Accelerating Software Releases With Continuous Delivery

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Market-Leading Storage Solutions

Shared Storage Infrastructure

Clustered Data ONTAP®
for Shared Infrastructure

Dedicated Storage Solutions

Flash Arrays
for ultra-high performance

E-Series Systems
for price/performance at scale

StorageGRID®
for web-scale object storage
Sound Familiar?

THE #1 PROGRAMMER EXCUSE FOR LEGITIMATELY SLACKING OFF:
"MY CODE'S COMPILING."

HEY! GET BACK TO WORK!

COMPILING!

OH. CARRY ON.
Perspective & Environment

- 3,722 Developers
- 9 sites
- 25 Million Lines of Code
- Single Development Branch
- Continuous Delivery
Accelerating Product Delivery is Critical

“The days when a successful organization could release software once every 12 to 18 months are over.”

Kurt Bittner, Forrester, July 2013

Waterfall
- Annual releases
- Mostly manual

Agile
- Release more than once a year
- Some automation

Continuous
- Weekly/daily updates
- Massive automation
Accelerated Delivery Means…

**BUILDS**
- Nightly
- Hourly
- Every Check-in

**RELEASES**
- Yearly
- Quarterly
- Monthly
- Daily

**ARTIFACTS**
- Code
- Content
- Binaries

**CODE**
- Home Grown
- 3rd Party
- +Open Source

**TEAMS**
- Small
- Big
- Distributed
- Global
1000 foot view of NetApp Build

**SCM**
- Source Code in Perforce

**Compute**
- Diskless Clients (NFSboot from filers)
- In-house developed distributed Engine
- NFSv3 mounts for build workspaces

**NetApp Storage (6280 filers)**
- Faster workspace Snapshots/Flexclones
- SFO (fail over) & Junction paths - cDOT
- Diskspace footprint reduction with Flexclone

**File System – NFSv3**
- Storage Efficiency – Acceleration – Collaboration
- Deduplication
- Compression
- Flash Cache
- FlexVol®
- Data Protection
- SnapMirror
- High Availability Scale Up/Scale Out
- cDOT, cDOT 8.2
- Backup
- SnapVault, Volume SnapMirror
Perforce details

- One central P4d instance
  - Database size: 980G
  - Daily journal size: 44G
  - Commands run daily: 1.7M
  - Users: 3,722
  - Depots: 570G
  - Clients: 246K
  - Four proxies distributed geographically
Perforce Topology @NetApp

Commit/Edge Server

Svlin02
Production
(depot, offline
database, rotated
journal & log)

Bangalore/RTP
Edge Servers

Remote Site
Clients

Site servers
(edge server) and
DR/backup (RTP only)
ESS12
Multiple FC
connections

Remote Site Proxy

Remote Site
Clients

Local Filer (NAS)
Proxy cache

Remote Site
Proxy

NANE/PTC

WAN

scm13 & scm14
.production
commit server)
w/ 19.27fs E5740
Multiple FC
connections

scm16 & scm17
(SVL edge server)
ESS12
Multiple FC
connections
Perforce database locking

- **Problem Statement**
  - Perforce metadata is stored in 40 Berkeley DB format files in P4ROOT.
  - The various processes invoked on the P4 server for each command locks these DB files (as needed) to ensure data integrity.
  - This reduces Perforce *concurrency* and reduces overall performance.
  - For large Perforce sites, this is the *single biggest factor affecting performance*.

- **Solution**
  - Deploying EF540 (all-SSD enterprise storage) in this environment helps to solve this problem.
Performance Results (EF540 Vs local DAS SSD)

Lock Times in Seconds

- Average of Read Wait
- Average of Write Wait
- Average of Write Held
- Average of Read Held

March 14\textsuperscript{th} cutover
Initial post-cutover results

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## Perforce Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Before EF540 (local SSD) (seconds)</th>
<th>After EF540 (seconds)</th>
<th>Degree of Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P4 flush</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVL</td>
<td>35.5</td>
<td>2.1</td>
<td>16x</td>
</tr>
<tr>
<td>RTP</td>
<td>37.7</td>
<td>2.1</td>
<td>18x</td>
</tr>
<tr>
<td>PTC</td>
<td>40.7</td>
<td>2.2</td>
<td>18x</td>
</tr>
<tr>
<td>NB</td>
<td>35.3</td>
<td>3.1</td>
<td>11x</td>
</tr>
<tr>
<td>Average*</td>
<td>37.3</td>
<td>2.375</td>
<td>15x</td>
</tr>
<tr>
<td><strong>WS_merge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVL</td>
<td>19.0</td>
<td>4.9</td>
<td>3x</td>
</tr>
<tr>
<td>RTP</td>
<td>42.8</td>
<td>7.5</td>
<td>5x</td>
</tr>
<tr>
<td>PTC</td>
<td>26.9</td>
<td>11.0</td>
<td>2x</td>
</tr>
<tr>
<td>NB</td>
<td>63.6</td>
<td>39.5</td>
<td>1.5x</td>
</tr>
<tr>
<td>Average*</td>
<td>38.075</td>
<td>15.725</td>
<td>2.5x</td>
</tr>
<tr>
<td><strong>P4 resolve</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVL</td>
<td>424.1</td>
<td>122.7</td>
<td>3x</td>
</tr>
<tr>
<td>RTP</td>
<td>271.9</td>
<td>2.5</td>
<td>100x</td>
</tr>
<tr>
<td>PTC</td>
<td>388.5</td>
<td>5.0</td>
<td>75x</td>
</tr>
<tr>
<td>NB</td>
<td>443.9</td>
<td>20.7</td>
<td>20x</td>
</tr>
<tr>
<td>Average*</td>
<td>382.1</td>
<td>37.725</td>
<td>10x</td>
</tr>
</tbody>
</table>

**Note:** Perforce Server located in SVL
Average * = All sites are equally weighted
Faster workspaces from SCM

- **Daemon**
  - A SCM client for each codeline that is setup at the time of the codeline creation.
  - Process involves syncing this client to pick up latest changes on the codeline, and run the needed builds.
  - Once the build is complete, a snapshot of the client is preserved.
  - By using these snapshots as their client base instead of creating individual workspaces, developers are able to get populated, prebuilt workspaces in matter of minutes.
Sync with SCM and perform full build to create initial copy of workspace

Perform incremental sync—build frequently (15 minute interval)

TAKE SNAPSHOT
CREATE CLONE
CHANGE OWNERSHIP
PERFORM FLUSH

Benefits of NetApp Technology
- Workspace availability in minutes (<5 mins) vs. hours
- P4 sync vs P4 flush reduce the workloads on Perforce & proxy servers
- Leverages NetApp FlexClone capabilities
- Debug capability reduced to minutes
- Reduced disk consumption
- Improved consistency and stability in process
- Measured against developer time, multi-million dollar benefit

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Before

- Perforce reads/writes the files, as needed
- Various interfaces – network, fiber channel, etc.

"Create a new workspace, please."
NetApp executes the move

Perforce is updated when it completes
- Updates Perforce database

Benefits from both architectures
- Perforce’s use of standard files
- NetApp’s file handling capabilities

"Create a new workspace, please."
Continuous Integration

- Poll for code line submittals
- Kick off smoke tests
- Kick off CITs
- Build and propagate to all sites

Every 10 minutes:
- Continuous Build
- Snapshot™
- FlexClone®
- Smoke Test

Every hour:
- Back out culprit

Every 3 hours:
- 30+ CITs

Daily build in Sunnyvale

Daily Nightly build

Propagate
Accelerating Innovation

- **Standard workspace methods**
  - 80 minutes

- **Hard links**
  - 40 minutes

- **Workspace cloning**
  - 2-3 minutes
  - No build necessary
  - Minimal data transfer work
  - Saves NetApp 100 person years/year
Continuous Integration Benefits

- One development branch
- Continuous delivery of features
- Less overhead on branching
- Faster bug identification
Q&A
NetApp Collateral List

White Papers:
- WP-7181 Optimizing EDA Workflows

Best Practice TRs:
- TR-4143 Optimizing VCS Performance
- TR-4164 Perforce Deployment Guide
- TR-4142 Backup and Recovery for Perforce
- TR-4067 NFS Implementation Guide on cDOT
- TR-4063 pNFS Best Practices for cDOT
- TR-3183 Optimizing RedHat NFS Clients
- TR-4270 Optimizing Cadence Virtuoso Liberate
- TR-4238 Optimizing VCS Performance on cDOT
- TR-4239 Optimizing VCS Performance with pNFS
- TR-4237 Making LSF Storage-aware
Thank you