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Link Aggregation Strategies

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ABSTRACT:**High Data volume data transfer face problems of low speeds for large file/video transfers over the network, especially in digital/HD video editing, where popular applications require high speed video streaming. It is one of the provisioning approaches for flexible, reliable and high capacity communication. In this mechanism aggregating multiple Ethernet links and achieves a higher data transfer for a single file across networks. Most recently used Gigabit Ethernet cards are provided between the devices which scales up two orders of magnitude to 1000 Mbps, while maintaining the compatibility with systems. Both node connected to an 802.3ad aggregated link and comprise the appropriate number of active link with respect to the traffic load. The present link aggregation exists increases the bandwidth only in the case of multiple data streams. In other wards the bandwidth increase can be seen only while using multiple TCP or UDP streams. The performance characteristics are measured by the experimental test bed including LAN and MAN. The effect of data transmission caused by the link aggregation is addressed.**

Keywords: Gigabit Ethernet,HD video editing, link aggregation, multiple data streams.

I. INTRODUCTION

There are number of reasons affected in the transmission of high capacity communication like network load, link failure, switch failure, and connection problems. In this case we can apply this method for reducing the transmission time and increasing the throughput. Link aggregation is a mechanism or a method to combine the number of physical link into a single logical link or combining the number of tasks into a single task. We can able to increase the bandwidth between the devices by providing high speed Ethernet cards, Gigabit Ethernet cards etc. The main aim of the project is to increases the transmission speed of the single data files. The bandwidth increase can be seen only while using multiple TCP or UDP streams (i.e. multiple conversations). . The performance characteristics are measured by the experimental test bed including LAN and MAN. The effect of data transmission caused by the link aggregation is addressed.

II. PHYSICAL ISSUES IN LINK AGGREGATION

A. Addressing

Each network interface controller is assigned a unique MAC address. Usually this address is programmed into the ROM during manufacturing. In the initialization process the device driver reads the contents of the ROM and transfers the address of a register within the MAC address is used as source and destination address during the transmission of packets.

B. Frame distribution

When applying LAN technologies frames are sometimes divided into number of sub-frames or smaller units to perform transmission. In this particular situation the communication channels do no support sub-frames. One complete frame has to be transmitted to a single link. Using aggregated links the task is to select which link is capable to transmit a given frame. The sending time of longer frame is more as compared to sub-frame. In order to transmit the frame by using sequence number and it will restored at the receiver side.

C. Technology constraints

In this principle the device applied in the aggregation restrict the throughput using an aggregation of four 100Mb/s links instead of one 100Mb/s link will increase the capacity but the throughput on each link remains the same.

III.EXISTING LINK AGGREGATION MODEL

Link aggregation channel has been developed in variety of transmission channels, including ADSL, ISDN, ATM, SHDSL etc. Current link aggregation model can be classified into bonding models, frame-based models, and packet based models.

Bonding models needs identical link rates, and perform link aggregation at the physical layer. It will use bits or bytes of data for operation. Frame-based models implemented in data link layer and use transport protocol for transmission. The packet-based models perform aggregation at the network layer. Packet from a single data flow may be transported over a single link and multiple data flow may be transported over a multiple link.

IV.LINK AGGREGATION SERVICES

The basic concept of IEEE 802.3ad is based on the network layer-2 protocol. We turn off the spanning loop function of switch equipment's and merge two or more bandwidth together. With the help of trunk link we can set up a virtual logic connection between two DTE that are composed with N full-duplex paths which are in parallel.

A. Advantages

1) Increase Bandwidth:-It can merge many paths into a logic path to raise bandwidth. Theoretically bandwidth will be increased linearly.
2) Increase Reliability:-If any entity line is broken down in logic path, it will not affect the connection. The trunk link has the backup function.
3) Load Balance:-It can scatter the MAC-client traffic load to each path by using trunk link. When trunk link is settled logically, there is only one line. However as long as one entity line is broken down, the trunk link load balance will shift traffic to the other path. At most four entity lines can be used to form a logic connection at one time.

B. Disadvantages

1) Does not support multi-node:-Basically it only supports connection between two nodes instead of multi-nodes.
2) Does not support different MACs:-The IEEE802.3ad only supports 802.3 series of MAC protocol instead of other network environments.
3) Half-duplex model:-The trunking system only supports half-duplex model.
4) Does not support links of different speed:-The trunk link doses not support links of different speed. It is not allowed for each DTE to use different speed such as 100Mbps to 10Mbps. Links with the same speed is essential.

V. LINK AGGREGATION AND ITS APPLICATION

Aggregation technologies are used to improve the performance and management of a workgroup network in a number of ways. This section presents some scenarios for setup of link aggregation in a network backbone.

A. switch-to-switch

In this scenarios multiple workstations are linked together in an aggregation group between the switches S1 and S2.By aggregating multiple links, higher speed connections can be achieved without any failure occurred in the hardware.

In the Fig 1 depicts the two switches are connected using four GE links. If one link fails between the two switches, that link responsibilities take over another link and connection is maintained, the traffic between the two workgroups are distributed over the 4GE links. This configuration reduces the number of ports of the switch available for the connection.

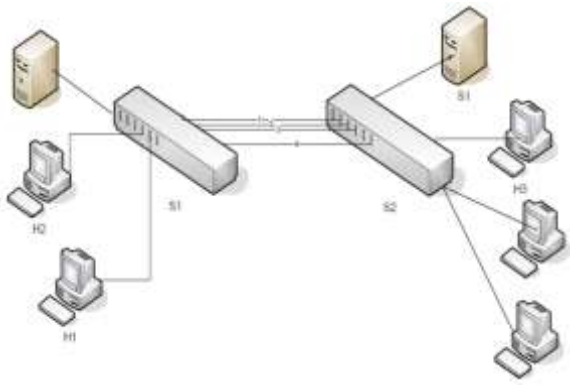

Fig 1 A Sample Model of switch-to-switch connection

B. switch-to-server

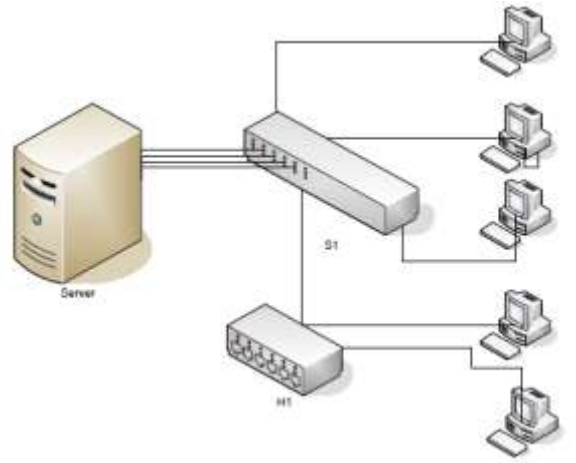

Fig 2 A Sample Model ofswitch-to-server connection

Many of the applications available today in a single in a single 100Mb/s link. Link capacity is the limiting factor for overall system performance. Aggregating links is to improve the access to applications and system performance. This diagram shows the connection between server and switch, and Fig 2 shows a trunk with physical links. Switch is connected to nine clients and two Ethernet hubs.

One server is connected to a switch using four 100Mb/s links. In this application, link aggregation is used to improve the performance of the link-constrained server. By aggregating multiple links better performance is achieved without require any hardware upgrade.

C. Server-to-server

Application such as data warehousing and data distribution movements are done by using this link aggregation method. This aggregation connections are useful for multiprocessing and or server redundancy applications. This application (eg:-Fig 3)shows how link aggregation group can be employed between 3 servers.

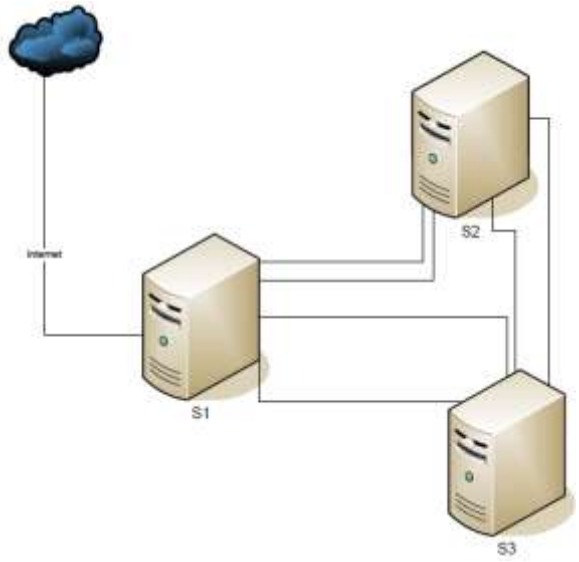

Fig 3 A Sample Model of Server-to-Server

VI.LINK AGGREGATION WITH HIGH AVAILABILITY BONDING

The link aggregation mechanism should be take place by using high availability bonding. The driver is used, which allows the kernel to present single logical interface for two physical links.

To guard against layer two (switch)layer one(cable)failure, a machine can be configured with multiple physical connections to separate switch devices while presenting a single logical interface. Bonding support under Linux is part of a high availability solution. This bonding technique can be used to reduce the single point of failure.

Aggregating the bandwidth of multiple physical links is a common approach used to increase network performance. However it will follow splitting a flow over multiple paths with different characteristics can result in transport control problems, which reduce the performance of that particular flow. In this paper briefly explained how link aggregation should performed in Wi-Fi links.

It is used to aggregate multiple Wi-Fi links. The figure shows the two Linux computers each attaches with multiple cards were setup to achieve aggregated wireless links. This technique is used to bond multiple wireless LAN interface into one logical interface. Bonding process requires two P.C terminals.Modes for the Linux bonding driver are supplied as parameters to the kernel bonding module at load time. The behaviour of the single logical bonded interface depends upon its specified bonding driver mode. There are seven different bonding modes available in standard Linux distributions. In this study we use the round-robin mode, which allocates one packet in turn to each bonded interface, achieving an even load among all interfaces. The other different modes are,

A. Round Robin:-

Transmit network packets in sequential order form the first available network interface slave through the last. This mode provides load balancing and fault tolerance.

B. Active Backup:-

Only one network interface slave in the bond is active. A different slave becomes active if and only if the active slave fails. The single logical bonded interfaces MAC address is externally visible on only one port to avoid distortion in the network switch. This mode provides fault tolerance.

C. XOR:-

Transmit network packets based on modulo network interface. This selects the same network interface slave for each destination MAC address. The mode provides load balancing and fault tolerance.

D. Broadcast:-

Transmit network packets on all slave network interfaces. This mode provides fault tolerance.

E.Adaptive transmit load balancing:-

Linux bonding driver node that does not require any special network switch support. The outgoing network packet traffic is distributed according to the current load on each network interface slave.

F.IEEE 802.3ad Dynamic link aggregation:-

Creates aggregation groups that share the same speed and duplex settings, utilizes all slave network interfaces in the active aggregator group according to the IEEE802.3ad specification.

G. Adaptive load balancing:-

The bonding driver intercepts the replies sent by the local system on their way out and overwrites the source hardware address with the unique hardware address of one of the network interface slaves in the single logical bondedinterface such that different network peers use different MAC address for their network packet traffic.

VII.EXPERIMENTAL SETUP

It is implemented according to the IEEE802.3ad standard. It will increase the bandwidth (assuming the system has enough resources to process additional data) and fault tolerance of the

connection. Link Aggregation offers an efficient and low-cost solution to increase bandwidth between server and switch. Another advantage it provides is that if a connection fails completely the remaining links can take over the traffic and thus replace the broken line. The Link Aggregation driver helps to increase the network performance by distributing the network traffic among the network adapters belonging to the same group (load balancing). As soon as the server is contacted the driver assigns links to the diverse applications according to the network load. This way, bandwidth can be extended proportionally to the network adapters. All ports that are configured for Link Aggregation (two or more) can be used to transmit and/or receive frames, depending on their configuration. If one connection fails the aggregated connection will lose bandwidth but remain stable as long as at least one connection of the group is working.

The protocol is able to automatically detect the presence and capabilities of other aggregation capable devices, beyond the features required for Link Aggregation in the IEEE 802.3ad standard, the drivers support an additional failover feature, Redundant Switch Failover (RSF). At the moment this feature is only implemented in the driver for Windows 2000, but will be available for other operating systems in the future.

The concept behind this implementation is to establish two or more TCP connections which are on two or more separate network interface cards [en0, en1, en2 and en3]. This can be achieved by configuring en0, en1, en2 and en3 in four different subnets. The data to be send will be partitioned into different segments which are simultaneously send over the four interfaces and reassembled at the receiving side. In short, for this solution we are required to develop our own protocol. As per our preliminary experiments, we hope to get maximum throughput using this solution.

Theoretically the bandwidth shall increase based on the number of Ethernet links available. However, the real performance of the aggregation with more than two links can be verified only after the implementation.

The system (Fig 4) consists of a read module, message queue implementation and threads for reading operation in the sending side. In the receiving side also, threads for reading data, message queues and a write module will be implemented. In the sending side, file read operation will be carried out by a single main thread. File will be read as a chunk of 'N' bytes and a header will be added to this chunk of file content. The protocol header will contain the sequence number. After adding the header, the data will be written to a message queue.

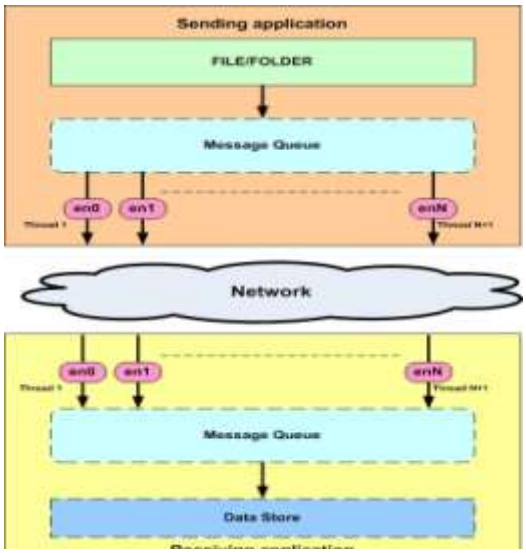

Fig 4 System Architecture

The data from the message queue will be sent to remote application through TCP/IP stack. The data sending operation will be carried out in multiple threads. Number of simultaneous threads will be equal to number of physical Network interfaces [en0, en1…en [N-1]].

At the receiver end data will be read from the TCP/IP stack using multiple threads. The received data will be stored in a message queue. The file will be recreated based on the 'N' bytes chunk containing sequence number as header information. File recreation operation will be carried out in a single thread.

VIII. CONCLUSION

This application shall transfer the data across the multiple links to achieve higher speed. Link Aggregation offers two main features which are essential forevery network administrator: it provides increased capacity and a failsafe system. By employingLink Aggregation the costs for upgrading the performance and the resiliency of asystem can be kept reasonable because both benefits can be attained using existing hardware. By using the automatic configuration protocol LACP we can provide redundancy withautomatic switching to the standby link in case the active link fails.The Link Aggregation driver enables load balancing not only on the basis of MAC address informationbut also on the basis of IP, TCP, and UDP information.Higher throughput by aggregating multiple links is possible with existing hardware.

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