THE USE OF "GOTO FUNCTION BLOCK" AND "DELAY FUNCTION BLOCK" IN THE DESIGN AND SIMULATION OF CDMA 2000 1 X RTT PHYSICAL LAYER RADIO CONFIGURATION 3—FORWARD FUNDAMENTAL CHANNEL

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ABSTRACT

MATLAB is a technical language that can be used for a variety of studies in science. One of its toolboxes: "simulink" along with other toolboxes can be use in modeling a communication system. My research was mainly prompted by the problem of poor GSM services in our country, Nigeria. In the course of searching for a better alternative to the GSM technology, I discovered CDMA 2000 1x RTT. The evidences to show that CDMA 2000 1x RTT is a better technology than the GSM are contained in the comparisons (between some of the GSM's and CDMA-one's parameters), made by Qualcomm, an American-based Telecom. Company. CDMA 2000 1x RTT is an improved version of CDMA-one (also known as IS-95). It was originally developed by Qualcomm. In order to portray (on the screen) the physical layer for the Forward Fundamental Channel-Radio Configuration 3 of CDMA 2000 1x RTT, I decided to use some already built functions in MATLAB 7.1 version to achieve this. Interactive blocks in the communication toolbox contained in the MATLAB software were used extensively in this modeling. Results showing the performances of the system at various stages in the network were also obtained, using the Spectrum Scope and the Scatter Plot Display Blocks. Results obtained showed that if the transmitted signal was to be tapped at undue stages in the network, poor (unclear) signal will be received. A clear signal can only be received when measures have been put in place to counter the effect of signal distortion by noise and establishing a system that will perform direct opposite functions as those done by the transmitter subsystem and the encoder subsystem.
Keyword: Matlab, CDMA, Telecommunication

INTRODUCTION
As we all know, telecommunication industry is the fastest growing industry in our society today. It has experienced a great boost particularly due to the introduction of wireless systems for communication. Before the introduction of GSM in Nigeria, less than five thousand NITEL lines were active (Diokpara, 2006). Of course, NITEL was as at then (between 1970 and 1998) the only service provider in the country. But when GSM came in more service providers came up and today over twenty million telephone lines are active (according to an NCC report, 2006). Similar increase has been experienced across the other countries of the world. Now, with the advent of GSM in Nigeria, it was thought that the problems of crosstalk and other related interferences were over, since these were characteristics of analogue systems. Now, the truth remains that a lot of cross talking and other network problems do occur in GSM, particularly when ever it rains. Some of the problems usually encountered include:

(a) The computer tells you that the number you are dialing is not available, while actually the number is available.

(b) The computer tells you that you do not have credit while you actually have.

(c) Sometimes, one will be calling another subscriber, he himself will be hearing what the other person is saying but that person he is speaking with will not be hearing him. In most cases, both will not hear each other.

The case of the crosstalk involves some other person other than the intended person picking your call. All these are annoying. It got to a point where NCC has to intervene by telling MTN (one of the major service providers in the country) not to make any further advertisement until she has worked on her network, to improve on the grade of service she renders (according to a news report). Even the house of representative, in one of their sessions, told the Nigerian Communication Commission's Officials, to look into the problems of poor GSM services in the country and come up with solutions. Up till date, no tangible solution has been provided. My research was majorly geared by my desire to provide solutions for these problems experienced in our GSM network. In the course of literature study, I discovered CDMA (code division multiple access). A detailed comparison of some of the qualities/features of GSM and that of CDMA was made by Qualcomm (an American based telecomm. Company). At the end it was discovered that CDMA has far-reaching qualities than GSM, to the point that it is less susceptible to crosstalk and other interferences. So CDMA is the solution I found to the problems of poor GSM services in the country. In this study I concentrated on the computer modeling of CDMA 2000 1x RTT Radio Configuration 3-Forward Fundamental Channel.

MATERIALS AND METHOD

MATLAB is a high performance language for technical computing. The name MATLAB implies 'matrix laboratory'. MATLAB has been in existence for many years now, and have been receiving inputs from many users (www.mathworks.com). MATLAB incorporates another software package called: simulink, which can be used extensively for simulation. There are various toolboxes that could be found under this software package. Some of them include: communication toolbox (the one I made use of in my work), fuzzy logic toolbox, wavelets toolbox, e.t.c. All these toolboxes allow one to use MATLAB environment for various specialized applications. For the communication toolbox, there are various interactive blocks that were developed and stored in the library browser by the MATLAB engineers. Each of these interactive blocks is designed to serve a specific purpose in communication. It is left for the user to study them and know how to use them to achieve his purpose.

Now we say briefly that simulink is a software package for modeling, simulating, and analyzing dynamic systems. It turns our computer into a laboratory for modeling and analyzing systems. Now, during the modeling the encoder subsystem was called up from a demo published in MATLAB. This encoder was designed to portray exactly that of a real life CDMA 20001x RTT Radio Configuration 3-Forward Fundamental Channel. Also were called up include: the transmitter, the receiver, and the decoder. All these were placed in a single

subsystem. Then the channel, the "Goto Function blocks", the "From blocks", the Power Control subsystem, the Hard Decision blocks, the Spectrum Scope blocks, the Scatter Plot scopes, the Delay blocks, the Error Rate Calculation blocks, the Bernoulli Binary block and the Display blocks were all called up from the library browser of the communication toolbox. These were placed in the subsystem containing the encoder, transmitter (modulator), the receiver and the decoder. At last all these blocks were indirectly connected using the "Goto Function blocks" and the "From blocks".

The use of the "Goto Function blocks" and the "From blocks" in the design of the physical layer of CDMA 20001x RTT Radio Configuration 3-Forward Fundamental Channel, gave the system a 'wireless outlook' on the screen. This provided for a model that could be used for tutelage (of this concept) in our schools. Using this model to teach students about CDMA 2000 will facilitate their understanding of this technology, such that when they come across it in real life they will not have difficulties in handling it. The "Goto block" labeled 1 communicates with the "From blocks" labeled 2, 16, and 12. The "Goto block" labeled 3 communicates only with the "From block" labeled 4. The one labeled 5 communicates only with that labeled 6. 7 communicate with 9 and 13. 8 communicate with 11 and 15. 17 communicate with 10 and 14. These are the ways the "Goto Function blocks" and the "From Function blocks" in the model communicate. They do not just communicate without the person designing the model directing them. The "Goto tag" and the " Tag visibility" contained in the blocks' parameter dialog box determines where and how the signal from each block will go. Now for 1 to communicate with 2, 12 and 16 means that they all have the same Goto Tag: "original signal" and their visibility defined within the local subsystem. The same thing applies to other Goto Function blocks and their corresponding From blocks. Let us see Figure 1.
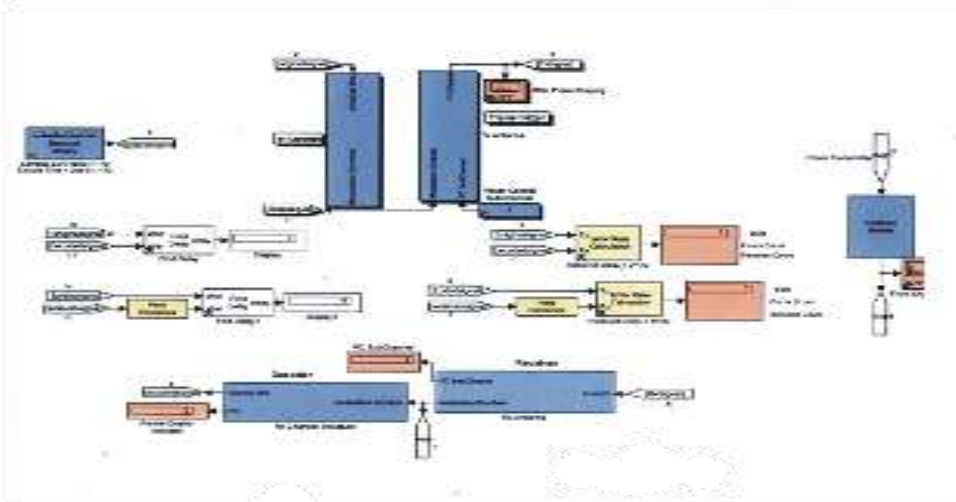

Figure1: Modeled physical layer of CDMA 1 x RTT radio configuration 3

The Use of "Goto Function Block" and "Delay Function Block" in the Design and Simulation of CDMA 2000 1 X RTT Physical Layer Radio Configuration 3—Forward Fundamental Channel

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RESULTS AND DISCUSSION

The signal (Bernoulli Binary) from the signal generator was sent first to the encoder which performs frame quality indicator, tail bits attachment, convolutional encoding with rate ¼ and constraint length 9, repetition and puncturing, all on the signal. At the end an coded signal is obtained. The signal is then passed to the transmitter which transmits the signal through the air interface (multipath Rayleigh fading channel) to the receiver. Then after performing decoding function on the signal received, a clear signal (as clear as the original one) will be received. This is evident in the results obtained using the error rate calculation blocks. Before calculating the error rate, the receive delays were first computed using the Receive Delay blocks. Then the results of the Receive Delay blocks were used in the parameter dialog boxes of the Error Rate calculation blocks to compute the bit error rate.

The receive delay between the original signal and the decoded signal is calculated to be 344. And that between the coded signal and the received signal is 1560. These results were obtained by varying the correlation window length of the delay blocks until these stable values were obtained within the simulation time (0.0 to 0.05). Now, the values of the receive delays were substituted into the parameter dialog boxes of the Error Rate Calculation blocks in order to determine the number of errors occurring and the rate at which the bit errors are occurring. The bit error rate is computed by dividing the number of error counted with the number of samples that were compared. This was done as a running statistics by the block. For the bit error rate between the coded signal and the received signal, the number of samples that were compared is 744 and the number of error obtained is 375. By comparing these two, the block outputs a bit error rate of 0.504. This means that the rate at which the error is occurring is 0.504, since it is computed as a running statistics as the block compares the number of errors with the number of samples.

The implication of this is that a clear signal is not received here. Thus we need to pass the signal through another process to ensure that a clear signal is received. And that is through the decoding process. The decoder performs depuncturing, derepetition, convolutional decoding, encoder tail bits detachment and computes frame quality indicator extraction. All these were direct opposite functions to the encoder. And at the end a clear signal is received. This is evident in the number of errors received between the original signal and the decoded signal and the corresponding bit error rate. Here, out of the 172 samples compared, no error was obtained. Thus a zero bit error rate was also obtained. See the simulated model in Figure 2
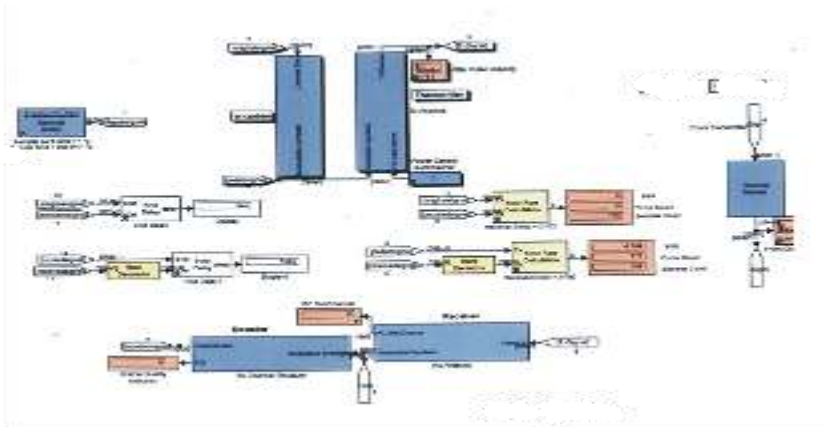
Figure2: Results shown in the simulated model

CONCLUSION

As a way of conclusion, I wish to say that the study was not so easy, considering the huge financial involvement - particularly in the area of purchasing the software and the Computer system used in this work. On the other hand, during the period of data collection, most of the people I interviewed had limited knowledge of the technicalities required in telecommunication. So, limited information was obtained in from people in that regard. I was therefore exposed to much study of literatures in order to acquire enough information needed for me to carry out this research in any case, the purpose of the research work was achieved. It was discovered that the incessant problem of cross talk and poor voice quality usually experienced in GSM could be minimize, if not eliminated, using CDMA. This is revealed mainly in the literature review-- from the comparisons of GSM parameters to those of CDMA'S made by Qualcomm. It was realized that CDMA has far-reaching qualities than GSM. CDMA is the technology needed in such a country like Nigeria for pure voice quality and data transmission during telephony. Next, I was able to model CDMA 2000 1 x RTT physical layer radio configuration 3 – forward fundamental channel. Simulated results were obtained and interpreted. It could be noted that the modeling was done using mainly the Goto function blocks and the From function blocks.

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