CCA
Common Component Architecture

BABEL

version 0.99.0 (aka 1.0rc1)

This changes everything…
… and change is GOOD

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We’re celebrating!

- **With 0.99.0, We’ve satisfied every item on our 1.0 release criteria**
- **The 1.0 Release Criteria document has been our roadmap since Dec 2003**

0.99 is a major change

1. **Complete rewrite of Parser**
2. **Changed Type Resolution**
3. **Modifications to SIDL**
4. **Improved babel-{cc,cxx,f77,f90} scripts**
5. **Significant RMI & multithreading improvements**
6. **A new feature we haven't found a name for yet**

1. Complete Rewrite of the Parser

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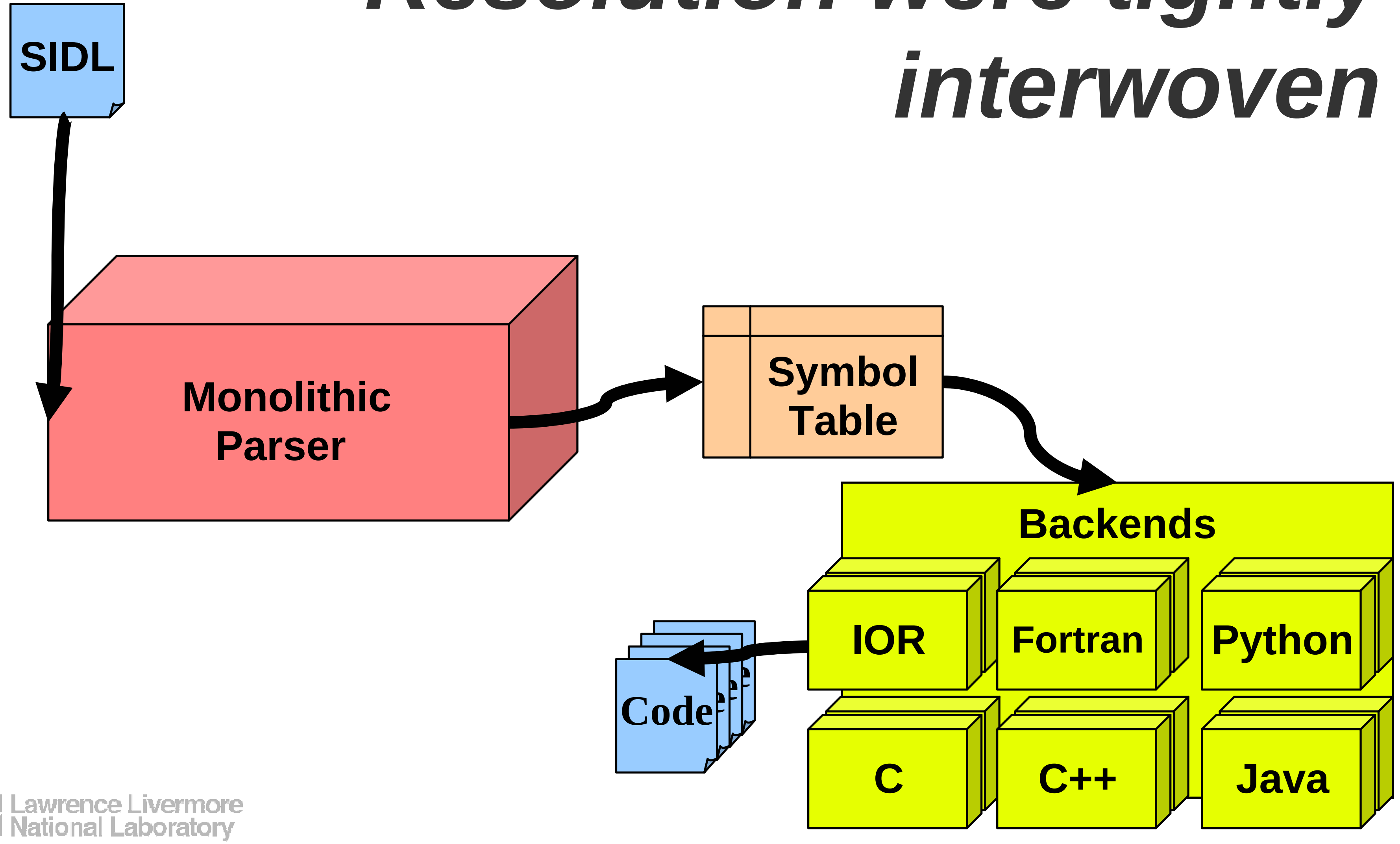
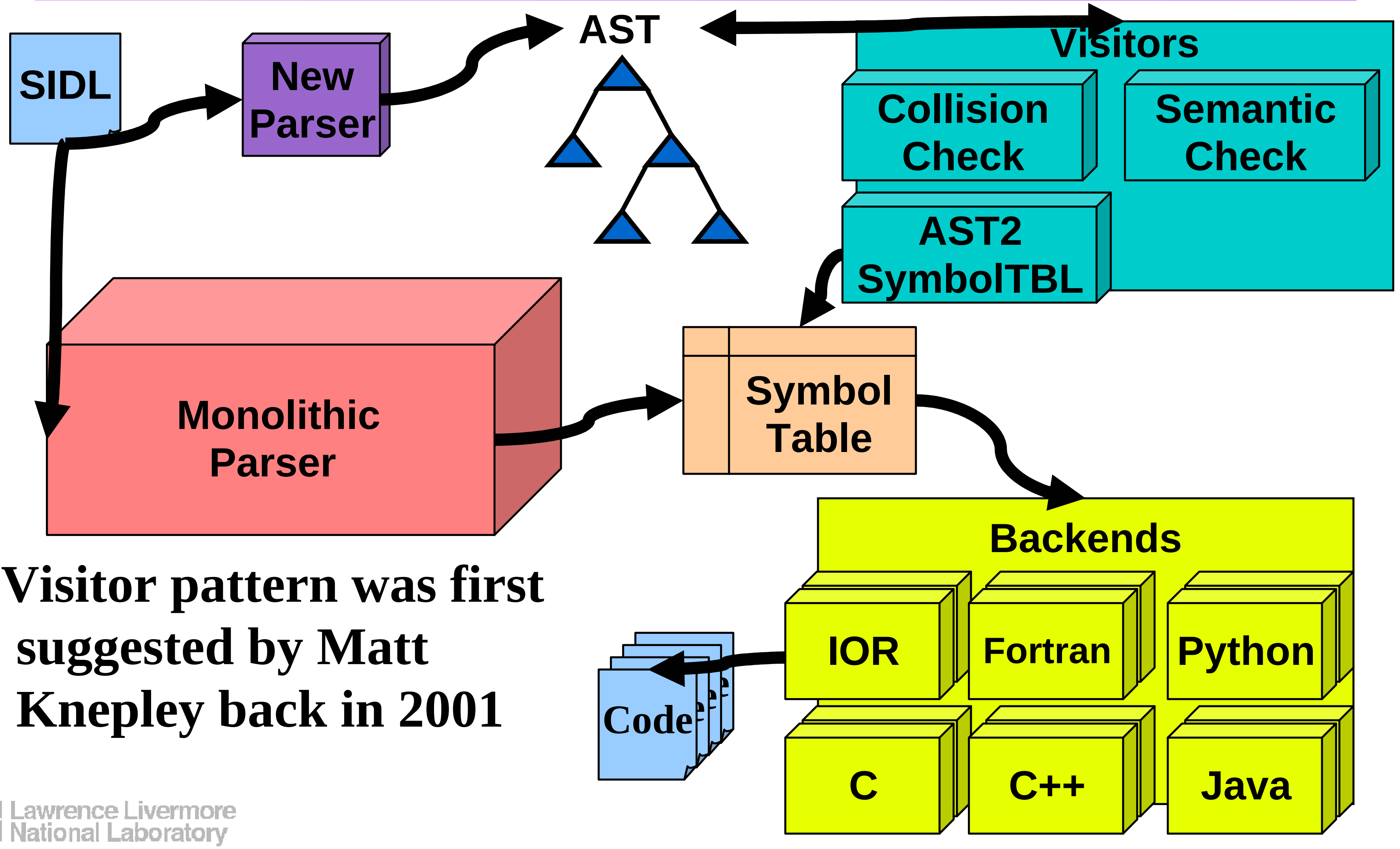
- Better error messages!
- Change type resolution (more on this later)
- Easier to adapt in the future (structs are coming!)
- Easier for 3rd parties to participate.

Before: *Parsing, Checks, & Resolution were tightly interwoven*

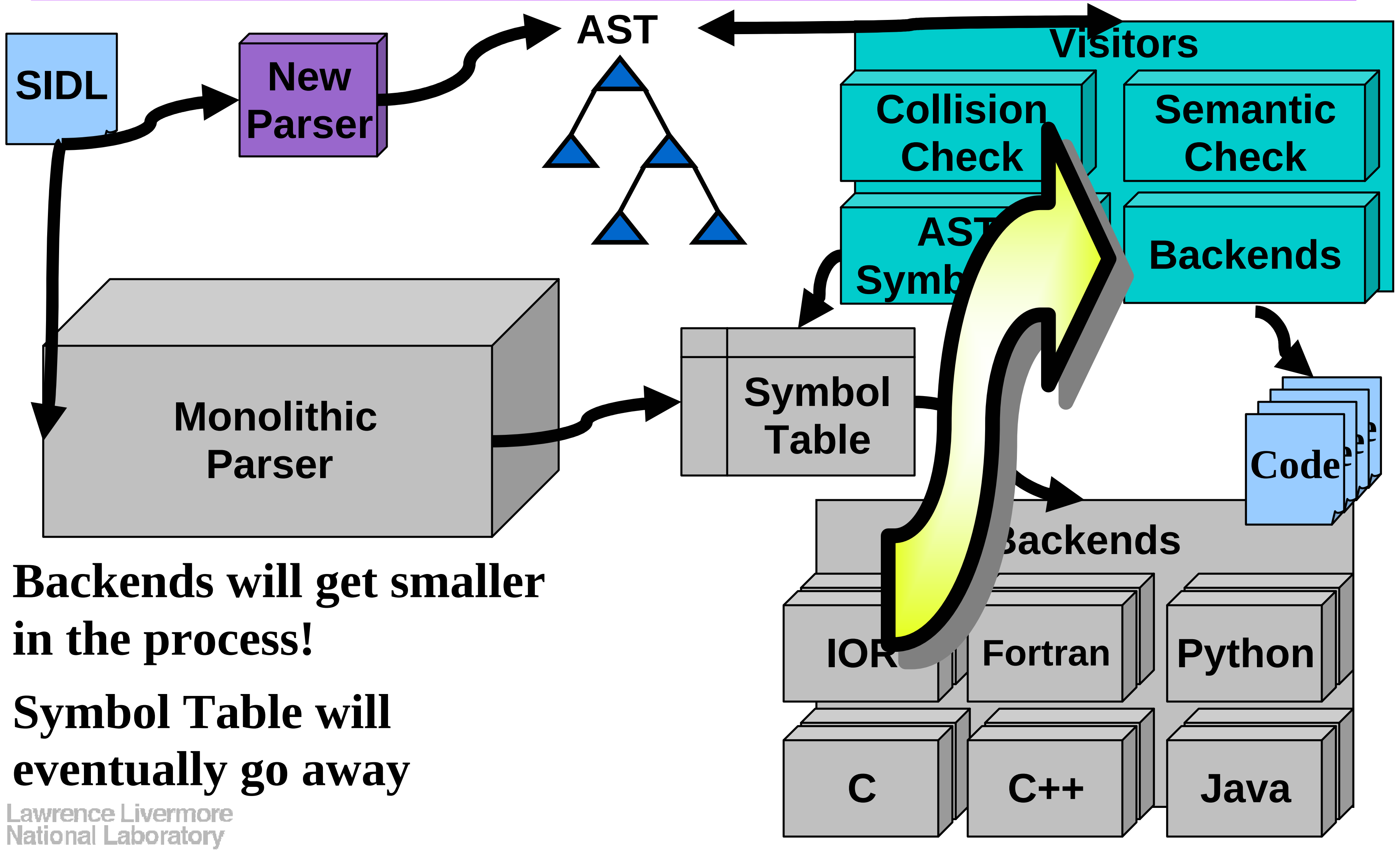


*Now: Decoupled the stages & visitor pattern**



* Visitor pattern was first suggested by Matt Knepley back in 2001

FUTURE: Backends will migrate off of Symbol Table to AST



- Backends will get smaller in the process!
- Symbol Table will eventually go away

2. Changed Type Resolution (it was too aggressive)

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```
package foo {

  class A {
    foo.B bar();
  }
  class B { }
}
```

```
package foo {
  class B { }
  class A {
    foo.B bar();
  }

}
```

- **Now:** These two files are now equivalent
- No longer need special attention which order SIDL files appear on the command line.

3. Modifications to SIDL

a. **Added a global scope indicator**
b. **Added a “from clause” to resolve multiple-inheritance induced collisions**
c. **Broadened rarray extents from single variables to expressions**
d. **Allow leading underscore or digit in method suffix**
e. **Added %attrib{ } blocks to add arbitrary user data for custom bindings**

3.a. Added a Global Scope Indicator

```
package foo
  version 0.0 {
  class A {
    package foo {
      class A {
        foo.A bar();
      }
    }
  }
}
```

- **Q: What does bar() return?**
  - **Before: foo.foo.A**
  - **Before: foo.A was not addressable from that scope**
  - **Now: use ".foo.A" to specify top level scope**

3.b. The new (and novel) FROM Clause

```
interface I1 { init( in int i );}
interface I2 { init( in float f );}
class C implements-all I1, I2 { }
```

- **Before:**
  - **would throw a signature Conflict...**
  - **and print 37 lines of text stderr/stdout**
- **Now:**

```
Signature conflict between method
"abstract  void init( in double d)  throws sidl.Runtime
 from "pkg.I2" and method
"  void init( in int i)  throws sidl.RuntimeException"
 from "pkg.C".
```

3.b. The new (and novel) FROM Clause

- **New syntax to resolve the conflict**

```
interface I1 { init( in int i ); }
interface I2 { init( in float f ); }
class C implements-all I1, I2 {
  init[f]( in float f ) from I2.init;
}
```

- **Restriction: can only introduce new suffix! (langs that support overloading can't handle more)**
- **Python: methods can be removed! May want to upcast to expected type.**

3.c. Broader extents of Raw Arrays

- **Before:**

```
void foo( in rarray<int,2> A(m,n),
          in int m, in int n );
```

- **Now: Allow simple arithmetic expressions & constants**

```
void foo( in rarray<int,3>
             A(2*m,2*n+3*(n+1), 3),
          in int m, in int n );
```

- **Limitation: max one variable per expression in a dimension**
  (Why? #eqns == #unknowns)

3.d. Allow leading underscore or digit in method suffix

- **Now: following inits are all legal**

```
interface Iface {
  init( in int i );
  init[2]( in int i, in int j );
  init[2a]( in int i, in char a );
  init[_]( in bool not_recommended );
  init[_2yikes]( inout Iface scary );
}
```

- **Warnings issued if/when you stumble on an internal suffix. (e.g. [_f])**

3.e. *The extensible %attrib{ } blocks*

- **WARNING: This feature matters iff you are writing a new backend, or parsing Babel's XML**

```
%attrib{ key1 }
%attrib{ key2=”some value” }
%attrib{ key1, key2=”some value”, keyN }
```

- **Intention is**
  - **to make SIDL more extensible**
  - **Support development of innovative features**

What's an attribute?

- **Metadata associated with Types, Methods, or Arguments in SIDL**
- **Before: Only supported “built-in” attributes**
  - **Types could be final or abstract**
  - **Methods could be local, static, abstract, and/or final**
  - **Args can be copy**
- **Now: can add arbitrary attributes with the %attrib{ }comand.**

Possible Uses

- **Specify a default value for an argument**

```
void foo( %attrib{ default="1.0" }
          in double d );
```

- **Specify a parallel operation that returns the max of all processes' values**

```
%attrib{ collective } void
    foo( %attrib{ reduce="max" }
         out double d );
```

Interesting properties

- For all built-in attributes, X: "%attrib{ X }" is equivalent to "X"
- For all SIDL, C/C++,Fortran, Python, and Java keywords, K: %attrib{ K } is not precluded (separate tokenizer avoids collisions)
- Attributes are preserved in XML
- Backends should quietly ignore attributes they don't understand

0.99 is a major change

1. Complete rewrite of Parser
2. Changed Type Resolution
3. Modifications to SIDL
4. **Improved babel-{cc,cxx,f77,f90} scripts**
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4. Improved the babel-{cc,cxx,f77,f90} scripts

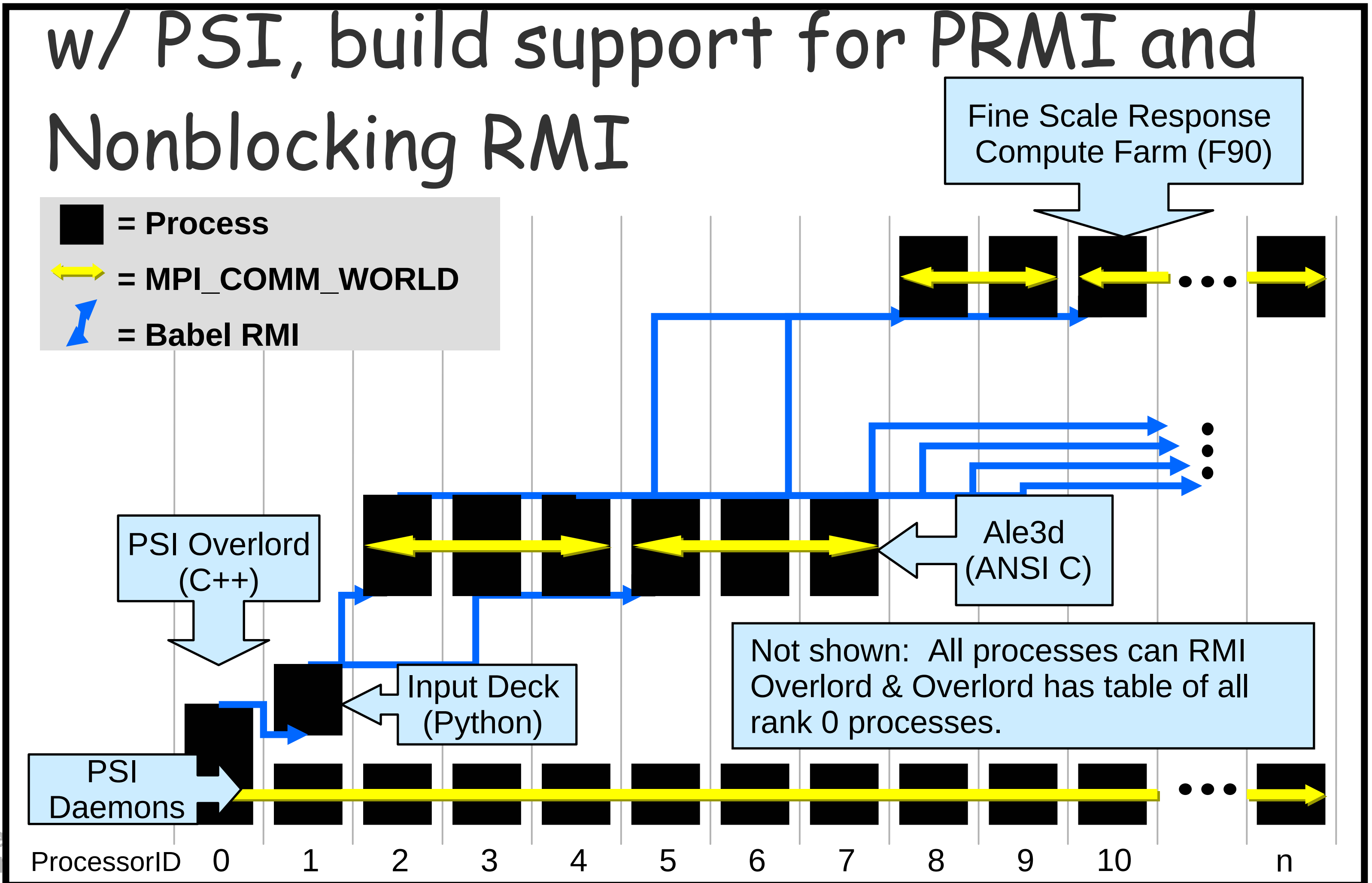
- **These scripts orchestrate the compiler, babel-config, and babel-libtool for you.**

```
% babel-cc -c -n pkg_cls_Impl.c
$(bindir)/babel-libtool --quiet --tag=CC --mode=compile
gcc -c -I$(includedir) -I/usr/include/libxml2
pkg_cls_Impl.c
```

- **There will be more work here for 1.0.**
- **Will support "--with-mpi"**

5. Significant RMI and Multithreading Improvements

Thanks to PSI…


w/ PSI, build support for PRMI and Nonblocking RMI
■ = Process
= MPI_COMM_WORLD
= Babel RMI
Fine Scale Response Compute Farm (F90)
Ale3d (ANSI C)
PSI Overlord (C++)
Input Deck (Python)
Not shown: All processes can RMI Overlord & Overlord has table of all rank 0 processes.
PSI Daemons
ProcessorID 0 1 2 3 4 5 6 7 8 9 10 n

6. A new feature we haven't found a name for yet

New constructor capabilities

- **Useful for temporarily wrapping a native language structure as a Babel object**
- **For C and Fortran, it can act** like **a C++ placement new. You can initialize the private data struct before creating the object**
- **Requires tight coupling between client and implementation**

Temporarily wrapping native objects (C++)

- **Assume a C++ Mesh called myMesh & SIDL class MeshWrap**

```
#include “foo_MeshWrap_Impl.hxx”
 ....numerous lines skipped....
 {
   // create a Babel Impl object to wrap MyMesh
   MeshWrap_Impl m = new MeshWrap_Impl();
   m.setMesh(myMesh); // call a non-Babel method on
                      // the Impl class
   // pass m to a Babel object meshRefiner through
   // a Babel method call
   meshRefiner.refineMesh(m);
 } // m goes out of scope and is garbage collected
 // myMesh was temporarily wrapped up for a Babel
 // call and can now be used by the rest of the C++ app
```

Temporarily wrapping native objects (Java)

- **Assume a Java Mesh called myMesh & SIDL class MeshWrap**

```
{
  // create a Babel Impl object to wrap MyMesh
  MeshWrap_Impl m = new MeshWrap_Impl();
  m.setMesh(myMesh); // call a non-Babel method
on
                     // the Impl class
  // pass m to a Babel object meshRefiner through
  // a Babel method call
  meshRefiner.refineMesh(m);
} // m goes out of scope and is garbage collected
// myMesh was temporarily wrapped up for a Babel
// call and can now be used by the rest of the
// Java app
```

Temporarily wrapping native objects (Python)

- **You can new the Impl in Python or...**
- **You can wrap any Python object that implements the required methods! (DANGEROUS but very Pythonic)**

```
from foo.MeshWrap import MeshWrap
babelMesh = MeshWrap(impl = myMesh)
# babelMesh is a Python object wrapping
# myMesh. RuntimeException's will occur
# if myMesh doesn't implement all the
# expected methods
```

Example of Dangerous Python

- **SIDL file**

```
package f version 1.0 {  class S {
      void sayHello(in string hello);
 }}
```

- **Any Python instance that implements sayHello can be wrapped as follows:**

```
>>> from f.S import S
>>> s = S()
>>> s.sayHello("Tom")
>>> class Override:
...     def sayHello(self, name):
...         print "Python says hello to " + name
...
>>> o = Override()
>>> s = S(impl = o)
>>> s.sayHello("Tom")
Python says hello to Tom
```

Temporarily wrapping native objects (C, F77)

- **For C, pass a pointer to the private struct defined in the _Impl.h file to the _wrapObj(void *data, sidl_BaseInterface *_ex) method.**
- **For F77, pass an opaque to the _wrapObj method.**
- **These values are stored in the IOR and ctor2 is called instead of ctor.**

Temporarily wrapping native objects (F90)

```
use x_y_z_impl
type( x_y_z_wrap) :: myData
type(x_y_z_t) :: myObj
allocate(myData%d_private_data)
! ...
! initialize myData%d_private_data
! ...
call wrapObj(myData, myObj, exception)
```

In case you hadn't heard...

- **Original (D)C++ binding is gone.**
- **UC++ binding is now the default C++ binding.**
- **See Tom's Jan 2006 talk on what's involved in upgrading.**

Conclusion

- Babel 0.99.0 is our first release candidate for Babel 1.0
  - No new features planned between now and 1.0.
  - Bugfixes and Documentation fixes still in the works
  - Babel 1.0 will be out before SciDAC meeting
- Babel 0.99.0 is a big change from Babel 0.11.x series.
- Change is good!