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**View on AI 1.13: Impact of IMT-2020 in 71-76 GHz and 81-86 GHz into Automotive RadAR in 76-81GHz**

1. **Summary**

Automotive radars are already commercially available over 10 years, they have shown that radar based functions provide a significant contribution to improve traffic safety for vehicle passengers, pedestrians and other vulnerable road users. Vehicle Users and responsible authorities recognize this important contribution.

Automotive radar based functions are a key element for autonomous driving vehicles, as well as for current and future driver assistance functions. For autonomous driving vehicles and driver assistance functions, it is important that the radar-based functions are available in any traffic situation, without any interference and performance degradation.

For autonomous driving vehicles, automotive radar is one of the three different independent sensor technologies for environment sensing. The other sensor technologies are Lidar and video camera. An autonomous driving vehicle depends on the data from each of the three sensor types, loss of the data from one sensor type cannot be compensated by another. In higher levels of automation, autonomous driving vehicles do not have elements like steering wheels and brake pedals where the driver could react when environment sensing of the vehicle would fail.

The studies provided to ITU-R TG5/1 by GER, RUS and SUI concluded that even with a spurious emission limit of -30 dBm/MHz for IMT-2020 BS and UE operating in the bands 71-76 GHz and 81-86 GHz, automotive radars cannot be sufficiently protected.

It should be noted, that the CEPT position for the bands 71-76 GHz and 81-86 GHz is No Change.

1. **BOSCH view on AI 1.13, bands K and L**

In the band 71-76 GHz (band K), BOSCH supports No Change (method K1)

In the band 81-86 GHz (band L), BOSCH supports No Change (method L1)

1. **Background**

**3.1 Results of the studies**

Studies from two different sources were provided for both bands 71-76 GHz and 81-86 GHz.

One set of studies was provided by GER, RUS and SUI. The studies concluded that even with a spurious emission limit of -30 dBm/MHz for BS and UE operating in the bands 71-76 GHz and 81-86 GHz, automotive radars cannot be sufficiently protected. The following assumptions were used in the studies

Roll-off of the IMT-2020 unwanted emissions:

In the absence of an agreed model for the roll-off of the IMT-2020 unwanted emissions above 76 GHz and below 81 GHz, the unwanted emissions were assumed flat over the range 76-81 GHz.

IMT-2020 antenna pattern in the adjacent bands

There was no measurement of the IMT‑2020 antenna pattern in adjacent bands available.

Deployment scenario for the IMT-2020 components in 71-76 GHz and 81-86 GHz

It was found that there was no clear agreed information available about the foreseen deployment of IMT‑2020 UEs with respect to vehicles for these bands

However based on the available information about the expected deployment scenarios for the IMT-2020 components, a deployment in urban areas was assumed.

The results and conclusions of all studies were reflected in the

DRAFT NEW RESOLUTION [E113-IMT 70/80 GHZ] (WRC-19)**International Mobile Telecommunications in frequency bands 71-76 and 81-86 GHz**

(Draft CPM report chapter 2/1.13/5.13.6)

**3.2 Introduction to automotive radar sensors**

Automotive radars are commercially available in vehicles since the early 2000s. In the beginning, these systems were providing assistive functions such as adaptive cruise control (ACC) and collision avoidance (CA). Due to price and availability, only a few vehicles were equipped with radar sensors.

The technology evolved since the introduction of automotive radars. Based on significant research efforts, it was possible to further integrate the hardware for automotive radars. This helped to increase the availability and lower the piece price for a unit. This lead since 2010 to a significant increase in the number of radar equipped vehicles. The development and implementation of new functions that add to the safety of both vehicle passengers and pedestrians require more radar sensors to be deployed per vehicle.

* 1. **Operational characteristics of automotive radars**

With new radar based functions, today a vehicle is typically equipped with one to three radar sensors: one front facing, two at each rear corner of the vehicle.

In some vehicle implementations, the number will be even higher. Figure 1, from Report ITU‑R F.2394, illustrates the deployment of the radar sensor in a vehicle.

FIGURE 1

Geometrical sketch of automotive radar antenna position and direction for one vehicle
 (see Report ITU‑R F.2394)



For autonomous driving vehicles the number of radar sensors per vehicle is estimated to be 12 to 15.

The new radar based functions provide additional safety features to the existing features in urban and suburban scenarios for the vehicle passengers and the surrounding Vulnerable Road users.

 The following non‑exhaustive list shows examples for the radar based functions

 – Autonomous emergency braking in urban and sub urban situations.

 – Lane keeping assist / lane departure warning.

 – Pedestrian detection.

 – Rear crash.

 – Pre crash.

 – Parking aid.

**3.4 Autonomous driving vehicles**

For autonomous driving vehicles, automotive radar is one of the three different independent sensor technologies for environment sensing. The other sensor technologies are LIDAR and video. An autonomous driving vehicle depends on the data from the three sensor types, loss of the data from one sensor type cannot be compensated by another.

For autonomous driving vehicles the number of radar sensors per vehicle is estimated to be typically 12 to 15. In fully autonomous driving vehicles the number of radars could be higher.

In higher levels of automation, autonomous driving vehicles do not have elements like steering wheels and brake pedals where the driver could react when environment sensing of the vehicle would fail.

**3.5 Technical characteristics of automotive radars**

Automotive radar sensors are operational when the vehicle is in operation. Data is continuously acquired and stored. The function of the automotive radar sensor is always active independent of the vehicle speed.

Automotive radars are designed for operation in a dynamic environment, since the vehicle is moving on the roads at various speeds. Depending on the road the environment for the radar varies.

Automotive radars are designed for operating and providing full functionality in their operating environment. The design takes into account effects like e.g. rain, snow and clutter.

Automotive radars are designed for operation in the presence of the signals from other automotive radar sensors in the same frequency band.

Additional interference sources reduce the measurement range for the automotive radar sensor and will therefore lead to a degradation or unavailability of the radar functions.

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