The Improved C++ Binding for Babel

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History

- It was the third age of mankind....
- The original Cxx was by Gary Kumfert
- As Babel evolved demand for new features grew
- Steve Parker prototyped what he wanted in a C++ binding for use with SCIRun.
- It was called U(tah)Cxx.
Goals

- Implicit Upcasting
- New babel_cast<>() operator for downcasts
- Ability to call stub methods from the Impl without the self pointer.

~ Access from a derived Impl class to it’s base Impl class’s data.

X C++ style throwing of derived class exceptions.
Implicit Upcasting

- Implicit upcasting is simply a matter of reflecting the SIDL class hierarchy in the C++ class hierarchy.
**babel_cast<target>(source)**

- The original Cxx binding overloaded the assignment operator to cast stubs. Now we use babel_cast. If the cast is bad, the result is nil.

- Old:
  ```
  A a = return_c();
  C c = a;
  if(c._is_nil()) die();
  ```

- New:
  ```
  A a = return_c();
  C c = babel_cast<C>(a);
  if(c._is_nil()) die();
  ```
O Calling Stub from the Impl

- The Cxx binding included a “self” pointer for calling stub methods from the Impls
- UCxx we have the Impls inherit from the stubs so we can call directly.

Giving this hierarchy:
Catching derived exceptions

- In C++ this is legal:
  ```cpp
  void foo() throw (A) { throw C;}
  int main() { try{ foo() } catch (C c) {/*…*/}}
  ```

- Something similar is possible with the Babel C binding.

- We received many requests to make this work with the UCxx binding. It doesn’t.
X It doesn’t work. Why not?

- It does not work in C++ because, with Babel, exceptions must pass through the IOR.
- It works in C because in C you catch the IOR pointer.
- It cannot work for C++ because the C++ binding must throw a type it expects to catch.
- The binding does, however, always attempt to match the most derived type first.
Access to a base Impl’s data

- Many users requested that a derived Impl class be able to access its base class’s data directly.
- This immediately suggests some kind of inheritance. We decided on public.
- Giving us this hierarchy:
Which led to problems….

• First, not every Impl can reasonably be expected to access it’s parent’s data. What if the parent is written in Fortran?
• So such inheritance is optional. (The user must write it in the splicer blocks)
• Due to the possibility of diamond inheritance, all inheritance is now virtual.
• This will compile, the user may have his ImplS inherit from each other. But…
It’s not the same data

- Unfortunately, this probably doesn’t do what you wanted. To see why, consider class B.

The IOR creates it’s own A for Babel inheritance! So you cannot access the A pointed to in the IOR from B.
Possible solutions?

• What might work to fix this problem?
  – Use placement new to initialize the C++ object with space allocated by the IOR.
  – Find some way to get the address of A_Impl and B_Impl as created by C++, and use them to initialize the IOR pointers.
  – Give the developer some way to get pointers to the IOR defined supers.
  – The developer could only export the top of the class hierarchy through Babel.
UCxx Downsides?

- I have not done a performance study yet, but I suspect (compared to Cxx):
  - Object creation/destruction may be a little slower
  - Function calls take the same amount of time
- All UCxx namespaces exist in the top level namespace ucxx. So:
  - ::ucxx::package1::package2::class
  - ::ucxx::sidl::array<bool> barray
  - (This is so Cxx and UCxx can be used together without collisions.)
Review
(What’s new again?)

• The self pointer is gone from the Impl
  – Old: self.foo();
  – New: foo();

• Upcasting is implicit (bar takes an A)
  – Old: A a = c; bar(a);
  – New: bar(c);

• Downcasting uses babel_cast<>()
  – Old: C c = a;
  – New: C c = babel_cast<C>(a);
Tutorial Part 1

- This tutorial shows implicit upcasting and the babel_cast<>() operator.
- In this we have a Babelized priority queue that takes interface “Comparable.”
- We have a class “Integer” that implements Comparable.
- Put Integers into PriorityQueue and take them out again in order.
In this tutorial we have a Babelized “Time Client.”

A time client returns the time as a string. It has an interface for getting time from another machine over a network.

“TimeClient” has a function “getTime” that makes a connection and gets the time.

“TCPTimeClient” makes a tcp connection and gets the time from another machine.

If getTime is called on a normal TimeClient, the time on the local machine is returned.
Conclusion

- UCxx makes the C++ Babel binding seem more like C++
- UCxx is still experimental, but we expect it to become the preferred C++ binding. However, for now details may change
- Ucxx also fulfills some of the Babel 1.0 release criteria.
- Please make suggestions about what you would like to see!