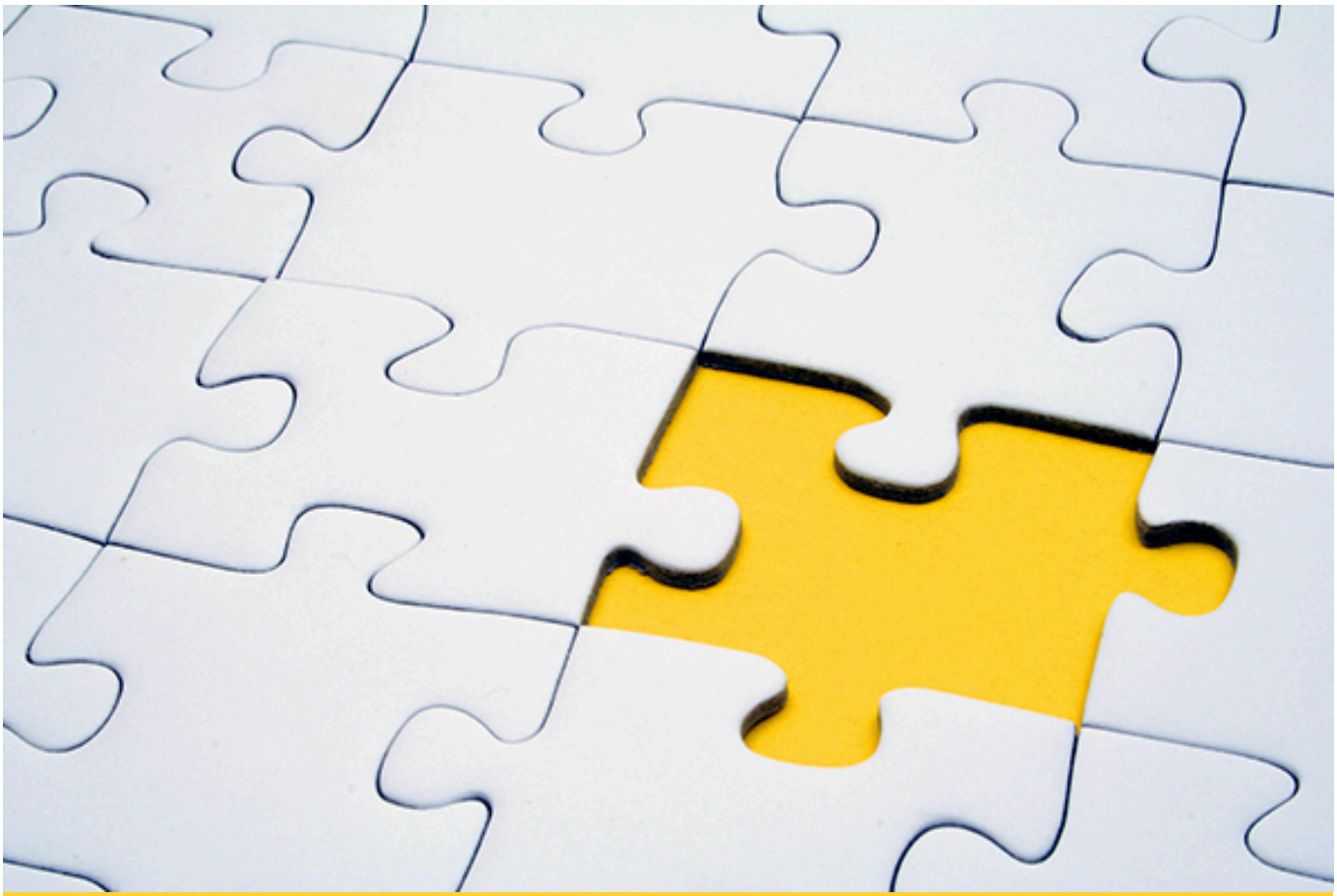

The beanstalk protocol

Illustrated description

by Keith Rarick, edited for print format by Petri Savolainen

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Preface

Beanstalk is a simple, fast work queue. Its interface is generic, but was originally designed for reducing the latency of page views in high-volume web applications by running time-consuming tasks asynchronously.

Philotic, Inc. developed beanstalk to improve the response time for the Causes on Facebook application (with over 9.5 million users). Beanstalk decreased the average response time for the most common pages to a tiny fraction of the original, significantly improving the user experience.

Many thanks to memcached for providing inspiration for simple protocol design and for the structure of the documentation. Not to mention a fantastic piece of software!

- Keith Rarick -

Protocol overview

The beanstalk protocol runs over TCP using ASCII encoding. Clients connect, send commands and data, wait for responses, and close the connection. For each connection, the server processes commands serially in the order in which they were received and sends responses in the same order. All integers in the protocol are formatted in decimal and (unless otherwise indicated) nonnegative.

Names, in this protocol, are ASCII strings. They may contain letters (A-Z and a-z), numerals (0-9), hyphen (”-"), plus ("+"), slash ("/"), semicolon (”;"), dot ("."), dollar-sign ("$"), underscore ("_"), and parentheses ("(" and ”)"), but they may not begin with a hyphen. They are terminated by white space (either a space char or end of line). Each name must be at least one character long.

> The protocol contains two kinds of data: text lines and unstructured chunks of data. Text lines **terminated by \r\n** are used for client commands and server responses. Chunks are used to transfer job bodies and stats information. Each job body is an opaque sequence of bytes. The server never inspects or modifies a job body and always sends it back in its original form. It is up to the clients to agree on a meaningful interpretation of job bodies.

The client may issue the "quit" command, or simply close the TCP connection when it no longer has use for the server. However, beanstalkd performs very well with a large number of open connections, so it is usually better for the client to keep its connection open and reuse it as much as possible. This also avoids the overhead of establishing new TCP connections.

General error responses

If a client violates the protocol, such as by sending a request that is not well-formed, or a command that does not exist, or if the server has an error, the server will reply with one of the following error messages.

Therefore, these errors might be returned in response to any command. Clients should be prepared to handle them as such.

OUT_OF_MEMORY

The server cannot allocate enough memory for the job. The client should try again later.

INTERNAL_ERROR

Indicates a bug in the server. It should never happen. If it does happen, please report it to the project maintainers.

BAD_FORMAT

The client sent a command line that was not well-formed. This can happen if the line's length exceeds 224 bytes including \r\n, if the name of a tube exceeds 200 bytes, if non-numeric characters occur where an integer is expected, if the wrong number of arguments are present, or if the command line is malformed in any other way.

UNKNOWN_COMMAND

The client sent a command that the server does not know.

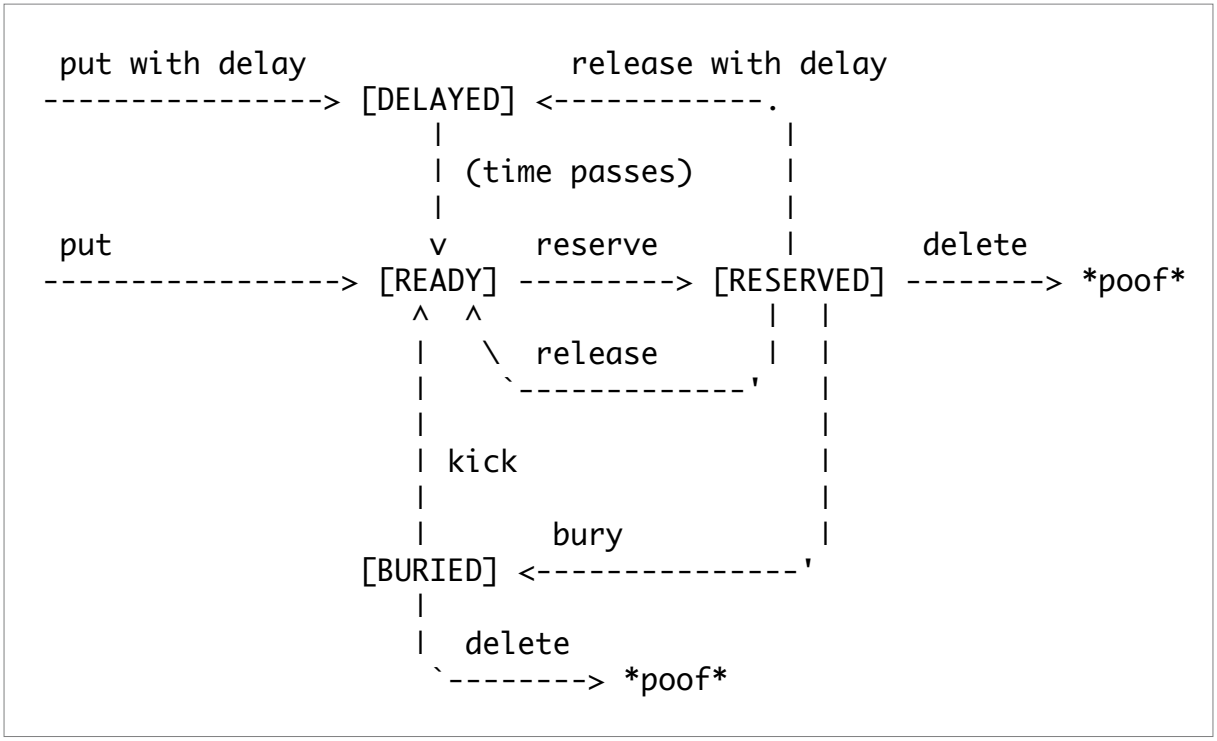
Note that as a last resort, if the server has a serious error that prevents it from continuing service to the current client, the server will close the connection.

Job Lifecycle

A job in beanstalk gets created by a client with the "put" command. During its life it can be in one of four states: "ready", "reserved", "delayed", or "buried". After the put command, a job typically starts out ready. It waits in the ready queue until a worker comes along and runs the "reserve" command. If this job is next in the queue, it will be reserved for the worker. The worker will execute the job; when it is finished the worker will send a ”delete" command to delete the job.

Here is a picture of the typical job lifecycle:

Here is a picture with more possibilities:



The system has one or more tubes. Each tube consists of a ready queue and a delay queue. Each job spends its entire life in one tube. Consumers can show interest in tubes by sending the "watch" command; they can show disinterest by sending the "ignore" command. This set of interesting tubes is said to be a consumer's ”watch list". When a client reserves a job, it may come from any of the tubes in its watch list.

When a client connects, its watch list is initially just the tube named "default". If it submits jobs without having sent a "use" command, they will live in the tube named ”default".

Tubes are created on demand whenever they are referenced. If a tube is empty (that is, it contains no ready, delayed, or buried jobs) and no client refers to it, it will be deleted.

Producer Commands

There are two commands for job producers: "put" (a job) and "use" (a tube). These are described in detail next.

PUT A JOB

The "put" command is for any process that wants to insert a job into the queue. It inserts a job into the client's currently used tube (see the "use" command below).

put <pri> <delay> <ttr> <bytes>

<data>

<pri>	An integer < 2**32. Jobs with smaller priority values will be scheduled before jobs with larger priorities. The most urgent priority is 0; the least urgent priority is 4,294,967,295.
<delay>	An integer number of seconds to wait before putting the job in the ready queue. The job will be in the "delayed" state during this time. Maximum delay is 2**32-1.
<ttr>	Time to run, an integer number of seconds to allow a worker to run this job. This time is counted from the moment a worker reserves this job. If the worker does not delete, release, or bury the job within <ttr> seconds, the job will time out and the server will release the job. The minimum ttr is 1. If the client sends 0, the server will silently increase the ttr to 1. Maximum ttr is 2**32-1.
<bytes>	An Integer indicating the size of the job body, not including the trailing \r\n. This value must be less than max-job-size (default: 2**16).
<data>	The job body; a sequence of bytes of length <bytes> from the previous line.

After sending the command line and body, the client waits for a reply, one of:

INSERTED <ID>

Indicates success, <id> being the integer id of the new job

BURIED <ID>

Indicates the server ran out of memory trying to grow the priority queue data structure. Again, <id> is the integer id of the new job

EXPECTED_CRLF

The job body must be followed by a CR-LF pair, that is, "\r\n" — but was not. These two bytes are not counted in the job size given by the client in the put command line.

JOB_TOO_BIG

The client has requested to put a job with a body larger than max-job-size bytes.

DRAINING

This means that the server has been put into "drain mode" and is no longer accepting new jobs. The client should try another server or disconnect and try again later. To put the server in drain mode, send the SIGUSR1 signal to the process.

USE A TUBE

The "use" command is another one for producers. After "use" has been used, subsequent put commands will put jobs into the tube specified by this command. If no use command has been issued, jobs will be put into the tube named "default".

use <tube>

Here, <tube> is a name at most 200 bytes. It specifies the tube to use. If the tube does not exist, it will be created. The response is:

USING <TUBE>

<tube> is the name of the tube now being used.

Worker Commands

A worker is a process that wants to consume jobs from the queue, using "reserve", ”delete”, "release", and ”bury" commands.

GET A NEW JOB FROM QUEUE

The first worker command, "reserve", reserves a job, and is simply like this:

reserve

Alternatively, you can specify a timeout:

reserve-with-timeout <seconds>

This will return a newly-reserved job. If no job is available to be reserved, beanstalkd will wait to send a response until one becomes available. Once a job is reserved for the client, the client has limited time to run (TTR) the job before the job times out. When the job times out, the server will put the job back into the ready queue. Both the TTR and the actual time left can be found in response to the stats-job command.

If more than one job is ready, beanstalkd will choose the one with the smallest priority value. Within each priority, it will choose the one that was received first.

A timeout value of 0 will cause the server to immediately return either a response or TIMED_OUT. A positive value of timeout will limit the amount of time the client will block on the reserve request until a job becomes available.

During the TTR of a reserved job, the last second is kept by the server as a safety margin, during which the client will not be made to wait for another job. If the client issues a reserve command during the safety margin, or if the safety margin arrives while the client is waiting on a reserve command, the server will respond with:

DEADLINE_SOON

This gives the client a chance to delete or release its reserved job before the server automatically releases it.

TIMED_OUT

If a non-negative timeout was specified and the timeout exceeded before a job became available, or if the client's connection is half-closed, the server will respond with TIMED_OUT.

Otherwise, the only other response to this command is a successful reservation in the form of a text line followed by the job body:

RESERVED <ID> <BYTES>
<DATA>

<id> is the job id -- an integer unique to this job in this instance of beanstalkd.

<bytes> is an integer indicating the size of the job body, not including the trailing "\r\n".

<data> is the job body -- a sequence of bytes of length <bytes> from the previous line. This is a verbatim copy of the bytes that were originally sent to the server in the put command for this job.

GET (RESERVE) A JOB BY ID

A job can be reserved by its id. Once a job is reserved for the client, the client has limited time to run (TTR) the job before the job times out. When the job times out, the server will put the job back into the ready queue.

The command looks like this:

reserve-job <id>

Here, <id> is the job id to reserve. This should immediately return one of these responses:

NOT_FOUND

if the job does not exist or reserved by a client or is not either ready, buried or delayed.

RESERVED <ID> <BYTES>
<DATA>

See the description for the reserve command.

DELETE A COMPLETED JOB

The delete command removes a job from the server entirely. It is normally used by the client when the job has successfully run to completion. A client can delete jobs that it has reserved, ready jobs, delayed jobs, and jobs that are buried. The delete command looks like this:

delete <id>

Here, <id> is the job id to delete. The client then waits for one line of response, which may be:

DELETED

… to indicate success.

NOT_FOUND

… if the job does not exist or is not either reserved by the client, ready, or buried. This could happen if the job timed out before the client sent the delete command.

RELEASE A JOB NOT COMPLETED

The release command puts a reserved job back into the ready queue (and marks its state as "ready") to be run by any client. It is normally used when the job fails because of a transitory error. It looks like this:

release <id> <pri> <delay>

<id>	the job id to release.
<pri>	a new priority to assign to the job.
<delay>	an integer number of seconds to wait before putting the job in the ready queue. The job will be in the "delayed" state during this time.

The client expects one line of response, which may be:

RELEASED

to indicate success.

BURIED

if the server ran out of memory trying to grow the priority queue data structure.

NOT_FOUND

the job does not exist or is not reserved by the client.

BURY A JOB TO SAVE IT FOR LATER

The bury command puts a job into the "buried" state. Buried jobs are put into a FIFO linked list and will not be touched by the server again until a client kicks them with the "kick" command.

The bury command looks like this:

bury <id> <pri>

<id>	the job id to bury.
<pri>	a new priority to assign to the job.

There are two possible responses:

BURIED

Success

NOT_FOUND

job does not exist or is not reserved by the client

TOUCH A JOB

The "touch" command allows a worker to request more time to work on a job. This is useful for jobs that potentially take a long time, but you still want the benefits of a TTR pulling a job away from an unresponsive worker. A worker may periodically tell the server that it's still alive and processing a job (e.g. it may do this on DEADLINE_SOON). The command postpones the automatic release of a reserved job until TTR seconds from when the command is issued.

The touch command looks like this:

touch <id>

Here, <id> is the ID of a job reserved by the current connection. There are two possible responses:

TOUCHED

Success

NOT_FOUND

job does not exist or is not reserved by the client

WATCH A TUBE

The "watch" command adds the named tube to the watch list for the current connection. A reserve command will take a job from any of the tubes in the watch

list. For each new connection, the watch list initially consists of one tube, named "default".

watch <tube>

Here, <tube> is a name at most 200 bytes. It specifies a tube to add to the watch list. If the tube doesn't exist, it will be created.

The reply is:

WATCHING <COUNT>

<count> is the integer number of tubes currently in the watch list.

IGNORE A TUBE

The "ignore" command is for consumers. It removes the named tube from the watch list for the current connection.

ignore <tube>

Here, <tube> is a name at most 200 bytes. Responses may be:

WATCHING <COUNT>

success, <count> is the integer number of tubes currently in the watch list

NOT_IGNORED

the client attempted to ignore the only tube in its watch list

Other Commands

There are several other commands, or actually, command families. They are introduced next.

PEEK A JOB

The peek commands let the client inspect a job in the system. There are four variations. All but the first operate only on the currently used tube.

peek <id>

return job <id>

peek-ready

return the next ready job

peek-delayed

return the delayed job with the shortest delay left

peek-buried

return the next job in the list of buried jobs.

There are two possible responses to these commands:

NOT_FOUND

If the requested job doesn't exist or there are no jobs in the requested state.

FOUND <ID> <BYTES>
<DATA>

If the command was successful. In that case,

<id> is the job id.

<bytes> is an integer indicating the size of the job body, not including the trailing "\r\n".

<data> is the job body -- a sequence of bytes of length <bytes> from the previous line.

KICK BURIED OR DELAYED JOBS

The kick command applies only to the currently used tube. It moves jobs into the ready queue. If there are any buried jobs, it will only kick buried jobs. Otherwise it will kick delayed jobs. It looks like:

kick <bound>

Here, <bound> is an integer upper bound on the number of jobs to kick. The server will kick no more than <bound> jobs. The response is of the form:

KICKED <COUNT>

<count> is an integer indicating the number of jobs actually kicked.

The kick-job command is a variant of kick that operates with a single job identified by its job id. If the given job id exists and is in a buried or delayed state, it will be moved to the ready queue of the the same tube where it currently belongs. The syntax is:

kick-job <id>

Here, <id> is the job id to kick. The response is one of:

NOT_FOUND

if the job does not exist or is not in a kickable state. This can also happen upon internal errors.

KICKED

when the operation succeeded.

GET JOB STATS

The stats-job command gives statistical information about the specified job if it exists. Its form is:

stats-job <id>

Here, <id> is a job id. The response is one of:

NOT_FOUND

if the job does not exist.

OK <BYTES>
<DATA>

<bytes> is the size of the following data section in bytes.

<data> is a sequence of bytes of length <bytes> from the previous line. It is a YAML file with statistical information represented by a dictionary.

The stats-job data is a YAML file representing a single dictionary of string keys to scalar values. It contains these keys:

id	the job id
tube	is the name of the tube that contains this job
state	"ready" or "delayed" or "reserved" or "buried"
pri	the priority value set by the put, release, or bury commands.
age	the time in seconds since the put command that created this job.
delay	is the integer number of seconds to wait before putting this job in the ready queue.
ttr	time to run -- is the integer number of seconds a worker is allowed to run this job.
time-left	the number of seconds left until the server puts this job into the ready queue. This number is only meaningful if the job is reserved or delayed. If the job is reserved and this amount of time elapses before its state changes, it is considered to have timed out.
file	the number of the earliest binlog file containing this job. If -b wasn't used, this will be 0.
reserves	the number of times this job has been reserved.
timeouts	the number of times this job has timed out during a reservation.
releases	the number of times a client has released this job from a reservation.
buries	the number of times this job has been buried.
kicks	the number of times this job has been kicked.

GET TUBE STATS

The stats-tube command gives statistical information about the specified tube if it exists. Its form is:

stats-tube <tube>

Here, <tube> is a name at most 200 bytes. Stats will be returned for this tube. The response is one of:

NOT_FOUND

if the tube does not exist.

OK <BYTES>
<DATA>

<bytes> is the size of the following data section in bytes.

<data> is a sequence of bytes of length <bytes> from the previous line. It is a YAML-formatted dictionary of string keys with scalar values:

name	tube's name
current-jobs-urgent	number of ready jobs with priority < 1024 in this tube
current-jobs-ready	number of jobs in the ready queue in this tube
current-jobs-reserved	number of jobs reserved by all clients in this tube
current-jobs-delayed	number of delayed jobs in this tube
current-jobs-buried	number of buried jobs in this tube
total-jobs	cumulative count of jobs created in this tube in the current beanstalkd process
current-using	number of open connections that are currently using this tube
current-waiting	number of open connections that have issued a reserve command while watching this tube but not yet received a response.
current-watching	number of open connections that are currently watching this tube.
pause	number of seconds the tube has been paused for.

cmd-delete	cumulative number of delete commands for this tube
cmd-pause-tube	cumulative number of pause-tube commands for this tube.
pause-time-left	number of seconds until the tube is un-paused.

GET SYSTEM STATS

The stats command gives statistical information about the system as a whole. Its form is:

stats

The server will respond with:

OK <BYTES>
<DATA>

<bytes> is the size of the following data section in bytes.

<data> is a sequence of bytes of length <bytes> from the previous line. It is a YAML-formatted dictionary of string keys with scalar values, described below. Entries described as "cumulative" are reset when the beanstalkd process starts; they are not stored on disk with the -b flag.

current-jobs-urgent	number of ready jobs with priority < 1024
current-jobs-ready	number of jobs in the ready queue
current-jobs-reserved	number of jobs reserved by all clients
current-jobs-delayed	number of delayed jobs
current-jobs-buried	number of buried jobs
cmd-put	cumulative number of put commands
cmd-peek	cumulative number of peek commands
cmd-peek-ready	cumulative number of peek-ready commands
cmd-peek-delayed	cumulative number of peek-delayed commands
cmd-peek-buried	cumulative number of peek-buried commands

cmd-reserve	cumulative number of reserve commands
cmd-use	cumulative number of use commands
cmd-watch	cumulative number of watch commands
cmd-ignore	cumulative number of ignore commands
cmd-delete	cumulative number of delete commands
cmd-release	cumulative number of release commands
cmd-bury	cumulative number of bury commands
cmd-kick	cumulative number of kick commands
cmd-stats	cumulative number of stats commands
cmd-stats-job	cumulative number of stats-job commands
cmd-stats-tube	cumulative number of stats-tube commands
cmd-list-tubes	cumulative number of list-tubes commands
cmd-list-tube-used	cumulative number of list-tube-used commands
cmd-list-tubes-watched	cumulative number of list-tubes-watched commands
cmd-pause-tube	cumulative number of pause-tube commands
job-timeouts	cumulative count of times a job has timed out
total-jobs	cumulative count of jobs created
max-job-size	maximum number of bytes in a job
currrent-tubes	number of currently-existing tubes
currrent-connections	number of currently open connections
currrent-producers	number of open connections that have each issued at least one put command
current-workers	number of open connections that have each issued at least one reserve command

current-waiting	number of open connections that have issued a reserve command but not yet received a response
total-connections	cumulative count of connections
pid	process id of the server
version	version string of the server
rusage-utime	cumulative user CPU time of this process in seconds and microseconds
rusage-stime	cumulative system CPU time of this process in seconds and microseconds
uptime	number of seconds since this server process started running
binlog-oldest-index	index of the oldest binlog file needed to store the current jobs
binlog-current-index	index of the current binlog file being written to. If binlog is not active this value will be 0
binlog-max-size	maximum size in bytes a binlog file is allowed to get before a new binlog file is opened
binlog-records-written	cumulative number of records written to the binlog
binlog-records-migrated	cumulative number of records written as part of compaction.
draining	set to "true" if the server is in drain mode, "false" otherwise
id	random id string for this server process, generated every time beanstalkd process starts.
hostname	hostname of the machine as determined by uname
os	OS version as determined by uname
platform	machine architecture as determined by uname

LIST ALL TUBES

The list-tubes command returns a list of all existing tubes. Its form is:

list-tubes

The response is:

```
OK <BYTES>
<DATA>
```

<bytes> is the size of the following data section in bytes.

<data> is a sequence of bytes of length <bytes> from the previous line. It is a YAML file containing all tube names as a list of strings.

SHOW CURRENT TUBE

The list-tube-used command returns the tube currently being used by the client. Its form is:

list-tube-used

The response is:

```
USING <TUBE>
```

<tube> is the name of the tube being used.

LIST WATCHED TUBES

The list-tubes-watched command returns a list tubes currently being watched by the client. Its form is:

list-tubes-watched

The response is:

```
OK <BYTES>
<DATA>
```

<bytes> is the size of the following data section in bytes.

<data> is a sequence of bytes of length <bytes> from the previous line. It is a YAML file containing watched tube names as a list of strings.

PAUSE A TUBE

The pause-tube command can delay any new job being reserved for a given time. Its form is:

pause-tube <tube-name> <delay>

<tube> is the tube to pause

<delay> is an integer number of seconds < 2**32 to wait before reserving any more jobs from the queue

There are two possible responses:

PAUSED

to indicate success.

NOT_FOUND

if the tube does not exist.

QUIT

The quit command simply closes the connection. Its form is:

quit

… and that's all.