

Integration of Resource Reservation Protocol with Earliest Deadline First to Achieve Real Time Communication in Switched Ethernet

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Abstract: Nowadays ethernet is both LAN and WAN technology. This is possible because of switched ethernet. Switched ethernet is a modern counterpart of the historical ethernet. Switched ethernet replaces the shared medium of historical ethernet with a dedicated segment for each station. These segments connect to a switch, which can connect many of these single stations. This paper presents an integrated approach for real time communication in switched ethernet system by using RSVP (Resource reservation protocol) and EDF (earliest deadline first) algorithm. The node which wants to reserve the resources is scheduled in the switch according to EDF.

Keywords: EDF, Real Time Communication, RSVP, Switched Ethernet.

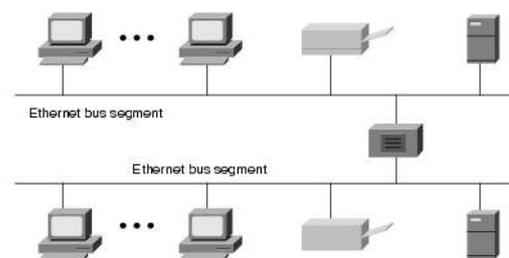
I. INTRODUCTION

Real time system has become increasingly important in our current scenario of networking. In current network the support for real time data is very important. Nowadays ethernet technology is being adopted by most of the organization for implementing their LAN (Local Area Network) and MAN (Metropolitan area network). So achieving real time data transfer is an important aspect of modern ethernet. Real time systems are that type of system which completes the task correctly within the time limit. In real time system, every task has a deadline. Deadline means by that time task should execute.

II. ABOUT ETHERNET

This follows the bus topology in which multiple computers share a single shared medium. While a computer is sending a frame, the other computers must wait for the medium to get free. Therefore the computer which wants to send data has to check whether the medium is free or not. Suppose more than one computer starts sending the data at the same time, collision will occur. So the computers have to wait for a random number of period and starts sending again. To implement this policy CSMA/CD (Carrier sense Multiple access with collision detection) protocol is used. CSMA /CD protocol is a multiple access protocol. It senses the medium after sending the frame to see if the transmission was successful. If so, the sending is finished and if there is a collision the frame is sent again.

And moreover the task of identifying the destination machine is distributed among all computers. It is distributed because each and every computer in the network receives the frame and all the computers check the destination address in that frame. If the frame has its own address then that computer accepts that frame and all others discard that frame. So, the task here is distributed. A pictorial representation of this is shown below



Each computer in the network is identified by using MAC (Medium Access Control) address. It is the address which is there on the network interface card.

But nowadays switched ethernet is used. Since modern ethernet networks, built with switches and full duplex connections, no longer need to utilize CSMA/CD because each ethernet segment, or collision domain, is now isolated. CSMA/CD is still supported for backwards compatibility and for half-duplex connections.

To achieve backward compatibility ethernet switch emulates CSMA/CD even though there is no bus sharing and collision. CSMA/CD NIC (Network Interface Card) cannot tell difference between a switch and a bus. It pretends as if connected to a bus. Now here the meaning of collision is buffer overflow. If buffer overflow at the switch happens it send collision signal back to the computer. Legacy NIC responds with retransmit and exponential back off.

III. RESOURCE RESEVRVATION PROTOCOL (RSVP)

Resource Reservation Protocol is a transport layer protocol used to reserve network resources and enable running internet applications to gain quality of service. Reservations are receiver-initiated for unicast and multicast traffic. RSVP can be used with multicast and

unicast traffic. RSVP is not a routing protocol, but it does use routing protocols and consults the local router tables for routes.

A typical reservation flow is initiated by sending a PATH message downstream to the receiver. Each node in the data path establishes a PATH state, to maintain the appropriate QoS. A PATH message states the flow ID, reservation information, and the source and destination address. Once the PATH message reaches its destination, the receiver passes the request to the local RSVP process, which passes the request to admission control and policy control. Admission control determines whether the node has the available resources to satisfy the request. Policy control determines whether or not the user has permission to request the reservation. If either of these is not successful, the RSVP process sends an error response to the sending program. If Admission control and Policy control succeed, parameters are set in the packet classifier and packet scheduler to implement the appropriate QoS. A RESV message is then sent upstream from the receiver to each node in the reverse data path. It reserves the required resources on the way. The RESV message uses the same flow information used in the PATH message. Routers along the path commit to the reservation and then store the information in a flow table. This process is repeated until the sender gets the RESV message. The reservation is then set up. Then the required information is being transmitted. Once the sender and receiver are done with the reserved flow, a PathTear message is sent to tear down the flow. Resources are then released to be used in a later reservation. So during this period the resources are dedicated for the sender and transmitter who reserve it. No other system can use that resource.

IV. EARLIEST DEADLINE FIRST (EDF)

Earliest deadline first is an optimal scheduling algorithm in real time system, in the sense that if a real-time system can be scheduled such that all jobs complete by their deadlines, then EDF will also schedule the system such that all jobs complete by their deadline.

Earliest deadline first assign priority to jobs based on deadline. Earliest is the deadline, higher the priority. It is simple, just requires the knowledge of deadlines. The process with high deadline is scheduled first, then after the next and so on.

V. RSVP AND EDF FOR REAL TIME COMMUNICATION IN SWITCHED ETHERNET

Switched Ethernet has a dedicated path between individual computers and their destination. Each computer is connected to a port in the switch. Switch ports generally operate in full-duplex mode. The pictorial representation is shown below

When a switch receives an ethernet frame, it wants to distribute it only to the port where the destination host is connected. It achieves this by referring to its 'Learned Address Table' (LAT), a list of entries that matches the network host MAC addresses to the switch's ports. This LAT is populated by monitoring network traffic.

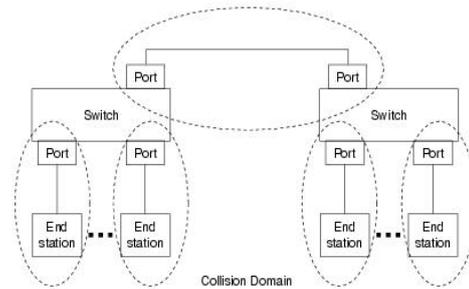


Figure 1

In doing so, the switch 'learns' what devices are connected to each of its ports. Thus there is no problem with the route identification. Computer from one segment can communicate with a computer in another or same segment. Here the problem is when a real time communication occurs, there is a chance of getting delay in the communication due to overflow in the switch buffer. When any overflow occurs, the CSMA/CD detects it and gives this information to the sender. The sender waits for a random period of time and starts sending again. And then there is a chance of missing the deadline of that real time communication. Hence to solve this problem, one of the solutions is to reserve the required resources in advance and then start the communication. Hence this is a connection-oriented approach. For reserving the resource, resource reservation protocol is used. In practice RSVP is implemented on transport layer, but here it is on data link layer. In this implementation RSVP uses MAC address.

Now another scenario that can occur is, in real time communication, a node from one collision domain communicates with a node in another collision domain and at the same time some other node also initiates a communication to the same collision domain. So one of the transmitters should wait for the other to complete. Suppose the sender who didn't get the permission has earliest deadline than the other one, then it will lose the chance. So it is better to check who has earliest deadline and allow that sender to reserve the resources and starts the communication.

This is done by using EDF algorithm. EDF is an optimal scheduling algorithm in the sense that if a real-time system can be scheduled such that all jobs complete by their deadlines, then EDF will also schedule the system such that all jobs complete by their deadline. Earliest deadline first (EDF) assign priority to jobs based on deadline. Earlier the deadline, higher the priority. It is simple, just requires the knowledge of deadlines.

VI. HOW RSVP WORKS IN SWITCHED ETHERNET

In switched ethernet also, RSVP can be used for both unicast and multicast communication. Typical reservation flow is initiated by sending a PATH message downstream to the receiver. Each node in the data path establishes a PATH state, to maintain the appropriate QoS. A PATH message states the flow ID, reservation information, and the source and destination MAC address. Once the PATH message reaches its destination, the receiver passes the

request to the local RSVP process, which passes the request to admission control and policy control. Admission control determines whether the node has the available resources to satisfy the request. Policy control determines whether or not the user has permission to request the reservation. If either of these is not successful, the RSVP process sends an error response to the sender. If Admission control and Policy control succeed, parameters are set in the packet classifier and packet scheduler to implement the appropriate QoS.

A RESV message is then sent upstream from the receiver to each node in the reverse data path. The RESV message uses the same flow information used in the PATH message. Switches in compliance with EDF module, along the path commit to the reservation and then store the information in a flow table. This process is repeated until the sender gets the RESV message. The reservation is then set up. Once the sender and receiver are done with the reserved flow, a Path Tear message is sent to tear down the flow. Resources are then released to be used in a later reservation.

VII. CONCLUSION

In this paper, the approach for real time communication is by using RSVP on data link layer for reserving the resources and EDF algorithm for real time scheduling. Hence both the best concepts i.e., RSVP and EDF is integrated for achieving real time communication in a switched network.

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