

## SRD/MG

### 53<sup>rd</sup> Meeting of SRD/MG

Biel/Switzerland, 07 – 09 September 2011

SRDMG(11)xx

**Date issued:** 2 September 2011

**Source:** Automotive industry (ACEA and CLEPA)

**Subject:** Contribution to Road map the future use of spectrum for SRD

Password protection required? (Y/N)\*

N

#### Summary

At the ECC workshop in Mainz April 2011 industry presented a variety of new spectrum requirements for short range devices within the frequency band 863-870 MHz as well as within the 870-876 MHz band. The FM WG adopted a roadmap to identify the spectrum requirements and the frequency opportunities to be considered as well as a framework for compatibility and sharing studies to be performed.

The automotive industry within the European Automotive Manufacturers Association (ACEA) and the European Association of Automotive Suppliers (CLEPA) provides this contribution to the roadmap activities within the SRD/MG and the FM working group with spectrum requirements based on existing and new radio services in the automotive industry for the next 10-15 years. This contribution is intended to further detail the contributions in the System Reference document (ETSI TR 102 649-2).

A list of typical future vehicle applications for the above mentioned frequency bands are provided. Several new radio services will be safety related and security services which will need spectrum regulation with higher protection against interferences than the standard short range devices while other services such as comfort systems and infotainment can use the existing SRD bands based on non interference and non protection conditions and different mitigation conditions but the use of the 870-876 MHz will improve reliability of the services. The automotive industry has categorised the applications with category 1 and 2 for this reason.

It is therefore important that the spectrum regulation for the new bands within 870-876 MHz provides an opportunity for sub bands with predictable sharing environment for safety related services. This is not meant to be exclusive bands but a sharing environment where predictable sharing is provided to the particular services. Automotive applications may share with other similar services based on specific sharing requirements..

The automotive industry is prepared to work with the CEPT and the European Commission to find acceptable solutions for all parties.

---

\* ECC policy is that in general all documents should be publicly available unless the author of the document requires that it be restricted to ECC family participants only

## Proposal

It is proposed that the future requirements for the new and innovative automotive radio communication services and functionalities are considered in the context of the implementation of the extended frequency bands for short range devices in 870-876 MHz in accordance with the Roadmap for future spectrum for Short Range Devices in Europe.

It is also proposed that in the consideration of the new spectrum requirements from several industry areas solutions are found to provide a predictable sharing environment for special services such as safety related applications.

In addition to the list of applications in this document an annex provides a list of examples for technical and operations information for typical automotive SRD applications. It is expected that the technical specification be provided in more details during the development of compatibility studies within SE24.

## Background

The automotive short range radio communication services have for many years been developed and operated within the Short Range Devices domain in the frequency bands 433.05-434.790 MHz and the 868-870 MHz under the regulatory regime of the ERC REC 70-03 and the EC Decision 2006/771/EC on harmonisation of the radio spectrum for use by Short Range Devices.

The general trend within the automotive industry is that short range communication services are developing rapidly and is expected to be expanded further over the next 10-15 years due to e.g raw material economy, weight, vehicle integration, functionality on safety, security, environment and comfort. This includes new radio communication services and applications to meet the increasing regulatory requirement for improved road safety and sustainable driving but also a technology paradigm shift where wireless communication replaces in car wired systems and where comfort systems and integrated infotainment systems are required by the customers.

The increasing requirements for safety services which are often politically mandated increases the general spectrum requirement and in particular frequency bands with a more predictable sharing environment.

ACEA and CLEPA appreciate the ETSI system reference document TR 102 649-2 for typical existing and new short range device applications. As indicated in the system reference document there is a need for more frequency spectrum for future SRD applications but here is also a need to consider a new approach for some applications requiring a higher level of protection with a more predictable sharing environment. This should be considered in the implementation of the Roadmap for future spectrum for SRD applications as adopted by the FM WG in May 2011.

The automotive vehicle manufacturers and suppliers within ACEA and CLEPA see a strong need for a range of new short range radio communication services within the next 10-15 years. It should be born in mind that the automotive industry is operating with a lead time of 7 years and a 15+ year's lifetime of vehicles. A long term and sustainable spectrum planning within both existing SRD bands but also within the bands 870-876 MHz is therefore absolutely necessary and ACEA and CLEPA are prepared to actively contribute to this process.

The medium to long term service development for the automotive industry includes the services and applications in the table below which justify spectrum availability for both given and future comfort services within short range device bands (Category 2) and safety/security services where a predictable sharing environment is justified by the nature of the service (Category 1). Some of the safety services are currently using the frequency band 434/868 MHz band but with the envisaged exponential take up of these services caused by EU regulatory initiatives mandating the services there is a strong requirement for more spectrum as well as for more predictable sharing environment.

List of current and future automotive applications.

Vehicle application	Description	Comments	Roadmap for spectrum needs	Category
<b>Active Safety</b>	Cooperative communication V2V and V2I for certain advanced safety and traffic efficiency applications requiring UHF propagation conditions e.g. looking around corners. This band is not intended to substitute 5.9 GHz.	An ongoing global requirement for 700-800 MHz ITS spectrum. In Japan 715-725 MHz allocated for Safety related	Needed for future developments within the next 5-10 years	1
	Remote control of vehicles - supervision channel. Continuous communication of position signals, watchdog and integrity signals	Autonomous driving requires interference protection within local area	Existing systems which will be further developed within the short to medium term	1
	Collision Avoidance of Vehicles on proving ground Monitoring of vehicle positions by continuous communication of position signals, event-based other messages (wrong way warning message etc)			1
<b>Diagnostic data exchange</b>	Currently utilised for commercial vehicles but will be extended to passenger cars in the future.  Diagnostic data exchange requires communication within but also to and from vehicles to provide for ongoing monitoring of vehicle functionalities and driver guidance. Diagnostic Data Exchange will support increased sustainability functionalities and reduction of CO <sub>2</sub> in vehicles  Communication with truck and trailer. Communication enables the driver to monitor the status of important points on the trailer – breaks, lighting – and tyre pressure individually.	Safety and Environmental related	Short to medium term requirement	1
<b>Freight protection</b>	Transfer of selected freight data. Authorities following commercial vehicles – special transports Cold store freight trailers providing data on temperature inside cargo container	Security	Short to medium term requirement	1
	Wireless camera link in trailer to monitor animals	Safety	Short to medium term requirement	1
	Wireless camera link to monitor children back seat			1
	Wireless rear view camera link for trailers			1
	Tire pressure monitoring systems for trailers	Safety		1
<b>Environmental /safety systems</b>	Tire Pressure Monitoring Systems (TPMS) are designed to improve road safety and to reduce CO <sub>2</sub> emissions. (flat tire/low pressure tire)	Safety -environmental Regulatory requirement for TPMS	Short to medium term requirement	1
	Wireless transmission of tire pressure safely and securely	Security	Short to medium term requirement	1
	Vehicle alarm systems such as panic alarm initiating functions such as siren and flashing lights	Security	Short to medium term requirement	1
	Wireless seat occupancy detection	Security	Short to medium term requirement	1
	Wireless sensors for pedestrian protection	Security	New service under development. Political safety requirement which is expected to be installed in all vehicles with in medium term	1

Vehicle application	Description	Comments	Roadmap for spectrum needs	Category
	Rear view camera	Security	Medium term requirement	1
	Remote Key Entry allows the driver to manually open the vehicle with radio controlled key	Available in all new cars – state of the art	Existing service	2
	Keyless or passive entry systems based on bidirectional communication between vehicle and driver. Proximity sensors built into the door detects the approaching driver. Allow access, comfort installation of vehicle facilities and starting engine with button without key ignition. Passive start without ID is not possible.	Existing system but increasing requirement in all vehicles. System more sensitive than Remote Key Entry system	Short to medium term requirement	2
<b>In car remote operation</b>	Wireless in car communication replaces existing wired connections for opening and closing of windows, sunroof, retractable hardtops, doors and trunk etc. Existing in-car remote operation will increase and in addition accessibility from outside the vehicle.	Comfort systems	Short to medium term requirement	2
<b>Comfort systems outside the vehicle</b>	Personal Car Communication allowing driver to receive information at a greater distance telling <ul style="list-style-type: none"> <li>- That lights or infotainment system is on</li> <li>- Detection of persons or animals left in the vehicle</li> <li>- Starting heating/cooling of vehicle</li> <li>- Status feedback of vehicle locking</li> <li>- Fuel level reading</li> <li>- Checking/controlling battery charging</li> <li>- Activating vehicle WIFI / GSM /vehicle position / car finder</li> <li>- Other control requirements</li> </ul> Some of the functions need significantly higher larger distance than typical remote key entry systems but will be integrated in the remote key entry systems and thus appear in the same volume.	Comfort systems	Short to medium term requirement	2
	Wireless sensors for different applications			2
<b>Infotainment</b>	Control of individual passenger radio and television and individual internet access within vehicles requiring increased communication both in-cars and external communication	Aftermarket/ nomadic devices but standard option in high end cars. Future requirement for all cars	Medium term requirement	2

## Examples of technical and operational information for typical automotive SRD applications.

To define parameters for such applications is under the current research conditions not widely possible. Therefore the parameters are not very detailed and could not yet be specified for a lot of different special application. The indications below are, however, intended to clarify the operational requirements.

### Active safety services completing but not substituting the 5.9 GHz ITS operation

#### Application description:

- Inter vehicle hazard warning in rural areas for secondary roads with a small number of vehicles, which are out of the communication range of max. 1000 m at 5.9 GHz or where connectivity is not available due to a hilly environment and winding roads. Use case could be ice warning, broken vehicle or other hazards behind a curve.
- Intersection collision warning in urban areas with narrow streets, where building hinders the required line of sight for communication at 5.9 GHz.

#### Communication bandwidth:

- Message size: 300 Byte including overhead for security etc.
- Rural scenario: Message transmission rate 1/s, 80 vehicles in a circle with 5 km radius (about 1 vehicle/square km) => 192 kbit/s
- Urban scenario: Message transmission rate 10/s, 25 vehicles within communication range => 600 kbit/s

#### Latency for messages:

- 100 ms for a message in the intersection scenario

#### Communication range:

- maximum range in rural areas 5 km,

#### This results in the following technical requirements

- Bandwidth: 1 MHz
- Transmit power: max. 500 mW
- Mitigation techniques: Transmit Power Control (TPC)

Others: 1 channel (Japan allocated 10 MHz in the range from 715 MHz to 725 MHz)

### Remote Control of Vehicles on Proving Ground

#### Application description:

- Remote control of vehicles (supervision channel): continuous communication of position signals, watchdog and integrity signals, event-based other messages

#### Net communication bandwidth:

- 1 KByte/s continuously (per vehicle, 10 vehicles)

#### Duration and latency for messages:

- <100 ms for a message of size 0,1KByte (200 ms round trip)

#### Communication range:

- typical range 2 km, maximum range (Papenburg) 5 km
- including roads going through wooded areas (within typical range); behind bushes (max. range)

#### This results in the following technical requirements

- Bandwidth: 200kHz (133 kHz plus overhead for data security, e.g. authorisation ~30 Byte/message => factor 1,3 min.)
- Transmit power: 125 – 500 mW
- Mitigation techniques: Transmission Power Control; with continuous transmission spectrum.
- Others: separation into channels requires additional spectrum

## Collision Avoidance of Vehicles on Proving Ground

Application description:

- Monitoring of vehicle positions: continuous communication of position signals, event-based other messages (wrong way, warning message, ...)

Net communication bandwidth:

- $4 * 50 \text{ Byte/s}$  continuously (per vehicle, 150 vehicles in total)  $\Rightarrow 30 \text{ KByte/s}$

Latency for messages:

- $< 100 \text{ ms}$  for a message of size  $0,2 \text{ KByte}$  (200 ms round trip)

Communication range:

- typical range 2 km, maximum range (Papenburg) 5 km
- including roads going through wooded areas (within typical range); behind bushes (max. range)

This results in the following technical requirements

- Bandwidth:  $500 \text{ kHz}$  ( $400 \text{ kHz}$  plus overhead for data security, e.g. authorisation  $\sim 30 \text{ Byte/message} \Rightarrow$  factor 1,15 min.)
- Transmit power:  $125 - 500 \text{ mW}$  (better to be specified: signal at limit of proving ground)
- Mitigation techniques: Transmission Power Control; with continuous transmission spectrum.

Others: TDMA, packet oriented

## General technical parameters for automotive SRD applications

- Preferred mitigation technique (LDC – LBT/AFA)

Preferred: LDC

Besides a remark: From the technical point of view, it is possible to realize LBT/AFA for Remote Key Entry systems (RKE). This will, however, result in higher system-costs regarding the need of transceiver in both key and car.  
There is, however, no possibility to use LBT/AFA for keyless entry systems (= keyless-go). The needed time for searching and synchronizing a free channel, will be too long.  
This is also indicated in TR102 649-2 chapter B.3.4 “Summarizing”.

Bandwidth: ► Bandwidth and transmit power

Per channel:

Occupied Bandwidth (transmitter aspect):  $120 \text{ kHz}$

Required receiver bandwidth:  $200 \text{ kHz}$

The regulation should allow to use at least 5 channels:  $\geq 1 \text{ MHz}$  bandwidth

See also description in TR102 649-2 chapter B.3.3.4, B3.3.5

Transmit power: The proposed regulations in TR102 649-2 chapter 7.2.2, table 3 g6 are sufficient

RKE:  $\leq 0,5 \text{ mW}$

Keyless entry (KG) key side:  $\leq 0,5 \text{ mW}$

Keyless entry (KG) car side:  $\leq 20 \text{ mW}$

Comfort functions (summer opening of windows, open the top etc):

$\leq 0,5 \text{ mW}$

Diagnostic functions (feature for car workshop), key side:

$\leq 0,5 \text{ mW}$

Diagnostic functions (feature for car workshop), car side:

$\leq 20 \text{ mW}$

► Duration and Latency requirements for messages

Duration:

Remote Key Entry (RKE):

≤ 100ms per telegram and per channel

≤ 200ms per channel inside 1 second.

≤ 600ms all channels inside 1 second.

≤ 1.6s per channel inside 1 hour. (4 open and 4 closing activities assumed)

≤ 4.8s all channels inside 1 hour. (4 open and 4 closing activities assumed)

Keyless entry (KG):

≤ 20ms per telegram and per channel

≤ 100ms per channel inside 1 second.

≤ 100ms all channels inside 1 second.

≤ 600ms all channels inside 1 hour. (4 open, 4 closing and 4 engine start activities assumed)

Comfort functions (summer opening of windows, open the top etc):

≤ 20ms per telegram and per channel

≤ 500ms all channels inside 1 second.

≤ 80s all channels inside 1 hour. (4 activities assumed, 40s pressed key button)

Diagnostic functions (feature for car workshop):

≤ 50ms per telegram and per channel

≤ 300ms all channels inside 1 second.

≤ 18s all channels inside 1 hour (works only when engine is active and speed >0km/h).

Latency requirements (values describe the needs for the RF-telegram, not the system aspect):

Remote Key Entry (RKE)

maximum allowed latency: < 50 ms

Keyless entry (KG):

maximum allowed latency: < 5 ms

maximum allowed latency per each single telegram: < 1 ms

Comfort functions (summer opening of windows, open the top etc):

maximum allowed latency: < 5 ms

Diagnostic functions (feature for car workshop):

maximum allowed latency: < 50 ms

Duty cycle:

See description in TR102 649-2 chapter 7.2.2 "Proposals and justification for RFID, non-specific SRDs and specific SRDs".

► Requirement to avoid in car interference

$T_{on\_max}$ :

A maximum continuous transmission time should be defined. For example < 100 ms

$T_{off\_min}$ :

Also a minimal transmission OFF-time should be defined.

In addition the above parameters should be vary in dependency of transmission power / or generated field strength inside the car. A device which generate a lower field strength inside the car, there is not the need to find hard regulations.

Also the look of  $T_{on\_max}$  and  $T_{OFF\_min}$  should be for the whole system, not only for one device.

For example: A look to a keyless entry system should not be only for the key or only for the car side, the look should include all relevant RF participants (all

involved keys and the relevant ECU).  $T_{on\_max}$  and  $T_{off\_min}$  should reflect the behavior of the whole system.

Further more it could be helpful, to view at which time the system will be activated. Possible timescales could be:

- a) engine off, car locked
- b) engine off, car unlocked
- c) engine on, speed = 0km/h
- d) engine on, speed > 0km/h

► Requirements for standardisation

duty cycle: A regulation in dependence of the observed time (1s, 1h, 1 day) should be sought.  
general: The proposed regulation in TR102 649-2 fits to our needs.  
A further development regarding  $T_{on\_max}$  and  $T_{off\_min}$ , also duty cycle with different observation times (1s, 1h) should be started.

In general the technical parameters may be considered as follows:

- Maximum of power levels : 10 mW
- Mitigation technique : LBT or Duty Cycle < 1%
- Sub band to be created : necessity to divide the bandwidth 3 MHz by 100 or other value to be discussed

Dependent on the different requirements the technical parameters for the band 870-873 MHz may be similar to the current technical requirements for the band 868.0-868.6 MHz.

**Existing Tire pressure monitoring systems (TPMS)**

- Transmit frequency, range of variation: +/- 100ppm
- Maximum power level: <0.5 mW
- Under driving conditions one telegram is typically transmitted every 60 sec
- Length of data frame: <20 ms
- ASK or FSK
- TPMS sensor is a transmit only component
- Frames are repeated 2 to 8 times to ensure correct transfer
- For interference mitigation, distance between the frames varies