TSG-RAN Working Group 1 meeting #6 **TSGR1#6(99)828**
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Agenda item:
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Title: Channelization code allocation in uplink multi-code transmissions
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1 Introduction

At the last meeting in Cheju, it was agreed that the uplinlk multi-code transmission for high data rate is only applied for a spreading factor of 4. But, there was remained the detail method for channelization code allocation of DPDCH, when multicode transmission is applied.
This contribution proposes the method of channelization code allocation for more than one DPDCH.

2 Proposal

In [1], dedicated physical channels are spread by OVSF code $C_{SF,\ \text{code number}}$. Therefore, DPCCH is spread by OVSF code $C_{256,1}$ and DPDCH is spread by OVSF code $C_{SF,\ \text{code number}}$. For DPDCH, Ericsson proposed the method of channlization code, when multicode transmission is applied[2]. The concept is as follows:

- When one DPDCH is to be transmitted, $DPDCH_1$ is spread by the OVSF code $C_{4,2}$.
- When more than one DPDCH is to be transmitted, $DPDCH_n$ is spread by the code $C_{4,k}$, where $k = 2$ if $n \in \{1, 2\}$, $k = 3$ if $n \in \{3, 4\}$, and $k = 4$ if $n \in \{5, 6\}$.

We agreed the basic concept that the same OVSF code for I and Q is pairwise assigned for $DPDCH_n$. However, we would like to propose different order of k according to our PAPR (peak to average power ratio) simulation results.

Figure 1 and 2 show the case of one DPDCH transmission spread by single OVSF code with high power of the DPDCH. The best thing is still the one spread by code $C_{4,2}$ in this case like the relative low power (e.g. high SF) case of DPDCH.

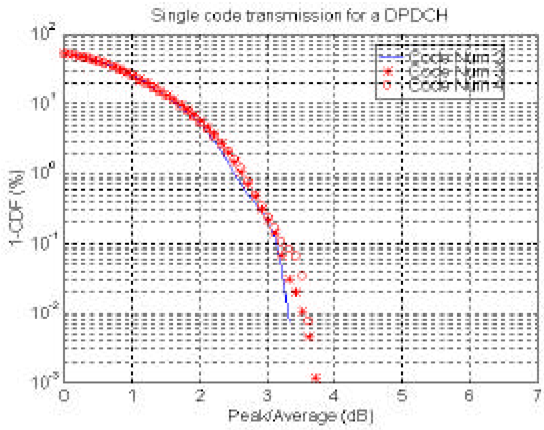

Figure 1. Single Code Transmission for a DPDCH
($DPDCH_1$ = 21dB, DPCCH =0 dB)

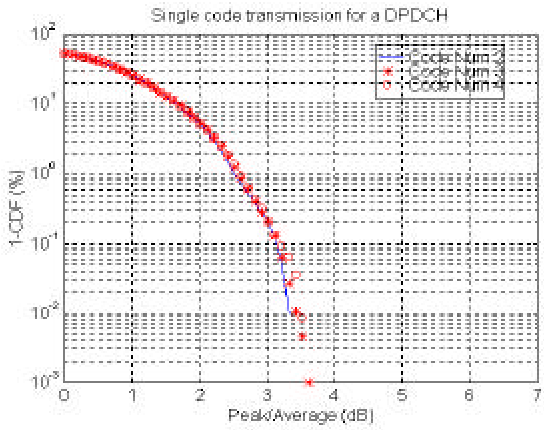

Figure 2. Single Code Transmission for a DPDCH
($DPDCH_1$= 24dB, DPCCH = 0dB)

Figures 3 to 12 show the PAPR results in multicode transmission case. There are two cases of power setting for DPDCH with DPCCH set to 0dB. One is 21dB and the other 24dB for DPCCH. For multicode transmission, the OVSF code $C_{4,2}$ has to be first allocated before the other codes $C_{4,3}$ and $C_{4,4}$.

In Figure 3 and 4, it is assumed that the 2 DPDCHs are spread by single OVSF code. When both DPDCHs are spread by the same code $C_{4,2}$, the performance improvement is significant than the other cases. In Figure 3 and 4, the '*' marker is the result spread by $C_{4,2}$ and $C_{4,3,}$ for $DPDCH_1$ and $DPDCH_2$, respectively. And the 'o' marker is the result spread by $C_{4,2}$ and $C_{4,4.}$ At the point of 10^{-1}(1-CDF(%)), the result spread by the same code $C_{4,2}$ is about 2dB better than the one spread by the codes $C_{4,2}$ and $C_{4,3}$ or $C_{4,4}$.

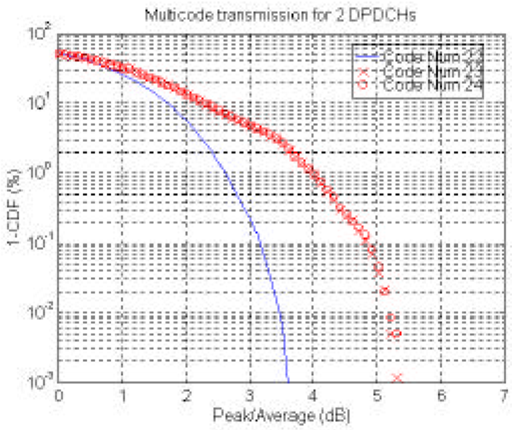

Figure 3. Multicode Transmission for 2 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

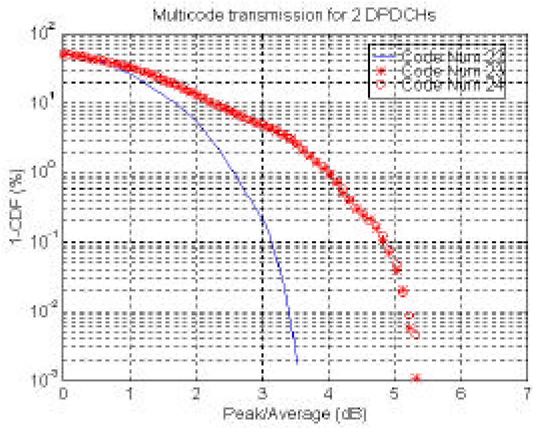

Figure 4. Multicode Transmission for 2 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

Figure 5 and 6 is the cases of 3 DPDCHs. The $C_{4,2}$ is first allocated for $DPDCH_1$ and $DPDCH_2$, and then $DPDCH_3$ is spread by code $C_{4,3}$ or $C_{4,4.}$ Figure 7 and 8 is the case of 4 DPDCHs. The $C_{4,2}$ is first allocated for $DPDCH_1$ and $DPDCH_2$, and then $DPDCH_3$ and $DPDCH_4$ are spread by the same code $C_{4,3}$ or $C_{4,4.}$ From these Figures, we can find out that OVSF code $C_{4,4}$ is better than the code $C_{4,3}$ as the second code allocation.

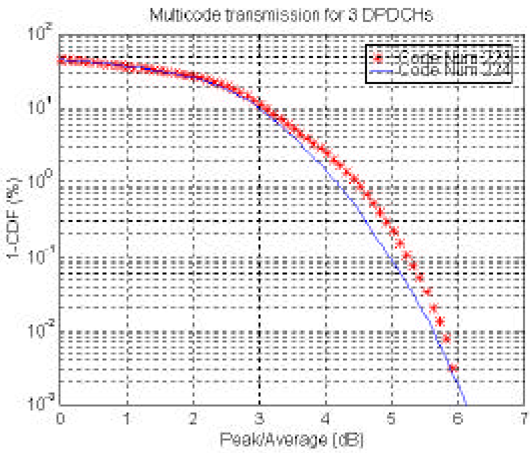

Figure 5. Multicode Transmission for 3 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

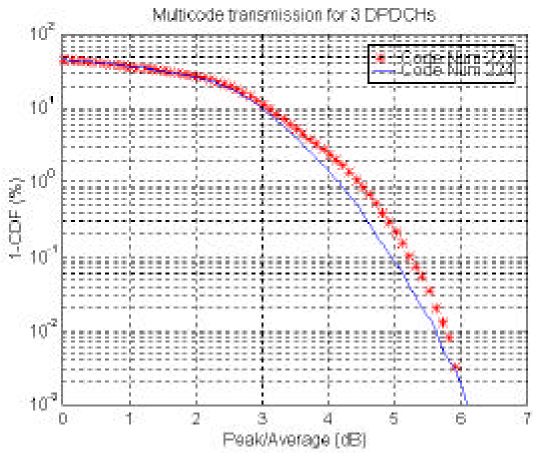

Figure 6. Multicode Transmission for 3 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

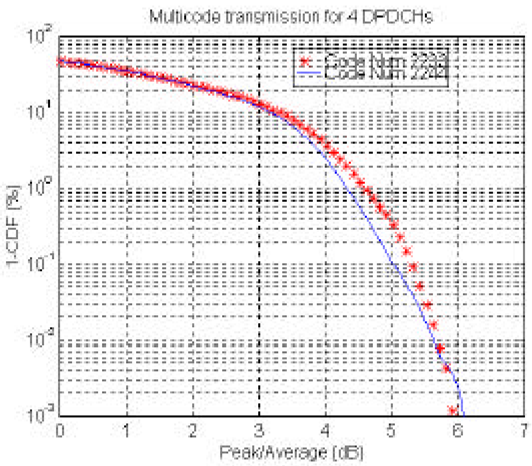

Figure 7. Multicode Transmission for 4 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

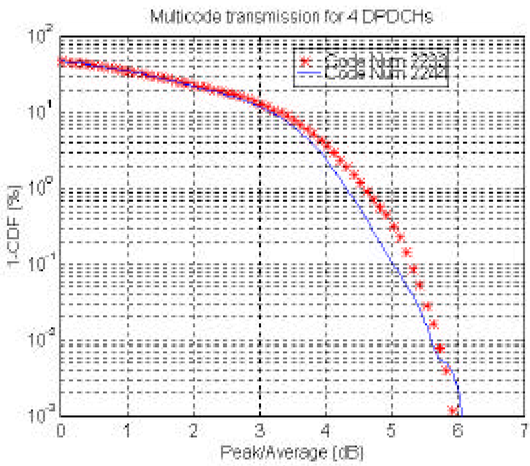

Figure 8. Multicode Transmission for 4 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

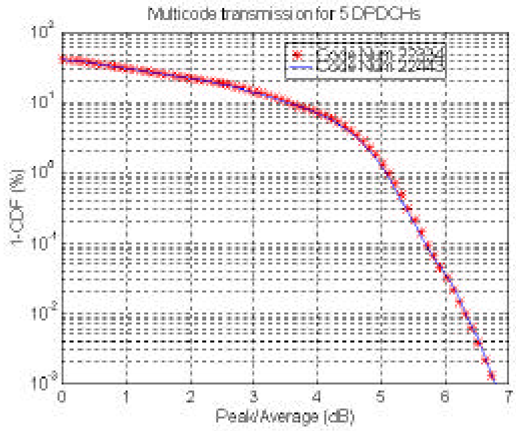

Figure 9. Multicode Transmission for 5 Ch. DPDCHs (DPDCHs = 21dB, DPCCH = 0dB)

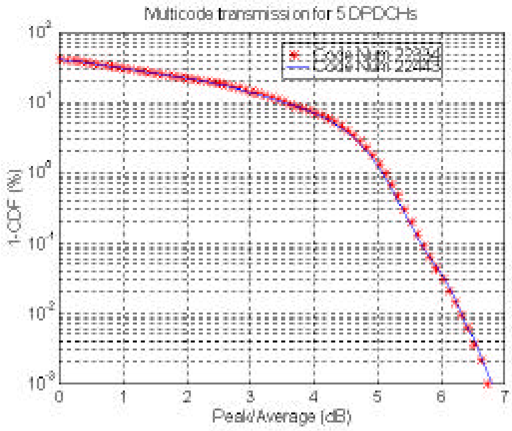

Figure 10. Multicode Transmission for 5 Ch. DPDCHs (DPDCHs = 24dB, DPCCH = 0dB)

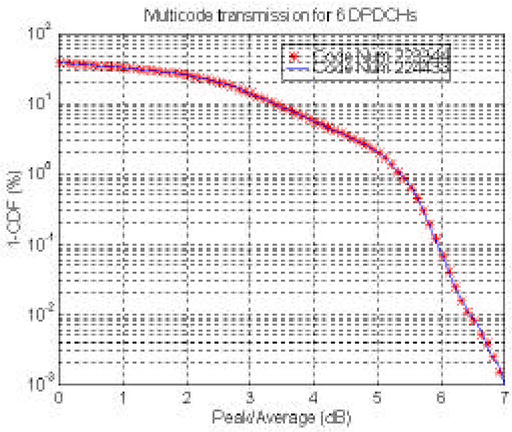

Figure 11. Multicode Transmission for 6 Ch. DPDCHs (DPDCHs = 21dB, DPCCH = 0dB)

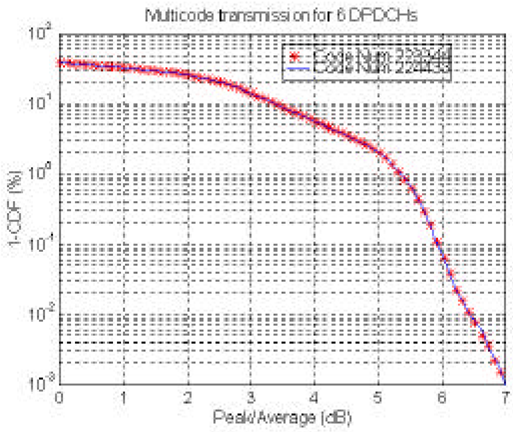

Figure 12. Multicode Transmission for 6 Ch. DPDCHs (DPDCHs = 24dB, DPCCH = 0dB)

Figures 9 to 12 are the results of 5 and 6 channels of DPDCH. These results show almost the same performance regardless of OVSF code allocation order.

For multicode transmission of DPDCHs with spreading factor of 4, the best channelization code allocation in uplink is to spread with the same code $C_{4,2}$ in case of 2 DPDCHs, and for 3 and 4 DPDCHs the best way is to spread the $DPDCH_3$ and $DPDCH_4$ by code $C_{4,4}$.

3 Conclusion

From the simulation results of PAPR, we propose the *k* order for code allocation as follows:

- When more than one DPDCH whit spreading factor of 4 are to be transmitted in uplink, $DPDCH_n$ is spread by the code $C_{4,k}$, where $k = 2$ if $n \in \{1, 2\}$, $k = 4$ if $n \in \{3, 4\}$, and $k = 3$ if $n \in \{5, 6\}$.

Reference

[1] TS25.213 v2.1.0(1999-4), “Spreading and modulation”

[2] Ericsson, “Uplink channelization code allocation in UTRA/FDD”, TSGR#6(99)845,Espoo, Finland, July 13-16,1999