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Discussion Paper on Motivation for the WI proposal: UMTS Heterogeneous networks

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Motivation for the WI proposal: UMTS Heterogeneous networks

- **The SI on UMTS Heterogeneous networks is proposed to be completed at RAN#62.**
- **A RAN1 CR to TR25.800 v12.0.0 is presented for approval and the conclusions are captured in the following slides.**

HetNet co-channel deployment (1/4)

- **Heterogeneous networks offer substantial throughput gains for HSPA. The gains increase as the percentage of UE offloaded from Macro cell to LPN increases.**
- **When placing LPNs within the Macro area, throughput increases significantly as the number of LPNs per Macro area and/or LPN transmit power increases**
- **UL/DL imbalance in HetNet creates issues such as HS-DPCCH reliability and uplink interference, limiting the downlink and uplink throughputs. To increase throughput gains, more UEs can be offloaded from Macro nodes to LPNs by applying the cell individual offset (CIO) to bias towards the LPNs during serving cell selection.**
- **Example performance**
  - DL: with 4 37dBm LPNs and CIO=3dB, the gains are in the order of 250% and 100% for the average and 5% UE throughput, respectively, with offloading percentage of about 50%.
  - UL: when placing 4 37dBm LPNs per Macro area, around 40% of the UEs are offloaded to LPNs and then above 250% average throughput can be achieved.

HetNet co-channel deployment (2/4)

- **Reliability of the control information**
  - DL: based on this study, it was found that some problems may arise when applying CIOs exceeding 6dB for single Rx antenna UEs and exceeding 9dB for dual Rx antenna UEs.
  - UL: to ensure HS-DPCCH reliability, several alternatives have been addressed, including boosting of HS-DPCCH or changes in power control/SIR can be done in current networks, or a new uplink pilot channel can be added.
- **Further gains can be achieved**
  - when the CIO values are adapted based on the cells' loading (decentralised biasing)
  - by minimizing interferences from UEs not in Soft HO towards Macro and LPN base stations originating from the UL/DL imbalance - limiting macro UL UE throughput, applying different values of CIO or receiver sensitivity level in LPN, ICIC or changing the carrier frequency for UEs

HetNet co-channel deployment (3/4)

- **E-DCH decoupling was one of the solutions considered in order to reduce the negative effect of DL/UL imbalance.**
  - EDCH decoupling gains up to 12% respect to the baseline co-channel deployment can be achieved depending on the scheduling algorithm. These gains are observed for CIO values between 3dB and 6dB, for which both UL and DL throughputs are maximized.
  - For CIO values up to 6dB, in the downlink the F-DPCH transmitted by the non-serving LPN is reliable and the same F-DPCH power as in baseline co-channel deployment can be used in E-DCH decoupling. Extra signalling information is needed to be exchanged between the network and the UE to decouple the UL in case of the UE entering SHO area.
- **E-DCH decoupling scheme was identified as a method which solves the problem with reception of UL HSUPA scheduling related information (happy-bit, Scheduling Information) by the serving macro cell.**
  - Other schemes improving the Scheduling Information reception reliability were also part of the study e.g. E-TFC selection back-off for UL SI, Dynamic power boosting etc.

HetNet co-channel deployment (4/4)

- **Network Assisted Interference Cancellation (NAIC) was studied and potential benefits and techniques have been identified.**
  - Both pre-decoding and post-decoding interference cancellation have been considered, and substantial gains of post-decoding IC over Type 3i can be achieved based on link level simulations. The link level simulation gains of pre-decoding over Type 3i receiver are also promising. Further system level investigations are needed in order to conclude on the benefits of NAIC.
- **Restricted Resources Subframe (RRS) pattern NAIC technique considers restricting the modulation or code set of the interferer on some pre-configured subframes**
  - UE throughput gains over a baseline without RRS pattern have been shown in link level simulations. Further evaluation of the impact on Macro capacity is needed.

WID proposal

- **It is proposed to open a WI in the following areas:**
  - Co-channel interference management –
    - Specify solutions to mitigate UL/DL imbalance.
  - Support range expansion for co-channel and multi-carrier deployment with and without multi-flow (e.g CIO, Macro power reduction, extended active set).
  - Consider support solutions of CIO adaptation for co-channel and multi-carrier deployment needing to ensure capacity improvements. Specify signalling for decentralized biasing
  - NAIC (Network Assisted Interference Cancellation)
    - Consider using NAIC to enhance LPN edge UE performance. Both pre-decoding and post-decoding IC should be considered and the gains and reliability of needed signaling to enable IC should be evaluated.

Thank you !