A NOMENCLATURE FOR CONGESTION CONTROL ALGORITHM IN PACKET NETWORKS

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ABSTRACT

The practice of rising networks in computer field experienced a fiery growth over the last few years and this progress bring the severe network problem in form of congestion. In the present state this congestion issue is at higher priority in network design/formation and research due to increasing or over provisioned of resources like bandwidth and demanding network application. Due to above situation many techniques have been proposed and on the way to evolve. The functioning of network worsens due to overload of network resources such as links, processor timing, memory space, and failure of router is common in packet switched network due to problem of congestion, and this situation bring the adverse effect like long delay of message reception, waste of system resources, and network failure i.e. when network ceases in bottleneck condition. Congestion control scheme is taken as control policy to achieve defined goals like round trip delay, throughput, and optimization in a distributed network environment.[2] This paper refine a nomenclature that follows such a theory not only provide framework for comparative study of existing approaches but also helps in future direction for new development in congestion control.

INTRODUCTION

In direction to prevent network failure the congestion control is good measure for network traffic controlling in the present and future research in network communication. Many procedures have been proposed and some of them employed in real life. Since years of research struggle and determinations make the problem of network congestion as serious issue and high priority in future of fast Growing speed and size of network. The existing methods for network congestion control cover a broad range of techniques including window/buffer flow control, slow start, schedule based control, binary feedback, rate based control etc. [8][9]For example, it is now common to see internet gateways drop 10% of the incoming packets because of local buffer overflows. It is not easy to characterize and compare the features among various congestion control methods. Generally recent literature focused on the system of congestion avoidance and congestion recovery [1], so researchers need detailed knowledge to understanding the similarities and difficulties and to decide the best case to avoid network congestion. The nomenclature discussed in this paper used in packet switched computer network. The considered network is distributed nature and each control scheme is executed at each node to maintain certain level of stable condition. It is believed that this nomenclature of congestion

control bring the rational framework for comparative study of existing approaches and maintain the balance for future development for congestion control. [3]

CONGESTION AND ITS CONTROL IN PACKET SWITCHING NETWORK

Network congestion is concern of resource sharing. In the case of packet switch resources are shared among the nodes participated in network like communication switch, channels, and buffer spaces. These problem are mostly become the bottlenecks for network. Networks need to serve all user requests for data transmission, which is unpredictable and bursty in nature with respect to transmission starting time, rate and size, and physical resources has finite capacity to manage and sharing among different transmissions. As a result the congestion would occur if the resources cannot meet the all user's current demands. Performance behavior becomes the formal aspect of network congestion. Fig-1 shows the throughput-load relationship in packet switch network without actual means of flow control. It is seen that as the load capacity is small, network throughput generally keeps up with the increase of the load until the offered load reaches the knee point. Where the increase of the throughput becomes much slower than the increase in the load. As the same way if load on network become increasing the queues on switching nodes build up in the network, resulting dropping of packets and throughput reached at maximum and then decrease sharply to a small value almost zero. This is the point which is said to be congestion. [8]

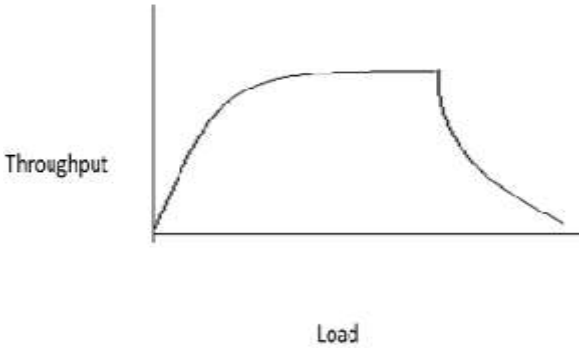

Fig. 1: Network performance

In order to retain network in healthy state certain mechanisms should be followed to prevent the network from operating in the congested region for any substantial period of time. So these methods are generally known as congestion control of networks. Several points are involves to control congestion in the network system including host machines of source and destination, switching nodes. As we know several algorithms has been devised and they are classified into two cases as congestion prevention and congestion rescue. And we know congestion prevention is avoidance in nature its scope is to make up the maximum point so that congestion could not occur. Whereas the aim of congestion rescue is to regain the operation of a network to its normal state after congestion has

occurred. Whenever congestion occur the network may collapse without congestion rescue scheme. [4] so that congestion rescue methods works well even if we adopt the congestion prevention schemes too to retain the throughput in state of abrupt change of the network.

NOMENCLATURE OF CONGESTION CONTROL ALGORITHMS.

Here we get new vision for new nomenclature for congestion control algorithms in computer networks that are based on the control theory. First we bring out the analogy between the closed system and the network system. So control system is taken as combination of objects merged by some form of interdependence. The objects involved in the system are not in the equilibrium state as compared to the surrounding or relative to each other. Under the influence of external force system is in transition state which is entirely dependent on the explicit effect or interaction between components. Simple case of control system is maneuvering the automobile; rider in closed loop fashion continuously exerts control over outputs of the system like speed and orientation of the car/bike. A computer network is interconnected of individual computer. It is considered as multiple users generating jobs in closed queuing network of servers signify the network routers. So that we can view the congestion control in the network as a control system for the purpose of maintaining the overall traffic within certain normal levels. The whole network system regarded as the control system with input/output from each host system. The level of network system for control of congestion can be considered as a composition of queue lengths at servers at routers and end-nodes. The feedback signal is taken as the difference between the present state of the system and some predefined limits. [18,19]

As with the condition of any control system during network system the rapid state of the network fluctuates dynamically. The idea behind network control is to bring the optimal level of throughput and overall delay for the communication traffic system in the network system, which is our ultimate goal in devise congestion algorithm. Whereas the general observation to optimize any congestion control algorithm is to enhance the function power, which is defined as the ratio of the throughput to delay. The application of this function in the control of a network result in the closed loop sequence of operations that justifies the correspondence between network and control system. But the store and forward technique of network system consist of group of globally distributed autonomous resources like large no. of communication links via different media devises, switching nodes and host machines connected by links. The globally located environment commits uneven delay in communication and unreliability. Due to these effects this network system is some more complex to handle than legacy centralized system. There is not devised policy that established control theory that masters the computer network system.so the above analogy bring the light on the concept that how control theory relates to network system.

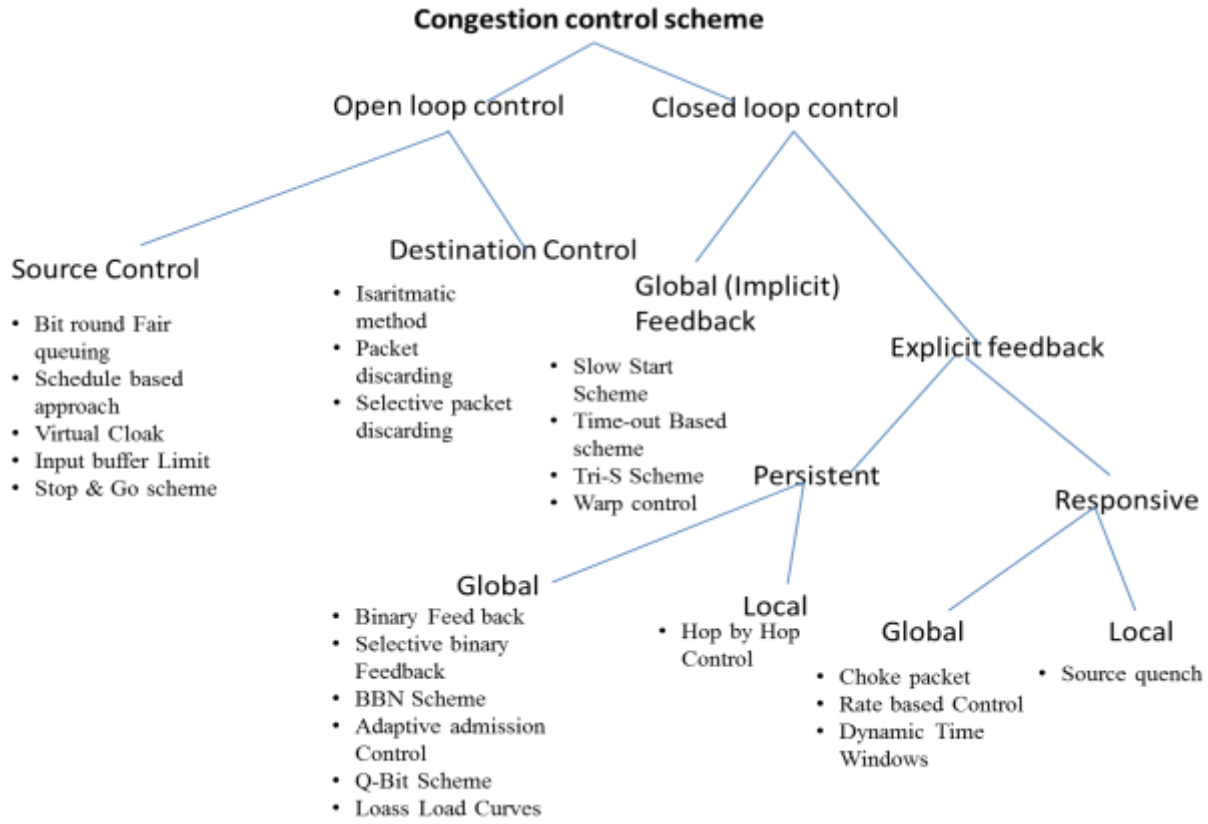

Fig. 2: Classification of Existing Congestion Control Algorithms.

CONTROL THEORY BASED CLASSIFICATION

As discussed above the control theory concept we can devise new scheme of classification of congestion control algorithms. This system algorithms are based on the decision making process of individual algorithm. The main categories of congestion control algorithm in the classification are: open loop and closed loop various categories are shown in fig 2.

Open loop congestion control

In which decisions are not based on any feedback scenario of congested spots in the network. These algorithms do not monitored dynamically. The algorithms behave as controller truly based on its own present knowledge of local node like bandwidth and buffers state in the system. Under these schemes we have admission control rights to control to stabilize the traffic arrival pattern.

Closed loop congestion control

The process of control decisions in these algorithms is based on the feedback information system to the sources. This feedback can be global or local: global mean feedback goes from destination to

source and local mean feedback from immediate neighbors. By this ways network tend to monitor it dynamically. This feedback may be implicit or explicit.

Comparison/classification of packet switched network

Basically above discussed congestion control algorithm in the literature, but this nomenclature provide new framework for classify existing congestion control algorithms. Fig 4. Shows the table of various congestion control algorithm under each category.

Open loop based on source control

These are entry controlled traffic algorithm which works at arrival pattern of traffic and use knowledge of locally. Algorithm included in this category are: bit-round fair queuing method [5], the schedule based control[9],the virtual clock[17], the input limit buffer model[8], and stop and go policy[6]

Open loop working on destination control

Control operation is performed at the destination end without any knowledge of feedback. They include packet discarding [11] and selective packet discarding [15]

Closed loop based on inherent feedback

Under this category realize closed loop control through certain feedback information between source and destination. (Globally) algorithm include: slow start [7], timeout based [27], Tri-S scheme [13]

Closed loop based on persistent global feedback

Feedback information about the state of network traffic network system is constantly present globally. Example binary feedback [25], adaptive admission congestion control [24], BBN scheme [26], adaptive admission control [23], the Q-bit control scheme [10], loss load curves [14]

Closed loop working on persistent, local feedback

Feedback information s propagated between immediate neighbors instead of sending it all the way from the destination to sources. Hop by hop [22]

Closed loop working on responsive global feedback

Feedback is generated in this category in response to the traffic conditions in the network such as queue length in a switch raises beyond certain limits and feedback nature is global. Example: choke packet [21, 11], rate based control [4] and dynamic time window [20]

Closed loop with responsive local feedback

The only algorithm iin this category is quench scheme [11] which is closed loop control scheme with feedback only generated in response to congested conditions in the network.

CONCLUSION

In this paper it is bring out a new nomenclature for congestion control algorithm in packet switched network system based on control theory. This deliver balanced outline for comparative study of current algorithm and bring path for more new strategies to overcome problem. Generally all open system algorithms are the admission control traffic feature to stabilize the traffic arrival pattern at the source ends. So lacks of global feedback open loop schemes are not enough to protect network against all traffic patterns. The worry is which performance indicator we should use for traffic indicator in the network and rapidly used for network congestion monitoring remain the major challenges in the design and development of future congestion control strategies for computer networks.

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