Simplified HA/DR Using Storage Solutions

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Abstract

Perforce administrators have many choices for HA/DR solutions depending on RTO/RPO objectives. Using an effective storage solution such as NetApp filers simplifies HA/DR planning in several ways. In this session, we'll illustrate a sample enterprise Perforce storage architecture highlighting NetApp features such as SnapMirror technology to simplify and improve HA/DR infrastructure.
INTRODUCTION

There are many things to consider when planning an enterprise Perforce server deployment. You can accelerate the planning process by benefitting from the experience of a sensi – “one who has gone before.” There are many of those at this conference!

Downtime due to unplanned events such hardware failures, datacenter failures, and regional disasters can be very costly and affect the continuity of businesses. NetApp® storage solutions provide a range of data protection features that provide backup, high availability, compliance and disaster recovery solutions to safeguard critical data.

This presentation reviews a sample Perforce server deployment architecture suitable for large-scale enterprise environments. Specific hardware is not discussed, though key features of NetApp filers that play a part in enterprise deployments are highlighted. The basic structure discussed scales to extremely large and busy environments, and takes into account requirements common among enterprise environments.

MAJOR LEAGUE REQUIREMENTS

Large enterprise environments typically have needs like the following:

- **Scalability** to meet the performance demands of many hundreds up 10,000 and more users.
- **Storage Capacity** to truly embrace the Version Everything mindset of Perforce.
- **High Availability** designed to optimize server uptime even in the face of common hardware failures.
- **Disaster Recovery** solution to ensure continuous access to data even in event of a regional disaster impacting the primary data center.
- **Globally Distributed Development** to maintain performance for sites across the globe.
- **Comprehensive Global View** allowing users across the globe to share various digital assets.

The structure reviewed in this presentation is intended to have just enough sophistication to meet demands such as these.
When designing a best-of-breed storage solution for an enterprise Perforce deployment, the needs of different types of data should be considered.

The table below describes the types of data to be aware of when planning the storage architecture for a Perforce server intended to serve a large number of users (many hundreds to 12,000 and more).

<table>
<thead>
<tr>
<th>Volume</th>
<th>Comments</th>
<th>“Best of Breed” Enterprise Storage Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versioned Files</td>
<td>Optimize for <strong>high storage capacity</strong>, expandability, and performance for long sequential read/writes.</td>
<td>Modern filers such as SAN or NAS, with underlying “spinning disk.” Technology.</td>
</tr>
<tr>
<td></td>
<td>This is where most of the data goes, often many Terabytes of storage. Petabytes, anyone?</td>
<td>Underlying LUNs configured with RAID5 or RAID6, optimized for capacity and cost.</td>
</tr>
<tr>
<td></td>
<td>SnapMirror functionality enables point-in-time data backup.</td>
<td>XFS or EXT4 filesystem.</td>
</tr>
<tr>
<td></td>
<td><strong>Metadata (db.*)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optimize for <strong>low latency</strong> and performance for random read/write. Performance optimization can prevent or reduce performance bottlenecks that can occur at peak load in large-scale environments.</td>
<td>Solid State Disk (SSD) solutions. Not all SSD is created equal!</td>
</tr>
<tr>
<td></td>
<td>Metadata is typically small in comparison to versioned files. However, database trees can grow to many Gigabytes, even up to a few Terabytes for very large sites.</td>
<td>Direct Attached Storage (DAS), with underlying LUNs configured with RAID 1+0, optimized for performance for random I/O.</td>
</tr>
<tr>
<td></td>
<td>Perforce “offline checkpoint” procedures allow instant cutoff and backup regardless of db size.</td>
<td>XFS or EXT4 filesystem. Optionally EXT2 (faster but non-journaled) is viable if lack of journaling is mitigated some other way, e.g. Consulting SDP.</td>
</tr>
<tr>
<td>Journal and Logs</td>
<td>Optimize for performance for long sequential reads/writes. Frequent log and journal rotation strategies result in low storage capacity needs.</td>
<td>Often piggybacks on the filer.</td>
</tr>
<tr>
<td>Offline Storage</td>
<td>Optimize for high storage capacity, removability. For archive and unload depots to support long-term archival strategies.</td>
<td></td>
</tr>
</tbody>
</table>
HIGH AVAILABILITY VS. DISASTER RECOVERY
High Availability (HA) and Disaster Recovery (DR) are cousins in the data protection world, but there are significant differences. Among the differences:

- HA is about maintaining availability of the Perforce service with minimal disruption in the face of routine hardware failures.
- HA presumes a LAN environment, typically two machines next to each other on the same rack in a data center, connected by high-bandwidth, low-latency local network, with just a few inches for those electrons to travel at near light speed.
- For HA, there is a reasonable expectation of zero data loss for any single point of failure.
- DR presumes a WAN environment, typically two machines separated by thousands of miles, ideally on different tectonic plates on the planet surface. It’s a long haul for those electrons!
- In a “Disaster”, it is understood that there will be downtime, and there will be data loss. Downtime and some degree of data loss are deemed acceptable in DR, as they are utterly unavoidable. The goal with DR is to limit, quantify and minimize data loss and downtime.

Perforce’s built-in replication technology thinks of metadata separately from versioned files. It always replicates metadata, since the ‘p4d’ process can do that faster and more reliably than any external means. However, using built-in replication for archive files is optional, because that problem can be solved as well or better with a hardware solution, such as a filer.

FAULT TREE ANALYSIS, RPO, AND RTO
When planning for HA and DR, we like to work with customers to do basic fault tree analysis. Fault tree analysis essentially endeavors to list many things that can break (potential failures), and tries to figure out how to prevent or minimize harm for each type of failure. This type of analysis provides useful risk management insight, and helps guide HA/DR efforts.

After reviewing a terrifying list of potential failures, the likelihood of occurrence and impact of each type of failure is considered, as well as mitigations or corrective actions. Armed with an understanding of various risks to service availability, realistic Recovery Point Objective (RPO) and Recovery Time Objective (RTO) goals can be set. Put another way, RPO is tolerance for data loss, and RTO is tolerance for downtime. These are considered for each type of failure, and often summarized to high-level goals for the system as whole.

When doing this sort of analysis, one comes to appreciate the advantages that modern filers bring to the table. For example, individual disk drives have lower mean time between failures than many other system components. With Raid-DP®, even simultaneous failure of two disk drives will not result in data loss.

A SAMPLE DEPLOYMENT ARCHITECTURE
The sample deployment architecture below illustrates a “bare metal” infrastructure. Virtual infrastructures are becoming more common and are constantly improving. A variety of improvements in both virtualization technologies and Perforce product architecture make
virtualization appealing for some environments. But for environments with a thirst for speed, or operating near the limits of scalability, dedicated hardware still holds the performance records.

The sample deployment architecture we review here could be considered one of a set of “boilerplate” deployment architectures intended to fit a range of customer environments. This particular architecture uses dedicated Perforce server machines. The illustrations in the accompanying PowerPoint presentation do not indicate whether the filers are dedicated. Due to the way filers are used in this sample for versioned files only, filers need not be dedicated to Perforce for great performance. The Perforce server machine and its local storage for metadata are dedicated.

Key aspects of this sample deployment architecture, illustrated in the PowerPoint presentation, are:

- Reliance on filers to simplify HA with zero data loss, by eliminating the need to replicate archive files in the local LAN environment.
- Reliance on Perforce replication technology to simplify DR with minimum data loss.
- Takes advantage of Snapshot® technology to produce a point-in-time snapshot of the versioned file tree. Combined with offline checkpoints, a point-in-time state of the entire Perforce data set can be captured without downtime.
- p4-01, p4-02, and p4-lifeboat each have local storage for metadata, optimized for best performance.
- ‘p4 pull’ replication technology is used both for functional reasons (like meeting HA/DR requirements) and performance improvements (horizontal scaling, e.g. offloading requests from automated builds).

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1 For purposes of this paper, “zero data loss” means that data loss is limited to committed transactions; transactions in process are always at risk. It also assumes systems were functioning properly up to the point of failure.
THE FUTURE
Looking into my crystal ball, and our product roadmap, I see:

- Even more data going into Perforce, as the benefits of the Version Everything are realized by more organizations.
- Even more horizontal scaling of the Perforce product architecture.
- Filers becoming more prominent visibly in “bare metal” Perforce as well as “behind the scenes” for virtual deployments.
APPENDIX A: NETAPP STORAGE TECHNOLOGIES

NetApp’s data protection solutions offer Perforce customers a simplified and quick approach to backing up and recovering critical Perforce data. These solutions were designed to improve overall operational efficiency of backup and recovery.

Integrated into NetApp’s storage platform are capabilities that provide high availability and resiliency in case of storage hardware failures. These include:

- **Raid-DP®** – high performance Raid 6 (dual parity) implementation which protects against simultaneous failure of two drives in the same RAID group.
- **Active-Active** - HA Pair controller configuration which provides high-availability solutions during planned and unplanned downtime events

Below are highlights of other integrated data protection solutions that NetApp provides to protect against many different types of disaster scenarios ranging from the most common failures such as power, hardware, network or application failures within data the datacenter to the most catastrophic events such as floods, hurricanes or natural disasters include the following:

- **Backup and Recovery:**
  - **Snapshot®** – creates disk-to-disk point in time backup copies in native format.
  - **SnapRestore®** - data recovery software uses stored Data ONTAP® Snapshot™ copies to recover anything from a single file to multi-terabyte volumes, in seconds.

- **Disk to Disk Backup**
  - **SnapVault®** software - speeds up and simplifies backup and data recovery, protecting data at the block level. Also a disk-to-disk backup for NetApp FAS systems.
  - **Open Systems SnapVault® (OSSV)** software - leverages block-level incremental backup technology to protect Windows®, Linux®, UNIX®, SQL Server®, and VMware® systems running on mixed storage. Replication-based disk-to-disk backup for open system storage servers.

- **Application Aware Backup and Recovery Solutions for Applications**
  - **SnapCreator** - provides a central framework that integrates NetApp Snapshot™ technology with applications.
  - **SnapDrive** - simplify storage provisioning for UNIX or Windows platforms, and automate OS-consistent backup and restore of application data.

- **Tools for Backup Administrators to simplify processes:**
  - **OnCommand™** Unified Manager automates the management of physical and virtual storage for NetApp storage systems and clusters.
  - **SnapProtect®** - management software accelerates and simplifies backup and data recovery for shared IT infrastructures. Provides a single management console which allows you to create, catalog (for indexing and fast search of Snapshot copies), and manage application-aware Snapshot copies across disk-to-disk to-tape processes.
SIMPLIFIED HA/DR USING STORAGE SOLUTIONS

• Tools for Compliance
  o **SnapLock®** compliance software - a flexible data permanence solution for meeting strict data retention regulations or internal IT governance policies. Allows for creation of non-rewritable, non-erasable volumes to prevent files from being altered or deleted until a predetermined retention date.

• High Availability and Business Continuity
  o **SnapMirror®** - data replication technology provides disaster recovery protection and simplifies the management of data replication. Provides three modes of mirroring: sync, semi-sync, and asynchronous.
  o **MetroCluster™** - high-availability and disaster recovery software delivers continuous availability, transparent failover protection, and zero data loss.

• Archival
  o **Tape** - NetApp’s tape backup and restore solution uses Network Data Management Protocol (NDMP) version 3 and 4 which efficiently maximizes network bandwidth. NDMP-enabled commercial backup applications can be used to perform a dump backup or restore.

NetApp also provides global support and services that assist in fixing problems and/or assist in backup and recovery planning. Services that are offered include:

• **Autosupport and Storage Availability Audits** – monitoring and reporting technology that checks the health of NetApp storages systems on a continual basis. Provides a call-home feature that if the storage has any failure it will automatically contact NetApp support to handle or replace part.

• **Personalized support services** – availability of NetApp Support Account Manager, NetApp Support Advisor or NetApp Resident Support engineer to provide 24x7 incident management, education, onsite reactive and proactive support.

In addition, NetApp’s data protection services leverage NetApp storage efficiency technology to reduce both storage and management costs. Core to NetApp data protection is its' Snapshot technology. When a snapshot is done, only new or changed blocks are transferred to disk to reduce backup windows, minimize network traffic and reduce disk capacity.

Perforce can take advantage of NetApp’s SnapMirror technology to provide a replicated copy (read-only) of Perforce file depots for access by clients in a distributed development environment. Perforce current software release provides a functionality which allows the file depots not to be replicated at remote site and to leverage NetApp SnapMirror to handle the replication. This provides the added benefit of using the storage resources to do the replication instead of the host (Perforce server), allowing the Perforce server to handle other workload.