The Apache DBD Framework

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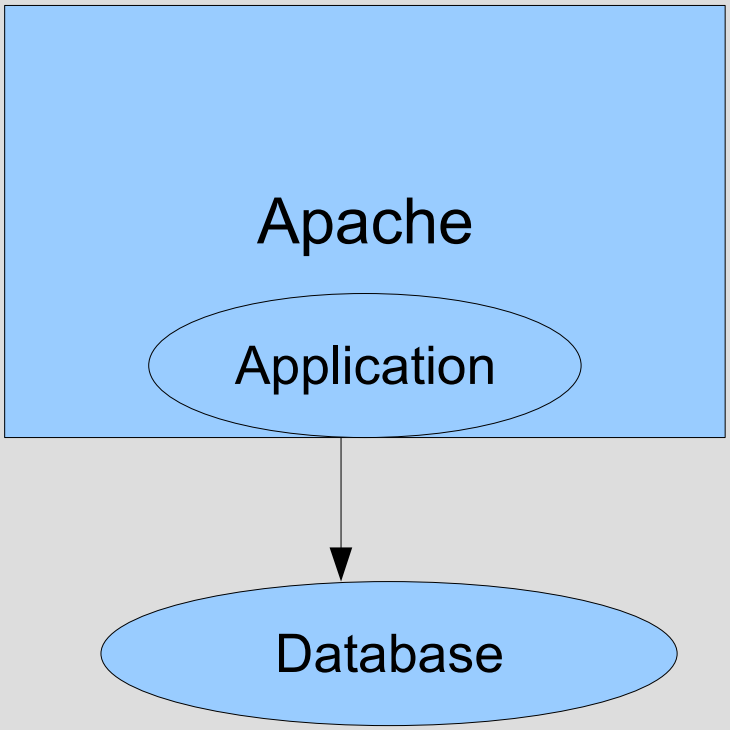
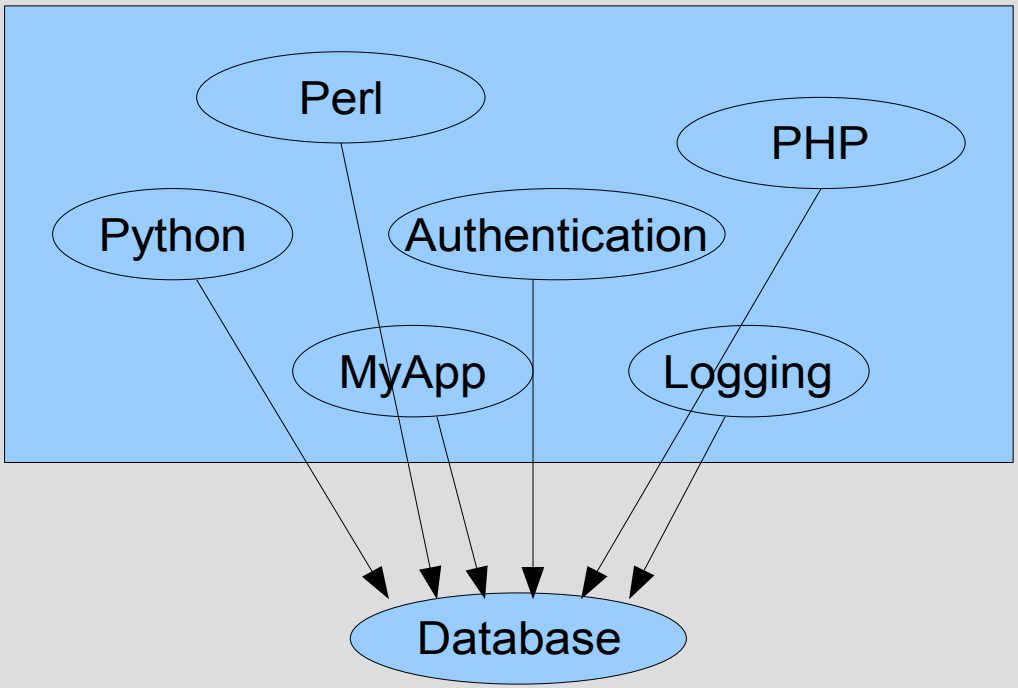
The Apache DBD Framework

- The Need for DBD
- Historical Context
- DBD Architecture
- apr_dbd
- DBD Drivers
- mod_dbd
- DBD for Server Administrators
- DBD for Module Developers
- DBD for Scripting
- DBD for Standalone Applications

Traditional Application

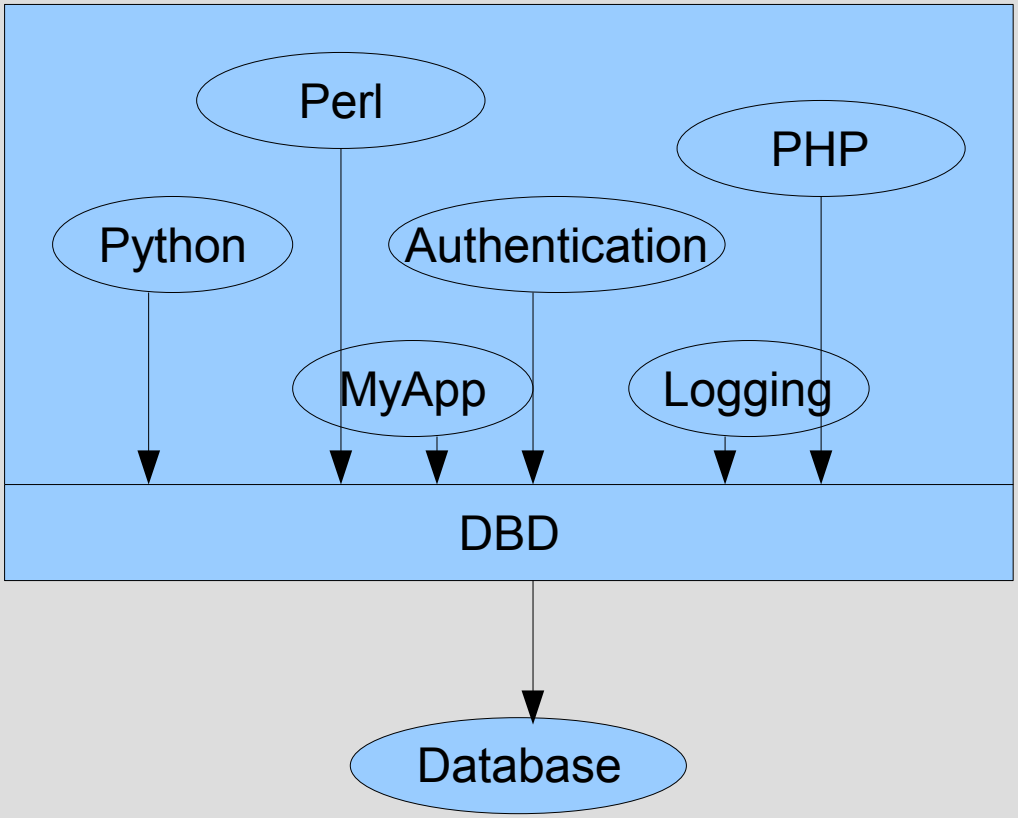


Traditional Applications



N Applications = N expensive connections

DBD Applications



N Applications = 1 expensive connection

Traditional Connections

- Trad. CGI: one connection per request

Problem: opening and closing connections is expensive, so this grows very inefficient as hit rates rise.

- LAMP: one (or N) connection per worker

Problem: expensive connections held even when not in use, and number increases linearly with number of workers.

DBD Connections

- Shared Pool of database connections
- Persistent – no per-request overhead
- N:M – no per-worker overhead
- Dynamically resizes to meet traffic levels

Scalability: DBD vs LAMP

- No overhead as number of database applications grows
- No overhead due to non-database traffic as number of workers (Web traffic) grows.
- Reduced overhead in database traffic

- Worst case: reduces to traditional model

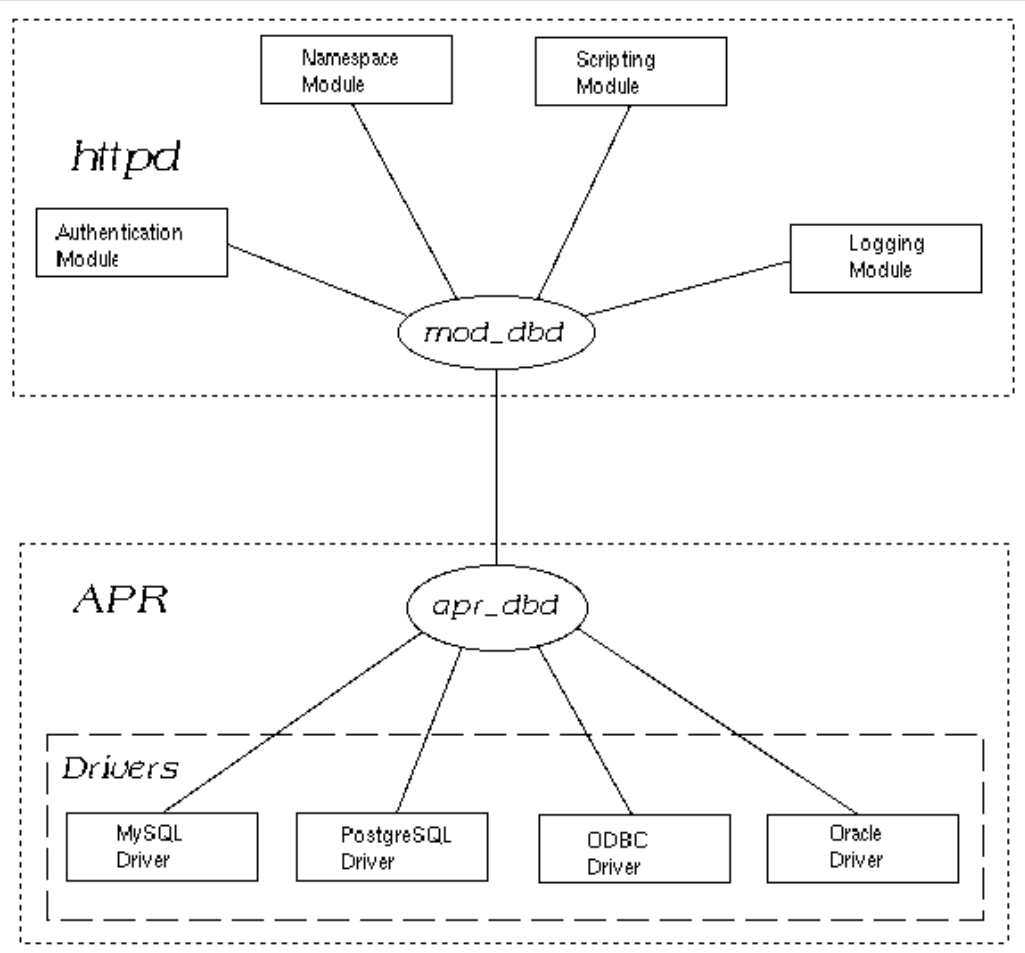
- Best case: Reduces overhead from
  O(NumApps * NumWorkers) to O(1)

A Brief History

- Prior Art: Perl DBI/DBD; libdbi, etc
- Prerequisite: apr_reslist
- Site Valet: DBD-like layer with connection pooling
- ApacheCon 2003: BOF session
- Connection Pooling Modules for individual databases
- Connection Pooling Module for libdbi
- The current architecture:

  mod_dbd + apr_dbd

DBD Architecture



apr_dbd

#include “apr_dbd.h”

- Opaque Types
- Drivers
- Interface Layer
- Queries
- Query Results
- Transactions
- Other API functions

Opaque Types

- apr_dbd_driver_t
- apr_dbd_t
- apr_dbd_transaction_t
- apr_dbd_prepared_t
- apr_dbd_results_t
- apr_dbd_row_t

Driver

```
#include “private/apr_dbd_internal.h”;

struct apr_dbd_driver_t {
    /* Declare functions implementing each API func */
} ;
APU_DECLARE_DATA apr_dbd_driver_t
            apr_dbd_foo_driver = {
    /* Functions implementing each API func
     * based on the underlying database's API
     */
};
```

Drivers

- Statically linked or dynamically loaded
- Separate compilation an option
- Current build doesn't support dynamic load

```
apr_dbd_get_driver() {
    /* Check for it in  loaded drivers */
#if APR_DSO_BUILD (and not already found)
        /* If threaded, obtain a mutex */
        /* Load driver */
#endif
}
```

Interface Layer

```
static int apr_dbd_do_something(
    apr_dbd_driver_t* driver,
    apr_dbd_t* handle, ...)
{
   /* minimal apr_dbd code if required */

    return driver->do_something(handle, ...) ;
}
```

Queries

apr_dbd_query (no results)
apr_dbd_select (returns a result set)

apr_dbd_prepare (prepare a query)
/* Using printf-like format string for query */

apr_dbd_pquery (prepared query/argc-argv)
apr_dbd_pselect
apr_dbd_pvquery (prepared query/varargs)
apr_dbd_pvselect

Query Results

apr_dbd_num_cols
apr_dbd_num_tuples
apr_dbd_get_name
apr_dbd_get_row
apr_dbd_get_entry

Transactions

apr_dbd_transaction_start
apr_dbd_transaction_end
apr_dbd_transaction_state

Native Database

apr_dbd_native_handle

- get handle on the underlying database for (non-portable) operations supported by a database client library but not by apr_dbd

Other API

apr_dbd_init
apr_dbd_name
apr_dbd_open
apr_dbd_check_conn
apr_dbd_close
apr_dbd_select_db
apr_dbd_error
apr_dbd_escape

mod_dbd

- Threaded and Unthreaded models
- Connection pooling
- Alternatives: persistent or one-off connections
- Exports ap_dbd API

ap_dbd

```
struct ap_dbd_t {
  /* driver, handle, statements, pool */
};
```

ap_dbd_prepare	(startup)
ap_dbd_open	(indefinite lifetime)
ap_dbd_close	(close after an open)
ap_dbd_acquire	(request-oriented)
ap_dbd_cacquire	(connection-oriented)

Server Configuration

```
<VirtualHost foo.example.com>
    DBDriver pgsql
    DBDParams “host=db.example.com
            user=apache pass=secret”
    DBDMin 5
    DBDKeep 20
    DBDMax 50
    DBDExptime 120
#DBDPrepareSQL, DBDPersist
</VirtualHost>
```

DBD for Modules

- httpd.conf: prepare statements at server startup with ap_dbd_prepare
- Req/Conn Processing: ap_dbd_[c]acquire normally preferred
- **Caution**: an acquired connection is attached to the request_rec, and returned to every module that uses acquire. Always leave clean and unencumbered. Use open/close if your module can't share with other modules!
- apr_dbd API for database ops

DBD for Scripting

Goal for developers of scripting languages: integrate apr_dbd into familiar scripting idioms

Example: perl

```
$sql = new DBD::APR driver => mysql
                    params => ... etc ...;
```

Standalone perl will use apr_dbd; mod_perl will substitute the ap_dbd API calls for obtaining a database connection

Embedded scripting

```
<table>
  <caption>Query Results</caption>
  [set res [apr::dbd::pselect $stmt $params]]
  <thead><tr><th>[apr::dbd::get_name $res 0]</th>
   <th>[apr::dbd::get_name $res 1]</th></tr></thead>
  <tbody>[foreach $row [apr::dbd::get_row $res]
       <tr><td>[apr::dbd::get_entry $row 0]</td>
            <td>[apr::dbd::get_entry $row 1]</td></tr>
    ] </tbody>
</table>
```

Embedded SQL

mod_sql, mod_sqil

```
<table>
<caption>Search Results</caption>
<sql:select
    query=”select foo from bar where all is not lost”
    format=”<tr><td>$1</td><td>$2</td>” />
</table>
```

Standalone DBD Apps

- Don't forget apr_dbd_init !
- apr_dbd API is a direct alternative to native database client libraries, and other multi-database APIs such as libdbi, ODBC.
- Selling points include resource management with APR pools, connection pooling support (as in mod_dbd) with apr_reslist, and APR optional function API.

Examples

- Authentication
- Authorization
- Embedded SQL
- Embedded Scripting
- General Scripting
- Logging to SQL
- SQL-based vhost configuration
- SQL backend for DAV

References

- Applications Development with Apache (the apache modules book) contains by far the most complete reference.
- http://httpd.apache.org/docs/2.2/mod/mod_dbd.html
- http://people.apache.org/~niq/dbd.html
- http://apache.webthing.com/database/
- http://www.apachetutor.org/dev/reslist