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Universal Mobile Telecommunication System Handover Signalling Messages Performance

Hamza Sidahmed Zeinelabdein Sidahmed , Amin Babiker A /Nabi Mustafa

University of Neelain Faculty of Engineering, Sudan, Khartoum
Corresponding author E-mail: *hamzasidahmed@ymail.com*

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ABSTRACT

The purpose of this paper is to analyze and simulate different kinds of the real time application and non-real time application such as Electronic Mail , web browsing, File Transfer Protocol (FTP) and different voice codec. In addition to that the paper also, shows how these applications will generate the signalling protocol messages such as Radio Resource Control (RRC), Node b Application Part (NBAP) and Radio Access Network Application Part (RANAP) during handover in Universal Mobile Telecommunication System (UMTS) using OPNET Modeler 14.5. After execution of the simulation the result shows that the File Transfer Protocol generate a large amount of signalling messages than Electronic mail and Web browsing and for voice codec the codec G.723 generate large amount of signalling messages than another codec.

KEYWORDS:- ***Universal Mobile Telecommunication System; Signaling Messages; Real Time ; Non-Real Time.***

I. INTRODUCTION

Third generation systems as Universal Mobile Telecommunication System (UMTS) are designed for multimedia communication. Moreover, the person-to-person communication can be enhanced with high quality images and video. In addition, access to information and services on public and private networks will be enhanced by the higher data rates and new flexible communication capabilities of the third generation system [1]. In the next generation of the mobile networks, the delay and the delay variation one of the most important quality of service parameters. The cell handover causes increasing signalling traffic, which can be critical from the point of view of delay variation[2]. Mobile phones can maintain their connections in cellular networks when they move from one cell area to another. The procedure, which switches a connection from one base station to another, is called a HandOver (HO) or a handoff. It is possible that an HO does not involve a change of the base station but only a change of radio resources [3].

II. RELATED WORKS

A. Handover Types:-

1)Soft handover:-

Soft handover is a mechanism that enables the mobile device to communicate with a number of base stations at the same time. Soft handover allows the User Equipment (UE) to communicate through another cell to maximize the utilization of this signal. The soft handover mechanism can generate a lot of traffic over the RAN IUB and IUR interfaces and this increased data transfer is weighed against efficiencies that can be made over the air interface. [4] In soft handover, the main issue for terminals is how to react to multiple power control commands from several sources. This issue solves by specifying the operation, such that the terminal combines the commands but also takes the reliability of each individual command decision into account in deciding whether to increase or decrease the power.

2)Softer handover: -

During softer handover, a mobile station is in the overlapping cell coverage area of two adjacent sectors of a base station. The communications between mobile station and base station take place concurrently via two air interface channels. This requires the use of two separate codes in the downlink side so that the mobile station can recognize the signals.

3)Hard Handover:-

The Hard Handover procedure used to change the radio frequency band of the connection between the UE and UTRAN or to change the cell on the same frequency when no network support of macro diversity exists. It uses to change the mode between FDD and TDD. This procedure is used only in the Cell-DCH state [1].

B. Handover decision:-

From the gathered radio measurements, the UTRAN estimates the quality of the current radio channel and the quality of the neighboring radio channels. Then it compares the overall quality of service provided with the current radio channel with the requested limits and with the estimated quality of service of the neighboring cells. Depending on the outcome of this comparison, the UTRAN may activate the handover procedure or the macro-diversity procedure and transfer the communication path to another radio channel in another cell. In addition, the UTRAN may activate the handover procedure to balance the traffic loading between several radio cells [5].

C. Signaling Protocol:-

1)RRC:- Radio resource controller is the radio network control protocol and provides the functions related to management and control of the radio network transmission resources such as the MAC, RLC and PDCP layers, etc. The primary purpose of RRC procedures is to establish, maintain and release radio resource connections between the mobile device and the network. Its functions include such things as handover procedures and cell reselection. RRC is the control protocol between the UE and the RNC.[4] The RRC layer performs the establishment, reconfiguration and release of radio bearers in the user plane. At establishment and reconfiguration of the radio bearers, the RRC layer performs admission control and selects parameters describing the radio bearer processing in Layer 2 and Layer 1, based on information from higher layers.

2) NBAP: - The Node B Application Part signalling protocol NBAP signalling between the RNC and Node B is the equivalent of RRC signalling between the RNC and UE. For example, if the RNC decides that a radio link should be reconfigured then the UE is informed using RRC signalling whereas the Node B is informed using NBAP signalling. NBAP signalling procedures are categorized as common or dedicated. Common procedures are either not related to a specific UE or involve the request of a new Node B communication context for a specific UE. Dedicated procedures related to an existing Node B communication context. Dedicated NBAP messages include the Node B communication context identity as part of the message. The most frequently used dedicated NBAP procedures tend to be radio link addition, radio link reconfiguration, radio link deletion, radio link restoration, radio link failure and compressed mode command [4].

3) RANAP:-The Radio Access Network Application Part protocol provides the radio network signalling between the core network and the radio access network across the IU interface. RANAP covers procedures for both the circuit and packet domains of the core network. The general services offered by RANAP are general control services, notification services and dedicated control services[1]. RANAP supports a number of functions including the following: Management of radio access bearers (RABs), i.e. setting up, modifying and releasing RABs between a mobile and the core network. In general, the core network performs the RAB management; the RAN has the capability to request the release of RABs [5].

II.METHODOLOGY:-

The key components of Optimizing Network Engineering Tools (OPNET), it gives powerful apparatuses that help the student in the design phase of a modelling and simulation project, i.e., the working of models, the execution of a reproduction and the examination of the yield information. It has an itemized library of models that offer help for existing models or develop new models of their own. OPNET has three principle sorts of device - the Model Development apparatus device, the Simulation Execution device and the Results Analysis device. These three devices are used together to simulate, model and analyze a network.

A. Topology and configuration:-

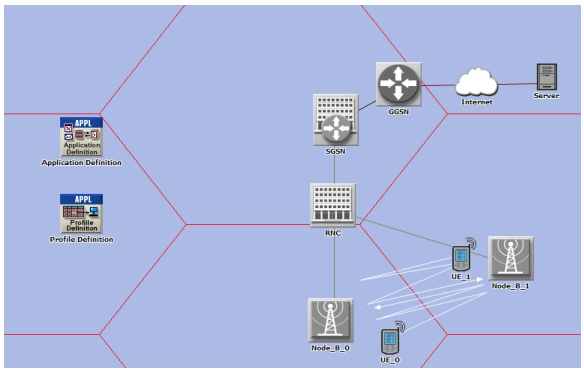

Figure 1. UMTS Model

The network topology shown in Figure 1 describes the UMTS Network using OPNET.The UMTS model as in figure 1 consist of user equipment's (UE s) , node B(NB) ,and Radio Network Controller(RNC), which are connected to the packet data network via Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN) over a common IP cloud . an ATM Link is used to interconnect between NB,RNC,SGSN , while an Ethernet link is used between the SGSN and GGSN . Different types of application are being used such as file transfer application, EMAIL, WEB browsing and different types of voice codecs like G.711, G.726, G.729, G.723, GSM FR, GSM HR, and GSM EFR.

III.PERFORMANCE METRICS:-

A. Radio Resource Control Measurement Report:-

The RRC layer, in terms of what to measure, controls measurements performed by the UE when to measure and how to report include both air interface and other systems. The Radio Resource Control layer also performs the reporting of the measurements from the UE to the network [5]. The Serving RNC decides, based on measurement reports received from both UE and UTRAN, whether a handover is necessary and then initiates this handover [6]. Those RRC Measurement Reports include measured the signal strength of primary CPICH of all cells the UE is able to measure on radio interface: the cell in which the call was set up as well as neighbour cells of this cell.

B.Physical Channel Reconfiguration Complete:-

This procedure uses to establish, release and reconfigure physical channels. The decision to initiate this procedure is made by the UTRAN. The decision may be based on the measurement information received from the UE, or it may be purely a UTRAN internal decision (e.g., because of low network resources). The UTRAN sends a physical channel reconfiguration message to the RRC in the UE.[8]The Physical Channel Reconfiguration message instructs the UE to stop using the cell with scrambling code 100 as the serving cell and to start using the cell with scrambling code 200 [4].The RRC Physical Channel Reconfiguration message contains all parameters that allow UE to find provided dedicated physical channels in new cell [7].

C.Radio resource control Radio bearer set-up and release:-

In UMTS, the user data channel within the access stratum above the Radio Link Control (RLC) sub layer called the radio bearer. The RNC is responsible for setting up, maintaining and ultimately releasing radio bearers as required the set-up of a radio bearer. Is comparable to the establishment of a logical data connection and does not indicate whether packet-switched or circuit-switched data transmitted over the radio bearer [9].

D) NBAP Radio Link Addition Request Packet:-

The radio link addition, the procedure used when a softer handover radio link added to the active set. The quantity of signaling information transferred by the radio link addition procedure is less than that transferred by the radio link setup procedure because the Node B already has knowledge of the existing one or more radio links (more than one radio link if the UE is already in softer handover prior to triggering the radio link addition procedure). An NBAP Radio Linkt Addition Request message is smaller than an NBAP Radio Link Setup Request message and is likely to have a larger IUB overhead [4].

E) NBAP Radio Link Deletion Request Packet:-

The soft handover procedure (radio link addition and deletion) implemented when the number of radio links of the UE reaches the maximum number of macro–diversity tributaries allowed. The radio link deletion, the procedure used when a radio link removed from the active set. This could occur during an active dedicated channel connection if either soft or softer handover radio links removed. Alternatively, it could occur at the end of a dedicated channel connection when all radio links removed from the active set. The RNC proceeds to clear the resources at the Node B by sending an Radio Link Deletion Request NBAP. [4].

F) RANAP RAB assignment setup/release packet:-

Assume now that after successfully attaching to the core network, the mobile needs to request a service, e.g. to establish a voice call via the CS domain. To support this new call, a new RAB needs to establish across IU-CS to establish a new RAB or to modify/release an existing RAB, the RAB Assignment procedure executed on IU interface (this procedure applies to both IU-CS and IU-PS). When the MSC receives the mobile's request, it sends a RAB Assignment Request message to the RNC. This message commands the RNC to establish the corresponding radio bearer between the RNC and the mobile and identifies the information required by the RNC to set up a new AAL2 channel, which is going to support the requested RAB. [5]When the RAB has been released the SGSN indicates that packet switch connection is now deactivated by sending the SM to deactivate PDP context accept message to the UE. [10]

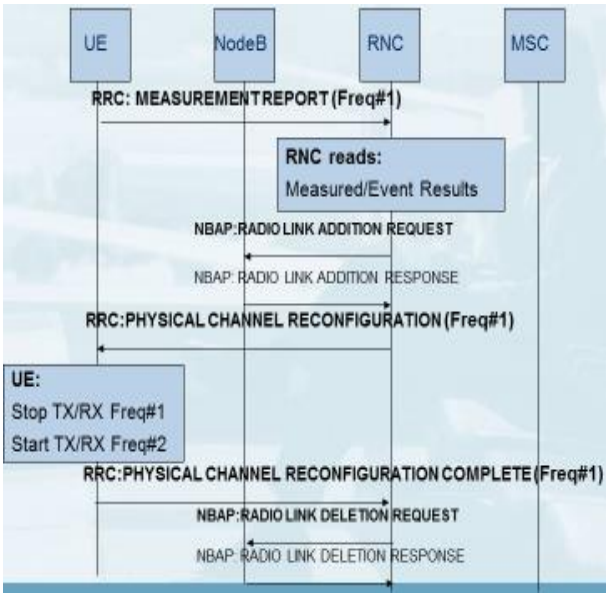

Figure 2. UMTS Handover Messages Flow

IV. Result and Discussion:-

1)Radio Resource Control Measurement Report:-

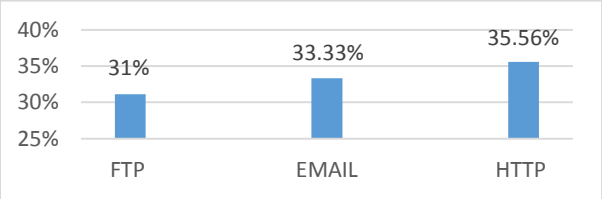

Figure 3. Radio Resource Control Measurement Report messages

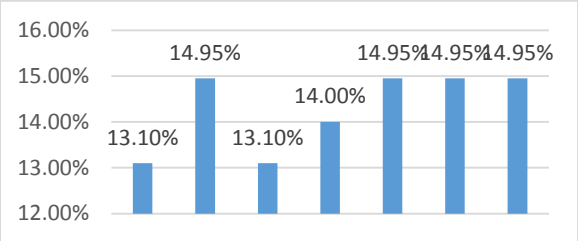

Figure 4. Radio Resource Control Measurement Report messages

The Measurement Report is a signalling message parameter that related to the RNC to decide if the handover is necessary and carried by RRC layer. The result shows that the web browsing generates the highest number of Measurement Report messages and the File transfer protocol (FTP) generates the lowest number of Measurement Report messages. For the voice, codec like GSM.HR, GSM.FR, GSM.EFR and G.729 generate the same ratio of the Measurement Report signalling message and the codec G.711, G.723 generates the lowest number of the Measurement Report messages.

2)Physical Channel Reconfiguration Complete:-

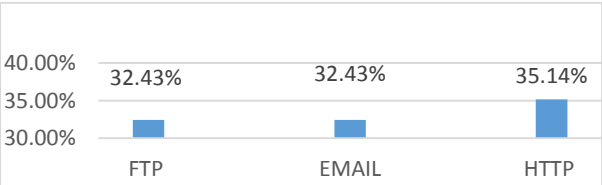

Figure 5. Radio Resource Control Physical Channel Reconfiguration Complete messages

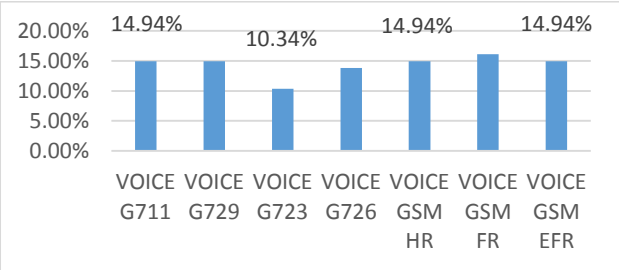

Figure 6. Radio Resource Control Physical Channel Reconfiguration Complete messages

The Physical Channel Reconfiguration is a signalling message parameter related to the UE to stop using scrambling code 100 as the serving cell and start using the cell with scrambled code 200. The result shows that the File transfer protocol (FTP) and Email generate the lowest number of Physical Channel Reconfiguration signalling message while the web browsing generates the highest number of Physical Channel Reconfiguration signalling message. For the voice codec, the results show that the G.711, G729, GSM HR, GSMEFR generates the same number of Physical Channel Reconfiguration signalling messages.The codec GSM FR generates the highest number of Physical Channel Reconfiguration signalling message. The codec G723 generates the lowest number of Physical Channel Reconfiguration signalling message.

3) Radio resource control Radio Bearer setup:-

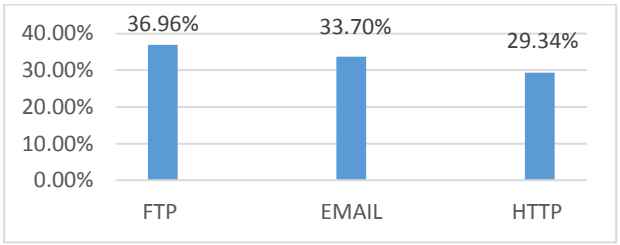

Figure 7. Radio resource control Radio Bearer setup messages

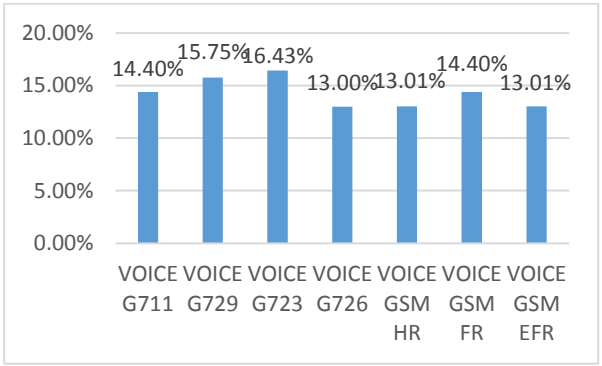

Figure 8. Radio resource control Radio Bearer setup messages

The radio bearer parameter is the service provided by the layer 2 for transfer of the user data between a UE and RNC. The result shows that the File Transfer Protocol (FTP) generates the highest number of the Radio Bearer setup-signalling message and the web browsing generates the lowest number of the Radio Bearer setup-signalling message. For the voice, the codec the G.723 generates the highest number of Radio Bearer setup signalling message of and the lowest one is GSM.HR.

4)Radio resource control Radio Bearer release:-

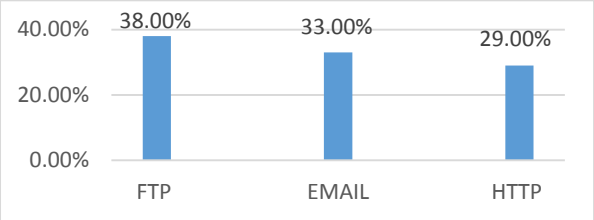

Figure 9. Radio resource control Radio Bearer release Messages

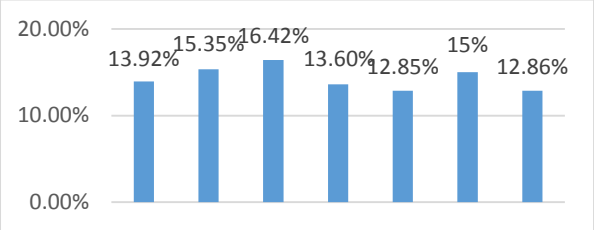

Figure 10. Radio resource control Radio Bearer release Messages

In the radio bearer released message for the voice codec, we found that the codec G.726, GSM.HR, GSM.FR generates the lowest number of the radio bearer released signalling message. The codec G.723 generates the highest ratio of the radio bearer released signalling message.

5) NBAP Radio Link Addition/ Deletion Request Packet:-

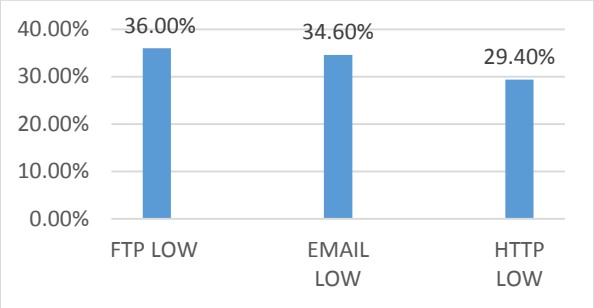

Figure 11. Radio Link Addition Request messages

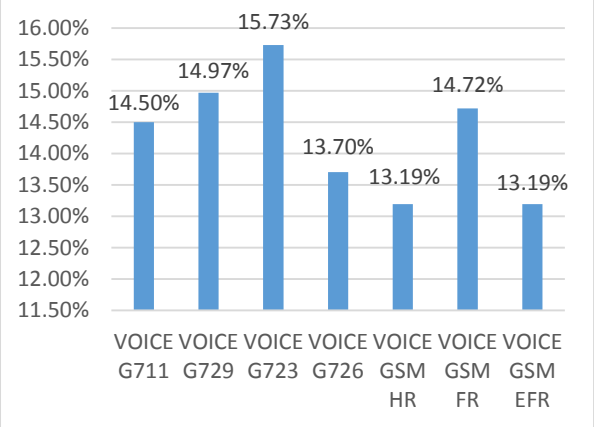

Figure 12. Radio Link Addition Request messages

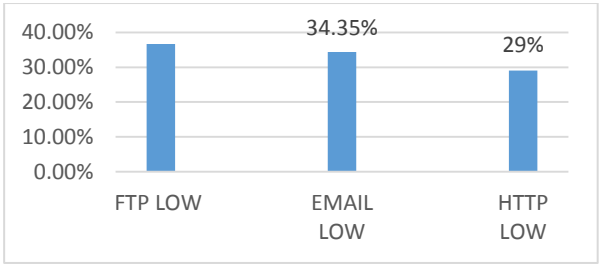

Figure 13. Radio Link Deletion Request messages

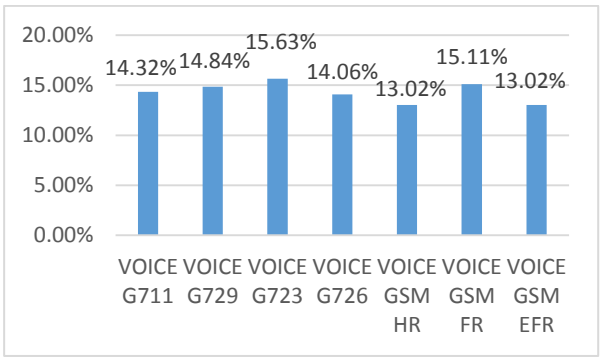

Figure 14. Radio Link Deletion Request messages

The radio link parameter is the logical association between signal UE and single UTRAN access point it is physical realization comprises one or more radio bearer transmissions. The result shows that the number of radio link addition /deletion message in (FTP) higher than the web browsing and email. For voice, the codec G.723 generates the highest number of the radio link addition and deletions signalling message and codec GSM EFR, GSM HR generates the lowest number of messages.

6)RANAP RAB assignment (release)/ (setup) packet:-

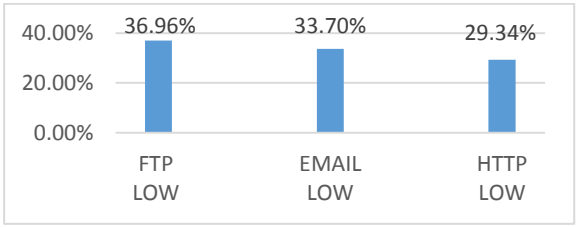

Fig. 15 RAB assignment setup packet messages

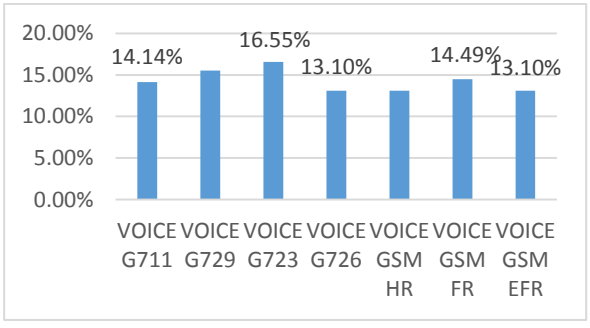

Figure. 16 RAB assignment setup packet messages

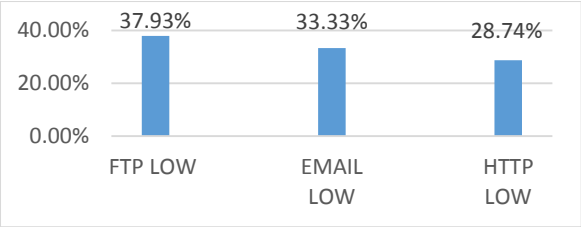

Figure. 17 RAB assignment release packet messages

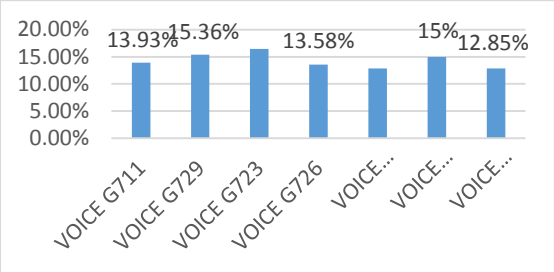

Figure. 18 RAB assignment release packet messages

The radio access bearer is the service that the access stratum provides to non-access stratum for transfer of user data between UE and Core Network. The result shows that the FTP generates the highest ratio of the radio access bearer-signalling message and the web browsing generates the lowest ratio. For the voice codec the result shows that the codec G.723 generates the highest radio ratio access bearer signalling message and CODEC GSMEFR, GSM HR have the lowest ratio.

V. CONCLUSION

In this paper, simulate different kinds of real-time application and non-real time application. To see the number of the signalling message in different layers like radio resource controller and node b application part and radio access network application part. The result shows that the application file transfer protocol has many messages like RANAP RAB assignment (release), Radio resource control Radio Bearer setup and releases, NBAP Radio Link Deletion and deletion Request. The voice codec G.723 generates a large amount of the signalling message during handover so this types of application have a bad impact to the mobile network because it generates signalling load in the network which effects to the quality of service and makes heavy congestion in the network. In addition, the result shows that the radio network application part has the number of the signalling message than radio resource controller and the node B application part.

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