Gerrit Performance Tuning

How to Properly Tune and Size your Gerrit Backend

Git Sizing / Performance Tuning - FAQ

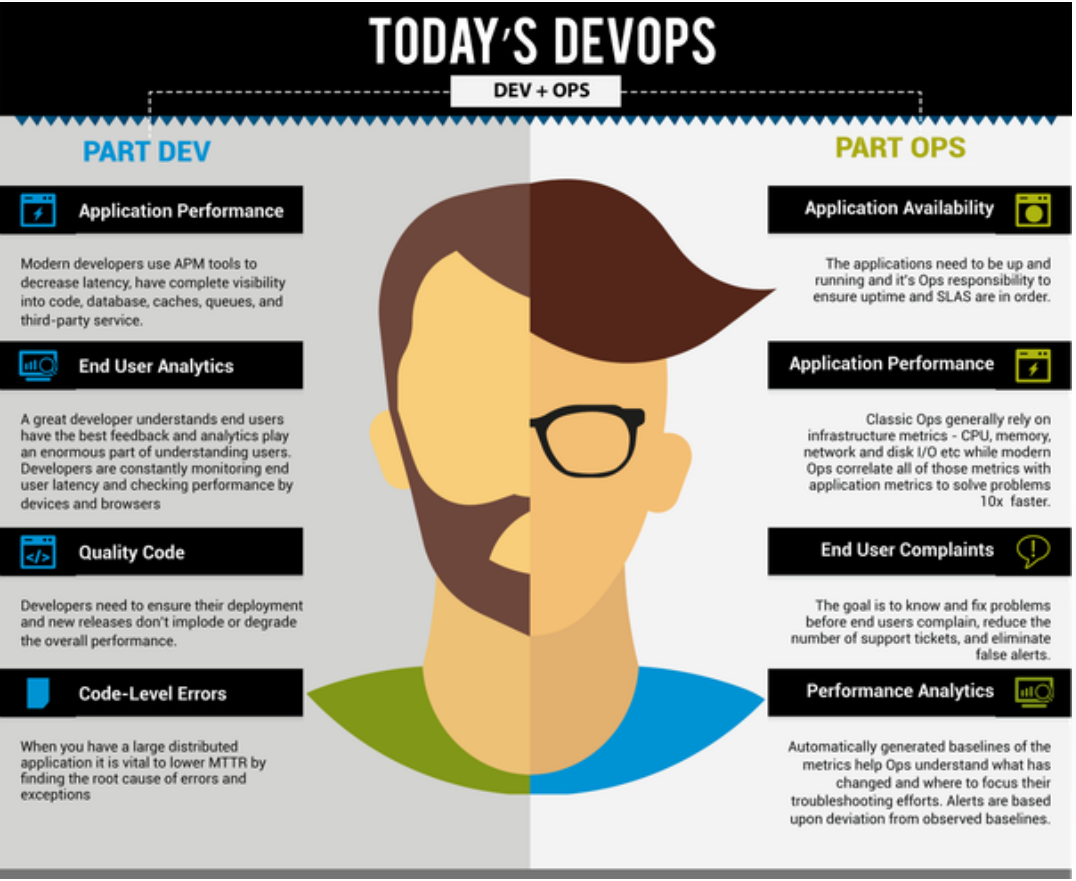
- How many servers will I need?
- Which cloning protocols to offer?
- How to set those gazillion gerrit.config options?
- How many CPUs and how much RAM will I need?
- What the heck is pack size?
- How often should you run garbage collection?
- Does it make any difference whether I go with a native Git or JGit based backend?
- How do you handle hundreds of polling CI users without compromising performance for your human end users?
- What about clustering and replication?

One Size Fits All?

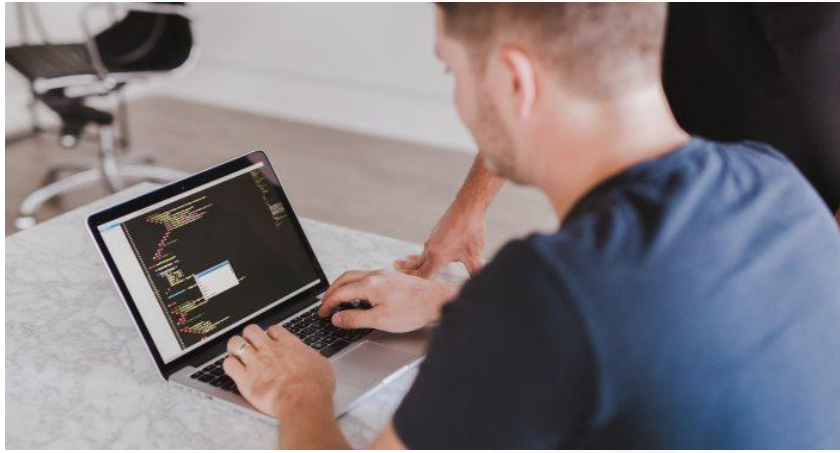
“It Depends …”

One Size does not fit all.

Responsibility of Gerrit Ops Engineer



Typical Ops Engineer in Today's world



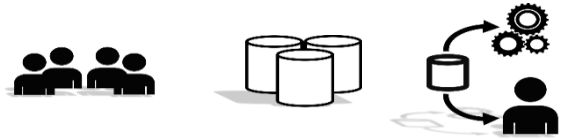
- Jack of all trades
- Responsible for dozens of applications
- No Gerrit expert knowledge
- No Java expert knowledge
- Basic Git knowledge
- No access to special HW
- Limited test bed (not same load pattern as on production)
- No access to Gerrit multi master / GFS technology
- No overview about all their user base (tens of thousands of developers in different geographies)

Challenge

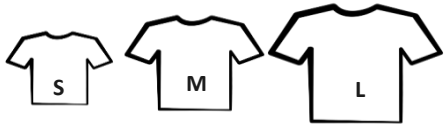
- Tuning advice that is
  - actionable
  - not “one size fits all”
  - targeted at ops people with no expert Gerrit / JVM knowledge
  - only uses easy to measure factors for its recommendations
  - does not require special HW or test beds
  - not depending on proprietary Gerrit extensions/technology
- Keep Motivation up to go through all of this

Gerrit Performance Tuning in 5 Steps

1. Get your numbers



2. Size your hardware

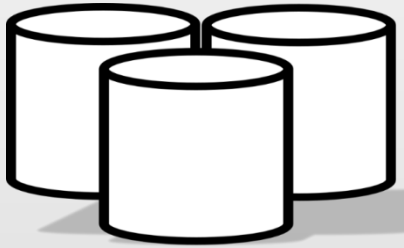


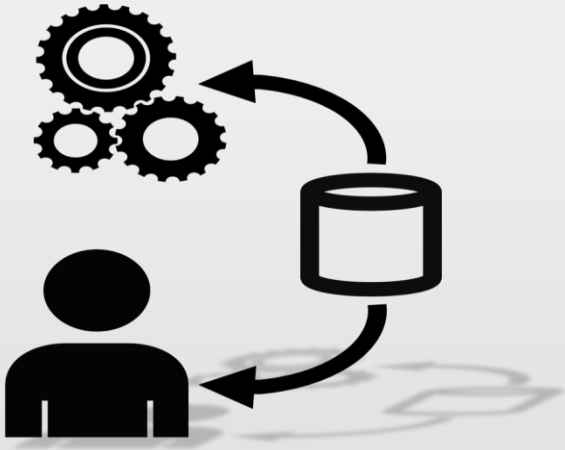
3. Tune your gerrit.config

4. Configure Garbage collection

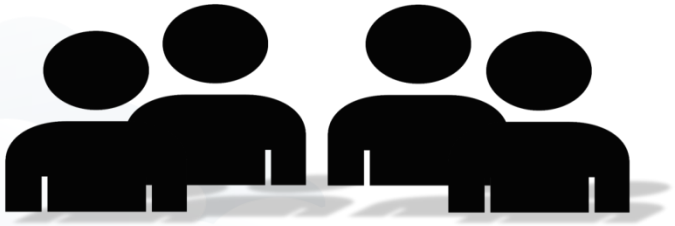
5. Deal with heavy CI load

1. Get Your Numbers





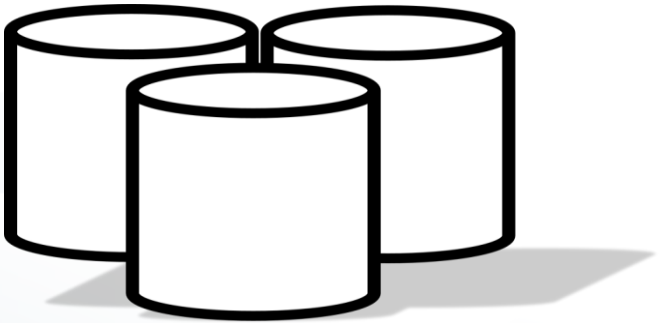
Step 1: Get your numbers



Number Of Users

- The number of users is only an indirect factor for Gerrit tuning as most Git operations are done completely offline.
- The more users you have, the more repositories and push/fetch requests you will probably encounter.
- The majority of load is typically caused by build systems (CI). The biggest enterprise instance we have seen has 15k active users.

Step 1: Get your numbers



Number Of Repositories

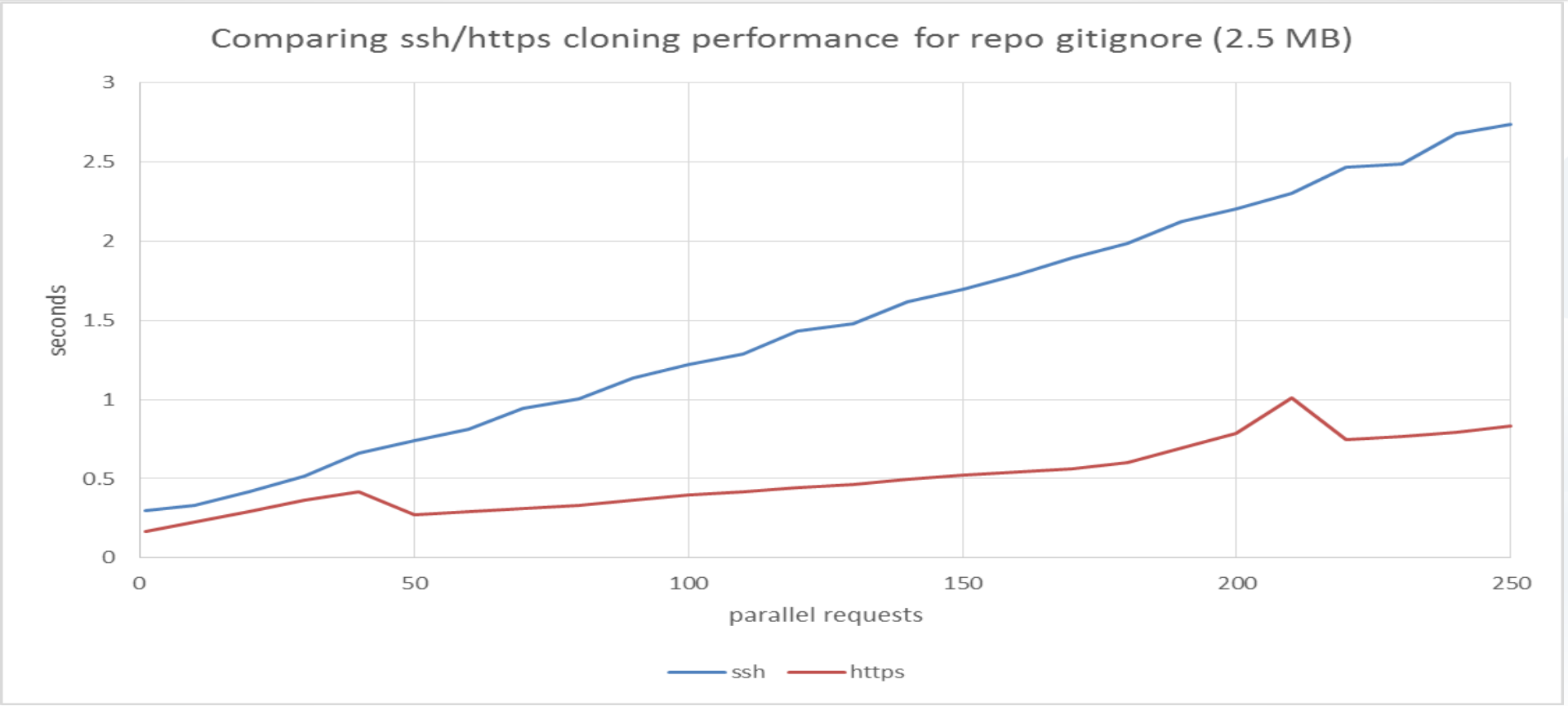
- The number of repositories (Gerrit projects) determines how much disk space you need.
- We have seen instances with more than 10k repositories but would not recommend more than 2500 per server.

Step 1: Get your numbers

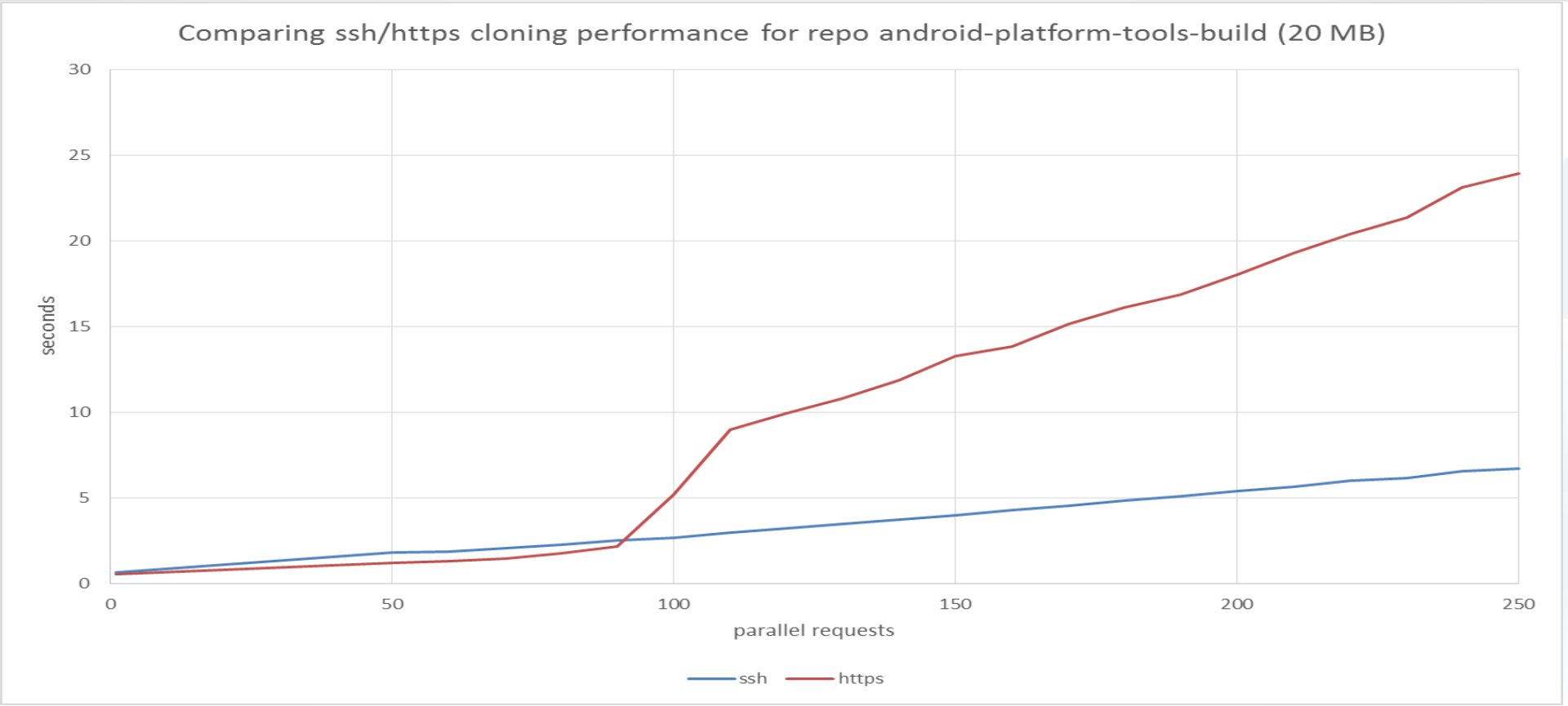
Protocol

- ssh allows you to use public key cryptography which is stronger than passwords
- ssh is recommended for CI users as this allows push based notifications (see step 5).
- http(s) seems to perform better if the majority of the operation time is the connection request itself (not much data transferred, no heavy IO)
- Hybrid approaches are possible

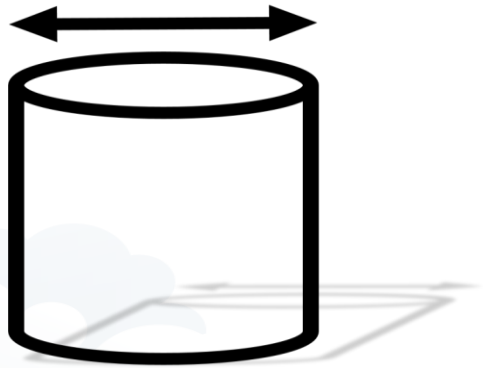
ssh vs https


Comparing ssh/https cloning performance for repo gitignore (2.5 MB)
seconds
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
parallel requests
ssh
https

ssh vs https


Comparing ssh/https cloning performance for repo android-platform-tools-build (20 MB)
seconds
30
25
20
15
10
5
0
0
50
100
150
200
250
parallel requests
ssh
https

Step 1: Get your numbers

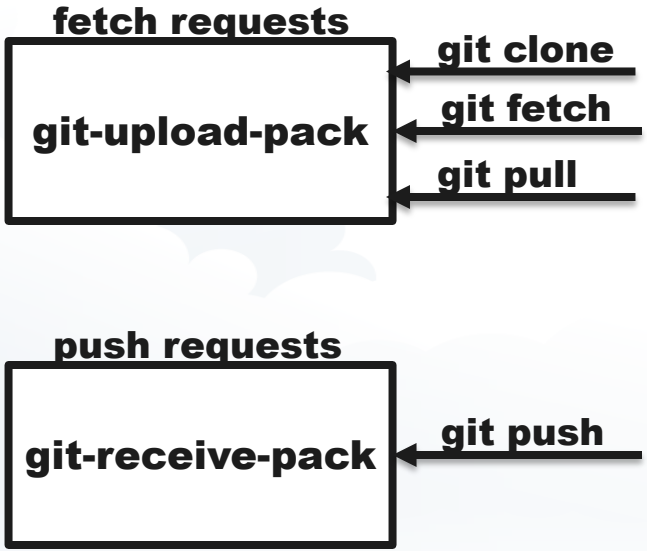


Repository Size

- Repository size determines the amount of storage you need on disk. In addition, it influences the needed memory during a clone request as pack files have to be loaded and streamed.
- The largest repository on disk should still fit in 1/4 of your heap.
- Garbage collection across all projects will take longer, the more repository data has to be processed.
- Gerrit can handle at least 1TB of total repository data easily.

Step 1: Get your numbers

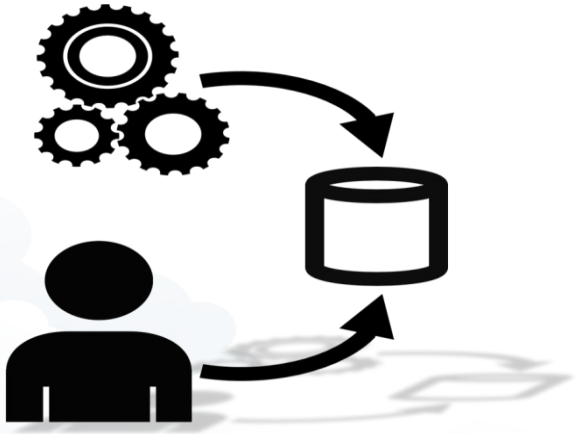
What are the fetch/pull requests and how many will I have per day?



How to count #fetch requests per day:

```
fgrep "git-upload-pack" sshd_log  | wc -l
+
fgrep "git-upload-pack" httpd_log | wc -l
```

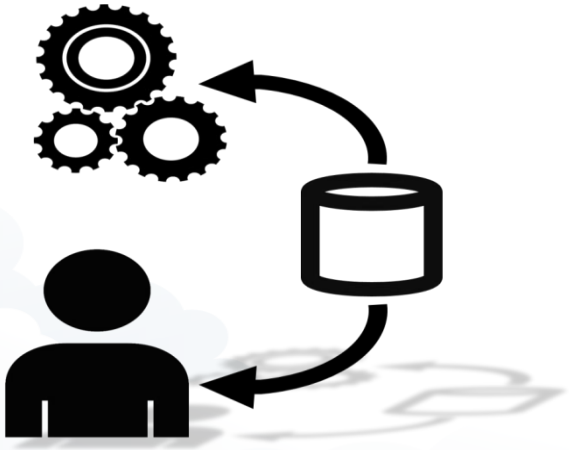
Step 1: Get your numbers



Number Of Push Requests

- In most enterprise settings, push requests contribute less than one percent to the number of total operations. Because of this, their number can be typically neglected.

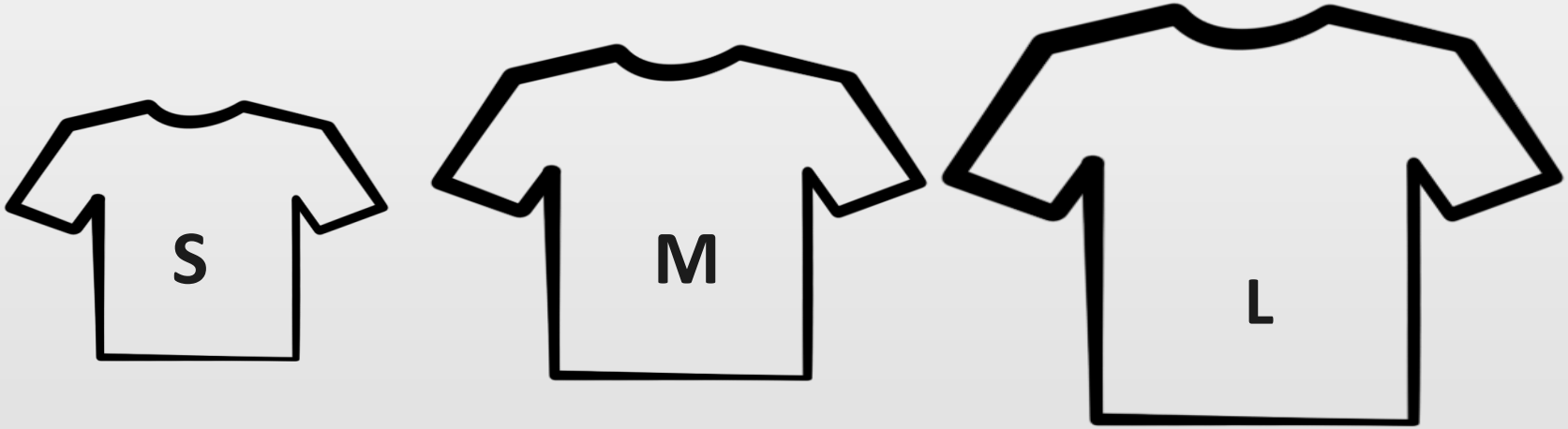
Step 1: Get your numbers



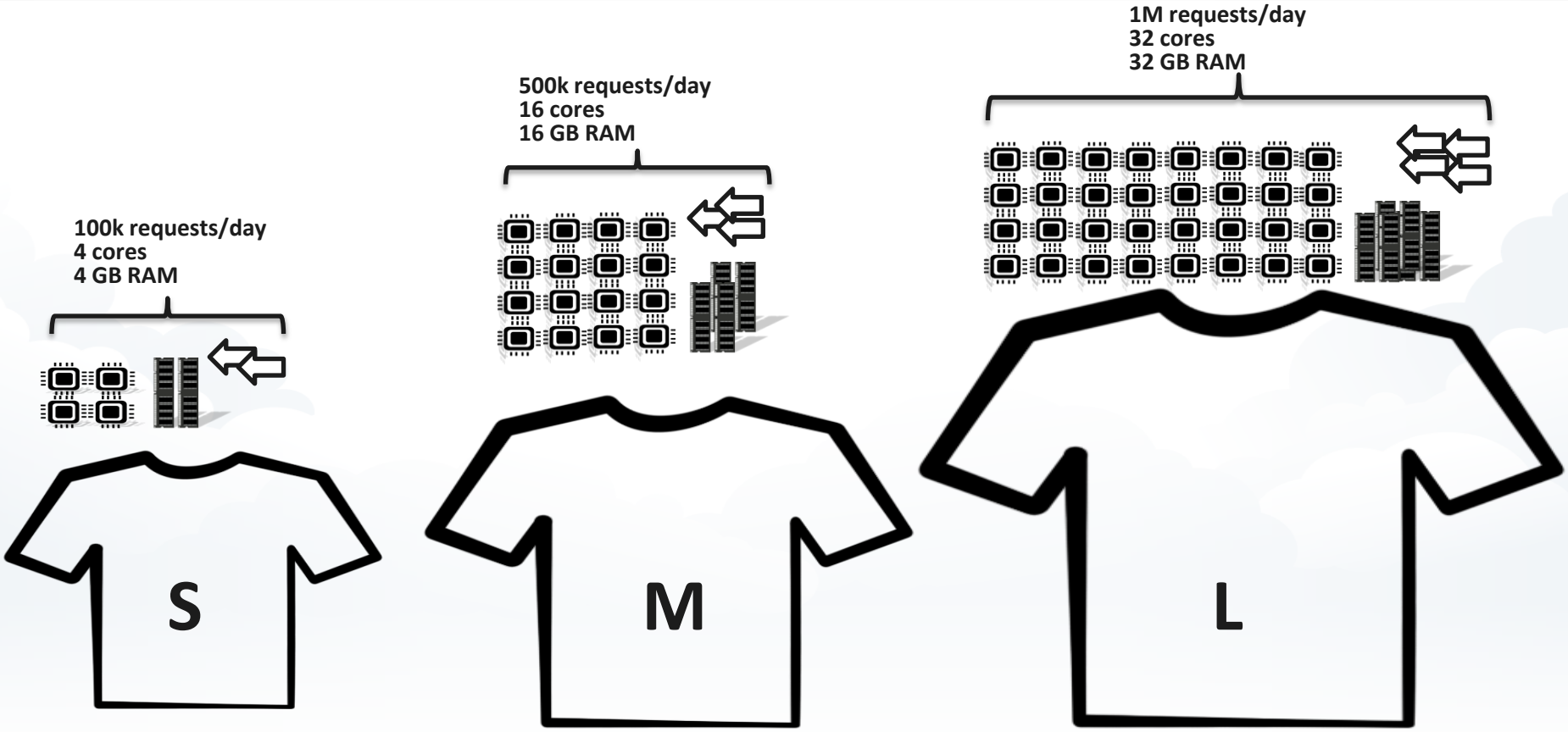
Number Of Fetch Requests

- This is probably the most important tuning factor. To improve throughput, fetch requests should be handled in parallel, but parallel cloning needs CPUs as well as memory.
- A Gerrit server optimized for heavy load (32 cores, 32 GB RAM) can handle about 1M fetch requests per day, processing up to 50 in parallel.

2. Size Your Hardware



Step 2: Size your hardware



Step 2: Size your hardware

Number of Servers

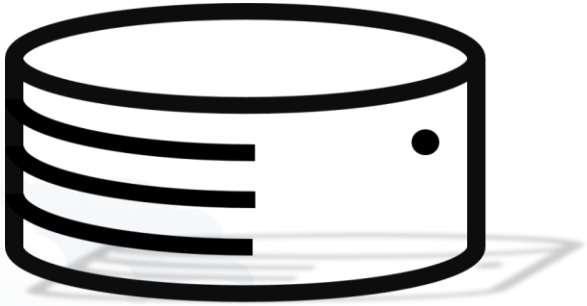
- Whenever horizontal scaling is not cost efficient any more (> size L), we recommend setting up another server.
- If the number of repositories exceeds 2500, a new server should be used as well or reviews will get painfully slow.
- Use Gerrit's replication feature to synch repository content and permissions to servers in different geographies if network is the limiting factor.

Step 2: Size your hardware

Network

- The higher the network bandwidth, the shorter it will take to fetch and push repositories. Depending on the average Git repository size and number of parallel requests, network connectivity ~~can~~ will become the primary bottleneck.
- Most enterprises have Gigabit connections.

Step 2: Size your hardware



Disk Storage

- Storage needs are determined by the Git repository sizes.
- Fast storage (SSDs) really pay off as git fetch, push and gc are all IO heavy.

3. Tune Your gerrit.config

- File etc/gerrit.config
  - Section accounts
  - Section addreviewer
  - Section auth
  - Section cache
  - Section change
  - Section changeMerge
  - Section commentlink
  - Section contactstore
  - Section container
  - Section core
  - Section database
  - Section download
  - Section gc
  - Section gerrit
  - Section gitweb
  - Section groups
  - Section hooks
  - Section http
  - Section httpd
  - Section index
  - Section ldap
  - Section mimetype
  - Section pack
  - Section plugins
  - Section receive
  - Section repository
  - Section rules
  - Section execution
  - Section sendemail
  - Section site
  - Section ssh-alias
  - Section sshd
  - Section suggest
  - Section theme
  - Section trackingid
  - Section transfer
  - Section upload
  - Section user

Step 3: Tune your gerrit.config

`receive.timeout`

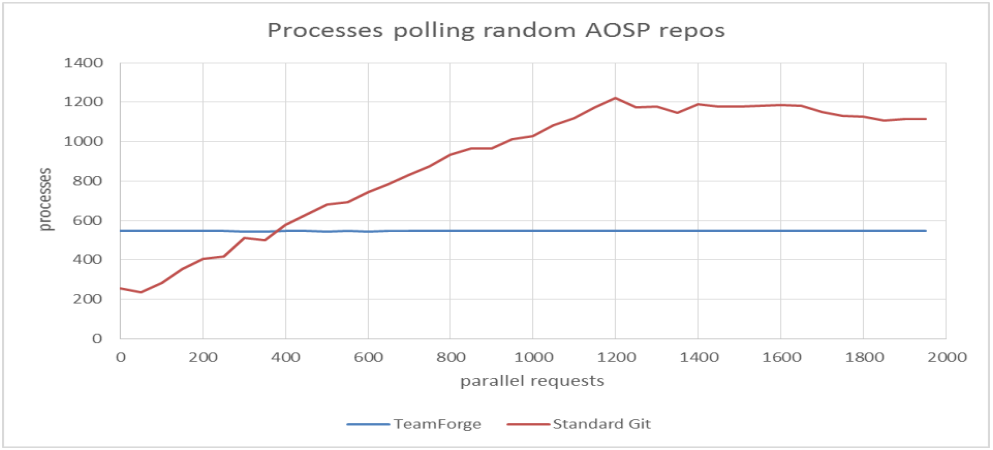
4 min

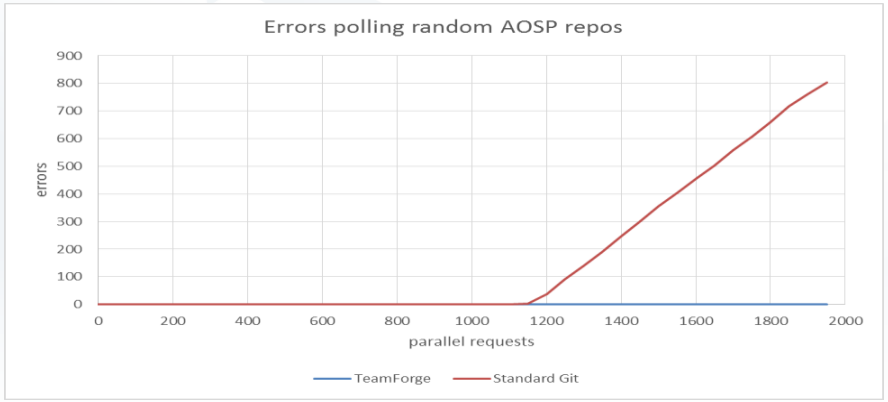
4 min

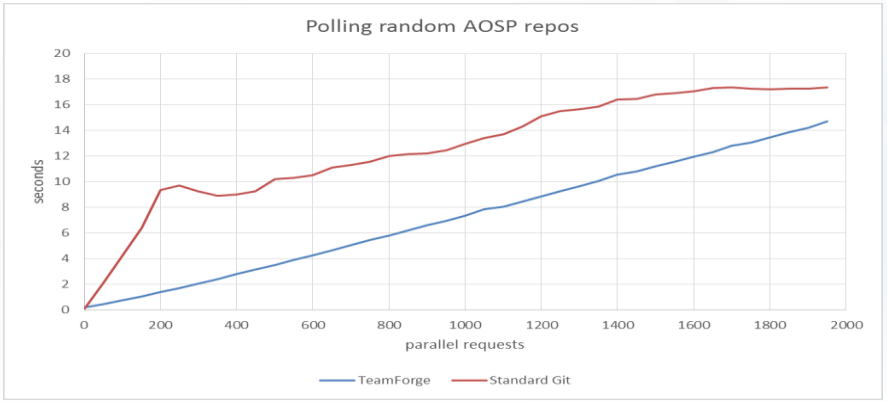
4 min

- ***Timeout to process incoming changes and update refs and Gerrit changes***
- Default 2min

Why ssh thread pooling is a good thing







Step 3: Tune your gerrit.config

`sshd.threads`

8

32

64

- ***Threads to process ssh requests, limiting the number of possible parallel clones/pushes***
- sshd.batchThreads will be deducted from this number
- Defaults to 1.5 * <#Cores>
- Recommend

$$\lim_{x \to \pi/4} [\sec(x)/\sin(x)] * \langle \#Cores \rangle$$

$$= 2 * \langle \#Cores \rangle$$

Step 3: Tune your gerrit.config

`httpd.maxThreads`

25

50

100

- ***Threads to process http clone/push requests and review related activities***
- Default is 25

Step 3: Tune your gerrit.config

`database.poolLimit`

50

150

250

- ***DB connections for Gerrit***
- As a fetch/push request or a review action can consume multiple connections
- Recommend to set at least to `sshd.threads` + `httpd.maxThreads`
- Default is 8

Step 3: Tune your gerrit.config

`database.poolMaxIdle`

16

16

16

- ***Maximum time before a DB connections gets released***
- As DB pool size is typically increased from its default value, this parameter should be too
- Default is 4

Step 3: Tune your gerrit.config

container.heapLimit

4g

16g

32g

- ***Java heap used for Gerrit. The more repository data Gerrit can cache in memory, the better***
- Recommend to set at least to <Cores> GB size heap size allocated for Gerrit
- The largest repository on disk should still fit in ¼ of your heap. Our experience tells 32 GB per 1M daily requests is pretty common

Step 3: Tune your gerrit.config

`core.packedGitLimit`

1g

4g

8g

- ***Maximum cache size to store Git pack files in memory***
- Default 10 MB is way too small if you frequently clone large repositories and like to cache their data
- Recommend ¼ of your heap size

Step 3: Tune your gerrit.config

`core.packedGitWindowSize`

8k

16k

16k

- ***Number of bytes of a pack file to load into memory in a single read operation***
- 16k is a common choice
- Default is 8k

Step 3: Tune your gerrit.config

`core.packedGitOpenFiles`

1024

2048

4096

- ***Maximum number of pack files to have open at once***
- Too small number can cause repository corruption during gc
- If you increase this to a larger setting you may need to also adjust the ***ulimit*** on file descriptors for the host JVM, as Gerrit needs additional file descriptors available for network sockets and other repository data manipulation

4. Configure Garbage Collection

Step 4: Configure garbage collection (~gerrit/.gitconfig)

`gc.interval`

1week

3 days

1 day

- ***Determines how often Gerrit garbage collection (JGit gc) is run across all repositories***
- Running JGit gc frequently is crucial for good fetch/push performance as well as a smooth source code browsing experience
- JGit gc is more efficient than command line git garbage collection and causes less problems with Gerrit running in parallel
- Parameters to control JGit gc's resource consumption are in `~gerrit/.gitconfig` Don't forget to

Step 4: Configure garbage collection (~gerrit/.gitconfig)

`pack.threads`

1

4

8

- ***Threads used for Gerrit (JGit) garbage collection***
- ¼ <#Cores> is a common choice

Step 4: Configure garbage collection (~gerrit/.gitconfig)

`pack.windowMemory`

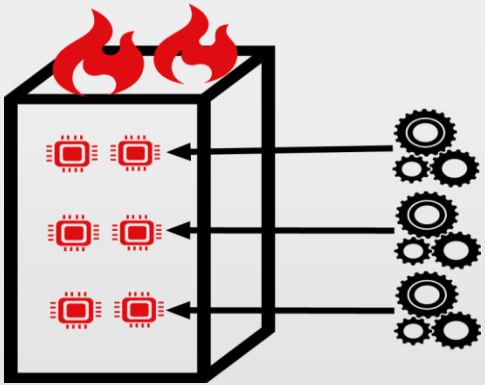
1g

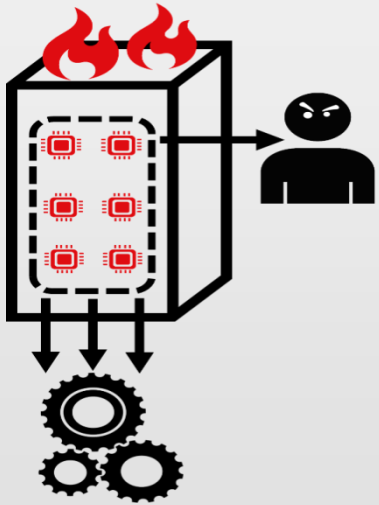
4g

8g

- **Use this setting to control how much memory (Java heap) is used for Gerrit garbage collection (JGit gc)**
- ¼ of the configured Java heap is a common choice

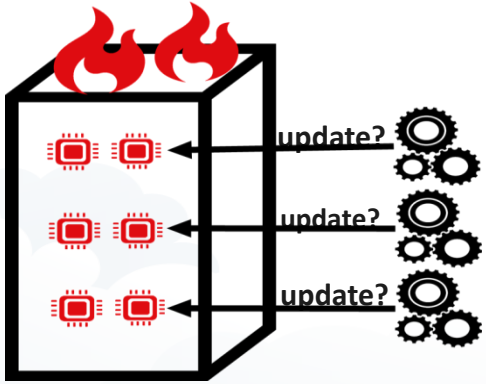
5. Deal With Heavy CI load



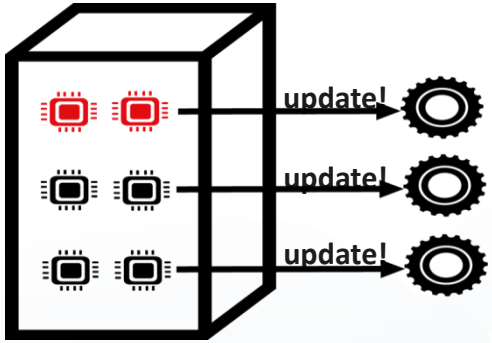


Step 5: Deal with heavy CI load: Push vs Poll

Notify your CI push based (stream-events) instead of polling

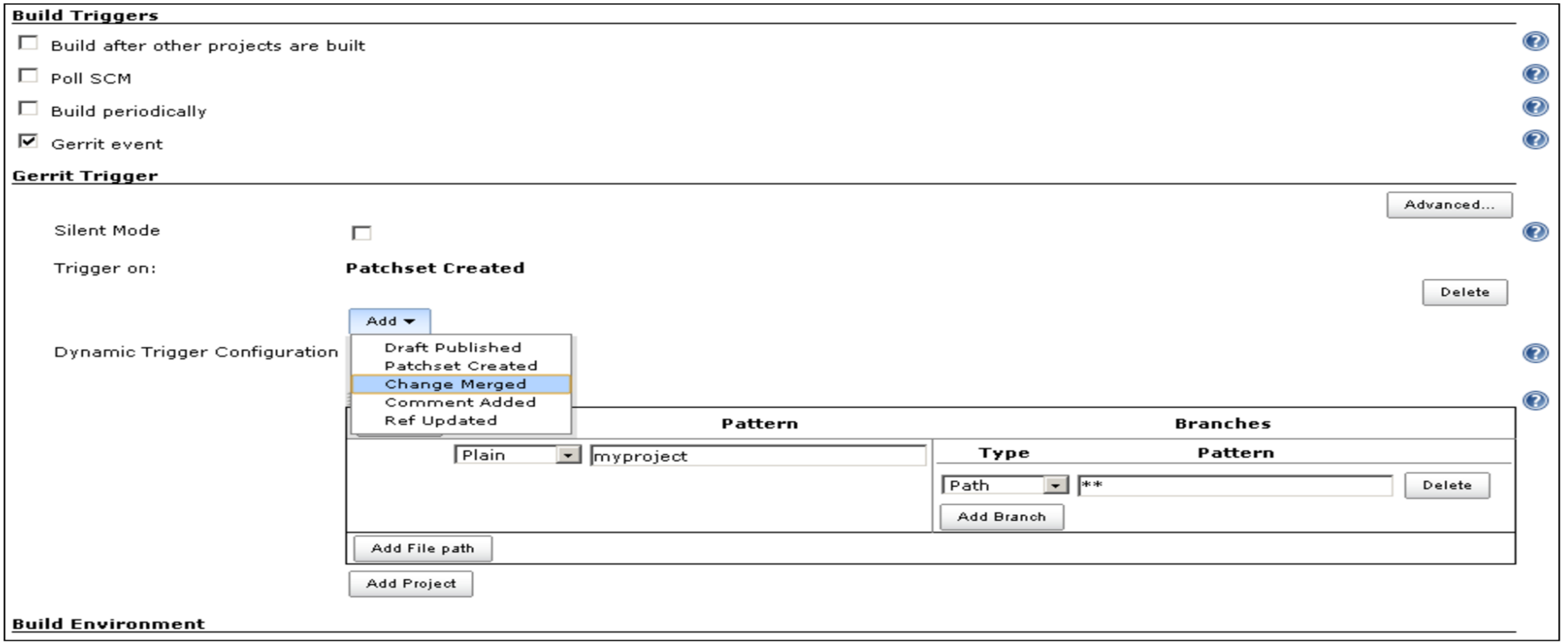


Frequent polling

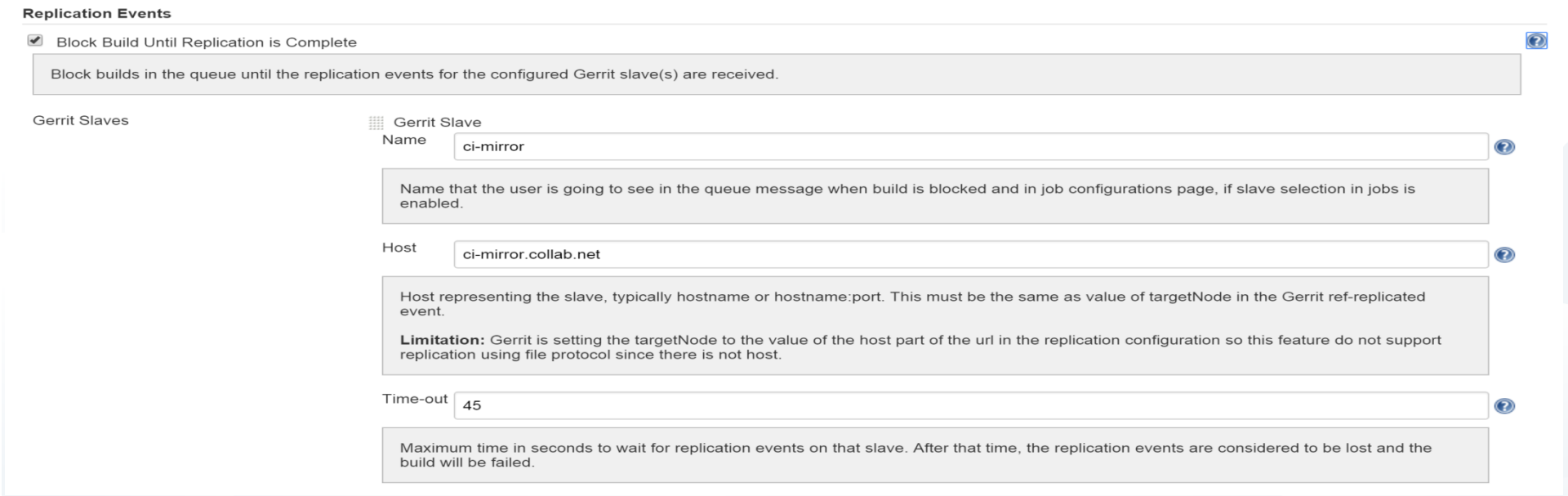


Push based notification

Use Jenkins Gerrit Trigger Plugin

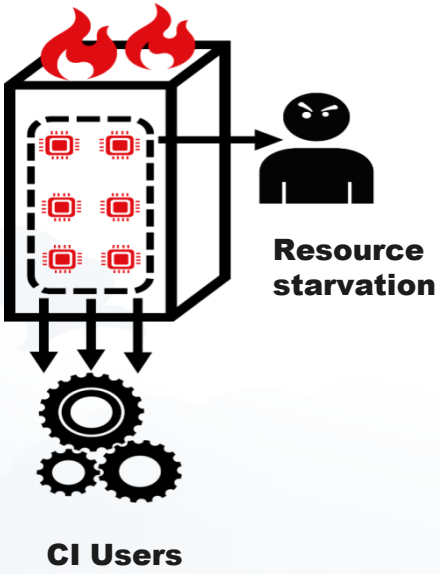


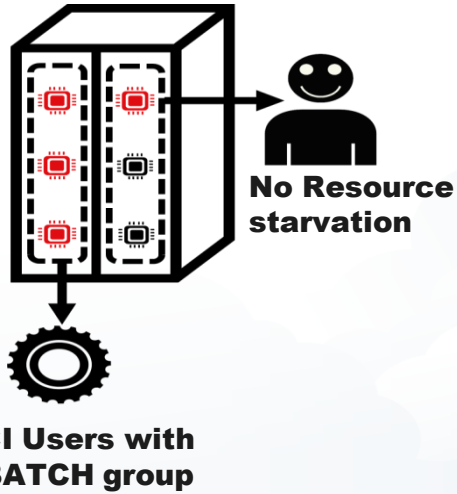
Use Jenkins Gerrit Trigger Plugin: Replication Config



Step 5: Deal with heavy CI load: Segregation

Mark CI users as BATCH users and have a separate thread pool





Step 5: Deal with heavy CI load

`sshd.batchThreads`

2

4

8

- ***Threads reserved to users in a Gerrit group with the BATCH capability***
- This allows to separate CI users causing heavy load from human users in different thread pools
- **Recommend to set**
  Interactive users to have
  `<sshd.threads> - <sshd.batchThreads>`
- This can improve clone/push performance for human users

Step 5: Deal with heavy CI load

`sshd.commandStartThreads`

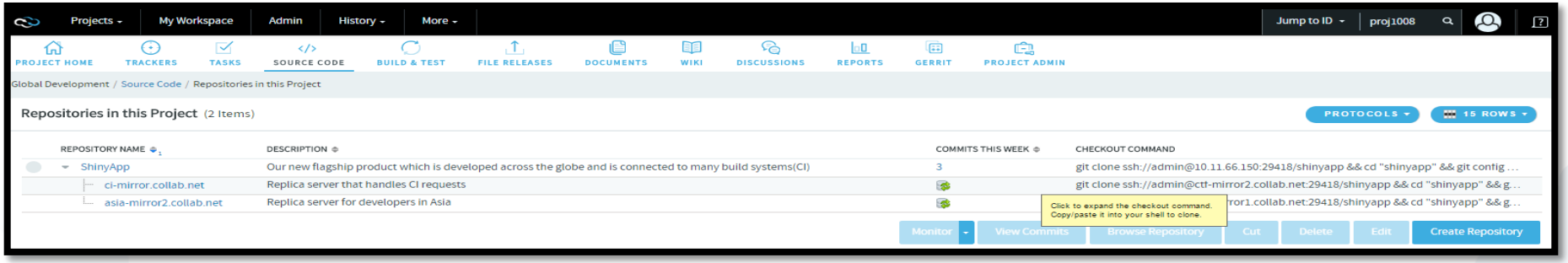
2

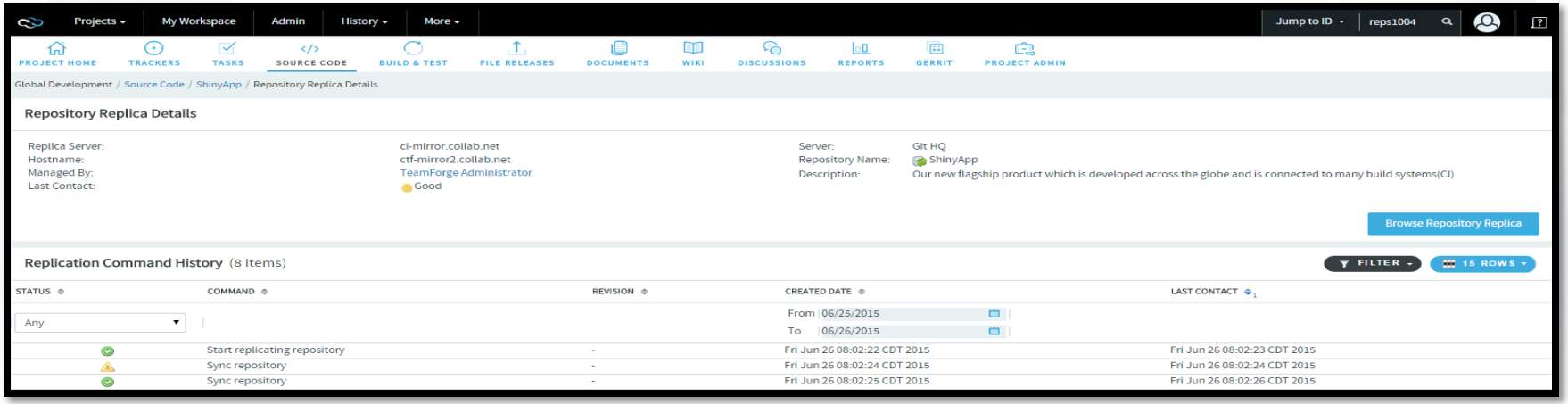
3

5

- ***Threads used to process incoming ssh connection requests***
- Setting should only be adjusted if you have CI system that create a burst of connection requests in parallel. Especially in AOSP build environments, increasing this value helped reducing the average wait queue size
- Default is 2

Step 5: Deal with heavy CI load: Replication





Step 5: Deal with Heavy CI load (replication.config)

`remote.NAME.timeout`

30

45

60

- ***Seconds to wait for network read or write to complete before giving up.***
- Especially in WAN environments, don't let this clog your replication queue
- Default was 0 (unlimited)

Step 5: Deal with Heavy CI load (replication.config)

`remote.NAME.threads`

2

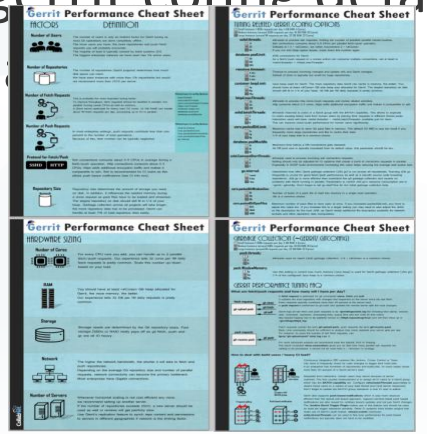
4

8

- ***Number of worker threads to dedicate to pushing to the repositories described by this remote.***
- The more threads, the lower the chance get clogged by one problematic repository
- Default is 1

Follow Up Actions

- If you like our Cheat Sheet, share it: http://bit.ly/1kmpO7V
- Come up with an official “Gerrit T-Shirt Sizing” Approach
- Provide sample configurations for different T-Shirt sizes
- Adjust gerrit.config default optio for small lo



Summing up gerrit.config options

		Gerrit Defaults			
sshd	threads	**1.5*<core>**	**8**	**32**	**64**
	batchThreads	0	2	4	8
	commandstartThreads	2	2	3	5
httpd	maxThreads	25	25	50	100
database	poolLimit	8	50	150	250
	poolMaxIdle	4	16	16	16
core	packedGitLimit	10m	1g	4g	8g
	packedGitWindowSize	8k	8k	16k	16k
	packedGitOpenFiles	128	1024	2048	4096
container	heapLimit	-	4g	16g	32g
receive	timeOut	2min	4min	4min	4min

Questions?