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USER MANAGEMENT IN COMPRESSED MODE

1 Introduction

In the UMTS FDD mode the system is said to operate in compressed mode when a base station provides idle gaps to allow a user equipment to perform measures. Two different means to provide idle gaps are specified in document S1.12:

- *Decrease the coding rate and increase the number of punctured bits*. There are some cases where the idle time required cannot be provided by this method (i.e. quality of service not satisfied, puncturing required higher than maximum allowed, …).

- *Halve the spreading factor of the user entering into compressed mode:* This approach is only applied when it is not possible to apply the previous one. This method has two major drawbacks: the code resources needed by the user are doubled and the instantaneous interference introduced in the system by this user is doubled as well.

In ETSI and 3GPP there have been some proposals to use a secondary scrambling code in the cell for users entering into compressed mode needing to halve the spreading factor. This solution enables a new set of OVSF codes to be used in the cell when a code shortage situation is reached. However, code shortage is unlikely to happen in systems to be deployed in the near future since interference will be the capacity limiting factor. Only if powerful location/beamforming/transmit adaptive antennas techniques are developed code shortage may be reached.

In the case where no more codes in the cell can be used due to interference, the introduction of a secondary scrambling code in the cell does not bring any improvement. The information transmitted to the user entering into compressed mode will roughly introduce the same amount of intercell interference in the system as if it was transmitted using the primary scrambling code.

2 User management to reduce interference introduced in compressed mode operation

The problems presented above (code shortage and increase of interference) can be solved if **users having the same spreading factor are frame synchronised two by two**. In general two different cases can be identified when a user needs to halve the spreading factor to enter into compressed mode:

- *No code shortage and the system is not close to the maximum interference supported:* In this case there is no problem to allow a user requiring to halve the spreading factor to enter in compressed mode.

- *Code Shortage or system close to the maximum interference supported:* In this case, the user requiring to halve the spreading factor cannot be allowed to enter into compressed mode because there are no more available downlink codes or because of a risk of a system crash.
  However, if there is another user in the cell using the same spreading factor and synchronised with him, both users can be set to go into compressed mode operation (halve the Spreading Factor) and to share the same downlink spreading code. That is possible only if idle gaps of both users are scheduled one after the other. See Figure 1:

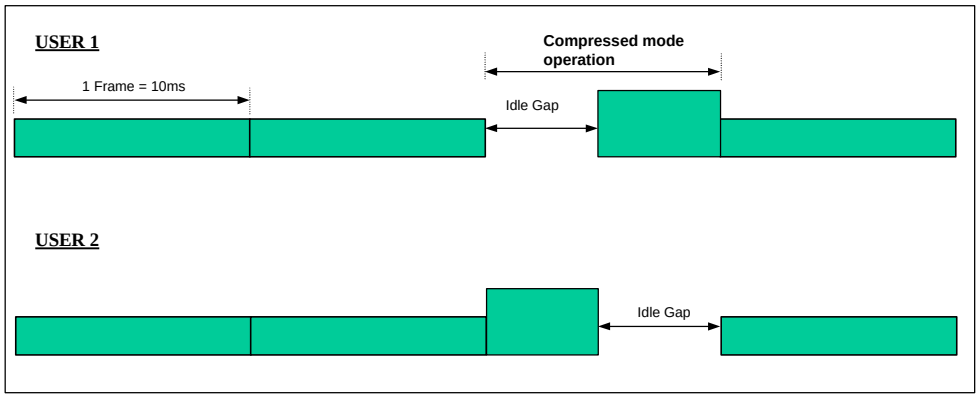

Figure 1: Synchronised users compressed mode operation

The scheme depicted in Figure 1 has the following advantages:

- The downlink code resources used in the system in compressed mode are the same as in normal mode since both users are halving the spreading factor (doubling the code resources required) but sharing the same spreading code.

- The total amount of interference introduced in the system in compressed mode is approximately the same than in normal mode since the power sent to user 1 does not overlap with the power sent to user 2.

- In the case where user 2 does not need to perform other system measurements and goes into slotted mode as a result of the previous situation, the idle gap can be used to monitor common pilots of the active cell. This information will be used to estimate the downlink channel path loss and send power control information to the base station. This will be applied to the data stream transmitted after the idle gap. Therefore, degradation of downlink performance in compressed mode will be reduced.

- This is a compatible solution with the secondary scrambling code.

- Current specifications assume that downlink users are chip synchronised but not frame synchronised. This leads to some interference averaging effect that improves system performance (DTX are placed at different time instants). If we consider current estimations of FDD cell capacity, the fact of having users synchronised two by two instead of having them asynchronous will have a minor impact on interference averaging.

3 Conclusion

This contribution has presented a simple method to reduce he impact of compressed mode on system performance. The implementation of this approach will need the following:

- The position of the idle gap in the frame is flexible. Already accepted in S1.12.

- Some higher layer signalling has to be introduced to inform a user that he will enter into compressed mode but that no measurements are required. Therefore, the UE can continue transmitting in the Uplink direction and it will have to monitor the downlink carrier during the gap length to estimate path loss and send TPC bits to the base station.