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NETWORK TRAFFIC PREDICTION IN 4G NETWORK BASED ON NEURAL NETWORK FOR IMPROVING QOS

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ABSTRACT

Many mechanisms based on bandwidth reservation and handoff mechanism is proposed in the literature to decrease the connection dropping probability for handoffs in mobile 4G communications. The handoff events occur at higher rate in packet-switched fourth generation mobile communication networks than in traditional cellular systems. Hence, an efficient bandwidth reservation mechanism for the neighboring cells is critical in the process of handoff during the connection of multimedia calls. This mechanism avoids the undesired force termination and waste of limited bandwidth in fourth generation mobile communication networks, particularly when the mobility of the mobility device is high. In this paper, a phased solution of priority detection, mobility scheduling and effective bandwidth estimation have been proposed. The motivation of the phases is to provide the Quality of Service (QoS) at regular communication and high mobility condition by considering the physical parameters. Meanwhile, a neural network based service model is incorporated to accommodate new metrics used in processing handoffs and task scheduling in fourth generation networks. This mechanism provides the advantages in terms of choosing the tasks in a priority based scenario and providing un-interrupted service at the time of handoffs as well as an effective way of utilizing bandwidth.

Keywords- *Neural Network, Iterative Process, Bandwidth Estimation, Weightages, Scheduler*

1. INTRODUCTION

Interest in providing the availability of routing through the internet and QoS, content distribution and file sharing services, enabling multicasting or protecting from Denial of Service (DoS) attacks have been addressed by different application layer overlay design proposals [1]. Recently, it has seen that the rise of the Internet as a means of content delivery [1] is due to the growing popularity of smart handheld devices as a means of content consumers. Available content includes software and smart-phone applications, music and video files available, and media streaming applications. Each type of contents is associated with a particular desired quality of service but low delays between request and reception is good for all types of content [2]. 4G networking frameworks have recently received a lot of attention on the research community, as they provide an efficient infrastructure to use available networking resources in a transparent, scalable and cost-effective way. 4G networks are initially designed and considered for huge content distribution across networks [3]. One of the trends in internet is that it is being applied to the transfer of massive content [4]. Increasing number of communication software such as Skype and Peer-Cast, the area of audio or video conferencing and streaming are built on distributed architectures based on the 4G model.

1.1 Architecture

Universal Mobile Telecommunication System (UMTS) is developed in terms of various applications, services and bandwidth. The development of UMTS network is mainly based on the GSM or GPRS network that can support different types of applications such as data, voice and video. UMTS network is able to efficiently interact with other networks [6]. This service ranges from legacy applications such as data transfer to voice and multimedia calls [7]. In order to satisfy the user requirements, proper end-to-end QoS must be provided to the application flows [8]. A 4G QoS architecture is required to provide resource guarantees that allow differentiation or prioritization of services, and to deploy the performance improvement techniques that boost the performance by properly reallocating resources to users [9]. 4G (or) Next Generation Networks (NGN) allows connectivity anytime, anywhere with

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QoS and mobility functions [10]. The 4G network consists of internet protocols to facilitate the subscribers by enabling the selection of every application in any environment. In 4G cellular networks, a high bandwidth along with high data rate is required and also a quicker and optimized strategy of handover is required to make the clear and reliable communication. The 4G network system runs with the cooperation of 2G and 3G and imparts the IP based wireless communication. The main target in 4G is video streaming on IP based protocol, such as IP TV. If [11] 4G is deployed efficiently, it can solve many problems related to the speedy connections, performance, connectivity, and end user performance. These networks are helpful in reducing the Signal to Noise Ratio (SNR) at the receiver side along with the achievement of scalability and higher data rates.

1.2 Advantages and Disadvantages

This new breed of systems creates an application level virtual network with their own overlay topology and routing protocols [12]. Overlay networks are used increasingly for network sensitive applications such as distributed web caching, content dissemination and stream processing [13]. A 4G network is a distributed network architecture in which participants make a portion of their resources, such as processing power, disk storage or network bandwidth, directly available to other network participants without the need for central coordination instances such as servers or stable hosts. Peers are both suppliers and consumers of resources, in contrast to the traditional client-server model [14]. A 4G network is distributed, scalable, cost-effective, cooperative resource sharing and self-organizing network. It encourages Service Providers (SPs) to deploy many real-time applications over large scale heterogeneous networks.

Flooding-based systems do not scale due to the bandwidth and processing requirements that are imposed on the network. It does not provide guarantees to lookup time or content accessibility [1]. The simple pileup of hardware on servers is not sufficient to meet the rapidly increasing user demands. The dynamic boosting of network connections occurs commonly during a popular live streaming program. Freeloading is identified as a problem for peer-to-peer systems because many earlier peer-to-peer protocols allowed non-excludable access to overlay resources [13]. In systems, all mobile device requests were served indistinguishably, regardless of the amount and quality of the contributions that the requesting peer had made to the overlay [16]. Without authentication, adversary nodes can spoof the identity and falsify the messages in the overlay. As a result, a malicious node launches man-in-the-middle or denial-of service attacks.

1.3 Factors Affecting QoS in 4G network

Latency: It is also known as time to delivery. Latency is defined as the time from which a publisher publishes an event and a subscriber to that event receives notification that is available. The overlay network must effectively reduce the overall latency of event notifications. The latency can also be defined as delay.

Bandwidth: Bandwidth represents the resources available across a path during event transfer. It is denoted by the number of events transferred between the publisher and subscriber per unit time. If a subscriber doesn't specify the requirement, then the broker network assumes the default values, which provide the maximum possible bandwidth available along a path.

Reliability: Reliability plays an important role in peer to peer networks. It can be defined as the frequency of error occurred on the network [18].

Packet-loss: Packet transmission is done by the sender but it is not received by the destination. This is called packet loss [24].

At the time of data transmission, we should be aware of the following:

Buffer cache ratio- [13] Buffer cache ratio plays a vital role in transmission when a data packet is transmitted through another node.

Available capacity- [12] Availability capacity is directly related to the bandwidth. As bandwidth determines the availability of the number of channels at the time of data transmission so it plays a vital role in the content awareness.

CPU speed- CPU processing speed is a major issue in the data transmission since it controls the traffic factors at different time.

Memory size- Buffer cache ratio is a factor of memory that is present at different nodes. It plays a significant role in the time delay and heavy traffic.

1.4 Basics of Neural Network

The term neural network was traditionally referred to a network or circuit of biological neurons. The modern usage of the term often refers to the artificial neural networks, which are composed of artificial neurons or nodes. Thus the term may either refer to biological neural networks,

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made up of real biological neurons, or artificial neural networks, for solving artificial intelligence problems. Unlike Von Neumann model computations, artificial neural networks do not separate memory and processing, and operate via the flow of signals. Artificial intelligence, cognitive modeling, and neural networks are information processing paradigms which are inspired by the way the biological neural systems process the data. Artificial intelligence and cognitive modeling try to simulate some properties of biological neural networks. Artificial neural networks have been applied successfully to speech recognition, image analysis and adaptive control, in order to construct software agents (in computer and video games) or autonomous robots. A neural network consists of interconnected nodes, called neurons. Every connection in the network is characterized by a weight. NN comprises several layers of neurons like an input layer, one or more hidden layers and an output layer. The NN architecture is feed-forward in which the information travels through the network only in the forward direction.

To maintain the high bandwidth and high data rate through a variety of tasks, the network traffic prediction in 4g network based on neural networks with multi-task learning decomposition method is proposed. The solution is provided in three phases depends on neural networks and iterative process.

To provide an obvious research work, a well-defined introduction for the proposed method has been discussed. In the second section, some of the dignified researches are collected and described in the literature review. Then the paper is defining the problem and briefly describing the proposed work in section three. In the last section, the procedure is concluded with the overall proposed method advantages and future work.

2. LITERATURE REVIEW

In [19], the authors have proposed the various wireless mobile technologies and several applications of 4G mobile communications as well as the LTE (Long Term Evolution). Various networks in 4G, such as MIMO and OFDMA evolution and FDMA, CDMA, as well as TDMA are discussed. And also describes the security and quality of service in 4G. The challenges in 4G faces and their up-to-date solutions are also proposed. To improve the QoS, the authors proposed a scheme of combining mobility protocol called SMIP and application layer protocol called SIP. QoS level and security in 4G can be improved and the packet loss is decreased during the handover process. The authors confirm the resource allocation during the handover process by combining the two protocols and mobility management can be optimized.

In [20], with the introduction of new packet-optimized radio technologies, such as High Speed Downlink/Uplink Packet Access - HSDPA, HSUPA, as well as new radio access network architecture such as 3GPP Long Term Evolution in mobile networks, the variety of multimedia applications are available. The end-to-end QoS support has been recognized as one of the key requirements for successful employment of modern mobile networks. The necessity of creating the adaptive QoS application protocol is achieved by the fact that today's mobile networks still employ the best effort QoS approach. This approach cannot satisfy the requirements of modern mobile networks. But, there is a need for an in-depth study of application level QoS protocols and mechanisms.

In [22], two bandwidth reservation schemes have been proposed to reduce forced termination of multimedia handoffs in the packet-switched 4G wireless systems. Support Vector Regression (SVRBR) and Particle Swarm Optimization (PSOBR) techniques are employed to compute the amount of reserved bandwidth for the handoffs in the expected target cells. This work also tries to decrease the call blocking probability of new connections by using a channel borrowing technique. Meanwhile, a proportional differentiated service model is incorporated into their schemes to accommodate new metrics used in processing handoffs in packet switched 4G wireless systems.

The simulation result shows that both the proposed schemes, the SVRBR and the PSOBR, perform better than the Fixed Reservation (FR) scheme, the Without Reservation (NR) scheme, and the Rate-Based Borrowing scheme (RBB) when call blocking probability for new connections, call dropping probability for the handcuffs, and bandwidth utilization are compared. Although both the SVRBR and the PSOBR schemes achieve performance, less execution time for the PSOBR scheme verifies its feasibility in the real-time applications. The feasibility of applying other intelligence tools such as Neuro-fuzzy and genetic algorithms should be included in the proposed scheme to improve the accuracy of the motion prediction for the MH.

In [23], a new QoS measurement for Multimedia and data transmissions is proposed by considering a heterogeneous and delay sensitive applications.

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Based on this measurement, four scheduling schemes are proposed. Compared to the weighted round-robin and modified proportional fair schemes, the proposed schemes find the different tradeoffs between individual fairness and system performance, while the heterogeneous nature and delay sensitivity of payloads are considered. Packet loss is not considered hence it is the major drawback.

In [24], the complex structure of different metrics are identified since the multiple routing metrics have important implications on the complexity of path computation while the problem of finding a path subjected to multiple constraints is difficult. In this research, researcher designed a new efficient algorithm to compute paths that satisfy multiple constraints for Routing Optimization for 4G-device Performance (RO4P) on ad-hoc network.

4G devices in ad hoc mode offer minimal security against unwanted incoming connections. For example, ad-hoc 4G devices cannot disable SSID broadcast like infrastructure mode devices can. Attackers generally will have little difficulty in connecting to the ad-hoc device if they get within signal range. Signal strength indications are accessible when connected in infrastructure mode and is unavailable in an ad - hoc mode. Therefore, some difficulty must be faced whenever re-positioning an ad-hoc device is needed to achieve a better signal. The Wifi networking standards (including 802.11g) require only ad-hoc mode communication that supports 11 Mbps bandwidth.

3. PROPOSED METHODOLOGY

3.1 Problem Definition

In [19], the best solution was provided in the field of QoS using some latest technology of modeling. But technological change does not guarantee high end delivery. There are some physical parameters like noise present at the current time in technology, which affects the QoS. The solution in [20] is able to provide the high generation of data packets and provide a high end delivery of data packets. This method was unable to describe the huge technological error present in the high end data transfer. The method present in [22] was able to solve the problem by handoff. The QoS was maintained in the solution but there was an absence of dynamic data packet transmission in the real scenario. There is no efficient solution present in [23] for maintaining high data rates at edge nodes as well as there are no effective methods to solve the issues of jitter. Though one of the best routing algorithms was provided in [24] unable to solve the issues of high end data delivery and the dynamic issues. The two main disadvantages are as follows:

- Did not solve the problem of switching between services and hidden layers are not specified.
- Did not inform how other mobile devices and their services affecting the QoS of one mobile device.

The neural network proposed in [25] is a single step procedure in which there are two outputs in the procedure; those are main task and extra task. The solution is provided on the basis of multi-task learning multi-resolution learning. The neural network is applied under the condition of multitasking. Multi-learning is the process of applying the tasks in neural network as input or trained set. For multi resolution learning, a filtering technique is used. The hidden layers are conditions, services, or QoS on which this method [25] assigned the weight on the input tasks. The disadvantages of [25] are:

- There is a chance of the degradation of QoS at the time of handoff. A 4G network has frequent handoffs as it has high mobility.
- The hidden layers are not optimized for QoS.
- The neural network divides all the tasks. But 4G networks have high data transfer rates. So a number of tasks should serve to the mobile device. So other tasks should be treated as input for another neural network.

To provide a solution for the errors discussed above, the proposed method is divided into three phases. The first phase consists of the solution for 4G network at high mobility. The second phase chooses the correct sorting of tasks or services provided by provider to user. The third phase provides bandwidth estimation to enhance the work of the solution. Before describing all the phases, a fundamental structure of 4G network architecture and a brief description of neural network are described.

3.2 Traffic Prediction based on Neural Network

3.2.1 System Architecture

A 4G mobile network consists of several hexagonal structured cells with a service provider called as a base station. There are number of services and users present in the network. These devices are mobile in nature. These devices may be mobile, laptop, tablets, or any networking devices. The mobile devices are highly movable along the cells in 4G network. The mobile device is getting services from a base station. The base station or the

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service providers of the 4G network are providing a number of tasks to the mobile device. The tasks may be video streaming and video calling. Each cell has six neighbor cells around it. The mobile device can enter only into these cells due to physical limitation. A structure of 4G network is given below.

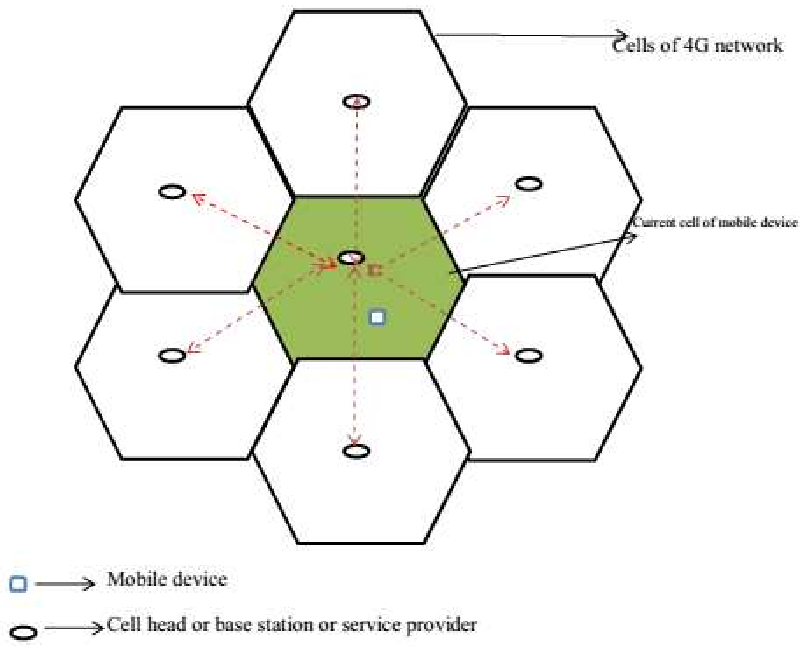

Figure: 1 System Architecture Of The 4G Network

For avoiding the traffic of data packets in communication with regular and handoff conditions, the current system proposes the neural network based technique among the base station and mobile nodes along with bandwidth detecting technology for 4G networks. The solution consists of three phases. The first phase is applied at the time of handoff only while the second phase and third phase are applied on both handoff and regular data transfer between service provider and user. For providing a better idea of the proposal, the below architecture is given.

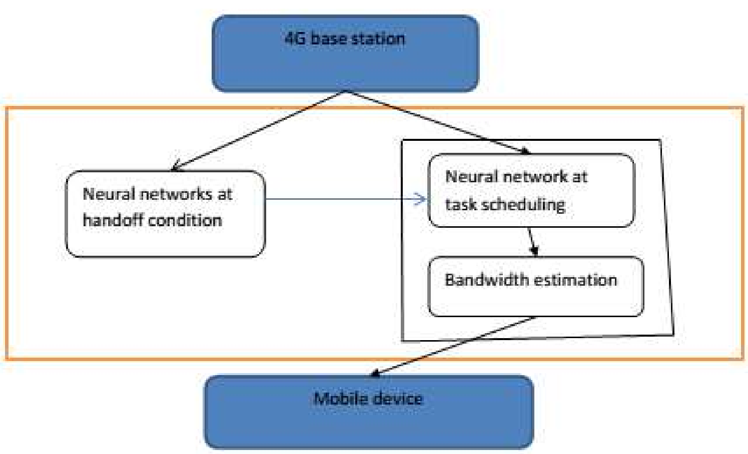

Figure: 2 Architecture Diagram

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3.2.2 Neural network

The complexity of real neurons is highly abstracted when modeling the artificial neurons. They basically consist of inputs, which are multiplied by weights (strength of the respective signals), and then computed by a mathematical function which determines the activation of the neuron. Another function called identity, computes the output of the artificial neuron (sometimes in dependence of a certain threshold). ANNs (artificial neural network) combine artificial neurons in order to process the information.

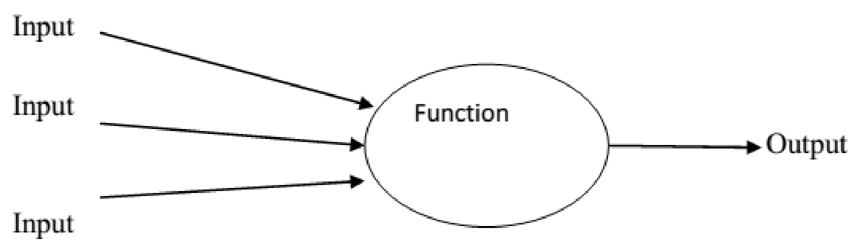

Figure: 3 An Artificial Neuron

When the weight of an artificial neuron is high, the input is strong. Weights can also be negative, so it can be assumed that the signal is inhibited by the negative weight. Depending on the weights, the computation of the neuron will be different. By adjusting the weights of an artificial neuron, output can be obtained that is needed for specific inputs. But when there is an ANN with hundreds or thousands of neurons, it would be quite complicated to find all the necessary weights. But it can be found that some algorithms can adjust the weights of the ANN to obtain the desired output from the network. The process of adjusting the weights is called learning or training.

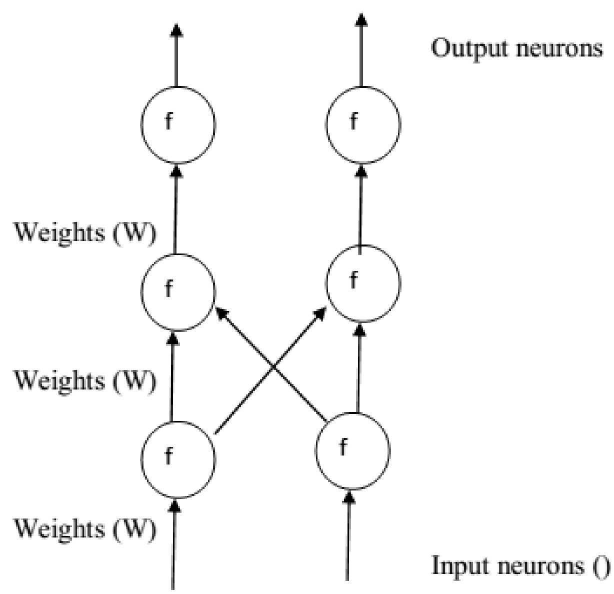

Figure: 4 Input Output Relation Of Neural Network

The functions at hidden layer is given by-

$$A_j(x,w) = \sum_{i=0}^{n} x_i * W_{ij} \qquad (1)$$

where $A_j(x,w)$ =output value,

X_i =input trained set,

W_{ij} = weightages.

3.2.3 Channel availability Estimation

For channel detection, this method provides a service and number of mobile device condition. So the formula given below has been evolved. Suppose

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(i) There are 'i' number of tasks and 'j' number of mobile nodes, (ii) Every task is using BW_t amount of bandwidth and a service provider has a fixed amount of bandwidth, and (iii) The fixed amount of bandwidth is BW_t and the average uses of BW_a, then channel availability can be detected as-

$$AV_{ch} = \frac{BW_T - \sum_{j=0}^{j} MB_j \left(\sum_{i=0}^{i} T_i \right)}{BW_{AV}} \quad (2)$$

where AV_{ch} = channel available.

BW_T =total bandwidth available at base station.

MB_j =mobile nodes where j=0 to n where n is the maximum number of mobile node.

T_i = total bandwidth required for a task or services for a single mobile node where i=0 to n.

BW_{AV} =it is the average bandwidth for a mobile node

3.2.4 Solution for high mobility of 4G network

In the first phase, the movement of a mobile device from one network to another network is called handoff of the mobile node or device between base stations (mobility along cells). At the time of the handoff, the QoS is degrading to a lower value [24]. At this time, choosing the right base station or the right cell for the next service area is proposed here. In this neural network, there are six inputs (X_1-X_6) or six values in the trained set. Each value of trained set is related to the channel availability of the base station of the cells around the current cell. The details of channel availability detection technique have been proposed in paper [26]. Here the channel availabilities of the neighbor cell's base station are the inputs or the trained set to the neural network. The output of the neural network is arranged as the highest number of channel availability is main (suppose X_1) and others are extra value (X_2-X_6). The main value (X_1 channel availability having base station) is chosen as the next service provider for the MD. The hidden layers or the weightages depend upon the facilities or services available in that cell. The facility availability is related to video streaming, internet available and video calling.

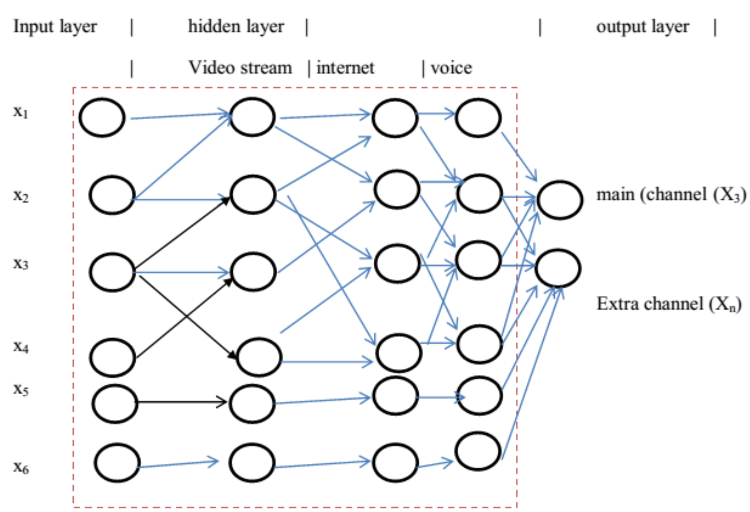

Figure: 5 Showing Neural Network Procedure At The Base Station For Phase-1

Figure 5 shows that there are six inputs to the neural network. The inputs in the trained sets are related to the channel availability of six neighbor cell service provider. The channel availabilities are mentioned as X_1, X_2, X_3, X_4, X_5, and X_6. For providing the weightage system, three hidden layers are considered. The layers are video stream, internet, voice as W_{1i}, W_{2i}, W_{3i} respectively. The decision taking table present at the base station for deciding the next cell for providing the service to the mobile node is given below-

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Table: 1 Result Analysis For High Mobility Condition

Inputs	Weighatage-1	Weighatage-2	Weighatage-3	Output	Selected
X_1	…..	……	……..	……	
X_2	……	……	…….	…..	
X_3	…….	……	…..	……	X_3
X_4	….	…..	…….	…..	
X_5	….	…..	…..	…..	
X_6	…..	……	……	…..	

The table-1 has six attributes. The attributes are inputs, which are the channel availability of neighbor cells, attributes from the second to fourth be the weightages applied in neural networks, and the fifth one show the output from the corresponding neural network and the sixth one is the selected node.

Algorithm for the phase 1-

Step 1- Develop a neural network as proposed in [26].

Step 2- Provide six inputs as the trained set, which consists of available channels of six neighbor cells.

Step 3- Assign the weightage on the link of the neural network as user's choice that depends upon matter of time.

Steps 4- Obtain the channel available as output of the neural network. Choose the cell having the channel bandwidth for next communication.

Example

There are six cells around a single service provider's area. There are six neighbor cells around the cell. Suppose the service provider provides the services of voice call with weightage 10, internet with weightage 7 and video stream with weightage 5 to the mobile node. At the time of first phase, the six station's channel availability are 5, 6, 8, 9, 3 and 7; their corresponding cells are A, B, C, D, E and F. Here this method considers the simple non-overlapping neurons for smooth calculation.

According to the given formula-1, the corresponding values will be calculated as follows:

A-5*10+5*7+5*5=50+35+25=110
B- 6*10+6*7+6*5=60+42+30=132
C-8*10+8*7+8*5=80+56+40=176
D-9*10+9*7+9*5=90+63+45=198
E-3*10+3*7+3*5=30+21+15=66
F-7*10+7*7+7*5=70+49+35=154

If the above condition is considered, the most valued output will be the cell D. So the next service provider will be D. This method can take cross neuron networks as a mobile device and get service. This type of procedure is adapted in the phase two also.

3.2.5 Task Scheduling Phase

In the second phase, all tasks (T_1-T_n) are applied as a trained set to the neural network at the base station of the 4G network. The Tasks (T) are the services provided by a base station to a specific Mobile Device (MD). This method uses a series of neural networks and three hidden layers in neural network for quality of service. The hidden layers are jitter (W_{11}), bandwidth (W_{22}), and packet loss (W_{33}). It uses iterative process of neural network to find the tasks in descending order (higher priority to lower priority, which is derived as main task from the output of the first neural network to derived main task or the output of the last neural network). The result of the previous neural network or the output is kept aside and the other tasks are set as trained set for the second neural network. The hidden layers or weightages kept same (W_{11}, W_{22}, and W33) as the first neural network. The result or the output of the second neural network is treated as the second main task. This procedure is continued till the last task (n^{th}) being the main task of neural network (n^{th}). Thus the order of the task from one to n^{th} are detained.

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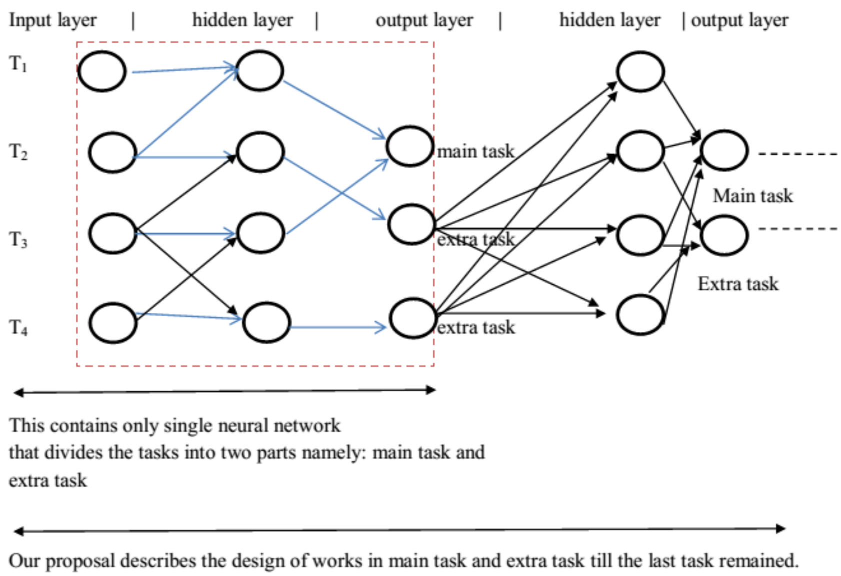

Figure: 6 Architecture Of Neural Networks In The Second Phase

The diagram of the iterative neural network shows that there are four tasks. The tasks are defined as the T_1, T_2, T_3 and T_4. All tasks are treated as trained set to the neural network. Weightages present on the neurons of neural network. The details about the hidden layer (consists of neurons and functions) is described in the next diagram. The figure 3 clearly shows that the output except a single output, of the first neural network is applied to another neural network. This process continues till the end.

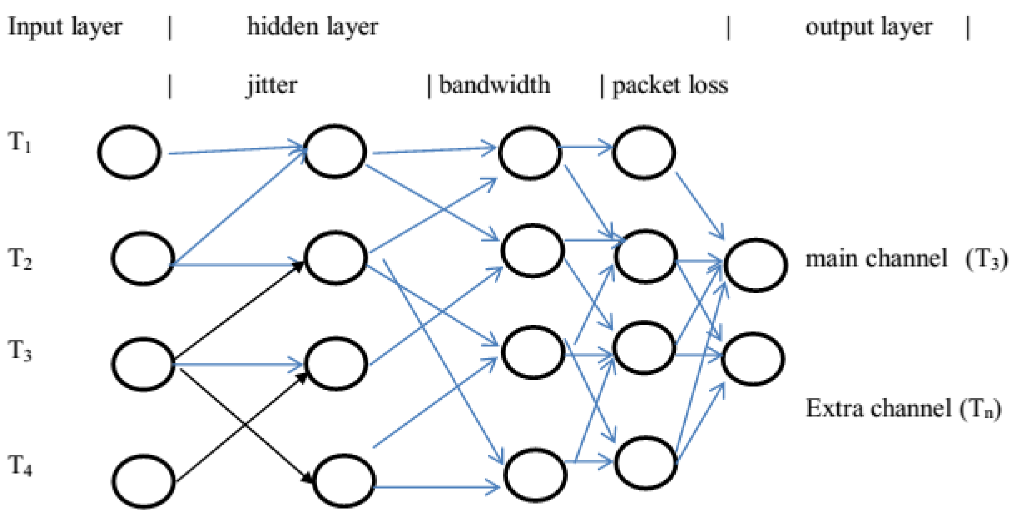

Figure: 7 Hidden Layer Present For Task Scheduling

The above figure shows that there are four tasks or services provided by the service provider those are set as trained set or input to the neural network. The weightages are given on the parameters like jitter, bandwidth and packet loss. These parameters are dependent upon the tasks as the tasks present in the 4G network have their own requirements on these parameters. The function calculation is given in the equation (1).

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Table: 2 Result Of Neural Network Into Priority Based Tasks

SERIAL NUMBER	Neural network number	Task identity
1	1st	T_1
2	2nd	T_2
3	3rd	T_3
…	….	…..
…	….	…..
N	nth	T_n

The table has three attributes. The first attribute is the index of the table or the serial number. The second attribute is the number of neural networks applied, and the third one is the selected output from the corresponding neural network. Here the outputs of the phase are T_1 to T_n tasks in a sorting order.

Algorithm for second stage

Step-1- Set all the tasks (each task has task ID) provided by the 4G network as trained set to the neural network.

Step-2- First all the tasks are provided as the trained set for the neural network.

Step-3- The output or the highest valued output of the neural network treated as the first task (highest priority) for the mobile device.

Step-4- Then the entire set of tasks except the first task are applied as a trained set to the next neural network. The neural network is same as the first neural network.

Step-5- The second main task is treated as second highest priority. The step is repeated. This procedure is continued till the last task remained.

3.3 Bandwidth Estimation phase

In the third phase, a suitable bandwidth estimation technique is applied to the derived solution in phase-one and two. The formula to apply the input tasks has been detected and is able to calculate the exact amount of bandwidth required after scheduling tasks with consideration high mobility factor. To achieve this, there are two pre-defined values BW_{AV} and D_{To} is determined by the user before applying the last phase or the current phase.

For the bandwidth detection,

$$BW_R = C * D_{Tr * BW_{Av} * \frac{1}{D_{To}}} \qquad (3)$$

where c= constant

D_{Tr} = input trained set (the task received from phase-2)

BW_{AV} = bandwidth of selected channel

D_{To} = maximum number of inputs

BW_R =bandwidth assigned to the specific task of the specific mobile node.

Algorithm for the third phase

Steps-1- Obtain the correct task or data set from the phase two.

Step-2- Obtain the bandwidth of the channel available from the base station.

Step-3 – Obtain the maximum number of inputs of transmission.

Step-4- Obtain the channel bandwidth as shown in the formula (3) [2].

3.4 Integrated Algorithm

Step-1- The service provider detects whether the mobile device is in handoff scenario or not. If it is not in handoff scenario, it directly goes to step 3. If the mobile node is in handoff condition, it goes to step 2.

Step-2- Apply channel availability of the six neighbor cells as given in phase one. Then go to the phase two.

Step-3- In this step, the tasks or the services are provided by the base station to the mobile node and process them in the iterative neural network logic as given in phase two.

Step-4- Obtain the bandwidth as given in phase three.

Step-5- Communicate with the mobile device by using the chosen tasks. If handoff present, the chosen service provider will communicate with the mobile device.

4. SIMULATION RESULTS

4.1. Simulation Model and Parameters

In this section, we simulate our proposed Network Traffic Prediction based on Neural Network (NTP-NN) in UMTS network. The simulation tool used is NS-2 [27], which is a general purpose simulation tool that provides discrete event simulation of the user defined

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networks. In the simulation, mobile nodes move in 800 meter x 800 meter rectangular region for 30 seconds simulation time. Initial locations and movements of the nodes are obtained by the Random Way Point (RWP) model of NS2. All nodes have the same transmission range of 250 meters. We compare our proposed scheme with the MTL technique of [25].

The simulation topology for the experiment is shown in Figure 8.

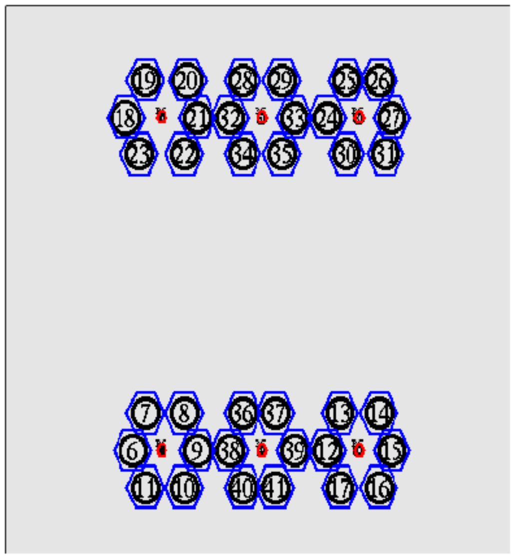

Figure: 8.1 - Simulation Topology before Handoff

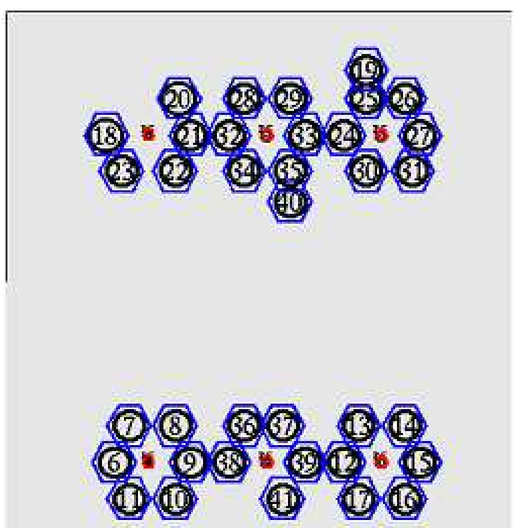

Figure: 8.2 - Simulation Topology after Handoff

The simulation parameters are summarized in Table 3.

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Table: 3 Simulation Parameters

Number Of Nodes	36
No. of Cells	6
Users per Cell	6
MAC Layer	Mac/Hsdpa
Antenna	Omni Antenna
Packet Size	500bytes
Simulation Area	800 x 800m
Txpower	0.66 w
RxPower	0.395 w
Routing Protocol	NOAH
Traffic Model	CBR
Initial Energy	4.1 J
Simulation Time	30Sec
Speed of mobile	25 m/s

4.2. Simulation Results

A. Based on Rate

In our first experiment, we vary the data sending rates as 100, 200…400 Kb.

Figure 9 shows the maximum bandwidth measured. From the figure, our proposed NTP-NN attains 68.9% more bandwidth than MTL.

Figure 10 shows the average delay measured. From the figure, it is apparent that our NTP-NN scheme attains 86.21% less end-to-end delay, when compared to the MTL scheme.

From Figure 11, we can observe that our proposed NTP-NN has 17.6 % low average power consumption, when compared with the MTL.

From the figure, it is clear that our NTP-NN scheme have 86.1% more delivery ratio, when compared with the MTL scheme.

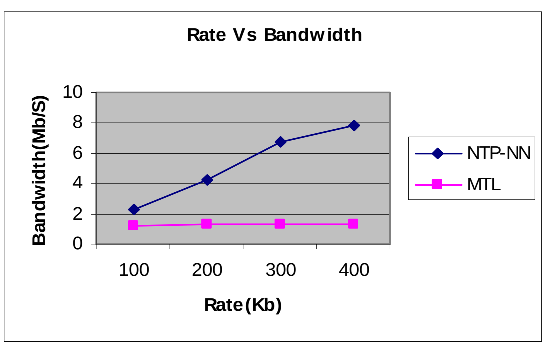

Figure: 9 Rate Vs Received Bandwidth

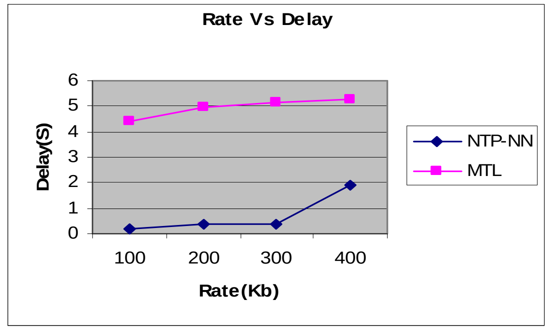

Figure: 10 Rate Vs Delay

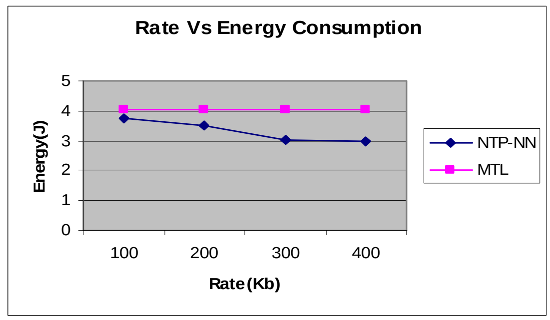

Figure: 11 Rate Vs Energy

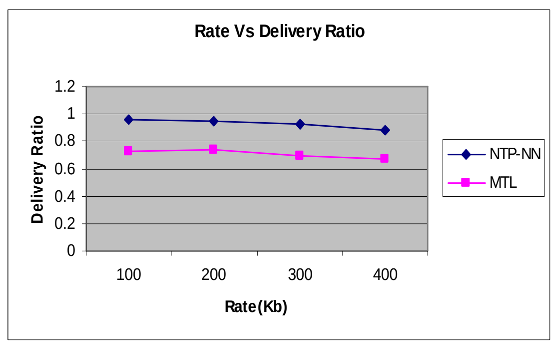

Figure: 12 Rate Vs Delivery Ratio

B. Based on Users

In our next experiment, based on users we measure the throughput of each user in both the schemes.

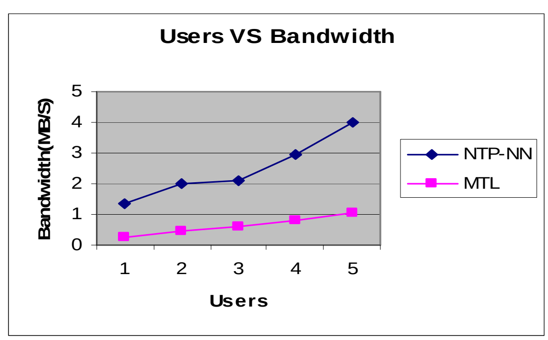

Figure: 13 Users Vs Received Bandwidth

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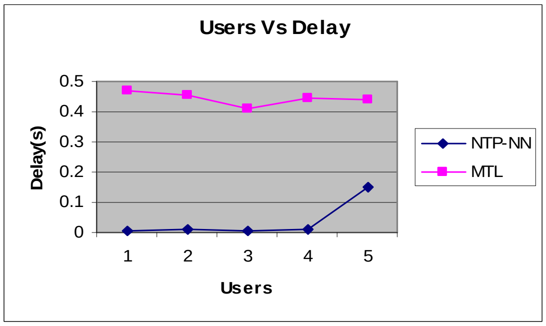

Figure: 14 Users Vs Delay

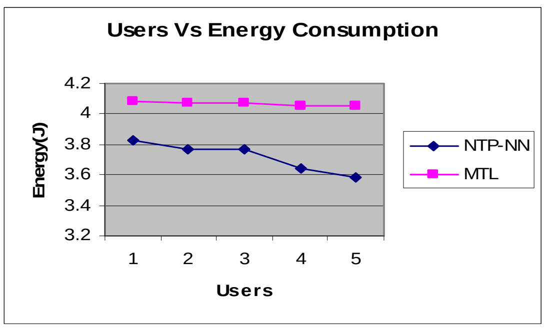

Figure: 15 Users Vs Energy Consumption

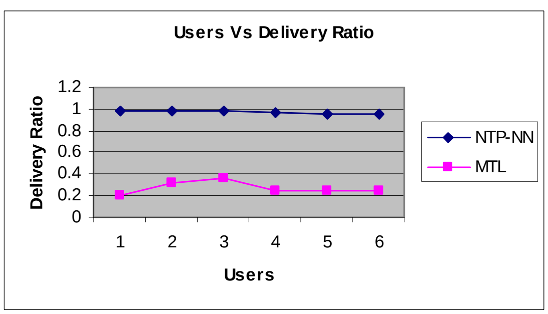

Figure: 16 Users Vs Delivery Ratio

Figure 13 shows the maximum bandwidth measured. From the figure, our proposed NTP-NN attains 75% more bandwidth than MTL.

Figure 14 shows the average delay measured. From the figure, it is apparent that our NTP-NN scheme attains 98.5% less end-to-end delay, when compared to the MTL scheme.

From Figure 15, we can observe that our proposed NTP-NN has 9.1% low average power consumption, when compared with the MTL.

From the figure 16, it is clear that our NTP-NN scheme have 72.7% more delivery ratio, when compared with the MTL scheme.

5. CONCLUSION

This paper described a neural network based solution on 4G network and bandwidth estimation. The research is done in three phases. The first phase was used to attain high mobility of the mobile device and the solution was provided for the fast handoff in 4G network. The second phase included neural network for detecting the job's priority. The third phase had been provided the better bandwidth to the all the present service.

An effective bandwidth calculation made more resources available in the network. The iterative neural network method has been scheduled the jobs according to the priority. As the solution is timely based, the paper is more effective in terms of current scenario. The main issue of quality of service is degradation at the time of handoff, whose amount is more in 4G networks as they have high mobility.

The future work should focus on the cost-effectiveness in terms of bandwidth and time. There should be some distributed system to be developed so that no dependency on the base station will be presented.

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