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E2E Congestion Control Policies Encouragement in Real World

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ABSTRACT

Widespread use of Internet with the heavily used varied traffic generating technology has made congestion a significant problem. Indeed there will be unfairness to competing TCP traffic in the absence of congestion control policies and will be a potential for congestion collapse. A flow can be considered as unresponsive, TCP unfriendly which unable to reduce its offered load at a router in response to enlarged packet drop rate. One of unfair flow can be named as disproportionate-bandwidth flow which uses more bandwidth than other flow in time of congestion.The presence of Smart router mechanism can also play pivotal role in times of congestion which identifies and restrains the bandwidth of selected best effort flow.Therefore to fight against unfairness, future protocol designs should include end to end congestion control policies. This paper discusses several approaches for identifying those flows which is not suitable for bandwidth regulation.

1. INTRODUCTION

In Internet, congestion happens due to overload, and is worsened by heterogeneity of networks.For instance, user wants to achieve high throughput in a network will force all the sources blast packets as fast as they can, so that bottleneck network links run at close to 100% utilization. While this approach seems reasonable, but can cause dangerous situation in the network. All it really accomplishes are long packet queues and resultant end-to-end delays, as well as increased packet loss rates, which for a reliable end-to-end transport layer would cause a large number of retransmissions. A central design element that shaped the Internet is the end-to-end congestion control of transmission control protocol (TCP). TCP's end to end congestion control policy play pivotal role in deciding the robustness of Internet but it is not possible to rely on all hosts to control the congestion adopt end to end control policy in their Internet application. There is need for proactive policy in network which control its own resource utilization. If congestion occurs due to lack of bandwidth then there can be several policies for controlling the worst position. One mechanism can be scheduling discipline of packet deployment in routers that separate each flow as much as possible from the effect of other flow. This approach can be named as per-flow scheduling policy that isolates the bandwidth accessed by each best effort traffic flow. Other approach can be end to end congestion control policy adoption with router support to share the scarce bandwidth and to motivate it for continued use.

2. RELATED WORK

B.Krishna Chaitanya [1] study the fairness of TCP variant and UDP over shared link and found that UDP traffic occupy the link to largest extent and lead the poor performance of any other TCP variants. He also found that TCP Reno and New Reno performance is similar to larger extent but not more than SACK and perform even better than Tahoe.

Forouzan Pirmohammadi et.al [2] study fairness of TCP and UDP in vehicular ad hoc network and found that in VANET purposed MAC based approach can improve the fairness using timer and onlyworked

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on fairness improvement problem among TCP flows. UDP in wireless network when shared with TCP media form a big challenge for TCP traffic and purposed a solution when data traffic make disjoint into TCP and UDP for each category with seprated timer setting give better result as proved with simulation.

Mohammed M. Kadhum et. al [3] studied TCP friendly system for multimedia transmission based on UDP and concluded that multimedia traffic will be dominating traffic and emphasized that there will be soon larger requirement of bandwidth but due to limitation multimedia traffic may become source of major congestion particularly when UDP is present. It is suggested by author to adopt congestion congestion-aware and friendly UDP based multimedia system which support congestion control, reduce packet loss, increase throughput, high network utilization and will improve performance of network in real time.

S£AWOMIR NOWAK et. al [4] studied about fair scheduling for TCP and UDP streams and found that lot of Internet application are using UDP protocol to transport data and TCP comes with lot of congestion control mechanism with support of active queue managements techniques at router level. Author raises a question whether it is possible to create such condition in queue for treat fairly for both types of data streams. Experimenting with various performance metrics like the length of queue, number of rejected packets, transmission time and RTT parameter author concluded that RED algorithm is suitable only for TCP protocol with congestion control algorithm and UDP gave worst performance with AQM. Itsuppresses the TCP transmissions and suggest for future AQM with UDP and TCP.

Sally Floyd [5] studied about negative impacts of non-congestion controlled best effort traffic, unfairness against competing TCP traffic. It isrecommended by author for the inclusion of end to end congestion control protocol for best effort traffic.

Sanjeev Patel et. al [8] studied about existing congestion control algorithms and displayedvarious performance parameters of RED, SFQ, and REM for different network scenarios and found that SFQ has a minimum average loss ratio as compare to RED. In other way RED achieved the best result in terms of the delay but in terms of throughput, loss ratio, and utilization REM exhibit the remarkable results. REM suggested better by author in all scenarios.

RED queue management detects incipient congestion in advance and communicating the same to the end-hosts, allowing them to lean down their transmission rates before queues begin to overflow and packets start dropping [9]. In order to be efficient, RED must ensure that congestion notification is conveyed at a rate which sufficiently suppresses the transmitting sources without underutilizing the link.

FRED proposes to transform RED mechanisms to provide fairness by using per-active-flow accounting to make different dropping decisions for connections with different bandwidth usages [10]. When a flow persistently occupies a considerable amount of the queue's buffer space, it is identified and restrained to a smaller buffer space. Severity of congestion is indicated by queue lengths in various queue management algorithms.

3. WEIGHTED ROUND ROBIN SCHEDULING

Packets are classified into various service classes at initiation. Various classes can be real time, interactive, file transfer and then packets are assigned to their relevant queues. Each queue is serviced in round robin manner. Other name of weighted round robin [6] queue is class based queuing (CBQ). Working diagram is depicted below in figure 1[7]

4. EXPERIMENT EVALUATION

Following scenario illustrate UDP and TCP flows on said nodes competing for bandwidth with given router with first come first serve scheduling policy and other experimented with WRR scheduling policy. Source node H1 maintained with 3 TCP agents with unlimited data FTP traffic generators to H3 with 20

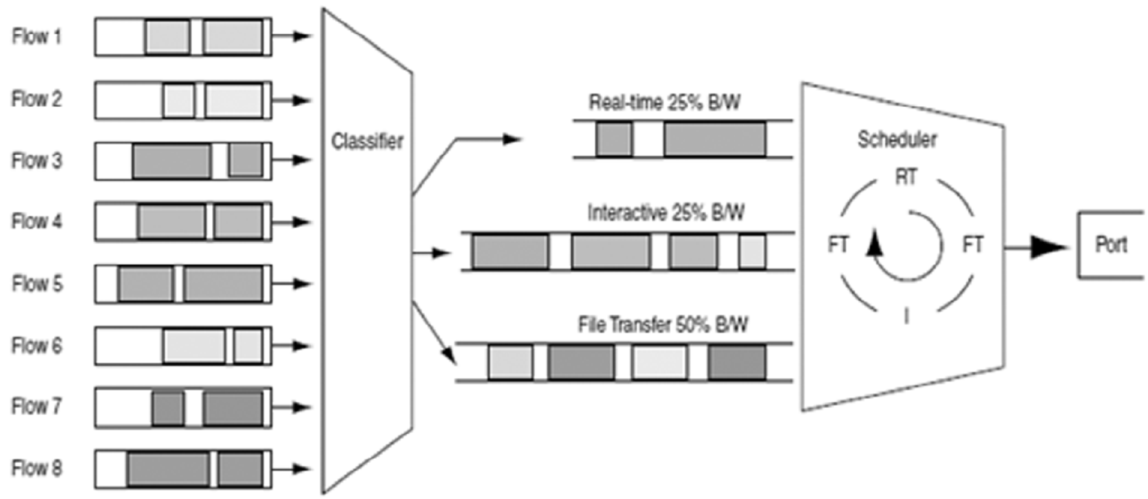

Figure 1: WRR working (Source author)

Table 1
Simulation Environment

Simulator	NS2.35
Operating System	Cent OS 6.7
Number of Nodes	Source Nodes: 2 (H1, H2) Target Nodes: 2 (H3, H4) No. of Routing Nodes: 2 (R1, R2)
Traffic Agents	1(One) UDP with CBR traffic generators 3(Three) TCP with FTP traffic generators with SACK
Queue Management	First in First Out (FIFO)
	Weighted Round Robin (WRR)
Bottleneck Bandwidth	X = 3Mb
	X = 256Kb (for congestion collapse)

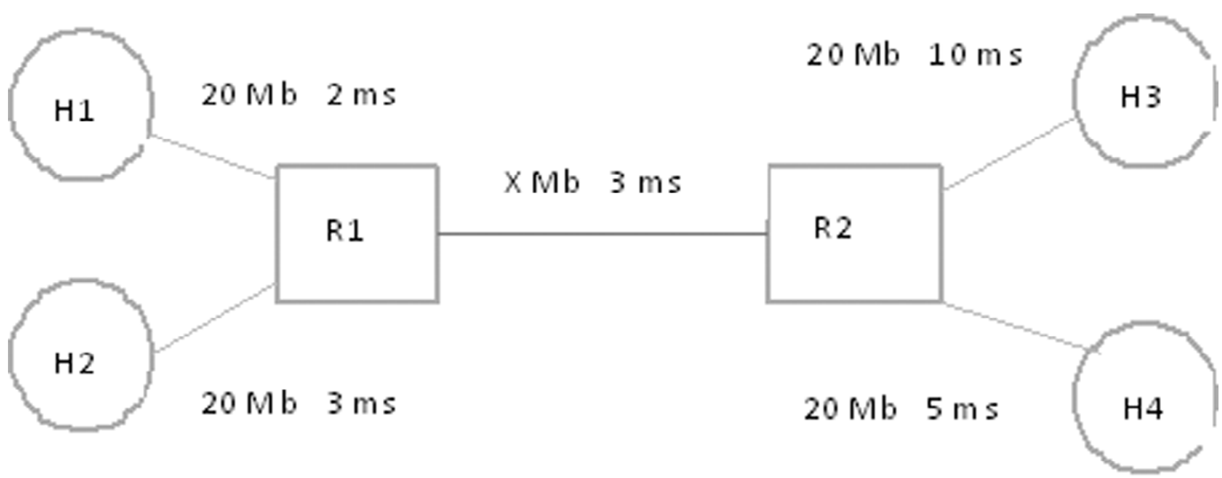

Figure 2: Dumbbell Network

Mbps bandwidth, 2ms delay and other node H2 to H4 with single constant bit rate (CBR) traffic generator with UDP agent and 20 Mbps, 3ms delay. Both routers attached with 2Mbps, 3ms delay and with single output queue with FCFS scheduling policy. UDP agent flow sending rate maintained up to 2 Mbps as Table1 reflects.

One of the performance metrics used here is goodput for experiment evaluation for testing unfairness. Goodput can be defined as the bandwidth delivered to receiver after excluding duplicate packets of the flow. As below results represented here by three representations, one for the arrival rate of UDP at router R1 with red line, another is goodput of UDP with green line and last representation is goodput of TCP with blue line. X-Axis of chart reflects sending rate of UDP at on routers between R1 and R2 link. The red dashed line reflects the arrival rate of UDP at router and green dotted line reflects the goodput of UDP flows. Aggregate goodput reflected with bold line on the top of chart.

As chart reflects when UDP flow sending rate is little then goodput of TCP flow is high and also bandwidth usage is high on R1-R2 link, but when UDP sending rate became higher TCP flows back off

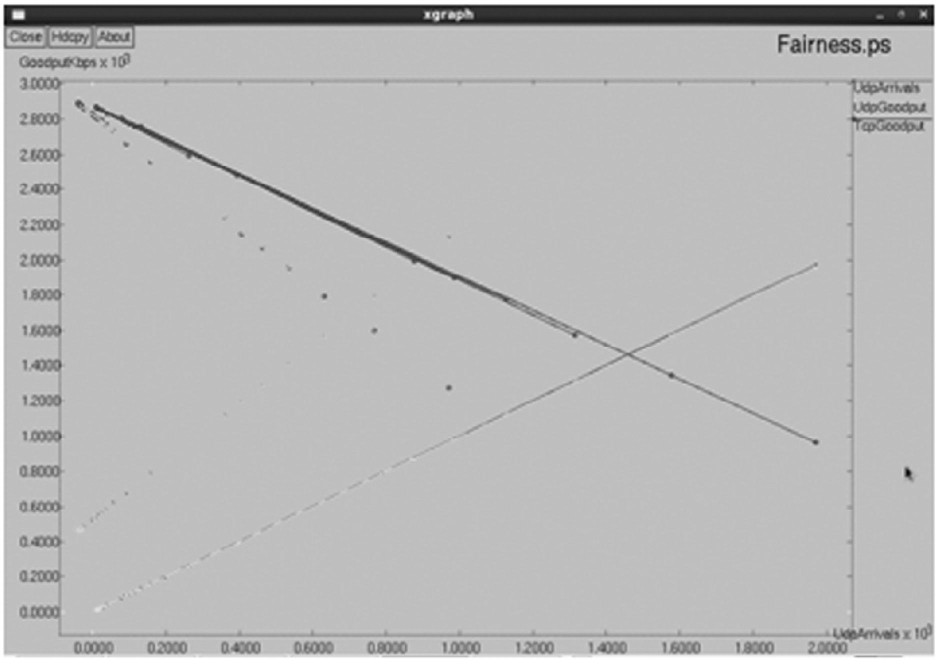

Figure 3: Fairness Test

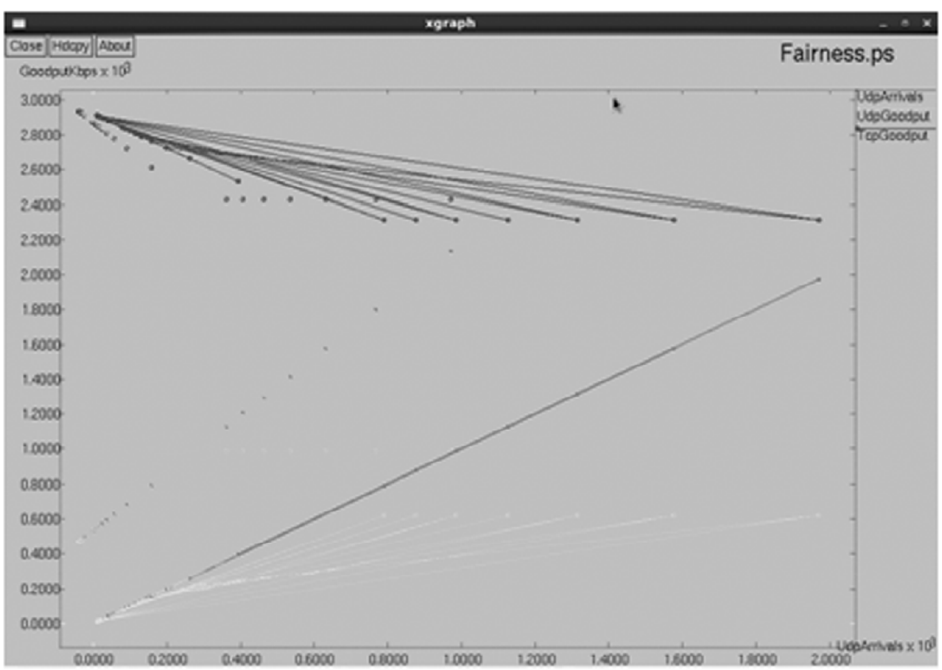

Figure 4: Per Flow Fairness with Weighted Round Robin

response due to packet drop on bottleneck queue and also UDP bandwidth usage became high and TCP usage of bandwidth became so little that reflects unfairness under First come first serve scheduling.

Weighted Round-Robin (WRR) scheduling can explicitly control the allocation of bandwidth among set of competing flows. Above figure 4 reflects the scenario with each flow assigned an equal weight in unit of bytes per second and also UDP flow is exhibit 30% approximately of the link bandwidth.

Figure 5 reflect the scenario after bottleneck bandwidth is 256Kb, this means congestion collapsed therefore TCP goodput with FIFO queue management technique goes down and UDP slowly increase their goodput because their overwhelming nature of UDP traffic. If we increase the bandwidth then there can be no chance of increasing goodput because of UDP.

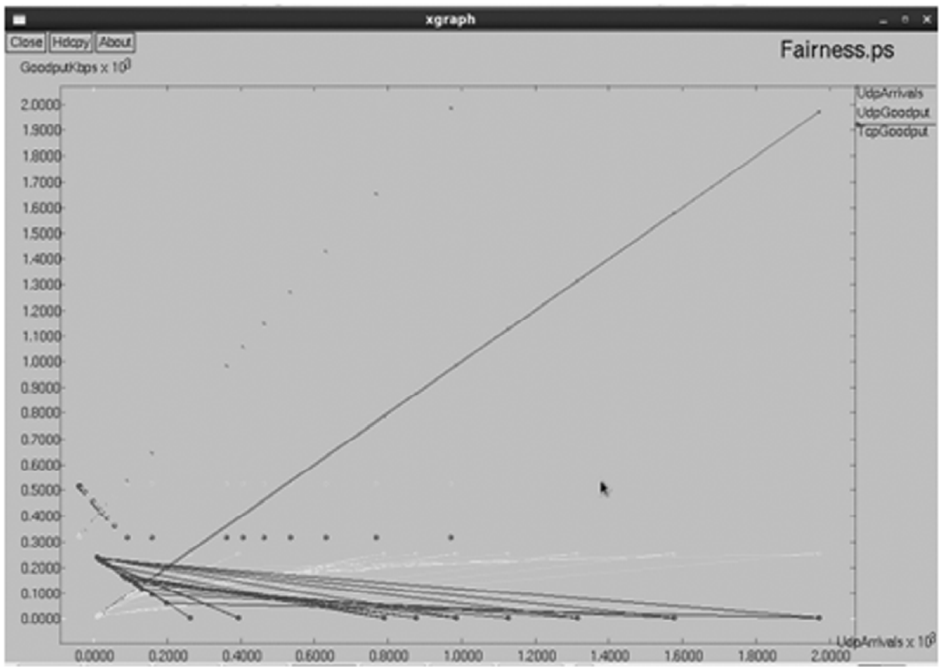

Figure 5: Goodput comparision with UDP and TCP with 256kbps with FCFS Scheduling

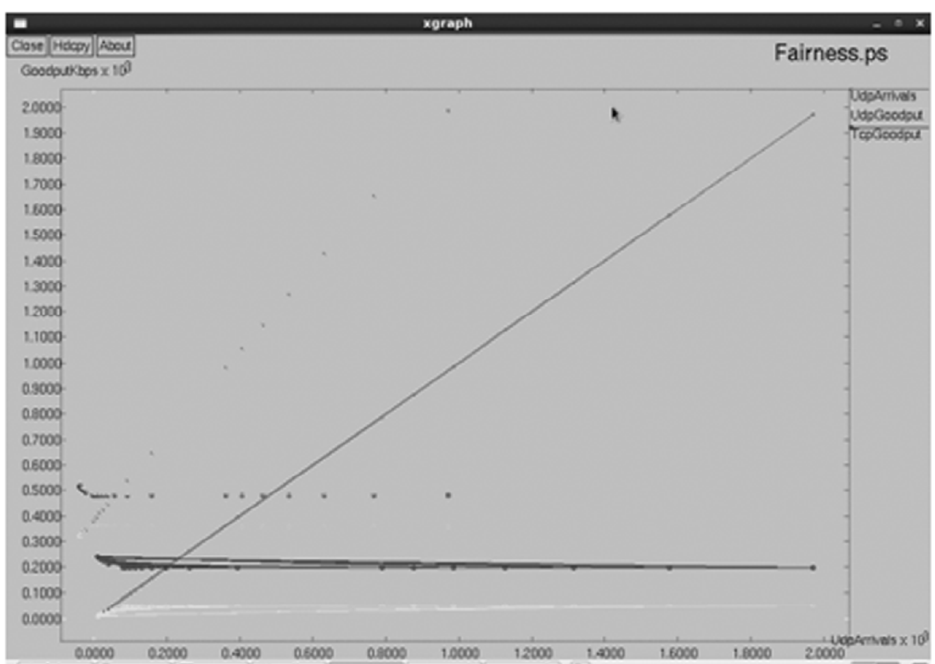

Figure 6: Goodput comparison with WRR with 256kb bottleneck bandwidth

As figure 6 displaying the same scenario as figure 5 except the router using WRR scheduling instead of FIFO. Situation becomes controlled with goodput improvement as figure exhibiting by WRR scheduling and also some improvement can be noted down in congestion collapse as well as unfairness.

5. CONCLUSION

The major reason behind unfairness and congestion collapse is unresponsive flow that does not incorporate end to end congestion control mechanism and do not reduce their network load when encounter packet drop problem. Unresponsive flow always inflicts on well behaved responsive flow and it causes the bandwidth starvation and become of victim of unfairness. One of the first problem caused illustrated in figure below which reflects TCP flows throughput comes down due to UDP unresponsive flow for scarce bandwidth due to end to end congestion control problem. TCP flow reduces their sending rate when encounter the position of congestion and UDP flow got opportunity to use the available bandwidth

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