

HIGH-PORT WHITEPAPER SERIES

#3: The Plumbing. How Do I Connect Many Drives?

Large Drive Counts and High Port RAID Controllers

Today, you are faced with a large number of problems that have to be solved when creating storage platforms. In the past, you selected a CPU performance point, added some memory and a SCSI controller to connect to your disk drives and you were good to go. About the only choice on the I/O side was whether to go with single- or dual- channel SCSI.

But the world has changed. Motherboards have multiple CPU sockets and CPUs have multiple cores. Memory capacities are increasing quickly, as are the demands of your customers' operating systems. I/O got more complicated with the advent of blindingly fast (but expensive) Serial Attached SCSI (SAS) drives and low cost, high-capacity (slower) Serial ATA (SATA) drives. And then, to top it all off, virtualization entered the picture, so you might not even know whether your system will be host to one operating system or ten.

Designing a system (or a range of systems) that can support these diverse needs is difficult. But when it comes to the I/O side, a Unified Serial™ (SATA/SAS) controller can help you handle high speeds and high port counts.

RAID controllers built with Unified Serial Architecture can connect to both SATA hard drives and SAS hard drives. Today, you should probably not even consider purchasing SATA-only controllers anymore. Unified Serial controllers provide greater flexibility and much higher performance at the same or lower cost, so even if you plan to only use SATA drives, an Adaptec Unified Serial is a better choice. It also lets you cover the possibility that a customer will suddenly ask for SAS drives for some particular application, without having to re-qualify your system to accommodate them.

Having made that I/O decision there are really three more questions that you ought to consider:

- How many drives should I use?
- What type of drive should I use?
- How should I do the “plumbing” to connect up the drives?

We'll discuss each in turn in each whitepaper of this series.

How to work the plumbing?

So, if you've read the other whitepapers in our series, “*How Many Disk Drives Do I Need?*” and “*Which Drive Types Do I Need – SATA or SAS?*” you've decided to use more than eight drives, and you've figured out which kinds of drives to use. The only remaining question is how to connect the drives to the Unified Serial controller.

You basically have three options depending on what kind of backplane your server uses to seat the disk drives.

- No backplane – drives are mounted in the server chassis but not connected to any kind of backplane. Power and data are supplied to individual drives with directly connected cables.
- A passive backplane – drives connect to a backplane which has no active electronics. For each drive seated in the backplane there is a matching connector to which a drive cable can be attached.
- An active backplane – drives connect to a backplane which has one or more SAS expanders built into it. In this case, there are either one or two 4-port connectors on the backplane which can be cabled to a RAID controller. The drives connect to the expander on the backplane without additional cabling.

In the first and second case, you should use a high port count Adaptec Series 5 RAID controller. These controllers support 12-, 16- and 24- internal drive ports, plus 4 external for connecting to expansion storage. You simply connect the internal drives to the ports on the RAID controller using standard cables.

In the third case, the best controller to choose depends on how many ports are available on the backplane. If all eight are connected to the backplane, you would use the 8-internal port controller, while if only four are available your best solution is probably the 4-internal, 4-external controller, which allows for external connectivity to expansion storage.

If your server platform already exists, then the above choices are easy since you simply match up your design to one of the RAID Controllers in the Adaptec Unified Serial family. But if you are planning a new server configuration, should you go with an active or passive backplane design?

This is a tricky question involving a number of fairly complex issues.

The Plumbing. How Do I Connect Many Drives

The following table attempts to enumerate some of more obvious ones, and indicate the type of analysis that you should do before making a decision.

Issue	Things to think about...
Backplane design	Expander manufacturers have reference designs on which you can base your system, but you still have to build your own boards.
Hardware integration	You should expect to spend several months shaking out the issues if you opt for an active backplane design. If you haven't worked in this area before, there will be a pretty steep learning curve relative to passive backplane design. You may have to develop new debugging skills to get the board working.
System integration	Expander manufacturers will provide you with firmware. Hopefully, it works in the configuration that you are planning. If not, you will probably have to fix it yourself as the manufacturers tend to offer only limited firmware support unless you're going to ship a lot of units.
Compatibility testing	SAS expanders are notoriously picky about disk drives. You should expect to spend resources and time testing compatibility with your selected drives. If you plan to allow customers to add drives (or replace dead ones) by themselves, you'll have to worry a lot about compatibility because you can't control what they try to use. In any case, you'll want to support newer drives as they're developed during the lifecycle of your product and each one of these will need a separate backplane qualification process.
Materials cost	Unless you're going to ship a very large number of systems, you should expect to pay a premium price for the expander itself. On the other hand, the cabling to connect to an active backplane will be slightly cheaper than that needed to attach a passive backplane or individual drives.
Expandability	Most designs that use many disk drives will benefit from supporting additional expansion to JBODs or external RAID subsystems. Getting the best performance and also supporting expansion requires that you map the expander ports carefully. Adaptec 16-, 20- and 28-port Unified Serial RAID Controllers support an external connector which is already properly configured.
Failures and FRUs	An active backplane has a higher likelihood of failing in the field, simply because it contains more sophisticated parts. If you want to allow for this part to fail, you'll need to make sure that it can be replaced in the field. This may require special chassis design.
Firmware upgrades	You'll probably want to support firmware upgrades on the SAS expander. This can be a hazardous process with some chance of killing the expander. In that case you'll be even more interested in making the backplane a field replaceable unit (FRU).

Obviously, these issues can be dealt with. After all, Adaptec 16-, 20-, 28-port cards all have a SAS expander built into them, and the issues have already been solved. Whether you want to take on the burden of solving the issues yourself should depend on a careful analysis of material cost, development expenses and support costs.

Whichever choice you make, Adaptec has a RAID controller that will fit into your solution.

Conclusion

Designing the best storage subsystem for a new server platform isn't as easy as it used to be. SCSI configurations tended to be pretty straightforward and the mathematics of performance, cost and reliability were well-known.

The advent of SATA and SAS drives with widely differing performance and prices makes the problem somewhat more complex. Plus, virtualization brings a completely new problem with its own requirements for I/O.

More than ever, it will pay for general purpose or high-performance servers to support a large number of drives of different types.

Adaptec has designed its Series 5 Unified Serial RAID family with these issues in mind and deliberately supports a wide range of port-count configurations to help you implement these systems. Combined with best-of-breed performance, industry-leading compatibility testing and Intelligent Power Management capability, these RAID controllers are the best fit for all your designs.



Adaptec, Inc.

691 South Milpitas Boulevard
Milpitas, California 95035
Tel: (408) 945-8600
Fax: (408) 262-2533

World Wide Web: www.adaptec.com

Pre-Sales Support: US and Canada: 1 (800) 442-7274 or (408) 957-7274

Pre-Sales Support: Europe: Tel: (44) 1276-854-500 or Fax: (44) 1276-854-505

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