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Survey on MPTCP Tunnel: An Architecture for Aggregating Bandwidth of Heterogeneous Access Network Topology used in Simulations

Divya B M[1], Poojashree D B[2], Chandrika B N[3], Dakshayini K[4], Arpitha K S[5]
[1]*Assistant Professor, Department of Information Science Engineering, BGSIT College of Engg.*
[2, 3, 4, 5]*Dept.Of ISE BGS Institute Of Technology*

Abstract: ***TCP tunnel is a technology the aggregates and transfers packets sent between end hosts as a single TCP connection.by using a TCP tunnel, The fairness among aggregated flows can be improved and several protocols can be transparently transmitted through a firewall currently many applications such as SSH, VTun, and a TCP tunnel. However, since most application running on end hosts generally use TCP, two TCP congestion controls (i.e, end-to-end TCP and tunnel TCP) operate simultaneously and interfere each other. Under the certain conditions, it has been using a TCP tunnel severely degrades the end-to-end TCP performance. Namely, it has known that using a tcp tunnel drastically degrades the end-to-end tcp throughput for some time, which is callestcp meltdown problem. On the countrary, under other conditions, it is still an open issue how, when and why is a tcp tunnel malicious for end-to-end TCP performance in this paper, we therefore investigate effect of tcp tunnel on end-to-end performance using simulation experiment. Specifically, we quantitatively reveal effects of several factors(eg.,the propogation delay, usage of SACK option) on performance of end-to-end TCP and tunnel TCP.***
Keywords: TCP over TCP, TCPtunnel, Round Trip Time

I. INTRODUCTION

Multipath TCP (MPTCP)[1], allows an endpoint to simultaneously use multiple paths over multiple interface(e.g., wifi and LTE) for a single TCP session. As MPTCP does not require any modification in the application, it can be used any time if both the client and ther server support it. However , as MPTCP is not yet widely deployed, another approach to provide its advantages involves the creation of multipath tunnels between MPTCP proxies [2], which run all traffic between the proxies over the multiple path between them. When placed on a customer's access router, the proxy allows the customer's TCP traffic to benefit from the aggregation the DSL and the mobile network link capacity, and for network providers to offer better service than would be available with DSL alone, for this reason, various network providers are currently experimenting with use of multipath proxies to increase the bandwidth they can offer to their customers by aggregating the DSL and the mobile network link capacity on a customer's access router. An MPTCP proxy can only be applied to TCP traffic, however. Running other traffic such as IPTV or VOIP applications over UDP in a multipath TCP tunnel can lead to poor performance. We therefore propose a new approach for multipath bonding at layer[3], which is independent of the transport protocol and therefor applicable to UDP traffic as well. The proposed design aims to minimize loss while fully utilizing the available bandwidth and avoiding reordering. We implemented the proposed system in a lab testbed using a DSL connection and an LTE interface. Our tesrbed evaluation demonstrates that our prototype can reach our goal of high utilization with low loss within our target scenario, even with dynamic and cross-traffi conditions.

A. Bonding Architecture

Our architecture consists of two gateways, one at the cus-tomer side and one operated by the access network provider, connected by at least two tunnels. the approach could, however, be easily generalized to n access interfaces. The proxies build a "bonded" interface across these two connections. Each proxy consists of two components: an "ingress" which accepts traf-fic, assigns it to one of the two bonding interfaces based on interface conditions, and schedules its transmission; and an that takes traffic from the two bonding interfaces, merges it in the correct order, and sends it out. Each gate-way therefore acts as a transparent proxy. The customer gateway is designed either to be integrated into Customer Premises Equipment (CPE) with multiple access interfaces, or to be deployed as a separate middlebox connected to CPE for each interface. The provider gateway is connected to the Internet and/or to provider-hosted services (such as VoIP or video on demand).The customer side gateway sends upstream traffic to the provider's bonding server, and the provider's gateway sends downstream traffic to the customer side bonding server. The two proxies combine

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with each other to determine link on each of their bonded interfaces, as input to the scheduling algorithm used by each gateway. This arrange-ment is shown in Figure 1.The ingress uses a scheduling algorithm that, for each in-coming packet, decides with MPTCP tunnel to use. This ingress adds global (per bonded gateway pair) and local (per in-terface) sequence numbers to everypacket. These sequence numbers are used by the alternative gateway's egress to emit outgoing packets in orderand detect loss on both links.

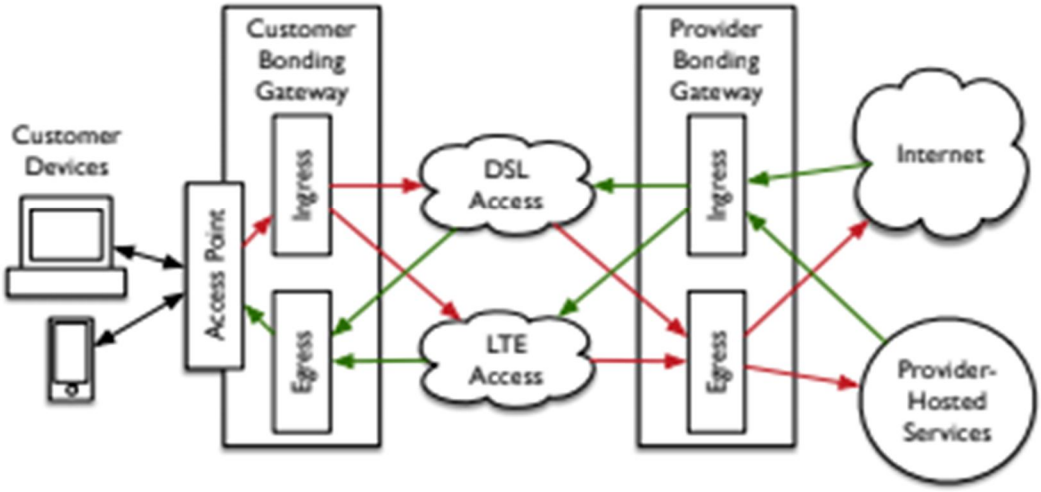

Figure 1:Bonding Architecutre

II. RELATED WORK

There are some researches about the aggregation of multiple heterogeneous access networks. In 1st type of the mechanism, end hosts cannot support multiple links. Devices that can be supported for MPTCP are deployed in network operators. The device are located in the home network is a CPE (provides by operator), and the one located in operators network can be an existing network device(eg., broadband network gateway) or an operator specially deployed device(eg.., BGW) that bundles multiple access links. This kind of research can be further divided into two classes: encapsulated approach and nonencapsulated approach. HYY is a network –layer encapsulated approach. HYA uses IP tunnel established between CPE and BGW to bundle multiple access networkx, An IP packet is appended to a new IP header and transmitted in IP tunnel through access networks. However, different access links have different network latencies. Which impairs network performance greatly it is difficult for a traffic scheduler to distribute packets to the appropriate links without the feedback from the transport layer. Further, there is an even larger set of proposals that discuss multipath routing, in various scenarios and based on different assumptions. Our approach differs from previous multipath routing work, such as[1,10]: as we address a different goal with fixed preference, full utilization of a lowercost fixed link while using a higher-cost wireless link to handle additional demand, therefore our approach can be much simpler than a generalized approach. The same is true for more generalized approaches as presented in [5,2] as well as bandwidth aggregation in vehicular networks[4], while these approaches and architecture concentrates on scheduling, the scheduling on our approach is simple, but the intelligence of our system lies in the outbound bonding box that performs the reordering.we would further like to note that on-going work focuses in addition on middlebox and path signalling mechanisms[5]. If such mechanism would be in place, they could further be used to provide additional guidance for our multipath bonding proxy.

III. SIMULATION

A. Simulation Configuration

The network topology used in simulations is shown in figure 2. simulations are performed while changing the propagation delay and performance of the access link and backbone link in figure 2, TCP tunnel was established between the ingress and egress routers, and TCP traffic was continuously transmitted from the source host to the destination host. We implemented a TCP tunnel module in OPNET modeller.

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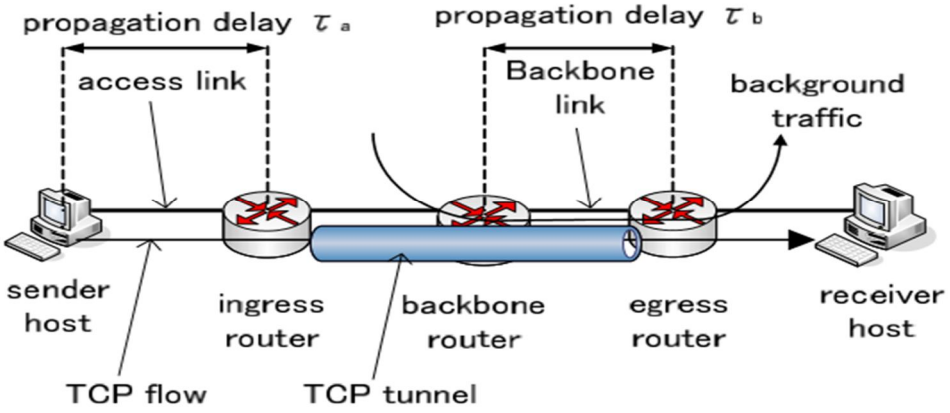

Figure 2:Network topology used in simulations

B. Intial Weight Increment(Iwi)

A very small loss fraction would not change Wmobiledespite congestion on the fixed link. However, in a situation where congestion is just arising, it is important to react quickly, therefore , when Wmobileis zero but loss is reported, IWI increases Wmobileby the number of lost packets. Wmobileis initially zero, and is clamped to a maximum value Wmobilemax. this clamp keeps IWI from overshooting and shifting too much traffic to the mobile link.

C. Delayed Weight Decrement(DWD)

After no loss has been reported for Tdwd, DWD decrements Wmobile by one for each interval Treportin which no loss has been reported. This shifts load back to the fixed line without including loss by shifiting the load too quickly. As loss reports are only received every Treportmilliseconds, Tdwd must be a multiple of Treport.

IV. MPTCP PROTOCOL

The single an simplest most important choice when designing a multipath protocol is the choice of the sequence numbering in [7,9,5], one single sequence number space is used, with the consequence of large re-ordering of sequence numbers at the receiver side. Since re-ordering is normally mistaken as a packet drop specification in, specific algorithms are needed to distinguish between normal multipath reordering and failures. Further , a single sequence number space makes it very difficult to tell which paths delivered a segment if the segment was sent redundantly (on more than one path).To fix those problems, the MPTCP tunnel proposal uses a two sequence number space, where each subflow has its own sequence space that identifies bytes within a subflow as if it were running alone. There ia also a data sequence space[6], which allows reordering at the aggregate connection level. Each segment containes the both sub-flow and the data sequence numbers in MPTCP protocol. Another important design choice is the way to deal with shared bottlenecks. There is a fairness problem if several multipath flows share a bottleneck.[7] solves that problem by trying to avoid establishing several subflows across the same bottleneck,

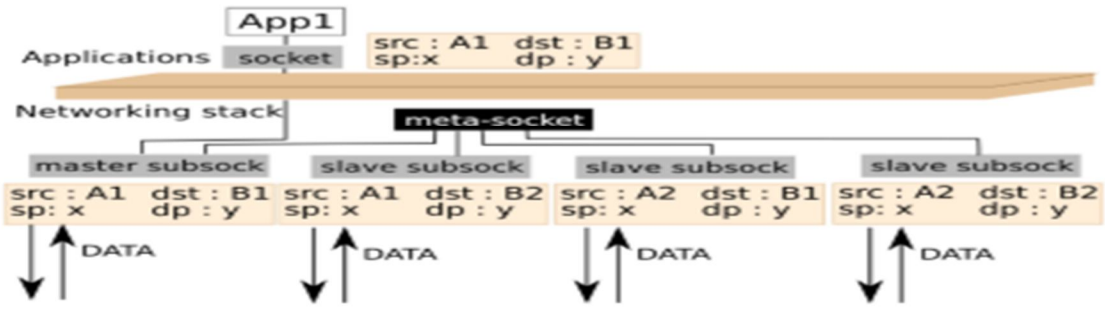

Figure 2: MPTCP architecture

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Thank to As external tool. Other approaches simply ignore the problem. In MPTCP, congestion control is coupled across paths, so as to guarantee fairness without needing to detect shared bottlenecks[8].MPTCP performs flow control in aggregate .A main aim of the MPTCP tunnel approach to multipath transport is that it must be deployable in the current web-site, without changing routers, middle boxes, or even NATs, for that reason each subflow looks to the network as a normal TCP flow, with the only difference that it carries new TCP options. Options ar used to declare MPTCP support, exchange current addresses and other control messages. The overall MPTCP tunnel architecture and design choices are detailed in[2], and the protocol is specified in[3].MPTCP works on the current internet, as we will show in our demonstration.

V. IMPLEMENTATION ISSUES

To validate the design of MPTCP and understand its impact on real applications, we added full support for MPTP to version 2.6.38 of the linux kernel. This is a major modification to TCP: our patch to the linux kernel, available http://mptcp.info.ucl.ac.be, ia about 10,400 lines of code. The software architecture is described in detail in [1].To our knowledge, this is the first full kernel implementation of MPTCP. We will focus on 3 of the more recent necessary improvements to the MPTCP tunnel implementation. We first briefly describe the algorithms that have been included in our MPTCP tunnel implementation to deal with middle boxes. Then we explain how to reduce the MPTCP memory usage. Finally we show how an MPTCP receiver is able to handle out-of-order data efficiently. The implementation allows opening subflows between different address pairs, or between the same address pairs but different ports. The latter can b used to leverage existing in network multipath solutions such as equal cost multipath(ECMP),allowing them to load balance at subflow granularity. Finally, our implementation is modular and it is easy to add support for new path management techniques that may become available. Connection specific information is held in a new structure at the connection-level, called meta-socket. This model-design keeps multipath identifiers for the connection, the list of subflows associated to this connection, and connection-level reordering queues.

VI. CONCLUSION

We have carried out an experimental investigation of multipath TCP in presence of WIFI and 3G.we have proposed and evaluated three handover modes: Full-MPTCP, Backup and single-path. Our experiments in commercial wireless networks demonstrate that MPTCP tunnels can play a role for mobile users and also WIFI/3G convergence today. Our measurements with skype demonstrate that existing unmodified applications already benefit from MPTCP.

VII. ACKNOWLEDGEMENTS

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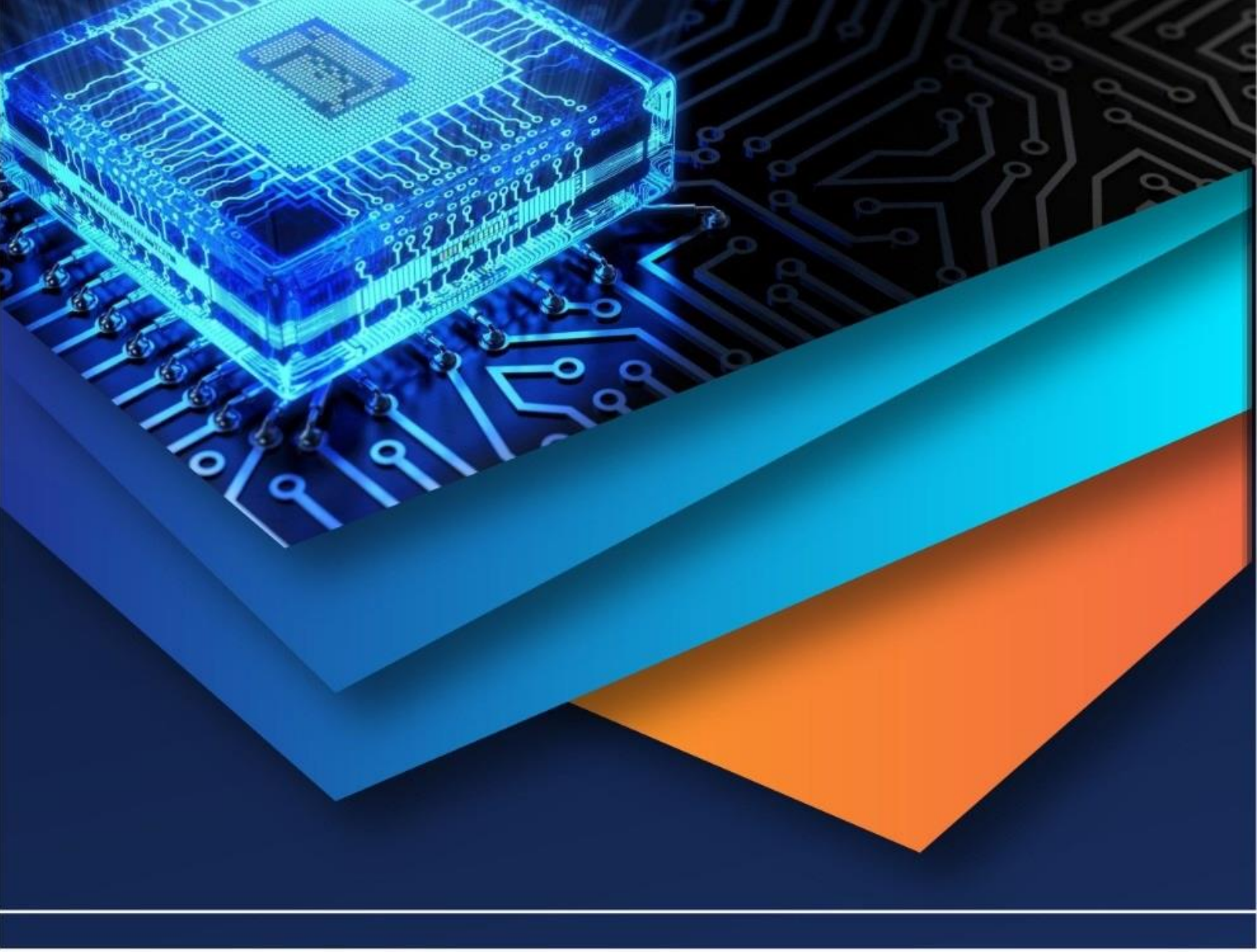

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