A Study on Bandwidth Estimation Aspects and Approaches

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Abstract

One of the major requirements of a mobile network is QoS optimization. This optimization can be achieved using different approach applied at different layers. One of such approach is bandwidth estimation and optimization. Bandwidth optimization is the work applied on data link layer and IP layer respective to physical and dynamic estimation. In this paper, a study is defined on bandwidth estimation along with different aspects and the methods. The aspects includes the metrics level study on the estimation applied with different approaches. The aim of this paper is to explore the concept of bandwidth estimation so that the election of the approach and parameters will be done. Keywords – Bandwidth Estimation, Metrics Analysis, IP layer

1. INTRODUCTION

One of the major requirements for any network is to optimize the communication. This optimization is required under critical conditions. One of such condition is heavy communication or the congestion situation over the network. There are number of existing approaches that work at different levels and at different layers to optimize the network communication. One of such approach is bandwidth optimization. Bandwidth optimization itself involves two main stages called bandwidth estimation and bandwidth assignment. This is one of most challenging as well as basic approach to optimize the communication in mobile network. Bandwidth estimation is about to identify the communication rate over some route. It is considered as the end to end communication performed under performance analysis, network routing and P2P communication analysis. This kind of communication also includes file distribution and continuous data transmission. The fragmented data communication also comes under the effective optimization. There are number of approaches available to identify the accurate bandwidth to optimize the traffic engineering in mobile network. This also includes the capacity estimation and planning support. This includes the information transmission that includes number of sub stages. These sub stages includes gateway selection, channel selection and routing. The communication performed under bandwidth estimation is more challenging in temporary adhoc network. This kind of network is supported by LAN as well as mobile networks. This kind of network supports the cooperative communication because the network is self organized and provides the infrastructure less communication over the network. It means the communication parameters change as the topology change or the mobility over the network nodes is obtained. This kind of communication is performed via radio medium. The communication in such networks is performed to optimize the network communication and to derive the node effective communication over the network. In a mobile network, the bandwidth estimation techniques are divided in two main categories shown in figure 1.

Figure 1 : Bandwidth Estimation Approaches

Intrusive Bandwidth Estimation

Bandwidth Estimation Approaches

Passive Bandwidth Estimation

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A) Intrusive Bandwidth Estimation

This kind of estimation is depends on the end-to-end probe packets estimation performed under available bandwidth along a specific route. This kind of estimation is route specific and performed dynamically over the network nodes. In adhoc networks such kind of estimation is preferred.

B) Passive Bandwidth Estimation

This kind of estimation is based on the local information extraction. This information includes the information exchange between nodes to identify the bandwidth requirement and to perform the local broadcast to the system. Current communication analysis is performed to estimate the bandwidth.

There is lot of research already don’t to identify the feasible as well as optimal paths between the source and destination points. This kind of work includes the current traffic estimation based on usage analysis. The QoS support analysis is performed to identify the effective and reliable path between a node pair. The network response analysis is obtained to obtain the required communication estimation and to achieve the effective communication over the network. This kind of estimation is based on the QoS aware analysis performed at early stage of communication. This communication incorporates the control scheme under QoS requirements. This kind of analysis is effective for real time applications defined under different MAC protocols. The bandwidth estimation in route optimization is itself the major application of QoS optimization.

In this paper, a study based work is defined on different QoS optimization approaches under bandwidth estimation. In this section, a study on QoS optimization is defined for mobile network. The section has discussed the importance of bandwidth estimation and also provided an overview on bandwidth estimation approaches. In section II, the work defined by earlier researchers is presented. In section III, the A study based work on bandwidth estimation is defined. In section IV, the conclusion obtained from the work is presented.

II. RELATED WORK

There is lot of work already defined by different researchers on bandwidth estimation for different networks and approaches. Some of the work presented by earlier researchers is presented in this section. Bandwidth estimation itself defines the capacity and load estimation of the network flow so that the required change in bandwidth can be done to obtain the QoS optimization.

The bandwidth itself represents the maximum capacity of traffic flow over the network path. This kind of network analysis can be done under two different ways called passive and active analysis approaches[6][7][8]. The passive measurement approaches relies on the traffic traces collected at earlier stage. This kind of traffic is efficient and accurate so that the network flow is limited to the scope of network route. There are some active probing techniques defined to control the network traffic. The main discussion in this work is on active probing approaches. These approaches are able to estimate the bandwidth instantly. These approaches basically include the extra probe packets to the network path for the estimation. There are number of associated methods shown in figure 2.

![Figure 2: Bandwidth Estimation Approaches](image)

A) Packet Pair Dispersion

In this probing technique, the source node sends the multiple packet pair to the receiver to do the estimation. The dispersion estimation is here performed for packet pairs and based on it the receiver computer performed the end to end capacity evaluation and estimation. This kind of estimation includes the cross traffic analysis along with measurement analysis so that the packet pairs are sent for the actual estimation. This kind of estimation is performed under statistical method so that the error identification over the traffic will be done. This approach is effective as the work is based on statistical measures.

B) Variable Packet Size Probing

In this approach, multiple packets of specific are communicated. This technique uses the TTL field in the IP header to force the packet probing and to expire it at specific hop. The source node uses the ICMP error message to that the measure to the RTT is performed to
the next hop. This TTL probing is effective for packet probing that can be suitably designed for the pair level probing that will be expired at each hop. This probing mechanism uses the ICMP error messages for the router so that the RTT based communication will be performed at each hop. As the cooperative communication analysis is performed, this probing approach performs the capacity estimation at each hop over the route.

C) Self Loaded Periodic Scheme

This probing mechanism performs equal sized packet probing that are transmitted in a series for train at particular rate. This kind of communication depends on the trends of the communication delay experienced with the stream. This kind of communication is verified by the sender and the communication is performed at different rate. The sender also analyzes the stream rate that is closer to the bandwidth. If the streaming rate is greater than bandwidth, the stream will result the short term over head to the available queue. it means the queue can be full and the bottleneck situation can occur. This situation can increase the one way delay on these probing packets. In other case, if the streaming rate is lower than the available bandwidth, the one way delay of the probing packets will not be increased. This method improves the accuracy as compared to other existing approaches. But this approach requires large number of packet stream and large computational time because of which it cannot be applied for real time application.

D) Trains of Packet Pairs

This approach uses the same conceptual structure as of self loaded periodic streaming method. In this method, the packets are sent over the streams by analyzing the stream rate and bandwidth. The main difference in these methods is in terms of approach adopted for bandwidth analysis. These approaches include the statistical processing approach based analysis approaches. The bandwidth estimation techniques are adapted under bandwidth estimation tools. There are number of such available approaches. Based on these approaches the decision regarding the estimation is taken.

There some bandwidth estimation tools that are used the eventual measures in the capacity estimation. These tool includes double end host analysis and single and host analysis. As the name suggests, the double end host analysis tool is applied on both the source and destination side. Because of this, this method is not scalable and requires the cooperative communication between two ends. But if these tools are implemented, more accurate estimation will be obtained. Whereas the single end host analysis tool is applied on sender side. It is easy to deploy but it is not much accurate as of double end method. The available stdies shows that the available measuring tools are effective for the rough estimation and later on it requires the effective coordination to the system so that more accurate and reliable estimation will be obtained. This kind of estimation is specific to the available bandwidth.

III. BANDWIDTH ESTIMATION METRICS

The bandwidth estimation is defined a metrics based task that involves three sub task called capacity estimation, available bandwidth estimation and buck data transmission capacity estimation. The capacity and bandwidth estimation are applied on dedicated path or the communication routes. These nodes are analyze to perform the end to end communication so that the effective and reliable communication will be obtained for the network route. This kind of estimation is performed at different layers. In this estimation work data link layer and IP layers are involved. The first layer is here defined to divide the data in smaller segments so that the hop based communication will be performed. The segments are here identified as the P2P links to that the dedicated virtual route will be generated. The shared network is also established to perform the collision free communication over the network. This kind of communication is based on the communication sequence analysis so that the segmented data will be transmitted over the network. The sequence data estimation is performed on each connected node either it is a simple node, switch, bridge or some other network device.

A) Capacity

The capacity estimation for the network connection or the link is performed to achieve the constant data transmission over the network or the route. This kind of transmission is dedicatedly defined for a particular segment. This kind of estimation is performed to identify the effective communication rate over the segment. This transmission rate for the segmented is limited respective to the physical bandwidth estimation and the propagation medium estimation. This kind of estimation can be performed respective to the electronic and optical estimation of the hardware. This IP layer based transmission is performed. This capacity estimation is performed on each hop so that maximum possible IP layer based transmission rate will be achieved for each hop. This kind of transmission rate can be achieved from size estimation approach. This capacity estimation is defined respective to bit rate and the IP layer specification.

B) Available Bandwidth

Bandwidth estimation is dedicatedly defined between a node pair. This includes the unused capacity estimation for
a specific period. This kind of capacity link estimation is based on the propagation medium and the transmission technologies. This estimation is also depending on dynamic factors such as the load and the time varying metrics. The communication is analyzed for a specific instance of time so that the transmission packet link will be analyzed with full link capacity under idle conditions. The instance oriented utilization is obtained for deriving the meaningful estimation under time averaging and network bandwidth utilization. The time specific estimation will be performed here under the bandwidth estimation and utilization with time interval based evaluation. This kind of estimation is time period specific. This estimation is done under averaging the timescale and for each timescale the estimation is performed distinctly.

C) Bulk Transfer Capacity Estimation

The bandwidth estimation is defined for network throughput estimation under TCP connection. This estimation is been performed under major transport protocol generation and estimation. This includes the factor generation and estimation under different parameters such as throughput, transfer size, type of cross traffic etc. TCP socket buffer size specification so that the sender and receiver size specification is defined. It also performs the congestion analysis for reverse path under the router buffer and load capacity analysis. This kind of link estimation is performed for network path. The variation analysis and specification is defined along with implementation of TCP connection.

IV. CONCLUSION

In this paper, a study on different bandwidth aspects and methods is defined. The paper has defined the basic bandwidth estimation framework along with different approaches and associated parameters.

References

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