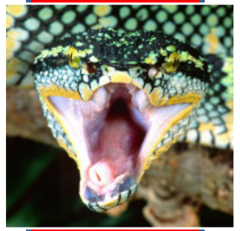
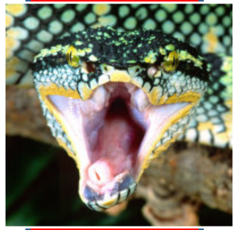


RCC Development

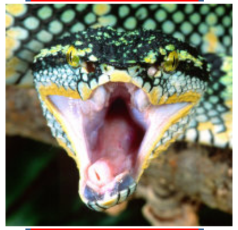
RCC Worker Overview



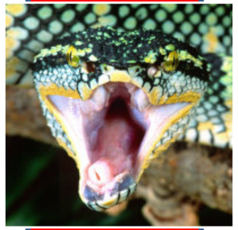
- RCC – Resource Constrained C/C++
- Supported GPP (x86-64 bit and Cortex A9)
- Supported OS (centos6, centos7, xilinx13_3, xilinx13_4)
- C and C++ language Workers
- Focus on C++ moving forward

Application Worker build steps

1) OPS: Use pre-existing or create new
2) OCS: Use pre-existing or create new
3) Create new App Worker (Modify OWD, Makefile, and source code)
4) Build the App Worker for target device(s)
5) Create Unit Test (<component>-test.xml, generate, verify and view scripts)
6) Build Unit Test
7) Run Unit Test



Execution model

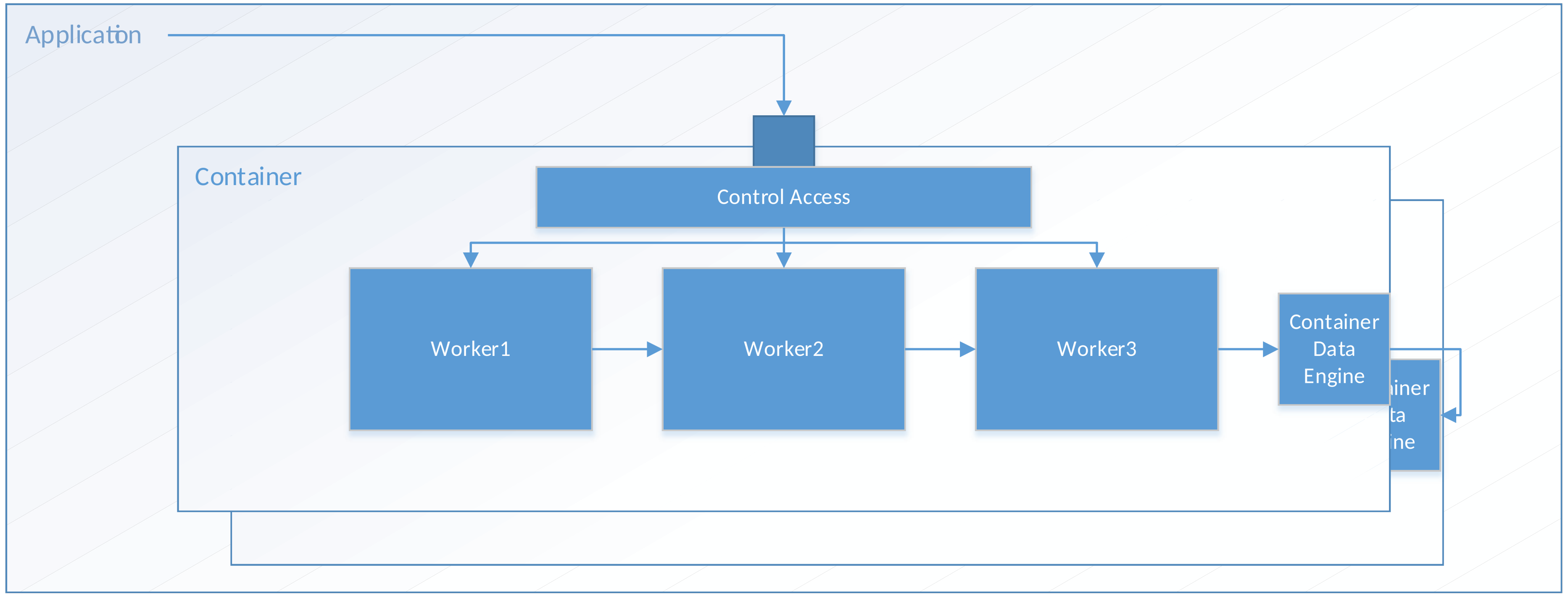


- Software Containers provide execution environment for Workers
  - Loads, executes, controls, and configures Workers
  - Moves data between Workers
  - Provides interfaces for local services
    - Including software watchdog timer
  - Evaluates data availability
    - Consumer's buffer has data
    - Producer's buffer has space

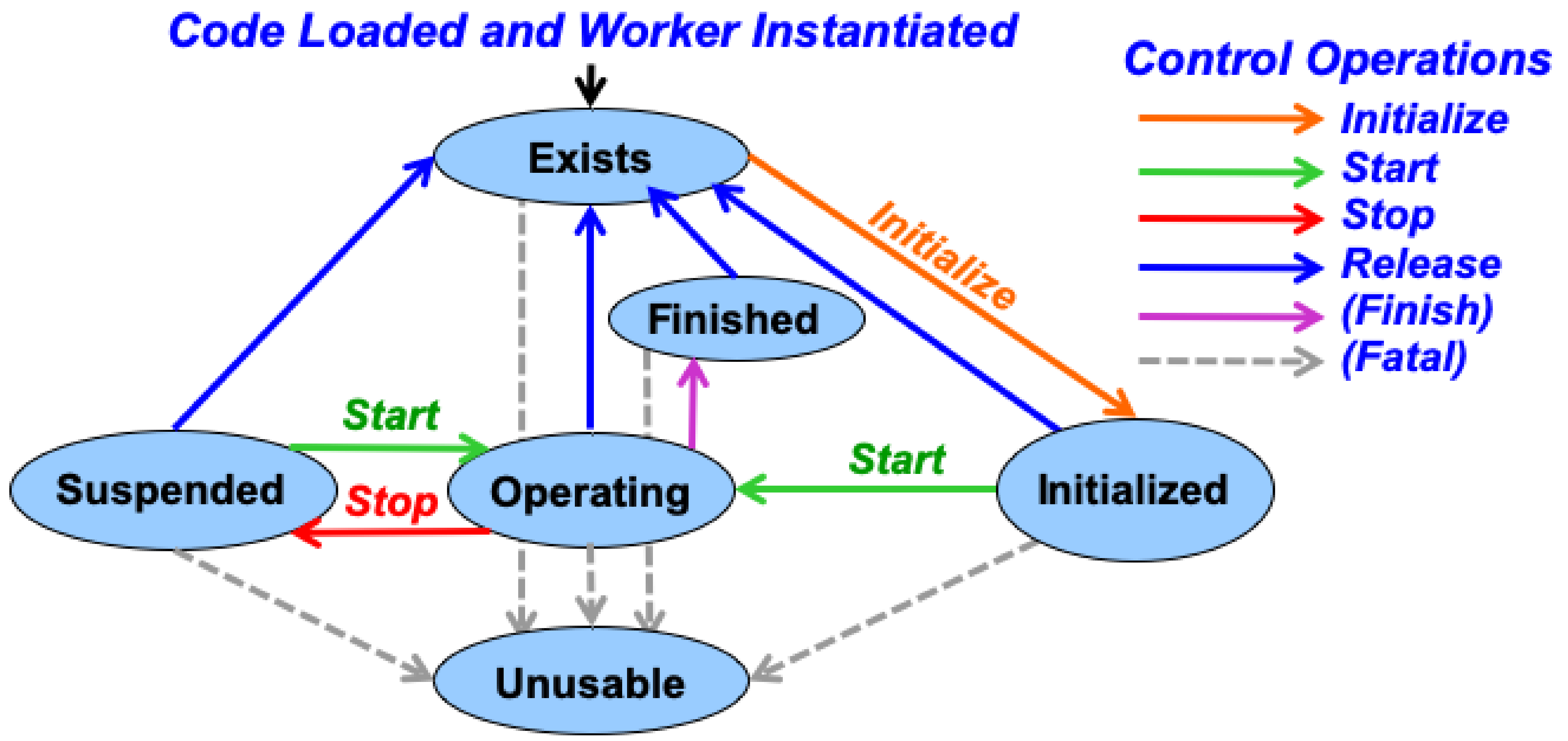
- Each RCC Container is a single *thread*

Execution model

- Shared buffers between Workers that are in the same Container

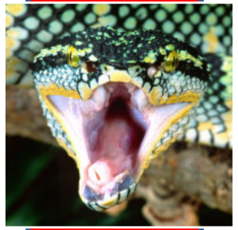


Worker Life Cycle



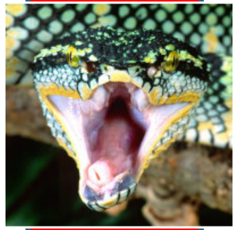
(Fatal): fatal error from control operation, other transitions based on success: non-fatal errors do not change states.
(Finish): is self initiated, not controlled from outside

`Run` Method



- Called by Container when all ports are ready (input ports have data and output ports have a free buffer)
  - Other advanced use cases, e.g. timeouts if run condition changed from default
- Return values to Container
  - `RCC_ADVANCE` (good state + advance all ports)
  - `RCC_OK` (good state)
  - `RCC_DONE` (finished state)
  - `RCC_ADVANCE_DONE` (finished + advance all ports)
  - `RCC_ERROR` (bad state: recoverable; still operating)
  - `RCC_FATAL` (bad state: **unrecoverable**)

Start/Initialize/Stop/Release



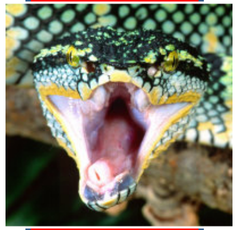
OWD XML:

```
<RCCWorker language="c++"
spec="myname_spec.xml"
ControlOperations="start, stop,
initialize, release"/>
```

C++:

```
RCCResult start() // others are
                  // initialize(),
                  // stop(), and
                  // release()
{
    //your code goes here
    return RCC_OK;
}
```

Property Access



OCS XML:

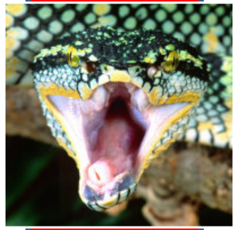
```
<property name="myprop"
type="bool" writeable="true"
volatile="true"/>
```

C++:

```
if (properties().myprop == true)
{
  //do something
}

properties().myprop = false;
```

Port Access: Scalar Length



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

OPS XML:

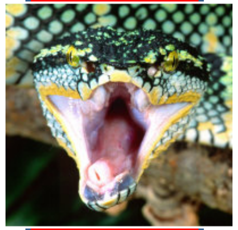
```
<Protocol>
<Operation name="myOp">
  <Argument name="myArg1"
    type="bool"/>
 <Operation/>
<Protocol/>
```

Input ports can be assumed based on the protocol, because there is no variable length data. As of 1.1, output port lengths no longer need to be set as long as all arguments are scalar:

C++:

```
//Nothing to do
```

Port Access: Scalar Data



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

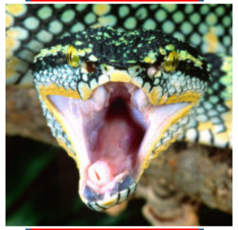
OPS XML:

```
<Protocol>
 <Operation name="myOp">
  <Argument name="myArg1" type="bool"/>
  <Argument name="myArg2" type="bool"/>
 <Operation/>
<Protocol/>
```

C++:

```
const bool inArg1  = myin.myOp().myArg1();
const bool inArg2  = myin.myOp().myArg2();
myout.myOp().myArg1() = false;
myout.myOp().myArg2() = true;
```

Port Access: Sequence Length



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

OPS XML:

```
<Protocol>
<Operation name="myOp">
  <Argument name="myArg1"
   type="bool"
   SequenceLength="2048"/>
 <Operation/>
<Protocol/>
```

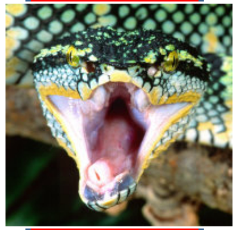
C++:

```
//length in elements
const size_t length =
  myin.myOp().myArg1().size();

myout.myOp().myArg1().resize(length);

//length in bytes
myout.setDefaultLength(2*sizeof(bool));
```

Port Access: Sequence Data



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

OPS XML:

```
<Protocol>
<Operation name="myOp">
  <Argument name="myArg1" type="bool"
   SequenceLength="2048"/>
 <Operation/>
<Protocol/>
```

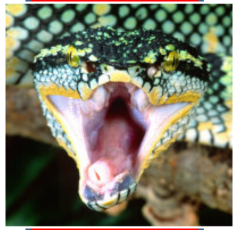
C++:

```
const bool* inData  =
  myin.myOp().myArg1().data();

bool*       outData =
  myout.myOp().myArg1().data();

for (int i = 0; length > i; i++)
{
  //do something with the data
  inData++;
  outData++;
}
```

Port Access: Opcode



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

OPS XML:

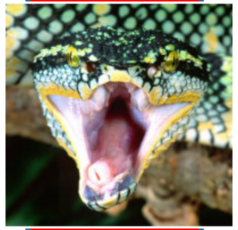
```
<Protocol>
 <Operation name="MyOp1">
  <Argument name="myArg1" type="bool"/>
  <Argument name="myArg2" type="bool"/>
 <Operation/>
 <Operation name="MyOp2">
  <Argument name="otherArg1" type="bool"
   SequenceLength="2048"/>
 <Operation/>
<Protocol/>
```

C++:

```
//for all outputs on this port
myout.setDefaultOpCode(My_protocolMyOp1_OPERATION);
//for the current output on this port
myout.setOpCode(My_protocolMyOp1_OPERATION);

switch(myin.opCode())
{
  case My_protocolMyOp1_OPERATION:
  {
     //do something
     break;
  }
  case My_protocolMyOp2_OPERATION:
  {
    //do something different
    break;
  }
  default:
  {
    cout << "bad Opcode" << endl;
    break;
  }
}
```

Port Access: Manually Advancing



OCS XML:

```
<Port Name="myin" Producer="false"
Protocol="my_protocol"/>
<Port Name="myout" Producer="true"
Protocol="my_protocol"/>
```

C++ advance all:

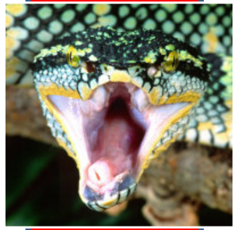
```
return RCC_ADVANCE;
```

C++ advance manually:

```
myin.advance();
myout.advance();

return RCC_OK;
```

Local Worker Variables



Define any local variables that you need as class variable.

OWD XML:

```
<RccWorker spec="myworker-spec.xml"
language="C++">
</RccWorker>
```

C++:

```
class My_workerWorker :
  public My_workerWorker base {

  bool myLocalVar1;
  bool myLocalVar2;

  …

  RCCResult run()
  {
     //use local variables
  }
```

Version 2 for rcc workers

OWD XML:

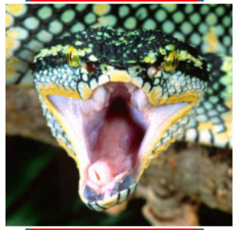
```
<RCCWorker language="c++"
spec="myname_spec.xml"
version="2"/>
```

It is recommended that all newly created workers use the latest interface version.

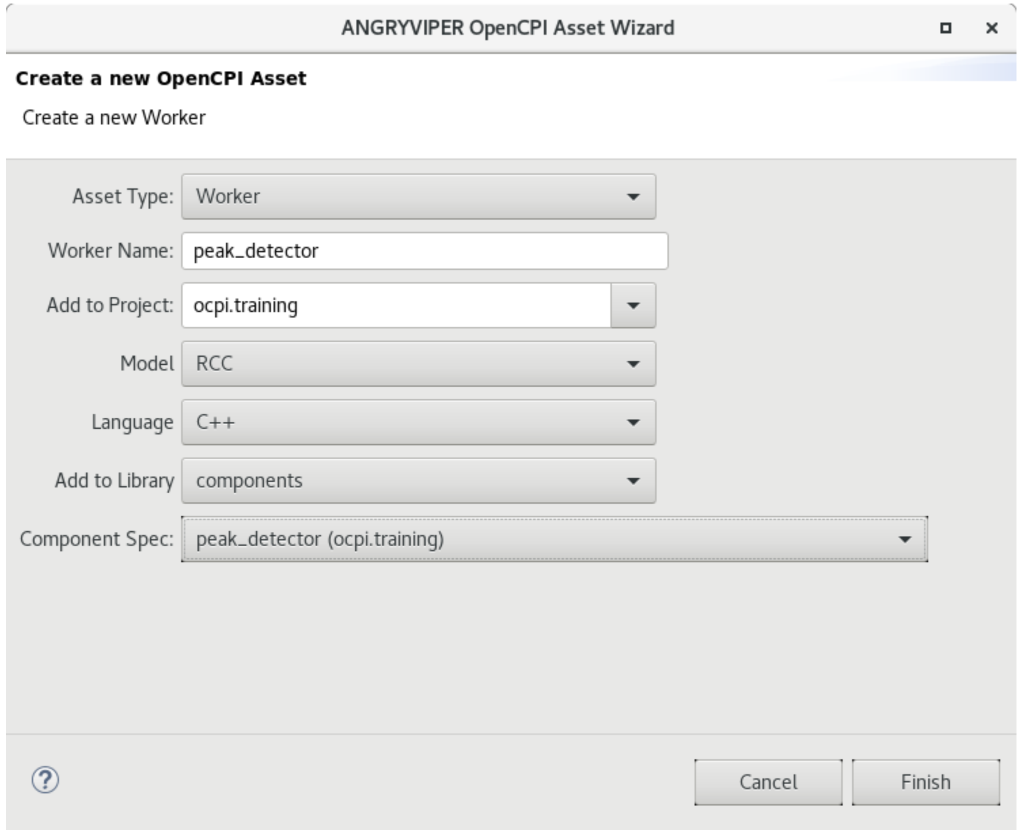
version 1:
interprets a zero length message(ZLM) with opcode 0 as end of file(eof) on both input and output ports

version 2:
eof is received on an input port:
`myin.eof()`

eof is set on an ouput port:
`myout.setEOF()`



RCC Worker Creation via AV IDE

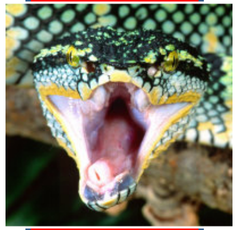

ANGRYVIPER OpenCPI Asset Wizard

Create a new OpenCPI Asset

Create a new Worker

Asset Type: Worker
Worker Name: peak_detector
Add to Project: ocpi.training
Model RCC
Language C++
Add to Library components
Component Spec: peak_detector (ocpi.training)

```
peak_detector.rcc/
|-- gen
|    |-- peak_detector_map.h
|    |-- peak_detector-build.xml
|    |-- peak_detector-params.mk
|    |-- peak_detector-skel.cc
|    |-- peak_detector-skel.cc.deps
|    |-- peak_detector-worker.hh
|    `-- peak_detector-worker.hh.deps
|-- Makefile
|-- peak_detector.cc
|-- peak_detector.xml
```



Cross Building

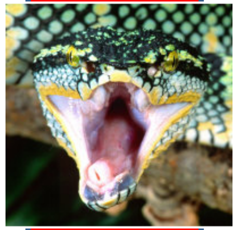
- The only currently supported cross building target is Zynq-arm
- To enable cross build:

```
% ocpidev build --rcc --rcc-platform xilinx13_3
```

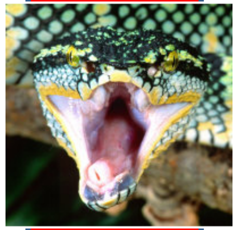
- To enable build for x86:

```
% ocpidev build --rcc
```

OR JUST USE THE IDE!



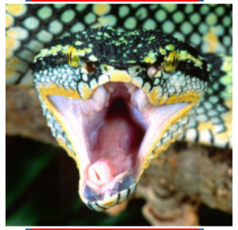
RCC Build Artifacts



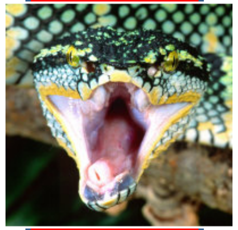
- A built RCC worker is a Linux Shared Object file
  - Dynamically loadable on the platform that it is built for

- Info about the worker (XML) embedded in .so

```
$ ocpixml get myworker.so
```

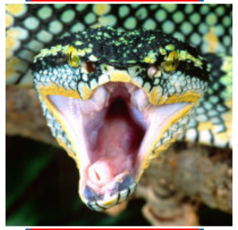


< Perform Lab 3 (PeakDetector) Now >



Advanced RCC Features and Functionality

Parameter Access



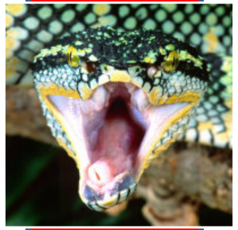
OWD XML:

```
<RccWorker spec="myworker-spec.xml"
  language="C++">
  <property name="myparam" type="bool"
   parameter="true">
</RccWorker>
```

C++:

```
if (MYWORKER_MYPARAM == true)
{
  //do something
}
```

Property Write Notifications



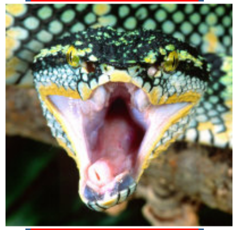
OWD XML:

```
<SpecProperty name="myprop"
type="bool" writeSync="true"/>
```

C++:

```
RCCResult myprop_written()
{
  //your code
  return RCC_OK;
}
```

Property Read Notifications



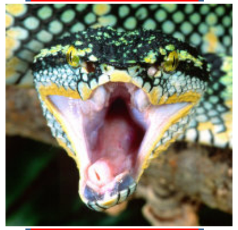
OWD XML:

```
<SpecProperty name="myprop"
type="bool" readSync="true"/>
```

C++:

```
RCCResult myprop_read()
{
  //your code
  return RCC_OK;
}
```

Optional Ports



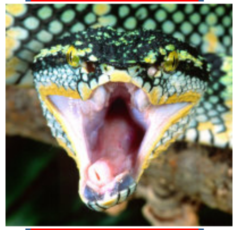
OCS XML:

```
<Port Name="myout" Producer="true"
  optional="true"
  Protocol="rstream_protocol"/>
```

C++:

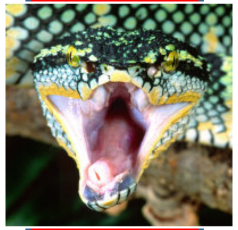
```
if (myout.isConnected())
{
  //output the data to the port
}
```

RCC Worker as a Control Proxy



- A C++ worker that can manipulate other workers' properties
  - Slave worker can be HDL or another RCC
  - Can be 1:1 or 1:many (workers and/or properties)
- Main use case is for platform development to simplify the user interface when developing a Board Support Package (BSP)

Running a worker in a debugger



- Documented in *RCC Development Guide*
  - Gives directions on how to break `gdb` in your worker when trying to debug
  - Can be used in a standalone graphical debugger as well such, *e.g.* `DDD`
  - As of release 1.5 `gdb` is available native on remote systems (e310) remote debugging using `gdbserver` is not required