Path Loss Prediction in WCDMA Systems using OVSF Codes

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ABSTRACT
Orthogonal Variable Spreading Factor (OVSF) channelization codes limit the performance of third generation(3G) mobile communication systems employing Wideband Code Division Multiple Access(WCDMA). Internal fragmentation occurs when allocated data rate is larger than what is requested while external fragmentation occurs when the OVSF code tree is too fragmented to support a call even if there are sufficient capacity remaining in the code tree. We propose single-code time-shared strategies that consider channel conditions while solving these fragmentation problems. Simulation results are discussed to show the benefits of the proposed scheme. Simulation results verify that our strategies do use the precious wireless bandwidth efficiently.

Keywords
WCDMA, OVSF code,Code Assignment, Code Blocking, Path Loss .

1. INTRODUCTION
OVSF codes can be represented as a binary code tree. The data rates provided by OVSF codes are always powers of two with respect to the lowest basic rate Rb. There are some possible rates that are supported are: 1Rb, 2Rb, 4Rb, 8Rb, etc. Sometimes the gap becomes larger as the rate increases, in such cases capacity waste is impossible to avoid. For instance, a call requiring a rate of 10Rb may be given a 16Rb code where 6Rb capacity is wasted. The wasted capacity increases as the spreading factor decreases. This is called the internal fragmentation problem. To relieve the internal fragmentation problem and better utilize the scarce wireless bandwidth, one solution is to use multiple OVSF codes to support a call. For example, a call requesting rate 10Rb can be supported by a 2Rb code and an 8Rb code. This direction has been explored in. However, using multiple codes implies higher hardware cost. In this paper, we consider another direction is to use a single code and adopt the time-sharing concept to solve the internal fragmentation problem. Timesharing allows two or more low-rate requests to share a high-rate code. For example, two calls requiring rates of 9Rb and 7Rb may share a 16Rb code without wasting any capacity. If we can choose suitable users to share a large-rate code, capacity waste can be reduced significantly [2]. Apart from this internal fragmentation problem, while connections are arriving and leaving the system, an OVSF code tree may become too fragmented to support newly arrival calls even if there are sufficient spaces in the code tree. This is referred to as the external fragmentation problem. A possible solution to this problem requires intelligent code assignment which addresses how to assign code(s) to a new call in the code. tree to avoid the tree becoming too fragmented. It is shown in code assignment scheme which plays a very important role in system utilization[3]. When handling internal fragmentation, selecting users to be supported by a single OVSF code can be mapped to a single given set of items. When applying code assignment to solve the external fragmentation problem, turns out to be a Classification of OVSF code assignment solutions for WCDMA systems [9].

2. WCDMA
An WCDMA is a 3rd generation mobile communication system that uses code division multiple access technology over a wide frequency band to provide high speed multimedia and efficient voice services. WCDMA is a high speed 3G mobile wireless technology which gives a faster data connection in mobile network currently up to 384kbps. WCDMA is complex system because of its arithmetic multiplicity of transmission and receiving of signals. Main theme of WCDMA is that the user can simultaneously transmit data in different rates and transmission varies over time. Also it enables better use of available spectrum and cost efficient. In WCDMA, Channelization codes are used to preserve the orthogonality between physical channels, in order to increasing system capacity. The OVSF codes are used as the channelization codes to provide multi-rate service. Spreading is the fundamental operation of WCDMA radio interface. The spreading codes in WCDMA are of two types namely channelization code and scrambling code. The channelization codes in WCDMA are OVSF codes. The channels in the forward link and reverse link use theses codes for transmission. OVSF codes are shorter in length and are made from orthogonal function.

3. APPROACH USING GENETIC ALGORITHM
A few studies on utilization of genetic algorithm (GA) [1] for OVSF code assignment have been reported where effective reallocation of OVSF code tree with a random initial population is addressed. But re adaptation of GA to new environments once its population converged is crucial in practice [1]. If the code tree structure changes, the system will not be able to effectively overcome the new reallocation problem because the optimum solution is not obtained by the GA for the previous code tree scenario

4. PATH LOSS
Path loss or path attenuation is the reduction in power density of an electromagnetic wave as it propagates through space. Path loss is a major component in the analysis and design of the link budget of a telecommunication system. This term is commonly used in wireless communications and signal propagation. Path loss may be due to many effects, such as free-space loss, refraction, diffraction, reflection, aperture-medium coupling loss, and absorption. Path loss is also

influenced by terrain contours, environment (urban or rural, vegetation and foliage), propagation medium (dry or moist air), the distance between the transmitter and the receiver, and the height and location of antennas. Fig.2 shows the block diagram of finding path loss. In wireless communications path loss can be represented by the path loss exponent whose value is normally in the range of 2 to 4 where 2 is for propagation in free space, 4 is for relatively lossy environments [11].

5. PATH LOSS PREDICTION

Calculation of the path loss is usually called prediction. Exact prediction is possible only for simpler cases such as free space propagation or the flat-earth model. For practical cases the path loss is calculated using a variety of approximations like Statistical methods (also called stochastic or empirical), radio wave propagation models, Deterministic methods [11].

6. EXISTING METHODOLOGY

6.1 Conventional Code Allocation Scheme (CCA)

In this method the in-coming calls or sessions are allowed to transmit if their requested codes are available and assignable if no assignable code available, the call is instantly blocked. It is very simple assignment method of codes to implement but has lot of possibilities of code block [10].

6.2 Hybrid Code Allocation Scheme (HCA)

This is a method where the partition is not fixed. The partition varies based on the statistics of call at that particular time[10].

6.3 Dynamic Code Allocation Scheme(DCA)

Here the allocated codes are dynamic in nature. It means a particular session may start transmitting with a particular OVSF code and end its session with a different code. The DCA gives efficient use of the channel resources with more throughput and little blocking but comes with it an additional signaling and delay [4].

6.4 Region Code Allocation Scheme(RCA)

RDA code allocation scheme which divides the whole channelization code tree into regions before any call arrives. The code region is defined by the probability of requests for each data rate based on prior knowledge of the network's call distribution. Under RDA scheme, for all incoming calls, first the channel capacity is checked after which the call seeks for spreading code directly from its code region. If assignable code is available it is allocated and the call session begins if not then if the probability to borrow spreading code from other regions is less than its blocking probability then a code is borrowed from other regions otherwise the call is blocked [10].

7. EXISTING CODE ASSIGNMENT APPROACH

The code assignment schemes which do not incorporate code sharing can be categorized into single code and multi code assignment schemes. The single code assignment scheme used single code to handle incoming calls [10]. The leftmost code assignment (LCA) [7], crowded first assignment (CFA) [7], fixed set partitioning (FSP) [8] and dynamic code assignment (DCA) [9] are single code assignment schemes. In the leftmost code assignment scheme, the code assignment is done from the left side of the code tree. In crowded first assignment, the code is assigned to a new call such that the availability of vacant higher rate codes in future is more. In the fixed set partitioning, the code tree is divided into a number of sub trees according to the input traffic distribution. In dynamic code assignment scheme, the blocking probability is reduced using reassignments based on the cost function. The DCA scheme requires extra information to be transmitted to inform the receiver about code reassignments [6].

8. OVSF CODE SYSTEM

In WCDMA the channelization code are OVSF codes. These codes are important for better system performance. OVSF codes are generated from the binary tree where the tree consist of large number of codes. OVSF codes are used to handle multimedia rates rates. These codes suffer from code blocking limitation which reduces the throughput and spectral efficiency of the system. For uplink, Channelization code (OVSF code) is used to separate different physical channels of one connection. For downlink, Channelization code (OVSF code) is used to separate different connections in a cell.

The OVSF codes can be represented by a tree. Fig. 1 shows a K layer code tree. The OVSF code tree is a binary tree with K layer, where each node represents a channelization code (k,m), k=0,1,…,K, m=1,…,2K. The lowest layer is the leaf layer and the highest layer is the root layer. The data rate that a code can be support is called its capacity. Let the capacity of the leaf codes (in layer K)be R. Then the capacity of the codes in layer (k-1),(k-2),…,1,0 are 2R,4R,…, 2^K-1 R respectively.

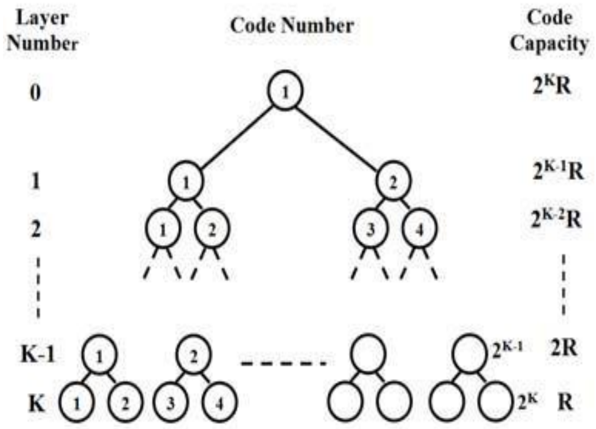


Fig .1 OVSF code tree

The maximum spreading factor N_{max}=2^^{k} where K represents the number of layers. The first and last layer is known as root and leaf layer respectively. OVSF Code Generator block generates an OVSF code from a set of orthogonal codes. OVSF codes were first introduced for 3G communication systems. OVSF codes are primarily used to preserve orthogonality between different channels in a communication system [9]

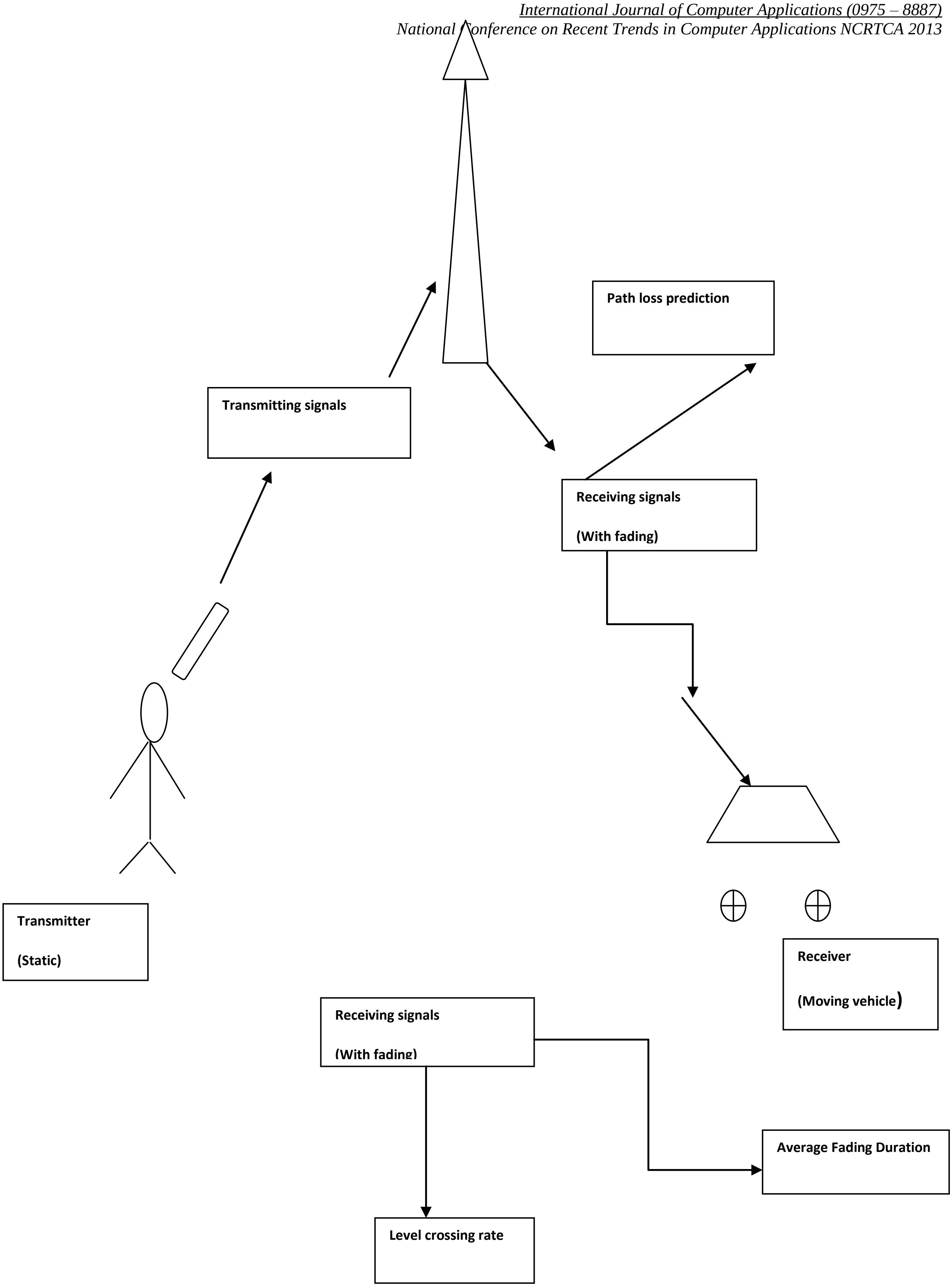
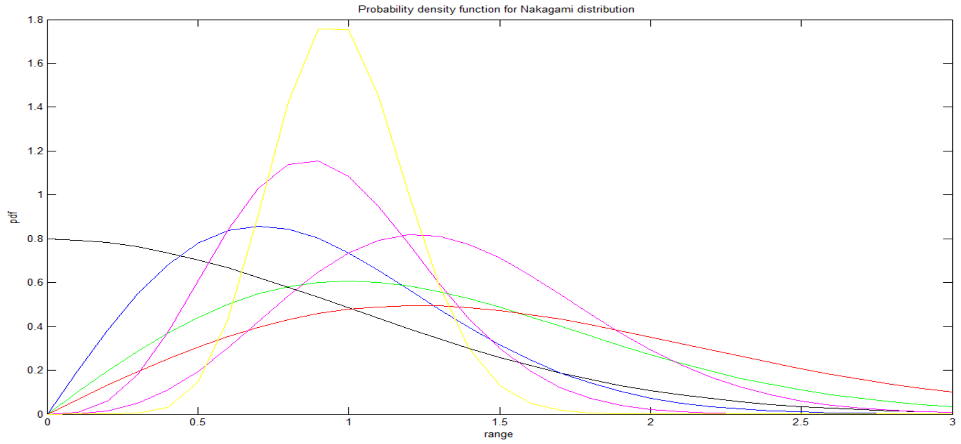


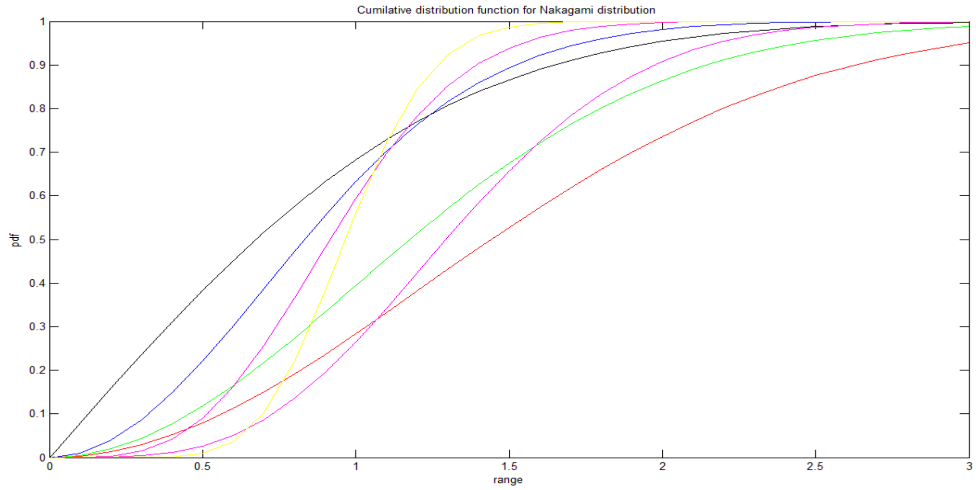
Fig 2: Block Diagram

9. SIMULATED GRAPHS

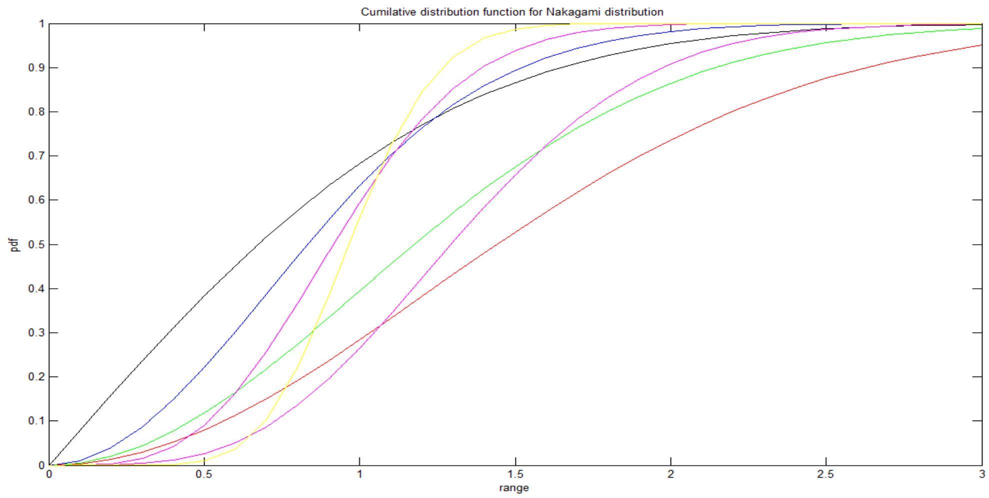
The path loss prediction is defined for the variation of distance and path loss.

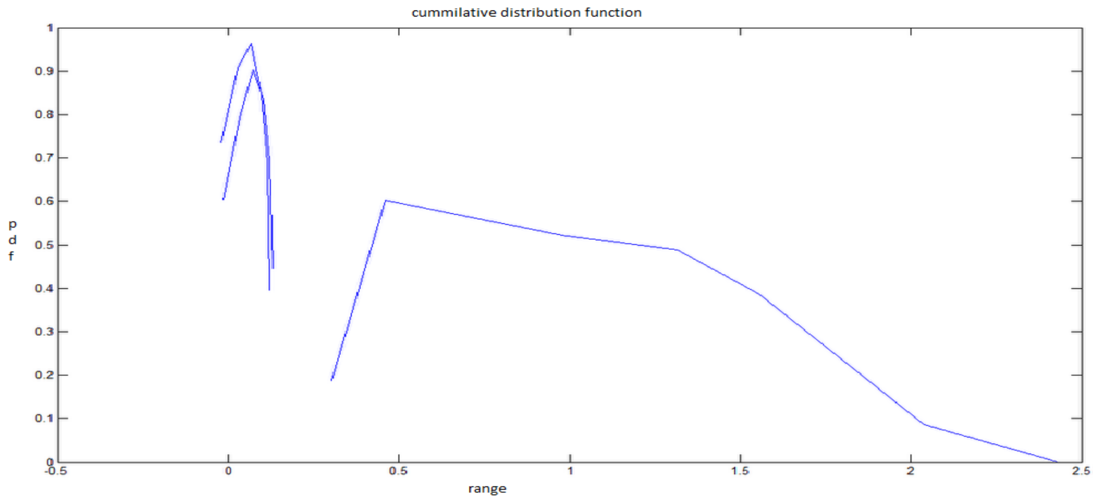


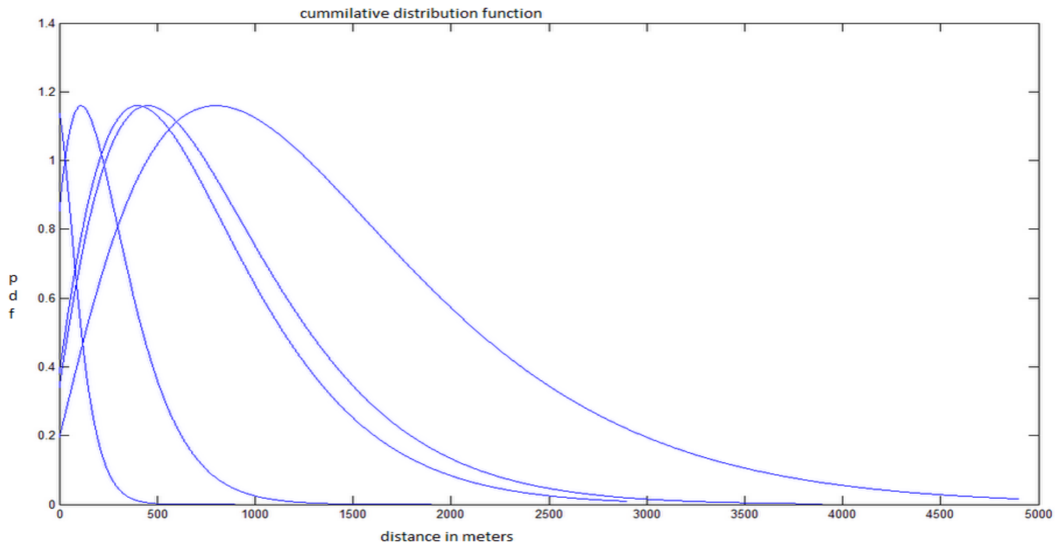
Probability Density Function

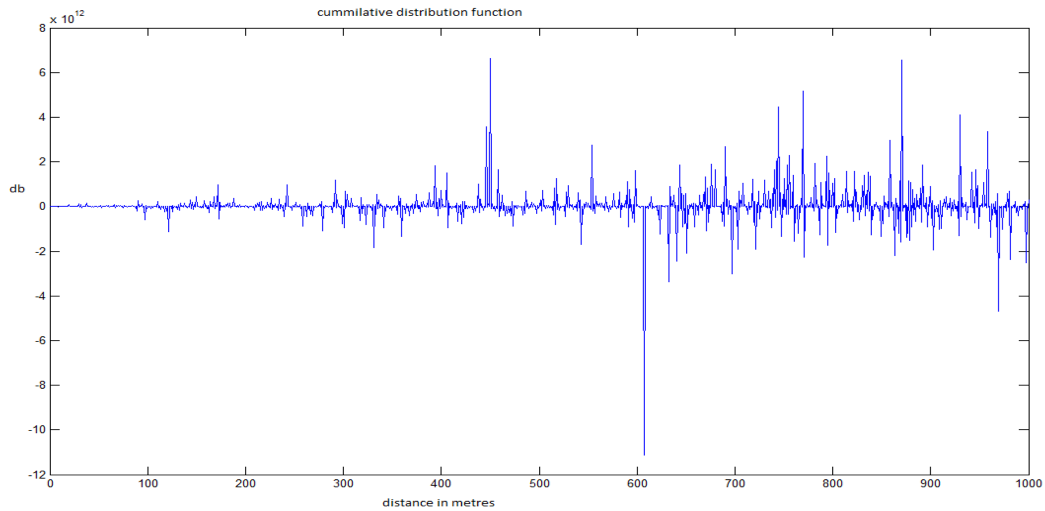


Cumulative Distribution Function




cummilative distribution function
p d f
range


cummilative distribution function
p d f
distance in meters


cummilative distribution function
x 10^12
db
distance in metres

10. CONCLUSION

The code blocking is the major limitation of OVSF based 3G systems. This will affect the calls also in real time. When we approach the codes in time slots based sharing method there is a chance of reducing it. This work is based on the optimized assignment of code slots for different order of priority within priority users, which will measure the probability density function and cumulative distributive function. The Level Crossing rate, average fade duration is calculated. Distribution function for path loss is also calculated which will stabilize our system with distribution properties.

11. REFERENCES

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