TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) ***TSGR2#6(99)821***

Sophia Antipolis, France, 16 - 20 August 1999

Agenda Item:

Source: CCL/ITRI

Title: Daft Proposal for Code Allocation Strategy

Document for: Discussion and Decision/Information

---

1. Introduction

Code allocation deals with the problem how different codes are allocated to different connections. The channelization codes used for spreading are Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between a user's physical channel [1]. The OVSF code is shown in Fig. 1. Each level in the code tree is described as $C_{SF,code\ number}$, where the spreading factor (SF) is ranging from 4 to 512 for the chip rate of 4.096 Mcps. A code can be assigned to a UE if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is assigned.

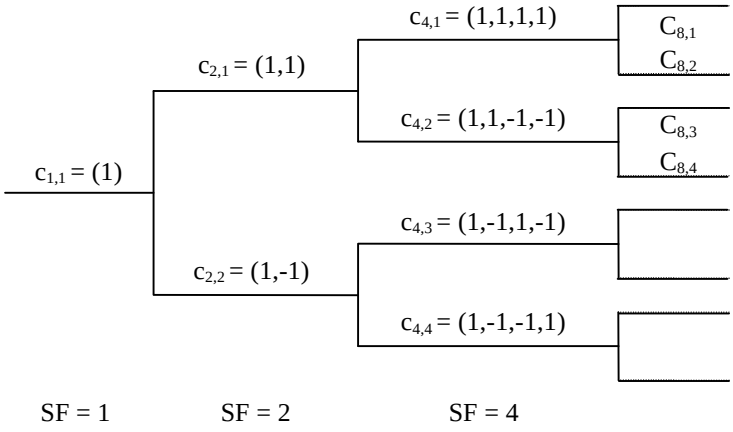

Fig. 1 Code-tree for generation of Orthogonal Variable Spreading Factor (OVSF) codes

For example, a random assignment of large-SF codes to low data rate channels may preclude a large number of small-SF codes. It inefficiently limits the number of remaining codes that could be used by other users. On the contrary, it will be advantageous to assign

codes to low data rate users in such a way as to minimize the number of unavailable small-SF codes. Moreover, it is expected to be advantageous to assign users operative at a particular data rate to closely related codes so as to minimize the number of small-SF codes being marked as unavailable. A proper code allocation algorithm is used to find the “closely related code” to prevent the BS from running out of codes and to utilize the system resource effectively. The so-called “closely related code” would be obtained via a code allocation strategy according to the available codes of the BS and the capability of the UE.

2. Criteria for Code Allocation

In the application, different UEs may request for different types of services with different transmission rates. Each UE may have the capability to use more than one code to support different data rates. Therefore, the ***first criterion*** for code allocation is the ***utilization***. The utilization is defined as the ratio of assigned bandwidth and overall bandwidth. A code allocation scheme that preserves more small-SF codes has a higher chance to provide a higher utilization. For example, $C_{4,1}$ and ($C_{8,1}$,$C_{8,3}$) are the available codes of a BS resulting from two different code allocation schemes. $C_{4,1}$ (which is equivalent to codes $C_{8,1}$ and $C_{8,2}$) can support a symbol rate up to 1024 kbps. ($C_{8,1}$,$C_{8,3}$) can also support the same symbol rate as $C_{4,1}$ does. However, only $C_{4,1}$ can support the UE that requests for 1024 kbps symbol rate using only one code (due to the capability of the handset). In this example, the former has more small-SF codes than the latter, thus, it will result in a better utilization.

The ***second criterion*** is the ***complexity***. The more codes are used, the complexity of the system will be increased. In some cases, there are more than one way to meet the first criterion mentioned above. For example, one UE can use either one code ($C_{4,1}$) or two codes ($C_{8,1}$ and $C_{8,2}$) as the channelization codes. Under this situation, the code allocation scheme that requires the least codes should be chosen.

3. Conclusion

OVSF codes are valuable resources in CDMA system. The objective of the code allocation is to support as many users as possible with less complexity. Therefore, utilization and complexity should be taken into account in the designing of a code allocation scheme.

4. Reference:

[1] 3GPP TS 25.213, v 2.1.0, Spreading and modulation (FDD), 1999-4.