An Optimized Clogging Manage and Fault Executive System

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Abstract
In this paper, a new OCMFES congestion control mechanism is introduced in multi-homing mode. Congestion in each route can be avoided or can be controlled, based on an Active Queue Management (AQM) method. Also, routers compute probability of congestion for the sources on the paths and then notify them. Therefore, the sources can adjust their sending rates on each path effectively and if necessary, can switch to an alternate path to prevent congestion. Simulations have been conducted with Opnet linked with NS2. The simulation shows that the new method can decrease packet loss, increase the amount of transmissions and stabilize queue length, as compared with standard OCMFES.
Keywords: OCMFES; AQM; congestion control; sending

1. Introduction

Optimized Congestion Control and Error Management (OCMFES) is a transport protocol that has been proposed by the IETF Signalling Transport (SIGTRAN) working group [1]. OCMFES inherited much of its design from TCP but improves several features to make its signal transmission more efficient. For example, OCMFES is defined as an alternative transport protocol for the Session Initiation Protocol (SIP). SIP is a internet telephony signalling protocol [2]. Although it was initially developed for telephone signalling, it is gradually expanded into a general-purpose transmission layer. Nowadays, OCMFES is a mature protocol standardized in RFC 4960 [3]. Multi-homing is one of the features that OCMFES natively supports. This feature makes it possible to obtain a high reliability and robustness against single interface and network failures. An OCMFES endpoint is considered multi-homed if there are more than one transport address that can be used as a destination address to reach that endpoint. OCMFES uses an end-to-end window based flow and congestion control mechanism similar to TCP [4]. OCMFES can support multi-homing and has respective congestion control for each multiple transport paths. Congestion occurs when the amount of data injected by sources in the network are larger than the amount of data delivered to destinations. Similar to TCP algorithms, OCMFES uses only implicit congestion information such delays or losses. Congestion control can be implemented as a distributed control strategy. Some mechanisms like Active Queue Management (AQM), executed by routers, detect congestion problems and inform sources (either implicitly or explicitly with the mechanism of Explicit Congestion Notification ECN [5]). These techniques are designed to reduce packet loss and the end-to-end delay as well as to improve network utility. An AQM algorithm regulates the queue length by drops/marks incoming packet with a given probability related to a congestion index (such as queue length or delay).

In this paper, a novel rate adjustment method is proposed to improve OCMFES congestion control. Here, characteristic of OCMFES multi-homing is considered. In this case, two paths are chosen as primary path and secondary path between each source and each destination. In this algorithm, based on an Active Queue Management (AQM) method, congestion on each route can be avoided or can be controlled by probability of dropping. Also, routers compute probability of congestion, which is named congestion degree, for each source on each path and feedback to the sources. Then, the sources can adjust their sending rates effectively on each route by receiving the feedback from paths. After that, the senders consider condition of path switch to prevent congestion. The remainder of the letter is organized as follows: main features of OCMFES are briefly introduced in Section 2. The related works are discussed in Section 3. In section 4, the proposed algorithm is presented. Simulation results are brought in Section 5 and the paper is concluded in Section 6.

2. Overview of OCMFES

Connection in OCMFES called an association. Data are transmitted in chunks which are a unit of user data or control information within a OCMFES packet consisting of a specific chunk header and specific contents dependent of its usage. Multi-homing is a feature of OCMFES. Based on this feature, an association may comprise multiple source and destination IP addresses. During association setup, one path is selected as the primary path, and provided that this path is available, all data are sent in this way. Any remaining paths serve as backup or alternate paths. On these paths, only Heartbeat packets are sent regularly to control reach-ability. Often, one of the alternate paths is defined as a secondary path and retransmitted data are passed on this route. The secondary path avoids additional and unnecessary congestion at the primary path. In OCMFES, the sender keeps an error counter for the primary path which counts the number of timeouts that occurs consecutively. If the error counter of the primary path reaches a set threshold, Path.Max.Retrans (PMR), the primary path is considered unavailable or unreachable and a failover is performed.

In case of a failure, OCMFES should quickly switch the transfer to an alternate path, but in case of mild congestion, it continues to use the same path. If the secondary path is used when the primary path failure is detected, the primary path is unusable and the secondary path is used as the primary path. Also, the next secondary path is selected from the alternative paths. Figure1 shows the OCMFES multi-homing concept. OCMFES and TCP support the same set of congestion control algorithms. The slow-start, congestion avoidance, and the fast retransmit mechanisms of OCMFES have been almost directly inherited from TCP. Additionally, the use of selective acknowledgements (SACK), similar to TCP SACK [6], is mandatory in OCMFES. In multi-homing mode, OCMFES has a separate set of congestion control parameters for each of multiple transport paths within an association.

3. Related Works

Results of preliminary and in-depth studies on various features of OCMFES have been reported in the literature. The most studies have been focused on the performance of OCMFES in different situations [7-9]. Some efforts in OCMFES congestion control with multi-homing features are as follows. Dahal and Saikia [10] have represented an adaptation of an RTT based Congestion Control scheme on OCMFES. This eliminates drops due to congestion, decreases packet latency and necessary packet retransmissions. In this method, based on RTT measurements, level of traffic load have been computed to avoid driving the network into congestion. Also, a scheme has been considered that OCMFES can switch to the alternate path to prevent congestion. A protocol named WiSE has been proposed by Fracchia and Chiasserini [11]. This is a sender-side transport-layer protocol that modifies the standard OCMFES protocol through the use of bandwidth estimation techniques. WiSE tries to infer whether losses are due to congestion or radio channel errors. The protocol computes available bandwidth for current path and an alternate path. If the current path is severely congested and the alternate path is lightly loaded, WiSE switches the transmission onto the alternate path using OCMFES's flexible path management capabilities.

Ho and Cheng [12] have proposed a new enhancement OCMFES called ROCMFES (Receiver Bandwidth Estimation OCMFES) based on receiver-side available bandwidth estimation. ROCMFES discriminates wireless loss from congestion loss over error prone wireless link by bandwidth estimation. This changes the principle of Heartbeat-Request of OCMFES to send Heartbeat-Request on primary path periodically. Receiver then utilizes the interval of Heartbeat-Request to calculate available bandwidth. Also, when loss rate exceeds the maximum path loss rate, primary path switches immediately to keep data transmission.

A new path management (quality-aware OCMFES) has been represented by Chen et al. [13] for wireless networks. This includes a new path failure detection method and ICE (idle path congestion window size estimation) mechanism. The new method uses cycle counting rather than single counting as in standard OCMFES to detect path failures. Cycle counting improves the original path failure detection method in a wireless environment. Also, the ICE mechanism can estimate the path quality and provides information for path switching decisions.

Chen et al. [14] have been proposed a jitter-based congestion control scheme with end-to-end semantics over wired-wireless networks. The new protocol, JOCMFES adopts jitter ratio to differentiate wireless loss from congestion loss. Because of multi-homing, different paths should maintain their parameters of jitter ratio when transmitting through the path. Available bandwidth estimation scheme will be integrated into their congestion control mechanism to make the bottleneck more stabilized. This study is different from the previous studies in considering AQM method for OCMFES. Also, routers inform the sender probability of congestion for paths to adjust its sending rates on the paths. Here, the sending rate on each path depends on its packet loss rate and its probability of congestion. Because these conditions affect the size of congestion window that shows the amount of data can be transmitted. So, by selecting appropriate load on each of the paths, throughput of the network can be increased and probability of packet loss can be decreased.

4. The Proposed Algorithm

To understand the proposed algorithm, the network topology for one sender is shown in Figure 2. There are a sender (S), a receiver (R) and several paths between the sender and the receiver. Three routers are on each route. The first route is the primary path, the second is the secondary path, and the others are the backups. Data are transmitted between the primary and the secondary paths. In this paper, the algorithm is implemented in the routers and the sources over wired networks. In what follows, the proposed algorithms for the routers and the senders will be described, respectively.

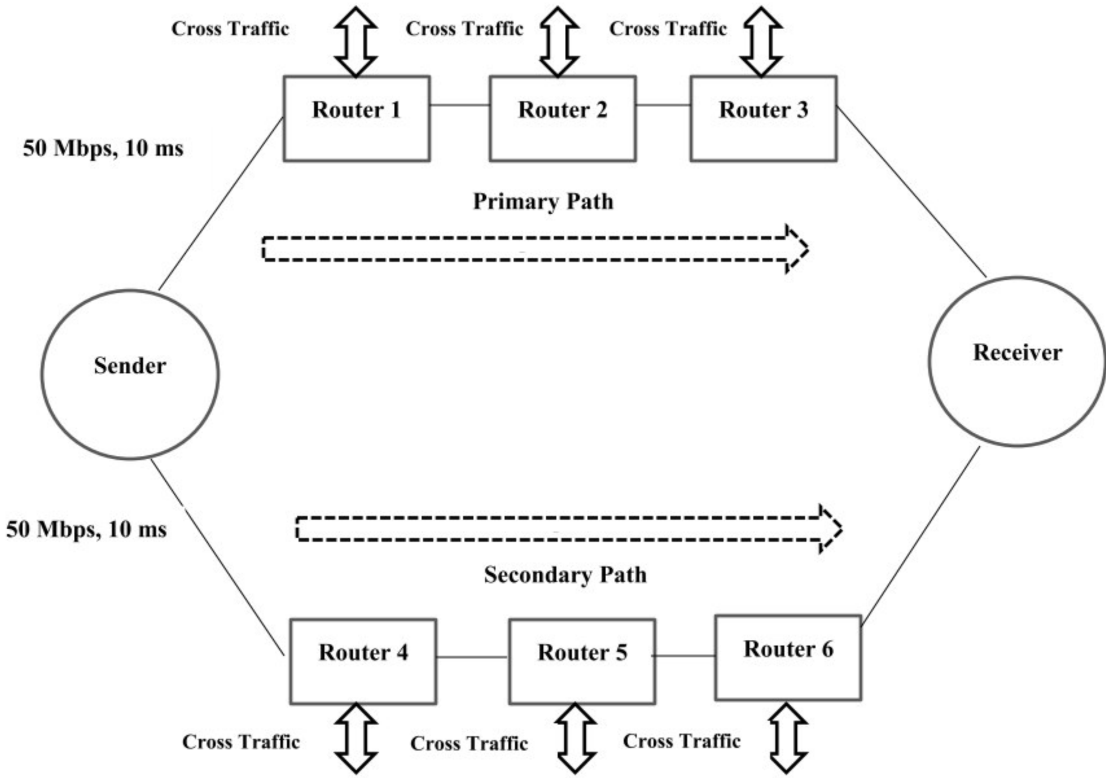

Figure 1. Network Topology

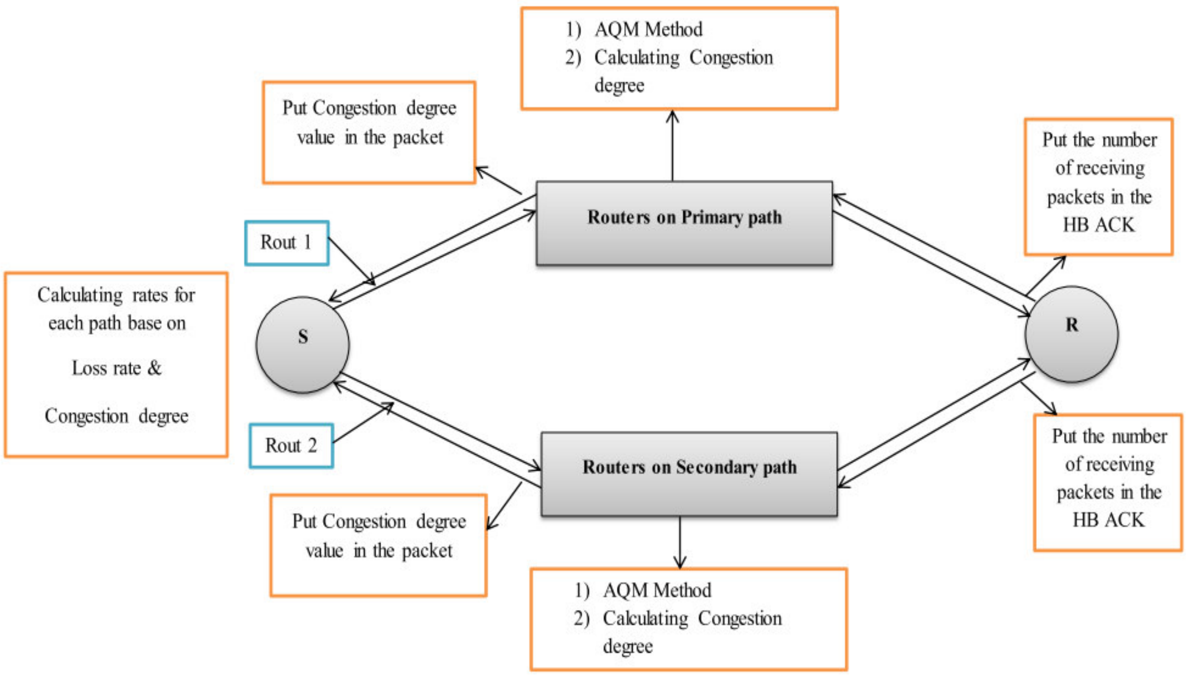

Figure 2. Block Diagram of the Proposed Algorithm

5. Simulation Results

To evaluate the performance of the proposed algorithm, Opnet modeller is linked with MATLAB. The network topology used in the simulation is the same as in Figure 2 for each sender. The endpoints are OCMFES agents. The capacity of links set 50Mbps and 20Mbps and the link delay is set 10ms. Three routers are concerned on each route. The maximum buffer size of each router is taken 50 packets. The current simulation focuses on three performance metrics: Throughput, Cumulative packet loss and Queue length. Both TCP and OCMFES control

congestion by changing the congestion window size to control the quantity of packets being transmitted. In addition, the packet transmission condition affects the size of the congestion window. For example, by occurring congestion or by increasing packet loss rate, the size of the congestion window is decreased. So, selecting the appropriate load on each of path in terms of packet loss rate and congestion occurrence, affects amount of data can be transmitted. The volume of data transmitted to the receiver per unit time is named throughput. Hence, with higher throughput, more data can be transmitted. Figure 3 compares the throughput of the new OCMFES and the standard OCMFES. As shown in Figure 3, with increasing transmission rates, throughput is increased in both protocols. Also, in the same transmission rates, the protocols have almost the same throughput values. However, it is clear that throughput degrades as the transmission rate exceeds 4Mbps. This occurs since congestion or drop occurs in the network happened. Notice that the new OCMFES scheme shows a higher throughput than standard OCMFES after the network becomes congested. Because with a proper load on the routes after congestion, the new protocol can increase the transmission rates. Figure 4 depicts the cumulative packet loss for the new OCMFES as well as the standard OCMFES. The cumulative packet loss at any time of the simulation is concerned as the sum of the packet loss since the beginning of the simulation until that time.
It is evident that at different times, the new OCMFES has a lower cumulative packet loss. This shows that the probability of the occurrence of the packet loss in the proposed algorithm is less than the OCMFES. This occurs since the proposed algorithm implements proper AQM method and appropriate rate adjustment to degrade the congestion as well as the packet loss.

In Figure 4, the experiment shows the instantaneous queue size for both of the protocols. The simulation is performed for 200 seconds. The results demonstrate that OCMFES is unable to control the oscillations in the instantaneous queue. In spite of that it is clear that the proposed AQM provides reasonable stability to the instantaneous queue. The proposed algorithm can stabilize the queue length around a desired level and achieves the lower standard deviation and based on Figure 4, the new scheme has lower value of cumulative packets loss.

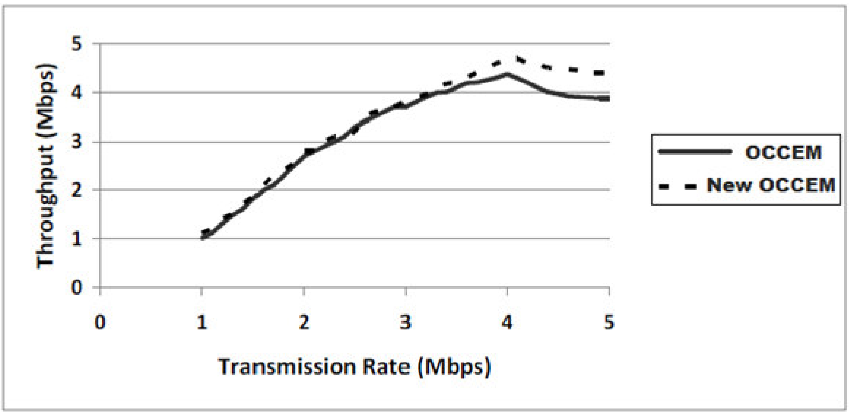

Figure 3. Throughput Comparisons

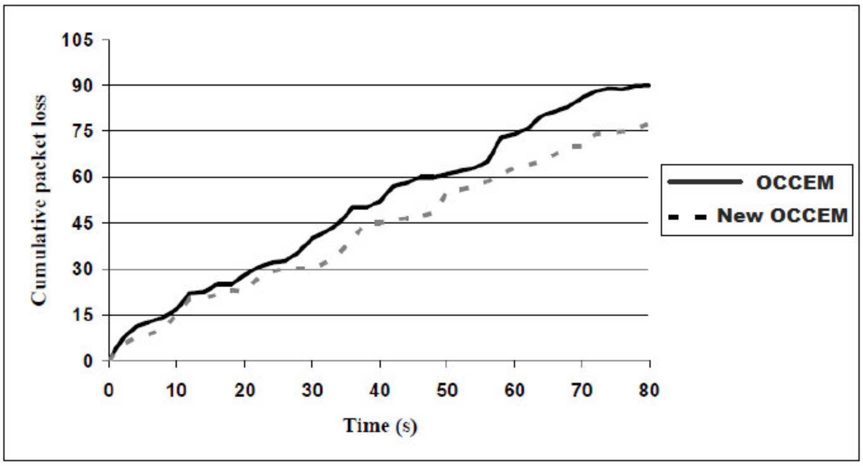

Figure 4. Cumulative Packet Loss

6. Conclusion

In this paper, a new rate adjustment method for OCMFES congestion control in multi-homing mode is presented. The data are sharing between two paths as the primary and the secondary path, the others are alternate. The algorithm is implemented on the sender and the routers. The routers calculate the probability of congestion for each sender and inform them. Also, based on an AQM method, incoming packets are dropped / marked with a given probability to prevent congestion. The sender defines the amount of data transmitted on each path depending on its packet loss rate and its probability of congestion on each routes. The simulation is performed in Opnet modeller linked with NS2. The experiments show that the new algorithm increases the amount of data that can be transmitted so, this achieves a better throughput. In addition, the proposed algorithm has a lower cumulative packet loss than the standard OCMFES. The new OCMFES can also stabilize the instantaneous queue around a desired value with reduced queue length oscillation while the standard!!! OCMFES is unable to control the oscillations in the instantaneous queue. With more accurate calculation of the congestion probability and with more effective optimization function, the new method can demonstrate even better performance and this can be an area of future research.

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