Scripting in an Enterprise Application Environment
Agenda

- Why Scripting?
- Why PHP?
- What is PHP?
- Our PHP-on-Java implementation.
- PHP in CICS
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The Application Landscape

Traditional developers building strategic applications

Developers building simple applications to solve simple problems

Usage

ERP
CRM
SCM
Enterprise applications

IT created applications

User created applications

Sales analysis

Dashboards

Number of Applications

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Requirements:

Quick to:

- **Learn**
  - Simple, forgiving language
  - Lots of examples, books
  - Google -> cut -> paste programming.

- **Build version 1.**
  - Powerful libraries, frameworks, patterns, idioms.

- **Evolve and change.**
  - No compile or deploy step.
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PHP, the language

- Imperative, Procedural and Object Oriented.
- Dynamic, weakly typed scripting language.
- Syntactically similar to C and Java.
- Server side web scripting and General Scripting.
  - Can be embedded in HTML.

```html
```
PHP on the Public Internet

- 20M+ web domains use PHP (~ 1/3 of the internet)
- 3M+ Programmers know PHP
- Significant web properties built on PHP

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PHP Community by the numbers

~ 150 programmers
(Source php.net svn)

19 Frameworks
(source phpframeworks.com)

1000s of programmers

100s of Significant OS applications

3 to 5 Million Programmers
(Source Gartner, 2007 Zend, 2008)

Frameworks, Open Source Applications (PHP)

Sites, & closed source applications.

VM, language, Extensions (C)

Java Community is 7M programmers
(Source Sun Nicrosystems 2008)
PHP inside the firewall?

Gartner (Dec 2007)

• PHP Developers to grow from 3 to **5.5 million** by 2013
• PHP Developers in Commercial or Corporate IT to grow from 13% to **60%** by 2013
• “Pay special attention to opportunities to leverage PHP in combination with Java development efforts”
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PHP Reference Implementation

PHP Language

C Language

Applications (100s)

Frameworks (19)

eZ components

- PHPBB
- MedioWiki
- SUGARCRM
- Wordpress
- TakePHP
- CodeIgniter

Vast array of modules implemented in PHP.
Rich set of extensions implemented in C

C Extensions

- PHP Language
- C Language

Zend Engine

Virtual Machine

- Scripts
- Applications
- Modules
- Frameworks

- Cryptography
- Procedural Database Clients
- OO Database Clients
- Connectivity (>10)
- Operating system
- Data formatting
- Caching
- Image processing
- XML processing (14)
- Many more.....

Apache HTTP server

Filesystem

Vast array of modules implemented in PHP.
Rich set of extensions implemented in C

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Another view of PHP

- No specification
- Incomplete documentation
- Incomplete tests
- No Unicode
- Inconsistent implementation
  - Inconsistent naming and parameter order.
  - Bizarre semantics in some corner cases.
- Reference Implementation based language
Is PHP a “proper” language?
Procedural and  OO

<?php
function ($bean, $message="default") {
    $bean["message"]=$message;
    return $bean;
}

.........
$b=foo ($mybean);
$a=foo($mybean,"mymessage");
?>

<?php
class myclass {
    public $myProperty = 'a default variable';
    public function displayProperty() {
        echo $this->myProperty;
    }
}
?>

Defaults to pass by value.
(easier for novice programmer)
Reference counting and copy-on-write allows efficiency.
Objects passed by reference in PHP5.
Stateless, shared nothing.

- Each “request” stands alone.
  - Think HTTP request.
    - All program state rebuilt afresh on each request.
    - State must be explicitly persisted.
      - Session (file, database, memcached....)
      - Database
      - File
      - Cached in the client(cookie, GET/POST parms.)
Dynamic Structure.

- Program structure is also rebuilt on each request.
- Definition of functions, classes, constants can vary from request to request.

```php
// filename: include1.php
<?php
    function foo ($a) {
        return ($a*2);
    }
?>
```

```php
// filename: include2.php
<?php
    function foo ($a) {
        return ($a*4);
    }
?>
```

```php
// filename: index.php
<?php
    if ($_GET["myparm"] >2) {
        include "include1.php";
    } else {
        include "include2.php";
    }
    echo foo ($_GET["myval"]);
?>
```

Here the definition of the function foo changes based on a request parameter.
PHP Request Processing.

Request

Execute includes

functions
classes
constants
Global
variables
Objects

Program state

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Shared nothing architecture
Threading model.

- Programming model has no threads.
  - No locks.

- PHP Programmer does not have to worry about
  - Thread safety.
  - Lock contention.
  - Deadlock.
  - Etc.

- Removes many sources of error and poor scalability.
Simple XML Handling in PHP

- PHP’s SimpleXML.
  - 3rd Generation XML extension.
  - Represents XML document as PHP object tree.

- Set the value of an element:
  ```php
  $xml = new SimpleXMLElement($xmlstr)
  $xml->movie[0]->characters->character[0]->name = 'Miss Coder';
  ```

- Set attribute “stars” on rating element using array syntax.
  ```php
  $xml = new SimpleXMLElement($xmlstr)
  $xml->movie[0]->rating['stars']=3;
  ```

- SimpleXML also allows iteration.

- PHP also has a DOM extension and XML stream parsers.
A word about Unit test

Will the LHC create a black hole?

Posted: 29 Sep 2008 07:00 AM PDT

Graph by Jonam H
Security

- Dynamic Language + unskilled programmers = security exposures.

- Early PHP implementations and applications were insecure.
  - Buffer overruns, CSRF, XSS, remote exploits.

- Language and implementation have evolved.

- Mantra:
  - Filter all input.
    - PHP has excellent “whitelist” based filtering.
  - Escape all output.
    - To the database and the client.

- Tainting has been proposed.
PHP Characteristics.

- Simple and Resilient
- Poor absolute performance
- Excellent scalability
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PHP-on Java Implementation Concept

PHP Community and Assets.

+ Java Community and Assets.

in

Java Platform environments
PHP in IBM Products.

- P8 Runtime
- Java Virtual Machine
- IBM CICS Transaction Server
- WebSphere Message Broker 7.0
PHP in WebSphere sMash

- Runs PHP 5 scripts
- Requires Java 5 SE or later.

- Extensibility via XAPI
  - XAPI-C for C extensions from php.net
  - XAPI-J for Java extensions, native libraries invoked over JNI and Project Zero interface
  - Extension language choice opaque to PHP script

- Java Bridge
- Debug using via xdebug protocol using Eclipse with PDT
STOP!
Compilation

- Script file
  - Lex and parse
  - AST
  - OpCode Compile
    - PHP Function
      - Conditional/non Conditional
    - PHP Class
      - Conditional/non Conditional
  - OpCode Executable
    - bytecode compile
    - .class
      - One per method/function/global
      - Synchronised on program cache entry
      - Key=(path|config)
      - On Disk Cache entry
        - On jar per script file.
        - One class per method, function plus global scope.
        - Keyed on config+path.
        - Loader recreates program cache entry
      - instance
        - Static fields used to cache linkage at runtime
    - Replicated in each runtime thread.

Caches

- Program cache Entry
  - Synchronised on program cache entry
  - On Disk Cache entry
    - loader recreates program cache entry

Instance cache.
- (request to request)
- Per runtime.

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Code Generation

- AST descended recursively to generate flat list of opcodes.
- Opcodes are unique to P8 and are stack based which is key to later translation to Java bytecode.
- Some simple optimisation are done. Execution context is evaluated and appropriate code generated.

PHP Source Code

```
1 + $x
(.php)
```

AST

```
PUSH int(1)
LOCAL x
ADD
```

P8 Opcodes

Less navigation
More throughput
Execution Context

LHS
ExectionContext. PREPARING_WRITE

RHS
ExecutionContext.READING

Astpw_assign_AssignStatement

Code generator has the execution context and generates appropriate code.

- PUSH int(1)
- LOCAL a
- ADD
- ALOCALVAL b
PHP evaluation order

$a[a1()][a2()] ;

$a[a1()] [a2()] ; Call a1

$a[a1()] [a2()] ; Call a2()

Get $a

$a[a1()] [a2()] ; Index into a by result of a1()

$a[a1()] [a2()] ; Index into a[a1()] by result of a2()
Further Execution Order Examples

- $a[a1()] [a2()] = b[b1()] [b2()] = c[c1()] [c2()]$
  - Order is $a1()$, $a2()$, $b1()$, $b2()$, $c1()$, $c2()$, $c[][]$
  - assign $b[][]$, assign $a[][]$

- $a[a1()] [a2()] = b[b1()] [b2()] + c[c1()] [c2()]$
  - order is $a1()$, $a2()$, $b1()$, $b2()$, evaluate $b[][]$, $c1()$, $c2()$, evaluate $c[][]$, assign $a[][]$
  - Could this be an unintentional inconsistency? ... bug? Tested on 5.2.1
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OLTP meets scripting... why?

- CICS systems execute millions (billions?) of business critical transactions per day
  - The “ities” - Secure, reliable, available, …
  - Assembler, COBOL primarily

- Has evolved many invocation styles/technologies
  - 3270 “green screens”
  - SNA, APPC
  - MQ Series
  - TCPIP
  - HTTP
  - SOAP
The Application Landscape

- Traditional developers building strategic applications
- Developers building simple applications to solve simple problems
- And the data they need is ultimately held where?

- Sales analysis
- Dashboards
- Number of Applications

- ERP
- CRM
- SCM
- Enterprise applications
- IT created applications
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Usage
The Application Landscape

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Data centre-hosting: Providing the “ities”

Number of Applications
Web programming with PHP and CICS

- Basic CICS/COBOL programming pattern is very similar to PHP
  - Request/Response
  - No threading
  - No implicit persistence
  - CICS Pseudo-conversations == the first shopping cart!

- Many CICS apps fit a RESTful model eg Atom
  - Find collections of data
  - View a collection
  - Pick an item
  - Update it
What is REST?

- REST is the acronym for "Representational State Transfer"
- It is the architectural model on which the World Wide Web is based

Principles of REST

- Resource centric approach
- All relevant resources are addressable via URIs
- Uniform access via HTTP – GET, POST, PUT, DELETE
- Content type negotiation allows retrieving alternative representations from same URI

REST style services

- are easy to access from code running in web browsers, any other client or servers
- can serve multiple representations of the same resource

PHP in CICS Transaction Server

- Runs PHP 5 scripts
- Requires Java 5 SE or later. CICS v3.2

- Extensibility via XAPI
  - XAPI-C for C extensions from php.net
    Subset compiled for System z
  - XAPI-J for Java extensions, native libraries invoked over JNI and Project Zero interface
  - Extension language choice opaque to PHP script

- Java Bridge. Access to CICS and DB2
- Debug using via xdebug protocol using Eclipse with PDT
JVM implementation in CICS continues to evolve

- JDK 1.1.8
- HPJ and Hotpooling
- IBM Persistent Reusable JVM (Shiraz)
- Continuous mode
- Java 5
- Java 6

Now, JVMServers
Comparing capacity (projected)

Graph assumes 18 Meg for Base JVM size, + 40 Meg of Engine, statics, classes etc, + 8M of app storage usage per thread.

(Null thread – no application state of its own, and not causing any addition classes to be loaded = 40Kb per thread)
JVMServers - why?

- JVMs up to now
  - Single task, serial reuse
  - Large memory footprint
  - Excellent isolation characteristics

- JVMServers
  - Multiple tasks (threads) in a JVM concurrently
  - Larger capacity
  - Risk of collateral damage
  - Not for customer application use in v4.1
JVMPool Architecture - CICS TS v3 (and v2)

Single CICS task dispatched into a JVM in the pool at a time. So concurrent task count limited to the number of JVMs that can fit in the region.

Each JVM 'costs' ~20Mb plus the application heap value.

Result is about 20 task/JVMs concurrently in each region.
New CICS TCB “mode”.

Called “T8” - dubbed as both a CICS TCB and an LE “pthread”.

JNI call to attach a pthread to an existing JVM.
Can attach multiple pthread/T8/CICS tasks to the JVM at the same time.

Therefore serve more requests using a single JVM.

JVMServer thread "cost" is...

Very, very like a WAS servant region.

Result is .... tasks per region.
JVMServer Architecture

Architected to allow multiple JVMServers in a single CICS.

Different types of work, or just a degree of isolation.
Deploying PHP for agility
In Conclusion

Simplicity wins.
Reliable simplicity wins reliably.
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