Gearman

MySQL Web Seminar

July 14, 2009

Eric Day – Sun Microsystems

http://www.oddments.org/

Gearman Overview

- History
- Basics
- Job Server
- Applications
  - Map/Reduce
  - Log Analysis
  - Asynchronous Queues
  - Narada
- Roadmap

“The way I like to think of Gearman is as a massively distributed, massively fault tolerant fork mechanism.”

- Joe Stump, Digg

History

- Danga – Brad Fitzpatrick & Company
  - Related to memcached, MogileFS, ...
- Anagram for “manager”
  - Gearman, like managers, assign the tasks but do none of the real work themselves
- Digg: 45+ servers, 400K jobs/day
- Yahoo: 60+ servers, 6M jobs/day
- LiveJournal, SixApart, DealNews, ...

Recent Development

- Rewrite in C
- New Language APIs
  - PHP ext, Perl XS, Drizzle, MySQL, PostgreSQL
- Command line tool
- Protocol additions
- Multi-threaded (50k jobs/second)
- Persistent queues
- Pluggable protocol

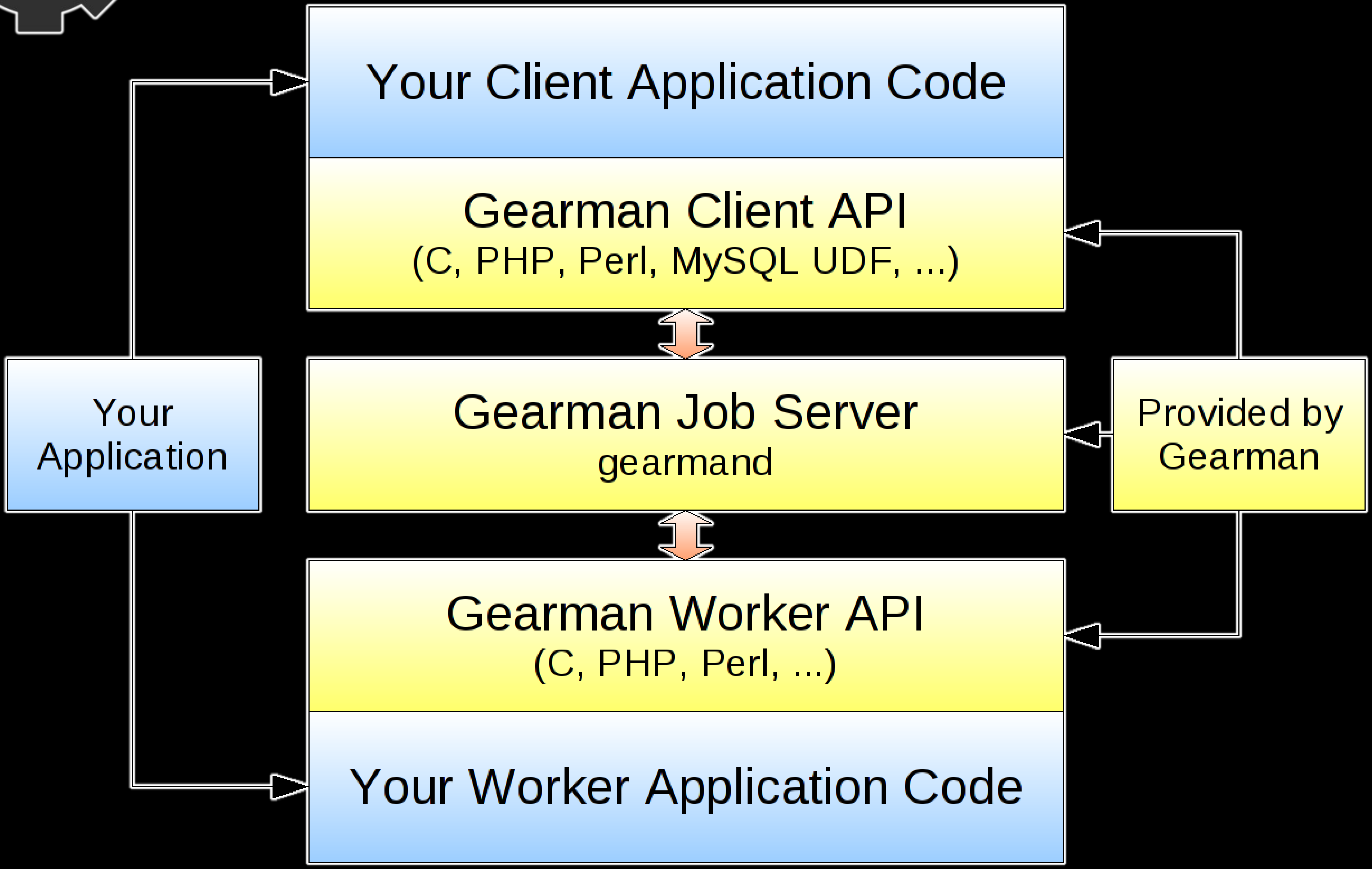
Features

- Open Source (mostly BSD)
- Multi-language
  - Mix clients and workers from different APIs
- Flexible Application Design
  - Not restricted to a single distributed model
- Simple & Fast
- Embeddable
  - Small & lightweight for applications of all sizes
- No Single Point of Failure

Basics

- Gearman provides a distributed application framework
- Uses TCP port 4730 (was port 7003)
- **Client** – Create jobs to be run and send them to a job server
- **Worker** – Register with a job server and grab jobs to run
- **Job Server** – Coordinate the assignment from clients to workers, handle restarts

Gearman Stack



Your Client Application Code

Gearman Client API

(C, PHP, Perl, MySQL UDF, ...)

Gearman Job Server

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Gearman Worker API

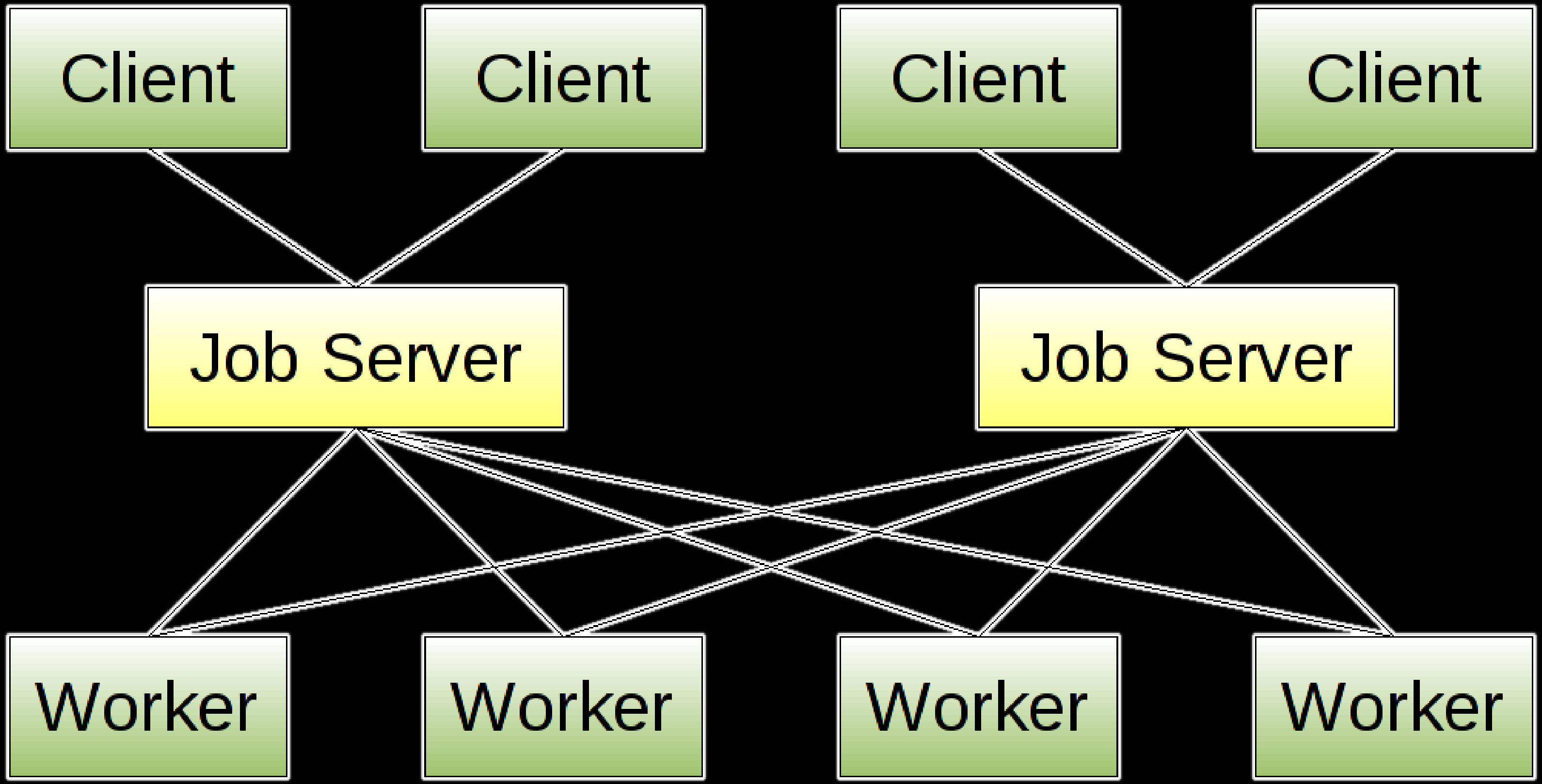
(C, PHP, Perl, ...)

Your Worker Application Code

Your Application

Provided by Gearman

No Single Point of Failure



Hello World

```
$client= new GearmanClient();
$client->addServer();
print $client->do("reverse", "Hello World!");
```

```
$worker= new GearmanWorker();
$worker->addServer();
$worker->addFunction("reverse", "my_reverse_function");
while ($worker->work());

function my_reverse_function($job)
{
  return strrev($job->workload());
}
```

Hello World

```
shell$ gearmand -d

shell$ php worker.php &
[1] 17510

shell$ php client.php
!dlroW olleH
```

How Is This Useful?

- Provides a distributed nervous system
- Natural load balancing
  - Workers are notified and ask for work, not forced
- Multi-language integration
- Distribute processing
  - Possibly closer to data
- Synchronous and Asynchronous queues

Job Server

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Job Server

- Listens on port 4730
- Clients and workers connect
- Handle job assignment
- Restart jobs on worker failure
- Advanced features
  - Pluggable persistent queue
  - Pluggable protocols

Job Server

- gearmand --help
- Common options

```
-d, --daemon
-h, --help
-l, --log-file=FILE
-p, --port=PORT
-P, --pid-file=FILE
-t, --threads=THREADS
-u, --user=USER
-v, --verbose
```

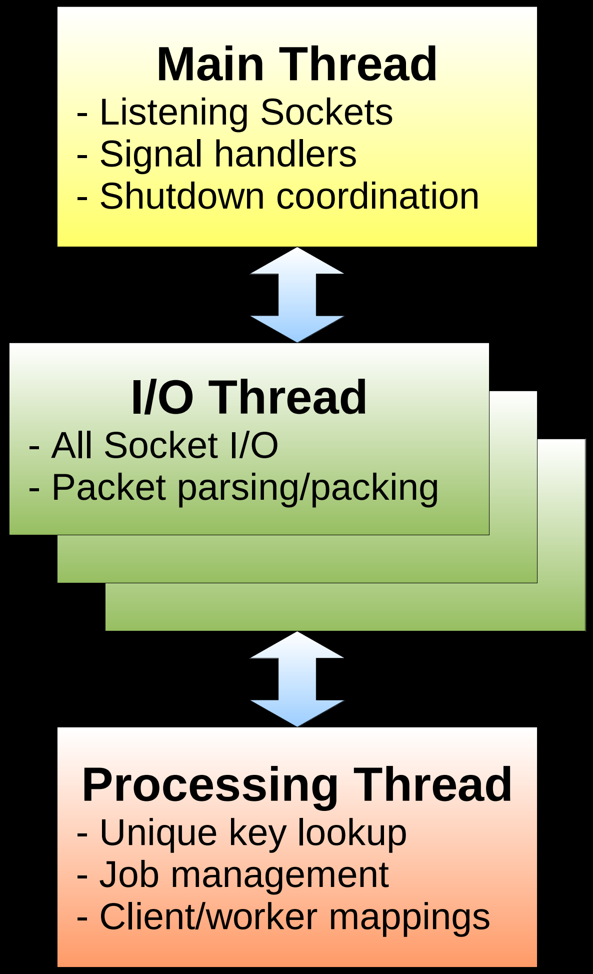
Verbose Option

- Can specify multiple -v
- Very useful for debugging

```
shell$ gearmand -vvvv
 INFO Starting up
DEBUG Initializing libevent for main thread
DEBUG Method for libevent: epoll
DEBUG Trying to listen on :::4730
 INFO Listening on :::4730 (6)
DEBUG Trying to listen on 0.0.0.0:4730
 INFO Creating wakeup pipe
DEBUG Creating 0 threads
 INFO Creating IO thread wakeup pipe
 INFO Adding event for listening socket (6)
 INFO Adding event for wakeup pipe
 INFO Entering main event loop
...
```

Threading Model

- Can run single threaded
- The -t option sets threads
  - I/O thread count
  - Default is -t 0
  - One thread/core
- Processing thread
  - Hashes and other state
  - No systems calls
  - Non-blocking



Main Thread
- Listening Sockets
- Signal handlers
- Shutdown coordination

I/O Thread
- All Socket I/O
- Packet parsing/packing

Processing Thread
- Unique key lookup
- Job management
- Client/worker mappings

Persistent Queues

- Only for background jobs
- Specify -q <queue> option
- libdrizzle module for Drizzle and MySQL

```
shell$ gearmand -vvv -q libdrizzle --libdrizzle-mysql
 INFO Initializing libdrizzle module
 INFO libdrizzle module using table 'test.queue'
...
 INFO libdrizzle replay start
...
DEBUG libdrizzle add: 3ec068d9-293c-4af8-943f-d265138e67f8
DEBUG libdrizzle flush
...
DEBUG libdrizzle done: 3ec068d9-293c-4af8-943f-d265138e67f8
```

Persistent Queues

- libdrizzle queue is as robust as your DB
- Can create your own table

```
libdrizzle Options:

     --libdrizzle-host=HOST
     --libdrizzle-port=PORT
     --libdrizzle-uds=UDS
     --libdrizzle-user=USER
     --libdrizzle-password=PASSWORD
     --libdrizzle-db=DB
     --libdrizzle-table=TABLE
     --libdrizzle-mysql

shell$ gearmand -q libdrizzle ...
```

Persistent Queues

- libmemcached
- PostgreSQL
- sqlite3
- Flat file
- Easy to add your own!

Pluggable Protocol

- Handle packet parsing and packing
- Optionally handle raw socket I/O
- HTTP protocol
- Others coming soon
  - memcached
  - XMPP
  - ?

HTTP Protocol

- GET and POST requests
  - Send workload with POST, Content-Length
- Function name from URL
- Optional headers
  - X-Gearman-Unique: <unique key>
  - X-Gearman-Background: true
  - X-Gearman-Priority: <high|low>
- Other headers ignored for now

HTTP Protocol

```
shell$ gearmand -r http &

shell$ nc localhost 8080
POST /reverse HTTP/1.1
Content-Length: 12

Hello World!

HTTP/1.0 200 OK
X-Gearman-Job-Handle: H:lap:1
Content-Length: 12
Server: Gearman/0.9

!dlroW olleH
```

Applications

Asynchronous Queues

- Background Tasks
- They help you scale
- Distributed data storage
  - Eventually consistent data models
  - Choose “AP” in “CAP”
    - Consistency
    - Availability
    - Partitions (tolerance to network partitions)
  - Make eventual consistency work
  - Conflict resolution if needed

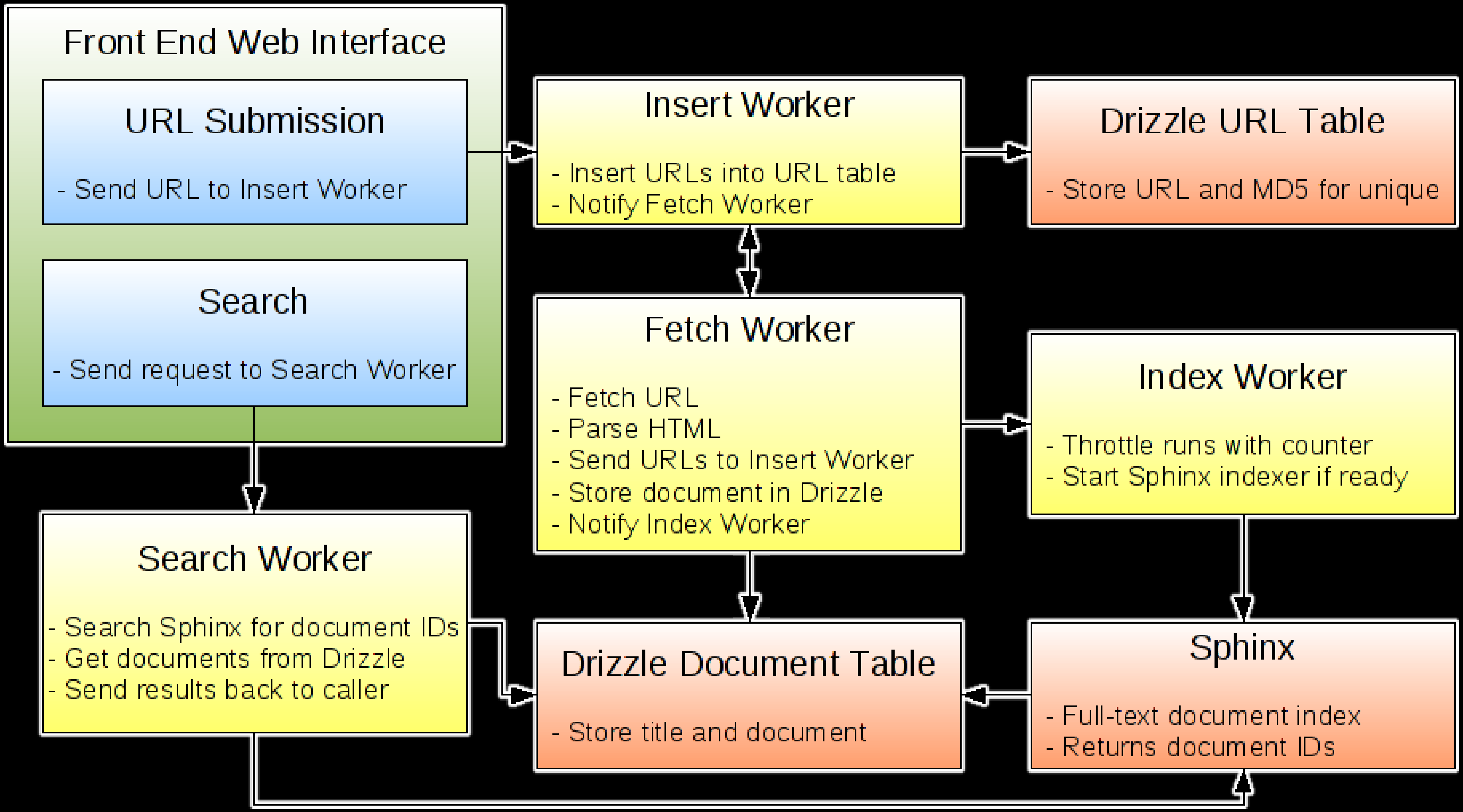
Asynchronous Queues

- Not everything needs immediate action
  - E-Mail notifications
  - Tweets
  - Certain types of database updates
  - RSS aggregation
  - Search indexing
- Allows for batch operations

Narada

- Example in Patrick Galbraith's book
- Custom search engine
- Perl, PHP, and Java implementations
- Asynchronous queues
- Drizzle or MySQL
- Optionally use memcached
- Easy to integrate into existing projects
- https://launchpad.net/narada

Narada



Front End Web Interface

URL Submission

- Send URL to Insert Worker

Search

- Send request to Search Worker

Insert Worker

- Insert URLs into URL table
- Notify Fetch Worker

Drizzle URL Table

- Store URL and MD5 for unique

Fetch Worker

- Fetch URL
- Parse HTML
- Send URLs to Insert Worker
- Store document in Drizzle
- Notify Index Worker

Index Worker

- Throttle runs with counter
- Start Sphinx indexer if ready

Search Worker

- Search Sphinx for document IDs
- Get documents from Drizzle
- Send results back to caller

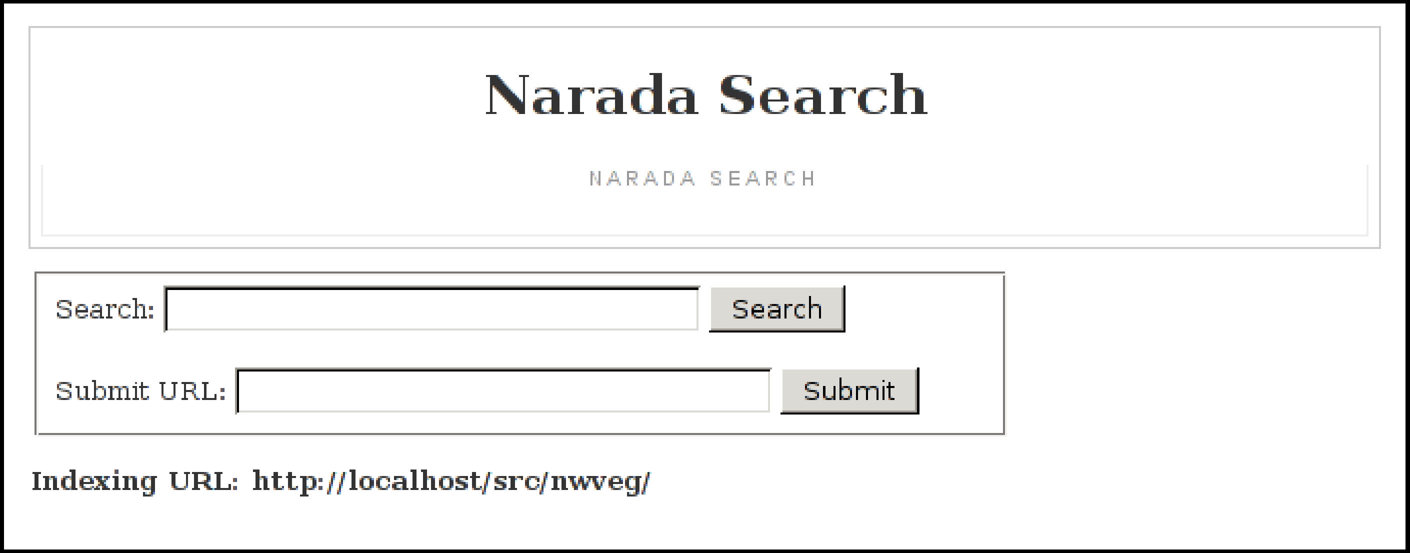
Drizzle Document Table

- Store title and document

Sphinx

- Full-text document index
- Returns document IDs

URL Submission



Narada Search

NARADA SEARCH

Indexing URL: http://localhost/src/nwveg/

Insert Worker

- Insert URL into table
- Notify Fetch Worker

```
shell$ php NaradaInsert.php
Insert URL: http://localhost/src/nwveg/
```

Fetch Worker

- Fetch URL, process HTML, find more URLs
- Store document and notify Index Worker

```
shell$ php NaradaFetch.php
Fetching: http://localhost/src/nwveg/
Protocol: http://
Domain: localhost
Path: /src/nwveg/
File:
Local URL: http://localhost/src/nwveg/index.php
Local URL: http://localhost/src/nwveg/news.php
Local URL: http://localhost/src/nwveg/whyveg.php
Local URL: http://localhost/src/nwveg/board.php
Local URL: http://localhost/src/nwveg/subscribe.php
Local URL: http://localhost/src/nwveg/discounts.php
...
Skipping Remote URL: http://twitter.com/northwestveg
Title: Northwest VEG - Home
```

Insert Worker

- More URLs from Fetch Worker

```
shell$ php NaradaInsert.php
Insert URL: http://localhost/src/nwveg/
Insert URL: http://localhost/src/nwveg/index.php
Insert URL: http://localhost/src/nwveg/news.php
Insert URL: http://localhost/src/nwveg/whyveg.php
Insert URL: http://localhost/src/nwveg/mvp.php
Insert URL: http://localhost/src/nwveg/veg101.php
Insert URL: http://localhost/src/nwveg/join.php
Insert URL: http://localhost/src/nwveg/volunteer.php
Insert URL: http://localhost/src/nwveg/events.php
...
```

Insert/Fetch Workers

- URL Feedback Loop
- Filter at some point
  - Recursion level
  - Restrict to given domain
- Now ready to index
- ...then search!

Index Worker

- Don't run indexer for every document

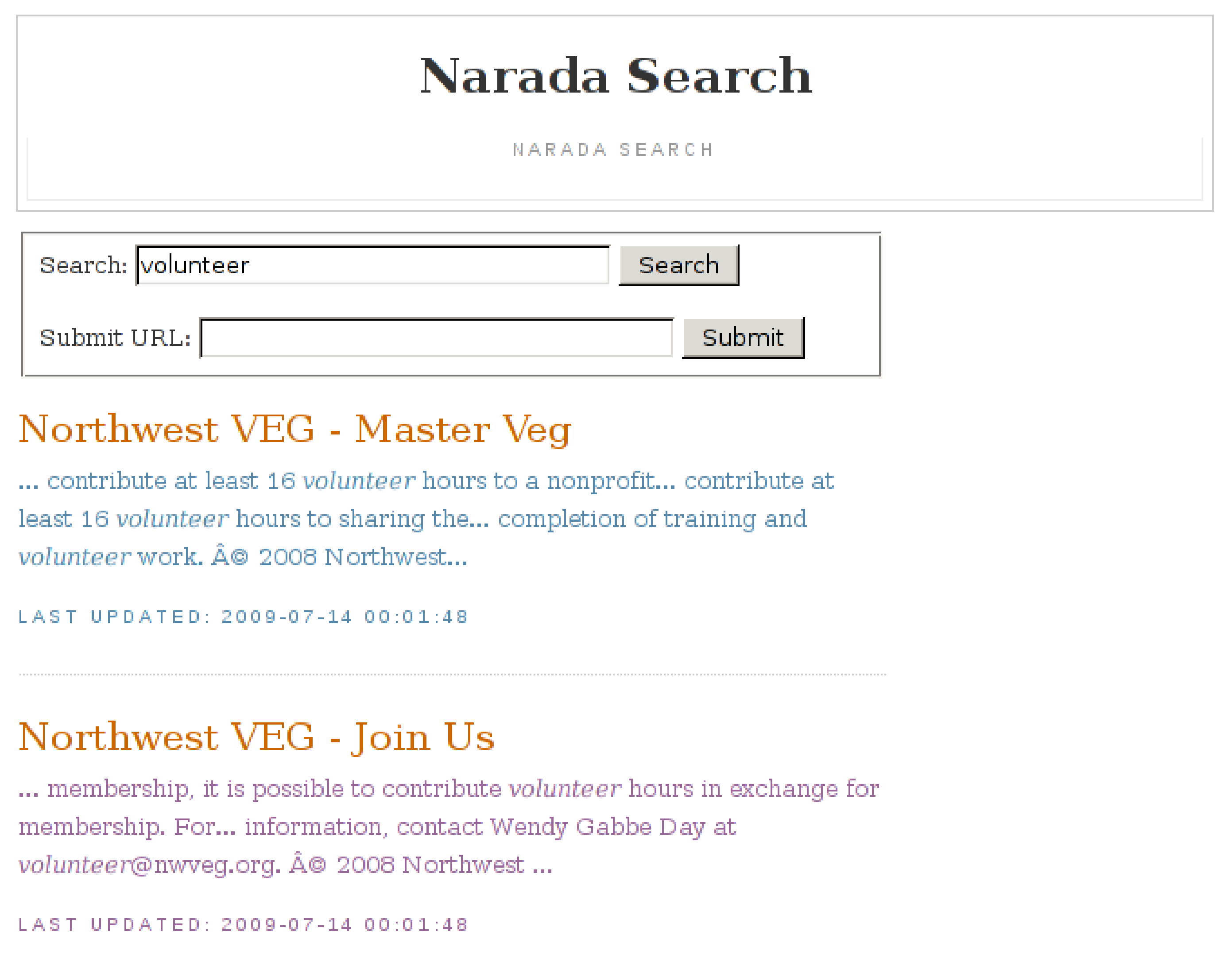
```
shell$ php NaradaIndex.php
Index Count: 1
...
Index Count: 10
Running Index
Sphinx 0.9.9-rc2 (r1785)
Copyright (c) 2001-2009, Andrew Aksyonoff

using config file '/home/eday/other/sphinx/etc/sphinx.conf'...
indexing index 'url'...
collected 25 docs, 0.1 MB
sorted 0.0 Mhits, 100.0% done
total 25 docs, 61524 bytes
total 0.085 sec, 718134 bytes/sec, 291.81 docs/sec
indexing index 'url_delta'...
collected 0 docs, 0.0 MB
total 0 docs, 0 bytes
total 0.045 sec, 0 bytes/sec, 0.00 docs/sec
distributed index 'dist_url' can not be directly indexed; skipping.
total 3 reads, 0.000 sec, 30.4 kb/call avg, 0.0 msec/call avg
total 9 writes, 0.000 sec, 8.3 kb/call avg, 0.0 msec/call avg
rotating indices: succesfully sent SIGHUP to searchd (pid=17010).
```

Search Worker

- Query Sphinx for document IDs
- Get documents from Drizzle or MySQL
  - Soon will get from memcached too

```
shell$ php NaradaSearch.php
1 Documents matched 'nonprofit'
2 Documents matched 'board'
5 Documents matched 'oregon'
3 Documents matched 'vegfest'
7 Documents matched 'volunteer'
```

Search



Narada Search

NARADA SEARCH

Northwest VEG - Master Veg

... contribute at least 16 *volunteer* hours to a nonprofit... contribute at least 16 *volunteer* hours to sharing the... completion of training and *volunteer* work. Â© 2008 Northwest...

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Northwest VEG - Join Us

... membership, it is possible to contribute *volunteer* hours in exchange for membership. For... information, contact Wendy Gabbe Day at *volunteer*@nwveg.org. Â© 2008 Northwest ...

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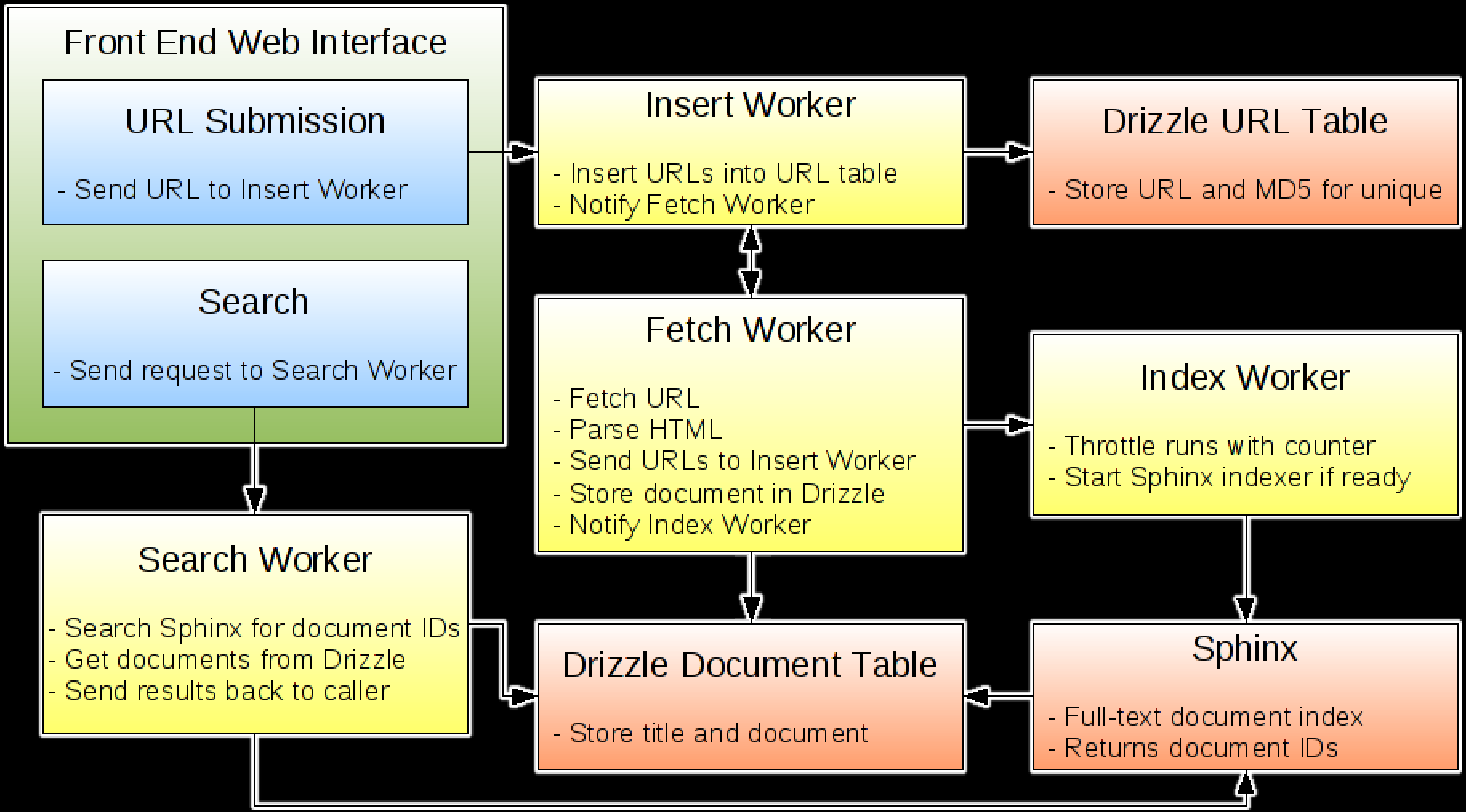
Narada



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What's Next?

- More protocol and queue modules
- TLS, SASL, multi-tenancy
- Replication (job relay)
- Improved statistics gathering and reporting
- Event notification hooks
- Monitor service

Get involved

- http://gearman.org/
- #gearman on irc.freenode.net
- http://groups.google.com/group/gearman
- Gearman @ OSCON
  - July 20-24 in San Jose
  - 3 Hour tutorial
  - 45 Minute Session (similar material)
  - Birds of a Feather (BoF)
  - Expo Hall Booth