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NETWORK LAYER SPECIFIC DATA TRANSMISSION FOR INTEGRATED NEXT GENERATION NETWORKS

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ABSTRACT

Being digitized the communication system, channels are having a severe workload in the current scenario. The internet and 4G services available in the global world are able to provide good service to both stationary and moving devices. Huge number of devices can be introduced in a specific region of the network. Devices can be operated in any layer of the network. Most of the challenges are faced in cross platform based service during handoff. For these kinds of handoff problems, this paper proposes a technology, which includes a variety of header formats in IP-v6 header format and a suitable protocol for cross layer handoff. This work is done on a layer wise handoff and dual communication with two base stations when handoff occurs. Multiple header format supports reliable, uninterrupted and delay avoidance in the communication system. The authorization and authentication are enhanced with two control units.

Key words: *Authentication, Authorization, Handoff, Signal Strength.*

1. INTRODUCTION

1.1 IPv6 Networks

Demand of identification of devices, which are connected through global network system leads to the invention of IP-v6 address in the network domains. The operation of devices in a variety of regions is highly needed. Devices deployed in different regions are adapted to work in some of the specific layers of the network. Although the human interface level of different device may same, they have different network accessing layers. Moving any device from one network region to another network region may have some problem in terms of delay, data requirement varying in layers of the network. Mobile handoff is a main problem in IP-v6 networks. Since more users moving around in search of Internet connection from their home to their office, Vehicular Ad-hoc Network (VANETs) has increasingly become popular [1]. Over the last few years, many new protocols have been developed for multimedia applications in the whole OSI layer's scale [2]. One of the most visible trends in today's commercial communication market is the adoption of wireless technology [3].

1.2. Architecture

In integrated WAN + LAN + 3G cellular systems, data and multimedia communications are carried from end to end over the existing Internet infrastructure [4]. A network consists of a number of layers for providing the service of communication [5]. Generally, the network consists of a physical layer, data link layer, network layer, transmission layer, session layer, application layer [6]. While the upper layers like session layer, application layer, are subjected to the software application. The parameters present in data link layer, the physical layer, network layer, transmission layer are affecting the communication channel. To provide a reliable and uninterrupted service, a number of protocols are introduced in the network layer and transmission layer. Data is transmitted as a data packet. The data packet is designed in a header format and is transmitted through a character array. Data always flow from source to destination by using a number of protocols. The source and destination are dynamically fixed by the user. Source and destination are identified as IP address format. When digital transmission is started its working in the world, few devices are acting upon it. At this time, the data packet is sent through IPv4 header format. Gradually the number of devices increases and requirement of new header format born. Although IPv6 needs more space in network bandwidth, it is applicable due to the invention of optical fiber cable and high speed processor. The header format is changed as the requirement of the network and new protocols are introduced to

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provide uninterrupted communication. The parameters present in the IPv6 header are dynamic.

1.3. Applications

Traffic on future wireless networks is expected to be a mixture of real-time traffic such as voice, multimedia teleconferencing, and games, and data traffic such as web browsing, messaging, and file transfers. All of these applications require widely varying and very diverse Quality of Service (QoS) guarantees for the different types of offered traffic. IPv6 header formats are supported anytime and anywhere. These header formats can be deployed in 3G and 4G networks. They are able to provide high speed internet and communication system [7]. The future Airborne Network will include a core of loitering or orbiting aircraft which provide inter-networking over multiple heterogeneous wireless links [8]. Nowadays, cross layer handoff is used to operate mobile devices in a random layer of the network. Due to the unique structure of a mobile ad hoc network it can be deployed anywhere at any time where fixed networks cannot be deployed [9]. Multicast protocol is used to minimize the energy dissipation in the network [10]. Wireless technologies provide mobile access to networks and services; eliminate the requirement for fixed cable infrastructures, and thus enable fast and cost-effective network deployment, re-organization and maintenance [11]. Next generation wireless networks offer the promise of high speed access as well as IP-based data services to the mobile hosts. Protocols must maintain the same level of performance in the wireless networking environment with frequent handoffs, as in the wire-lined environment [12] [13].

1.4. Issues

Transmission power control is important because of the interference limited nature of the wireless network. It has the potential to increase a network's track carrying capacity, reduce energy consumption, and reduce the end-to-end delay [14]. Cross layer design has the potential to destroy the modularity and make the overall system fragile [15]. Multi-hop wireless networks impose new challenges such as, the varying nature of the signal strength, higher bit-error rates [16], dynamic variations in channel quality, fading effects, interference problems, mobility, shared and contention based MAC. Multi-hop transmission and path selection at network layer needs some degree of interaction amongst different layers to optimize the overall network performance [17]. It is still critical to efficiently utilize the radio resources due to the fast growth of the wireless subscriber population, increasing demand for new mobile multimedia services over wireless networks, and more stringent QoS requirements in terms of transmission accuracy, delay, jitter, and throughput. Applications and protocols for wireless and mobile systems must deal with volatile environmental conditions such as interference, packet loss, and mobility [18]. Multimedia data transmission experiences a number of constraints that result to low QoS that is offered to the end user [19].

By considering the problems of cross platform in handoff technology and uninterrupted service in future networks, this paper proposes network layer specific data transmission for integrated next generation networks. This technique includes three stages. The first stage is request and response phase through a minimum overhead of transferring technology. The second phase includes authentication and authorization phase. The third stage includes providing a cross platform to the node.

In section 2, this paper discuss about some earlier works based on the platform changed scenario. In section 3, it enters into the third phase of problem definition and proposed method. Simulation results are provided in section 4.An overall conclusion is given at section 5 of the paper.

2. LITERATURE REVIEW

The Yuh-Shyan Chen et al. [20] have proposed a cross layer partner based fast handoff mechanism based on HMIPv6, called as PHMIPv6 protocol and their PHMIPv6 protocol is a cross layer. With the aid of the partner node, CoA can be pre-acquired and DAD operation can be pre-executed by the partner node before the mobile node initializes the handoff request. PHMIPv6 protocol can significantly reduce the handoff delay time and packet losses. The experimental results also illustrate that PHMIPv6 protocol achieves the performance improvements in the handoff delay time, the packet loss rate, and the handoff delay jitter.

Guangquan Chen et al. [21] have described a new cross-layer design considering coordinated scheduling for the performance improvement of delay-sensitive applications over heterogeneous wireless networks. Their proposed design utilizes information about the physical and data link layers and decides the connections transmission power, encoding mode or coordinated scheduling

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execution. According to the extensive simulation results, the design achieves improved performance in terms of packet loss rate, average delay and throughput, when compared to the existing systems.

A.Maheswara Rao et al. [3] have developed a Cross-Layer Based QoS Routing (CLBQR) Protocol for 802.16WiMAX Networks. In this protocol, the cross layer routing is based on the routing metrics such as power, link quality and end-to-end delay. In order to realize QoS provisioning with efficient resource allocation an optimal power allocation is required. They have used the Exclusive Expected Transmission Time (EETT) metric to estimate the link quality where EETT is a routing metric used to give a better evaluation of a multi-channel path. They use the average queuing delay at each node. The protocol is the derivative of the AODV routing protocol, which is the variant of classical distance vector routing algorithm. It achieves a higher packet delivery ratio with reduced energy consumption and delay.

The cross-layer design proposed by Jhunu Debbarma et al [22] was aimed to provide a solution for unidirectional link failure management, reliable route discovery, and power conservation. The link quality can be predicted by the received signal strength from the physical layer. The links having low signal strength can be discarded from the route selection. From the MAC layer, the minimum power required can be estimated by performing RTS/CTS packet exchange. Based on this, the application layer can readjust the transmission rate, to avoid collision. Their cross-layer design makes the AODV routing protocol to survive with heterogeneously powered ad-hoc networks by identifying and rejecting the asymmetric links at the RREQ broadcast stage itself.

Vertical handoff was defined in [14] as a process which transfers a user connecting from one technology to another. Vehicles and other mobile applications will expect seamless vertical handoff between heterogeneous access networks, via multiple interfaces. This is achieved by exchanging information across multiple layers of the same entity and by sharing information between nodes in the network. Therefore, if a link event is not propagated quickly enough across the protocol stack service disruption could occur due to latent handovers. The proposed frameworks introduce 3SE and its capabilities namely multi-homing, multi-streaming, address reconfiguration and able to distinguish between losses due to congestion and radio channel failures.

Among the main novelties introduced by 3SE, there are diversified bandwidth estimation and efficient use of multi-homing by the redefinition of primary and secondary path. In addition, they provide a complete solution to use 3SE as an efficient transport solution for MIH. The solution combines a path selection algorithm and the use of MIH services to optimize 3SEs behavior.

3. PROPOSED METHODOLOY

There are many solutions present to the problem of cross platform integration. Still these are not efficient as they are following different protocols related to only IP issues. Some authors have tried to give the solution in a web-based scenario. The web-based scenario is solved through virtualization of network structures in the network. Some author [1] has tried only on delay parameters to solve the solution. But the delay is working only in a single layer. Scanning is one of the technologies described by authors of paper [2]. Still it requires extra workload on the devices working on the network. Routing described in [3] is one of the methods that enhance the handoff technology. Still it is difficult to predict it when one network area is coming under the region of another network area. Although the method given in the paper in [4] is able to create good handoff, it is not reliable at unpredictable cases. The method given in [5] is working on path solution with more delay that causes more workload on finding a path.

Considering the above problems, this paper tries to solve the problem of integration in a different platform oriented network using three data packets in a single transmission.

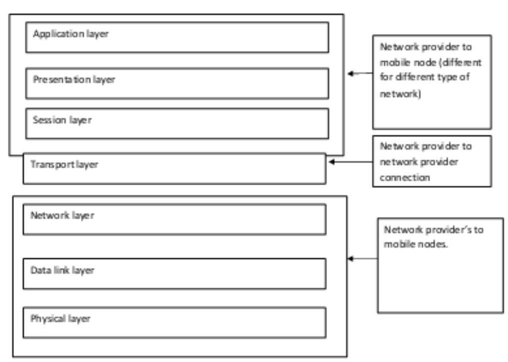

Figure-1 Shows The Requirement Of Different Layer

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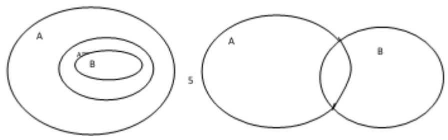

Figure-2 Shows One Network Area Is Coming Under Another Area And Figure-2b Shows Interception Two Different Areas

Before doing any handoff, the handoff area is determined. Here this method proposes dynamic decision. Every mobile device is able to detect the strength of different networks. This can be done through scanning the network availability at a standard time (t_s). The standard time (t_s) is manually set at the time of establishment of the network by the experts. Suppose the mobile device is moving from network A's domain to network B's domain. In the above figure-2, it is clearly shown that the network intersect area of A and B. The mobile node also decides the network area under which it wants to work.

So in this paper, the data packets are divided into three parts to communicate with the mobile nodes having same destination address (the destination address is the address of the mobile node, this may be the IP address or MAC address). The rough structure of the data packet is given by

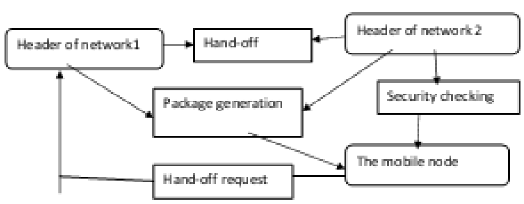

Figure-3 Shows The Data Packet Structure

First part consists of handoff that includes the request from the mobile node to the network provider; the second one is verification of second network provider with the mobile node and at the high level user interface. The third part is about making the platform for the mobile node and communicating with the mobile node.

By using data packets, a regular network providers head is communicating with the node.

The data is transferred through a package. The data packages are divided into three packets. Each data packet is responsible for either transport layer or lower layer or higher layer communications. The three types of data packets have the same data packet number.

DPN	Source	Destination	Information	Transport layer Protocols

Figure-4 Shows The Data Packet Format At Transport Layer

DPN	Source	Destination	Information	Higher layer Protocols

Figure-5 Shows The Data Packet Format For Presentation, Secession, Application Layer

DPN	Source	Destination	Information	Lower layer Protocols

Figure-6 Shows The Data Packet Format At Network, Data Link And Physical Layer

In the above figures, the DPN indicates the data packet number. Here the source denotes the network provider's address. The destination denotes the service getting a node's address. The information fields are related to the protocol fields and valuable data transfer. The DPN, source and destination fields are same for all the three packets shown above. The last field shown in the figures is the protocol sharing information fields that has sharing information about respective layer protocols.

3.1. Handoff scenarios

A node is working with a network that provides the required service to the node. Here the node can be movable or a stationary object. The signal to noise ratio (SNR) is used to select the node [29] [30] [31].

$$\text{Choose node}=\max\{SN_1, SN_2\ldots SN_n\} \qquad (1)$$

where SN_n are the signal to noise ratio, where n is the maximum number of signal the node is getting.

If the node moves from one domain to another domain, the mobile node can generate manual request to its network header.

In cross platform, this method proposes the handoff in transport layer only. The transport layer protocols such as HTTP, UDP, TCP/IP etc., are used for data transmission from one network header to other network header as well as network header for mobile node stationary nodes that is getting the service. In the first phase, when a node generates a handoff request to the network header, the network header is communicating with the other network header with the protocols of transport layer only.

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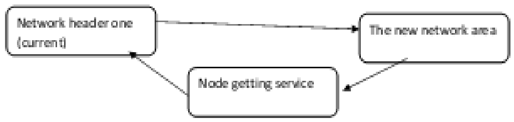

Figure-7 Shows Transport Layer Communication

The network header under which the current node is operating sends an information packet to the second network header. The data packet is given below-

Destination	Current	Nodes	Protocols of the transport

Figure-8 Shows The Handoff Request Packet From Network Header To Network Header

Here the second network's header is treated as a destination. Current header is the one under which the mobile node is operating. Every mobile node has its own identity in the network. This identity is used for communication between network header and the nodes those are getting service from the network headers.

3.2. Verification of nodes with the nodes

When a network header is getting requests from another network header, the second network header started verification about the node. At this time, the first network header from which the node is getting service is continuously providing service. The authentication and authorization take place in three stages. The first stage is about the network header's ability to take the node's request for communication. Every network header has permission for a limited number of nodes. As the networks belong to different functional area, they cannot accept any node without any security check. Network header first verifies whether the transport layer protocol may change or not. If the transport layer protocols can be changed then it checks for the higher levels of protocol changing scenario. If the higher level protocols can also be changed then the network header proceeds to the third step.

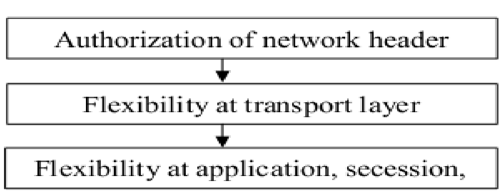

Figure-9 Shows The Architecture Of Authenticating Check And Flexibility Check

At all these stages, the first and second network headers are communicating with the node that is interested to work in the cross platform scenario. The first network header is responsible for regular information or data transmission. The second network header is doing its authentication check.

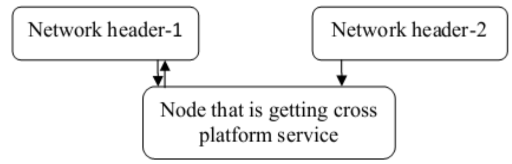

Figure-10 Shows The Relation Between Network Header And Node Getting Service At Second Stage

The above figure shows that the node that is getting service has two-way relations between the network header under which the service-getting node is working and service getting a node. This two-way communication is required for uninterrupted data transmission. It is clear from the above picture that the second network header is verified in single-way with the node getting the service facility.

3.3. Platform formation and transmission

After successfully crossing second stage, the process moves into third step. This step provides the platform, assigns the upper layer protocols to the node and does the handoff for further data transmission. In the first phase of third step, the second node provides the physical layer, data link layer and network layer protocol to the node interested in handoff. After successful assignment of lower layer protocols, the second network header assigns the higher layer protocols those belong to the application layer, session layer and presentation layer. Then it sends the request to the first network header. Then the first network header gives all the control to the second network header. Then the second network header starts communicating with node.

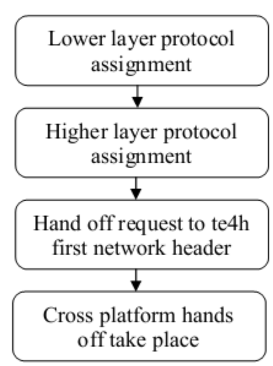

Figure-11 Shows The Architecture Of The Third Step In Cross Platform

The second request data packet from network header two to network header is given below.

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Destination	Current address	Node's identity	Status

Figure-12 Shows The Data Packet Send From The Network Header Two To Network Header One

In the above data packet, the destination is previous network header's identity. The current address is the network header that is going to provide the service to the node. Node's identity is the identity through which the node can be detected through the networks. Here the status denotes the status of success or failure. If it is successful, then the handoff takes place in a cross platform scenario. If the status is failed then the process failed to give cross platform technology.

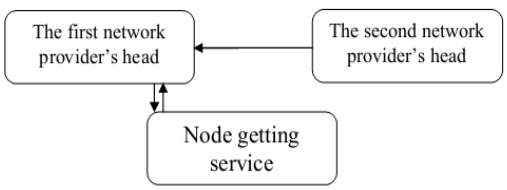

Figure-13 Shows The Architecture After Authorization Phase

The above figure clearly shows that after authorization the second network provider's head is communicating with first network provider's head. At the same time, the first network provider is providing the data transfer to the node interested in getting service.

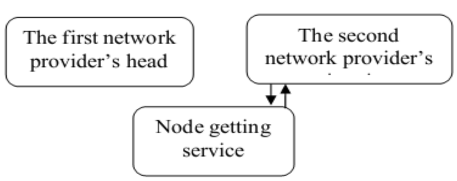

Figure- 14 Shows The Architecture After The Node Made Platform Independent Move

The above architectural diagram shows that after completing the procedure, the second network provider's head is communicating with the node getting service, while the first network provider's head remains separated.

The overall procedure is given below-

Step-1

1. The node that is interested to change the functional area first, must gather requirements like signal to noise ratio or functional requirement.
2. Then the interested node chooses the network header under which it is interested to work.
3. The node sends a request to the current network provider's head.
4. The network provider forwards the request to the second network header where the node interested to work.

Step-2

1. First, the second network's header verifies the transport layer protocols.
2. Then the second network's header goes through authentication and authorization phase.
3. Then it checks for lower layer's adaptability in the interested service getting node to the second network provider's head.
4. Then it checks for higher layer's adaptability in the interested service getting node with the second network provider's head

Step-3

1. After successful authentication and authorization, the header of second network provider sends acknowledgements to first network provider's head.
2. The second network provider makes the lower layer's platform for the interested node.
3. The first network header hands off the control to the second network provider's head.
4. The second network provider communicates by the node with the higher layer protocols.

4. SIMULATION RESULTS

4.1. Simulation Model and Parameters

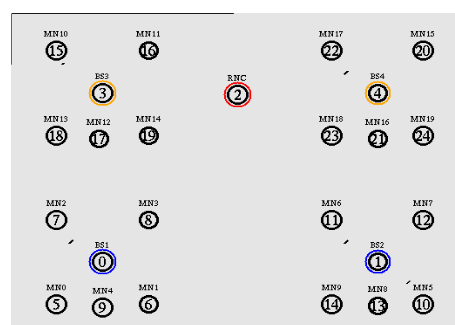
Figure-15 Simulation Topology

NS-2 [20] is used to simulate the proposed Network Layer Specific Data Transmission (NLSDT) for integrated next generation networks. In the simulation, clients (SS) and the base station (BS) are deployed in a 1000 meter x 1000 meter region for 50 seconds simulation time. It consists of 4 base stations among which, BS1 and BS2 are based on WLAN and remaining BS3 and BS4 are based on UMTS. Each network contains 5 mobile nodes (refer fig. 15). All nodes have the same transmission range of 250 meters.

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At 5 seconds, MN1 from BS1 begins to handoff to BS3 of UMTS network. At the same time, MN6 from BS2 of WLAN network begins to handoff to BS4 of UMTS network.

The simulation settings for UMTS are presented in Table 1. The simulation settings used for 802.11 and general parameters are summarized in Table 2.

Table 1: Simulation Settings For UMTS

Mac	Mac/Hsdpa
Base stations	2
Clients per base station	5
Downlink/Uplink BW	32kbs
HS-DSCH Scheduling mode	Proportional Fair Scheduling
RLC_BUFFER_SIZE	10Mb
MN speed	10 m/s

Table.2: Simulation Settings For WLAN

Area Size	500mtsX 500mts
Mac	802.11
Base stations	2
Clients	5
Radio Range	250m
Simulation Time	50 sec
Traffic Source	TCP
No. of TCP Flows	2
Packet Size	100 – 500 bytes
Rate	50 to 250 kb

4.2. Performance Metrics

We compare our proposed NLSDT with the Normal IPv6 Handoff. We mainly evaluate the performance according to the following metrics:

Throughput: It is the amount of traffic that is received in the destination, represented in Megabits / second.

Delay: It is the average end-to-end delay occurred at the destination for all flows.

Packet Delivery Ratio: It is given by the ratio of packets successfully received to the total number of packet sent.

4.3. Results

A. Based on Packet Size

Initially the packet size is varied from 100 to 500 bytes and the above metrics are evaluated for both the schemes.

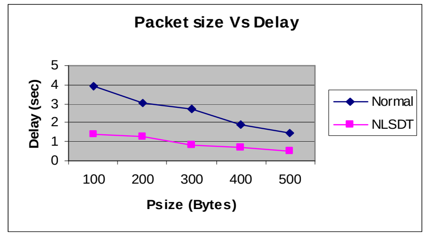

Figure- 16 Psize Vs Delay

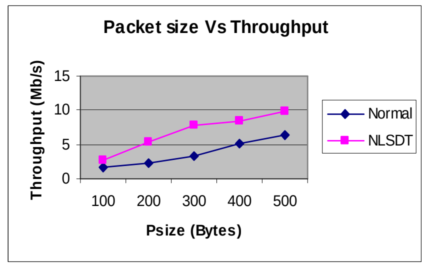

Figure- 17psize Vs Throughput

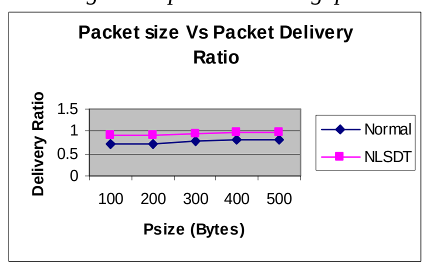

Figure- 18 Psize Vs Delivery Ratio

Figures 16 to 18 show that NLSDT outperforms the normal handoff scenario in terms of delay, throughput and delivery ratio, respectively, when the packet size is increased.

B. Based on Rate

Next, the traffic rate is varied as 50,100,150,200 and 250 Kb and the above metrics are evaluated for both the schemes.

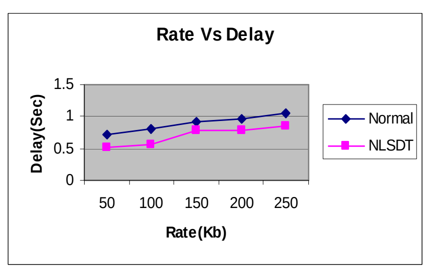

Figure- 19- Rate Vs Delay

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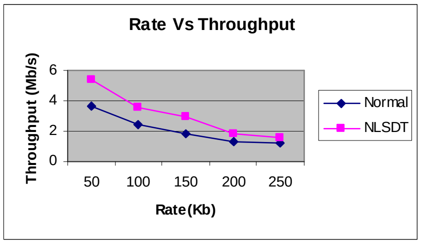

Figure- 20 Rate Vs Throughput

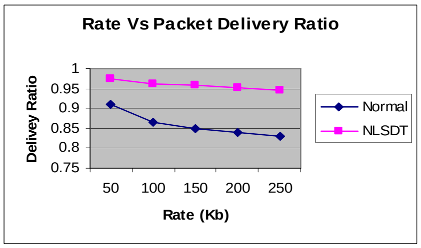

Figure- 21 Rate Vs Delivery Ratio

Figures 19 to 21 show that NLSDT outperforms the normal handoff scenario in terms of delay, throughput and delivery ratio, respectively, when the rate is increased.

5. CONCLUSION

Considering the problem of platform dependent service where a node can be stationary or can be movable across a range of networks, this method proposes a network layer specific data transmission for integrated next generation networks for platform independent service. This method is considered as a method of hand off with a platform independent procedure for device acting on a range of networks and different functional units.

The proposed method describes the data packet in three data packet packages. The packages of packets are having same data packet number. So there is no ambiguity in detecting the data packets. As handover took place at transport layer, there is no interruption in data transmission. The authentication checking is done at both network heads. Therefore, the data are more securely transferred. The procedure is also less cost as it allocates resources only after all the verification done. Protocols related to different layers can be adapted for all layers. So the proposed method can work in different platforms having different protocols.

The methods given in this paper should be enhanced to create a network and base station at dynamic manner. The paper can be also extended neutralized platform formation at dynamic manner for more efficiency in the network.

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