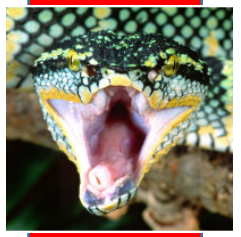
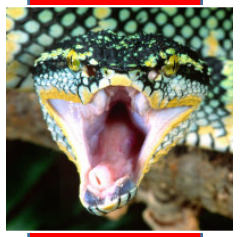


Tools and Debugging

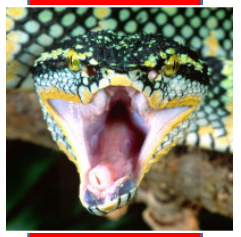
ocpihdl, ocpixml, and ocpi_debug

Outline



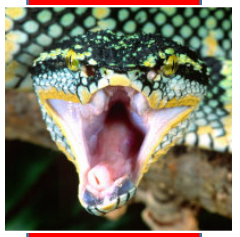
1. Collect HDL device/worker information: ocpihdl and ocpixml
2. Review worker lifecycle
3. Control worker state with ocpihdl
4. Change and view worker properties
5. Introduce ocpi_debug

Using ocpihdl



- We can use ocpihdl to:
  - Probe the xml of the currently loaded bitstream
  - Display currently loaded workers
  - View/change worker status
  - Set/change worker properties
  - Reset workers
  - Step through an application
  - ...
- Without options, ocpihdl prints out all of its uses

Finding the available HDL devices on target FPGA-based platform



$ ocpihdl search

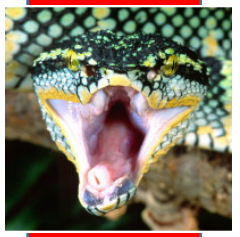
- Provides information for available HDL devices
  - Name
  - Date of bitstream creation
  - Platform
  - Part
  - UUID (Unique identifier of the bitstream)

```
% ocpihdl search
OpenCPI HDL device found: 'PL:0': bitstream date Mon May  1 08:59:51 2017, platform "matchstiq_z1",
 part "xc7z020", UUID 10226754-2e6e-11e7-88f7-573bc8e8124c
```

$ ocpihdl probe

- Similar to "search", but you can specify a device

Loading/Probing the Bitstream



- Examine the XML packaged into *any* artifact (including bitstreams):

  $ ocpixml get <.so or .bitz artifact filename>

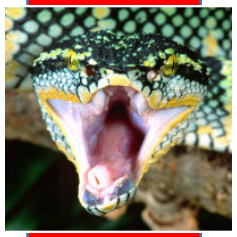
- Load a bitstream:

  $ ocpihdl load <path to bitstream>

- Examine the XML packaged into a *currently loaded* bitstream:

  $ ocpihdl getxml <output-file>

Loading/Probing the Bitstream



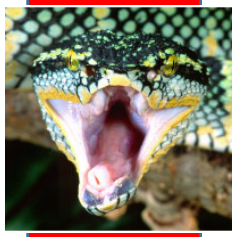
$ ocpihdl **getxml** <output-file>

$ grep controlOperation <output-file>

- What controlOperations are implemented by each worker?

```
% grep controlOperation output.xml | tail -4
<worker name="pattern" model="hdl" package="ocpi" specname="ocpi.pattern" sizeOfConfigSpace="21
47483712" controlOperations="initialize">
<worker name="bias" model="hdl" package="ocpi" specname="ocpi.bias" sizeOfConfigSpace="42949672
96" controlOperations="initialize" Timeout="444">
<worker name="capture" model="hdl" package="ocpi" specname="ocpi.capture" sizeOfConfigSpace="21
47487744" controlOperations="initialize">
<worker name="ocscp" model="hdl" package="ocpi" specname="ocpi.ocscp" controlOperations="stop">
```

Loading/Probing the Bitstream

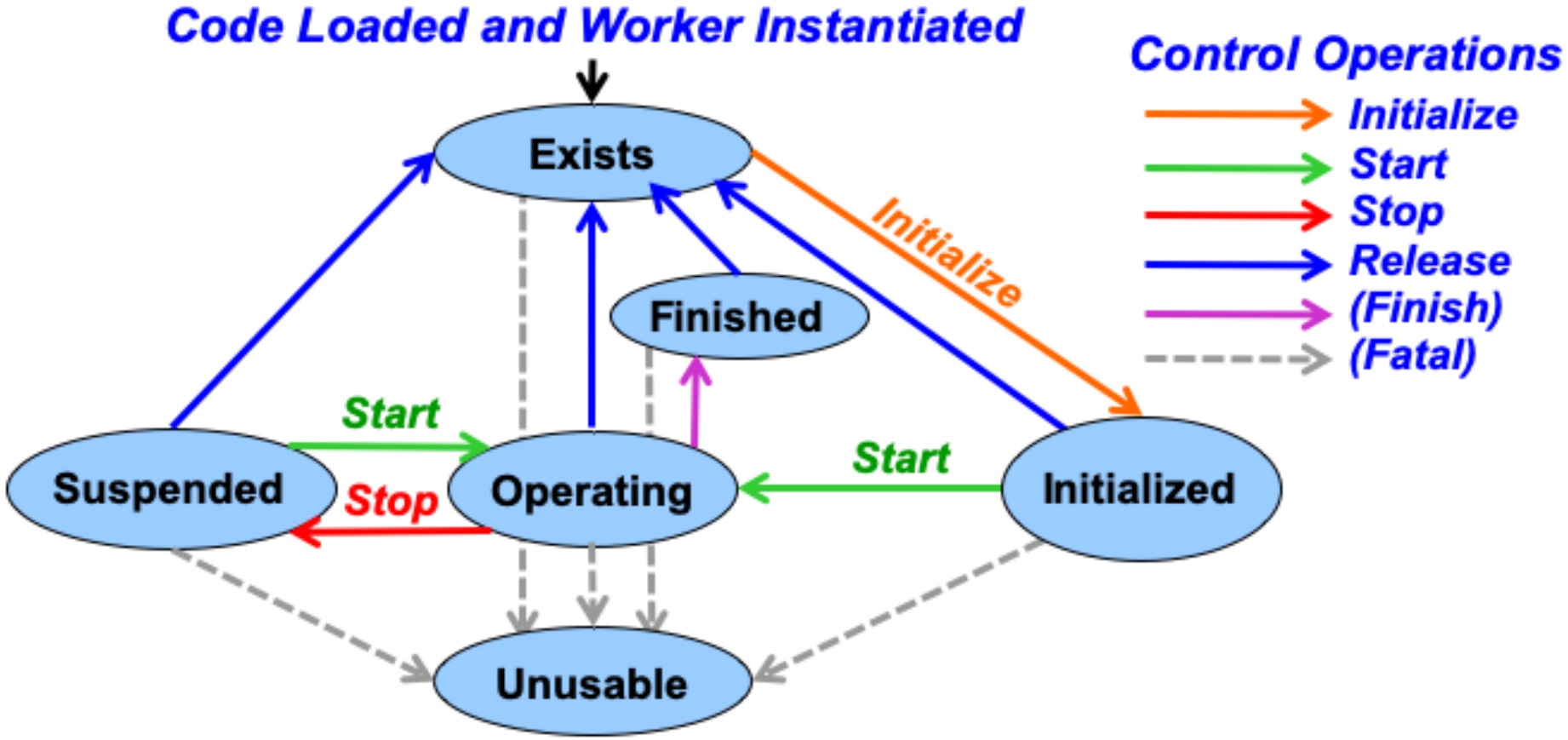


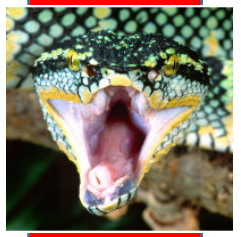
- If you ever want to remove the bitstream from the FPGA:

  $ ocpihdl unload

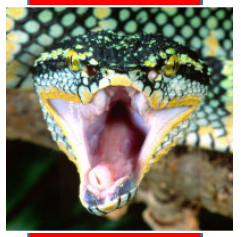
  - Most commonly used when the system's processor functions independently from the programmable logic
  - **CAUTION: Unloading an FPGA which implements a PCIe interface may result in the card being unusable and may require a system reboot**

Worker LifeCycle





Controlling Workers



- Find worker index and other information

  $ ocpihdl get
  - Can specify <index/worker-name> (and even <property>) here as well

- Reset or Unreset the control reset signal into workers

  $ ocpihdl wreset/wunreset <index>

- Perform other control operations on workers

  $ ocpihdl wop <index> start/initialize/stop

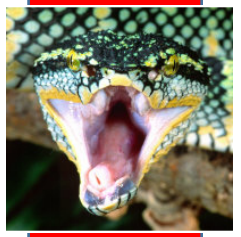
- Set worker properties

  $ ocpihdl set <index/worker-name> <property> <value>

- Observe worker state

  $ ocpihdl status <index/worker-name>
  - Add -v to see worker properties

View Worker Information from Bitstream

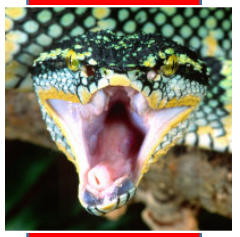


$ ocpihdl get

```
% ocpihdl get
HDL Device: 'PL:0' is platform 'matchstiq_z1' part 'xc7z020' and UUID '10226754-2e6e-1
1e7-88f7-573bc8e8124c'
Platform configuration workers are:
  Instance p/matchstiq_z1 of io worker matchstiq_z1 (spec ocpi.platform) with index 0
  Instance p/time_server of io worker time_server (spec ocpi.devices.time_server) with
 index 1
Container workers are:
  Instance c/ocscp of normal worker ocscp (spec ocpi.ocscp)
  Instance c/unoc_term0_0 of io worker sdp_term (spec ocpi.devices.sdp_term)
  Instance c/unoc_term1_0 of io worker sdp_term (spec ocpi.devices.sdp_term)
  Instance c/unoc_term2_0 of io worker sdp_term (spec ocpi.devices.sdp_term)
  Instance c/unoc_term3_0 of io worker sdp_term (spec ocpi.devices.sdp_term)
  Instance c/tb_bias_wti0_time_client of normal worker time_client (spec ocpi.time_cli
ent)
  Instance c/metadata of normal worker metadata (spec ocpi.metadata)
Application workers are:
  Instance a/pattern of normal worker pattern (spec ocpi.pattern) with index 2
  Instance a/bias of normal worker bias (spec ocpi.bias) with index 3
  Instance a/capture of normal worker capture (spec ocpi.capture) with index 4
```

- We can identify them by their indices

Controlling Workers

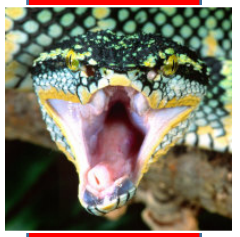


- If the worker is "RESET"

  $ ocpihdl wunreset <index>

```
% ocpihdl status 2
Status of instance 'a/pattern' of worker 'pattern' is 'RESET'
Worker 2 on device pl:0
 Status:     0x00008000
 Control:    0x00000000 not enabled (reset asserted);  timeout value is 1
 ConfigAddr: 0x00000000
 PageWindow: 0x00000000
  Instance a/pattern of normal worker pattern (spec ocpi.pattern) with index 2
% ocpihdl wunreset 2
Worker 2 on device pl:0: reset deasserted, was asserted
% ocpihdl status 2
Status of instance 'a/pattern' of worker 'pattern' is 'EXISTS'
Worker 2 on device pl:0
 Status:     0x00008000
 Control:    0x80000000 enabled (reset not asserted);  timeout value is 1
 ConfigAddr: 0x00000000
 PageWindow: 0x00000000
  Instance a/pattern of normal worker pattern (spec ocpi.pattern) with index 2
```

Controlling Workers



- If the worker implements the "initialize" controlOperation:

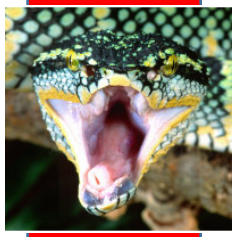
$ ocpihdl wop <index> initialize

```
% ocpihdl wop 2 initialize
Worker 2 on device pl:0: the 'initialize' control operation was performed with result 'success'
01)
% ocpihdl status 2
Status of instance 'a/pattern' of worker 'pattern' is 'INITIALIZED'
Worker 2 on device pl:0
 Status:     0x00048000 opValid:0x0:init
 Control:    0x80000000 enabled (reset not asserted);  timeout value is 1
 ConfigAddr: 0x00000000
 PageWindow: 0x00000000
  Instance a/pattern of normal worker pattern (spec ocpi.pattern) with index 2
```

- Ultimately, to bring the worker to "OPERATING":

$ ocpihdl wop <index> start

Controlling Workers



- Writable worker properties can be changed:

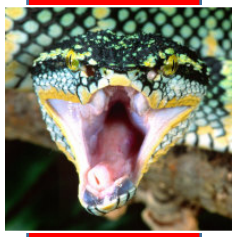
  $ ocpihdl set <index/worker-name> <property> <value>

- Readable (the explicit flag, not the concept) / Volatile properties can be read:

  $ ocpihdl status -v <index/worker-name>

```
% ocpihdl set 2 step true
Setting the step property to 'true' on instance 'a/counter'
% ocpihdl status 2 ; ocpihdl get -v 2
Status of instance 'a/counter' of worker 'counter-1' is 'OPERATING'
Worker 2 on device pl:0
 Status:     0x091f0000 addrValid beValid:0x1 opValid:0x1:start wrtValid:1
 Control:    0x80000004 enabled (reset not asserted);  timeout value is 16
 ConfigAddr: 0x00000008
 PageWindow: 0x00000000
  Instance a/counter of normal worker counter-1 (spec local.counter) with index 2
  0             counter: 2
  1                 max: 9
  2           ocpi_debug: true
  3          ocpi_endian: little
  4                step: true
```

Debugging



- ocpi_debug
  - Worker parameter that can enable debugging
  - Set to *true* in OWD before building workers for debugging
  - Add debugging functionality to worker that depends on ocpi_debug

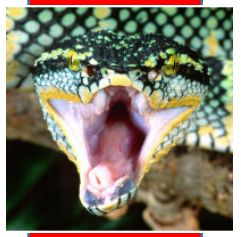
- In VHDL: "ocpi_debug"

```
debug_gen : if its(ocpi_debug) generate
```

- In C++: "<WORKER_NAME>_OCPI_DEBUG"

```
if (COUNTER_OCPI_DEBUG) {
```

Execution and Debug Utilities



- Log level
  - export OCPI_LOG_LEVEL=8
  - ocpirun -l 8 (lowercase L)
  - OCPI_LOG_LEVEL=10 make tests
- "ocpirun -C" finds containers, including simulators
- "ocpiview" is used to view simulation waveform results
- printf/cout
- ocpi_debug OWD parameter
- gdb