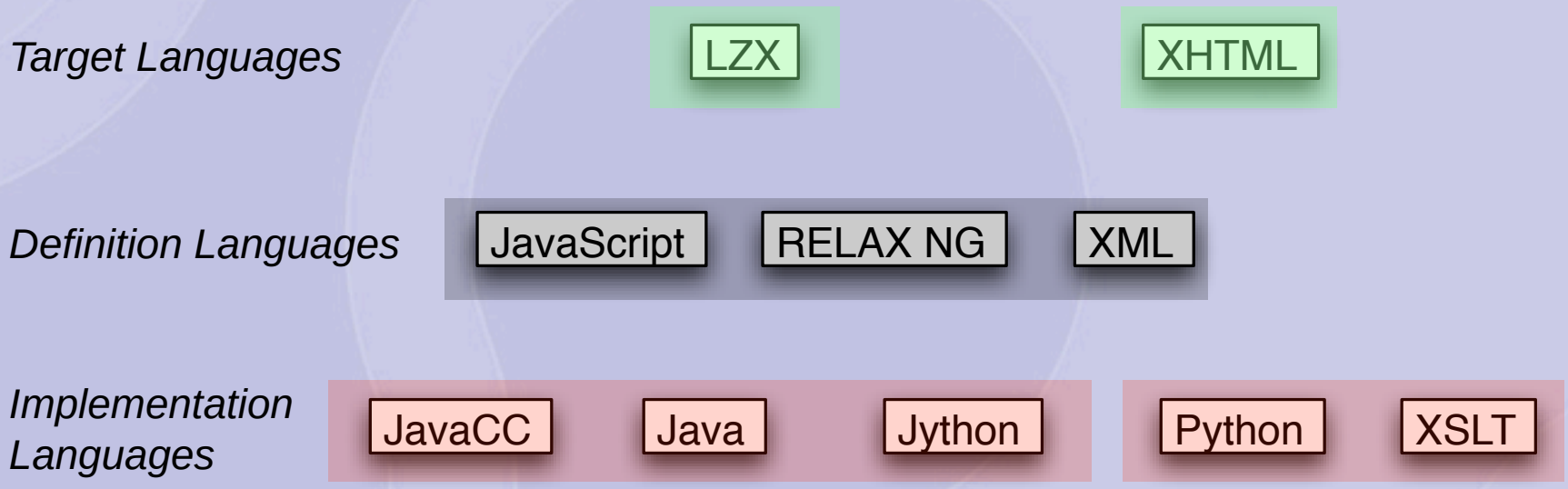
OpenLaszlo:
A Python Success Story

PyCon 2005

Oliver Steele
Chief Software Architect
Laszlo Systems, Inc.

March 23, 2005

Lots of Languages



Outline

- What we built
  - OpenLaszlo platform
  - Demos
  - Architecture
- How we built it
  - Script compiler
  - Cool features
  - Doc tools
  - Synergy
- What we learned
  - Technical challenges
  - Social challenges
  - Why it worked (and what didn't)

Laszlo Systems

- Founded in 2001
- Team from Apple, Adobe, Allaire, Excite, GO, Farallon, and Macromedia
- 20 developers in Boston and San Francisco Bay
  - (Looking for 21st)
- News
  - October 5, 2004: Platform released as Open Source
  - October 13, 2004: Company receives Series B funding
  - March 2005: Earthlink announces use of Laszlo Mail

Laszlo Vision

Develop and market Rich Internet Applications for customer-facing websites

Establish the Laszlo platform as the standard, open source software platform of choice for such applications

Demos

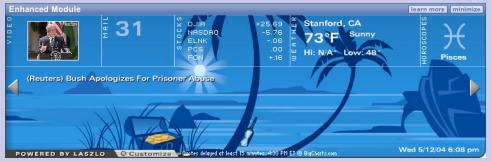
- Calendar
- Dashboard

Who Uses OpenLaszlo?

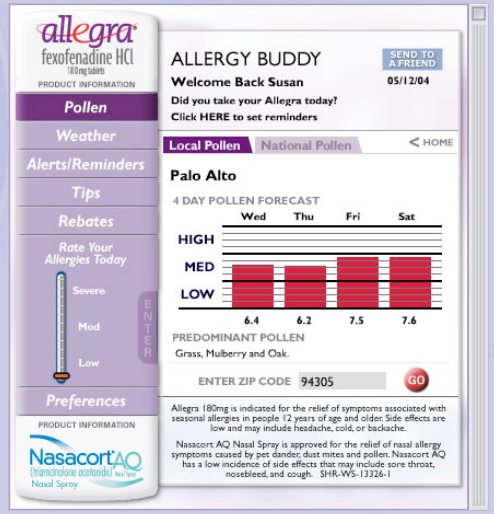
ZIFF DAVIS MEDIA

BEHR

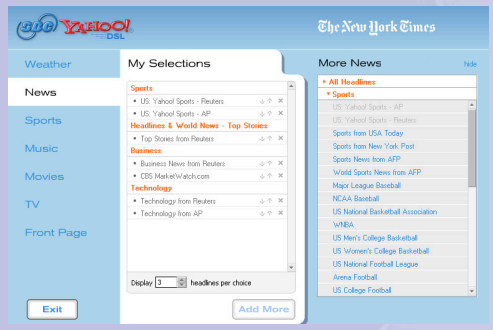
EarthLink



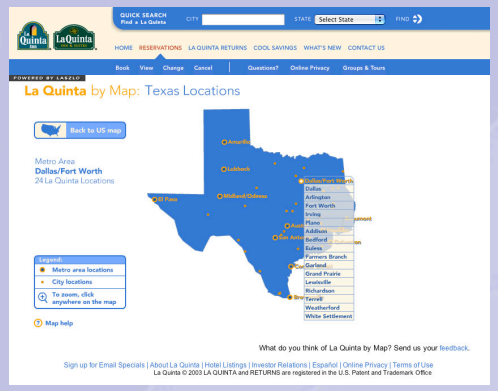
Aventis



SBC YAHOO! DSL

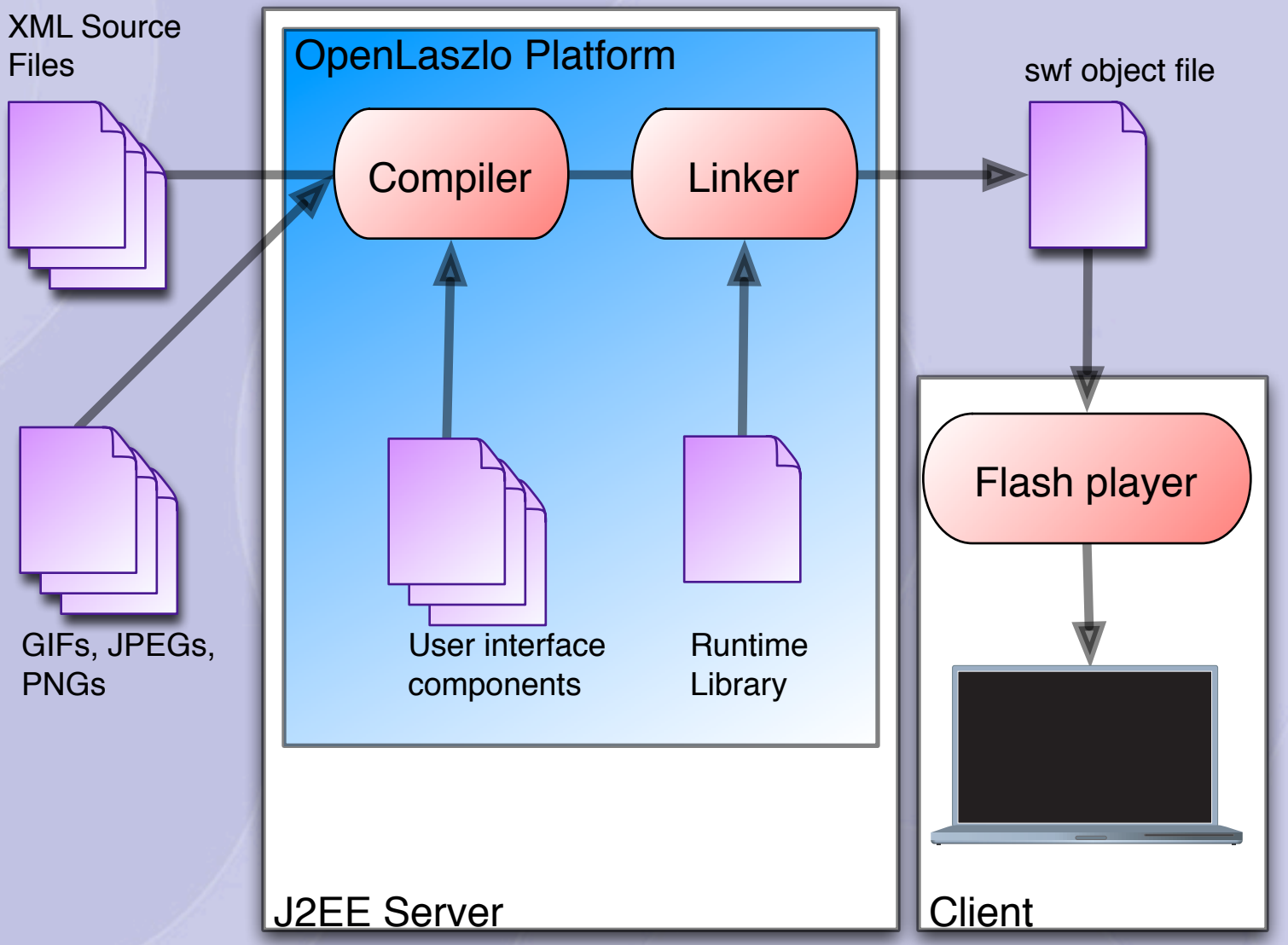


La Quinta Inn

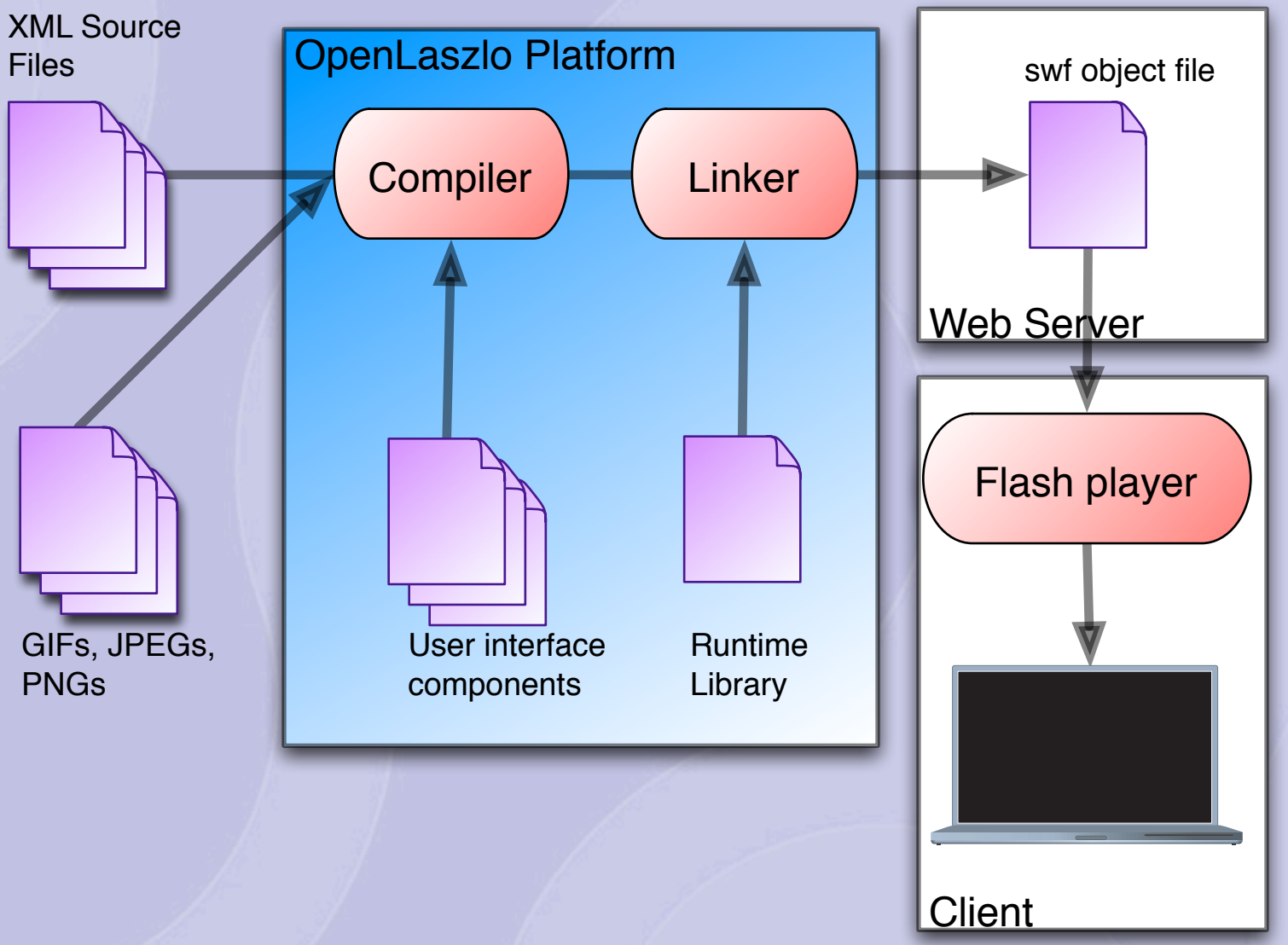


Over 20M consumers have used Laszlo-based applications

Under the Hood: Platform Architecture



Under the Hood (2): Removing the Server



Script Compiler

- Compiles JavaScript to Flash bytecode
- Plus unanticipated cool features

Laszlo Source Code (LZX)

```
<canvas>
  <window>
    <button
        onclick="
          animate('x', 100, 1000, true)">
      Click me!
    </button>
  </window>
</canvas>
```

- Source hierarchy mirrors object hierarchy
- Embedded JavaScript
- Constraints, data binding, and declarative states

Script Compiler

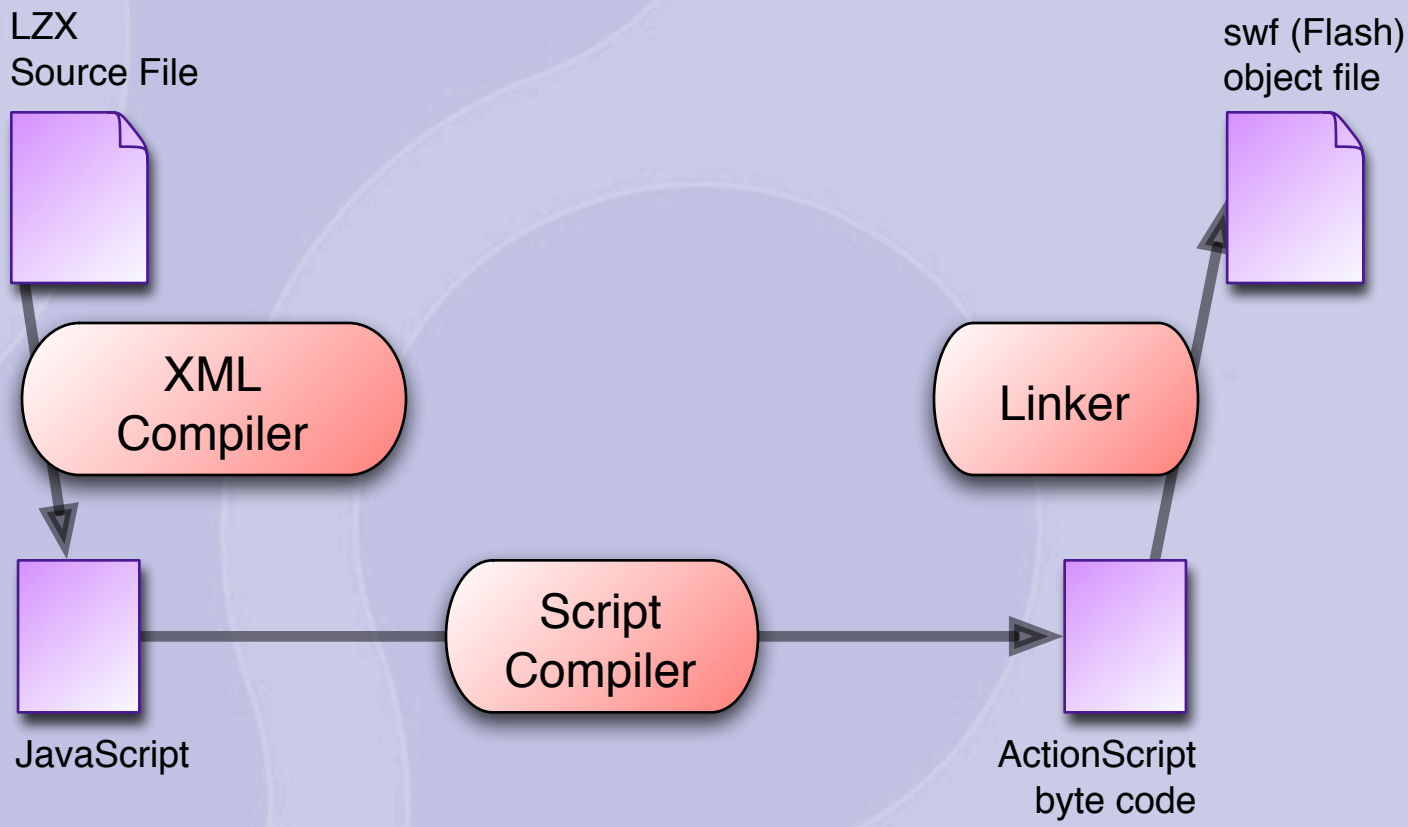
- Requirements
  - 100% Java
  - JavaScript -> ActionScript byte code
  - Three months (concurrent with language design, API design, XML compiler, and compiler architecture)
- Why not Java?
  - I'd written a lot of code in Java and Python, and didn't think I could write the Java version in time.
    - JWordNet
    - PyWordNet
- Evaluation
  - Java
  - Jython
  - SML
  - ICON

Script Compiler: The 10,000 foot view

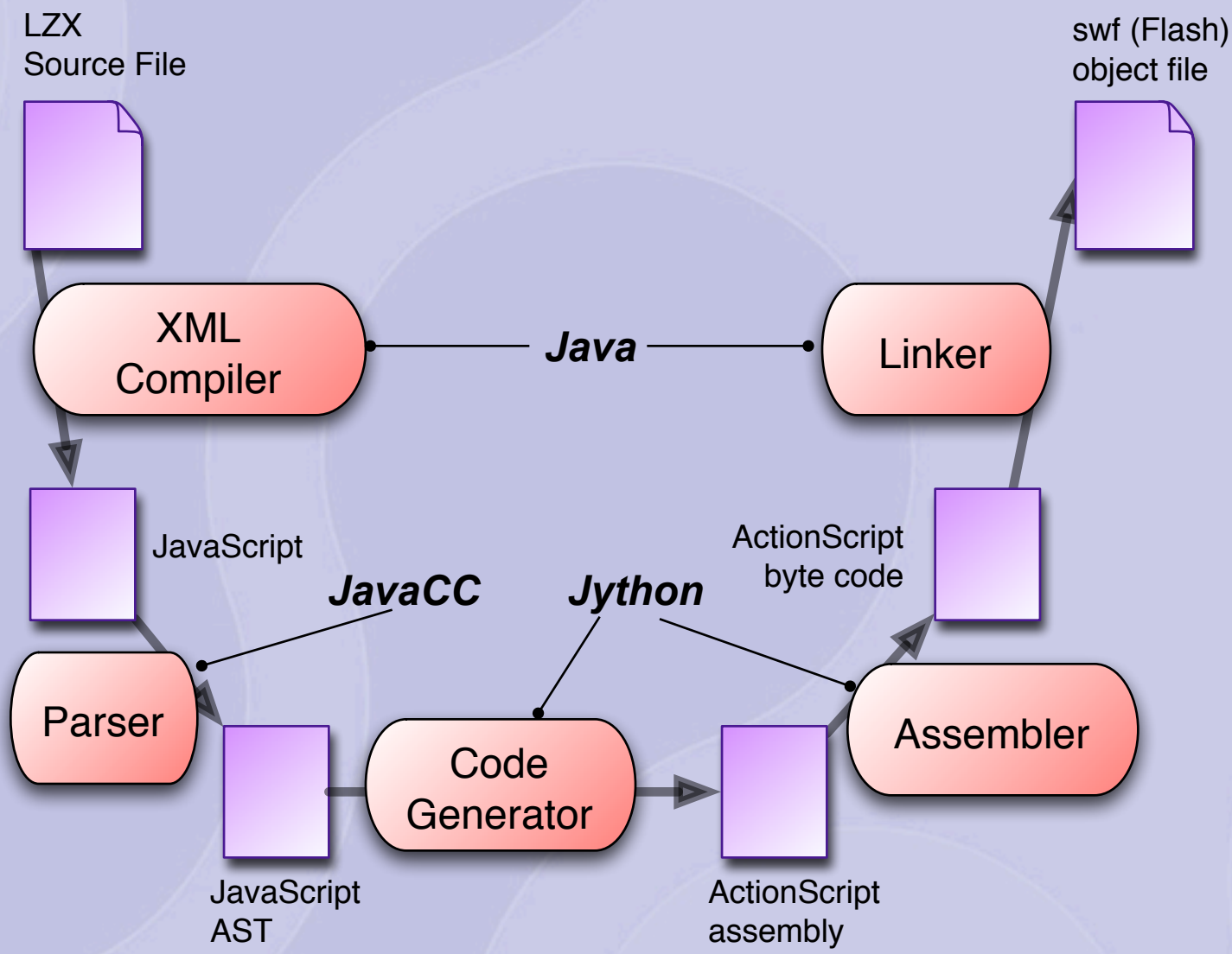

```
<window>
 <button>Click me!</button>
</window>
```

```
8845000800617474727300 6e61
6d65004c7a496e7374616e74696
1746556965770043 6c69636b2
06d6521006368696c6472656e0
077696e646f7700627574746f6e
007465787400960c0007020000
0008000700000000 43960d0008
0408000807080307010000 0043
9609000801080607020000 0043
9605000701000000 4296090008
0108050703000000 4396070007
0200000008023d1700
```

Script Compiler: The 5,000 foot view



Script Compiler: The 1,000 foot view



Compilation Stages

LZX (XML)

```
<window>
 <button>Click me!</button>
</window>
```

JavaScript

```
LzInstantiateView(
 {name: "window",
  attrs: {},
  children:
  [{name: "button",
    attrs: {text: "Click
me!"}}]},
 2);
```

ActionScript assembly

```
constants 'attrs' 'name'
'LzInstantiateView'
'Click me!' 'children'
'window' 'button' 'text'
push '2' 'attrs' '0'
initObject
push 'children' 'attrs'
'text' 'Click me!' '1'
initObject
push 'name' 'button' '2'
initObject
push '1'
initArray
push 'name' 'window' '3'
initObject
push '2'
'LzInstantiateView'
callFunction
pop
```

Byte code

```
88450008006
17474727300
6e616d65004c
7a496e737461
6e746961746
55669657700
436c69636b2
06d65210063
68696c64726
56e0077696e6
46f770062757
4746f6e00746
5787400960c
00070200000
00800070000
000043960d0
00804080008
07080307010
00000439609
00080108060
70200000043
96050007010
00000429609
00080108050
70300000043
96070007020
0000008023d
1700
```

Embedded JavaScript

```
<button onclick="animate('x', 100, 1000, true)"/>
```

```
LzInstantiateView(
 {name: "button",
  attrs: {
   $events:
    {onclick:
     function $test$2Elzx_2_52_onclick_event () {
      animate('x', 100, 1000, true)}},
   clickable: true}},
 1);
```

Results

- Three months
- 4.5K LOC (3K Jython, 1.5K Java + JavaCC)
- 25 bugs over three years

Jython Advantages

- REPL
- Literal syntax
- Doctest
- Reflection
- Java integration

REPL

```
>>> c('a=b')
  constants 'a' 'b'
  push 'a' 'b'
  getVariable
  setVariable
>>> c('a=a*2')
  constants 'a'
  push 'a' 'a'
  getVariable
  push '2'
  multiply
  setVariable
>>> c('function f(a,b) {return a+b}')
  function2 f(r:2='a', r:1='b') ()
    push 'r:2' 'r:1'
    add
    return
  end
```

Doctest

```
    def substitute(self, str, **keys):
        """Parse an expression and replace any identifier with the same
        name as a keyword argument to this function, with the value of
        that key.  If the value has type Splice, it's spliced into place
        instead of substituting at the same level.

        >>> s = Parser().substitute
        >>> s('[0,1,2]')
        (ASTArrayLiteral, Literal(0.0), Literal(1), Literal(2))
        >>> s('[_0,1,2]', _0=Literal("sub"))
        (ASTArrayLiteral, Literal(sub), Literal(1), Literal(2))
        >>> s('[_0,1,2]', _0=s('[a,b,c]'))
        (ASTArrayLiteral, (ASTArrayLiteral, ASTIdentifier(a), ASTIdentifier(b),
ASTIdentifier(c)), Literal(1), Literal(2))
        >>> s('[_0,1,2]', _0=Splice(s('[a,b,c]')))
        (ASTArrayLiteral, ASTArrayLiteral, ASTIdentifier(a), ASTIdentifier(b),
ASTIdentifier(c), Literal(1), Literal(2))

        N.B., there is no attempt to enforce macro hygiene
        """
```

Concise Literal Syntax

```
DefineTests(
    'label',
    Stmts(['a: while (f()) b: while (g()) {break; h()}',
           'a: while (f()) b: while (g()) {break b; h()}',
           'a: while (f()) b: while (g()) {break a; h()}',
           'a: while (f()) b: for (p in obj) {break; h()}',
           'a: while (f()) b: for (p in obj) {break b; h()}',
           'a: while (f()) b: for (p in obj) {break a; h()}',
           'a: for (p in obj) b: while (g()) {break; h()}',
           'a: for (p in obj) b: while (g()) {break b; h()}',
           'a: for (p in obj) b: while (g()) {break a; h()}',
           'a: for (p in obj) b: for (p in obj) {break; h()}',
           'a: for (p in obj) b: for (p in obj) {break b; h()}',
           'a: for (p in obj) b: for (p in obj) {break a; h()}',
           ]))
```

Reflection

```
def visit(self, node):
    fn = getattr(self, 'visit' + node.name)
    fn(node, *node.children)

def visitArrayLiteral(self, node, *args):
  ...

def visitBinaryExpressionSequence(self, node, a, op, *args):
 ...

def visitFunctionDeclaration(self, node, *args):
 ...

def visitIdentifier(self, node):
 ...

def visitLiteral(self, node):
 ...
```

Jython disadvantages

- Execution speed
- Deployment issues

Port Assembler to Java

- 1.2KLoC Jython -> 2.7KLoC Java
- Harder to work with
- But...10 times as fast

Deployment Issues

- Deploying Jython within a J2EE Servlet has (had?) severe class loader issues
- Jython triggered a memory manager error in JVM 1.4
- Jython 2.0/Java 1.5 issues

However...

- Xalan, Xerces, Jing, Commons Logging, and JDOM all had issues too

The First Pattern

- Jython saved us a lot of time during development, but cost (less) time during deployment.
- But so did several other Java libraries
- But this still makes it difficult to justify, especially to deployers (who don't see the development-time advantages)

And then we were done...

Constraint System (Laszlo 1.0)

Requirements

- Width of view is a ***function of parent's width and view's 'border' property***
- Width is updated whenever parent's width changes
- Width is updated whenever 'border' property value changes

Observer Pattern

```
<view>
  <method event="oninit">
    registerListener(parent, 'width', myWidthListener);
    registerListener(this, 'border', myWidthListener);
    myWidthListener();
  </method>
  <method name="myWidthListener">
    this.width = parent.width - 2*this.border;
  </method>
</view>
```

Constraint expression

```
<view width="${parent.width - 2*this.border}"/>
```

Constraint Implementation

```
<view width="${parent.width - 2*this.border}"/>
```

```
LzInstantiateView(
 {attrs: {
  name: "view",
  $refs: {
   width: function $test$2Elzx_2_46_width_always () {
    this.setAttribute("width",
      parent.width - 2*this.border)}}}},
 1);
```

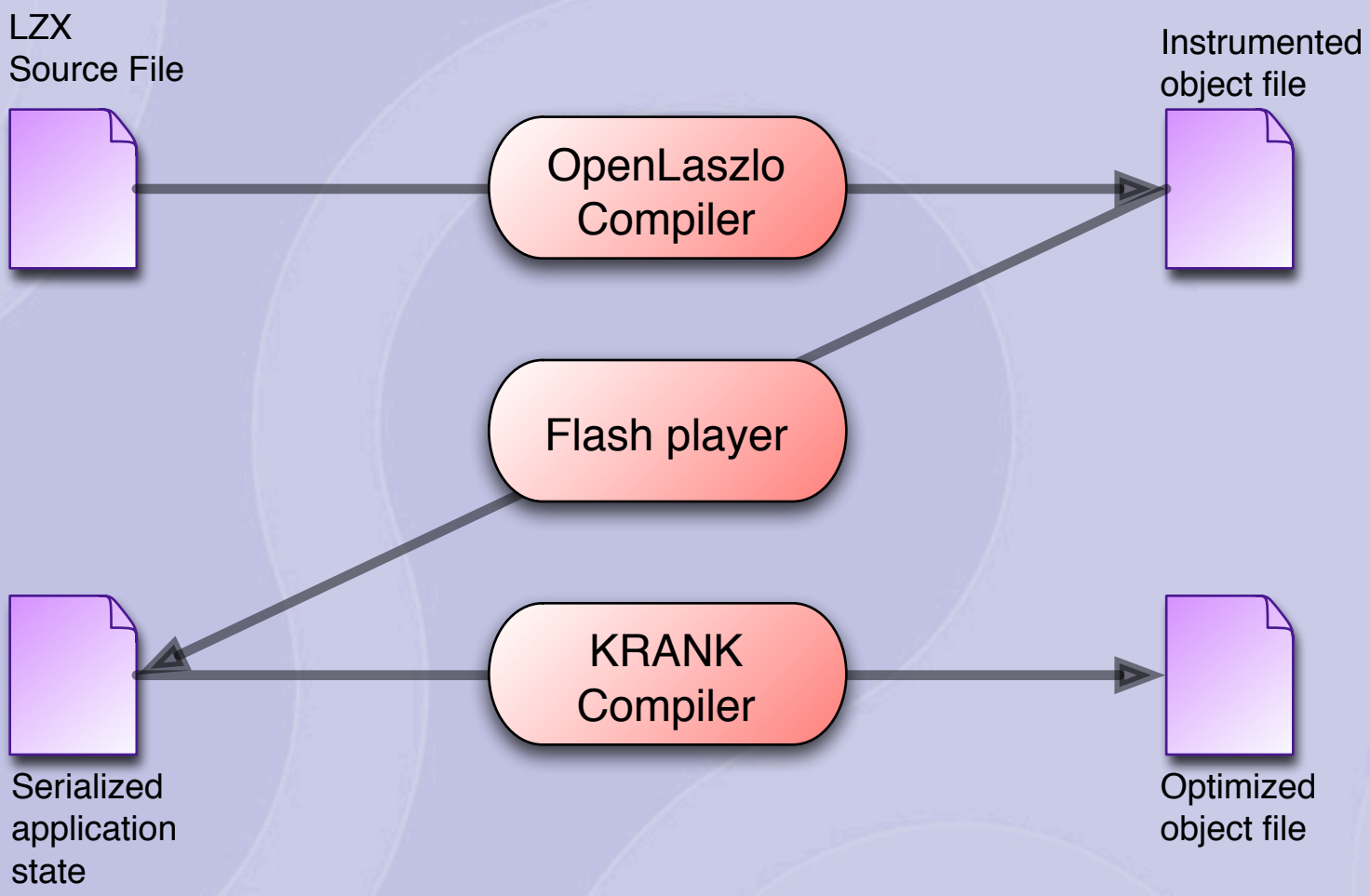
```
  $test$2Elzx_2_46_width_always.dependencies =
   [parent, 'width', this, 'border']
```

And then we were done...

KRANK Feature (Laszlo 2.0)

- Problem: Slow initialization time
- Solution: Initialize the application prior to deployment
- Results: 2-4x performance increase, at expense of developer time and application size

KRANK feature



But now we're really done..

The Second Pattern

- Python (Jython) is good for prototyping
- But, you don’t know when you’re done prototyping

OpenLaszlo Doc Tools

If false, the grid will never show a horizontal scrollbar, even if the rows are wider than the grid.

Attributes inherited from Basecomponent

doesenter, enabled, hasdefault, isdefault, style, styleable, text

Attributes inherited from Basegrid

bgcolor0, bgcolor1, columns, contentdatapath, hilite, multiselect, rowheight, selectable, showhlines, shownitems, showvlines, sizetoheader, spacing

Attributes inherited from Node

classroot, cloneManager, datapath, id, ignoreAttribute, immediateparent, initstage, name, nodeLevel, onconstruct, oninit, parent, placement, subnodes

Attributes inherited from View

align, bgcolor, clickable, clickregion, clip, cursor, defaultplacement, fgcolor, focusable, focustrap, font, fontsize, fontstyle, frame, framesloadratio, hassetheight, hassetwidth, height, layout, loadratio, mask, onblur, onclick, ondata, ondblclick, onfocus, onkeydown, onkeyup, onmousedown, onmouseout, onmouseover, onmouseup, onselect, opacity, options, pixellock, play, resource, resourceheight, resourcewidth, rotation, selected, selectiontype, source, stretches, subviews, totalframes, unstretchedheight, unstretchedwidth, valign, visible, width, x, xoffset, xscale, y, yoffset, yscale

Methods

Methods inherited from basecomponent

doEnterDown, doEnterUp, doSpaceDown, doSpaceUp, setStyle, setTint, updateDefault

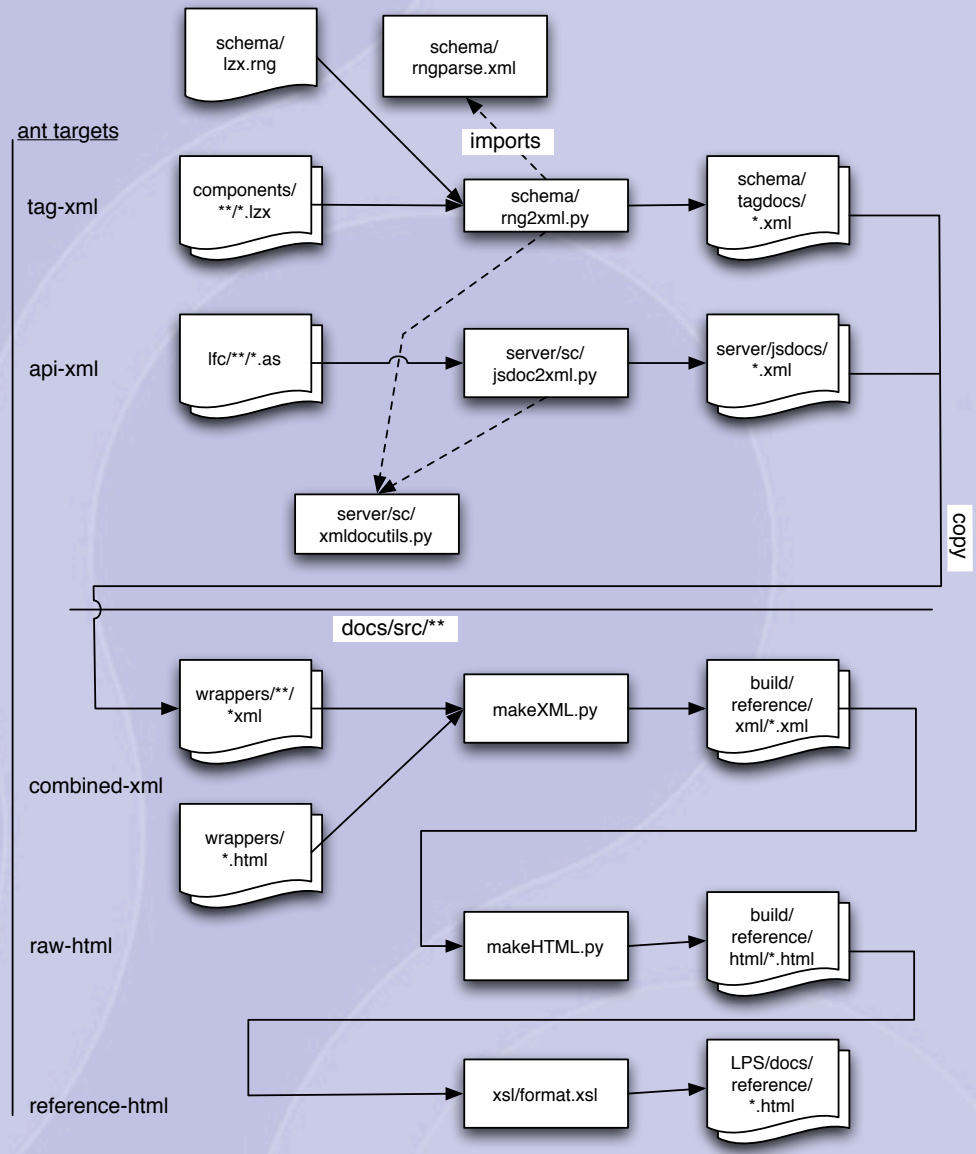
Methods inherited from basegrid

clearSelection, clearSort, getIndexForItem, getItem, getItemAt, getNumItems, getSelection, removeItemAt, select, selectItem, selectItemAt, selectNext, selectPrev

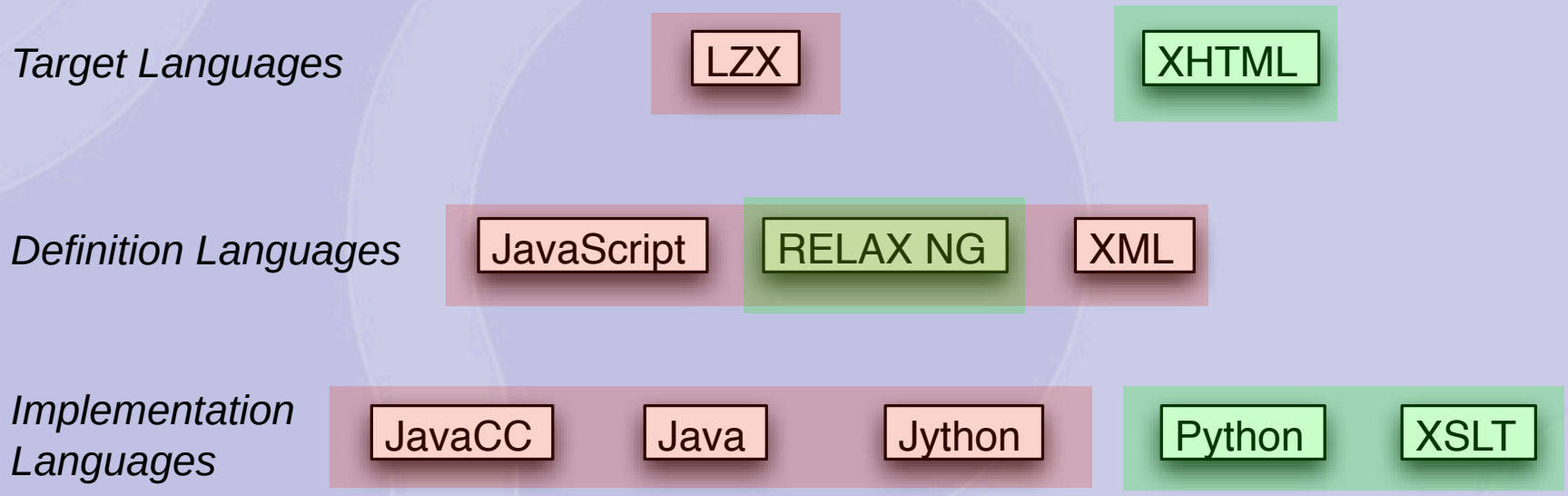
Methods inherited from LzNode

animate, applyConstraint, applyData, childOf, completeInstantiation, createChildren, dataBindAttribute, destroy, determinePlacement,

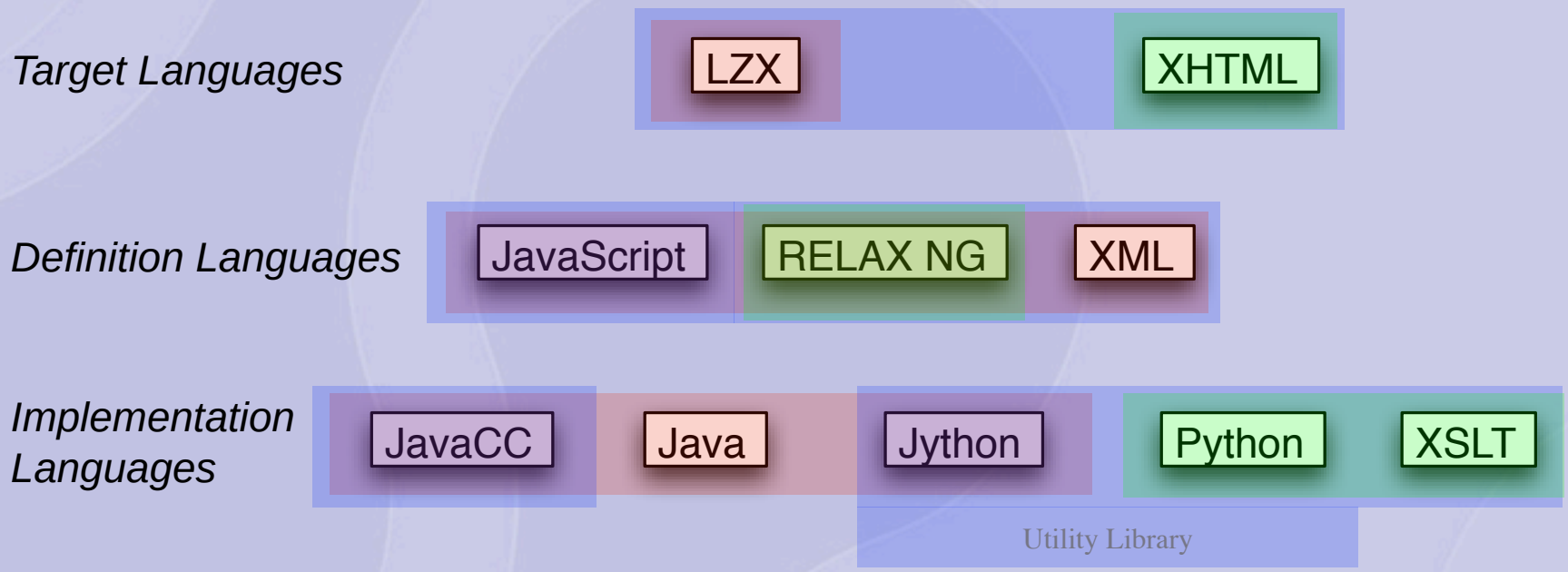
OpenLaszlo Doc Tools



Lots of Languages: Developers Guide



Lots of Languages: LZX Reference



The Third Pattern

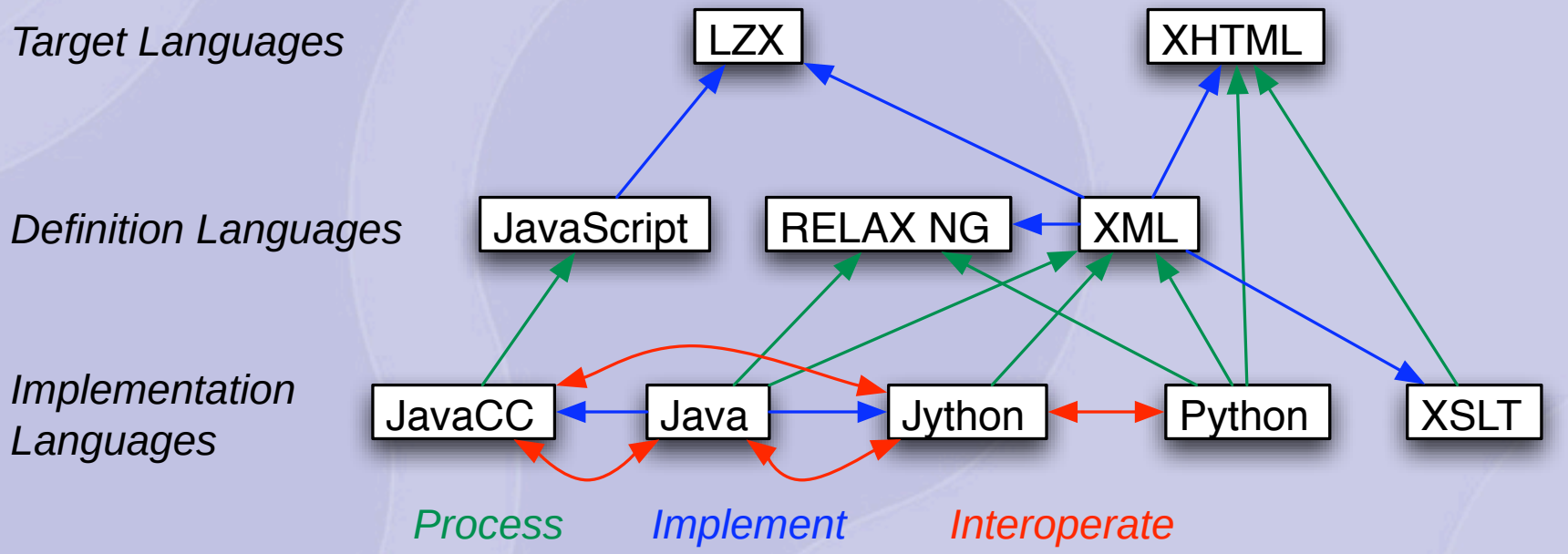
- There are different requirements for build system and deployment
- Components may move between build system and deployment...
- ...or be shared by both

Conclusions

Experimentation

- Let us experiment with new features:
  - Krank
  - Constraints
  - PUSH merge
  - Macros
- Swings of “I wish we had ported” vs. “I’m glad we didn’t port yet”
- Don’t know when you’re done prototyping

Lots of Languages (2)



Migration

- Smooth path between Python and Jython
- Possible path between Jython and Java
- Excellent integration between Jython and Java-based tools

What would help Jython?

- Smoother path to performance
- Smoother path to deployment

Q & A