 2 (cont.)

Characteristics	Unit	Radar 10	Radar 10A	Radar 11	Radar 12	Radar 13	Radar 14	Radar 14A	Radar 15
Function		Radionavigation, Surface and Air Search	Radionavigation, Surface and Air Search	Radiolocation	Radiolocation	Radiolocation	Radiolocation	Radiolocation	Radiolocation
Platform type (airborne, shipborne, ground)		Shipborne Ground	Ground (bistatic)	Ground	Shipborne	Ground	Ground	Ground (bistatic)	Ground
Tuning range	MHz	5 250-5 875	5 250-5 875	5 250-5 350	5 400-5 900	5 450-5 850	5 300-5 800	5 300-5 800	5 400-5 850
Modulation		Bi-phase Barker Code	Bi-phase Barker Code	Coded Pulse	Coded Pulse	Pulsed, non- coherent	NA	NA	Un-Modulated Pulse
Tx power into antenna	kW	90	90	0.400	25	750	50	50	1 000
Pulse width	us	0.30-14.0	0.30-14.0	0.08	0.32	1	NA	NA	.25-1
Pulse rise/fall time	us	0.04-0.1	0.04-0.1	.03/.03	.015/.035	.108/.216	.100/.100	.100/.100	.150/.200
Pulse repetition rate	pps	4 000-5 000	4 000-5 000	5 000	8 000	160-1 280	NA	NA	160 - 640
Chirp bandwidth	MHz	1.5	1.5	N/A	N/A	NA	NA	NA	NA
RF emission bandwidth –3 dB –20 dB	MHz	4 12 20 at –40 dB	4 12 20 at –40 dB	6 11	1.55 20	.8 4.1	470 490	470 490	1.8 10
Antenna pattern type (pencil, fan, cosecant-squared, etc.)		Fan	Fan	N/A	N/A	Pencil	Pencil	Pencil	N/A
Antenna type (reflector, phased array, slotted array, etc.)		Passive Phased Array	Passive Phased Array	Phased array	Phased array	Parabolic	Phased array	Phased array	Horn

TABLE 2 (*cont.*)

Characteristics	Unit	Radar 10	Radar 10A	Radar 11	Radar 12	Radar 13	Radar 14	Radar 14A	Radar 15
Antenna polarization		Horizontal	Horizontal	Vertical	Vertical	Linear Vertical	NA	NA	Vertical, Linear
Antenna main beam gain	dBi	33 (<55)	33 (<55)	16	25	42.94	40	40	42
Antenna elevation beamwidth	degrees	7	7	12.5	26	2.5	2.5	2.5	1.2
Antenna azimuthal beamwidth	degrees	1.8	1.8	12.5	2	2.5	2.5	2.5	1.2
Antenna horizontal scan rate	degrees/s	6-60	6-60	N/A	N/A	25	30	30	Variable - 45
Antenna horizontal scan type (continuous, random, 360°, sector, etc.)	degrees	360	360	N/A	360	360	360	360	360
Antenna vertical scan rate	degrees/s	N/A	N/A	N/A	N/A	25	N/A	N/A	variable - 45
Antenna vertical scan type (continuous, random, 360°, sector, etc.)	degrees	N/A	N/A	N/A	Electronically Steered	N/A	Electronically Steered	Electronically Steered	N/A
Antenna side-lobe (SL) levels (1 st SLs and remote SLs)	dB	−29	−29	N/A	N/A	−8.7	−40	−40	−22
Antenna height	m	45	30	N/A	30	NA	NA	NA	NA
Receiver IF 3 dB bandwidth	MHz	11	11	10	7	2.75	NA	NA	20
Receiver noise figure	dB	3	3	10	4	3	4	4	2.3
Minimum discernable signal	dBm	−115	−115	−111	−116	−107	−100	−100	−112

TABLE 2 (cont.)

Characteristics	Unit	Radar 16	Radar 17	Radar 18	Radar 19	Radar 20	Radar 21	Radar 22	Radar 23
Function		Aeronautical radionavigation	Multifunction	Multi-function	Multi-function	Multi-function	Multi-function	Multi-function	Multi-function
Platform type (airborne, shipborne, ground)		Airborne	Airborne	Ground	Ground	Shipborne	Ground/ship	Surface and air search, ground-based on vehicle	Search, ground-based on vehicle
Tuning range	MHz	5 440	5 370	5 600-5 650	5 300-5 700	5 400-5 700	5 300-5 750	5 400-5 850	5 250-5 850
Modulation		N/A	N/A	NA	Un-modulated Pulse	Un-modulated Pulse	N/A	Coded pulse/barker code and Frequency hopping	Coded pulse/barker code and Frequency hopping
Tx power into antenna	kW	0.200 peak	70 peak	7.5	250	350	300-400 peak	12 peak	70
Pulse width	us	1-20	6.0	0.0005-0.20	0.8 to 2.0	2	.05..4.0	4.0-20.0	3.5/6.0/1.0
Pulse rise/fall time	us	0.1	0.6	0.0005/0.0005	0.08	.096/0.33	0.1	0.2	0.3
Pulse repetition rate	pps	180-1 440	200	3 000	250-1 180	250-500	200-1 300	1 000-7 800	2 500-3 750
Chirp bandwidth	MHz			NA	NA	NA	NA	NA	NA
RF emission bandwidth -3 dB -20 dB	MHz			2 15	1.25 8.3	0.4 2.88	NA	5 Not available	5 Not available
Antenna pattern type (pencil, fan, cosecant-squared, etc.)		Pencil	Fan	Pencil	Pencil	Pencil	Conical	Pencil	Pencil
Antenna type (reflector, phased array, slotted array, etc.)		Slotted array	Parabolic	Parabolic Reflector	Parabolic Reflector	Parabolic Reflector	Parabolic	Phased array	Phased array

TABLE 2 (*end*)

Characteristics	Unit	Radar 16	Radar 17	Radar 18	Radar 19	Radar 20	Radar 21	Radar 22	Radar 23
Antenna polarization		Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Vertical	Vertical	Horizontal
Antenna main beam gain	dBi	34	37.5	38.5	44.5	40	44.5	35	31.5
Antenna elevation beamwidth	degrees	3.5	4.1	2.2	1	1.7	2.0	30	30
Antenna azimuthal beamwidth	degrees	3.5	1.1	2.2	1	1.7	2.0	2	2
Antenna horizontal scan rate	degrees/s	20	24	3.4	Variable	6	36	Variable	Variable
Antenna horizontal scan type (continuous, random, 360°, sector, etc.)	degrees	Continuous	180 Sector	360	NA	360	360	360	360 sector
Antenna vertical scan rate	degrees	45	N/A	6.5	Variable	NA	3	NA	NA
Antenna vertical scan type (continuous, random, 360°, sector, etc.)	degrees	Sector	N/A	NA	NA	NA	30	Sector	Sector
Antenna side-lobe (SL) levels (1 st SLs and remote SLs)	dB	−31	−20	−31	−25	−29	−30	−40	−30
Antenna height	m	Aircraft altitude	Aircraft altitude	10	10	10	10..40	10	6-13
Receiver IF 3 dB bandwidth	MHz	1.0	0.6	3	0.75	0.5	0.8	4	5
Receiver noise figure	dB	5	6	4	3	2	3	5	13
Minimum discernable signal	dBm	−109	−106	−123	−109	−115	−120	−103	−108

3 Operational characteristics

3.1 Aeronautical radionavigation radars

Radars operating in the ARNS in the frequency band 5 350-5 460 MHz are primarily airborne systems used for flight safety. Both weather detection and avoidance radars, which operate continuously during flight, as well as windshear detection radars, which operate automatically whenever the aircraft descends below 2 400 ft (732 m), are in use. Both radars have similar characteristics and are principally forward-looking radars which scan a volume around the aircraft's flight path. These systems are automatically scanned over a given azimuth and elevation range, and are typically manually (mechanically) adjustable in elevation by the pilot (who may desire various elevation "cuts" for navigational decision-making).

3.2 Radiolocation radars

There are numerous radar types, accomplishing various missions, operating within the radiolocation service throughout the frequency range 5 250-5 850 MHz. Table 2 gives the technical characteristics for several representative types of radars that use these frequencies that can be used to assess the compatibility between radiolocation radars and systems of other services. The operational use of these radars is briefly discussed in the following text.

Test range instrumentation radars are used to provide highly accurate position data on space launch vehicles and aeronautical vehicles undergoing developmental and operational testing. These radars are typified by high transmitter powers and large aperture parabolic reflector antennas with very narrow pencil beams.

The radars have auto tracking antennas which either skin track or beacon track the object of interest. (Note that radar beacons have not been presented in Table 2; they normally are tunable over the frequency range 5 400-5 900 MHz, have transmitter powers in the range 50-200 W peak, and serve to rebroadcast the received radar signal.) Periods of operation can last from minutes up to 4-5 h, depending upon the test program. Operations are conducted at scheduled times 24 h/day, 7 days/week.

Shipboard sea and air surveillance radars are used for ship protection and operate continuously while the ship is underway as well as entering and leaving port areas. These radars operate continuously during the ship's deployment, based on ship's schedule and availability. These radars perform missions such as marine environmental protection; law enforcement in ports, and inland waterways, coastal security; humanitarian assistance, and/or disaster response and search and rescue missions involving small cross section targets such as light aircraft, lifeboats, canoes, dinghies, and swimmers with life jackets. These surveillance radars usually employ moderately high transmitter powers and antennas which scan electronically in elevation and mechanically a full 360° in azimuth. Operations can be such that multiple ships are operating these radars simultaneously in a given geographical area.

Other special-purpose radars are also operated in the frequency band 5 250-5 850 MHz. Radar 7 (Table 2) is an airborne synthetic aperture radar which is used in land-mapping and imaging, environmental and land-use studies, and other related research activities. It is operated continuously at various altitudes and with varying look-down angles for periods of time up to hours in duration which depends upon the specific measurement campaign being performed.

4 Protection criteria

The desensitizing effect on radars operated in this band from other services of a CW or noise-like type modulation is predictably related to its intensity. In any azimuth sectors in which such interference arrives, its power spectral density can simply be added to the power spectral density of the radar receiver thermal noise, to within a reasonable approximation. If power spectral density of

radar-receiver noise in the absence of interference is denoted by N_0 and that of noise-like interference by I_0 , the resultant effective noise power spectral density becomes simply $I_0 + N_0$. An increase of about 1 dB for the radiolocation radars except ground based meteorological radar would constitute significant degradation. Such an increase corresponds to an $(I + N)/N$ ratio of 1.26, or an I/N ratio of about –6 dB. For the radionavigation service and meteorological¹ radars considering the safety-of-life function, an increase of about 0.5 dB would constitute significant degradation. Such an increase corresponds to an I/N ratio of about –10 dB. However, further study is required to validate this value. These protection criteria represent the aggregate effects of multiple interferers, when present; the tolerable I/N ratio for an individual interferer depends on the number of interferers and their geometry, and needs to be assessed in the course of analysis of a given scenario.

The aggregation factor can be very substantial in the case of certain communication systems, in which a great number of stations can be deployed.

The effect of pulsed interference is more difficult to quantify and is strongly dependent on receiver/processor design and mode of operation. In particular, the differential processing gains for valid-target return, which is synchronously pulsed, and interference pulses, which are usually asynchronous, often have important effects on the impact of given levels of pulsed interference. Several different forms of performance degradation can be inflicted by such desensitization. Assessing it will be an objective for analyses of interactions between specific radar types. In general, numerous features of radiodetermination radars can be expected to help suppress low-duty cycle pulsed interference, especially from a few isolated sources. Techniques for suppression of low-duty cycle pulsed interference are contained in Recommendation ITU-R M.1372 – Efficient use of the radio spectrum by radar stations in the radiodetermination service.

5 Interference mitigation techniques

In general, mutual compatibility between radiolocation (except ground based meteorological radars) and aeronautical radionavigation is fostered by the scanning of the antenna beams, which limits main beam couplings. Additional mitigation is afforded by differences between the waveforms of the two types of radars and the associated rejection of undesired pulses via receiver filtering and signal processing techniques such as limiting, sensitivity time control and signal integration. Additionally, interference can be mitigated by separation in carrier frequency or discrimination in time through the use of asynchronous pulse rejection/suppression techniques. In radar-to-radar interactions, separation in frequency is not always necessary for compatible operation because high degrees of isolation in power coupling and in time either occur naturally or can be achieved by good design. Additional details of interference mitigation techniques employed by radar systems are contained in Recommendation ITU-R M.1372.

¹ The protection criteria for ground-based meteorological radars is found in Recommendation ITU-R M.1849.