Traffic Class Field Analysis in Mobile IPv6 for Linux Environment

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Summary
Application on mobile device and wireless are popularly used. Such as Multimedia, VDO Conference, VoIP need different bandwidth. To supporting real-time and data streaming application. In this paper analysis of traffic class field control Mobile IPv6 (MIPv6). Author implement on Redhat Linux OS and test to control resource on Access Router (AR) by Differentiated Service (Diffserv) architecture. The bandwidths that can declare type of each class and control the traffic in the network.

Key words:
Mobile IPv6, Access Router(AR), Traffic Control, Differentiated Service(Diffserv), Linux OS

1. Introduction

Internet has established itself as the primary vehicle for our global system of electronic commerce and has more abundant devices connect to it. We can identify any device by using an IP address. The first version of IP address that most widely used is IP version 4 (IPv4). IPv4 has 32-bit address space; and now is not enough for new devices that need to connect to the Internet. IP version 6 (IPv6) is an answer to solve this problem or IPv6 called Internet Protocol Next Generation (IPng), as IPv6[3] has 128-bit address space pushing the theoretical limit unique IPv6 nodes to roughly 3.4E1038 unique addresses, which is more enough for new devices in the future. The first time Internet and Internet Protocol (IP) were designed to provide a best-effort, fair delivery service. Under a best-effort scheme, Internet treats all packets equally, no guarantees, no special resources allocation; and if it has congestion, packets are dropped to relieve the congestion. When new additions to Internet increasing traffic such as high volume client/server applications, web graphics and real time voice and video, then the best-effort mechanism is not suitable for these applications. IETF has defined two QoS (Quality of Service) mechanisms for IP network to support requirement of their application. These two mechanisms are Integrated services (IntServ): Reserves resources to provide a particular QoS[1] and Differentiated services (Diffserv): Classify traffic into groups which each is labeled and gets the service from the network differently.

Currently, Mobile devices are widely used and have new applications including delay sensitive, real time and data streaming application (e.g., video call or voice over IP)

and popular in near future. These applications need QoS guarantee the level of network performance for applications function. The number of mobile devices that support IP services is increasing.

All mobile devices desire connecting to Internet and use applications while they are moving. Unfortunately, IP does not support the mobility because whenever a device changes its physical location, generally it has to acquire a new network configuration. Consequently, a connection of the higher level protocol will be lost. Mobile IP (MIP) provides application-transparent IP-based mobility support by maintaining network connectivity while allowing a Mobile Node (MN) to retain its permanent IP address. MIP has two versions: MIPv4 and MIPv6. Applications in wireless network (or mobile network) are, for example, data streaming and real-time applications. Real-time applications need QoS guarantee the level of network performance for applications function, however there is no QoS mechanism suitable for the mobile network.

Currently, QoS mechanisms such as IntServ and Diffserv are not suitable to guarantee QoS in mobile environment. Because it was intentionally designed for wired network and does not consider many parameters affecting QoS in wireless network such as movement of mobile host, performance of the radio channel and the channel access method that shares equally between all mobile hosts.

Our proposed mechanism is implemented on MIPv6. However, before MIPv6, we test on the mobility by using the MIPv6. Author is setup MIPv6 environment by using MIPL package mipv6-0.9-v2.4.7 and Router advertisement daemon radvd-0.7.1 package. As author plan to setup MIPv6 by using TKN-MIPv6 implementation, thus the Redhat Linux OS version 7.1, Linux kernel versions 2.4.7 and distribution of software must support it.

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2. Background

2.1 Mobile IPv6 (MIPv6)

In Mobile IPv6 [5], each IPv6 mobile node has at least two addresses per network interface, namely the home address, which is a permanent IP address, and the care-of address (CoA), which is associated with the mobile node, when it visits a particular foreign network. Each time the mobile node moves from one subnet to another, it gets a new care-of address and it then registers its Binding Update (BU), consisting of a mobile node's home address and its care-of address, with the router in its home network acting as the home agent. This router then intercepts any packets addressed to the mobile node's home address and tunnels them to the mobile's care-of address using IPv6 encapsulation. The mobile node sends also a Binding Update (BU) to its correspondent nodes, which can then learn and cache the new mobile's care-of address. As a result of this mechanism, when sending a packet to any IPv6 destination, a host must first check if it has a binding for this destination. If a cache is found, the host sends the packets directly to the care-of address indicated in the binding, using an IPv6 routing head. If no binding is found, the packet is sent to the mobile node's home address.

2.2 Hierarchical Mobile IPv6 (HMIPv6)

When the mobile node frequently moves, it produces a significant BU signaling traffic to the home agent and correspondent nodes when Mobile IPv6 is used. Hierarchical Mobile IPv6 [2] is a localized mobility management that aims to reduce the signaling overhead due to mobile node's moving. Hierarchical Mobile IPv6 divides mobility management into two areas: the local domain or the intra-domain and the inter-domain. The mobility management is inside the local domain is handled by a Mobility Anchor Point (MAP). Mobility management are separated MAP domains is handled by MIPv6. The MAP acts as a local Home Agent. When a mobile node enters into a new MAP domain it registers with its regional care-of address (RCoA). The RCoA is the address that the mobile node will use to inform its Home Agent and the correspondent node about its current location. Then, the packets will be sent and intercepted by MAP, and routed inside the domain to the on-link care-of address (LCoA). The LCoA is the address that the mobile node uses as the care-of address in a MAP domain. When a mobile node performs a handover between two access points within the same MAP domain, it will inform only to the MAP not to the Home Agent. HMIPv6 [4] provides a mechanism to reduce the signaling overhead in case of handovers within the same domain and improve handover performance by reducing handover latency and packet losses since intra-domain handovers are performed locally.

2.3 Differentiated Service (Diffserv)

Current approaches IP quality of service include the IntServ and DiffServ architectures. The IntServ architecture defines mechanisms for per-flow QoS management and provides tight performance guarantees for high priority flows. It uses Resource Reservation Protocol (RSVP) as signaling protocol. Because it needs the signaling and maintaining per-flow router state, the scalability problem will occur when it has a large number of flows.

The differentiated service architecture (RFC 2478) is designed provide a simple and easy implementation. It does not have a scaling problem in large scale Internet backbones and not require a special control protocol such as the Resource Reservation Protocol (RSVP) or new application programming interfaces as in the case of Integrated Service (InServ) allocate network resources. Resource allocation is defined statically by means of SLA (Service Level Agreements) between administrative domains. Diffserv uses an aggregated flow approach, which is different from that of InServ that uses per flow approach. The ingress routers classify and mark up the packets at the entrance of the backbone network so that the packet can be processed differently in backbone routers. As a result, author can obtain different performance for each assigned class.

Currently, no research work justifies what kind of QoS mechanisms is suitable for mobile network. In this work, author consider that Diffserv is suitable for mobile network more than Inserv because of several reasons. First, the Diffserv does not require a signaling protocol that rise signaling overhead and setups delay on handover procedure. Second, it does not require excessive resources on intermediate routers for managing the changes of flows because of the movement of MNs. Finally, as Diffserv is gradually deployed in the global wired Internet, extending Diffserv to wireless access networks will provide the interoperability between wired and wireless networks.

The architecture of Diffserv is divided into two parts: the core network and the access network. The Core network consists of more core routers that forward packets according to the BA (Behavior Aggregates). BA is a QoS class that group flows of similar properties indicated in the packet header to determine how the packet should be treated along with the PHB (Per Hop Behavior) of each packet, such as what transmission queue the packets should be placed in. The Access network connects end hosts to edge routers. Edge routers (or Boundary routers) are placed at the edge of a Diffserv network and responsible for packet classification, metering and marking for incoming packets. Incoming packets are checked against the TCA (Traffic Conditioning Agreement), which is a profile of the traffic defined in the SLA.

3. Literature Review

The differentiated service defines three classes consisting of EF (Expedited Forwarding) class, AF (Assured Forwarding) class and BE (Best Effort) class [6].
EF class: It is used for delay-sensitive applications that need low-loss, low-delay and low-jitter transmission. A single DSCP value 101110 is used to indicate the EF flow. It provides flows with small delay and small jitter as well as with low packet drop rate that is suitable for interactive real-time applications. Our proposed framework defines this class for VoIP application.
AF class: It is used for traffic that does not have strict requirements but need guaranteed minimum bandwidth. AF class allows access to extra bandwidth if available. In this class, they are four standard classes using three DSCP (100xxx, 011xxx, 010xxx, 001xxx) and three levels of drop precedence using three DSCP (xxx010, xxx100, xxx110) values. It is a QoS class for elastic flows that does not have the strict requirements of EF flows, but need a minimum bandwidth to be guaranteed. In AF class we define only one AF class instead of four in Diffserv and one spatial priority instead of three in Diffserv. Applications that is appropriate for this class is for example video conferencing programs.
BF class: This class already exists in the current Internet and does not provide any QoS guarantee. This class uses DSCP value 000000. This class does not provide any QoS guarantee. In our proposed model, this class is used for TCP applications such as FTP and WWW.

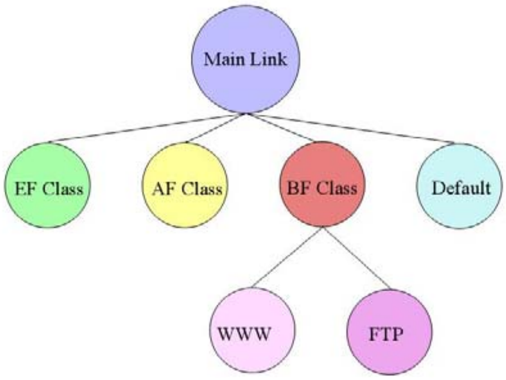

Fig. 1 Class Model of Data Type.

3.1 Design Router Advertisement Message

Type : 8-bit identifier of the type of option. The options defined are:

Option Name
Type 1 : Source Link-Layer Address
Type 2 : Source Target Link-Layer Address
Type 3 : Source Prefix Information
Type 4 : Source Redirected Header
Type 5 : Source MTU
New Option
Type 9 : Source QoS Information
Length :8-bit unsigned integer.

3.2 QoS models and mobility management

Table 1: Model and Management

QoS	***DiffServ***	***IntServ***	***Mobility Management***
QoS in Mobile IPv6	✓	✓	MIPv6
Quality of Service and Mobility for the Wireless Internet	✓	✓	Micro-mobility + fast handoff
QoS Provisioning in Mobile Internet Environment		✓	MIPv6
QoS Conditionalized Handoff for Mobile IPv6		✓	HMIPv6

3.3 Process of Communication

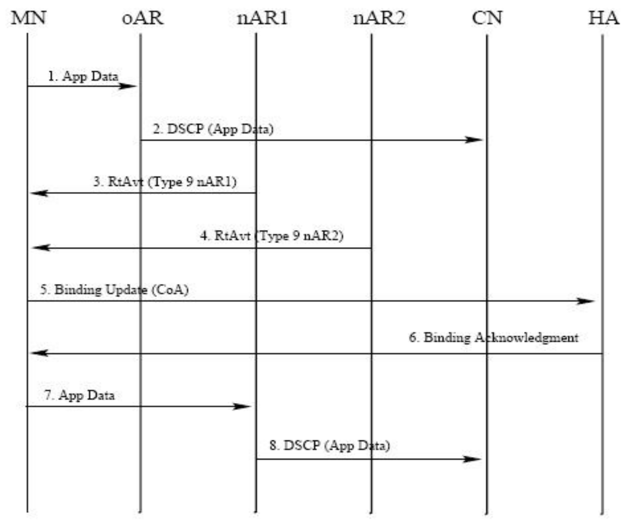

Fig. 2 Process of Communication.

Describe the process works as follows in figure.1
Step 1 : Mobile(MN) communicate and send data to oAR.
Step 2 : oAR send information to conversations(CN).
Step 3 : NAR1 Send Notification Option Type 9 to MN.
Step 4 : NAR2 Send Notification Option Type 9 to MN.
Step 5 : Mobile(MN) send the message to request a new registration (BU).
Step 6 : Intermediary in connection with the mobile device

(HA) will accept registration (BA).

Step 7 : Mobile(MN) communicate and send data to nAR1.

Step 8 : NAR1 send information to conversations(CN)

3.4 Flow Chat for Decision to move the Network

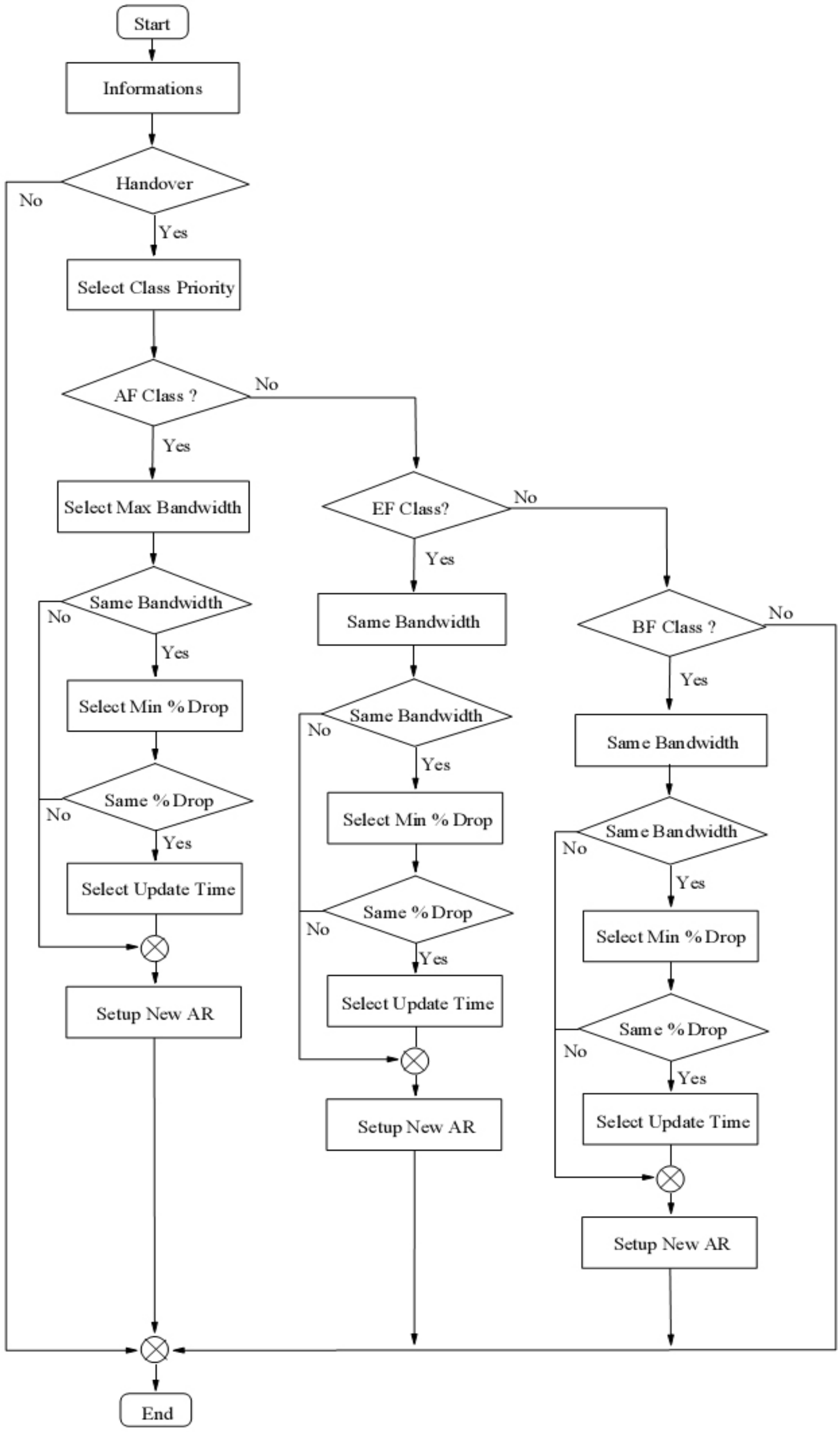

Fig. 3 Decision to move the Network

4. Design Example

4.1 Requirements

The trial will determine the number of intermediaries in contact with 4 nodes each node is connected MN2 to MN4 will be used within their own network is divided into EF, AF, BF Class with CN1, CN2 and CN3 serve receive. Contact information will be mobile by grade classes separately. The overview of connectivity are test equipment show in Figure 4 and Table 2 show the bandwidth of tree classes on AR1, AR2, AR3 and AR4.

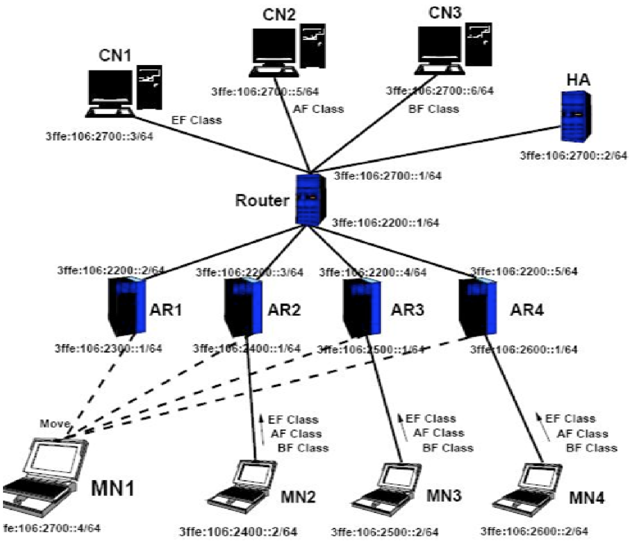

Fig. 4 Network Topology in Our Experiments.

TABLE 2: Bandwidth of Tree Classes

AR	*EF Class*	*AF Class*	*BF Class*
AR1	10 Mbps	20 Mbps	30 Mbps
AR2	10 Mbps	20 Mbps	30 Mbps
AR3	8 Mbps	17 Mbps	30 Mbps
AR4	5 Mbps	15 Mbps	30 Mbps

5. Performance Evaluation

5.1 Performance with regard to bandwidth EF Class

MN1 [6] to make data type EF Class by MN1 is connected to the AR1 and current data size 50 Mbytes to CN1 of bandwidth equal to 5 Mbps test performance when moving data network. MN1 measure the speed of data transmission and the time spent in transport from origin to destination MN1 intermediary in contacts show in Table 3.

When management does not share the bandwidth of each class. When mobile devices are small data bandwidth 5 Mbps will be sharing the bandwidth of other classes to use EF Class made other classes.

Table 3: No data and no control bandwidth EF Class.

No.	*Select (AR)*	*Priority Class (MN1)*	*BW (Mbps)*	*Time Transfer*
1	AR2	EF	4.5	80800
2	AR4	EF	5.2	78400
3	AR2	EF	4.4	81200
4	AR3	EF	4.8	79800
5	AR2	EF	4.2	81400
6	AR2	EF	4.3	8100
7	AR3	EF	4.7	80186
8	AR3	EF	4.7	80882
9	AR4	EF	5.1	78100
10	AR3	EF	4.9	79700

Mobile device will select the contact to move randomly selected. Test 10 times to move your own mobile device, if found to be contacted by intermediaries to contact any node already. Mobile devices will soon move themselves. Since internal nodes AR2, AR3 and AR4 are used bandwidth within different. When it is used by MN1 added, making the speed of data transmission within the intermediary nodes in contact time and reduced data will take up show in Table 4.

Table 4: No data and control bandwidth EF Class.

No.	*Select (AR)*	*Priority Class (MN1)*	*BW (Mbps)*	*Time Transfer*
1	AR2	EF	2.3	121200
2	AR4	EF	4.9	77800
3	AR4	EF	4.9	77100
4	AR2	EF	2.4	119800
5	AR3	EF	4.1	83700
6	AR2	EF	2.3	120100
7	AR3	EF	3.7	85882
8	AR3	EF	4.2	79800
9	AR3	EF	4.0	83186
10	AR2	EF	2.2	122400

Table 5: Send data and control bandwidth EF Class.

No.	*Select (AR)*	*Priority Class (MN1)*	*BW (Mbps)*	*Time Transfer*
1	AR4	EF	4.9	79200
2	AR4	EF	4.9	79800
3	AR4	EF	5.0	77400
4	AR4	EF	5.0	76800
5	AR4	EF	4.8	81100
6	AR4	EF	4.9	80100
7	AR4	EF	4.9	79800
8	AR4	EF	4.8	82700
9	AR4	EF	5.0	78100
10	AR4	EF	4.8	81400

Mobile device will select the contact move to the best node. The test of 10 times within the node AR2, AR3 and AR4 are used bandwidth within different. Table tests on MN1 moved to select the best node is the AR4 as AR4 has announced data that is now within the network bandwidth usage EF Class Left 5 Mbps make MN1 made the decision to move the AR4 show in Table 5 and comparing three intermediate from EF Class show in Figure 5.

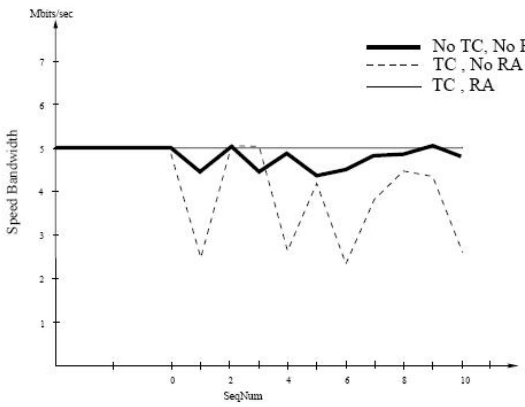

Fig. 5 Comparing of bandwidth used to send data through three intermediate form EF Class.

5.2 Performance with regard to bandwidth EF Class and AF Class

The experimental of traffic class control in the network. This will determine the importance EF Class and AF Class. For EF and AF is set to use more bandwidth in the BF Class will be divided into the class with the highest priority use. The experiment will test data with data from MN1 EF and AF Class size 50 MByte with bandwidth size 5 Mbps show in Table 6.

Table 6: No data and no control bandwidth AF Class.

No.	***Select (AR)***	***Priority Class (MN1)***	***BW (Mbps)***	***Time Transfer***
1	AR3	EF	4.7	80800
2	AR2	EF	4.9	77400
3	AR2	EF	4.8	75200
4	AR4	EF	4.4	83800
5	AR4	EF	4.9	79400
6	AR2	EF	4.9	7400
7	AR2	EF	4.7	80180
8	AR3	EF	4.9	80882
9	AR2	EF	4.7	78100
10	AR4	EF	4.9	74700

This will determine the importance EF Class and AF Class. For EF and AF is set to use more bandwidth in the BF Class will be divided into the class with the highest priority use. The experiment will test data with data from MN1 EF and AF Class size 50 MByte with bandwidth size 5 Mbps show in Table 7.

Table 7: No data and control bandwidth AF Class.

No.	***Select (AR)***	***Priority Class (MN1)***	***BW (Mbps)***	***Time Transfer***
1	AR3	EF	4.6	80700
2	AR2	EF	4.8	75100
3	AR2	EF	4.4	83200
4	AR4	EF	5.0	74100
5	AR4	EF	4.2	84600
6	AR2	EF	4.8	75200
7	AR2	EF	4.5	82100
8	AR3	EF	4.3	82300
9	AR2	EF	5.1	75000
10	AR4	EF	4.6	79900

Identical, The experiment will test data with data from MN1 EF and AF Class size 50 MByte with bandwidth size 5 Mbps show in Table 8 and comparing three intermediate from AF Class show in Figure 6.

Table 8: Send data and control bandwidth AF Class.

No.	***Select (AR)***	***Priority Class (MN1)***	***BW (Mbps)***	***Time Transfer***
1	AR4	EF	4.8	78200
2	AR4	EF	5.0	75800
3	AR4	EF	4.8	77400
4	AR4	EF	4.9	76800
5	AR4	EF	4.8	77300
6	AR4	EF	4.7	79100
7	AR4	EF	4.8	78800
8	AR4	EF	4.9	77100
9	AR4	EF	4.7	78800
10	AR4	EF	5.0	76200

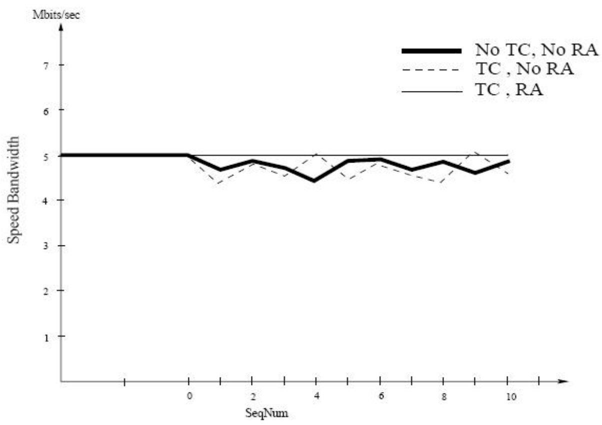

Fig. 6 Comparing of bandwidth used to send data through three intermediate form AF Class.

6. Conclusion

This paper propose a setting traffic control in DiffServ network by means of working to divide the class package and report use of such networks. Devices in the network increase efficiency in their move to connect to other networks. The data can then be continuously optimization. From performance tests of the network is measured by use of the network, each network with traffic control network more easy to use and control the use of each package. This information will help each kind can be used continuously. Prevent use of a network of other information that does not displace the very important work. When trials are critical to defining data types. Gives important information to share less bandwidth to use to type of critical information. Which information is important to use effectively and ensure the use, if the moving a network. If preliminary information network that will move. Can be help in the decision before making that move. The data are used to address the problem or not. Can guarantee that when moved. Submissions will be continuously and smoothly to the destination. You can also bring this technique to improve the application of the information that matters different than office test. The amount of control traffic more effectively. Including the application to remove the remaining bandwidth in a network share and use separate focus much will the balance of traffic in mobile networks.

The test results management bandwidth within the network in this paper can be expanded results. Design algorithm to control data traffic on network performance and is suitable for use under other conditions, such as the requested data bandwidth as the need to let mobile networks.

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