5G Notes

Codes for CDMA

A Guide on Codes and 3G Stat Sheet

Codes of CDMA

> *"It's all about being one in a billion"*

3G relies heavily on CDMA and CDMA relies heavily on Codes so 3G also relies heavily on these codes. But what are these codes and why do we use them?

We have already seen that 3G is a spread spectrum technology. One user's data can be transmitted through multiple frequencies within a spectrum. The same happens with all of the users. In other words, with 3G, the spectrum is really a chaos of data fragments (frames or packets) and being unique is of utmost importance. This uniqueness is achieved by a string of 0s and 1s called a **"Code".**

Each user is provided a different code while performing wireless communication. These codes need to be unique to make sure that no two users get cross connection and the process may fail. Such codes are majorly divided into two categories:

1. **Pseudo Random Codes**
2. **Mutually Orthogonal codes**

Let's look at both of them one by one

1. Mutually Orthogonal Codes

Let's jump to high school mathematics a little. Vectors can be represented as sequence of numbers in a matrix. And two vectors whose dot product (SOP of corresponding numbers) is 0 are called mutually Orthogonal.

In case of CDMA, generally a base station distributes 64 bit long mutually Orthogonal codes to the users and packs their data along with the code. So, every time the user receives a data-stream or packet it performs dot product of the initial 64 bits with its own code and if the result is 0, it ignores the information.

That's how CDMA grants time and frequency to the users and separates them with codes instead. Science community calls these orthogonal vectors **Walsh codes** whereas communication committee sometimes also refers to them as **chip codes**.

But things don't always go that smoothly.

2. Pseudo Random Codes

Sometimes the users keep moving too much in which case they may keep hopping between two or more base stations. It becomes difficult for base stations to manage a common Orthogonal code so such users are treated with a different approach.

They are provided a permanent (as long as the call lasts) PN (Pseudo Noise) or Pseudo Random Codes. The code is provided to respective base stations and the call remains intact. Such an arrangement is also useful when (rarely) base station runs out of mutually Orthogonal codes under high cellular traffic.

Base stations generate random code by adding difficult to predict intended noise in a smaller code signal. Such code seems random but is actually deterministic (pseudo). So, it won't be repeated by the BSc. One such popular PR or PN code is **Gold code.** Under critical applications like Military operations, Orthogonal codes are also replaced by PN codes.

As mentioned earlier, it's all about keeping the code unique. Oh, and you can also find 3G statsheet under the resources tab of this lecture.

Happy Learning :)