NetApp DevOps Solutions

NetApp DevOps Team

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P4 Flex: (Using FlexClones)

Accelerating SW and HW Development

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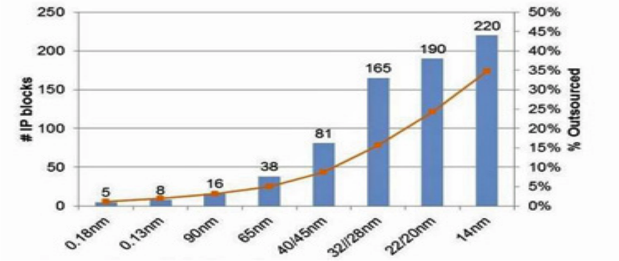
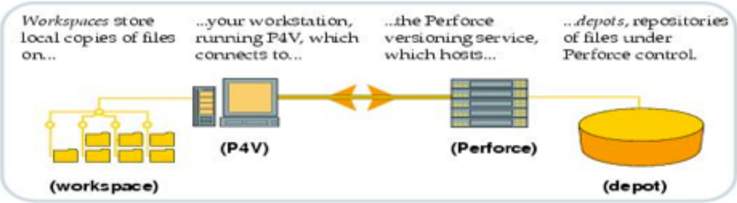
Imagine the Future

3-5x Storage Growth/Process Node





Workspaces store local copies of files on...

...your workstation, running P4V, which connects to...

...the Perforce versioning service, which hosts...

...*depots*, repositories of files under Perforce control.

Checkout → Build → Test

- **WHAT IF:**
- You could "Clone" or "Copy" a project without consuming storage?
- You could eliminate the need for full Checkouts?
- You could Clone a failed nightly regression or a release build almost instantaneously?
- Developers could delete their scratch space instantly with no filer load?
- Accelerate workflow and Optimize Engineering Infrastructure

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FlexClone Benefits

Proven productivity and efficiency improvements

- Greater developer productivity
  - Quick workspace creation (10X faster)
  - Faster builds (40X) using prebuilt object files
- Improved performance
  - Perforce server: offload resource intensive tasks like code checkout
  - Storage: improved caching in memory and flash, which improves system performance
  - Faster deletes: remove temp/scratch volume instead of lengthy file removals
- Reduced tool License and Storage costs
  - Faster tool runtimes due to incremental development
  - Use less storage to support multiple developers
  - Typically 75% saved per developer workspace

Faster Time to Market

- Better DevOps lifecycle management
  - Allow developers to snapshot work in progress with meaningful labels, return to them as needed for debugging
  - Move cloned volumes to different tiers of storage (SSD, SAS, SATA)
  - Move to different cDOT nodes, based on active workload, headroom

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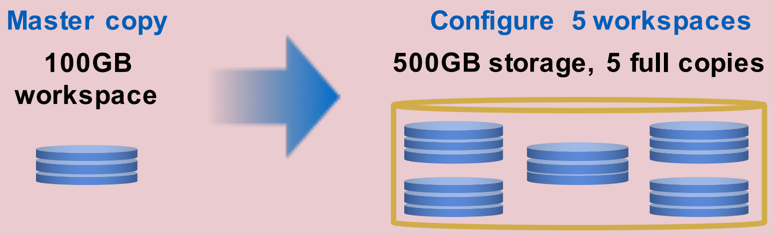
Workspace Configuration

Standard workspace copying



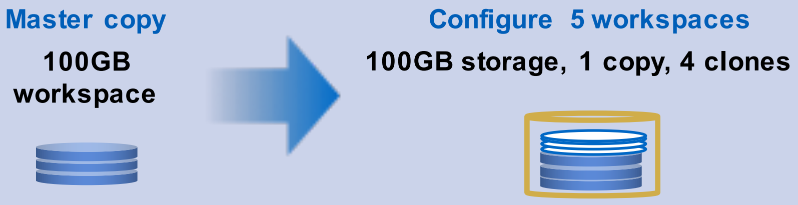
Master copy

100GB workspace

Configure 5 workspaces

500GB storage, 5 full copies

Rapid thin-provisioned copies with FlexClone



Master copy

100GB workspace

Configure 5 workspaces

100GB storage, 1 copy, 4 clones

- What is a big workspace?
  - Working with EDA data
  - Working with art or media for games
  - Large amount of build artifacts
  - 100+GB workspaces, one hour workspace provisioning time are not unusual

Provision in minutes versus hours

Standard workspace methods – one hour

Hard links – 30 min

Cloning – 2-3 min

No build necessary, minimal data transfer, saves $$$

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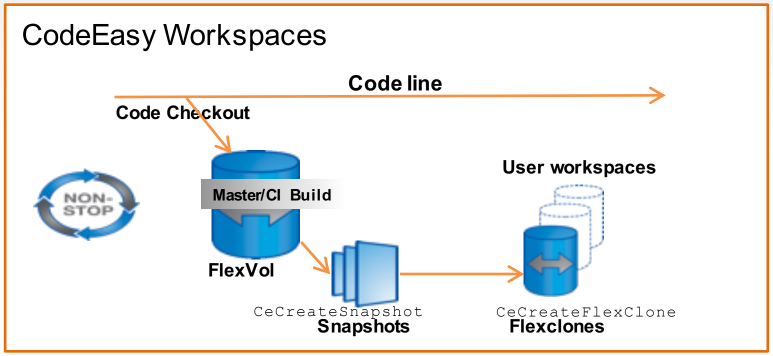
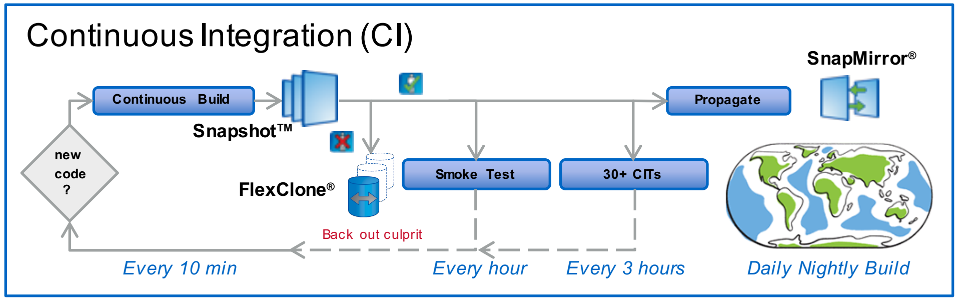
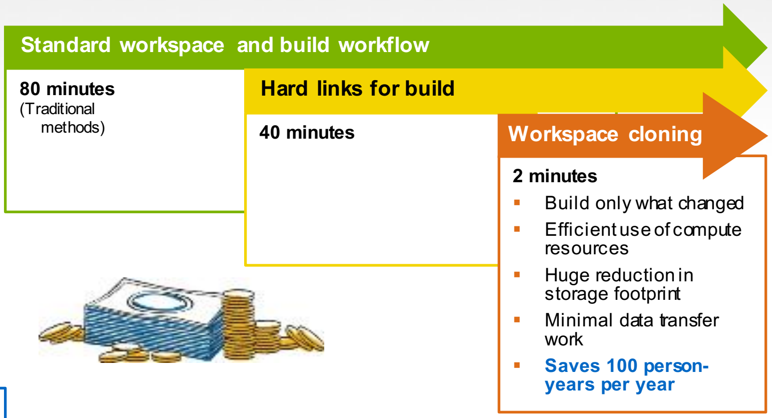
NetApp on NetApp DevOps Story







Standard workspace and build workflow

80 minutes (Traditional methods)

Hard links for build

40 minutes

Workspace cloning

2 minutes

- Build only what changed
- Efficient use of compute resources
- Huge reduction in storage footprint
- Minimal data transfer work
- **Saves 100 person-years per year**

Key Benefits

- 10x Faster workspaces from SCM—under two minutes for large codebases
- 40x Faster builds with prebuilt object files
- NFS directories for developer sandboxes
- Distributed software development environment
- Continuous integration with minimal storage foot print
- Faster feedback loop
- Keep the code lines stable

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Quick Start - Customer Enablement

Accelerate design workflows using NetApp Snapshot and FlexClone technology

CodeEasy Eval Kit

- General purpose example
- Small tarball reference of example scripts and documentation
- Scripts are simple, well-documented, easy-to-read Perl
- Supports Perforce, Git, SVN, SoS or even CVS
- https://github.com/NetApp/CodeEasy/

Perforce Flex

- Perforce Plug-in based solution
- Uses open-source p4broker script (Perforce 2007.2 or later)
- Python based
- Supported through the Perforce developer community
- Currently only supports UNIX and NFS environments
- https://swarm.workshop.perforce.com/projects/netapp-p4flex/

Scripts utilize NetApp Manageability SDK APIs
To automate creating volumes, SnapShots and FlexClones

Get started hours, not days

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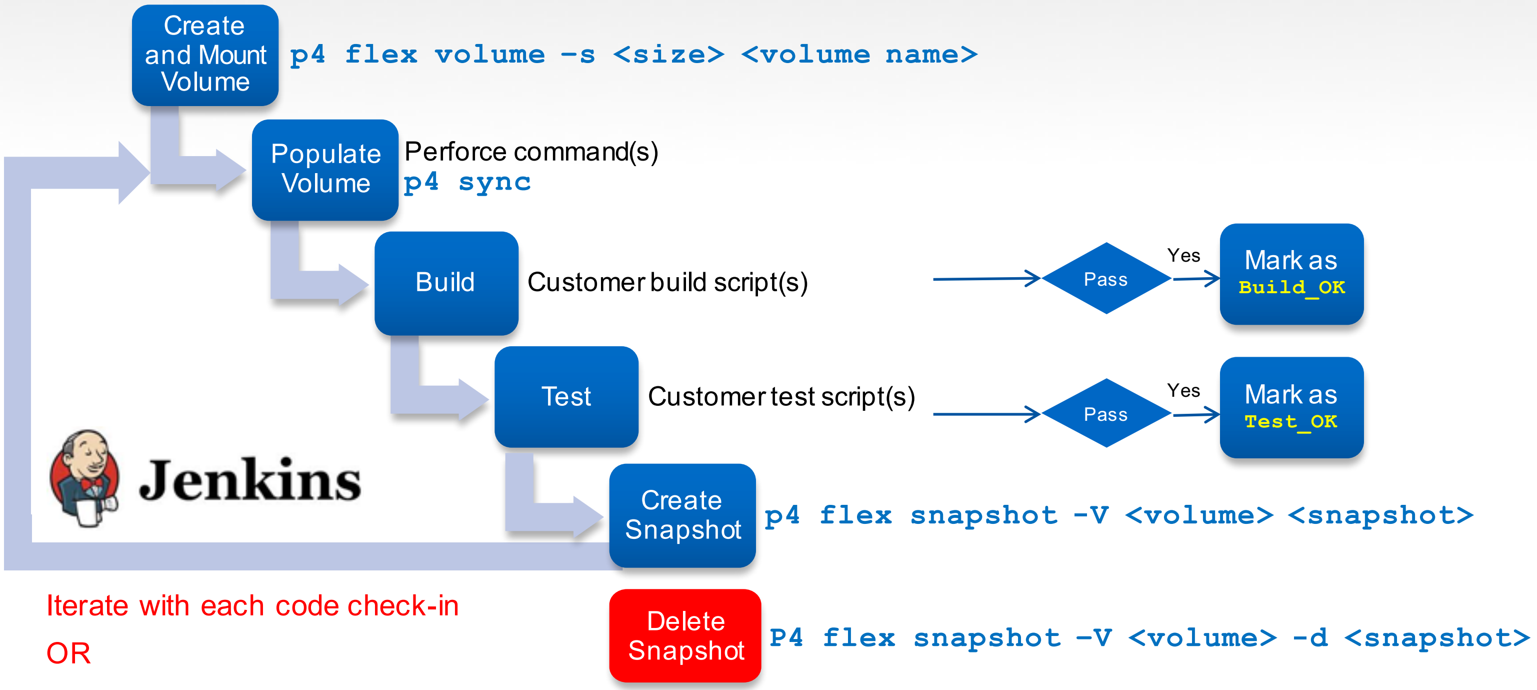
Perforce Flex - Build Flow

Iterative Continuous Build/Test/Snapshot flow



Create and Mount Volume

```
p4 flex volume -s <size> <volume name>
```

Populate Volume

Perforce command(s)

```
p4 sync
```

Build

Customer build script(s)

Pass

Yes

Mark as `Build_OK`

Test

Customer test script(s)

Pass

Yes

Mark as `Test_OK`

Create Snapshot

```
p4 flex snapshot -V <volume> <snapshot>
```

Delete Snapshot

```
P4 flex snapshot -V <volume> -d <snapshot>
```

Iterate with each code check-in

OR

Nightly Regression / Release Build

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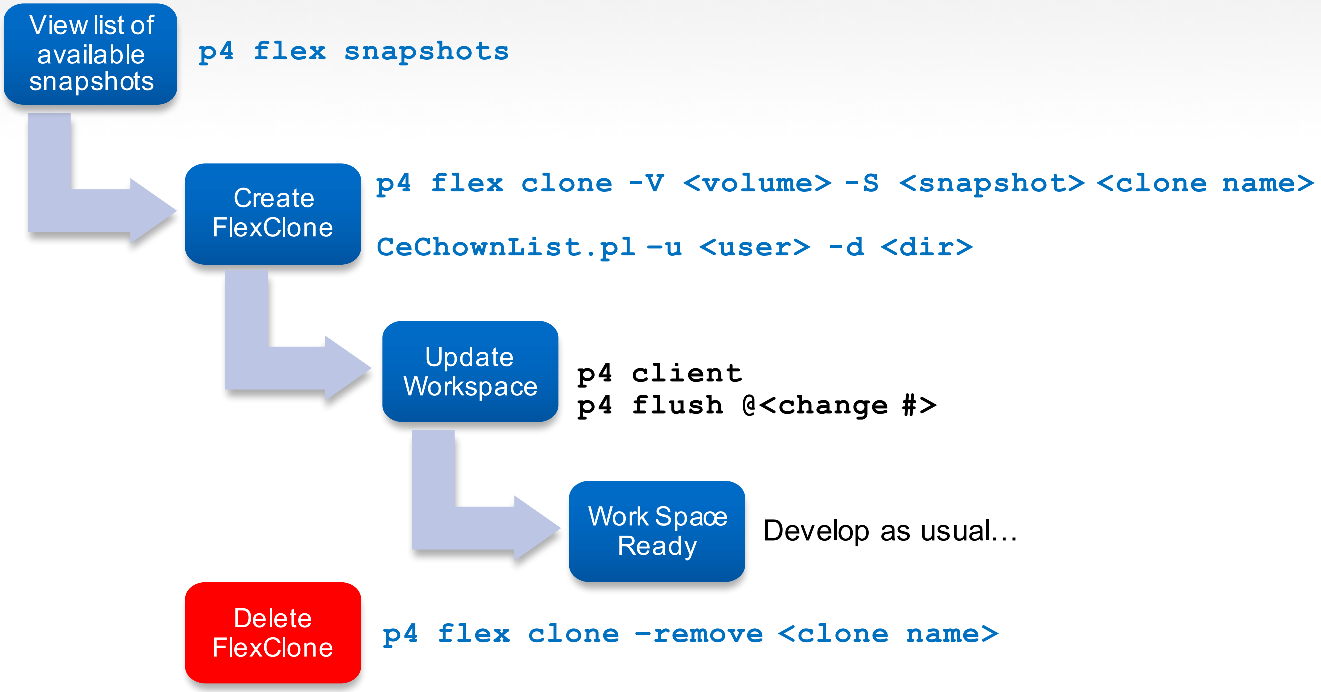
Perforce Flex – Developer Flow

FlexClone Enabled Workspace Creation



View list of available snapshots

```
p4 flex snapshots
```

Create FlexClone

```
p4 flex clone -V <volume> -S <snapshot> <clone name>

CeChownList.pl –u <user> -d <dir>
```

Update Workspace

```
p4 client
p4 flush @<change #>
```

Work Space Ready

Develop as usual…

Delete FlexClone

```
p4 flex clone –remove <clone name>
```

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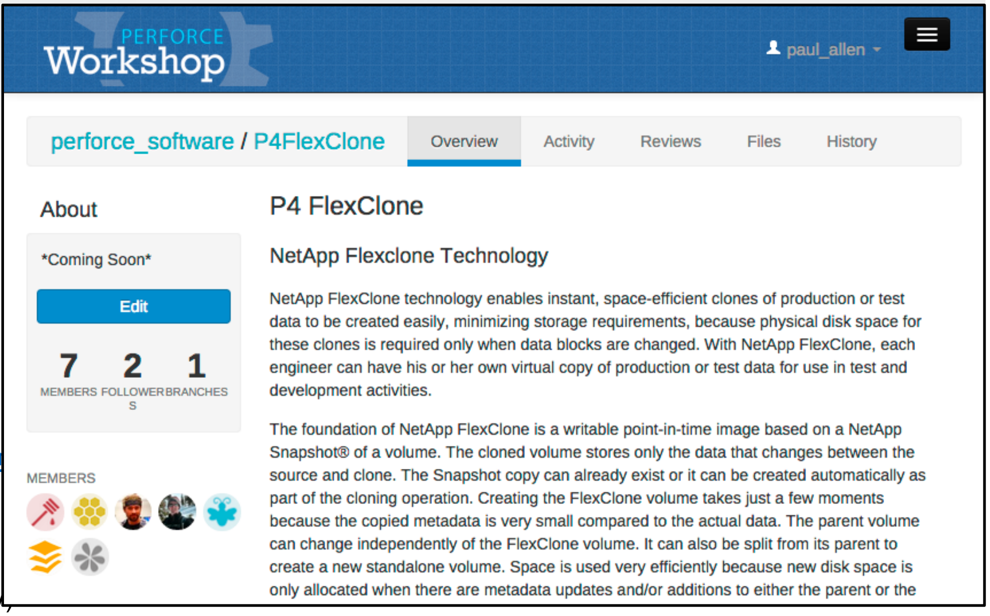
Perforce Flex Eval Kit Content

Flow requirements and downloads

Python Scripts | Getting Started Guide | Customization Guide | NetApp Manageability SDK

- cDOT 8.x
  - The evalkit was developed using cDOT8.3.x
  - **7-mode is not supported**
- Perforce 2007.2 or higher
  - P4Broker installed - http://www.perforce.com/perforce/doc.current/manuals/p4dist/chapter.broker.htm
  - Python 2.6 or later
- NetApp Manageability SDK 5.2.2 or later
  - Contains Python API's (as well as API's for C/C++, Java, MS Net, Perl and Ruby,
  - The examples in this eval kit use the Python API's
  - **This kit must be downloaded by the customer due to EULA requirements**
- Basic knowledge of Python coding



Coming Soon

P4 FlexClone

NetApp Flexclone Technology

NetApp FlexClone technology enables instant, space-efficient clones of production or test data to be created easily, minimizing storage requirements, because physical disk space for these clones is required only when data blocks are changed. With NetApp FlexClone, each engineer can have his or her own virtual copy of production or test data for use in test and development activities.

The foundation of NetApp FlexClone is a writable point-in-time image based on a NetApp Snapshot® of a volume. The cloned volume stores only the data that changes between the source and clone. The Snapshot copy can already exist or it can be created automatically as part of the cloning operation. Creating the FlexClone volume takes just a few moments because the copied metadata is very small compared to the actual data. The parent volume can change independently of the FlexClone volume. It can also be split from its parent to create a new standalone volume. Space is used very efficiently because new disk space is only allocated when there are metadata updates and/or additions to either the parent or the

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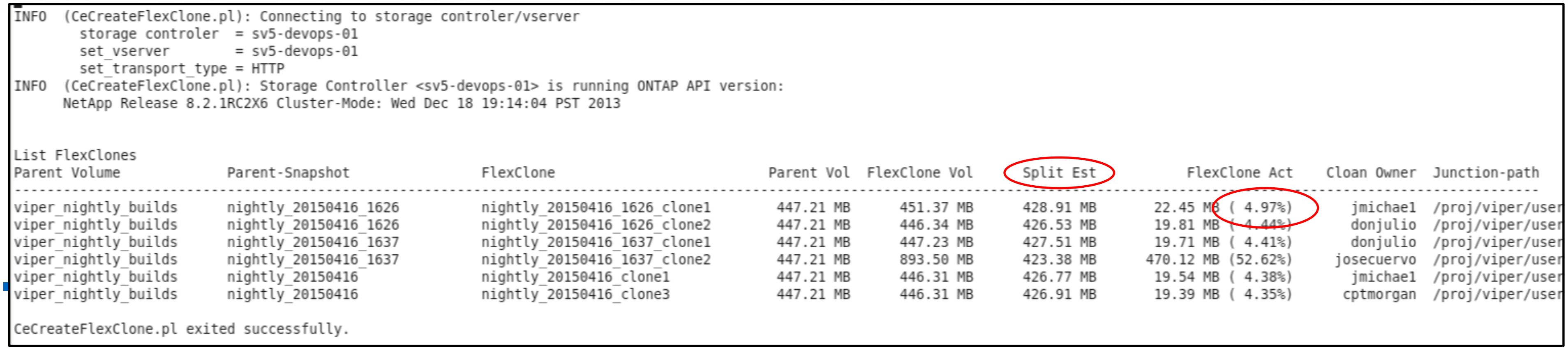
FlexClone Storage Management

- List the FlexClones
  - %> p4 flex clones



```
INFO  (CeCreateFlexClone.pl): Connecting to storage controler/vserver
        storage controler  = sv5-devops-01
        set_vserver        = sv5-devops-01
        set_transport_type = HTTP
INFO  (CeCreateFlexClone.pl): Storage Controller <sv5-devops-01> is running ONTAP API version:
      NetApp Release 8.2.1RC2X6 Cluster-Mode: Wed Dec 18 19:14:04 PST 2013


List FlexClones
Parent Volume             Parent-Snapshot                FlexClone                          Parent Vol  FlexClone Vol      Split Est           FlexClone Act    Cloan Owner  Junction-path
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
viper_nightly_builds      nightly_20150416_1626          nightly_20150416_1626_clone1        447.21 MB      451.37 MB      428.91 MB       22.45 MB ( 4.97%)       jmichael  /proj/viper/user
viper_nightly_builds      nightly_20150416_1626          nightly_20150416_1626_clone2        447.21 MB      446.34 MB      426.53 MB       19.81 MB ( 4.44%)       donjulio  /proj/viper/user
viper_nightly_builds      nightly_20150416_1637          nightly_20150416_1637_clone1        447.21 MB      447.23 MB      427.51 MB       19.71 MB ( 4.41%)       donjulio  /proj/viper/user
viper_nightly_builds      nightly_20150416_1637          nightly_20150416_1637_clone2        447.21 MB      893.50 MB      423.38 MB      470.12 MB (52.62%)     josecuervo  /proj/viper/user
viper_nightly_builds      nightly_20150416               nightly_20150416_clone1             447.21 MB      446.31 MB      426.77 MB       19.54 MB ( 4.38%)       jmichael  /proj/viper/user
viper_nightly_builds      nightly_20150416               nightly_20150416_clone3             447.21 MB      446.31 MB      426.91 MB       19.39 MB ( 4.35%)      cptmorgan  /proj/viper/user

CeCreateFlexClone.pl exited successfully.
```

- FlexClone Actual Size = FlexClone Vol Size – Split Est Size
  - Where the “Split Estimate” is the amount of shared storage between the clone and its parent volume.
- FlexClones consume <5% of the full volume

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Networking - Android Development

Preliminary Time and Storage Stats

- Early CodeEasy Testing

		Time (minutes)					
Company	Project	Full Code Checkout	Workspace Initialization	Build	Unit Test & Modularity ratchets	Total Co/Build/Test	FlexClone Creation
NetApp	Development release	20	0	30	10	60	2
Networking	Android Developer Builds	25		30		55	7

- Time Savings: 55 minutes -> 7 minutes

	Storage Usage					
Company	Volume Size	Typical Clone Size	Worst Case Clone Size	# of Clones/User	Number of Users (Distrubuted across 4 sites)	Total Clones
NetApp	120 GB	60 GB	10 GB	13	2000	26000
Networking	300 GB	50 GB	25 GB	4	500	2000

- Avg. Storage saving will be more like = 12GB * 1000 = ~12TB

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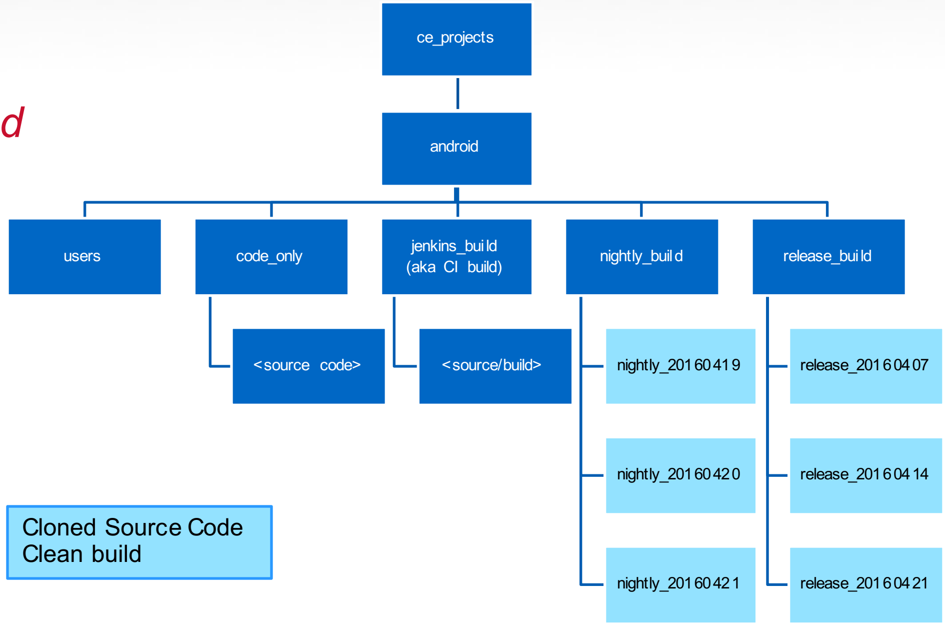
Accelerating Nightly and Release Builds

FlexClones can eliminate the need to every checkout code

- *Many build teams say they always build nightly and release builds from clean.* *Even when CI builds are incremental*
- *"We don't trust our build process or Makefiles"; So we build from clean new workspaces.*

- FlexClones can speed up code Checkout
  - Jenkins process to keep code_only directory in sync with latest good CI build change #.
  - Clone code_only snapshot to nightly_build, then start build
  - No p4 sync required – FAST!



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Traditional Bisect Flow

Code Checkout, Build, Test…Try again until found!

CI Builds

Change 39 <Head>

Change 38 (Bug)

Change 37 (Bug)

Change 36 (Bug)

Change 35

Change 34

Change 33

Change 31

Change 30

Change 29

Change 28

Change 27

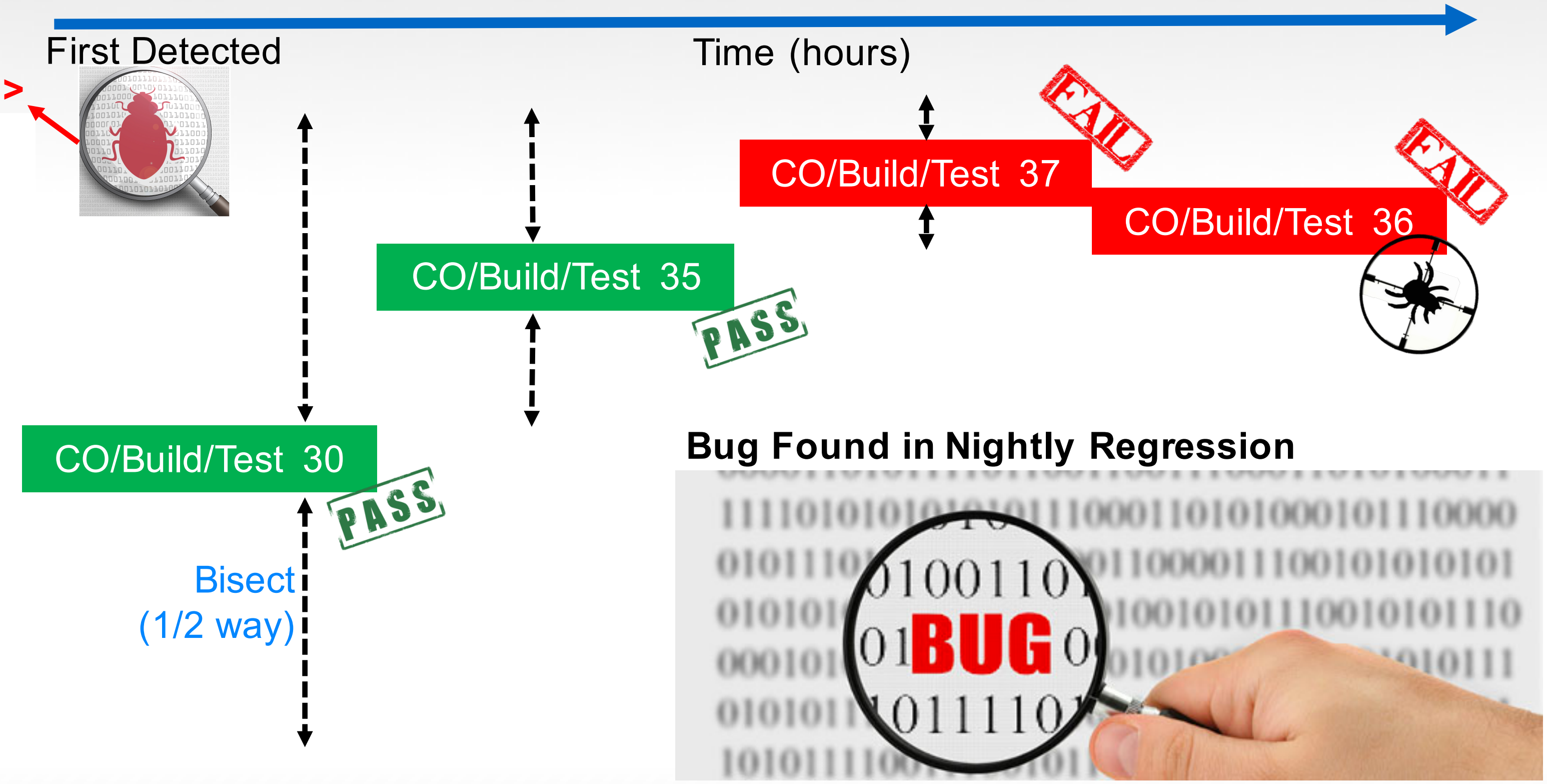
Change 26

Change 25

Change 24

Change 23

Change 22 (No Bug in Nightly Regression)



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Bisect Flow using FlexClones

FlexClone and Test…Try again until found!

CI Builds

Change 39 <Head> Bug Detected

Change 38 (Bug)

Change 37 (Bug)

Change 36 (Bug)

Change 35

Change 34

Change 33

Change 31

Change 30

Change 29

Change 28

Change 27

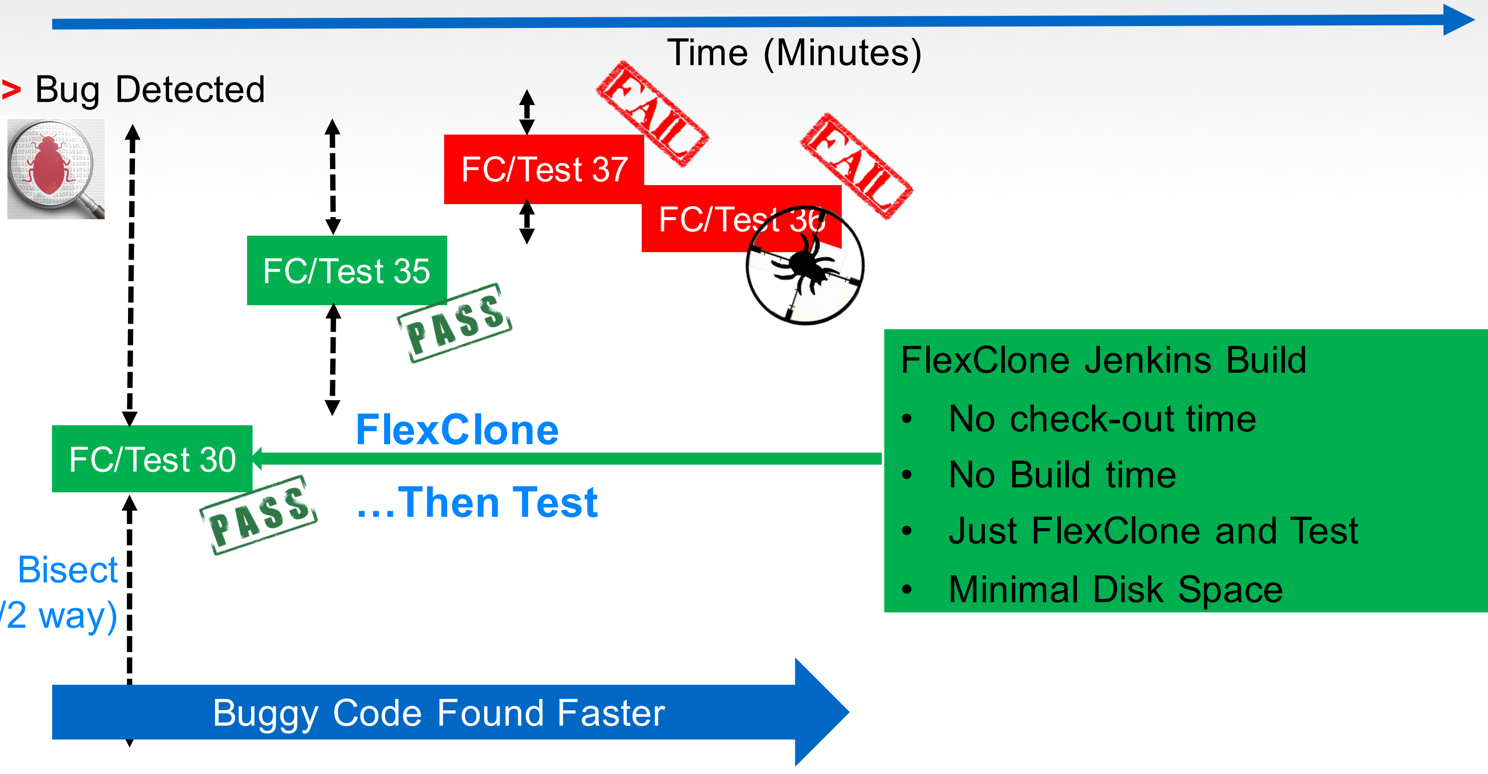
Change 26

Change 25

Change 24

Change 23

Change 22 (No Bug in Nightly Regression)



FlexClone Jenkins Build

- No check-out time
- No Build time
- Just FlexClone and Test
- Minimal Disk Space

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Bisect Flow using FlexClones (Parallel)

FlexClone and Test in Parallel

CI Builds

Change 39 <Head> Bug Detected

Change 38 (Bug)

Change 37 (Bug)

Change 36 (Bug)

Change 35

Change 34

Change 33

Change 31

Change 30

Change 29

Change 28

Change 27

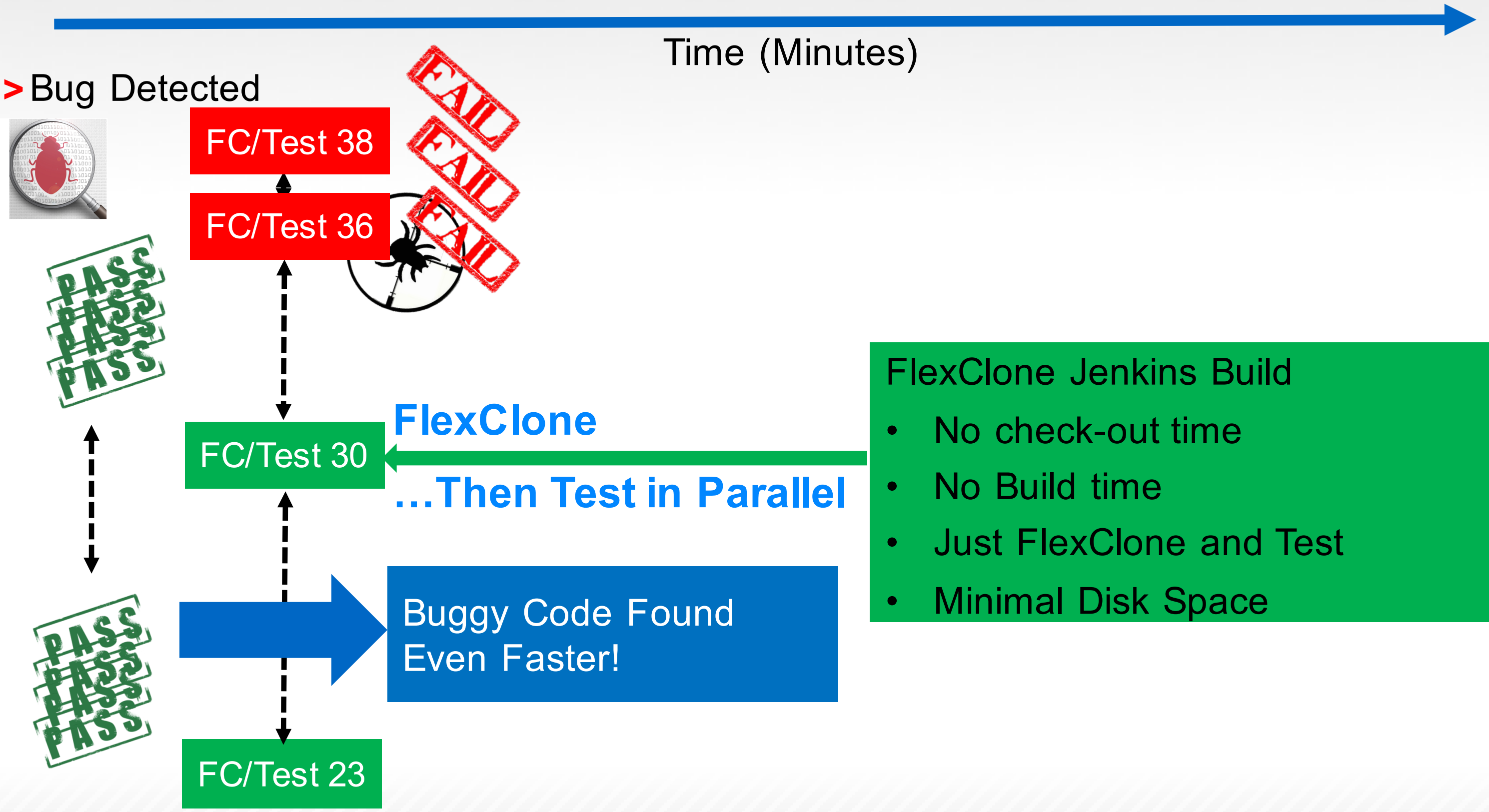
Change 26

Change 25

Change 24

Change 23

Change 22 (No Bug in Nightly Regression)



FlexClone

…Then Test in Parallel

Buggy Code Found Even Faster!

FlexClone Jenkins Build

- No check-out time
- No Build time
- Just FlexClone and Test
- Minimal Disk Space

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Additional Resources

- Download P4 Flex from Perforce Swarm Workshop Today
  https://swarm.workshop.perforce.com/projects/netapp-p4flex/
- Download CodeEasy/FlexClones for DevOps
  https://github.com/NetApp/CodeEasy/
- DevOps at NetApp: “CodeEasy” is the Name of the Game
  http://community.netapp.com/t5/Tech-OnTap-Articles/DevOps-at-NetApp-CodeEasy-is-the-Name-of-the-Game/ta-p/115673
- Git Tools - Debugging with Git
  https://git-scm.com/book/en/v2/Git-Tools-Debugging-with-Git
- Git Bisect in Action: Video
  https://www.youtube.com/watch?v=Qb6Wsb_qk14

Thank You

Additional Slides Content Below

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