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TECHNICAL REPORT

System Reference document (SRdoc);
Security Scanners (SSc) within the frequency range from 60 GHz to 90 GHz

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

The present document includes necessary information to support the co-operation under the MoU between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Post and Telecommunications Administrations (CEPT).

The present document covers the request for harmonised spectrum for sensor or radiodetermination applications using millimeterwave technology within the frequency range 68 GHz to 82 GHz. Communications applications or hybrid applications as a combination of sensor and communications applications are not treated within the scope of the present document.

The intention of the production of the present document is to create a basis for the industry to facilitate the market launch of new innovative and useful security scanners while avoiding any harmful interference with other radio services and equipment.

1 Scope

The present document describes security scanner applications within the frequency range 68 GHz to 82 GHz which may require a change of the present frequency designation/utilisation within CEPT.

The present document includes in particular:

- market information;
- technical information;
- regulatory issues.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] CEPT ECC Report 139 (02 2010): "Impact of Level Probing Radars Using Ultra-Wideband Technology on Radiocommunications Services".

[i.2] ETSI EN 302 372 (V2.1.1) (2016-12): "Short Range Devices (SRD); Tank level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.3] ETSI EN 302 729 (V2.1.1) (2016-12): "Short Range Devices (SRD); Level Probing Radar (LPR) equipment operating in the frequency ranges 6 GHz to 8,5 GHz, 24,05 GHz to 26,5 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.4] ETSI TS 103 361 (V1.1.1) (2016-03):" Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the Directive 2014/53/EU".

[i.5] ETSI EN 305 550-1 (V1.2.1) (2014-10): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 40 GHz to 246 GHz frequency range; Part 1: Technical characteristics and test methods".

[i.6] ETSI EN 303 883 (V1.1.1) (2016-09): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Measurement Techniques".

[i.7] CEPT/ECC Documentation, ERC REPORT 25: "European Table of Frequency Allocations", last updated in October 2018.

[i.8] ETSI EN 301 783 (V2.1.1) (2016-01): "Commercially available amateur radio equipment; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.9] ETSI EN 305 550-2 (V1.2.1) (2014-10): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 40 GHz to 246 GHz frequency range; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.10] CEPT/ERC/Recommendation 74-01: "Unwanted Emissions in the Spurious Domain"; May 2019 edition".

[i.11] "ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), (1998)".

[i.12] ETSI EN 301 091-1 (V2.1.1): "Short Range Devices;Transport and Traffic Telematics (TTT); Radar equipment operating in the 76 GHz to 77 GHz range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; Part 1: Ground based vehicular radar".

[i.13] ETSI EN 301 091-2 (V2.1.1): "Short Range Devices;Transport and Traffic Telematics (TTT);Radar equipment operating in the 76 GHz to 77 GHz range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; Part 2: Fixed infrastructure radar equipment".

[i.14] ETSI EN 301 091-3 (V1.1.1): "Short Range Devices; Transport and Traffic Telematics (TTT); Radar equipment operating in the 76 GHz to 77 GHz range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; Part 3: Railway/Road Crossings obstacle detection system applications".

[i.15] ETSI EN 302 264 (V2.1.1): "Short Range Devices; Transport and Traffic Telematics (TTT); Short Range Radar equipment operating in the 77 GHz to 81 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[i.16] ETSI EN 303 360 (V1.1.1): "Short Range Devices; Transport and Traffic Telematics (TTT); Radar equipment operating in the 76 GHz to 77 GHz range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; Obstacle Detection Radars for Use on Manned Rotorcraft".

[i.17] Recommendation ITU-R M.2057-1 (01/2018): "Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications".

[i.18] ETSI EN 302 217-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview, common characteristics and system-independent requirements".

[i.19] ERC/REC 70-03 (06 2019): "Relating to the use of Short Range Devices (SRD)".

[i.20] ETSI EN 301 091: "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Technical characteristics and test methods for radar equipment operating in the 76 GHz to 77 GHz band".

[i.21] ECC/REC (05)07: "Radio Frequency Channel Arrangements for fixed service systems operating in the bands 71-76 GHZ and 81-86 GHz".

[i.22] ECC/DEC/(11)02: "Industrial Level Probing Radars (LPR) operating in frequency bands 6-8.5 GHz, 24.05-26.5 GHz, 57-64 GHz and 75-85 GHz".

[i.23] Recommendation ITU-R M.1452-2 (05/2012): "Millimetre wave vehicular collision avoidance radars and radiocommunication systems for intelligent transport system applications".

[i.24] ECC/DEC/(04)03: "The frequency band 77-81 GHz to be designated for the use of Automotive Shor Range Radars".

[i.25] ECC/DEC/(16)01: "The harmonised frequency band 76-77 GHz, technical characteristics, exemption from individual licensing and free carriage and use of obstacle detection radars for rotorcraft use".

[i.26] Recommendation ITU-R M.2057-0 (02/2014): "Systems characteristics of automotive radars operating in the frequency band 76 to 81 GHz for intelligent transport systems applications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 303 883 [i.6], ETSI TS 103 361 [i.4] and the following apply:

Activity Factor (AF): ratio of active measurement periods t_m (bursts, sweeps, scans) within the overall repetitive measurement cycle T_m

NOTE: Activity factor of a radiodetermination device.

algorithm: automatic detection software

avatar: anonymous representation of a human figure for locating the detected objects

body position: bearing, including bearing of arms and legs

e-band: millimeter wave band ranging from 60 GHz to 90 GHz

Frequency Modulated Continuous Wave (FMCW): periodically linear frequency sweep of the transmit signal

NOTE: For distance measurement sensors often a sawtooth or a triangular modulation scheme is used. By mixing the current transmit signal with the reflected signal the round-trip time of the individual echoes and thus the distance of the different targets can be determined.

front panel: panel in front of the passenger

inspector: person who performs screening using the scanner or who carries out manual screening

manual screener: inspector who performs manual screening

manual screening: inspection by passing the hands over the body

panel: plate for scanning the front and back of the passenger

NOTE: See also "Front panel" and "Rear panel".

passenger: person to be screened

passenger guidance display: display in addition to the resolution station monitor, used to guide passengers from the scanner to the resolution station

position: place where the scanned person stands for screening

posture: body position

rear panel: panel behind the passenger

resolution station: area in which manual screening is performed

resolution station monitor: touchscreen used by the manual screener at the resolution station

scan procedure: sequence of actions to be performed by the scanned person and the screener

scanner: equipment used for screening

screener: inspector who operates the scanner(s)

screening: checking of the passenger

security checkpoint: location at which the security check is performed

security scanner: equipment used for screening

Stepped Frequency Continuous Wave (SFCW): transmit frequency in an SFCW modulation scheme not swept in a linear manner but rather in a stepped way with defined frequency increments and with a certain dwell time on each individual frequency step

NOTE: In contrast to the FMCW principle.

touchscreen: screen for controlling the scanner and for displaying the scan results

3.2 Symbols

For the purposes of the present document, the following symbols apply:

f_L	lowest frequency of the operating bandwidth
f_H	highest frequency of the operating bandwidth
t_m	active measurement time segment
T_m	overall repetitive measurement cycle time
Rx	Receiver

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AZ/EL	AZimut/ELevation
CW	Continuous Wave
DUT	Device Under Test
EIRP	Equivalent Isotropically Radiated Power
EM	ElectroMagnetic
FMCW	Frequency Modulated Continuous Wave
HERP	Hazards of Electromagnetic Radiation to Personnel
LPR	Level Probing Radar
MSS	Microwave SubSystem
Q-MSS	Q Microwave SubSystem
RF	Radio Frequency
SFCW	Stepped Frequency Continuous Wave
SRD	Short Range Devices
SRR	Short Range Radar
SSc	Security Scanner

4 Comments on the System Reference Document

4.1 Statements by ETSI Members

No statements or comments have been issued by ETSI members.

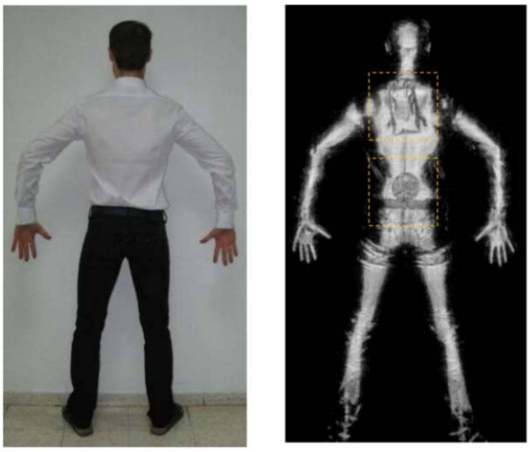
5 Presentation of the system and technology

5.1 Introduction

A Security Scanner (SSC) is a device that detects objects on a person's body for security screening purposes, without making any physical contact.

SScs work with electromagnetic waves. They use wavelengths in the millimeter range, e.g. around 4 mm (75 GHz) and operate at low signal power. The output power of a SSc, when transmitting, is in the very low milliwatt domain (e.g. 1 to 10 mW) and rather low compared to other radars or communication devices. This is much lower than, for example, that of wireless local area networks (WLAN) which invisibly surround us, or that of the ubiquitous mobile phone. The output power for WLAN is typically around 100 mW to 200 mW. A regular mobile phone transmits at about 1 000 mW to 2 000 mW. These output powers are therefore around 100 to 1 000 times higher than of a SSc.

Millimeter waves penetrate human skin only to a small extent and only by a few fractions of a millimetre as shown in Figure 1. They are for the most part reflected by the surface of the skin. Basically, the depth by which electromagnetic waves penetrate human skin decreases with increasing frequency. In the said frequency range around 75 GHz, the penetration depth is much less than for wavelengths of 150 mm to 300 mm, i.e. at frequencies of around 1 GHz to 2 GHz which are used by mobile phones. For fundamental physical reasons, millimeter waves are unable to penetrate the inside of the human body.



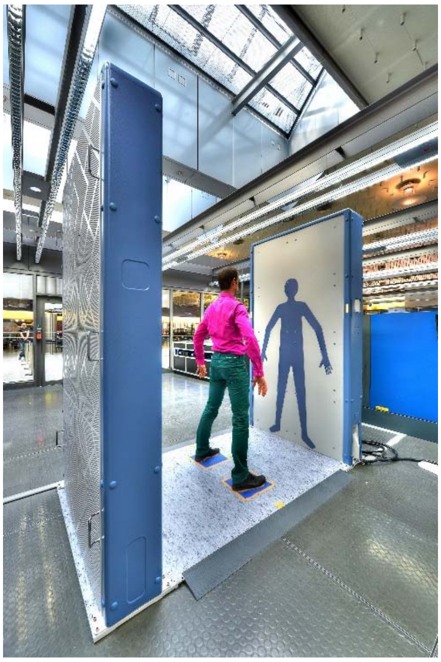
NOTE: Picture courtesy of Rohde & Schwarz and permission to be used in the present document has been granted.

Figure 1: Exemplary measurement data of a SSc

Generally, the length of time which the above-mentioned power is emitted is short (e.g. only a couple of milliseconds). A SSc is not transmitting permanently, but it is active for a short time only, immediately after the screener triggers a scan. Compared to the waves used by mobile phones, the signals emitted by the scanner penetrate less deeply (about one tenth), have a much lower power (about one thousandth) and are active for a considerably shorter time (about one ten thousandth). With the exception of the period of time mentioned above, a SSc is inactive and does not emit a signal.

5.2 Object detection

A SSc is an imaging device used for detecting objects concealed underneath a person's clothing. Potentially dangerous objects are detected by means of measurement-based evaluation of the millimeter wave signals emitted by the scanner and backscattered by the passenger, his clothing or by objects which he is wearing overtly or concealed inside or beneath his clothing. These signals are received and evaluated by the scanner. If necessary, the detection result is signalled in the form of a visual alarm which allows precise localization of the detected objects by the screener. Typical uses for this technology include detection of items for commercial loss prevention, smuggling and screening at government buildings and airport security checkpoints.



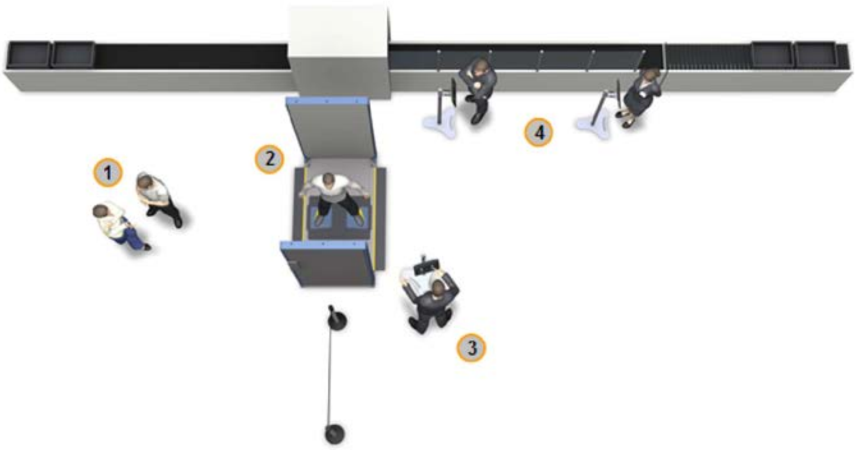
NOTE: Picture courtesy of Rohde & Schwarz and permission to be used in the present document has been granted.

Figure 2: An SSc in operation at an airport

There are different applications of SSc devices. Details of these applications are given below.

5.3 Security checkpoint

A SSc is usually used for screening persons at security checkpoints. The SSc automatically detects metallic and non-metallic objects of all types concealed inside or beneath clothing. These objects include potentially dangerous items such as weapons, explosives and liquids.



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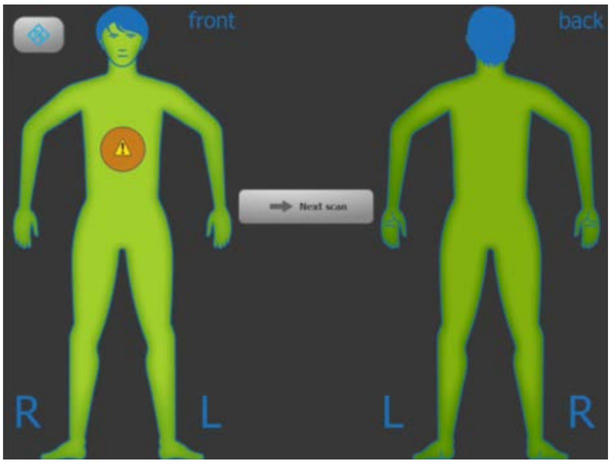
(1) Two persons waiting to be scanned
(2) A person being scanned
(3) An inspector operating the SSc via a touchscreen
(4) Further inspectors at resolution stations

Figure 3: Typical layout of a security checkpoint utilizing a SSc

Figure 3 shows an example layout of a security checkpoint equipped with a SSc, e.g. at an airport. On the left in the figure, a number of as yet unscreened passengers (1) are waiting in front of the SSc. The SSc here basically consists of two panels, the front panel and the back panel. A passenger (2) has already entered the SSc and adopted the posture required for scanning, i.e. facing the front panel with arms slightly splayed. The inspector (3) at the scanner (screener) instructs the passenger and triggers the scan at his touchscreen. He receives the scan results on the screen, e.g. simply a PASS, in case that no object had been detected, or an object indication as shown in Figure 4.



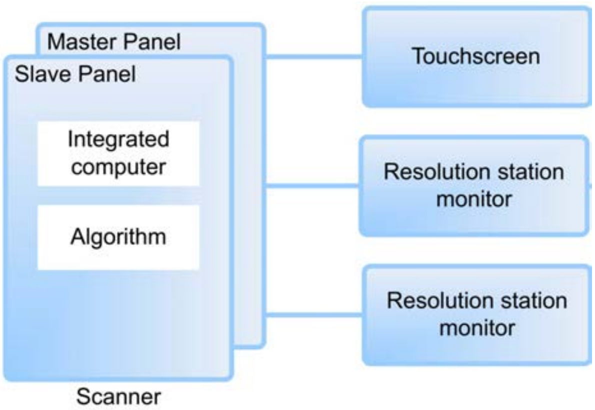
NOTE: Picture courtesy of Rohde & Schwarz and permission to be used in the present document has been granted.

Figure 4: Exemplary display on the touchscreen indicating a detected object

Optionally, the security checkpoint can have resolution stations. In Figure 3, one female and one male inspector (4) are waiting for passengers who may require manual screening. The inspectors each have their own resolution station monitors, which are used to forward information (detection result) from the scanner to the resolution station and also to send information from the resolution stations back to the screener (availability notification).

5.3.1 Security checkpoint architecture

Figure 5 shows the basic architecture of a security checkpoint as described above, consisting of the SSc (Security Scanner) with its two panels as the most important part, as well as peripheral components such as secondary monitors in addition to the touchscreen used for operation of the SSc.



NOTE: Picture courtesy of Rohde & Schwarz and permission to be used in the present document has been granted.

Figure 5: Typical architecture of a security checkpoint utilizing a SSc

5.3.2 Weapon early warning system

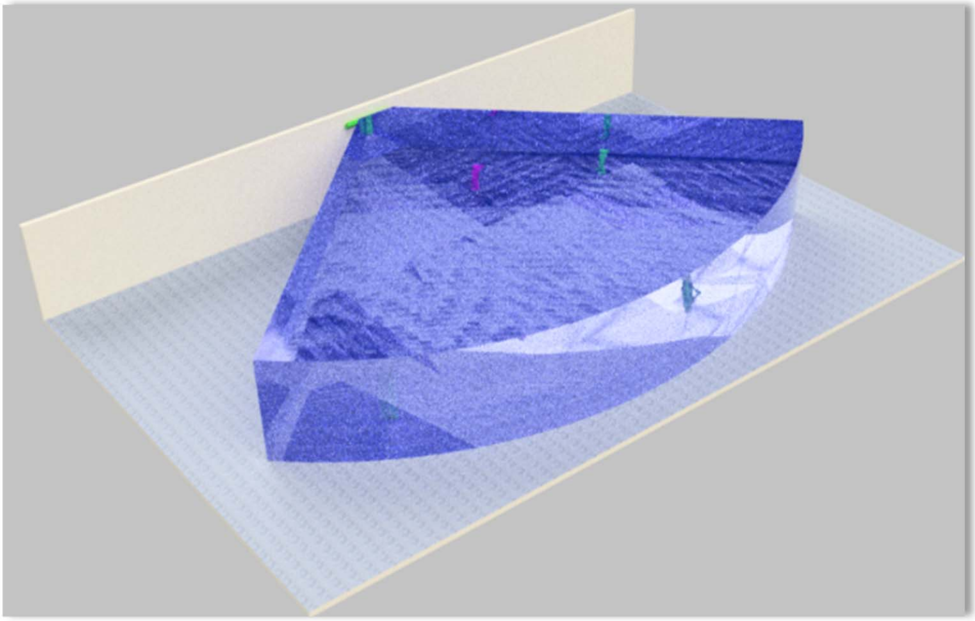
A concealed weapon early warning system provides a security approach that significantly improves the existing operational security methods on the market by expanding the security circle enabling a proactive approach and significantly improving public safety in sites such as airports, train stations, schools, shopping malls and public event venues. This application is deployed indoor as well as outdoor.

As an example, a typical scenario for an application of a concealed weapon early warning system which automatically detects, classifies and communicates the presence of threats in open spaces is given in Figure 6.

NOTE: Picture courtesy of Levitection and permission to be used in the present document has been granted.

Figure 6: Typical scenario for a weapon early warning system

The typical antenna pattern and area coverage of a concealed weapon early warning system is given in Figure 7. The system covers a 3D volume with a shape of quarter cylinder with a radius of 15 m and height of 2 m. The system is located at the center of the cylinder. This coverage volume is continuously viewed by the system for instantaneous early warning from multiple threats within the coverage.



NOTE: Picture courtesy of Levitection and permission to be used in the present document has been granted.

Figure 7: Area that is covered by a concealed weapon early warning system

The technology is based upon electro-magnetic imaging enabling:

1) early warning for concealed weapons and explosive devices;
2) a non-gate solution;
3) coverage of up to 400 m^3;
4) an undisturbed public flow inspection;
5) concurrent multi-threat detection and tracking;
6) autonomous real-time threat identification via Automatic Identification and communication of alerts;
7) seamless integration with command control applications and video surveillance systems.

6 Market Information

SScs enhance security in areas where potential threat by persons can occur. Therefore the potential market is diverse, with a large variety of potential sites, such as:

1) airport terminals;
2) central transportation centers;
3) major shopping centers;
4) stadiums, concert halls, museum & major sport sites and events;
5) government offices/major court houses/correction facilities;
6) education - universities, colleges and schools;
7) VIP offices, and visiting sites.

All those different potential sites are in need of SScs as a very high number of people enter and leave the sites every day. Areas with a crowd of people always show a high potential of assassinations as people entering the sites could carry some dangerous goods with them which could pose a threat to other people at the site. By installing and using SScs potentially dangerous tools and goods can be identified and excluded. Hence, SScs at the entry of the mentioned sites can avoid and prevent assassinations, explosions and attacks and thus protect many human lives.

SScs are used at airports to scan the passengers prior boarding to ensure that they do not carry any prohibited or dangerous goods with them in the airport and on the plane with which they could harm other passengers.

At central transportation centers passengers should also be checked before entering the bus, tram or the train to make sure that no one carries any dangerous goods or tools in order to protect the other people around them.

Major shopping centers are always busy and crowed by many people. In order to minimize the risk of anyone being hurt or injured by a person carrying a dangerous good, SScs should be used. Moreover, shopping malls have been the target of people placing bombs or fake bombs to frighten people. This can also be avoided by installing SScs as it will identify bombs when entering the site.

Stadiums, concert halls and so on have been the target of many terror attacks in the past. To ensure that people cannot enter the site with any harming and dangerous goods or tools like guns, knives or even explosives, SScs are highly needed to scan the people before entering the event. Furthermore, celebrities like famous singers have also been the target of attacks. This needs to be avoided as well.

Government offices as well as major court houses should install and use SScs to protect their staff as well as other people who are in the building. People entering such sites might be infuriated about their reason to go to government or court houses. Therefore, they could be a high danger for the staff and others. SScs will stop them from carrying dangerous goods or tools into the buildings.

Education centers, such as universities, colleges and schools are places where many young people are located. In the past, those places have been the target of rampages and other violent attacks. In order to avoid those attacks, SScs can scan the students and other visitors before entering the education site to make sure no one is carrying guns, knives or other dangerous tools.

VIP offices and visiting sites should use SScs to protect the visitors and to avoid any attacks. SScs at the entry can identify people who are carrying any prohibited goods and they can then be stopped.

The past has shown that people assassinating choose locations with a crowd of people or locations with specific persons, like celebrities or persons with a specific role like a lawyer. It is of high importance to avoid such incidents. In order to avoid it, people visiting such sites should be checked through SScs which will increase safety.

7 Technical information

7.1 Example specifications of the SSc R&S®QPS201

7.1.1 Summary specifications of the SSc R&S®QPS201

As an example the RF specifications of the SSc R&S®QPS201 from Rohde & Schwarz are given.

Table 1: RF specifications

Number of transmitting antennas per panel	3 008
Number of receiving antennas per panel	3 008
Number of reference channels per panel	65
Number of tiles („clusters") per panel	32
Antenna raster	3 mm
Aperture (W × H) of a panel	987 mm × 2 115 mm
Antenna height above ground level	122 mm to 2 237 mm
Beam width of an antenna (horizontal and vertical)	76°
Antenna tilt	0°
Transmitting time of a single antenna at a single frequency	80 ns
Transmitting time of a panel at a single frequency	240,64 µs
Dwell time at a single frequency	245,76 µs
Total transmitting time per posture	2 × 32 ms = 64 ms
Lag between front and back scan	100 ms
Repetition rate	0,2 Hz or less
Number of frequencies	128
Start frequency	69,895238 GHz
Stop frequency	79,895238 GHz
Peak output power	1 dBm
Antenna gain	6 dBi
Polarization	45° linear
NOTE: RF Specifications courtesy of Rohde & Schwarz and permission to be reproduced in the present document has been granted.	

7.1.2 Emission of the SSc R&S®QPS201

7.1.2.1 Transmitter (wanted) emissions within the operating frequency band

The datasheet values are given in the RF specification in the Table 1.

7.1.2.2 Transmitter (unwanted) emissions outside the operating frequency band

The transmitter unwanted emissions are emissions from the SSc originating from the transmitter but outside the operating band. It is the average power per unit bandwidth (centred on that frequency) radiated in the direction of main radiation (main lobe of the antenna). They are measured as maximum mean power spectral density (specified as EIRP) in the direction of main radiation of the radio device under test usually over a frequency range from 30 MHz to 2 times the carrier frequency except for the operating band of the SSc.

The limit for the transmitter unwanted emissions outside the operating bandwidths is proposed to be 20 dB less than the maximum mean power spectral density within the operating bandwidths. This value is adopted from ETSI EN 302 729 [i.3], clause 4.3.8.

7.1.2.3 Other (unwanted) transmitter emissions

Transmitters often emit very low power radio signals, comparable with the power of spurious emissions from digital and analogue circuitry. If it can be clearly demonstrated that an emission from the SSc is not a transmitter emission (e.g. by disabling the SSc's transmitter) or it can clearly be demonstrated that it is impossible to differentiate between other emissions and the transmitter (unwanted) emissions, that emission or aggregated emissions should be considered against the other emission limits.

The proposed limits for other emissions can be found in Table 2. The limits are in line with the recommended values in CEPT/ERC/REC 74-01 [i.10].

Table 2: Proposed limits for other emissions

Frequency range	Limit
30 MHz to 1 GHz	-57 dBm (EIRP)
above 1 GHz	-47 dBm (EIRP)

7.1.2.4 Receiver spurious emissions

Receiver spurious emissions are emissions of the receiver of a DUT when it is in a receive-only mode or is a receive-only device. Consequently, receiver spurious emission testing should apply only when the equipment can work in a receive-only mode or is a receive-only device.

For collocated Tx/Rx equipment that does not have a receive-only mode, the receiver spurious emissions are usually considered within the scope of the transmitter parameter "other emissions".

The proposed limits for receiver spurious emissions can be found in Table 3. The limits are in line with the recommended values in CEPT/ERC/REC 74-01 [i.10].

Table 3: Proposed limits for receiver spurious emissions

Frequency range	Limit
30 MHz to 1 GHz	-57 dBm (EIRP)
above 1 GHz	-47 dBm (EIRP)

7.2 Example specifications of the Q Microwave SubSystem (Q-MSS)

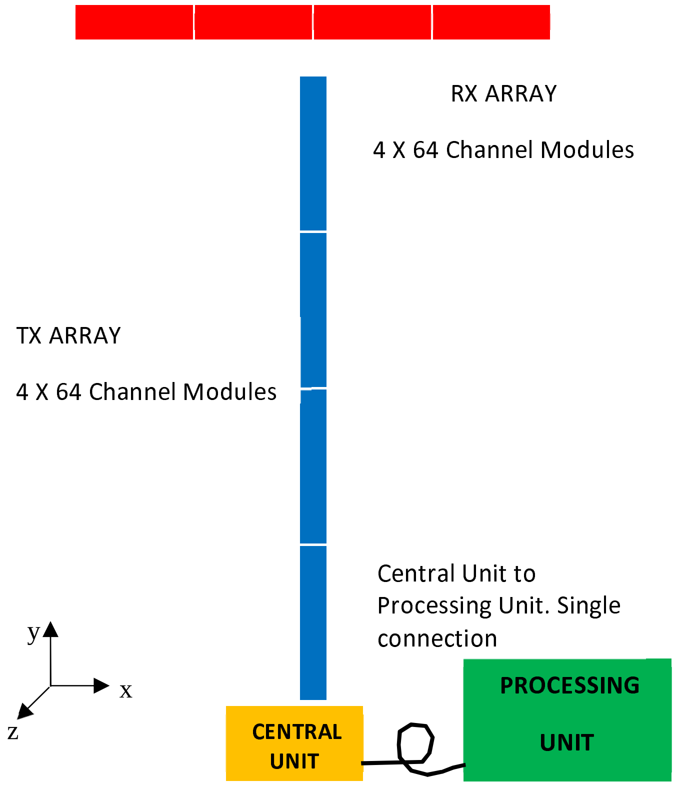
7.2.1 Product Description

Based on the Infineon chip, the Q Microwave SubSystem (Q-MSS) implements real time imaging of a short-range area. 256 transmitters (only one transmitting at a time) and 256 receivers are positioned in a T shape mechanical structure and are managed by a central unit controller, located behind the T.

Processing unit that performs the concealed weapon early warning algorithms that automatically detects, classifies and communicates the presence of threats in open spaces and distinguish them from innocent objects with extremely high probability of detection and negligible false positive.

The system communicates using standard wired communication (Ethernet).

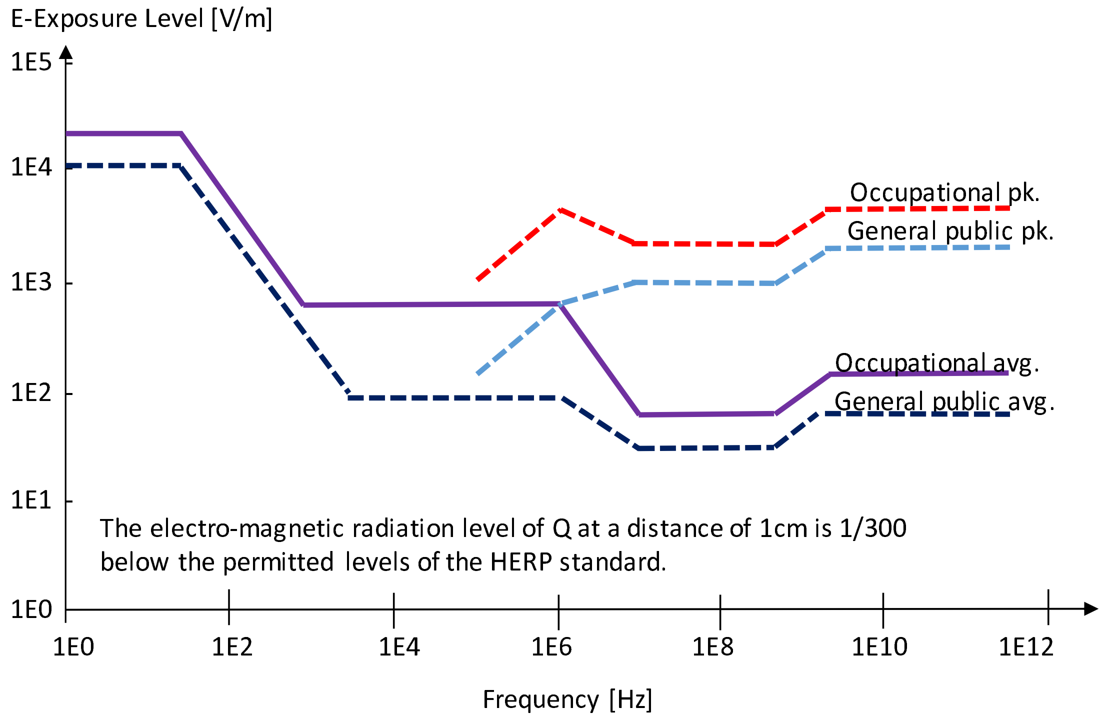
There are several versions of the line array with dimensions 50 cm, 100 cm and 180 cm. The main beam observation direction is in z direction, see Figure 8.



NOTE: Picture courtesy of Levitection and permission to be used in the present document has been granted.

Figure 8: Typical architecture for Q-MSS

Hazard of EM Radiation to Personnel is in line with the limits given by International Commission on Non-Ionizing Radiation Protection (ICNIRP Guidelines) [i.11] as shown below.



NOTE: This figure is courtesy of ICNIRP and permission to be reproduced in the present document has been granted.

Figure 9: Q Safety - HERP standard, HERP limits

The electromagnetic radiation level of Q at distance of 1cm from it is 1/300 below the permitted levels of the HERP standard.

7.2.2 Technical parameters

Technical parameters of an exemplary system Q-MSS from the company Levitection is provided in Table 4 given below.

Table 4: Technical parameters of the Q-MSS system

CHARACTERISTIC	Value			Unit
	Min	Nominal	Max	
Center frequency		73		GHz
Bandwidth		4 000		MHz
Waveform	Linear Frequency Modulation chirp			
Peak EIRP (see note 1)		16	20	dBm
			100	mW
Transmission duty cycle	2 %		8 %	
Average EIRP	3		9	dBm
	2		8	mW
Antenna coverage- AZ/EL		90		Degrees
Duration between transmissions		92		mSec
Transmission on/off ratio	37			dB
Spurious level, out of band			-66	dBc
Phase noise level (see note 2)			-97	dB
NOTE 1: Typical antenna gain is 5,5 dBi in boresight, and typical antenna output power is 10 dBm. NOTE 2: Over the entire system bandwidth. NOTE 3: Technical parameters of the Q-MSS courtesy of Levitection and permission to be used in the present document has been granted.				

7.3 Status of technical parameters

7.3.1 Current ITU and European Common Allocations

According to ITU allocation approved October 2018 the following allocations apply [i.7].

Table 5: Current ITU and European Common Allocation extraction

RR Region 1 Allocation and *RR footnotes applicable to CEPT*	European Common Allocation and *ECA Footnotes*	ECC/ERC harmonisation measure	Applications	Standard
66 GHz - 71 GHz				
INTER-SATELLITE MOBILE *5.553 5.558* MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE *5.554*	INTER-SATELLITE MOBILE *5.553 5.558* MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE *5.554*			
71 GHz - 74 GHz				
FIXED FIXED-SATELLITE (SPACE-TO-EARTH) MOBILE MOBILE-SATELLITE (SPACE-TO-EARTH)	FIXED FIXED-SATELLITE (SPACE-TO-EARTH) MOBILE MOBILE-SATELLITE (SPACE-TO-EARTH)	ECC/REC/(05)07 [i.21]	Fixed	ETSI EN 302 217-1 [i.18]
74 GHz - 75,5 GHz				
BROADCASTING BROADCASTING-SATELLITE FIXED FIXED-SATELLITE (SPACE-TO-EARTH) MOBILE Space Research (space-to-Earth) *5.561*	BROADCASTING BROADCASTING-SATELLITE FIXED FIXED-SATELLITE (SPACE-TO-EARTH) MOBILE Space Research (space-to-Earth) *5.561*	ECC/REC/(05)07 [i.21] ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19]	Fixed Radiodetermination applications Space research	ETSI EN 302 217-1 [i.18] ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3]
75,5 GHz - 76 GHz				
BROADCASTING BROADCASTING-SATELLITE FIXED FIXED-SATELLITE (SPACE-TO-EARTH) MOBILE Space Research (space-to-Earth) *5.561*	BROADCASTING BROADCASTING-SATELLITE FIXED FIXED-SATELLITE (SPACE-TO-EARTH) Amateur Amateur-Satellite *5.561 ECA35*	ECC/REC/(05)07 [i.21] ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19]	Amateur Amateur-satellite Fixed Radiodetermination applications Space research	ETSI EN 302 217-1 [i.18] ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3]
76 GHz - 77,5 GHz				
RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-Satellite Space Research (space-to-Earth) *5.149*	RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-Satellite Space Research (space-to-Earth) *5.149*	ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19] ERC/REC 70-03 [i.19] ECC/DEC/(04)03 [i.24] ECC/DEC/(16)01 [i.25] ERC/REC 70-03 [i.19]	Amateur Amateur-satellite Radio astronomy Radiodetermination Applications Radiolocation (civil) Railway applications SRR TTT	ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3] ETSI EN 301 091 [i.20] ETSI EN 302 264 [i.15] ETSI EN 301 091 [i.20] ETSI EN 303 360 [i.16]
77,5 GHz - 78 GHz				
AMATEUR AMATEUR-SATELLITE RADIOLOCATION *5.559B* Radio Astronomy	AMATEUR AMATEUR-SATELLITE RADIOLOCATION *5.559B*	ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19] ECC/DEC/(04)03 [i.24]	Amateur Amateur-satellite Radio astronomy Radiodetermination Applications SRR	ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3] ETSI EN 302 264 [i.15]

Space Research (space-to-Earth) *5.149*	Space Research (space-to-Earth) *5.149*			
78 GHz - 79 GHz				
RADIOLOCATION Amateur Amateur-Satellite Radio Astronomy Space Research (space-to-Earth) *5.149* *5.560*	RADIOLOCATION Amateur Amateur-Satellite Radio Astronomy Space Research (space-to-Earth) *5.149* *5.560*	ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19] ECC/DEC/(04)03 [i.24]	Amateur Amateur-satellite Radio astronomy Radiodetermination Applications Radiolocation (civil) SRR	ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3] ETSI EN 302 264 [i.15]
79 GHz - 81 GHz				
RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-Satellite Space Research (space-to-Earth) *5.149*	RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-Satellite *5.149*	ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19] ECC/DEC/(04)03 [i.24]	Amateur Amateur-satellite Radio astronomy Radiodetermination Applications Radiolocation (civil) SRR	ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3] ETSI EN 302 264 [i.15]
81 GHz - 84 GHz				
FIXED *5.338A* FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE MOBILE-SATELLITE (EARTH-TO-SPACE) RADIO ASTRONOMY Space Research (space-to-Earth) *5.149* *5.561A*	FIXED *5.338A* FIXED-SATELLITE (EARTH-TO-SPACE) MOBILE MOBILE-SATELLITE (EARTH-TO-SPACE) RADIO ASTRONOMY Space Research (space-to-Earth) *5.149* *5.561A*	ECC/REC/(05)07 [i.21] ECC/DEC/(11)02 [i.22] ERC/REC 70-03 [i.19]	Amateur Amateur-satellite Fixed Radio astronomy Radiodetermination Applications	ETSI EN 302 217-1 [i.18] ETSI EN 302 372 [i.2] ETSI EN 302 729 [i.3]
NOTE: Footnotes present in this table are shown in italics and refer to [i.7].				

7.3.2 Sharing and compatibility studies already available

In ECC Report 139 [i.1] the impact of level probing Radars (LPR) using Ultra-wideband technology in all currently available frequency bands for LPR on radio communication services has been investigated. The studies in the frequency ranges around 24 GHz and 80 GHz with the Fixed Service, EESS passive and the radio astronomy could easily be used as reference for the higher frequency ranges requested in the present document.

Recommendation ITU-R M.2057-0 [i.26] on "Systems characteristics of automotive radars operating in the frequency band 76 to 81 GHz for intelligent transport systems applications" provides information regarding current status of the two ITU Recommendations (Recommendation ITU-R M.1452-2 [i.23], Recommendation ITU-R M.2057-1 [i.17]) dealing with automotive radars. This result is useful as desensitizing effect on radars operated in this frequency band from other services of a CW, FMCW or noise-like type modulation is predictably related to its intensity. However it should be considered that SScs are using much lower e.i.r.p output power than current Automotive Radars in the Range 76 to 77 GHz [i.15] which are allowed to transmit 55 dBm e.i.r.p.

7.4 Information on relevant standards

Table 6: Information on relevant standards

Type	Application	Frequency Ranges [GHz]	ETSI Standard	Status	Remark	Responsible ETSI TC ERM
Generic	Short Range Devices (SRD)	40 to 246 GHz	ETSI EN 305 550-1 [i.5] ETSI EN 305 550-2 [i.9]	EN Approval Procedure (ENAP) started	RED compliant	TGUWB
SRD	Tank Level Probing radar (TLPR)	4,5 to 7 GHz, 8,5 to 10,6 GHz, 24,05 to 27 GHz, 57 to 64 GHz, 75 to 85 GHz	ETSI EN 302 372 [i.2]	Cited in the OJEU	RED compliant	TGUWB
SRD	Level Probing Radar (LPR)	6 to 8,5 GHz, 24,05 to 26,5 GHz, 57 to 64 GHz, 75 to 85 GHz	ETSI EN 302 729 [i.3]	Cited in the OJEU	RED compliant	TGUWB
SRD	Short range radar equipment	76 to 77 GHz	ETSI EN 303 091-1 [i.12] ETSI EN 303 091-2 [i.13] ETSI EN 303 091-3 [i.14]	Published by ETSI		TGSRR
SRD	Short range radar equipment	77 to 81 GHz	ETSI EN 302 264 [i.15]	Published by ETSI		TGSRR
SRD	Obstacle Detection Radars for Use on Manned Rotorcraft	76 to 77 GHz	ETSI EN 303 360 [i.16]	Published by ETSI		TGSRR
Amateur	Commercially available amateur radio equipment	Not specified in the standard	ETSI EN 301 783 [i.8]	Cited in the OJEU	RED compliant	TGMARINE

8 Radio spectrum request and justification

The future use cases considered in the scope of the present document (see clause 5.1) can be rated as fixed or quasi-fixed radiodetermination applications.

The security checkpoint application is indoor. The weapon early warning application is both indoor and outdoor.

The proposed limits, bandwidth and frequency range for indoor usage are given in Table 7 below.

Table 7: Proposed indoor limits for maximum peak power, mean power spectral density and frequency range

peak power EIRP	10 dBm	in the direction of main radiation
mean power spectral density EIRP	-30 dBm/MHz	in the direction of main radiation
Frequency range	68 GHz to 82 GHz	
Bandwidth	Up to 10 GHz	

Higher power is proposed to be considered in the 71 to 75 GHz range. The proposed limits and bandwidth in this frequency range are given in Table 8 below for indoor and outdoor usage.

Table 8: Proposed indoor and outdoor limits for maximum peak power, mean power spectral density and frequency range

peak power EIRP	20 dBm	in the direction of main radiation
mean power spectral density EIRP	-23 dBm/MHz	in the direction of main radiation
Frequency range	71 GHz to 75 GHz	
Bandwidth	Up to 4 GHz	

9 Regulations

9.1 Current regulations

There are currently no SSc frequency designations from 68 GHz to 82 GHz.

9.2 Proposed regulation

Table 9: Proposed regulatory parameters (in dependence on ERC/REC 70-03 Annex 6 [i.19])

Frequency Band	Power/Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	Notes
68 to 82 GHz	10 dBm peak EIRP in the direction of main radiation -30 dBm/MHz mean EIRP in the direction of main radiation	Not specified	Not specified	For indoor usage of SSc
71 to 75 GHz	20 dBm peak EIRP in the direction of main radiation -23 dBm/MHz mean EIRP in the direction of main radiation	Not specified	Not specified	For indoor and outdoor usage of SSc

Annex A: Bibliography

- ETSI TR 103 181-3 (V1.1.1) (08-2016): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Part 3: Worldwide UWB regulations between 3,1 and 10,6 GHz."

History

Document history		
V1.1.1	April 2020	Publication