



Information Society Technologies  
Specific Support Action  
COMeSafety  
Communication for eSafety  
Contract number FP6-027377

Deliverable

## D05 Frequency Requirements

Version number	1.0
Lead contractor	BMW Forschung und Technik GmbH
Confidentiality status	PU
Due date of deliverable	30.06.2006
Actual submission date	10.08.2006
File name	COMeSafety_DEL_D05_FrequencyRequirements_v10.doc



SIXTH FRAMEWORK PROGRAMME

## **Authors**

Dieter Seeberger, DC AG  
Abdel Kader Mokaddem, Renault  
Luisa Andreone, Michele Provera, CRF

## **General Secretary**

Rudolf Mietzner  
Softlab GmbH  
Zamdorfer Straße 120  
81677 München / Germany

Phone +49 89 / 9936 1216  
E-mail [Rudolf.Mietzner@softlab.de](mailto:Rudolf.Mietzner@softlab.de)

## **Project Coordinator**

Dr. Timo Kosch  
BMW Forschung und Technik GmbH  
Hanauer Straße 46  
80992 München / Germany

Phone +49-89-382-41107  
Fax +49-89-382-7044991  
E-mail [Timo.Kosch@bmw.de](mailto:Timo.Kosch@bmw.de)

## Revision chart and history log

Version	Date	Reason
0.1	22.05.2006	first draft
0.2	07.07.2006	Revision of the first draft Text added for chap. 2.3, 2.5, 3
0.3	10.07.2006	Text added for chap 2.4
0.4	01.08.2006	Text added for chap 2.2
0.5	02.08.2006	Executive Summary added
1.0	10.08.2006	Final draft released

## Table of contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Spectrum Request</b>	<b>2</b>
2.1	Frequency range	2
2.2	Bandwidth	3
2.3	General Requirements	7
2.4	Radio Parameter	7
2.5	Protection of ITS applications	9
<b>3</b>	<b>System Reference Document</b>	<b>11</b>
	<b>References</b>	<b>13</b>

## Executive Summary

Preventive and active safety systems will significantly contribute to road safety. Inter-Vehicle and Vehicle to Roadside Communication is a key technology for these systems. Timely communication provides both the consolidation of data from different vehicles to generate information and the distribution of information or control data.

Depending on the traffic conditions, the surroundings, the density of vehicles and the urgency of information the communication system must cope with many different situations. The basis requirement for an Inter-Vehicle and Vehicle to Roadside Communication System is the availability of a dedicated frequency spectrum. The present document describes the frequency requirements which are already specified in a System Reference Document provided by an ETSI Technical Group with contributions from different stakeholders including the related research projects of the FP6.

# 1 Introduction

In the past main efforts on road safety had been done mainly with the focus on passive safety systems, which address the crash and after crash phase. The goal was and still is to reduce the consequences of accidents. Examples for passive safety components are restraint systems, airbags or special material for energy absorption.

Passive safety systems are important to save the life and healthy of the vehicle occupants. But it would be much better to avoid accidents at all. Measures for the avoidance of accidents have to aim at the time before a collision happens. Traffic safety systems in this field are called preventive and active safety systems.

Depending on the time up to a potential accident there are three different phases of active safety. The first phase is characterized by driver information and foresighted driving. Examples of applications for this phase are traffic information and measures for traffic efficiency.

In the second phase, the support phase, warning & assistance systems give the driver advice and warn him if a dangerous situation is coming up. Applications in this phase are hazard warning, notification of stop sign violation or traffic adaptive cruise control.

With the increasing crash probability and the shorter the time gap up to a potential crash is, there will be no time left for interactions with the driver and active vehicle control will become necessary. An example for the intervention phase is the automatic emergency braking.

The basis for all three phases is communications. Inter vehicle communications (IVC) provides a fast information exchange directly between vehicles without any time lag, which is required especially in the support and intervention phases.

Less time critical, but very effective is the information gathering and distribution via IVC. Sensor data of different vehicles can be merged to generate new information, which wouldn't be available based on the sensor data of a single vehicle. In the next step it is useful to provide this information also to other vehicles, but also to road operators and traffic management systems. Therefore it is obvious to extend the IVC by roadside to vehicle communications (R2V).

R2V provides additional features due to the location of the roadside unit and the possibility to communicate information which is available in the road infrastructure, e.g. in vehicle signature for safety but also traffic efficiency. At intersections R2V can also be a measure to protect other traffic participants like pedestrians or cyclists.

Among experts the advantage of IVC and R2V is to be without controversy and there are several research projects funded by the EC developing the communication system itself or applications based on this type of technology. The common task of these projects is the support of the eSafety Initiative with its goals reduction of the number of road fatalities by 50 % up to 2010, improving the efficiency of road traffic, and promoting Intelligent Vehicle Safety Systems.

A fundamental pre-condition of the eSafety IVC and R2V system is the availability of an appropriate frequency band providing the required properties and use rights for reliable radio communications.

The present document resumes the spectrum requirements as already collected and provided in the System Reference Document, available as a 2 part deliverable of the European Telecommunications Standards Institute (ETSI).

## **2 Spectrum Request**

### **2.1 Frequency range**

Beside technical criteria there are two good reasons to introduce IVC and R2V in the 5 GHz band, which will be explained in the following chapters.

1. A common characteristic of all active safety applications is the fact that a certain penetration of equipped cars is required to have an impact on the road safety and traffic efficiency. Simulations resulted in a minimum penetration rate of 10 % for safety applications.

Investigations have shown that depending on the introduction scenario a minimum penetration rate of 10 % will be reached after 1.5 year if all new cars would be equipped with IVC systems. If only 50 % of the new cars would be equipped, it would take 3 years, which is a period, where business cars are already resold without having an advantage of the investment for an IVC system.

An additional stimulation must be provided for the system introduction. The system has to provide applications, which offer an immediate benefit to car holders and drivers. A promising strategy would be to provide together with the safety applications the possibility of hotspot access, which enjoys an increasing demand. Hotspot access at gas stations gives the possibility to get information about restaurants, sight seeing points or traffic data along the anticipated route. Other applications based on communications between vehicles and fixed stations are wireless media file exchange at home or wireless diagnosis at workshops.

Hotspot communications is based on WLAN technology. Currently systems most systems are operated in the 2.4 GHz band. But due to the fact that this band is already very crowded, recently a huge band is assigned for WLAN in the 5 GHz range. Usual WLAN PC-equipment provides the possibility to switch between these 2 bands and the introduction of 5 GHz WLAN hotspots will follow soon.

The vicinity to the 5 GHz WLAN spectrum is the premise for a cost-efficient multi-application communication system providing the capability for traffic safety and efficiency.

2. The USA decided already some years ago to introduce IVC and R2V system in the 5 GHz range. The Federal Communications Commission (FCC) assigned a band of 75 MHz from 5.850 GHz to 5,925 GHz for

ITS applications. To shorten the system development phase it was decided to take an existing standard as the basis for the new system. As a result of a technical evaluation the standard IEEE 802.11a was selected. The modified version, which considers among other features the mobility of the vehicles is currently under development and will be IEEE 802.11p.

The major car manufacturers are trading worldwide and for economical reasons it is desirable to avoid special versions for the different markets. At least the basic radio hardware including the antenna should be the same for the US and European market to avoid barriers to trade and to allow the exploitation of economy of scale effects. This is only possible if in Europe a frequency can be allocated in the 5 GHz band too.

## **2.2 Bandwidth**

Critical road safety applications for ITS system require  $2 \cdot 10$  MHz. Furthermore  $3 \cdot 10$  MHz of spectrum is needed within the same frequency range for road safety and traffic efficiency applications.

Road safety and traffic efficiency systems include a variety of applications. The following are just some examples:

- Collision Warning
- Curve Speed Warning
- Safe lane change manoeuvres
- Road departure prevention
- Cooperative manoeuvring (e.g. highway merging)
- Cooperative tunnel safety
- Hazard and incident warning
- Safe urban / extra urban intersections
- Wrong Way Driver Warning
- Vehicle-Based Road Condition Warning
- Work Zone Warning
- Approaching Emergency Vehicle Warning
- Hazard Warning in safety critical situations
- Traffic signal Violation Warning
- Emergency Electronic Brake Lights
- Highway Merge Assistant
- Intelligent Intersection Control

The European Integrated Projects SAFESPOT, CVIS, COOPERS are currently working on the definition of the reference applications that will be implemented in the test sites for road safety and traffic efficiency. In

particular the SAFESPOT integrated project is focused on the development of cooperative systems to prevent road accidents developing a "Safety Margin Assistant" that detects in advance potentially dangerous situations and extends "in space and time" drivers' awareness of the surrounding environment. The Safety Margin Assistant will be an Intelligent Cooperative System based on Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication.

When a certain specific ITS application requires the communication of a message, the information is included in a 500  $\mu$ S signal which is transmitted instead of the heart beat signal to other vehicles within the ad hoc network. If needed the information may be retransmitted by the vehicle receiving it to other vehicles up to a total distance dependent on the requirements of the specific application and the size of the ad hoc network.

A typical communication range is below 500 m for rural areas and 300 m in urban and suburban areas. Considering typical values for traffic density a proper value for an average communication range in rural and suburban areas is 300 m and messaging between 2 consecutive vehicles driving on a motorway with 120 km/h the safety distance and therefore the required communication range is about 60 m and the dynamic power level applied for this communication would be 3 dBm.

The Roadside Units (RSU) provide communication zones typically around 600 m in rural areas and 400 m in urban areas dependent on the particular application. With the RSU in the centre of the communication zone the communication range is 300 m for rural areas and 200 m for urban areas.

The transmitting power may be asymmetric for uplink and downlink communications as the RSU will deploy directive antennas. This means that the average interference contribution from RSU's will be significantly lower than the e.i.r.p. value would indicate.

The typical communication types may be described as follows:

- Vehicle-to-Vehicle (IVC) communication exchange for ad-hoc mobility mechanisms. These protocols maintain data vehicle connectivity and proper forwarding capabilities in a fast changing network spanned by the vehicles.
- Vehicle-to-Vehicle (IVC) applications, delivered potentially via multiple hops;
- Infrastructure-to-Vehicle (R2V) applications;
- Vehicle-to-Vehicle message forwarding, which extends the range, and the reliability of infrastructure communication. At the same time, this expended range also increases the concentration of communication in the proximity of infrastructure nodes.

### Average traffic scenario at crossing - leading to spectrum requirements

Scenario assumptions:

Area considered	~100 m around crossing
Number of vehicles	~100
Number of traffic light segments	~20
Number of other RSUs – active traffic signs	~50

The traffic scenario includes the following applications:

1. Inter-vehicle hazard warning
2. Traffic light (traffic signal efficiency)
3. Approaching emergency vehicle warning
4. IP-based safety messages
5. C2C beaconing (Vehicle + Roadside + traffic lights)

The necessary bit-rates (bits/s) for this scenario are indicated in the table below. There are some characteristics of ITS communications that has a great impact on spectrum utilization:

- The communication is used to prevent accidents. This means that there must be a high reliability to receive such a message. Therefore long-term blocking interference is unacceptable - either from other ITS users or non-ITS users.
- No central communication control will exist in an inter-vehicle situation. Hence there is a need to use ad-hoc transmissions with a high repetition rate so that a sufficient number of frames are transferred even in a high-speed closing scenario between vehicles on a motorway.

Inter-vehicle communications (mainly car-to-car frames are assumed in this table)

Crossing scenario.	Appl 1	Appl 2	Appl 3	Appl 4	Appl 5	Appl 6		
	MHW	Traffic signal efficiency	Approaching Emergency vehicle warning	IP based safety message	C2C beaconing vehicle	C2C Beaconing (traffic light and other RSUs)		
C2C NL overhead (bit)	372	372	372	372	136	136		
Security overhead	1033	1033	1033	1033	1033	1033		
IP overhead	0	0	0	480	0	0		
transport overhead	0	0	0	160	0	0		
Applicaiton-layer	200	500	300	160		0		
Transmisstion Frequency	10	4	5	6	1	1		
Bit rate (bit/s)	16050	7620	8525	13230	1169	1170	<b>47764</b>	bit/s
Number of transmitting stations	40	20	20	20	100	70		
Needed bandwidth (bit/s)	642000	152400	170500	264600	116900	81900	<b>1,43</b>	Mbit/s

It appears reasonable to apply a robust modulation scheme for safety-relevant transmissions in order to reduce the number of transmissions-errors and accordingly the number of retransmissions. For a 20 MHz channel of an IEEE 802.11a system the most robust modulation provides a data-rate of 6 MBit/s. Calculations show that in case of saturation (every station always has packets to be sent) the throughput above the MAC-layer will be less than 3 Mbit/s [Het01]. It is important to note that saturation has a great impact on the collision probability and the time needed to actually send a packet (latency). Furthermore the throughput will be dropped down by the hidden node problem due to shadowing effects in the traffic environment. Consequently, in a worst case scenario with simultaneous applications sending packets in parallel by different nodes a reasonable value to meet the latency constraints would be 3 Mbit/s, which corresponds to a 20 MHz channel with IEEE 802.11a or 2 x 10 MHz with IEEE 802.11p.

Vehicle to Roadside applications based on the same traffic scenario

Crossing scenario	Appl 7	Appl 8	Appl 9	Appl 10	Appl 11	Appl 12		
	Roadsign beaconing	Local hazard Map download	Slippery road warning	Hazardous goods rerouting	Local Traffic Warning	Cooperative routing		
WSMP overhead	80	80	80	80	80	80		
Security overhead	1033	1033	1033	1033	1033	1033		
IP overhead	0	480	0	0	0	480		
transport overhead	0	160	0	0	0	160		
Application data	160	100000	240	360	360	5000		
BPS per station	1273	101753	1353	1473	1473	6753		
Repetition rate	5	1	10	10	5	5		
# of stations	20	5	2	5	5	20		
Needed bandwidth	127300	508765	27060	73650	36825	675300	1,81	Mbit/s
Needed bandwidth	127300	508765	27060	73650	36825	675300	1,81	Mbit/s

This roadside to vehicle communication scenario gives a throughput of 1.81 MBit/s, which result analogue to the inter-vehicle communications in a reasonable spectrum requirement of 30 MHz independent of splitting into several channels.

The last 20 MHz inside the ISM band (5.855 – 5.875 GHz) is needed for Inter-vehicle communication of non-safety applications, i.e. applications where loss of communication does not have impact on safety issues. These applications would normally reside inside the 5.47-5.725 W-LAN band, but because of the high station mobility there is no possibility to apply Dynamic Frequency Selection (DFS). Applications would typically be partly infotainment such as vehicles travelling in a group would use interactive digital communications, and partly commercial such as updating fleet databases between commercial vehicles when they meet. Since this typically involves moving large amounts of data, there is no attempt to calculate this here. 20 MHz is the minimum to provide communications in one channel of an IEEE 802.11a system or 2 x 10 MHz to allow two platoons of communicating vehicles to pass without losing the communication.

## **2.3 General Requirements**

IVC has been a topic in the research since the European funded project PROMETHEUS which started in the second half of the eighties. Although many technical key challenges were solved in a number of research activities, IVC systems have not been implemented in vehicles so far.

One reason for this is that cheap radio hardware has not been commercially available so far. With the WLAN (IEEE 802.11) technology for the first time a radio technology is available as a mass product which fulfils the technical and business requirements. A second reason is, that no appropriate frequency band is available in Europe. In the US the allocation of 75 MHz of bandwidth for IVC and R2V communications has initiated strong and serious activities on developing and standardising radio systems adapted to the US traffic, road structure and regulations. The allocation of the frequency band was a strong impulse towards system implementation.

For advanced safety applications IVC systems have to be incorporated into cars to provide access to sensor data and to integrate the human machine interface. Also the installation of roadside units comes along with extensive planning effort and decisions on investigations. A definite frequency decision and implementation plan for the spectrum provision is required to support adequate and secure planning efforts for the car manufacturers and the road operators.

As the impact of road safety and traffic efficiency applications depends on the rate of equipped vehicles and installed roadside units, it is obvious that fast system introduction is a premise for the success of IVC.

Although advanced safety systems will increase the safety of car passengers, low costs are crucial for the willingness of customers to buy an IVC system. In particular car manufacturers made the experience that neither drivers nor car holders are willing to pay for operational cost, e.g. fees for the data transmission for active safety systems. Business cases must be based on buy and use models. The operation of safety applications must not cause any further costs. Therefore, the frequency band must allow operations without requesting any licence fee.

Particularly the spectrum for safety related ITS services must be individual license free because it is a public safety measure to improve road safety and as such there is a social engagement worthy to be politically supported. Furthermore individual licensing in a global car market would cause immense problems with the enforcement. In general costly licensing policies are expected to heavily slow down the take-off of advanced ITS services.

## **2.4 Radio Parameter**

The choice of the radio technology is crucial for the ability to fulfil the multiple requirements of targeted V2V and V2I applications: some

applications require a very high data rate, some are longer range with a medium data rate, and some have a low data requirement, but need to coexist with others. The radio technology has also to take into consideration the highly dynamic context of the communications.

The C2C-CC is currently preparing a specification for a Car to Car Communication System based on IEEE802.11p an amendment of the IEEE802.11 standard, variant of IEEE 802.11a.

IEEE802.11p, also referred to as Wireless Access for the Vehicular Environment (WAVE) is a MAC protocol being defined to support data exchange between high-speed vehicles (up to 200 km/h) and between these vehicles and the roadside infrastructure with ranges up to 1000m, in the 5.9 GHz operating frequency band, with an architecture specified to allow lower latencies (4 to 50ms) for real-time operation in a dynamic environment.

These advantages are linked to additional enhancements to 802.11 regarding the modulation and data structure scheme, providing automatic data rate and modulation scheme selection in cases of low received signal strength, and has an inbuilt frequency offset compensation mechanism that will enable Doppler compensation to be provided.

European regulations of WLAN frequencies require the solving of issues like interference with satellites and radar using the same 5.9 GHz frequency band. The amendment IEEE802.11h defines rules for Spectrum and Transmit Power Management Extensions and provides Dynamic Frequency Selection (DFS) and Transmitter Power Control (TPC) to the MAC protocol.

DFS ensures that channels containing radar are avoided and energy is spread across the band to reduce interference to satellites. TPC ensures that the average power is less than the regulatory maximum to reduce interference to satellites.

The maximum radiated power required is 33dBm e.i.r.p. (Equipment Class C) in accordance with the regulations and to support data rates of 3 /4.5 /6 /9 /12 /18 /24 /27 Mbit/s, the spectrum Mask for this equipment is given in the table below:

(in dBc)	+4,5 MHz Offset	+5,0 MHz Offset	+5,5 MHz Offset	+10 MHz Offset	+15 MHz Offset
<b>33dBm e.i.r.p.</b>	0	-26	-32	-40	-50

A detailed link budget has been evaluated in [SRDp1], it takes into account the antennas gain  $G_{e,s}$  in emission and reception, the power  $P_{e,s}$  in emission and reception and the path loss  $L(d, n)$  due to waves propagation within a range of transmission  $d$  and an environment coefficient  $n$ :

$$P_e = P_s + G_s + G_e + L(d, n)$$

For the requested  $EIRP = 33 \text{ dBm}$ ,  $G_s = G_e = 3 \text{ dBi}$ , and  $d = 1000 \text{ m}$  it is obtained a received power of  $P_e = -84 \text{ dBm}$ .

Considering the IEEE802.11p modulation schemes, this required receive input power correspond to data rates of 3 Mbit/s and possibly 4.5 Mbit/s, and can be supported over a range of about 1000 m. Note that for an  $EIRP = 30 \text{ dBm}$  as specified for IEEE 802.11a this communication range cannot be achieved.

## 2.5 Protection of ITS applications

Ad hoc communication between vehicles is subject to high dynamics. Connections between individual vehicles are often only of short duration and the channel access suffers under the problem, that transmitters, which cannot detect each other, might interfere at a common receiver. Using the spectrum in competition with other systems would aggravate the situation.

Depending on the traffic situation, the communication of information in good time and quality is crucial for the avoidance of accidents with all its consequences up to saving of life.

This does not mean that IVC needs an exclusive spectrum. But it is evident, that safety related ITS communications should not be delayed by other applications, which means there should be no contention with other applications for the same spectrum in the surroundings of the road network. For reliability of the information transfer safety relevant ITS communication should not interfere with other communication systems.

Compatibility studies will show, whether these requirements can be achieved under the existing regulations.

As a kind of 'effective protection' the principle of 'first come - first served' is applied for future frequency users, which means that any new frequency designation requested for other services will have to prove protection of ITS as an existing service by new compatibility studies.

Depending on the system implementation R2V communications provides more possibilities to control the channel and to improve the robustness of the communication links. With R2V communications at least the roadside unit is fixed and therefore the communication links are less dynamic than with IVC. But nevertheless the road safety and traffic efficiency applications require predictive sharing conditions.

In accordance with the ITU Radio Regulations and the European Common Allocation Table (ERC Report 25) the frequency band 5855-5925 MHz is allocated on a co-primary basis to

- The Fixed Satellite Service (Earth to Space)
- The Mobile Service

- The Fixed Service.

Furthermore the frequency band 5725-5875 MHz is designated as an ISM band (Industrial, Scientific and Medical equipment) and radio communication services within this band must accept harmful interference caused by these applications.

The band 5725-5875 MHz is also designated for Short Range Devices in Europe in accordance with ERC Recommendation 70-03. These applications are operating on a non interference and non-protected basis.

In Europe ECC Report 68 has defined the sharing conditions for Fixed Wireless Access applications (FWA) within the band 5725-5875 MHz.

Finally the frequency band 5250-5850 MHz is allocated to the Radiolocation service (civil and military radars) and the frequency bands above 5925 MHz allocated to the Fixed Service and the Fixed Safellite Service. These services needs protection from other services also from out of band emissions from ITS applications within the band 5855-5925 MHz.

Considering the ITS applications as a primary mobile service <sup>1</sup> compatibility will have to be agreed in sharing studies with the other primary services in the band and as the CEPT has decided that a full compatibility study should be developed both interference to and from the ITS applications should be considered.

Assuming successful compatibility with the other primary services in the band and with the primary Radiolocation service in the neighbouring band the sharing conditions for ITS has been defined and a frequency designation may be agreed by an ECC Decision and if applicable by an EC Decision in accordance with the Radio Spectrum Decision providing legal certainty to the frequency designation.

As the principle of 'first come - first served' is normally applied any new frequency designation for other services requested after the ECC or EC Decision regarding ITS will have to prove protection of ITS as an existing service by new compatibility studies.

Thus the use of ITS applications in Europe will be based on the interference potential described in the compatibility studies (interference to and from the ITS equipment) currently developed within the CEPT and with sufficiently detailed compatibility studies 'effective protection' and predictable sharing environment respectively will be ensured.

As it is questionable whether ITS applications are compatible with SRD applications and FWA application within the band 5855-5875 MHz the use of this sub band is envisaged for non safety applications and on a non protected basis.

---

<sup>1</sup> The definition of a Mobile Service in the Radio Regulations 1.24: A radiocommunication service between mobile and land stations, or between mobile stations.

### 3 System Reference Document

In general the spectrum allocation process starts at ETSI with the specification of the spectrum requirements in a so-called System Reference Document (SRDoc). The responsible group for ITS matters is the Technical Group 37 (TG37). This group is of course open for all ETSI members, but also non-members can join the group on invitation. Beside representatives from the industry, also some frequency administrations participate in TG37. Members of several currently running projects funded by the European Commission are represented in TG37.

Recently TG37 prepared 2 SRDocs requesting spectrum for ITS applications in the 5 GHz and 63 GHz spectrum. These SRDocs are available as ETSI Technical Reports. The spectrum with a bandwidth of 1 GHz in range from 63 - 64 GHz is already allocated, but the technical parameters for the spectrum usage are not fixed yet. Recently these parameters were specified in the SRDoc ETSI TR 102 400. Based on this SRDoc CEPT is investigating possible interference with other spectrum users.

The SRDoc for the 5 GHz ITS spectrum is divided into 2 parts. The first part provides the requirements for critical road safety applications with the focus on IVC [SRDoc p1]. Decentralised ad hoc communications between moving vehicles is subject to a high dynamic of the link quality and availability. Anyhow the road safety applications require a fast channel access and reliable communication links. This requires clear sharing conditions with primary use rights for IVC. The requested bandwidth of 20 MHz is split into 2 channels of 10 MHz each. One channel serves as a control and application channel and one only as an application channel.

The second part of the SRDoc requires spectrum for road safety and traffic efficiency with the focus on R2V communications [SRDoc p2]. The applications are less time critical, which allows some time for negotiation before the transmission of messages. The communication between vehicles and roadside units is more robust due to the possible antenna height and the possibility of a central organization of the channel access and spectrum distribution.

The SRDoc is not limited to a specific spectrum in the 5 GHz band, but the preferred spectrum is indicated as shown in [Figure 1](#). Especially the control channel of part 1 should ideally be in same frequency band as in the US, which is 5.885 – 5.895 GHz. The second channel of part 1 should be adjacent the control channel at 5.875 – 5.885 GHz or 5.895 – 5.905 GHz.

In addition to the spectrum for road safety and traffic efficiency the SRDoc part 2 requests 20 MHz of spectrum for non safety related applications. These applications complete the range of applications of the communication system to support the system introduction. They do not require any type of protection, and can therefore share the ISM spectrum.

The preferred spectrum range fits into the existing European frequency

Gelöscht: Figure 1

Gelöscht: Figure 1

table with a general allocation with mobile as a primary service in this range.

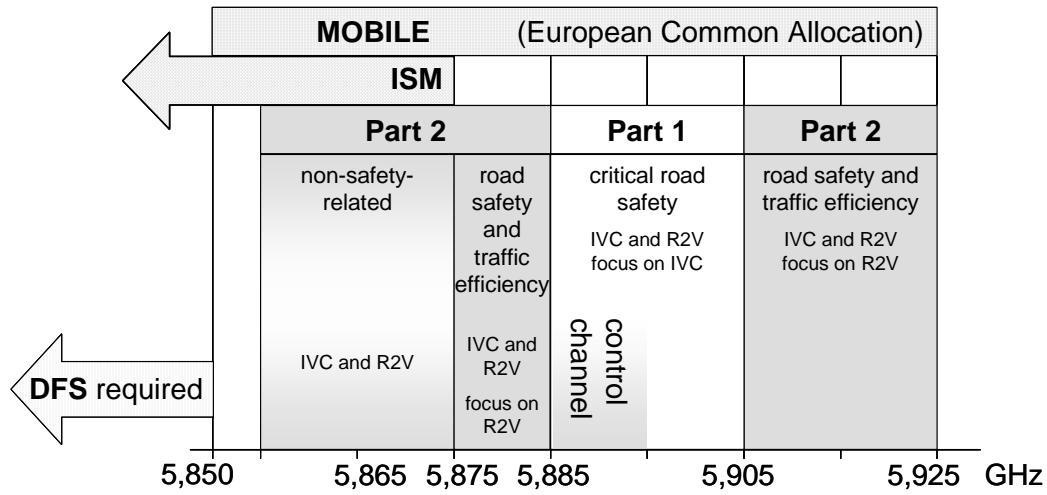


Figure 1: Preferred 5 GHz ITS spectrum

## References

- [SRDocp1] ETSI TR 102 492-1 V1.1.1 (2005-06)  
Electromagnetic compatibility and Radio spectrum Matters (ERM)  
Intelligent Transport Systems (ITS)  
Part1: Technical characteristics for pan-European harmonized  
communications equipment operating in the 5 GHz frequency range  
and intended for critical road-safety applications;  
System Reference Document  
ETSI, Sophia Antipolis, France, <http://www.etsi.org>
- [SRDocp2] ETSI TR 102 492-2 V1.1.1 (2006-06)  
Electromagnetic compatibility and Radio spectrum Matters (ERM)  
Intelligent Transport Systems (ITS)  
Part2: Technical characteristics for pan-European harmonized  
communications equipment operating in the 5 GHz frequency range  
intended for road safety and traffic management applications;  
System Reference Document  
ETSI, Sophia Antipolis, France, <http://www.etsi.org>
- [Het01] A. B. Hettich  
Leistungsbewertung der Standards HIPERLAN/2 und IEEE 802.11 für  
drahtlose lokale Netze  
ABMT Band 23, Wissenschaftsverlag Mainz, 2001

## Annex 1 Acronyms

C2C-CC	Car to Car Communication Consortium
CEPT	Conference of European Postal & Telecommunications
DFS	Dynamic Frequency Selection
EC	European Commission
ECC	Electronic Communications Committee
ERM	Electromagnetic compatibility and Radio spectrum Matters
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FWA	Fixed Wireless Access
IEEE	Institute of Electrical and Electronics Engineers
ISM Band	Industrial, Scientific and Medical Band
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
IVC	Inter Vehicle Communications
RSU	Roadside Unit
R2V	Roadside to Vehicle Communications
SRD	Short Range Device
SRD-MG	Short Range Device Maintenance Group
SRDoc	System Reference Document
TC	Technical Committee
TCP	Transmitter Power Control
TG	Technical Group
WLAN	Wireless Local Area Network