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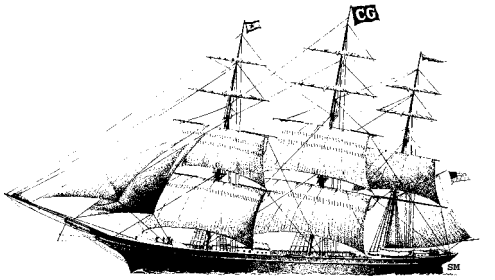

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Network QoS Paves the Way For SAN Consolidation

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Then and Now

There are similarities and differences between a *Ford Model T* build 95 years ago and a modern Ford sedan. Both are passenger vehicles for traveling over distances. Both are significant improvements over a horse and carriage. The difference is that a modern sedan is faster, more reliable, safer, less costly to own and operate, and more comfortable to drive. A Model T may be a nice collector's item, but you would not purchase one to meet your daily transportation requirements. Nearly a century of automotive development have resulted in a better vehicle today.

SAN Driving Toward Consolidation

In automotive terms, the **storage area networks (SANs) of today are similar to the Ford Model Ts of yesterday.** First, they are a significant improvement over direct-attached storage (DAS), which is more of a horse-and-carriage approach to storage. By disaggregating storage from servers and connecting them over a common network, SANs facilitate consolidation, raise capacity utilization, and simplify management. All worthy benefits, though it is still not a perfect situation. **SANs are often dedicated to individual applications, resulting in a proliferation of disconnected SAN islands.** The result is that bandwidth utilization overall is low and management is not as simple as it could be. Bottlenecks and application brownouts can also occur – in part because there is no resource sharing between the SAN islands. These factors impact IT costs, worker productivity, and ultimately business operations.

Many enterprises now see the need for the "modern sedan" equivalent for storage networking – a consolidated, enterprise-wide SAN. This would be more manageable and cost-effective and offer better resource utilization. The question is how to achieve it because the dynamics of networking change with scale. Management, security, performance, inter-operability, and provisioning become more complex in a large, consolidated SAN. Enterprises would need more sophisticated technologies, tools, and techniques.

Network QoS Paves the Way

Though there are various aspects to consider, one particularly important capability in a large environment is *network QoS* – a collection of technologies and techniques that provides greater visibility and control of network traffic and enables differentiated service levels. It makes a SAN transparent, like a glass house instead of a black box.

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In a consolidated SAN, a larger number of servers and storage systems (i.e., nodes) are accessing each other through the fabric. Multiple servers and applications fan into individual switch or storage ports. Inter-switch links (ISLs) and long-distance connections become shared arteries for traffic from multiple sources. It is like putting more vehicles through a city's street grid during rush hour. There are more simultaneous traffic flows, interdependencies, and congestion. **The benefit of consolidation is that this allows an enterprise to do more with less – to get more out of a SAN infrastructure.** It increases bandwidth utilization, lowers capital costs, and improves ROI. **Management can also be simpler with the right tools.** The downside is that the contention over fabric ports and paths impact the performance of applications and activities like backup and restore or data replication. Therefore, **network QoS becomes especially important.** It allows an enterprise to intelligently and proactively manage the contention and keep it from adversely impacting applications and business processes. QoS is like a coordinated system of traffic lights that directs traffic through a city more efficiently and lets emergency vehicles like ambulances and fire engines override it, if necessary.

For example, imagine that traffic from a transaction-processing application and an e-mail server are experiencing contention in a SAN. Though the performance of both applications is affected, the poor response time for transaction processing has a much greater impact on business operations. On the other hand, users would not be materially impacted if the e-mail server takes a few seconds longer to send or receive a message. Therefore, the job of network QoS is to make sure the transaction-processing application has priority. First, it must identify the source of traffic in real time. If there is conflict, it must delay or mitigate traffic from the e-mail server until transaction processing is finished. This can mean temporarily halting e-mail data flows altogether, like a red stoplight. It can also mean dedicating a larger percentage (e.g., 80%) of bandwidth to transaction processing and the remainder to e-mail. This would be a more sophisticated approach that would allow both applications to carry on processing without abrupt fits and starts, while still meeting business priorities.

QoS Details

QoS capabilities vary in sophistication and comprehensiveness. They encompass a broad spectrum of functionality, like the news categories of "entertainment" or "sports." However, it breaks down into three basic activities:

- **Classification** – Recognizing the source of data packets in real time, whether they are from a particular switch port, server, or application. This is a necessity because the network must be able to identify a traffic flow before it can take an intelligent action upon it.
- **Marking** – Indicating to other switches and routers how to handle particular packets. This capability was originally developed for diverse, multi-hop IP networks. It is now available as a proprietary feature in Fibre Channel SANs.
- **Enforcing** – This is the "action" part of QoS. It is the ability to dynamically manage traffic flows based on user-defined policy. It includes traffic prioritization, congestion avoidance by preventing low-priority traffic, controlling transmission rates of individual streams, and dedicating paths to specific traffic types.

QoS is a set of tools that enables the IT department to meet specific network (and therefore storage) service level agreements (SLA). The SLAs express the quality of the network link in quantitative terms, such as:

- **Bandwidth** – Akin to the width of a pipe, it is the amount of data that flows per unit time (e.g., MB/s).

- **Delay** – Similar to the length of a pipe, it describes how long it takes data to travel from end to end.
- **Jitter** – It describes variations in delay, which is not necessarily constant, and
- **Packet loss** – The likelihood of packets being dropped during transmission that would require resending them. It impacts performance. This is more applicable to networks running TCP/IP over Ethernet. Fibre Channel guarantees deliver at the link level because it is designed as a channel protocol.[1]

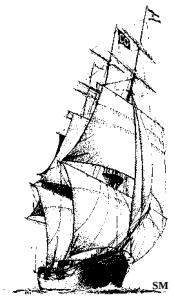
An SLA might include all of the above parameters and others, plus the percentage of time that the parameters are met. This allows for real-world tradeoffs between performance and cost. For instance, a 99.9% service-level guarantee is more reliable but also costlier to implement than one specified at 95%.

Conclusion

If you take a bird's-eye view of storage, the end game is to deliver storage as a service – in a measured, precise, dynamic, efficient, and cost-effective manner.[2] This is where the industry is headed, how storage technology is evolving, and where forward-thinking enterprises are reaching to go. As the basis of a "modern" storage architecture, SANs are an important part of the equation. They enable the broader trend of delivering storage as a service.

As enterprises demand more from their SAN infrastructure, they will eventually assemble a consolidated, all-inclusive network that serves their storage needs - enterprise-wide - in the most efficient and cost-effective manner. As this trend plays out, **QoS will become increasingly important. It is a critical technology for dealing with congestion in a consolidated environment and meeting business requirements for storage and networking.**

If you currently need or will grow into a sizeable enterprise SAN, QoS capabilities should be one of your purchasing decision criteria in networking equipment and software. This technology is nascent in the world of Fibre Channel SANs, though some vendors already offer forms of it. You should at least be comfortable with a vendor's view and development roadmap. *You don't want to be stuck driving a Model T in the 21st century!*



[1] See *Fibre Channel – The Defending Champion Has Staying Power* in **The Clipper Group Explorer** dated December 14, 2001, at http://www.clipper.com/research/TCG2001012.pdf.

[2] See *Storage Is Not Just a Box Anymore – Managing the Data Path* in **The Clipper Group Explorer** dated April 7, 2003, at http://www.clipper.com/research/TCG2003013.pdf.

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