Ian Mitchell, IBM Distinguished Engineer, CICS Transaction Server Architect.
Rob Nicholson, IBM Senior Technical Staff Member, MBCS, CEng, CITP.

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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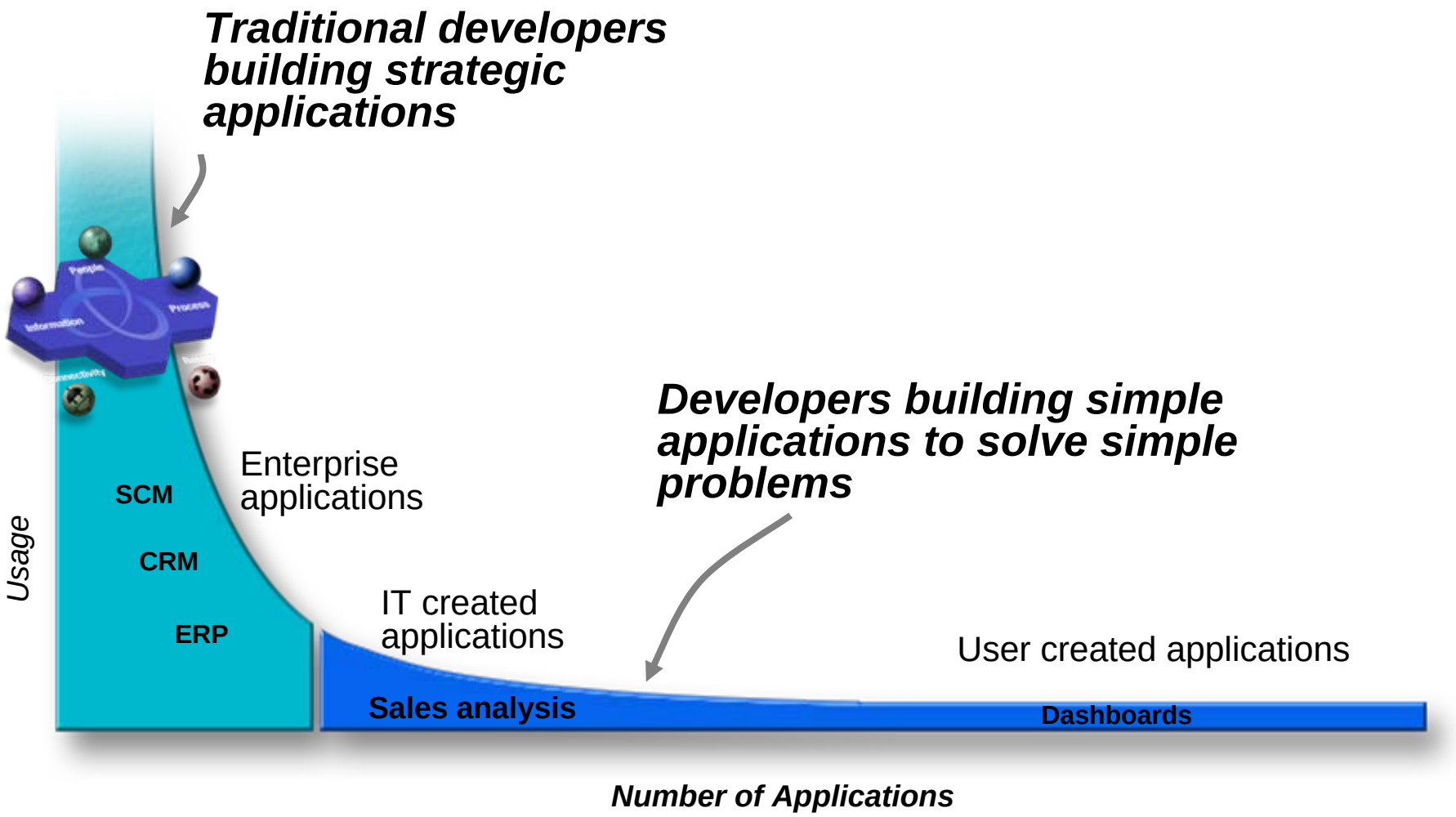
The Application Landscape



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.

Agenda

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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> <head><title>PHP Example</title></head>
  <body>
    <?php $myVar=$_GET["myparm"]; ?>
    <p>Hello from HTML</p>
    <?php echo "<p>myparm=$myVar</p>" ?>
  </body>
</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**

TIOBE Programming Community Index (Oct 2009)

Position Oct 2009	Position Oct 2008	Delta in Position	Programming Language	Ratings Oct 2009	Delta Oct 2008	Status
1	1	=	Java	18.718%	-2.23%	A
2	2	=	C	16.891%	+1.33%	A
3	5	⇈	PHP	10.390%	+1.78%	A
4	3	↓	C++	9.911%	-1.04%	A
5	4	↓	(Visual) Basic	8.729%	-1.08%	A
6	8	⇈	C#	4.433%	+0.67%	A
7	6	↓	Python	3.914%	-0.65%	A
8	7	↓	Perl	3.776%	-0.64%	A
9	11	⇈	JavaScript	3.033%	+0.36%	A
10	10	=	Ruby	2.458%	-0.40%	A

PHP Community by the numbers

~ 150 programmers

(Source php.net svn)

19 Frameworks

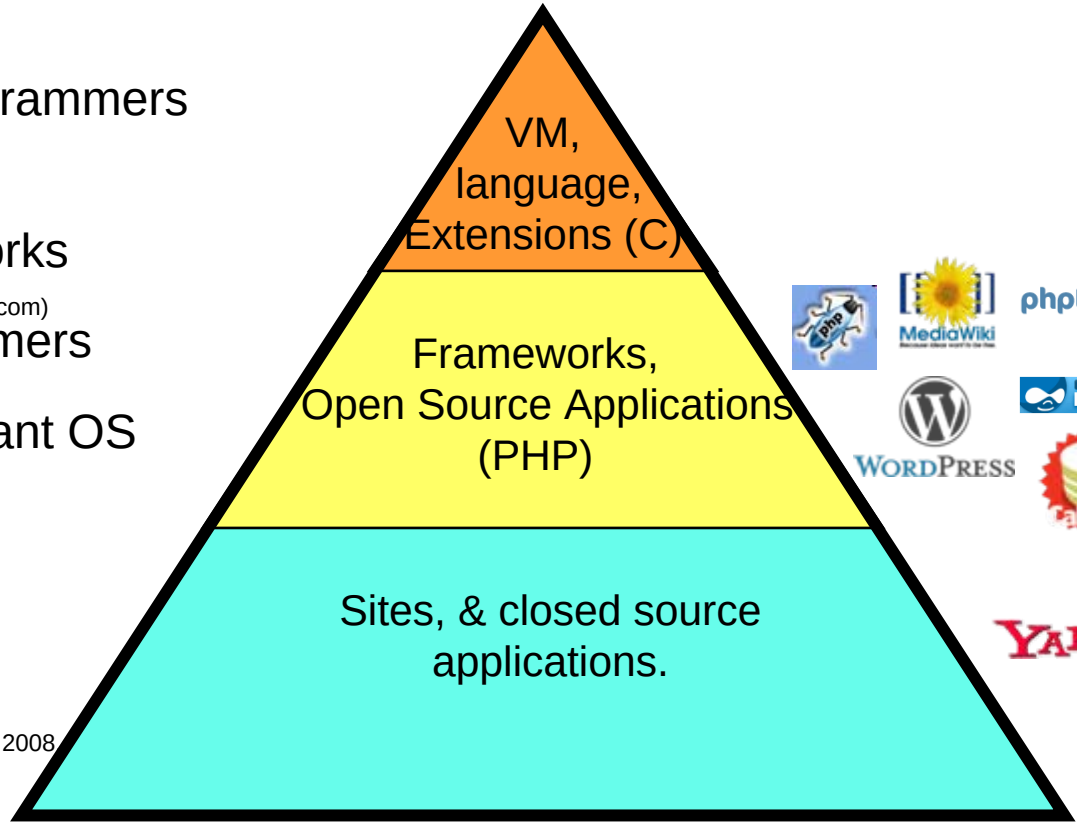
(source phpframeworks.com)

1000s of programmers

100s of Significant OS applications

3 to 5 Million Programmers

(source Gartner, 2007 Zend, 2008










Ning

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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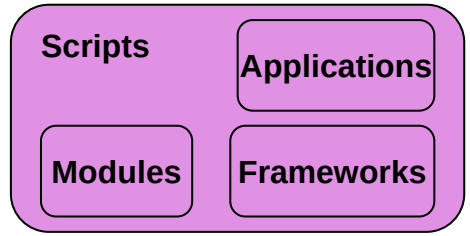
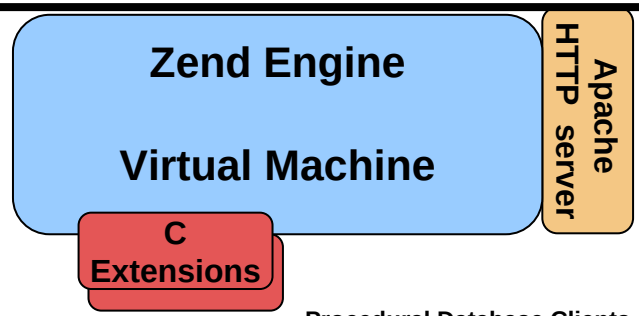
PHP Reference Implementation



C Language



Vast array of modules implemented in PHP.

Rich set of extensions implemented in C

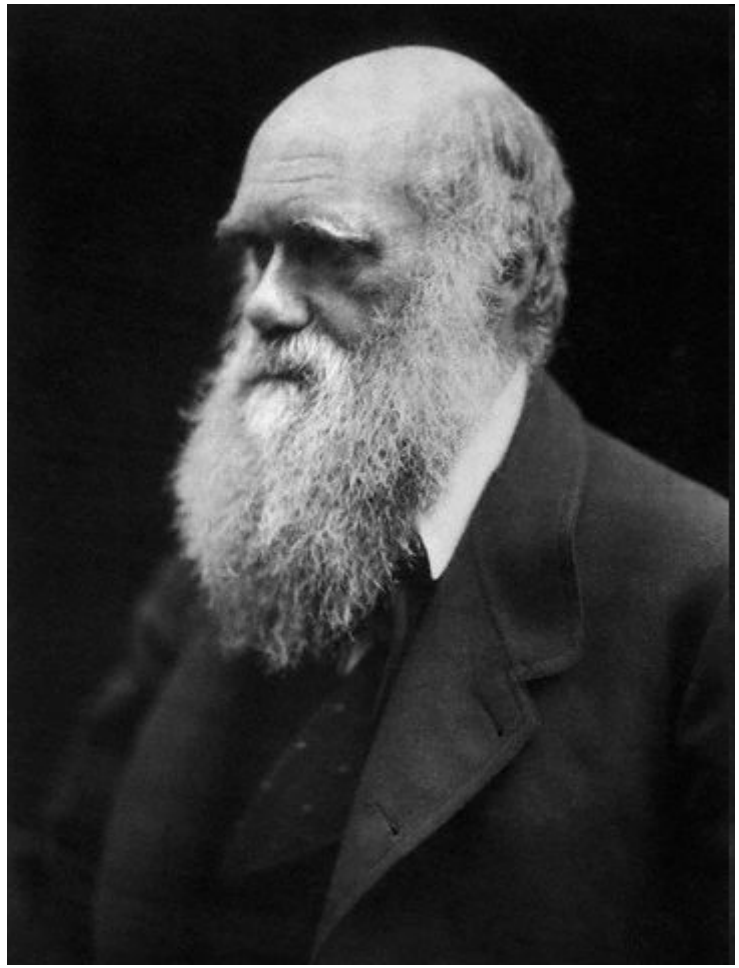
cryptography
Procedural Database Clients
OO Database Clients
Connectivity (> 10)
Filesystem
Operating system
Filesystem
Data formatting
caching
Image processing
XML processing (14)

Many more…..

Another view of PHP

- No specification
- Incomplete documentation
- Incomplete tests
- No Unicode
- Inconsistent implementation
  - Inconsistent naming and parameter order.
  - Bizare 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.

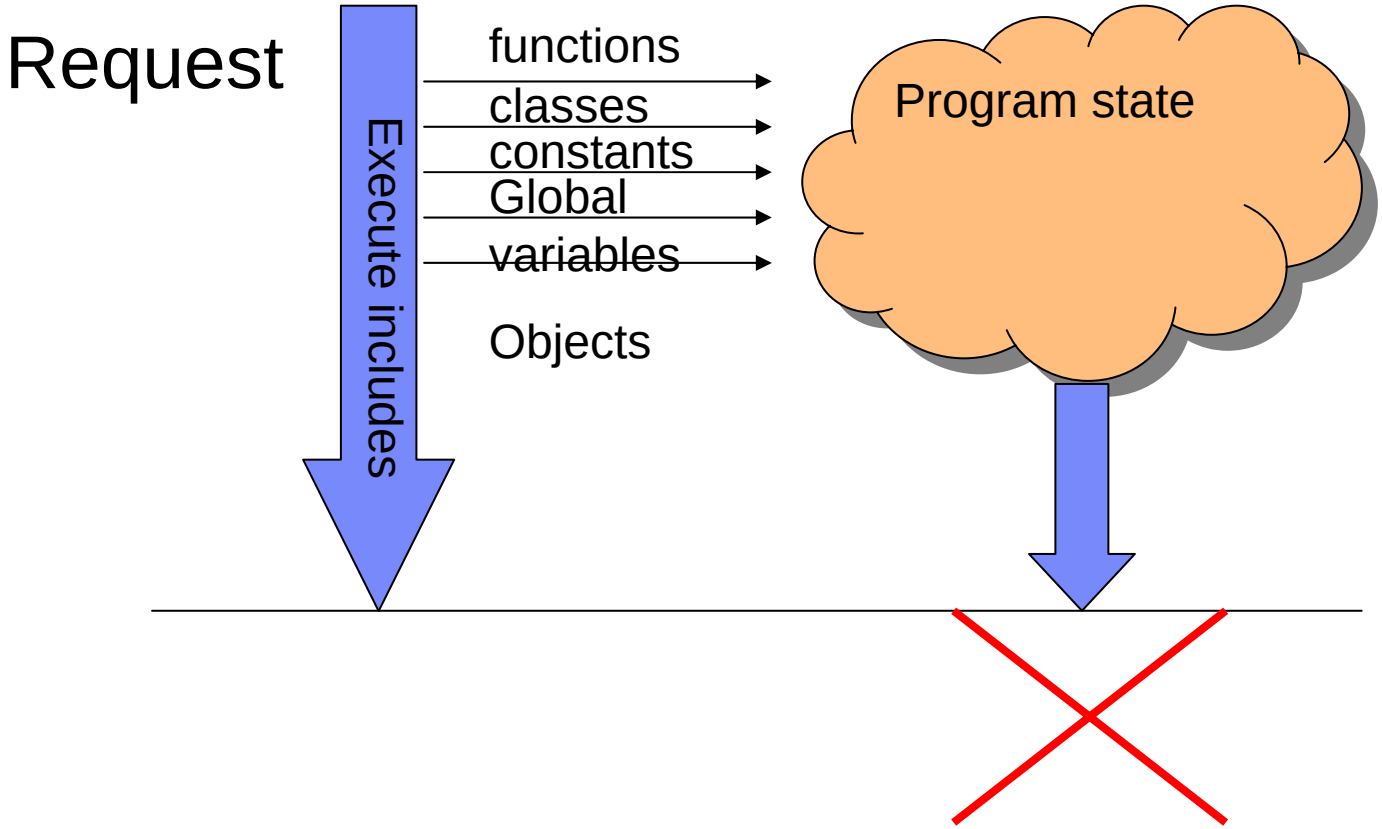
```
// filename: include1.php
<?php
   function foo ($a) {
      return ($a*2);
   }
 ?>
```

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

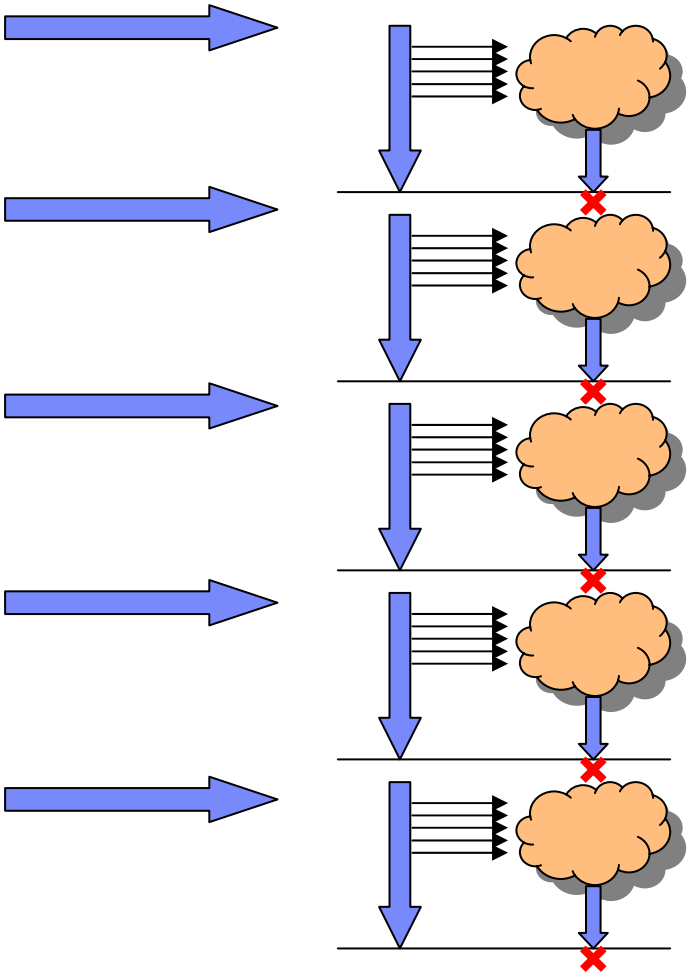
```
// filename: index.php
<?php
   if ($_GET[“myparm”] >2){
      include “include1.php”;
   } else {
      include “include2.php”;
   }
   echo foo ($_GET[“myval”]);
 ?>
```

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

PHP Request Processing.



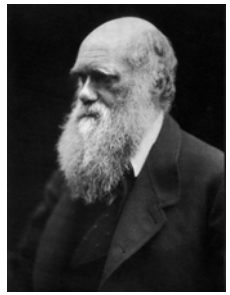
Shared nothing architecture



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:

```
$xml = new SimpleXMLElement($xmlstr)
$xml->movie[0]->characters->character[0]->name = 'Miss Coder';
```

- Set attribute "stars" on rating element using array syntax.

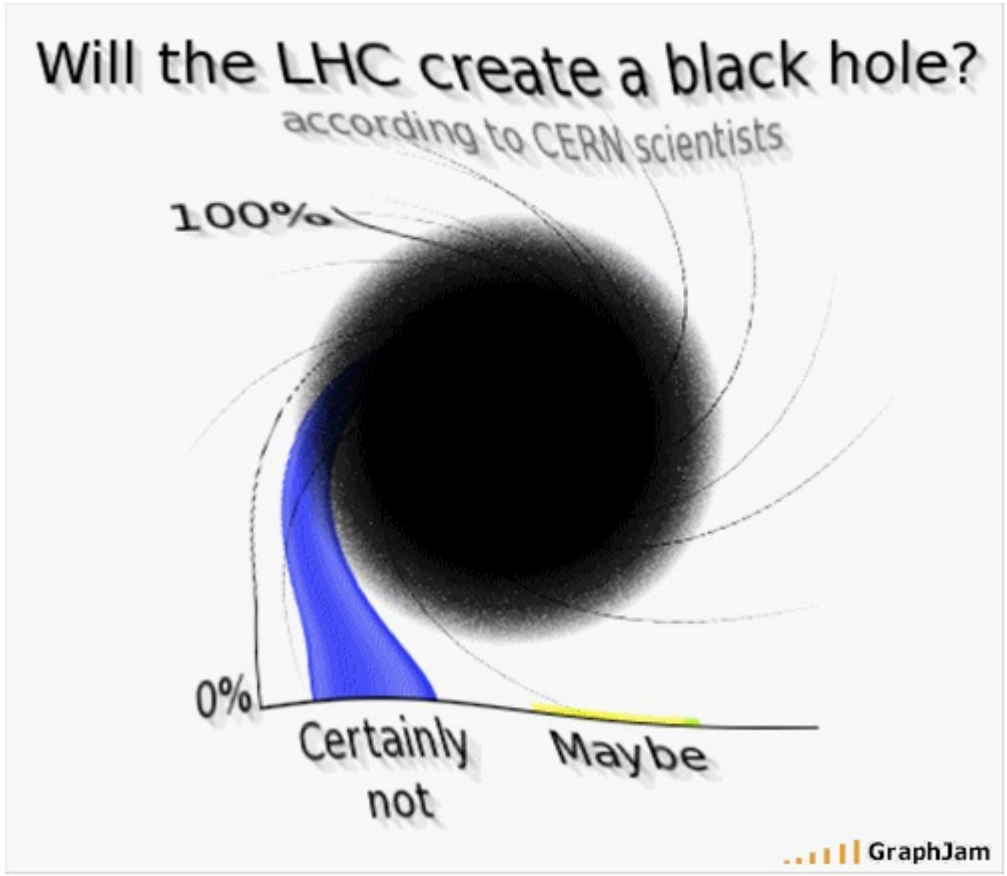
```
$xml = new SimpleXMLElement($xmlstr)
$xml->movie[0]->rating['stars']=3;
```

- 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 Joram 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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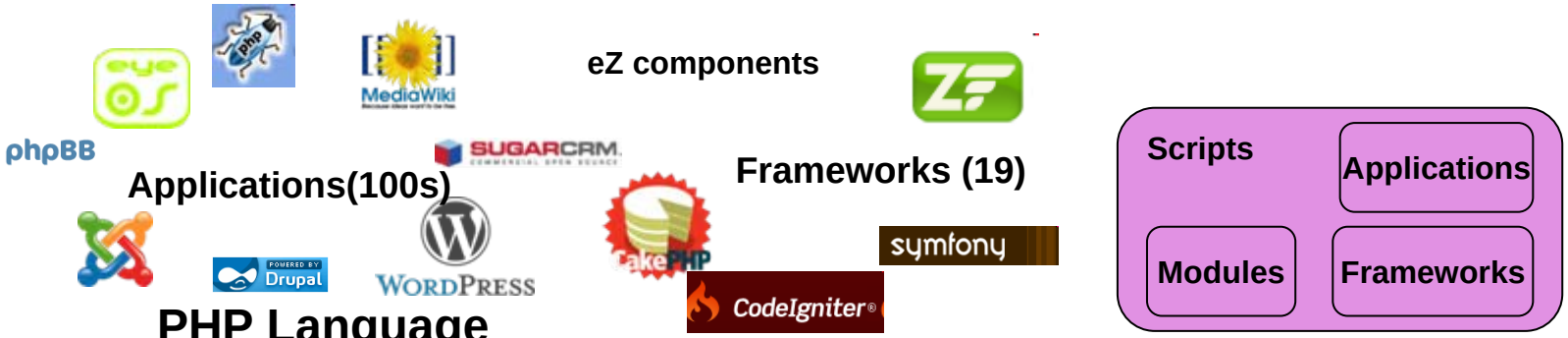
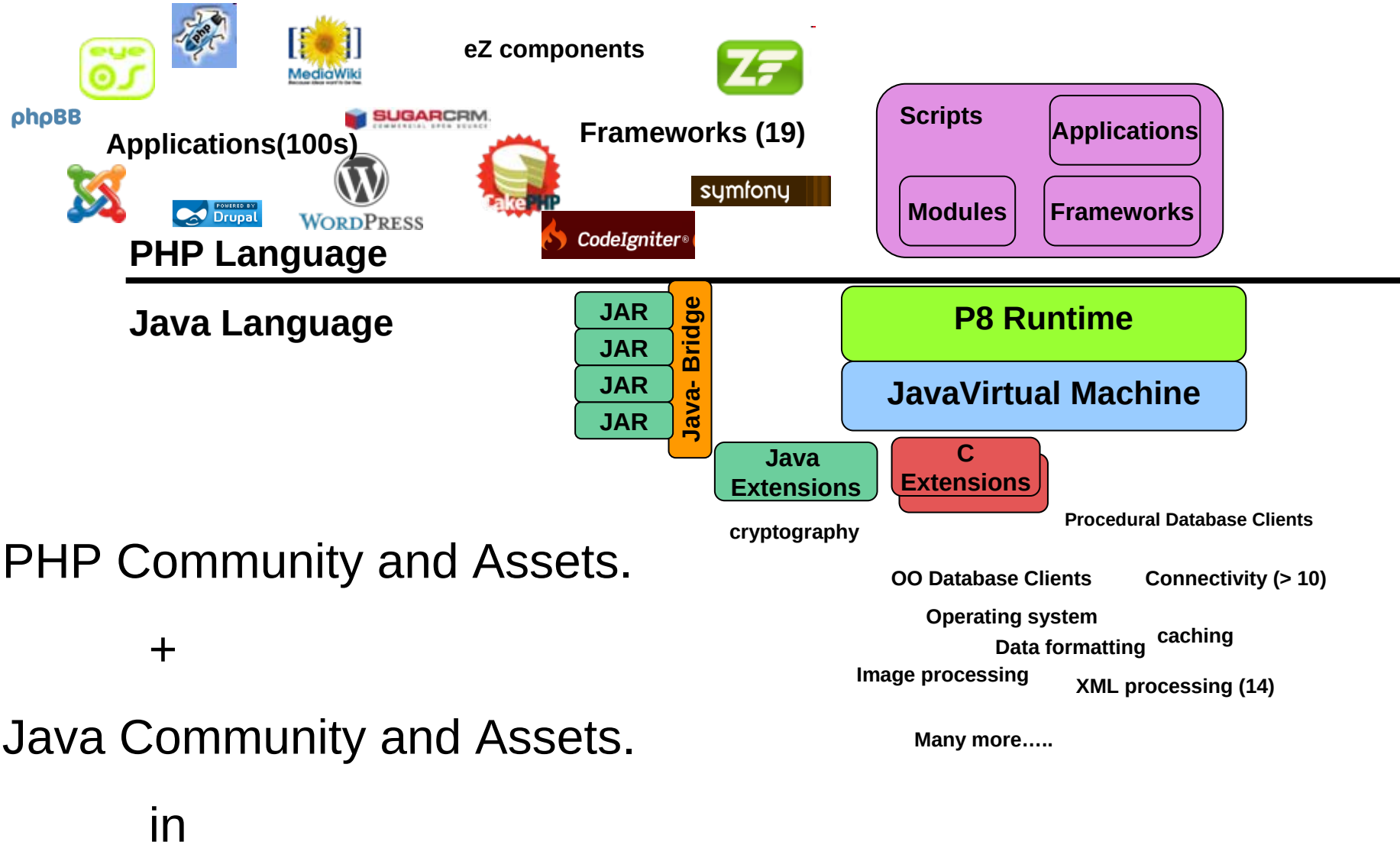


PHP-on Java Implementation Concept



PHP Community and Assets.

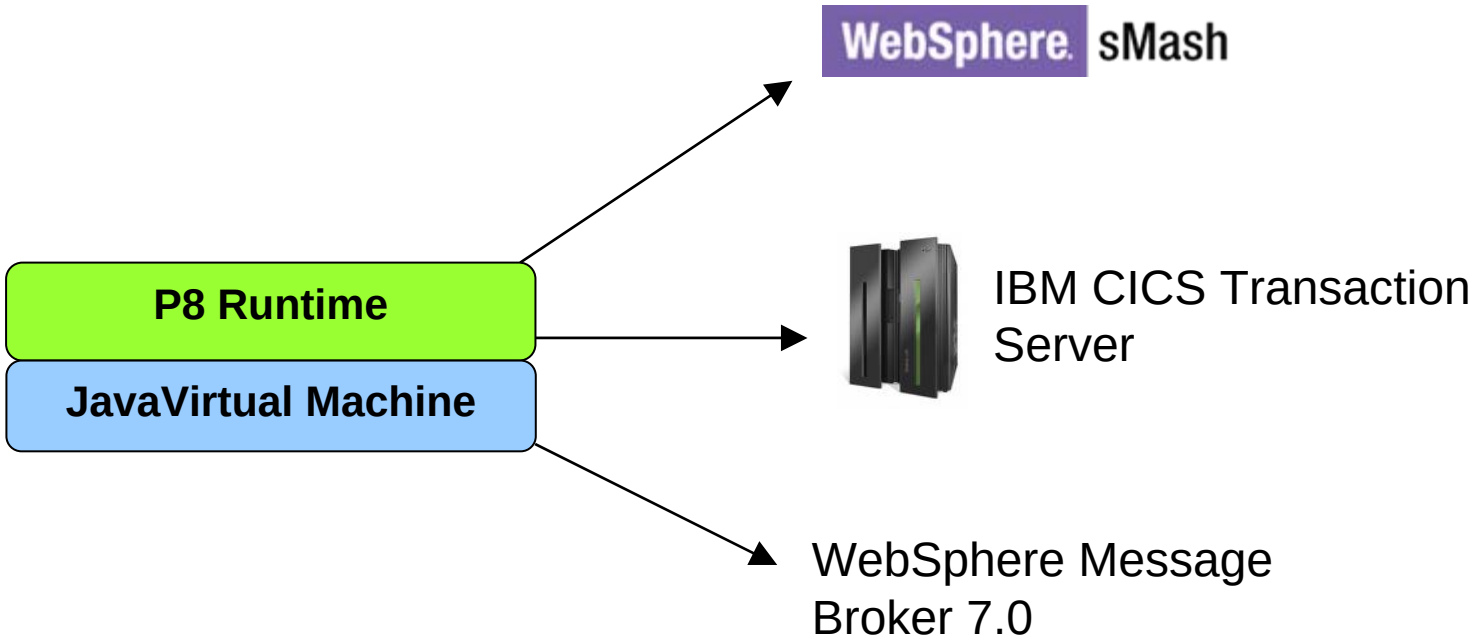
+

Java Community and Assets.

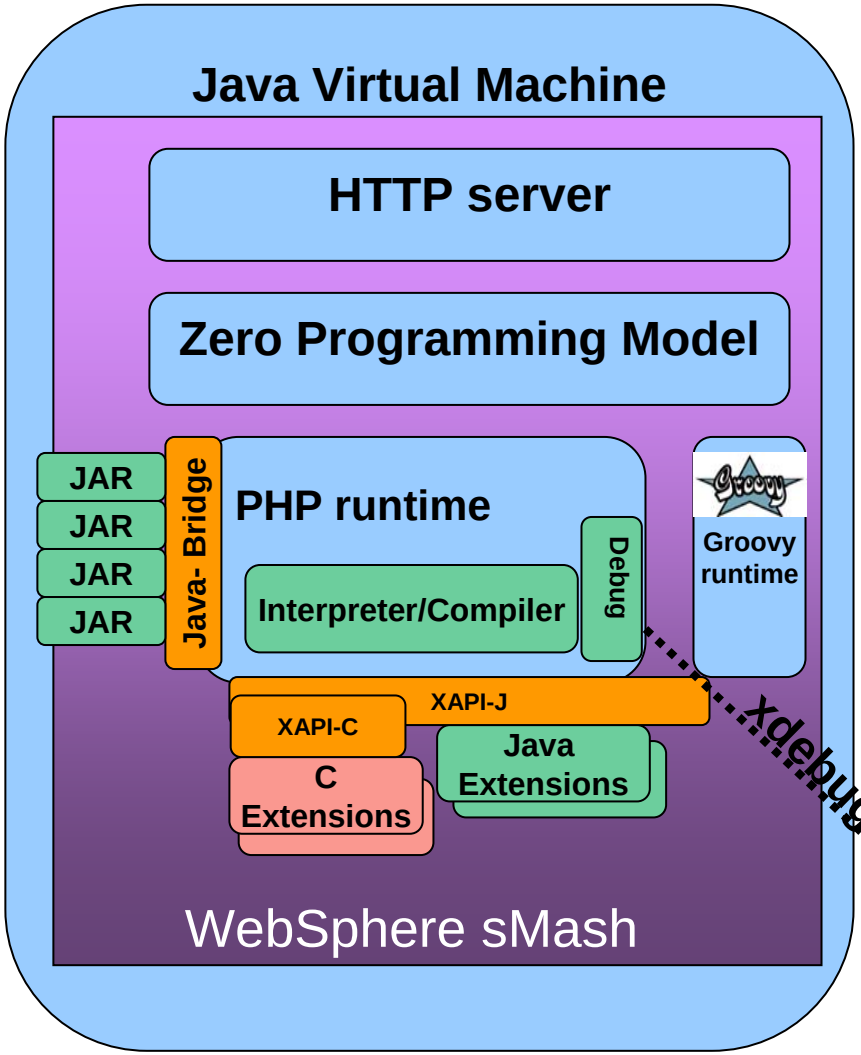
in

Java Platform environments

PHP in IBM Products.



PHP in WebSphere sMash



- Runs PHP 5 scripts
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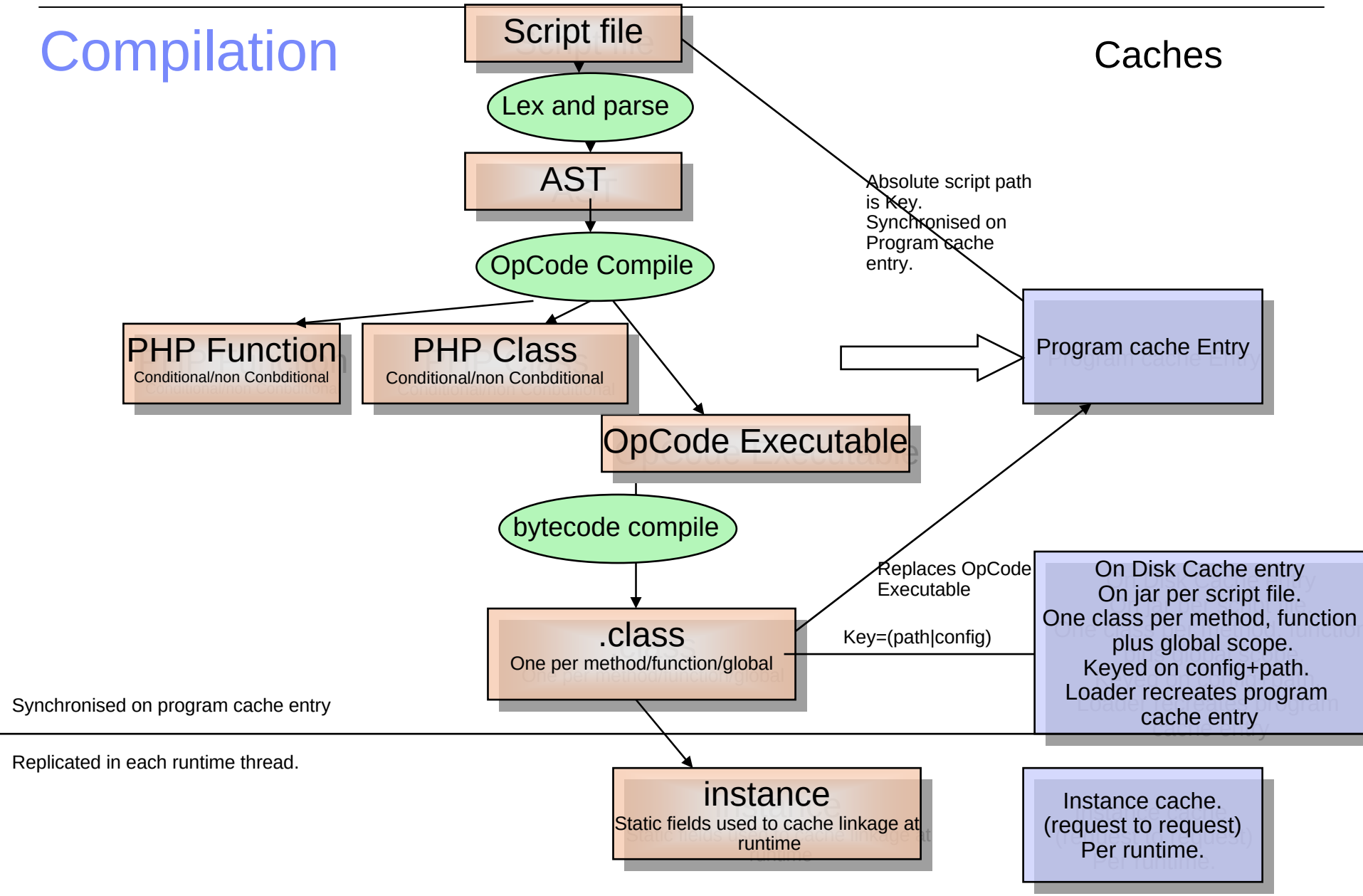
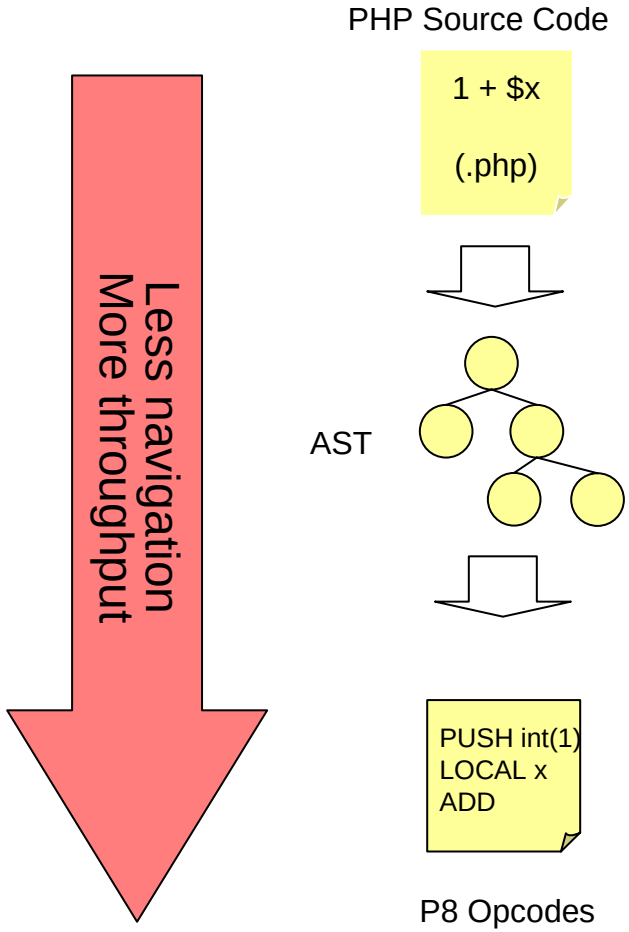
- Extensibility via XAPI
  - XAPI-C for C extensions from php.net
  - XAPI-J for Java extensions, native libraries invoked over JNI and Project Zero interface
  - Extension language choice opaque to PHP script
- Java Bridge
- Debug using via xdebug protocol using Eclipse with PDT

STOP!

Compilation

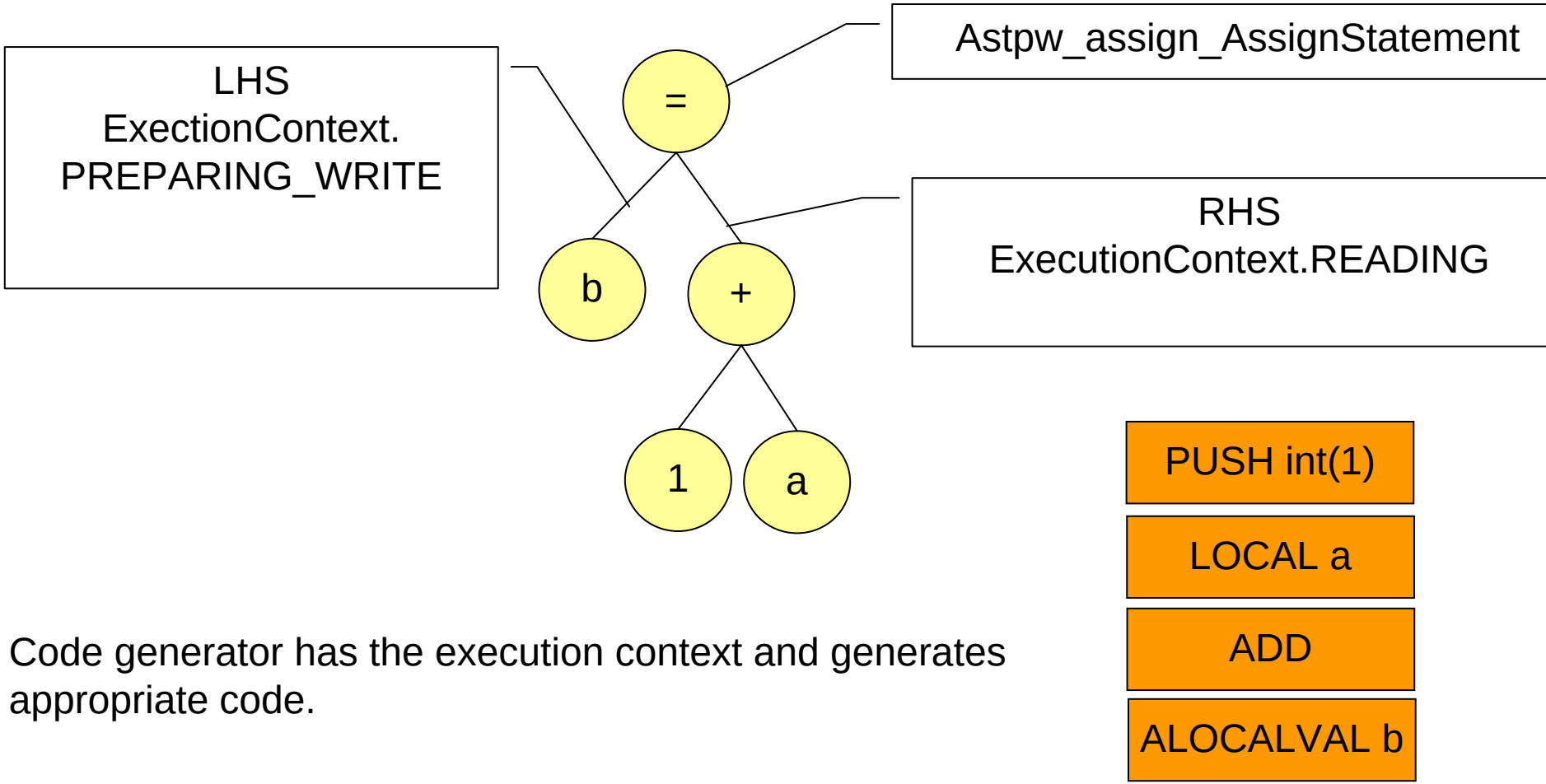


Code Generation



- 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.

Execution Context



Code generator has the execution context and generates appropriate code.

PHP evaluation order

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

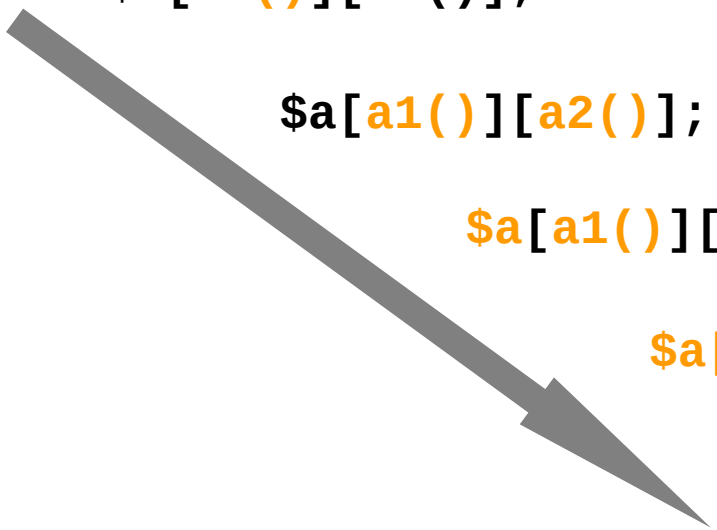
```
$a[a1()][a2()];
```
Call a1

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

```
$a[a1()][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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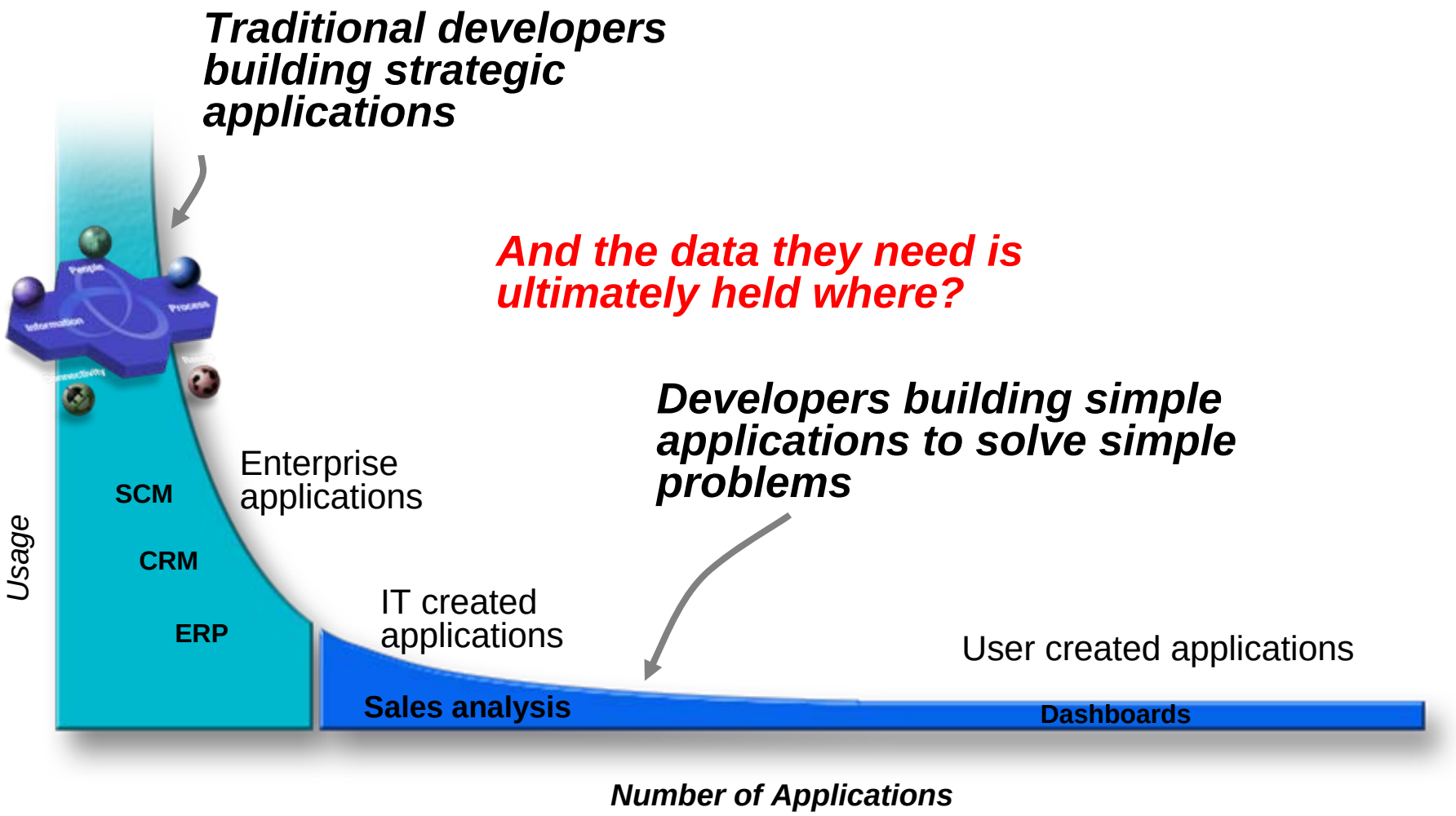
OLTP meets scripting... why?

- 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



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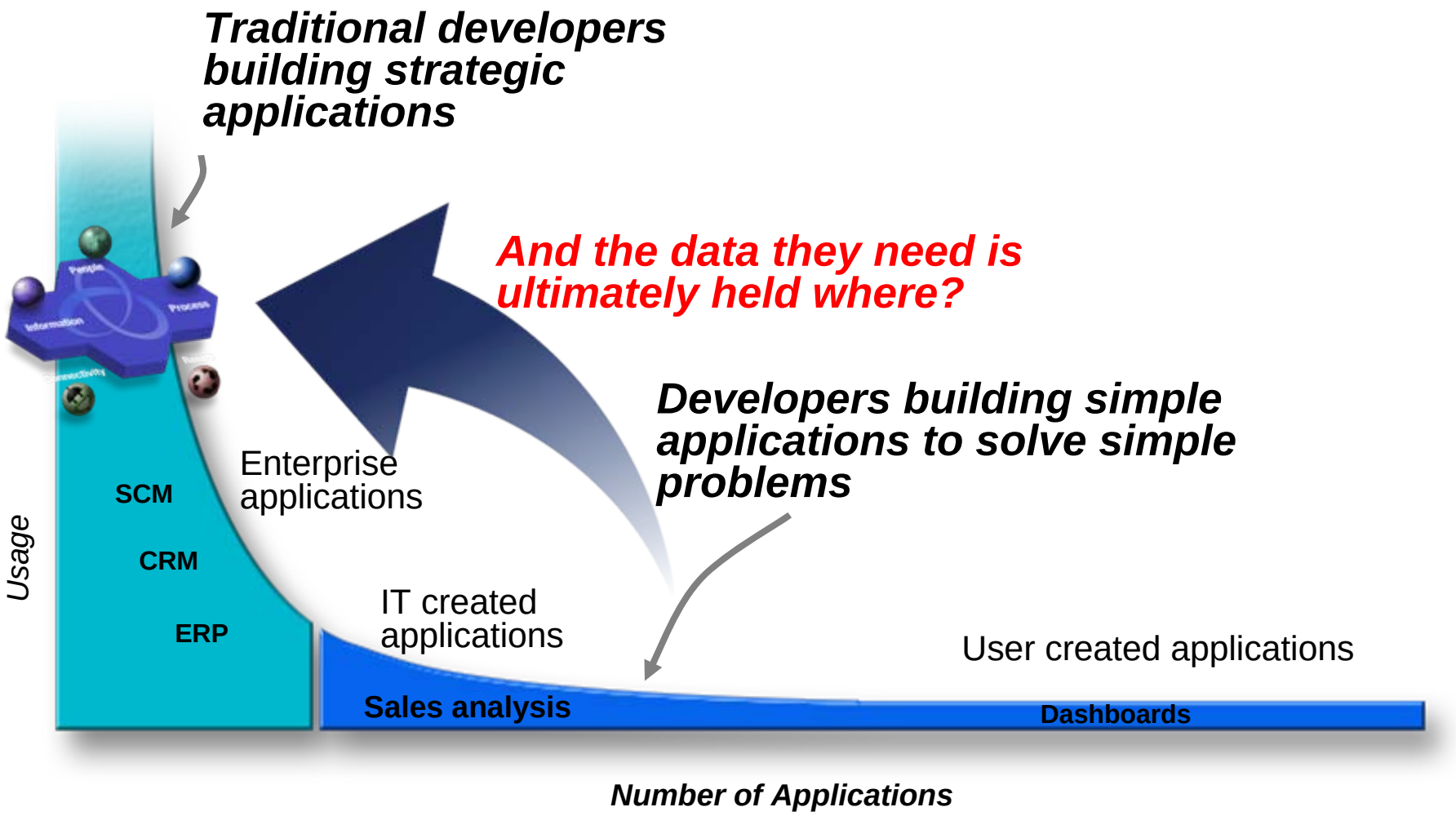
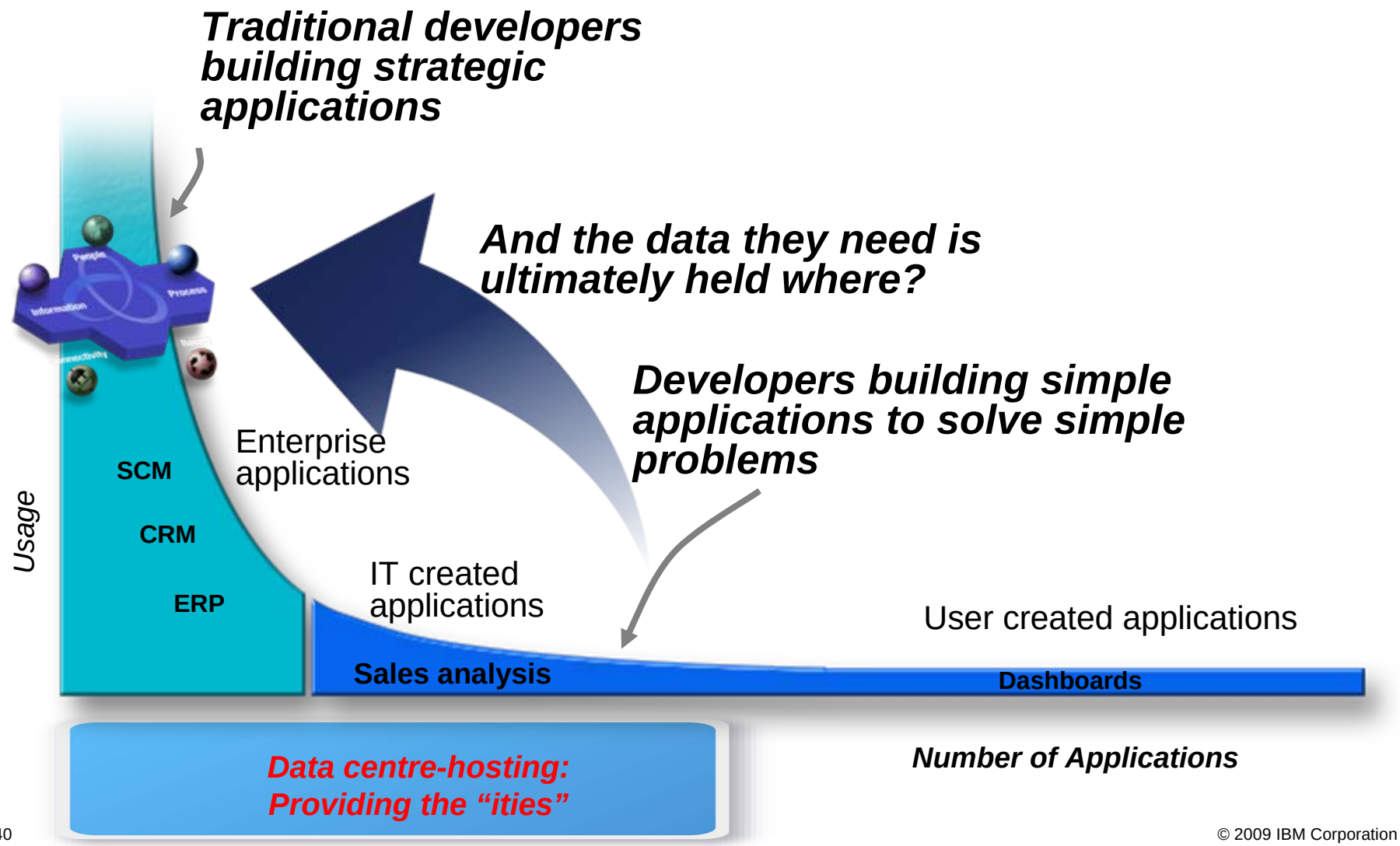


The Application Landscape



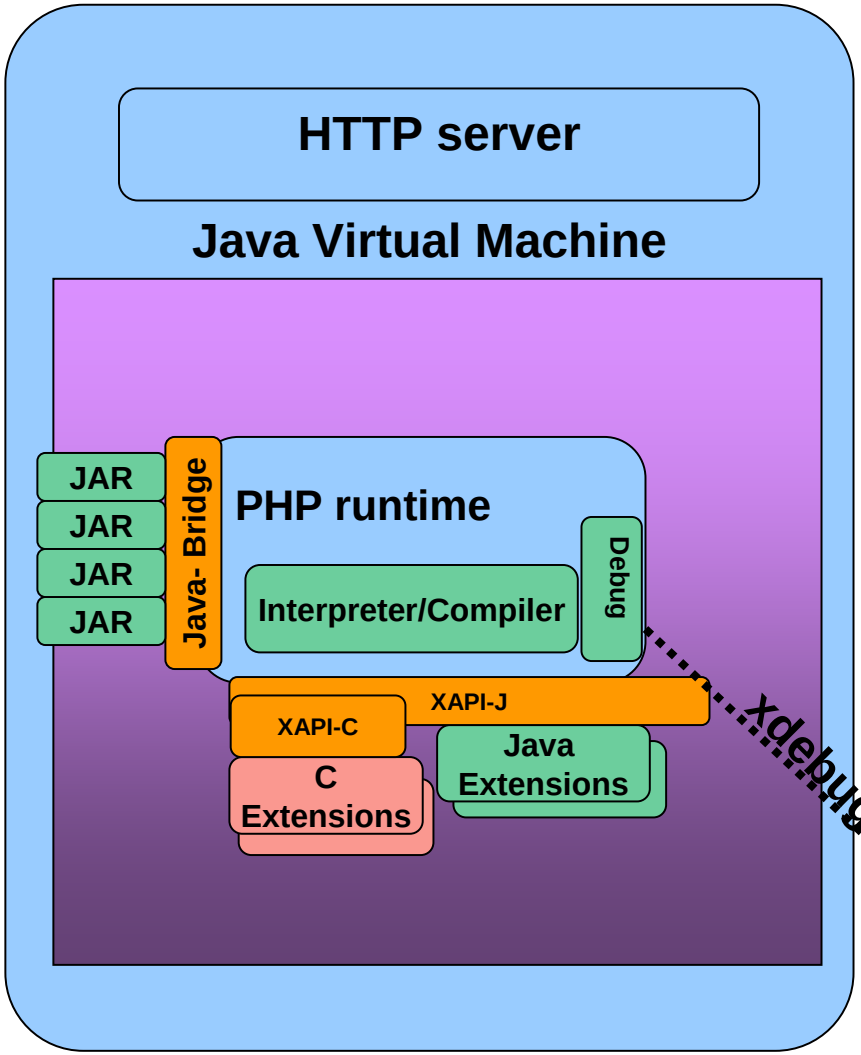
Web programming with PHP and CICS

- 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 „**Re**presentational **S**tate **T**ransfer“
- 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
- More info: http://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm

PHP in CICS Transaction Server

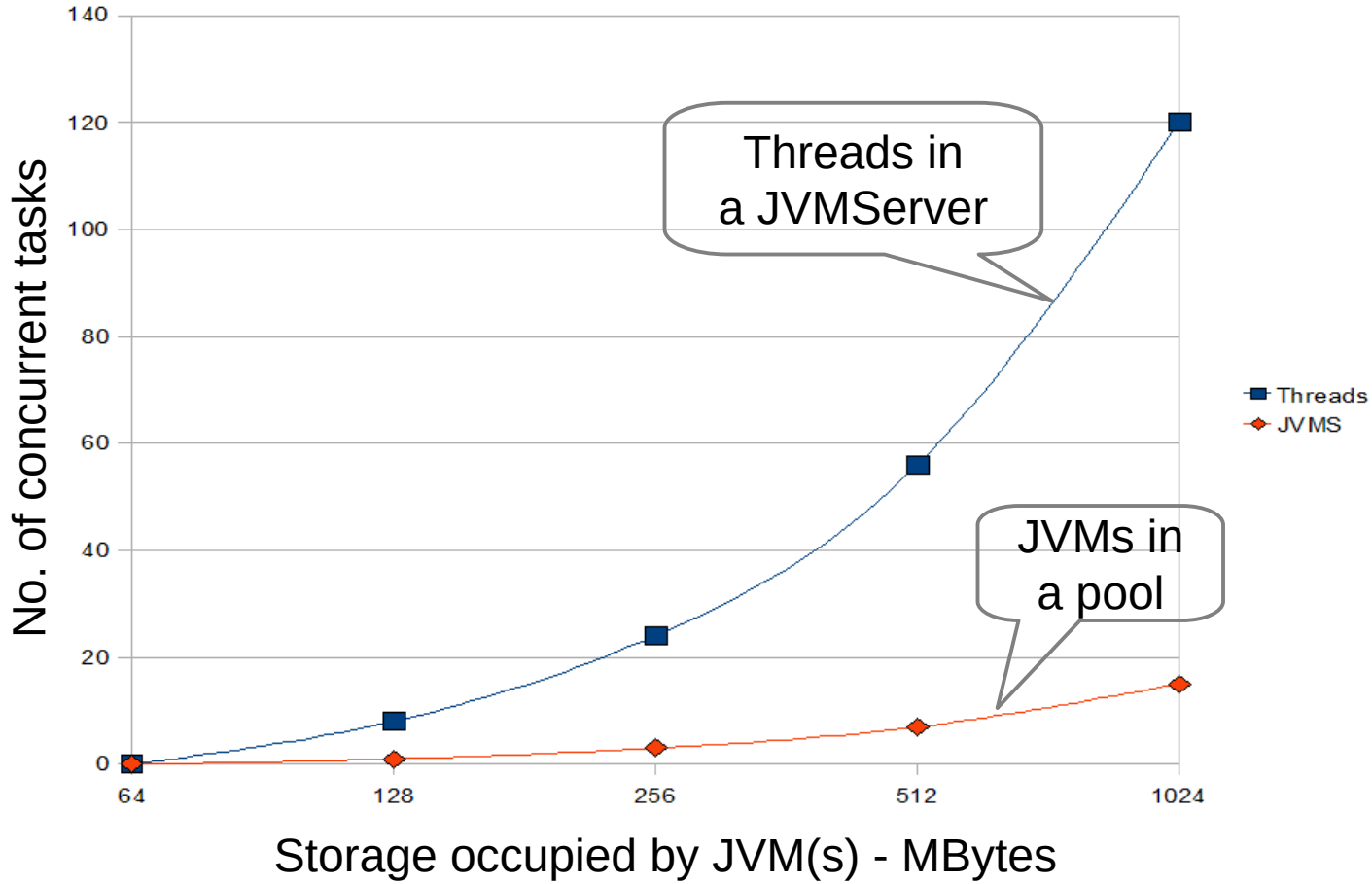


- Runs PHP 5 scripts
- Requires Java 5 SE or later. CICS v3.2
- Extensibility via XAPI
  - XAPI-C for C extensions from php.net Subset compiled for System z
  - XAPI-J for Java extensions, native libraries invoked over JNI and Project Zero interface
  - Extension language choice opaque to PHP script
- Java Bridge. Access to CICS and DB2
- Debug using via xdebug protocol using Eclipse with PDT

JVMServers

- 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?

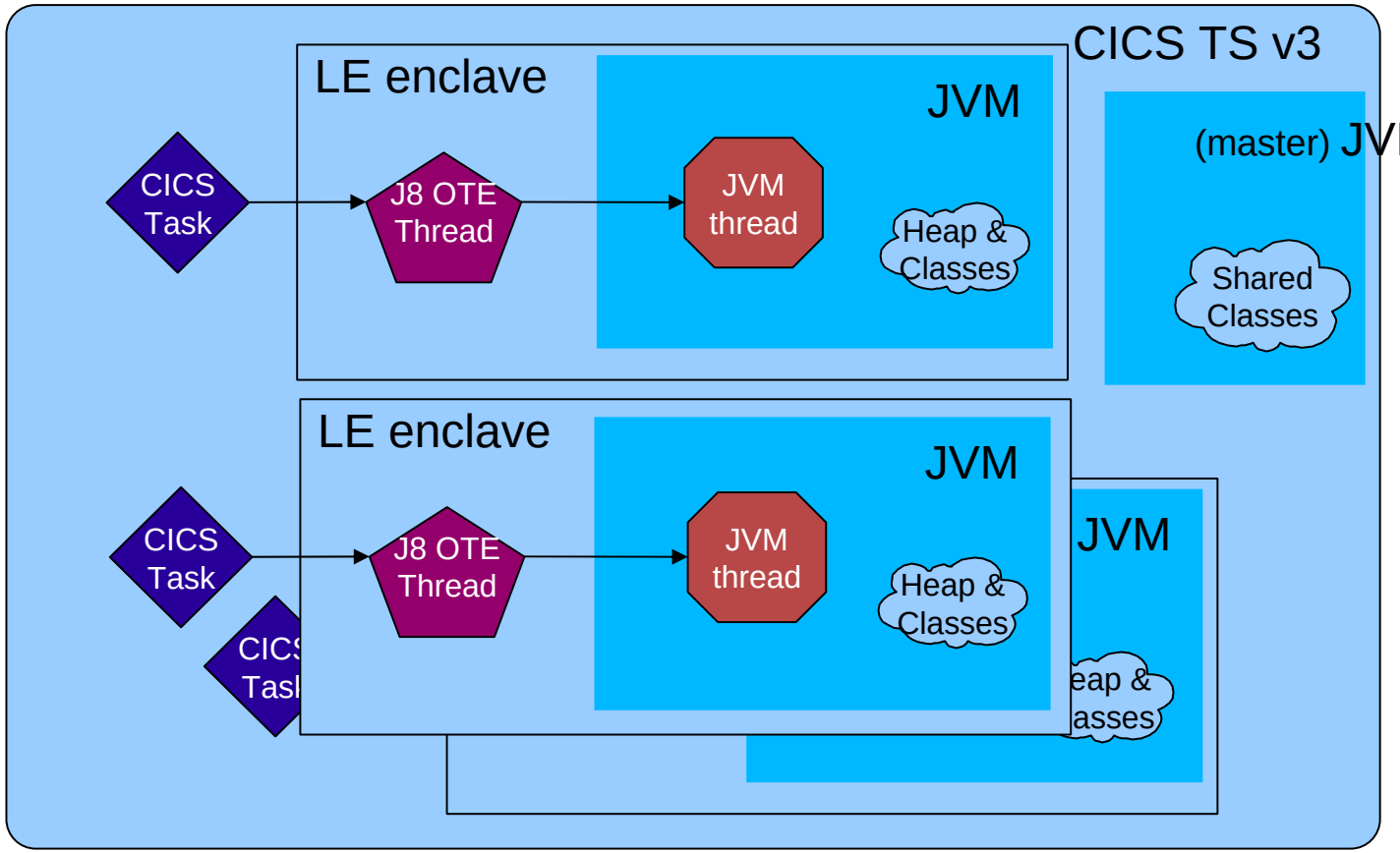
- JVMs up to now
  - Single task, serial reuse
  - Large memory footprint
  - Excellent isolation characteristics
- JVMServers
  - Multiple tasks (threads) in a JVM concurrently
  - Larger capacity
  - Risk of collateral damage
  - Not for customer application use in v4.1

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.

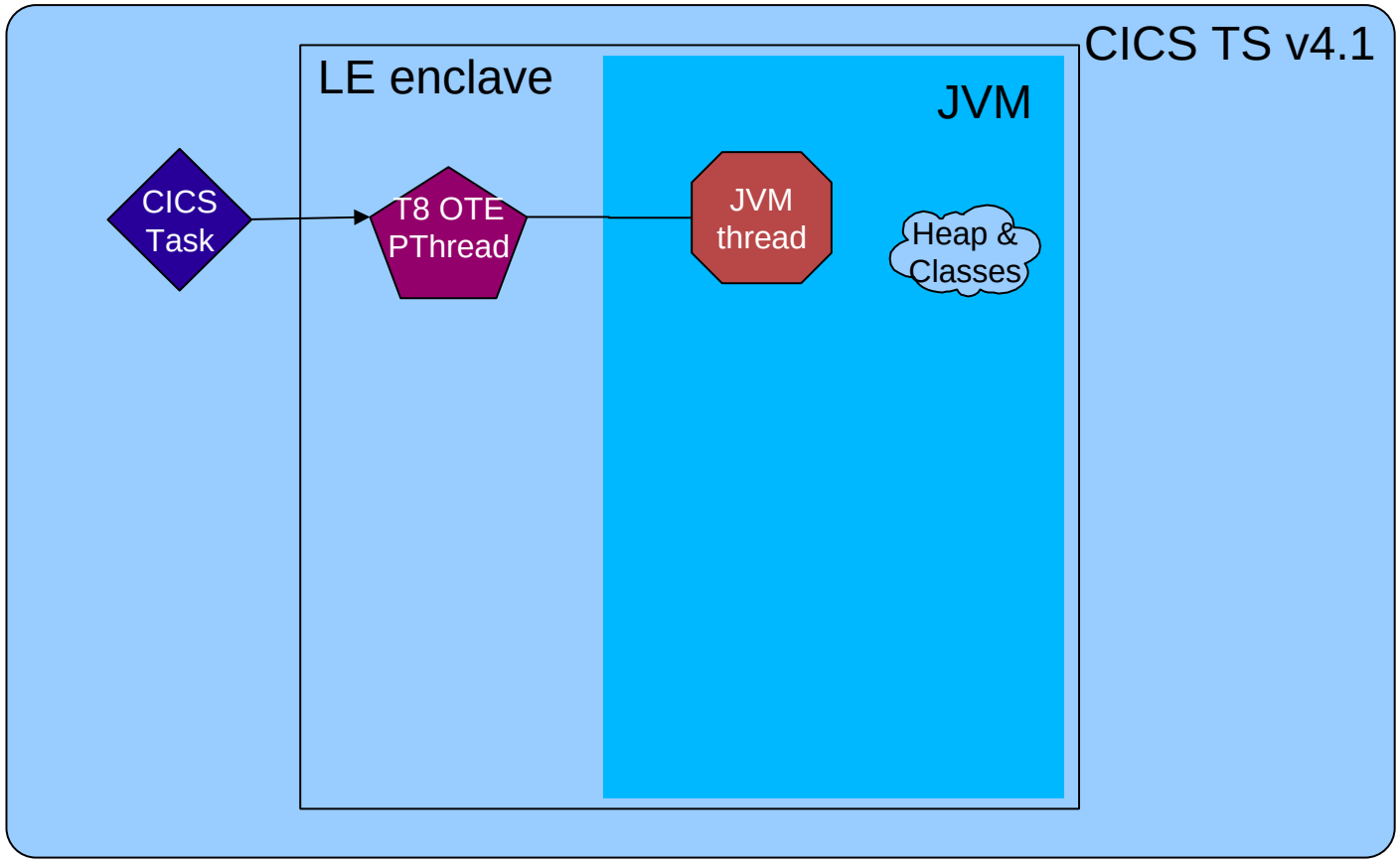


JVMServer Architecture

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.



JVMServer Architecture

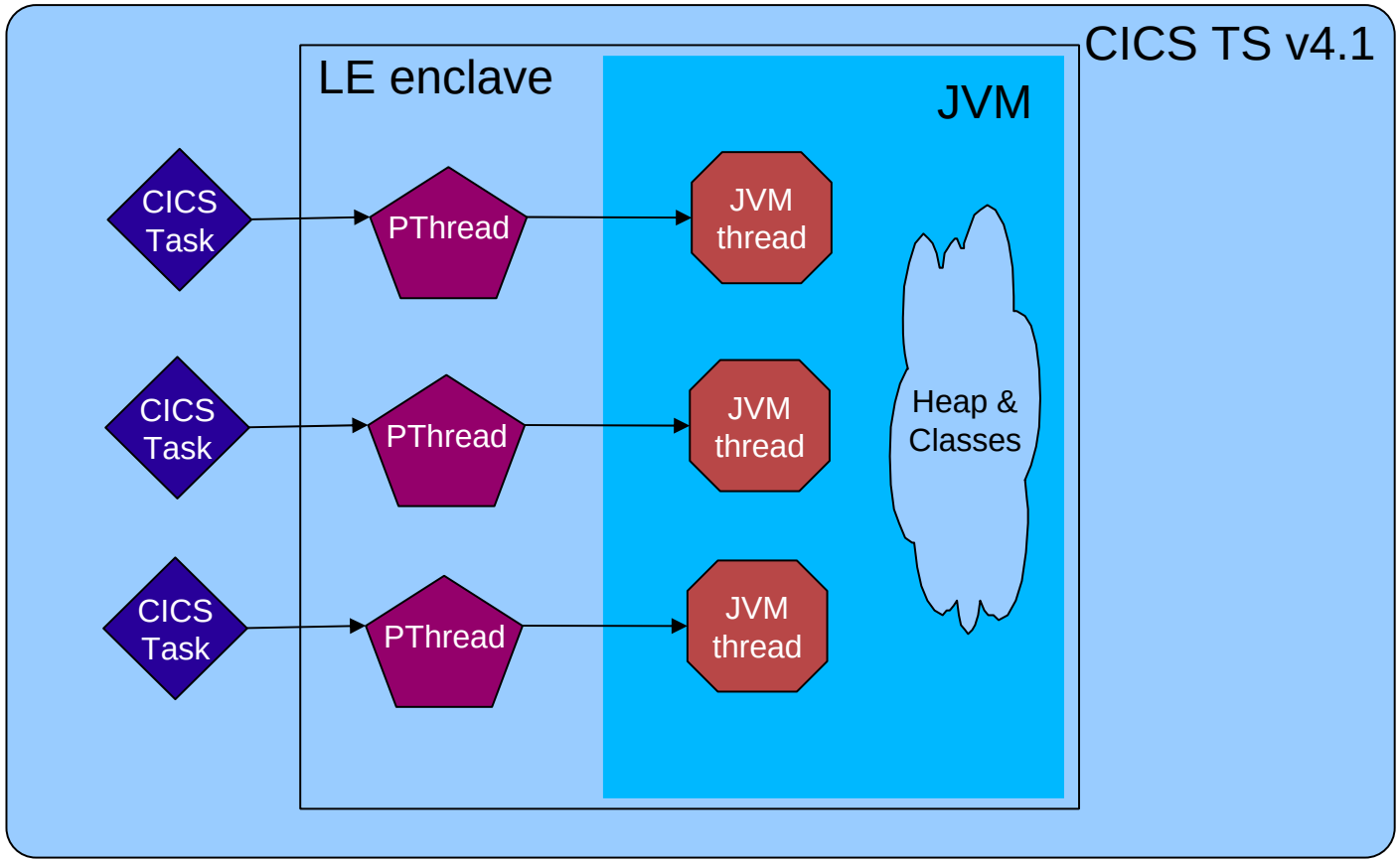
Can attach multiple pthread/T8/CICS tasks to the JVM at the same time.

Therefore serve more requests using a single JVM.

JVMServer thread "cost" is...

Very, very like a WAS servant region.

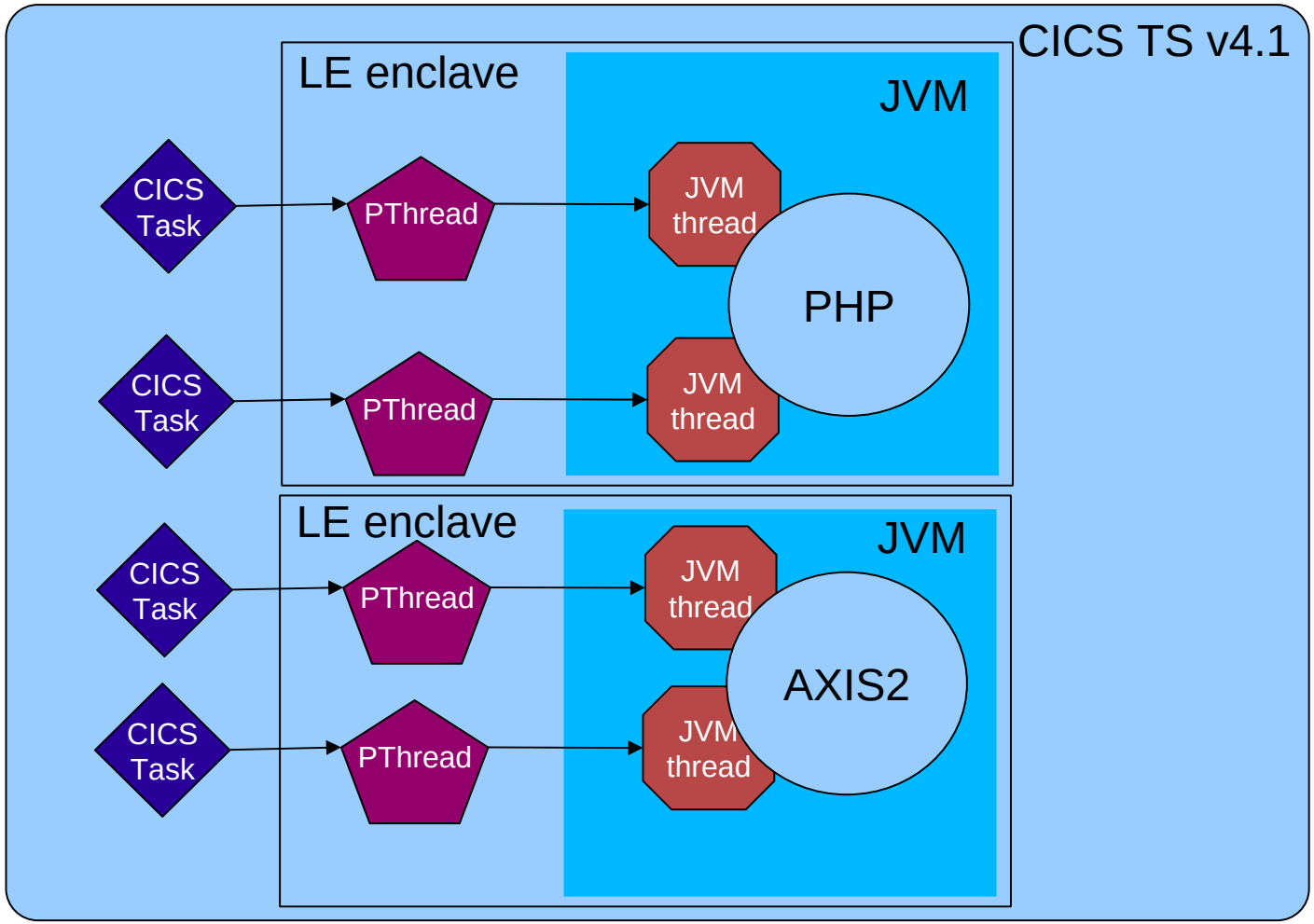
Result is .... tasks per region.



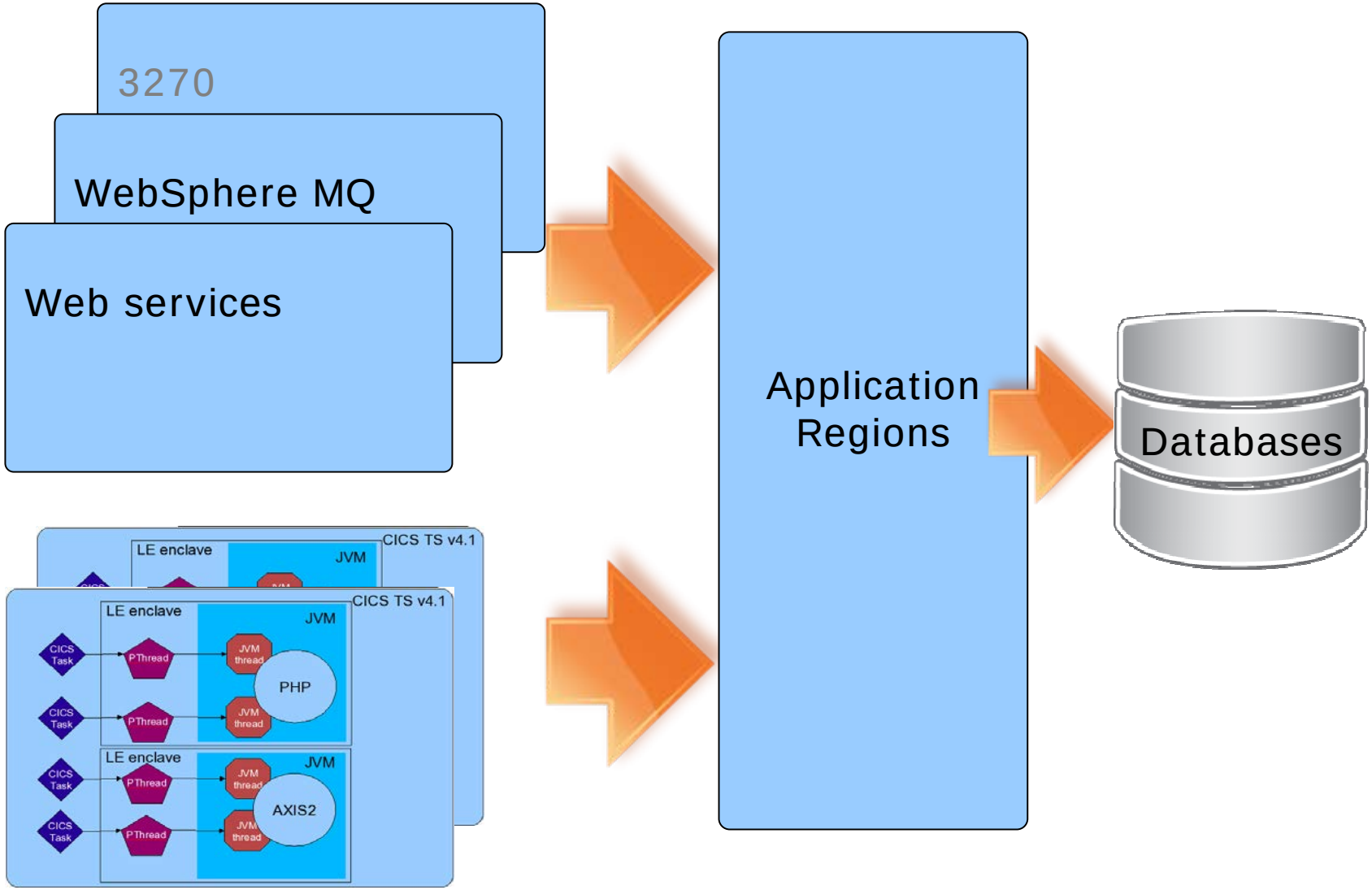
JVMServer Architecture

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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