

Lab 4: UVM Introduction

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Part 4 – Extra Credit Report

Objective

The objective of the extra credit work was to extend the functionality of the packet filter design by introducing advanced features beyond the core lab requirements. We implemented **Variable AXI Interface Widths**, allowing the packet filter to support data widths beyond the default 16-bit configuration.

Design Modifications

1. Parameterization of Interface Widths

- Introduced `INPUT_WIDTH` and `OUTPUT_WIDTH` parameters to the top-level DUT module.
- Calculated number of bytes per beat using these parameters.

2. Separate Logic for 8-bit vs. Wider Interfaces

- Used a `generate` block to split the logic:
 - A dedicated FSM for 8-bit wide data (could not complete).
 - A streamlined FSM for wider interfaces (above 8 bits) with efficient packet filtering and forwarding logic.

3. Header Extraction for Wide Interfaces

- In wide interface configurations, the 16-bit header is extracted from the uppermost bits of `in_tdata`.
- Message type is decoded from the high nibble of the header to determine whether the packet should be forwarded.

4. Packet Forwarding Logic

- Forwarded only those packets whose message types match the valid set (`0x0`, `0xA`, `0x5`, `0x3`).
- Ensured that partial packets and the `tlast` signal are correctly handled across wide interfaces.
- Introduced internal buffering (`pending_buffer`) to manage AXI backpressure and maintain throughput.

Simulation and Testing

We successfully simulated the enhanced DUT using various wide interface configurations. The implementation was verified for the following interface widths:

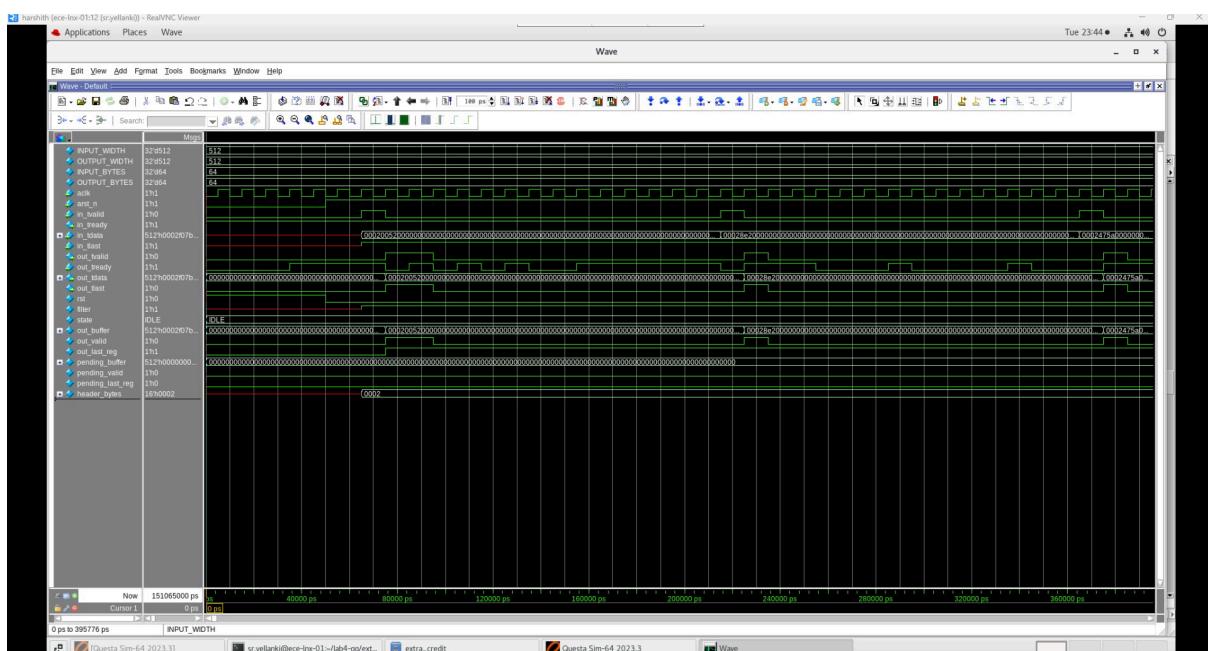
- `INPUT_WIDTH = OUTPUT_WIDTH = 32`

- INPUT_WIDTH = OUTPUT_WIDTH = 64
- INPUT_WIDTH = OUTPUT_WIDTH = 128
- INPUT_WIDTH = OUTPUT_WIDTH = 256
- INPUT_WIDTH = OUTPUT_WIDTH = 512

All simulations passed, and the waveform analysis confirmed the correct forwarding behavior and adherence to the AXI protocol.

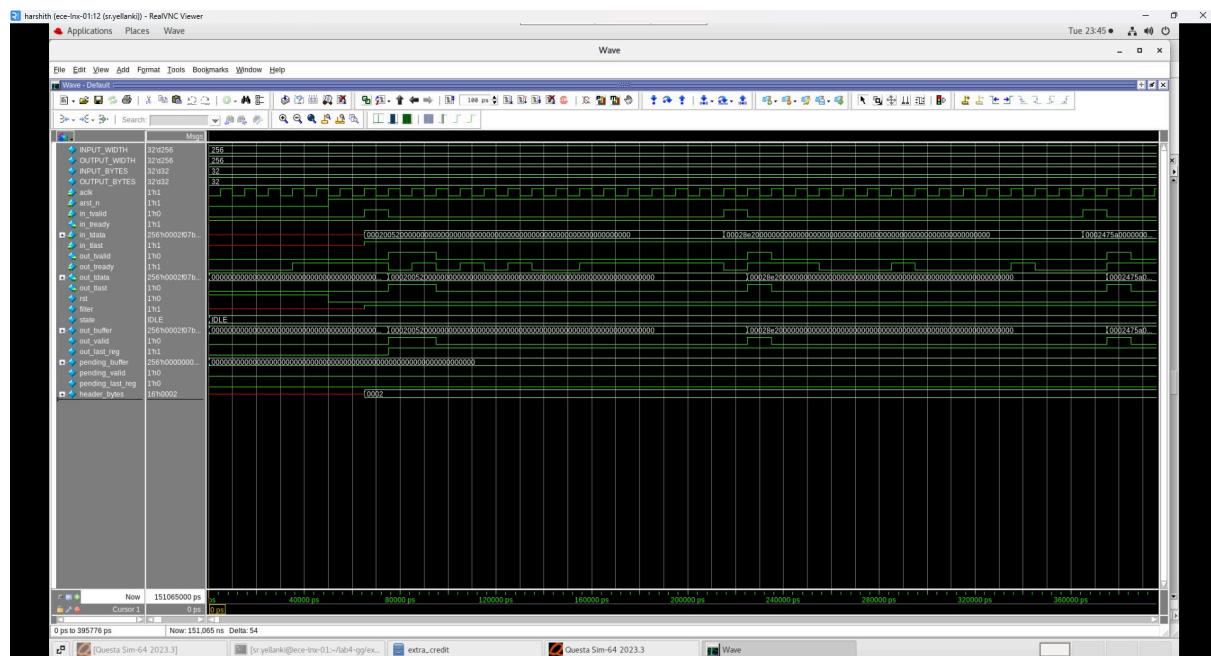
Width = 512

```
sr.yellanki@ece-lnx-01:~/lab4-gg/extra_credit
File Edit View Search Terminal Help
# Randomized packet: type=0, length=2
# UVM_INFO filter_scoreboard.svh(84) @ 149935 ns: uvm_test_top.env.scoreboard [SCOREBOARD] Test passed.
# UVM_INFO verilog_src/uvm-1.1d/src/base/uvm_objection.svh(1267) @ 151065 ns: reporter [TEST_DONE] 'run' phase is ready to proceed to the 'extract' phase
# UVM_INFO filter_base_test.svh(47) @ 151065 ns: uvm_test_top [filter_packet_test] -----
# UVM_INFO filter_base_test.svh(48) @ 151065 ns: uvm_test_top [filter_packet_test] --- TEST PASSED ---
# UVM_INFO filter_base_test.svh(49) @ 151065 ns: uvm_test_top [filter_packet_test] -----
# === Coverage Summary ===
#
# Input Packet Coverage: 20.83%
#   Type Coverage: 6.25%
#   Length Bin Coverage: 6.25%
#   Length Even/Odd Coverage: 50.00%
# Input Interface Coverage: 33.33%
#   Valid Coverage: 100.00%
#   Ready Coverage: 0.00%
#   Backpressure Coverage: 0.00%
# Output Interface Coverage: 100.00%
#   Valid Coverage: 100.00%
#   Ready Coverage: 100.00%
```



Width = 256

```
sr.yellanki@ece-lnx-01:~/lab4-gg/extra_credit
File Edit View Search Terminal Help
t] -----
# UVM_INFO filter_base_test.svh(48) @ 151065 ns: uvm_test_top [filter_packet_tes
t] --- TEST PASSED ---
# UVM_INFO filter_base_test.svh(49) @ 151065 ns: uvm_test_top [filter_packet_tes
t] -----
# === Coverage Summary ===
#
# Input Packet Coverage: 20.83%
#   Type Coverage: 6.25%
#   Length Bin Coverage: 6.25%
#   Length Even/Odd Coverage: 50.00%
# Input Interface Coverage: 33.33%
#   Valid Coverage: 100.00%
#   Ready Coverage: 0.00%
#   Backpressure Coverage: 0.00%
# Output Interface Coverage: 100.00%
#   Valid Coverage: 100.00%
#   Ready Coverage: 100.00%
#   Backpressure Coverage: 100.00%
#
# --- UVM Report Summary ---
#
# ** Report counts by severity
# UVM_INFO : 1007
```

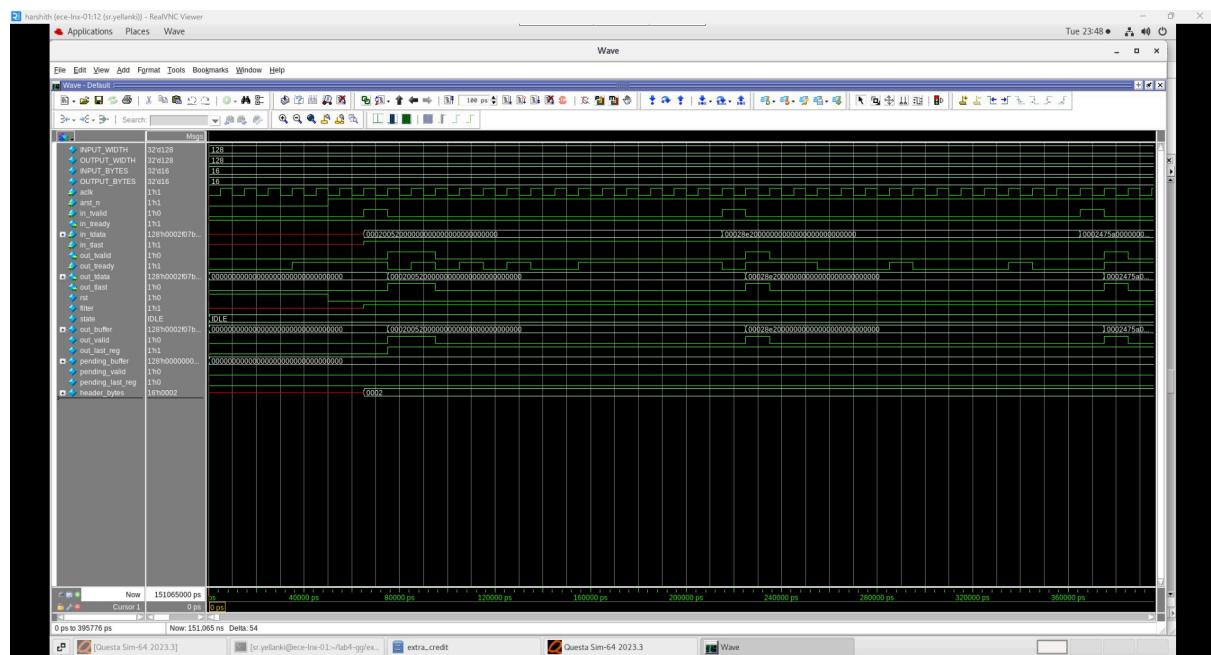


Width = 128

```
sr.yellanki@ece-lnx-01:~/lab4-gg/extra_credit
```

File Edit View Search Terminal Help

```
#  
# Input Packet Coverage: 20.83%  
#   Type Coverage: 6.25%  
#   Length Bin Coverage: 6.25%  
#   Length Even/Odd Coverage: 50.00%  
# Input Interface Coverage: 33.33%  
#   Valid Coverage: 100.00%  
#   Ready Coverage: 0.00%  
#   Backpressure Coverage: 0.00%  
# Output Interface Coverage: 100.00%  
#   Valid Coverage: 100.00%  
#   Ready Coverage: 100.00%  
#   Backpressure Coverage: 100.00%  
  
# --- UVM Report Summary ---  
  
# ** Report counts by severity  
# UVM_INFO : 1007  
# UVM_WARNING : 0  
# UVM_ERROR : 0  
# UVM_FATAL : 0  
# ** Report counts by id  
# [Questa UVM] 2  
# [RNTST] 1
```

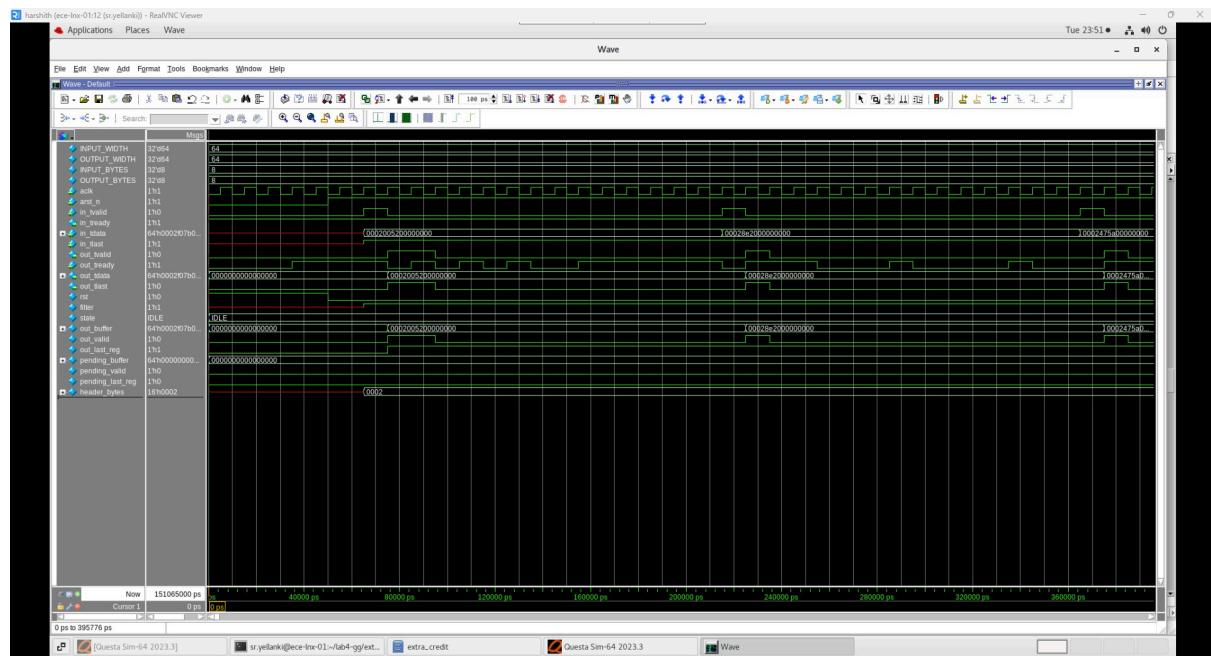


Width = 64

```
sr.yellanki@ece-lnx-01:~/lab4-gg/extra_credit
```

File Edit View Search Terminal Help

```
# UVM_INFO verilog_src/uvm-1.1d/src/base/uvm_objection.svh(1267) @ 151065 ns: reporter [TEST_DONE] 'run' phase is ready to proceed to the 'extract' phase
# UVM_INFO filter_base_test.svh(47) @ 151065 ns: uvm_test_top [filter_packet_test] -----
# UVM_INFO filter_base_test.svh(48) @ 151065 ns: uvm_test_top [filter_packet_test] --- TEST PASSED ---
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#   Valid Coverage: 100.00%
#   Ready Coverage: 0.00%
#   Backpressure Coverage: 0.00%
# Output Interface Coverage: 100.00%
#   Valid Coverage: 100.00%
#   Ready Coverage: 100.00%
#   Backpressure Coverage: 100.00%
#
# --- UVM Report Summary ---
```



Width = 32

```
sr.yellanki@ece-lnx-01:~/lab4-gg/extra_credit - □ ×
File Edit View Search Terminal Help
# UVM_INFO verilog_src/uvm-1.1d/src/base/uvm_objection.svh(1267) @ 151065 ns: reporter [TEST_DONE] 'run' phase is ready to proceed to the 'extract' phase
# UVM_INFO filter_base_test.svh(47) @ 151065 ns: uvm_test_top [filter_packet_test] -----
# UVM_INFO filter_base_test.svh(48) @ 151065 ns: uvm_test_top [filter_packet_test] --- TEST PASSED ---
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# Backpressure Coverage: 0.00%
# Output Interface Coverage: 100.00%
# Valid Coverage: 100.00%
# Ready Coverage: 100.00%
# Backpressure Coverage: 100.00%
#
# --- UVM Report Summary ---
```

