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| ECC PT1 # 57 |  |
| Sophia-Antipolis, France, 11-15 December 2017 |  |
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| Date issued: | 6th December 2017 |
| Source:  | Qualcomm |
| Subject:  | Synchronisation of MFCN in 3400-3800 |
| NGroup membership required to read? (Y/N) |
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| Summary:  |
| Full synchronization of TDD networks is required to guarantee non-interference between TDD networks. However, full TDD synchronization also requires selecting a preferred frame, which brings large drawbacks especially when multiple technologies are deployed within a band. Unsynchronized BEMs may not be practically achievable for AAS-BSs. Technology enablers for semi-synchronization are expected to be developed by 3GPP in the context of release 16.Selecting a preferred option today at European level is sure to bring drawbacks. It is recommended to describe the issues at hand and recommend for administration to adopt a decision at national level. |
| **Proposal:** -Identify the feasibility of the unsynchronized BEM level for AAS BSs, with or without harmonization, as a priority item to be clarified during the public consultation.-Avoid selecting a preferred option in the report. Describe issues, challenges and elements of response in the report. -Recommend synchronization framework to be decided at national level.-Adopt explanatory text below as required for the report.   |
| Background:  |
| See below |

**Synchronised TDD networks, non-synchronised TDD networks and semi-synchronised TDD networks**

The three following definitions apply:

*Synchronised operation*: Synchronised operation in the context of this Report means operation of TDD in several different networks, where no simultaneous UL and DL transmissions occur, i.e. at any given moment in time either all networks transmit in DL or all networks transmit in UL. This requires the adoption of a single frame structure for all TDD networks involved as well as synchronizing the beginning of the frame accross all networks.

*Unsynchronised operation*: unsynchronised operation in the context of this Report means operation of TDD in several different networks, where simultaneous UL and DL transmissions occurs between any 2 networks. The TDD networks either do not operate with the same TDD frame structure or did not synchronise the beginning of the frame.

*Semi-synchronised operation*: semi-synchronised operation corresponds to the case where part of the frame is synchronised, while MNO remain free to use the other part of the frame without coordination between networks. This requires the adoption of a frame structure for all TDD networks involved, including slots were the UL/DL direction is not specified, as well as synchronizing the beginning of the frame accross all networks.

**AAS base stations, protection of radars and non-synchronised emission levels**

The baseline level defined by ECC Decision (11)06 for unsynchronised TDD blocks is set at -34 dBm/5MHz per cell e.i.r.p.. In the context of ECC Decision (11)06, if two MNOs did not want to synchronise their networks, they would simply equipe their BSs with additional filters to achieve the required emission level.

Such emission level was adopted to avoid interference in cases where non-AAS base station face each other directly. In such case, such a low emission level is required.

It is no longer possible for AAS base stations to adopt external filters. Any filter must be inplemented within the AAS panel. For example, in order to respect the emission level below 3400 MHz, it is expected that AAS panel will have to be designed specifically for such level and that a 20 MHz separation will be required to achieve required filtering.

Proposal:

 -Clarify in the report the impact of the emission limit below 3400 on the band plan in 3400-3800, i.e. which is the first block usable.

Questions to be clarified during public consultation:

-Is it reasonable to assume that AAS base station cannot comply with the unsynchronised BEM, unless the frequency range for such unsynchronised networks is harmonised throughout Europe and appropriate guardband is adopted.

**Synchronisation between LTE and 5G NR**

5G NR supports a number of frame and can, in particular, adopt a frame structure aligned with some LTE frame structure. As such, it is technically feasible to achieve synchronisation between LTE and 5G NR.

This is especially relevant in the 3400-3800 MHz band as LTE licences are issued, or LTE networks are deployed, in most European countries. No CEPT country has announced its intention to completely refarm the band for 5G.

However, most of the benefits of 5G NR are linked directly to the innovative frame structures supported by 5G NR. In particular, 5G NR is optimised to allow quick UL/DL turnaround. This feature is essential for ultra low latency services which require fast acknowledgement. In essence, the latency of an air interface is restricted by the frame length, since it determines the fastest acknowledgment period possible. As such, it is clear that adopting an LTE frame structure would significantly restrict the performance and operational capabilities of 5G NR deployments in this band. One proposal – to support the missing capabilities in other bands – may enable networks to achieve 5G grade, but does not provide a solution for the 3400-3800 MHz band. This band would become de facto a ’LTE-frame-exclusively’ band that does not support true 5G networks. In summary, aligning NR to LTE TDD strcuture would not allow to meet the IMT-2020 latency requirements.

**Synchronisation between TDD networks in practice**

Currently, TDD networks are in operation in many countries based on synchronised operation.

Typically, following a spectrum auction for the band, the regulators invites the operators to agree between themselves on a common frame structure, which is then adopted at national level. This typically works well when MNOs use the same technology and plan to deliver similar services.

**Options discussed so far in the draft report**

*Option A*

*The permissive baseline limit applies to synchronized MFCN networks with time aligned UL and time aligned DL control transmissions (where the technology allows, data transmissions may or may not be time aligned based on agreements between MFCN operators). In other cases the restricted baseline limit applies* however, a*greements at national level (including bilateral agreements among* any pair of adjacent MNOs) *may be concluded to allow the relaxation of the restricted BEM.*

Option A provides some flexibility for 5G NR to 5G NR synchronisation.

However, it still restricts the flexibility available to MNOs, which may want to synchronise part of their frame and keep part of the frame flexible, with regulatory constraints, based on MNO’s agreement.

Furthermore, it creates an asymmetry between the different MNOs. An MNO operating an LTE network would have no incentive to agree to a 5G NR frame structure. He can even argue that is current equipment cannot fulfil such requirement. As such he can impose to all other operators either to adopt an LTE frame structure or to deploy non-AAS base stations to fulfill the non-synchronised BEM. In either case, the new network’s functionalities would be severely impacted.

*Option D:*

*The permissive baseline limit applies to MFCN operation with time-aligned UL (control and data) transmissions and time aligned DL (control and data) transmissions.*

*For transmissions that do not follow the time alignment described above, the restricted baseline limit must be respected during such non-time aligned transmissions however, agreements at national level (including bilateral agreements among any pair of adjacent MNOs) may be concluded to allow the relaxation of the restricted BEM.*

Option D creates an asymmetry between the different MNOs. An MNO operating an LTE network would have no incentive to agree to a 5G NR frame structure. He can even argue that is current equipment cannot fulfil such requirement. As such he can impose to all other operators either to adopt an LTE frame structure or to deploy non-AAS base stations to fulfill the non-synchronised BEM. In either case, the new network’s functionalities would be severely impacted.

Furthermore, even if 3GPP standardizes in the future technology to enable operation of non-synchronised or semi-synchronised network, it would require a review of the regulatory framework and an update of the licences to enable such technology evolution.

*Inter operator synchronisation and alignment of UL/DL transmissions should be encouraged. When a market-driven solution could not be found, the regulator could consider to impose a "preferred" UL/DL arrangement, which should be defined in advance of any licence being acquired. Operators willing to adopt the "preferred" UL/DL arrangement would be able to apply the "permissive BEM", while operators that would decide for an alternative UL/DL arrangement would be required to comply with the "restricted BEM".*

Such solution corresponds indeed to the current situation when TDD networks all based on the same technology were deployed. It is unclear how a regulator from a country with existing LTE network could impose a 5G UL/DL arrangement which de facto would impose operational restriction for existing LTE networks (have to apply restrictive BEM for the newly awarded frequency blocks) and would not protect their network from interference from the new networks.

Such formulation in practice would force regulators to impose a 4G frame structure as preferred UL/DL arrangement.

**What else can be done?**

National regulators will have a lot more information at disposal when awarding the band, including information about the national legacy situation.

National level solutions may include:

 -refarming the band for 5G NR networks,

-providing incentives for legacy networks to upgrade to 5G NR technology,

-adopting solutions based on coordination with legacy BSs, and differentiated regulatory framework for future BSs,

-adopting an intermediate solution that may not guarantee fully interference free operation while not restricting fully network innovative functionalities,

-adopting regulatory framework taking into account new enabling technologies as they become available,

-adopting a differentiated regulatory framework for macro-cell and micro/pico/femto-cells.

**Proposal for the report**

Given the current understanding of the issue, the report may include:

‘*The synchronized BEM enables interference-free coexistence between networks operating in synchronized mode. The non-synchronised BEM enables interference-free coexistence between networks operating in unsynchronized mode.*

*Inter operator synchronisation and alignment of UL/DL transmissions should be encouraged to avoid interference between macro-cells, innovative features should not be unduly restricted and flexibility would bring benefits to MNOs. Operators are best placed to identify the right compromise between interference free operation, innovative features and flexibility at national level. However, regulatory intervention may be required to avoid asymmetric effects between MNOs.*

*The national regulatory framework should enable the identification of the optimal solution for synchronisation, as well as possibly its evolution in time (as technology evolve), in order to both achieve efficient spectrum use and mitigate/avoid interferences.*’