Link Aggregation – An Overview

by

Chuck Easttom

As network usage increases, network administrators and engineers are presented with two issues. The first is the need for increased bandwidth. More users on a network leads to greater bandwidth requirements. The second issue is redundancy. As organizational operations become ever more dependent upon interconnected systems, the reliability of those network systems becomes more critical. According to Pieper and Tolley (1998), aggregation is an easily implemented solution to both problems. Aggregation is the process of taking multiple cables and combining the signals so that they operate as if those cables where a single cable, according to Pieper and Tolley (1998). What this means is that several cables are configured to operate in conjunction. They appear to network users as a single cable with bandwidth equal to the sum of the bandwidths of each cable. The cables all operate in parallel. This process is also sometimes referred to as link bundling.

Link aggregation addresses the bandwidth issue by allowing a network engineer to utilize the existing infrastructure, including cabling which might be older or possibly even outdated, and to combine the signals of that existing cabling to provide increased bandwidth. Aggregation also addresses the reliability issue since each physical cable in the aggregated provides failover redundancy for the others. For example if four category five cables are aggregated, the system gets the increased bandwidth, and has redundancy since any one of those cables can fail and the remaining cables will continue carrying transmissions, albeit with reduced bandwidth.

Aggregation is a process supported by many vendors. Sun Microsystems (2009), for example, provides manuals that explain in detail how one can establish an aggregation with their systems. In that manual Sun Microsystems (2009) lists the benefits of aggregation as increased bandwidth, automatic failover, load balancing, support for redundancy, and improved administration. Pieper and Tolley (1998) also addressed the increase bandwidth and automatic failover benefits as well as the related issue of support for redundancy. The load balancing benefit is due to the fact that there are separate cables making up the aggregate, according to Sun Microsystems (2009). Since the aggregate consists of separate cables it is possible to still route certain traffic along certain paths. For example voice over IP often causes a burden on networks. If that network issuing an aggregate of five category five cables, for example, two of those could be prioritized to handle the voice over IP traffic, preventing that load from impeding the other traffic. The benefit of improved administration stems from the fact that the various cables in the aggregate may be administered as if they where a single cable.

Holmes (2008) describes how to setup a link aggregate with Cisco routers. According to Holmes (2009), the primary purpose of a link aggregate is to increase the overall bandwidth between two switches. This explains the need for programming at the router or switch level in order to facilitate the creation of the link aggregate.

The efficacy of aggregation is clear, however the implementation can still be an issue. Wakerly (1998) discusses the process in depth. The key to successful link aggregation are the network connectivity devices, usually switches or routers, that are used to aggregate the transmissions from the disparate cables. According to Wakerly (1998), each aggregation device runs a state machine that allows it to ensure that the link is bi direction and to synchronize transmissions when that state machine is in the appropriate state. The use of a state machine in aggregation devices is a concept borrowed from the telecommunications industry where state machines are frequently used to handle diverse phone trunks and to appropriately route communications.

Pieper and Tolley (1998) discuss the IEEE 802.3ad standard which governs protocols used in link aggregation. This standard defines the Link Aggregation Control Protocol (LACP). This protocol functions by sending frames through all links that have the protocol enabled. If the protocol can locate a device on the other end of the link that also has LACP enabled, it will then send aggregated transmissions via that link. Link aggregation protocol can be configured to operate in one of two modes: active or passive. In active mode LACP will always send frames along the configured links. In passive mode however, only sends along links that it has received LACP data from, according to Pieper and Tolley (1998). In essence active mode assumes that once configuration is complete that all configured links are prepared to receive link aggregated transmissions. Passive mode waits for confirmation by receiving link aggregated transmissions from those devices.

Link aggregation is a cost effective way for network administrators and engineers to overcome issues of bandwidth and reliability. The process is now standardized with IEEE 802.3ad and is supported by multiple major vendors such as Sun Microsystems and Cisco. Those vendors offer clear instructions on how to configure link aggregation with their products. Since the process involves multiple cables connected via link aggregation protocol enabled switches or routers, Wakerly (1998) recommends that link aggregation be used primarily in creating high speed backbones on a network, rather than providing connectivity to individual nodes. Link aggregation provides an inexpensive way to establish high speed backbones on an existing network, according to Wakerly (1998).

References

Holmes, B. (2008). *Link Aggregation Interoperability of the Dell™ Powerconnect™ 6200 series*. Retrieved November 30, 2009 from http://www.dell.com/downloads/global/products/pwcnt/en/pwcnt_link_aggregation.pdf

Pieper, C., Tolley, B. (1998). *Link aggregation: Bolstering Bandwidth*. Retrieved December 2, 2009 from http://www.networkworld.com/news/tech/1130tech.html

Sun Microsystems (2009). *Overview of Link Aggregations*. Retrieved December 2, 2009 from http://docs.sun.com/app/docs/doc/816-4554/fpjvl?a=view

Wakerly, J. (1998). *Link Aggregation Protocol Techniques*. Retrieved December 1, 2009 from http://www.ieee802.org/3/trunk_study/april98/wakerly_042898.pdf