Coexistence study between dect-2020 nr in the 3.8 to 4.2 ghz band and mfcn below 3.8 ghz

## introduction

This study focusses on coexistence between DECT-2020 NR operating in 3.8 to 4.2 with MFCN below 3.8 GHz. The study only considers the protection of MFCN from DECT-2020 NR.

It is highlighted that DECT-2020 NR does not following the cellular approach of a base station and user equipment/user terminal[[1]](#footnote-2). Within a DECT-2020 NR network, the radio device can have the following roles based on their location and capabilities in the network:

* Sink node: this is the gateway between the back-end network and the DECT-2020 NR cluster(s), for example the gateway to the internet or local back-end. The sink node is always a fixed termination point radio device (RDFT) role.
* Router node: extends the network by routing messages to other devices or clusters. The router node operates as RDFT role for its cluster members, and it operates as a RDPT (portable termination point) role in the next cluster heading to a sink node.
* Leaf node: the end point of the network and can only send and/or receive data. A leaf node is RDPT device.

Devices within a DECT-2020 NR network can dynamically change roles depending on the needs of the network. Consequently, the terms ‘base station’ and ‘UE’ are not applicable when considering DECT-2020 NR.

## Parameters

All parameters used in this study are in accordance with Sections 4.4.2 (DECT-2020 NR) and 5.2.1 (MFCN below 3.8 GHz) of ECC Report 358. For this study the following parameters are highlighted for convenience.

Table 1: DECT-2020 NR parameters

|  |  |
| --- | --- |
| DECT-2020 NR parameters | |
| Frequency | 3.805 GHz  3.915 GHz |
| Bandwidth | 6.912 MHz |
| EIRP | 23 dBm |
| Transmission Power Control | -40 dBm to 23 dBm  (ETSI TR 103 943 V1.1.1 (2024-01)) |
| Antenna height | 10 m |
| Antenna gain | 0 dBi |
| Scenario | Outdoor urban |
| Clutter | Applied at DECT-2020 NR in accordance with Rec. ITU-R P.2108 (50% clutter applied beyond 250 m) |

Table 2: MFCN base station parameters

|  |  |
| --- | --- |
| MFCN base station parameters | |
| Frequency | 3.75 GHz |
| Bandwidth | 100 MHz |
| Antenna | See Table 23 of ECC Report 358 |
| Antenna height | 20 m |
| Scenario | Urban macro |
| Cell range | 600 m |

Net Filter Discrimination (NFD) is used to combine the DECT-2020 NR transmitter spectrum emission mask and MFCN receiver mask. The spectrum emission mask is derived from the values provided in Table 14 and Table 15 of the ECC Report 358 (DECT-2020 NR spectrum emission mask for a channel bandwidth of 6.912 MHz and spurious emission limits) and the receiver mask derived from the ACS and blocking values given in Table 24 of the ECC Report 358.

The NFD is calculated using the method given in ETSI TR 101 854. A bandwidth correction is applied if the interfering transmitter’s bandwidth is greater than that of the victim receiver. The NFD is included as a loss on the radio interference path. Table 3 provides the calculated NFDs for different frequency separations.

Table 3: Calculated NFD for MFCN and DECT-2020 NR

|  |  |
| --- | --- |
| DECT-2020 NR Channel Centre Frequency (GHz) | NFD dB (MFCN as victim) |
| 3.805 | 21.0574 |
| 3.815 | 22.8877 |
| 3.825 | 24.2855 |
| 3.835 | 25.8083 |
| 3.845 | 28.1724 |
| 3.855 | 28.9566 |
| 3.865 | 29.1181 |
| 3.875 | 29.1189 |
| 3.885 | 29.1191 |
| 3.895 | 29.1192 |
| 3.905 | 29.1194 |
| 3.915 | 29.1195 |

Other NFD values at greater frequency separations level off at 29.1195 dB. This levelling-off is an artifact of NFD calculations when extended spectrum masks are defined (i.e. masks that extend beyond the first adjacent channel or the out-of-band domain).

## The simulation approach

Information provided by mobile network operators indicates that it is not possible to know the location of current, or future, MFCN base stations. Consequently, we have a scenario where the location of the victim receiver cannot be known and the potential interferer could be deployed anywhere within the victim’s coverage area. Therefore, it is not practicable to assume a geographical separation distance. In such circumstances it is common practice to adopt a statistical approach, via Monte Carlo analysis, to determine the probability of interference based on randomly generated locations.

For this study, Monte Carlo simulations were developed in Visualyse Professional. Only the Urban Macro is studied under the assumption that, in the 3 to 6 GHz range, contiguous coverage (of MFCN) is not expected in this frequency range in rural areas, and any such base stations that may exist in small numbers will be isolated installations at specific locations.

Using the agreed technical and propagation parameters, the simulation used the following approach:

* the MFCN base station was placed at a fixed location on a smooth Earth;
* an MFCN UE was randomly placed within the base station coverage area and the base station antenna directed towards it;
* a DECT-2020 NR radio device was randomly located within the base station coverage area;
* transmit power of the DECT-2020 NR radio device was randomly adjusted across the TPC range;
* the propagation loss and interfering power level at the MFCN base station was determined in accordance with ITU-R Rec P.452 (50% time), incorporating the base station antenna gain;
* clutter was applied where appropriate and in accordance with Rec. ITU-R P.2108;
* NFD was applied;

The above steps were carried out for 500,000 snapshots. At each snapshot a single DECT-2020 NR radio device is assumed. This is on the basis that in a DECT-2020 NR network, the probability of two devices transmitting at the same time is very low as each time a radio device initiates a random-access transmission it has to monitor with listen-before-talk to check if the channel is free. In addition, within a licensed authorisation regime such as that expected in 3.8-4.2 GHz, it is unlikely that two geographically overlapping WBB LMP networks will be assigned the same channel.

At each sample the parameters that can change within the Monte Carlo simulation are:

1. Victim antenna relative gain, i.e. the base station gain in the direction of the DECT-2020 NR radio device.
2. Transmit power of the DECT-2020 NR radio device via transmission power control.
3. Pathloss between DECT-2020 NR radio device and MFCN base station (ITU-R Recs P.452 and P. 2108 losses are independently variable).

An example of a snapshot (for the case where DECT-2020 NR is operating at 3915 MHz) is provided in Table 4.

Table 4: Snapshot example (from Visualyse Professional)

| Urban Macro.(end-start).Link Calculation | |
| --- | --- |
| Worst I | -162.871793 dBW |
| Frequency | 3.75 GHz |
| Carrier | MFCN |
| Bandwidth | 100.0 MHz |
| N | -120.901605 dBW |
| **Urban Macro.(end-start).Worst Interferer** | |
| Station | DECT NR |
| Interfering Bandwidth | 6.9 MHz |
| Interfering Power | -34.389116 dBW |
| Interfering Peak Gain | 0.0 dBi |
| Interfering Relative Gain | 0.0 dB |
| Path Loss | 120.015078 dB |
| ITU-R P.452 (50% time) | 95.536198 dB |
| 452 free space | 95.533194 dB |
| 452 gaseous absorption | 0.003004 dB |
| 452 fade / enhancement | 0.0 dB |
| 452 ducting / layer reflection | 84.937342 dB |
| 452 tropospheric scatter | 147.203898 dB |
| Diffraction type | Bullington And Spherical Earth |
| Diffraction | 0.0 dB |
| ITU-R P.2108 | 24.47888 dB |
| Victim Peak Gain | 25.778448 dB |
| Victim Relative Gain | -5.126546 dB |
| Victim Feeder Loss | 0.0 |
| Unadjusted I Signal Strength | -133.752293 dBW |
| I | -162.871793 dBW |
| I/N | -41.970188 dB |
| **Advantages** | |
| NFD adjustment | 29.1195 dB |

## Results and summary

The probability of interference from DECT-2020 NR into MFCN is given by:

*Probability of interference = ∑Snapshots where protection criterion is exceeded / ∑Snapshots*

Table 5 gives the results for a DECT-2020 NR interferer at 3.805 GHz and 3.915 GHz based on a protection criterion of -6 dB I/N and with TPC for DECT-2020 NR.

Table 5: Probability of DECT-2020 NR radio device exceeds -6 dB I/N at the MFCN base station receiver (Urban Macro case)

|  |  |  |  |
| --- | --- | --- | --- |
| MFCN Scenario | Centre freq of DECT-2020 NR | NFD | Probability of interference |
| Urban Macro | 3.805 GHz | 21.0574 dB | 1.76% |
| Urban Macro | 3.915 GHz | 29.1195 dB | 0.515% |

## Conclusion

As can be seen from Table 5, the probability of interference into MFCN is very low for radio devices operating with a maximum EIRP of 23 dBm and with transmission power control. It is highlighted that this study does not assume any indoor use of DECT-2020 NR or antenna heights below 10 m, both of which would further reduce the probability of interference. In addition, it is assumed that the probability of interference would also reduce when considering real-world equipment performance.

1. <https://devzone.nordicsemi.com/nordic/nordic-blog/b/blog/posts/dect-nr-a-technical-dive-into-non-cellular-5g> [↑](#footnote-ref-2)