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Source: Ericsson GmbH, Eurolab, Vodafone Group Plc, Telecom Italia, Charter

Title: Considerations for the SBFD feasibility study

Document for: Decision

Agenda Item: 9.2.6, Study on evolution of NR duplex operation [RAN1 SI: FS_NR_duplex_evo]

Considerations for the SBFD feasibility study

- During the recent RAN1 meeting, there was some discussion from operators on the need to consider energy efficiency in the context of SBFD feasibility.
- We agree that, considering operators needs and network deployments, energy efficiency is very relevant to consider as part of feasibility.
- We also believe that there are several other aspects of site logistics that should be taken into account as part of considering feasibility.
- It is important to consider that, with large numbers of carriers and bands, achieving efficient multi-carrier and multi-band support with simplified site logistics (numbers of antennas, cables, antennas etc.), low weight and good energy efficiency is of high importance in today's marketplace.
- The following slides outline some examples for consideration.

Energy efficiency

- Different proposals have been put forward to achieve SBFD, which may include:
  - More powerful techniques for PA linearization, such as DPD.
    - This will add processing needs.
    - Any reduction of PA efficiency is important to consider.
  - Digital interference cancellation, for which an energy budget should be considered.
  - Receiver improvements to mitigate blocking and receiver non-linearities, which may impact receiver energy consumption.

gNB size and weight

- In order to achieve the TX-RX isolation, it is necessary to have separate TX and RX panels with a structure in-between.
  - If the antenna aperture and gain for both parts should be kept, this necessitates more than doubling of the form factor of the base station, with associated impacts of site planning, weight, wind load etc.
  - Otherwise, if the BS form factor is kept the same then the antenna aperture and gain needs to be reduced by at least 3dB, probably more (since the antenna area needs to contain the isolation structure).
  - Of the total theoretical gain of 7dB in uplink coverage by assuming a 4:1 DL:UL baseline TDD configuration, already 3-4dB would be lost.

Inter-sector and operator isolation within a site

- There is also considerable interference between the TX and RX of different sectors to the RX sub-band.
- Similarly, with SBFD there can be interference to the RX sub-band from other operator BSs sharing the same site, which necessitates an isolation between operators in the same site.
- There has been some initial discussion on the potential for mounting absorbers between sectors to mitigate this interference.
  - Depending on the size, weight, durability etc. of the absorption material, the need to mount absorbers could have the potential to considerably impact site logistics and lifetime.
- The feasibility study should consider the absorber performance vs. site logistics and lifetime considerations.

Multi-carrier and band considerations

- In most modern deployments, it is highly important that BS can transmit and receive multiple carriers and multiple bands or RATs.
  - Multi-carrier/band will make the signal structure of the TX-RX interference more complex.
    - If the interference suppression techniques only work for single carrier, then the SBFD BS would need to be deployed in addition to a regular BS handling other bands and carriers, with associated impacts on site and extra energy costs.
  - Regarding TX-RX isolation, is important that the isolation is not achieved over a narrow bandwidth and only with optimal beam directions.
    - The isolation needs to be achieved over most of the band which enables gNB to be configured according to operator's needs.
    - Otherwise, specific inflexible hardware variants of gNB with differently engineered antenna arrays need to be created for each operator configuration, and there is no flexibility for operators to re-configure the carrier planning in their networks once hardware is deployed.
  - The ability to build BS like current BSs that can be flexibly configured with carrier configurations as needed by the operator across a whole band or sub-band is an important part of the feasibility study.

Proposal

- The importance of the previously listed issues may depend on deployment scenario and obviously need to be weighed against gains to determine whether they impact feasibility.
- A feasibility study should outline consequences on site and multi-carrier operation to provide a complete picture of the feature.

- ***Proposal 1: Clarify that the feasibility analysis of SBFD in the SID RP-221352 includes studying aspects of energy consumption and other site/deployment related issues. Adopt the revised SID in RP-222488.***