Project Report on

Providing Reliable Services to a Large Unpredictable Number of Devices

SUBMITTED BY

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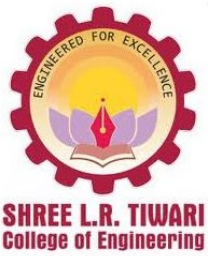

DEPARTMENT OF

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CERTIFICATE

This is to certify that the project entitled **"Providing Reliable Services to a Large Unpredictable Number of Devices"** is a bonafide work of the following student

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submitted to the department of **Electronics and Telecommunication** in partial fulfillment of the requirement for the award of the internship **certificate.**

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INTRODUCTION

Abstract

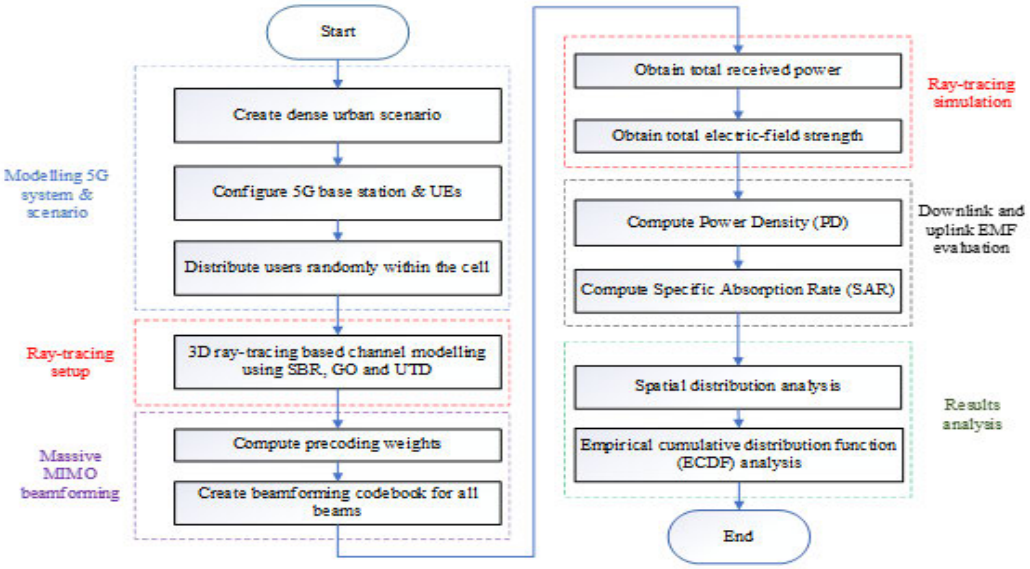
This project highlights how 5G is capable of providing service to an unpredictable number of devices in a given area. I have used NS-3 along with NetAnim to simulate how the gNBnodes interact with the UE Nodes to send and receive packets.

General Overview of Project

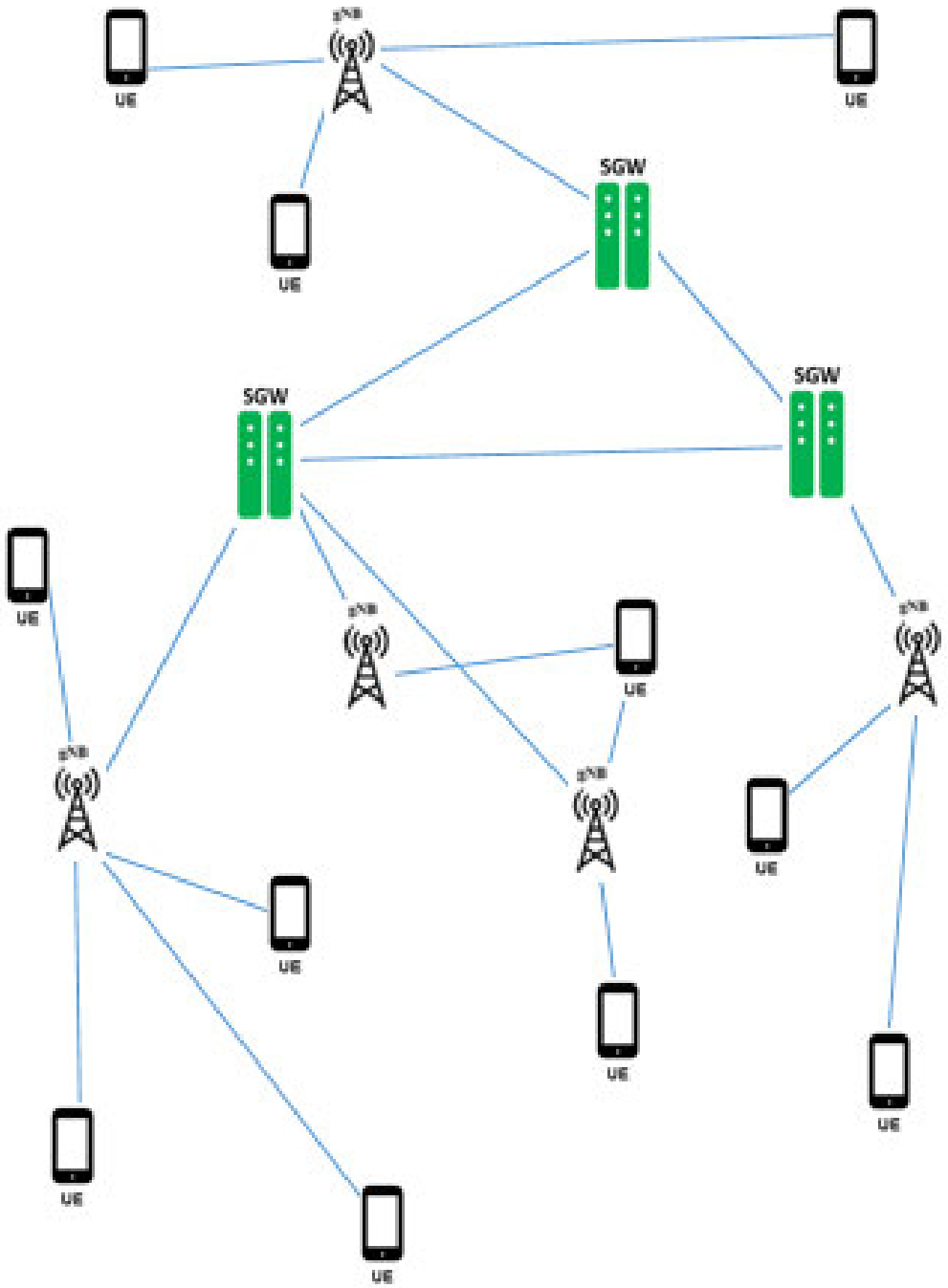
In this project, I have shown how 5G is capable of Providing Reliable Services to a Large Unpredictable Number of Devices in a given area. It shows how the gNB Nodes use Beam Forming along with TDMA and other 5G specific protocols. The UE Nodes are equipped with 5G mmWave Antennas and are IPv6 enabled. The simulation shows the UE Nodes interacting with the gNB Nodes using MiMo and TDMA to be able to access the internet at the marketed 1Gbps speeds and Low Latency.

HARDWARE / SOFTWARE DETAILS

Block Diagram



The Diagram shows how the gNB Nodes and UE Nodes interact and process the parameters in order to maintain reliable connection.



Code Description

The Code follows a structure that is used to simulate any type of Network based simulation:

1) Set default attribute values and random seed
2) Create nodes
3) Configure physical and MAC layers
4) Set up network stack, routing and addresses
5) Configure and install applications
6) Set up initial positions
7) Set up data collection
8) Schedule user-defined events and start simulation

The following Code Snippets used to simulate the interaction between the Nodes are explained using comments:

```
NodeContainer gNbNodes; //gNB Node Container
NodeContainer ueNodes;  //User Equipment Node Container
gNbNodes.Create (2);    // Create 2 gNB Nodes
ueNodes.Create (20);    // Create 20 UE Nodes
.
.
.
CcBwpCreator::SimpleOperationBandConf bandConf (3e9, 3e9, 1,
BandwidthPartInfo::RMa); // 3GHZ Central Frequency, 3GHZ Channel Bandwidth,
Number of Divisions for Channels, RMa protocol
.
.
.
nrHelper->SetSchedulerTypeId (TypeId::LookupByName
("ns3::NrMacSchedulerTdmaRR")); //Use TDMA
.
.
.

idealBeamformingHelper->SetAttribute ("BeamformingMethod", TypeIdValue
(DirectPathBeamforming::GetTypeId ())); //BeamForming Module
.
.
.
nrHelper->SetUeAntennaAttribute ("AntennaElement", PointerValue
(CreateObject<IsotropicAntennaModel> ())); //Setup Antenna Type
.
.
.
p2ph.SetDeviceAttribute ("DataRate", DataRateValue (DataRate ("100Gb/s")));
//Set Max DataRate
```

```
p2ph.SetChannelAttribute ("Delay", TimeValue (Seconds (0.00001))); //Set Max
Latency
.
.
.
Ipv6AddressHelper ipv6h; //Setup IPv6
Ipv6InterfaceContainer ueIpIface;
ueIpIface = epcHelper->AssignUeIpv6Address (NetDeviceContainer (ueNetDev));
// Assign IPv6 Addresses to the Network Cards in the UE Nodes
.
.
.
double totalTxPower = 8; //Set Transmission Power for the UE Nodes
.
.
.
string pattern = "DL|S|UL|UL|DL|DL|S|UL|UL|DL|";
nrHelper->GetGnbPhy (enbNetDev.Get(0), 0)->SetAttribute ("Pattern",
StringValue (pattern)); // Set Pattern to be used for Uplink and Downlink
.
.
.
nrHelper->AttachToClosestEnb (ueNetDev, enbNetDev); // Connect UE Nodes to
gNB Nodes for the initial phase
.
.
.
serverApps.Start (Seconds (SimTime)); //Start Server and Client
clientApps.Start (Seconds (SimTime)); //Applications to transfer
serverApps.Stop (Seconds (simTime));  //Packets to and from the
clientApps.Stop (Seconds (simTime));  //Server
.
.
.
NetAnimObj.SetBackgroundImage ("/home/os/repos/ns-3-allinone/ns-
3.36/scratch/BG.jpg", 0.00, 0.00, 1.00, 1.00, 1.00); //Set Background Image to be
used as a Backdrop
.
.
.
Simulator::Run ();              //Run and End the Simulation which runs for
Simulator::Destroy ();          //the preset SimTime
```

Software Used Details

NS-3 with NetAnim Modules and 5G-LENA Modules with NR.

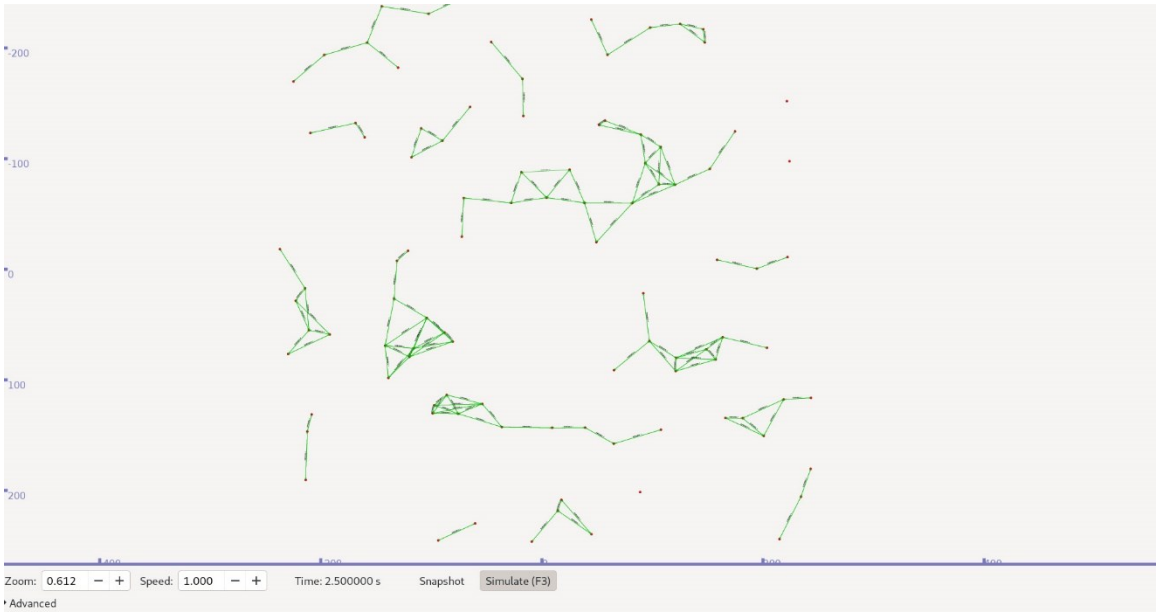
NS-3 is an open source discrete-event network simulator/emulator. NS-3 is committed to build a solid, well documented, easy to use and debug simulation core, which caters to the needs of the entire simulation workflow, from simulation configuration to trace collection and analysis. Compared to other open source simulators, NS-3 offers multi-RAT (Radio

Access Technology) and multi-band simulation capabilities, with Wi-Fi, WiGig, LTE (LTE-A, LAA, LTE-U), among others, already openly available.

NetAnim is a Network Animator that comes preloaded with NS-3. It is an offline animator based on the Qt toolkit. It currently animates the simulation using an XML trace file collected during simulation to display the topology and animate the packet flow between nodes. AnimationInterface registers itself as a trace hook for tx and rx events before the simulation begins. When a packet is scheduled for transmission or reception, the corresponding tx and rx trace hooks in AnimationInterface are called.

5G-LENA is born within the Mobile Networks group of a public research institute, CTTC (Centre Tecnològic de Telecomunicacions de Catalunya). The Mobile Networks group maintains a strong commitment with the NS-3 community in the area of LTE, its evolutions in licensed and unlicensed spectrum, and NR. It supports all the latest 3GPP Standards and the is under constant development to improve.

OUTPUT



The Diagram shows how the UE Nodes connect to the gNB Nodes.

APPLICATIONS

The Applications of 5G for Providing Reliable Services to a Large Unpredictable Number of Devices are:

1) In a Sports Stadium
2) In a Concert Hall
3) On a Railway Station
4) In an Airport
5) In a Subway
6) In a Shopping Center
7) In Schools/Colleges/Universities
8) At Tourist Attractions
9) At Theme Parks
10) In Malls
11) Commercial/Residential Estates

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