Summary - Capture_v2

Name	Capture_v2
Version	v1.0
Release Date	August 2018
Component Library	ocpi.assets.util_comps
Workers	Capture_v2.hdl
Tested Platforms	xsim, isim, matchstiq_z1

Functionality

The Capture_v2 component takes input port messages and stores their data in a buffer via the `data` property as 4 byte words. Metadata associated with each message is stored as a record in a metadata buffer via the `metadata` property. It captures four 4 byte words of metadata. The first metadata word is the opcode for the message and message size in bytes; opcode 8 MSB and message size 24 LSB. The second word is the fraction time stamp for the EOM. The third word is the fraction time stamp for the SOM. And the fourth word is the seconds timestamp for the SOM. So that the metadata can be read on a little-endian processor, the ordering of the metadata is as follows:

opcode (8-bit),
message size (24-bit),
eom fraction (32-bit),
som fraction (32-bit),
som seconds (32-bit)

Some example python code for reading in the `metadata` property values written to a file packed little-endian:

```
data = struct.unpack('<I', ifile.read(4))[0] # 32/8 = 4 bytes
```

When the number bytes sent for a message is not a multiple of 4, only the last (number of bytes modulus 4) least significant bytes of the last word in the data buffer represent received data. The (number of bytes modulus 4) most significant bytes will always be zero in the last word in the data buffer.

For example, if number of bytes is 5 and the last captured data buffer word is 0x0000005a, the last data received by Capture_v2 was 0x5a. If number if bytes was 6, the last data received was 0x005a.

The Capture_v2 component keeps count of how many metadata records (`metadataCount`) have been captured and a count of how many data words have been captured (`dataCount`). It allows for the option to wrap around and continue to capture data and metadata once the buffers are full or to stop capturing data and metadata when the data and metadata buffers are full via the `stoponFull` property.

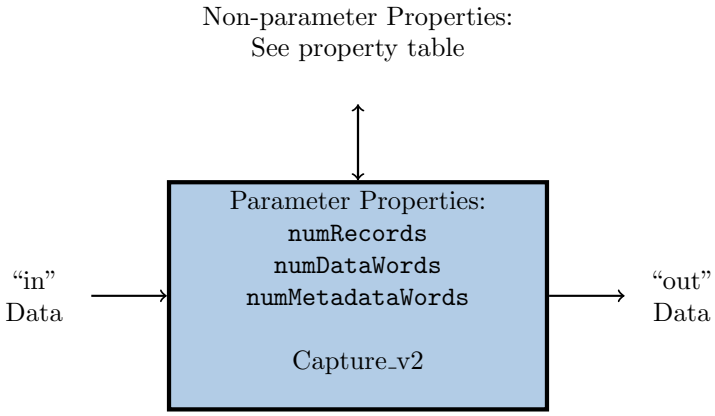
When `stopOnFull` is true, data and metadata will be captured as long as the data and metadata buffers are not full. If the data buffer is full before the metadata buffer, metadata will still be captured until the metadata buffer is full. If the metadata buffer is full before the data buffer, no more metadata and no more data will be captured. When `stopOnFull` is false, there will be a wrap around when the data and metadata buffers are full and data metadata will continue to be captured.

The component also has properties that keep track of whether or not the metadata and data buffers are full; `metaFull` and `dataFull`.

It has an (optional) output port so that it can placed between two workers. The input message are directly passed to the output port with a latency of the control plane clock cycles.

Block Diagrams

Top level



Source Dependencies

Capture_v2.hdl

- assets/components/util_comps/Capture_v2.hdl/Capture_v2.vhd
- core/hdl/primitives/util/util_pkg.vhd

Component Spec Properties

Name	Type	Default	SequenceLength	ArrayLength	ArrayDimensions	Parameter	Accessibility	Usage
stopOnFull	bool	false	-	-	-	false	Initial	True - Stop capturing data and metadata when the data and metadata buffers are full. If the metadata buffer is full before the data buffer, no more metadata and no more data will be captured. If the data buffer is full before the metadata buffer, no more data is captured, but continue to capture metadata until the metadata buffer is full. False - Wrap around and continue to capture data and metadata once the buffers are full. This stop functionality is independent of both the control plane 'stop' operation and 'finished' worker state.
metadataCount	uLong	-	-	-	-	false	Volatile	Counter of metadata records written.
dataCount	uLong	-	-	-	-	false	Volatile	Counter of words captured.
numRecords	uLong	256	-	-	-	true	-	Number of metadata records/messages to be captured.
numDataWords	uLong	1024	-	-	-	true	-	Number of four byte data words stored in the data buffer. If stopOnFull is true, meaning no wrap around, no more data will be captured once the data buffer is full.
numMetadataWords	uLong	4	-	-	-	true	-	Due to a limitation, cannot use constrained elements in unconstrained array declarations, so cannot directly set the second dimension for the metadata property to 4. The number of metadata words must always be 4, since there are four 4 byte words that are captured. The first metadata word is the opcode for the message and message size in bytes;opcode 8 MSB and message size 24 LSB. The second word is the fraction time stamp for the EOM. The third word is the fraction time stamp for the SOM. And the fourth word is the seconds timestamp for the SOM. So the default value must not be changed.
metaFull	bool	false	-	-	-	false	Volatile, Initial	Metadata buffer full flag.
dataFull	bool	false	-	-	-	false	Volatile, Initial	Data buffer is full flag.
stopZLMOpcode	uChar	0	-	-	-	false	Initial	Opcode associated with the ZLM which indicates the application is 'done'.
stopOnZLM	bool	false	-	-	-	false	Initial	Indicates stopping on ZLM of stopZLMOpcode.
stopOnEOF	bool	true	-	-	-	false	Initial	As of now, this indicates stopping on ZLM of opcode 0. In the future it is expected that OpenCPI will standardize a definition of EOF.
metadata	uLong	-	-	-	numRecords, numMetadataWords	false	Volatile	Multidimensional array containing metadata records.
data	uLong	-	-	numDataWords	-	false	Volatile	Data buffer containing data words.

Component Ports

Name	Protocol	Producer	Optional	Usage
in	-	false	false	Data input to capture
out	-	true	true	Data from input passed to output unchanged

Worker Interfaces

Capture_v2.hdl

Type	Name	DataWidth (b)	Advanced	Usage
StreamInterface	in	32	DataValueWidth = 8, NumberOfOpcodes='256', ZeroLengthMessages = true	Data input to capture
StreamInterface	out	32	DataValueWidth = 8, NumberOfOpcodes='256', ZeroLengthMessages = true	Data from input passed to output unchanged
TimeInterface	time	64 (32b sec MSW and 32b frac LSW)	-	Allows worker to capture timestamps

Control Timing and Signals

The Capture_v2 worker uses the clock from the Control Plane and standard Control Plane signals.

Worker Configuration Parameters

Capture_v2.hdl

Table 1: Table of Worker Configurations for worker: capture_v2

Configuration	numDataWords	numRecords
0	1024	256

Performance and Resource Utilization

Capture_v2.hdl

Table 2: Resource Utilization Table for worker: capture_v2

Configuration	OCPI Target	Tool	Version	Device	Registers (Typ)	LUTs (Typ)	Fmax (MHz) (Typ)	Memory/Special Functions
0	zynq	Vivado	2017.1	xc7z020clg400-3	412	678	N/A	DSP48E1: 1 RAMB36E1: 3
0	virtex6	ISE	14.7	6vcx75tff484-2	384	870	158.421	DSP48E1: 2 RAMB36E1: 5
0	stratix4	Quartus	17.1.0	N/A	415	813	N/A	Block Memory Bits: 65536

Limitations

Since the raw property address (props_in.raw.address) is currently 16 bits wide and `data` and `metadata` are raw properties that contain 4 byte words, the total address space for these properties is $2^{16}/4$. The framework does not throw an error when the total number of elements between the two array properties exceeds $2^{16}/4$ so the properties will not be filled correctly. This failure is run time and the application will successfully execute. Once AV-4254 is addressed to change the raw.address from 16 to 32, the new address space limit will be $2^{32}/4$.

Test and Verification

The Capture_v2-test.xml has a test property called `testScenario` that allows for four different test cases; testing sending no data, testing making only metadata full, testing making data full, testing sending multiple zlms (with different opcodes), a single word message, filling data and filling up metadata (for configurations where there are at least six metadata records).

An input file is generated via `generate.py`. The `generate.py` script will output different input data based on the `testScenario` chosen.

The tests are verified by `verify.py` script. It checks that the `metadataCount`, `dataCount`, status(`metaFull` and `dataFull`), `metadata` and `data` match the expected results.

There are also some custom tests located in the Capture_v2.test directory that tests things not currently supported by the test suite. These tests are: testing stopping on an opcode other than 0 (need to be able to set done='Capture_v2' in the app xml to be able to test this) and testing the Capture_v2 with no output connected. The tests are built and run manually via a `run_test.sh` script.

The custom tests also have `generate.py` and `verify.py` scripts but they are simpler versions than the ones in the top level Capture_v2.test directory or they are specific to the custom test.

Applications

For an example of the Capture_v2 component used in an application, please reference the tb_bias_v2 application located in `assets/applications/tb_bias_v2`.