

KM3NeT CLBv2



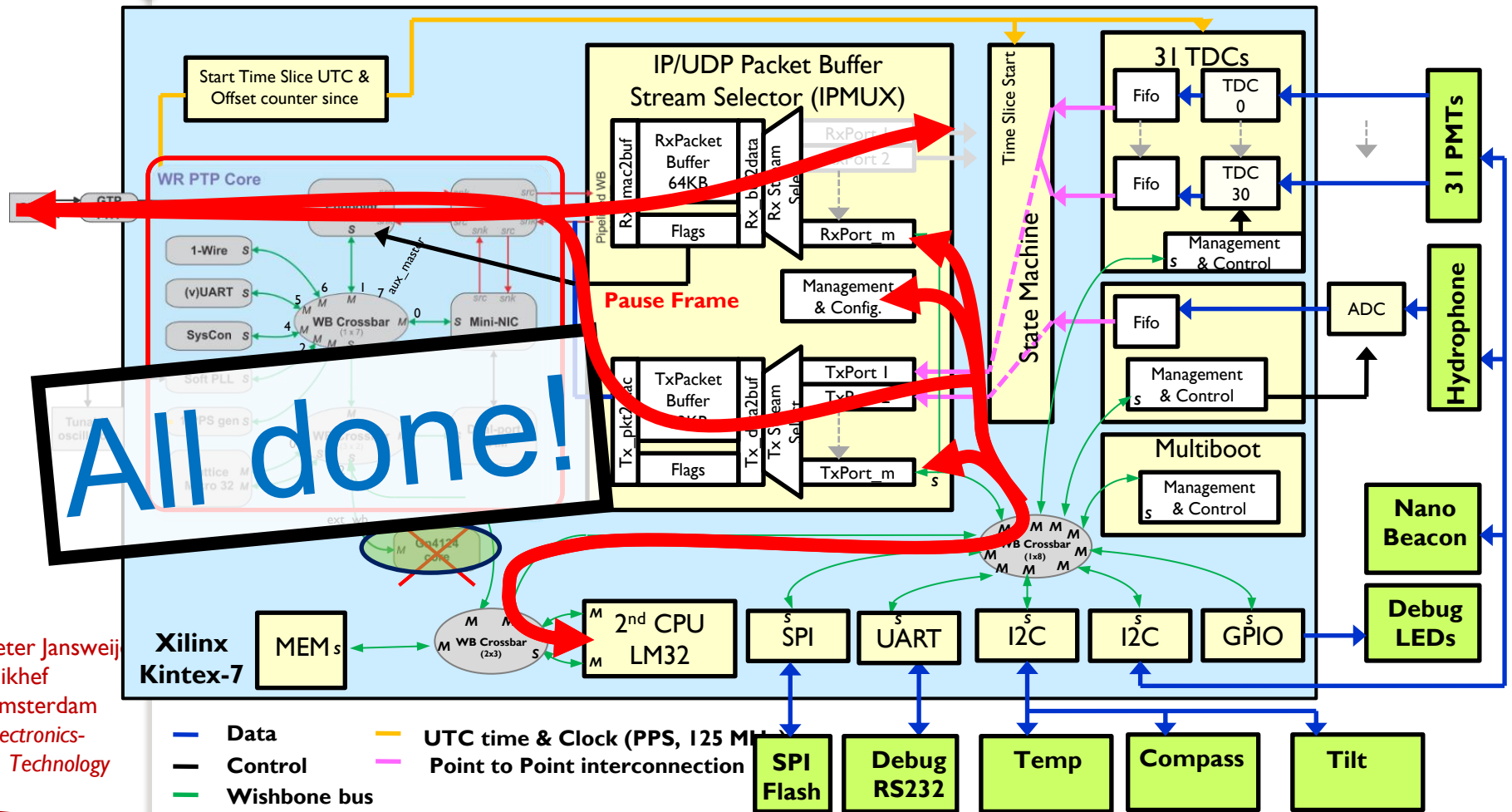
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First ping!

- Thanks to Vincent:

```
vincentb@ORDA: ~  
64 bytes from 192.168.1.10: icmp_req=1349 ttl=128 time=50.9 ms  
64 bytes from 192.168.1.10: icmp_req=1350 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1351 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1352 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1353 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1354 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1355 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1356 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1357 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1358 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1359 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1360 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1361 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1362 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1363 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1364 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1365 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1366 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1367 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1368 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1369 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1370 ttl=128 time=13.7 ms  
64 bytes from 192.168.1.10: icmp_req=1371 ttl=128 time=13.7 ms
```

UDP Packet Transmit/Receive LM32_2nd ipmux interface

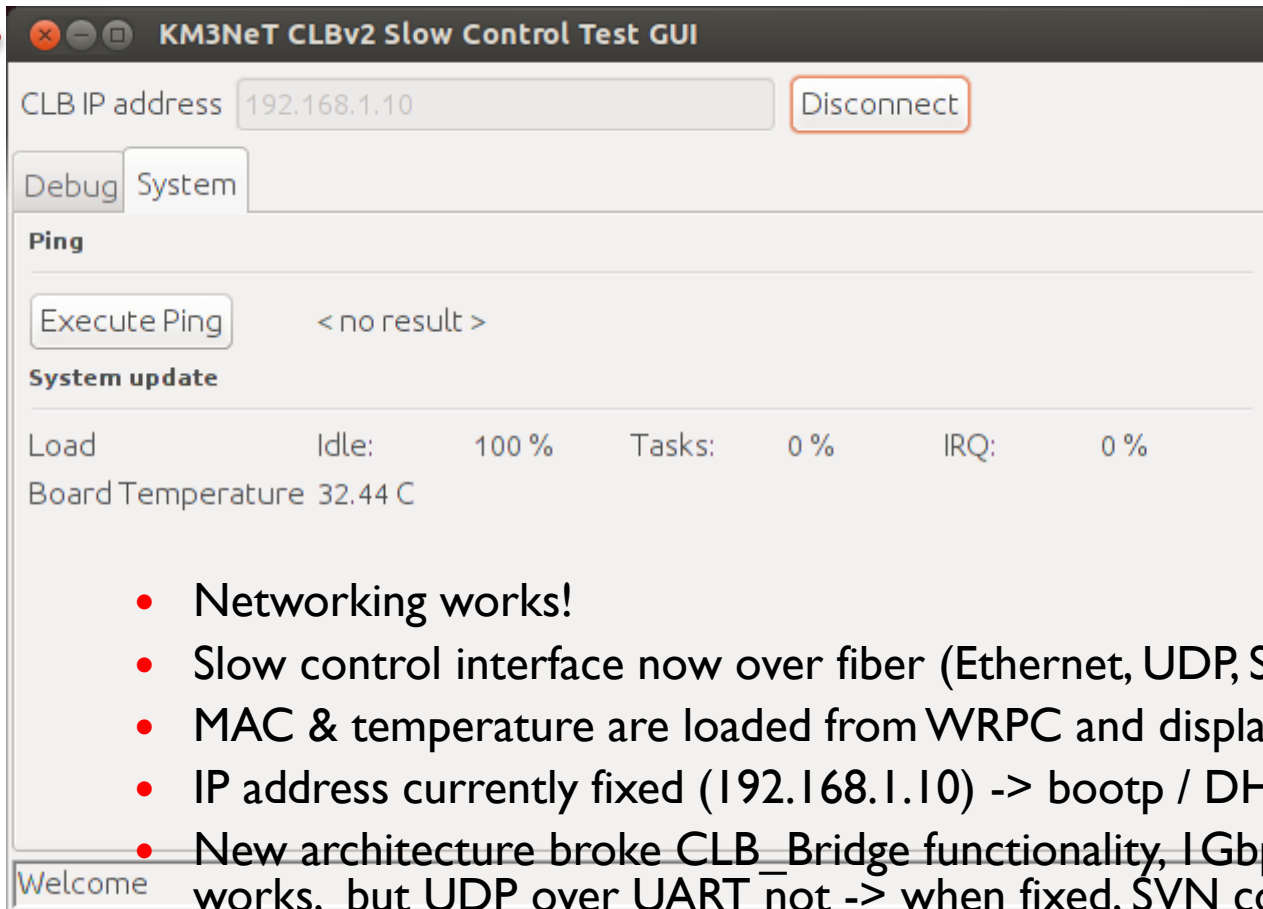


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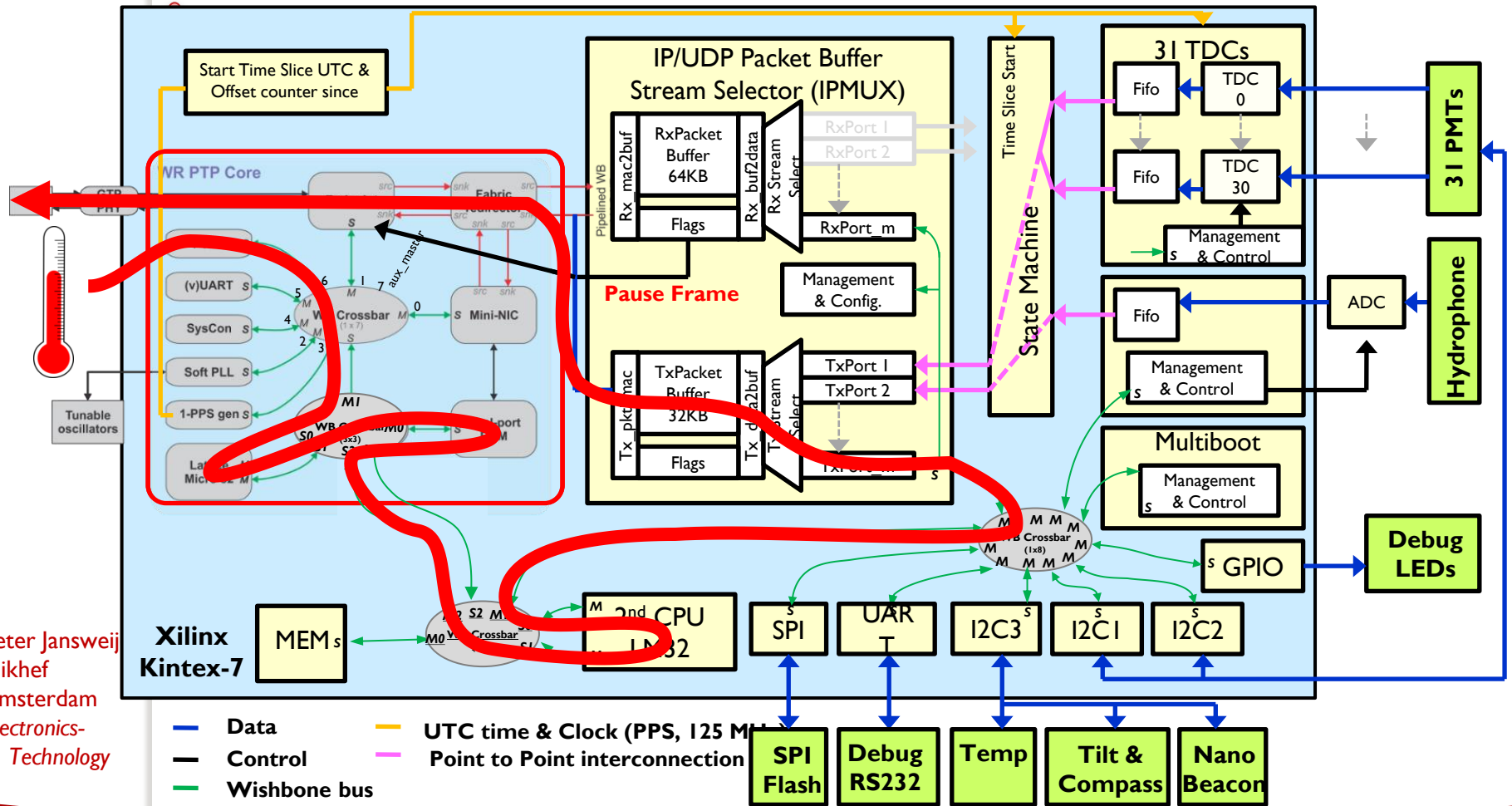


Vincent's slow-control temperature readout



- Networking works!
- Slow control interface now over fiber (Ethernet, UDP, SRP & MCF)
- MAC & temperature are loaded from WRPC and displayed
- IP address currently fixed (192.168.1.10) -> bootp / DHCP?
- New architecture broke CLB_Bridge functionality, 1 Gbps fiber works, but UDP over UART not -> when fixed, SVN commit, probably this week

Vincent's slow-control temperature readout exercises a lot of functionality!

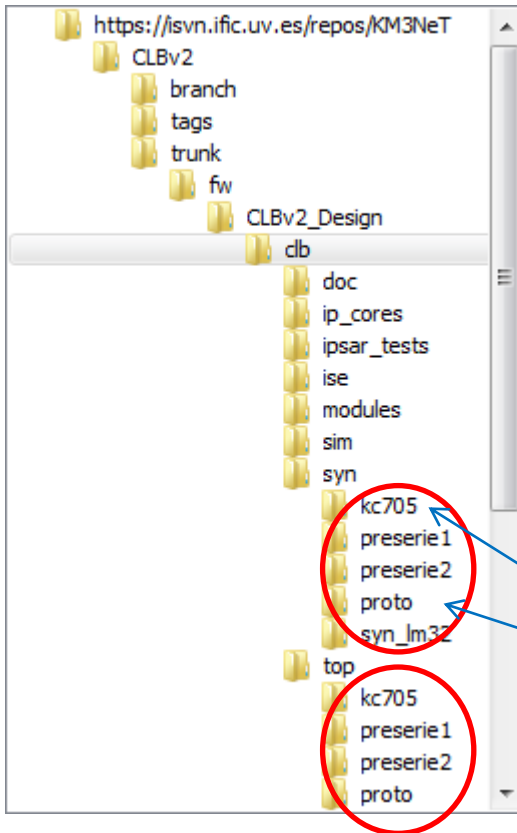


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PAUSE frames

- TX Pause implemented
 - request the shore station to halt
- RX Pause NOT implemented (yet) in white rabbit firmware
 - Respond to shore station halt request

SVN Organization



- One CLBv2 Design
- Different implementations, that is:

1. VHDL top file
2. Synthesis

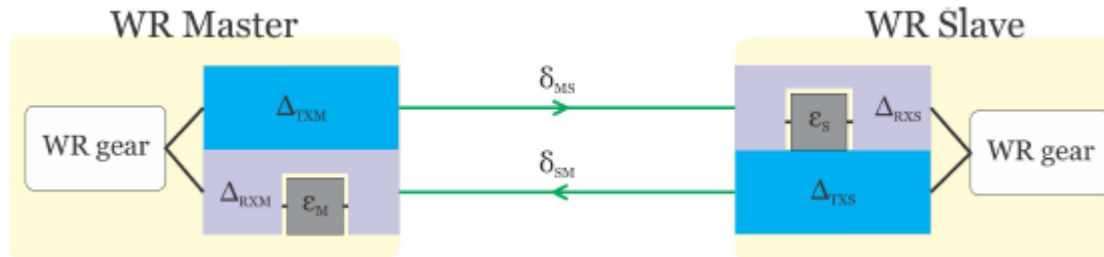
KC705 / CLBv2 Proto
Different UCF files!

Testing CLBv2 proto

- Looking forward to receive a CLBv2 prototype that is electrically tested and firmware loadable.
- Don't forget to ship one power board!
 1. I'll port the current KC705 design to the CLBv2 prototype (i.e. another place & route with the CLBv2 proto ucf file prepared by Antonio.
 2. Exercise the board (implicitly testing a lot of the functionality)

Calibration

Link delay model



- δ_{ms}, δ_{sm} : known fiber delays
 - (can be measured by solving timestamp measurements of fiber₁, fiber₂ and fiber₁₊₂)
- ϵ_s, ϵ_m : bitslide values
 - known by software
- Δ_{tx}, Δ_{rx} : **unknown**...
 - Hardware specific calibration parameters
- α : Asymetry factor
 - fiber specific parameter

Calibration

- KC705 Δtx and Δrx measured.
- Not a precise measurement yet, just to know if we understand the principles...
- Measure by feeding the tx/rx timestamp signal via register in IOLOGIC to pin (i.e. known delays and not depending on different synthesis cycles)
- And comparing this with Ethernet packet SOF in the serial bit stream at the electrical entry of the SFP
- Next: see if these numbers are okay; that is do they give a proper PPS alignment for setups:
 - KC705 <-> KC705
 - KC705 <-> SPEC
- Measure SPF propagation delays (Henk Peek)

Status Listing

- Skip the “done” list. Is’t getting long! 😊
- Currently:
 - Calibration procedure
- To do list (in order of priority):
 - Study: Every now and then 16 ns phase jump after startup
 - Study: Function `sdb_find_devices` fails (`dev/sdb.c`). Under investigation...
 - Study: Reset button on the KC705 puts the system in a weird state
 - Implement Rx Pause frames (if the white rabbit guys aren’t fixing this already in the next WRPC release)
- Wish list:
 - LM32 debugger

Backup Slides

More details...

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Wireshark 1.6.7

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.3	192.168.1.2	UDP	60	Source port: 8227 Destination port:
2	7.633487	192.168.1.2	192.168.1.3	UDP	60	Source port: 56782 Destination port:

Packet Details:

- Frame 2: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
- Ethernet II, Src: IntelCor_eb:ee:98 (00:15:17:eb:ee:98), Dst: NetworkR_6c:27:75 (00:00:30:6c:27:75)
 - Destination: NetworkR_6c:27:75 (00:00:30:6c:27:75)
 - Source: IntelCor_eb:ee:98 (00:15:17:eb:ee:98)
 - Type: IP (0x0800)
- Internet Protocol Version 4, Src: 192.168.1.2 (192.168.1.2), Dst: 192.168.1.3 (192.168.1.3)
- User Datagram Protocol, Src Port: 56782 (56782), Dst Port: igo-incognito (4100)
- Data (18 bytes)
 - Data: 0c001700000000000000000000000000000000 [Length: 18]

Packet Bytes:

```

0000  08 00 30 6c 27 75 00 15 17 eb ee 98 08 00 45 00 ..0l'u.....E.
0010  00 2e 00 00 40 00 40 11 b7 69 c0 a8 01 02 c0 a8 .....Peterj.....
0020  01 03 dd ce 10 04 00 1a 83 81 0c 00 17 00 00 00 .....
0030  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  
```

File: "/tmp/wireshark_eth2 20131... Packets: 2 Displayed: 2 Marked: 0 Dropped: 0

/dev/ttyUSB0 - PuTTY

```

1234
Wait for any key input) before LM32_2nd composes a packet...
Pressed: g...
: LM32_2nd waits for reception of a packet...
800
306c
2775
15
17eb
ee98
800
4500
2e
0
4000
4011
b769
c0a8
102
c0a8
103
ddce
1004
1a
5b91
c00
1700
0
0
0
0
0
10000

```

2

LM32_2nd
receives a
packet

```
peterj@Peterj-Ubuntu: ~/ipsar_tests/IPSAR_V3
File Edit View Search Terminal Help
peterj@Peterj-Ubuntu:~$ ./ipsar rxdatacpu.ips
peterj@Peterj-Ubuntu:~$ ./ipsar txdatacpu.ips
peterj@Peterj-Ubuntu:~$
```

NIKE

Transmit PAUSE frames

IPMUX Rx Buffer of 64 KB can hold 7 complete Jumbo Frames (9000 bytes + MAC_Hdr{6 + 6 + 2} = 9014 bytes)

Jumbo	Number of Bytes	% of ADRSIZE 14 (32678 Bytes)	% of ADRSIZE 15 (65536 Bytes)
1	9014	27,51%	13,75%
2	18028	55,02%	27,51%
3	27042	82,53%	41,26%
4	36056	110,03%	55,02%
5	45070		68,77%
6	54084		82,53%
7	63098		96,28%
8	72112		110,03%
9	81126		

Low Water Mark (@ 30 %)

High Water Mark (@ 50 %)

When “High Water Mark” is reached (i.e. buffer fills up after reception of 4 Jumbo Frames), then a Pause Request (0xFFFF) is issued.

When “Low Water Mark” is reached (i.e. buffer empties and there is still 1 Jumbo Frame available), then a Pause Request (0x0000) is issued which means “Cancel the Pause Request”

Transmit PAUSE frames

Small bug in ep_tx_framer.vhd

```
case counter(3 downto 0) is
  when x"0" => q_data <= x"0180";
  when x"1" => q_data <= x"c200";
  when x"2" => q_data <= x"0001";
  when x"3" => q_data <= regs_i.mach_o;
  when x"4" => q_data <= regs_i.macl_o(31 downto 16);
  when x"5" => q_data <= regs_i.macl_o(15 downto 0);
  when x"6" => q_data <= x"8808";
  when x"7" => q_data <= x"0001";
  when x"8" => q_data <= tx_pause_delay;
  state <= TXF_PAD;
when others => null;
```

globally assigned 48-bit multicast address
01:80:C2:00:00:01

"our" MAC address

MAC Control code
0x8808

Added missing MAC Control opcode
(0x0001) for sending a PAUSE frame.
See IEEE 802.3 Table 31A-1 MAC control
codes PAUSE (Annex 31B)

PAUSE Quanta

Transmit PAUSE frames

eth2 [Wireshark 1.6.7]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.2	192.168.1.3	UDP	9014	Source port: 39220 Destination port: bre
2	1.333664	192.168.1.2	192.168.1.3	UDP	9014	Source port: 36162 Destination port: bre
3	2.097926	192.168.1.2	192.168.1.3	UDP	9014	Source port: 53385 Destination port: bre
4	3.277618	192.168.1.2	192.168.1.3	UDP	9014	Source port: 48355 Destination port: bre
5	3.278006	NetworkR 6c:27:75	Spanning-tree-(for-br:MAC CTRL	60	MAC PAUSE: pause_time: 65535 quanta	
6	8.308334	NetworkR 6c:27:75	Spanning-tree-(for-br:MAC CTRL	60	MAC PAUSE: pause_time: 0 quanta	
7	19.597607	192.168.1.2	192.168.1.3	UDP	9014	Source port: 42642 Destination port: bre
8	20.605743	192.168.1.2	192.168.1.3	UDP	9014	Source port: 42516 Destination port: bre
9	21.565668	192.168.1.2	192.168.1.3	UDP	9014	Source port: 36930 Destination port: bre
10	22.813612	192.168.1.2	192.168.1.3	UDP	9014	Source port: 58782 Destination port: bre
11	22.814021	NetworkR 6c:27:75	Spanning-tree-(for-br:MAC CTRL	60	MAC PAUSE: pause_time: 65535 quanta	

Frame 5: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)

Ethernet II, Src: NetworkR 6c:27:75 (08:00:30:6c:27:75), Dst: Spanning-tree-(for-bridges)_01 (01:80:c2:00:00:01)

Destination: Spanning-tree-(for-bridges)_01 (01:80:c2:00:00:01)

Source: NetworkR 6c:27:75 (08:00:30:6c:27:75)

Type: MAC Control (0x8808)

MAC Control

Opcode: Pause (0x0001)

pause_time: 65535

0000 01 80 c2 00 00 01 08 00 30 6c 27 75 08 00 01 0l'u...

0010 ff ff 00 00 00 00 00 00 00 00 00 00 00 00

0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00

0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00

File: "/tmp/wireshark_eth2_20131..." Packets: 11 Displayed: 11 Marked: 0 Dropped: 0 Profile: Default

send 4 Jumbo frames
(4x ./ipsar txdata0.ips jumbo.bin)

KC705 responds with Pause Request 65535

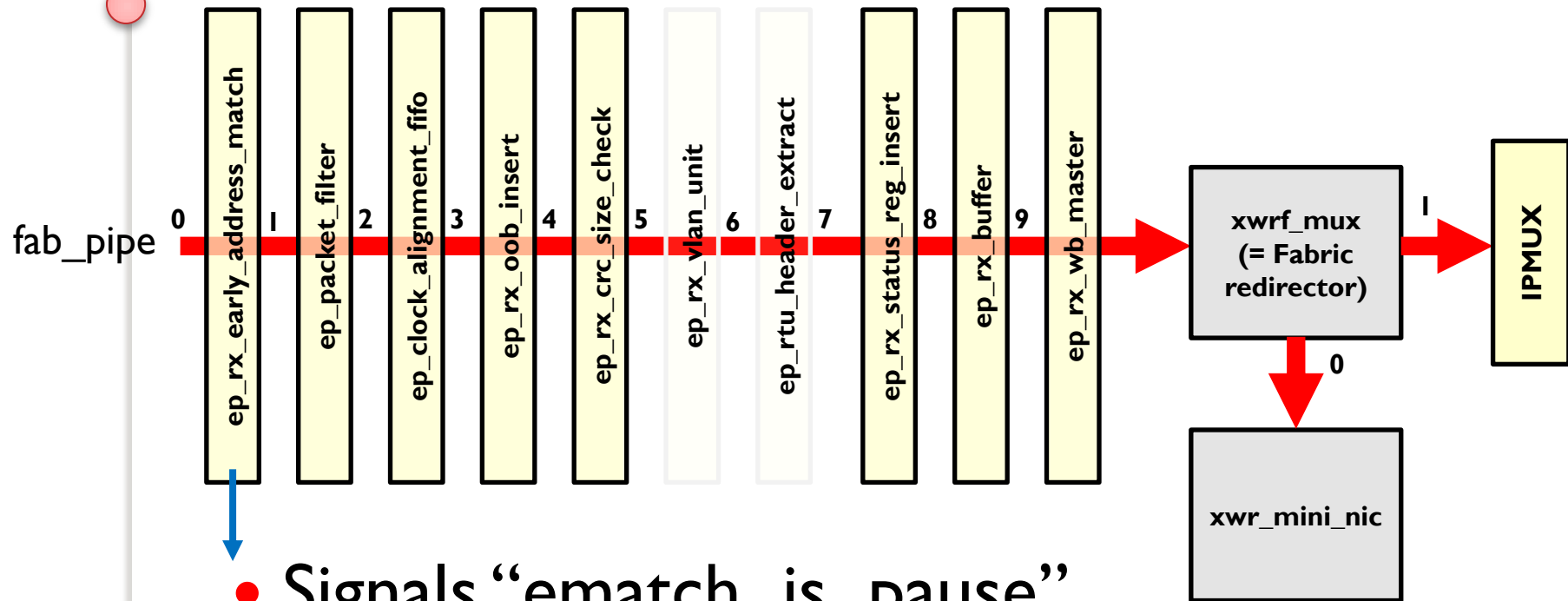
Enable Readout (SW11-I) =
Empty RX buffer => KC705
sends Pause Request 0

Again send 4 Jumbo frames

Again Pause Request 65535

- Hold IMPUX Rx buffer readout while sending Jumbo Frames from PC to KC705 Evaluation kit
 - (GPIO_DIP_SW => SW11-I implements readout enable)

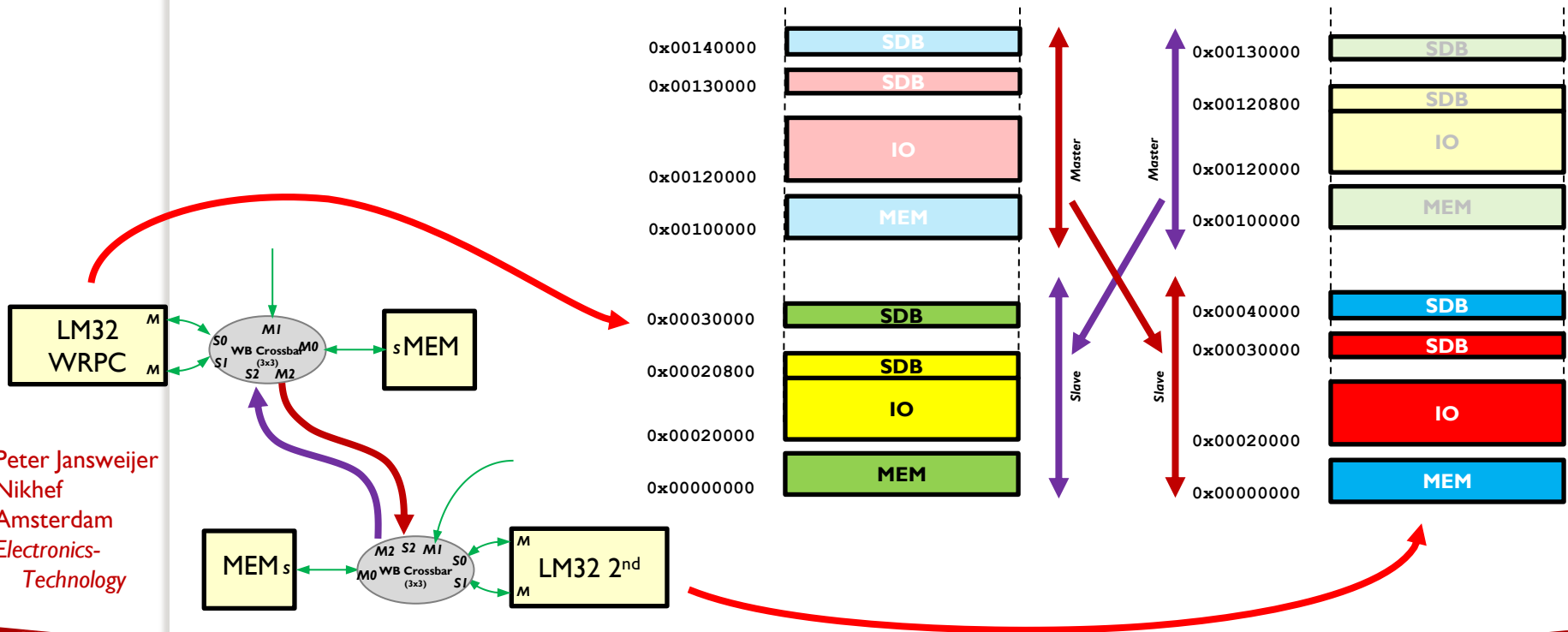
Receive PAUSE frames (ep_rx_path.vhd)



- Signals “`ematch_is_pause`” and “`ematch_pause_quanta`” are implemented but “open”

LM32_2nd integration two way bridge

- LM32_2nd is able to access LM32_wrpc memory space at addresses 0x00100000-0x00130000
- LM32_wrpc is able to access LM32_2nd memory space at addresses 0x00100000-0x00140000
- Function sdb_find_devices fails (dev/sdb.c). Under investigation...



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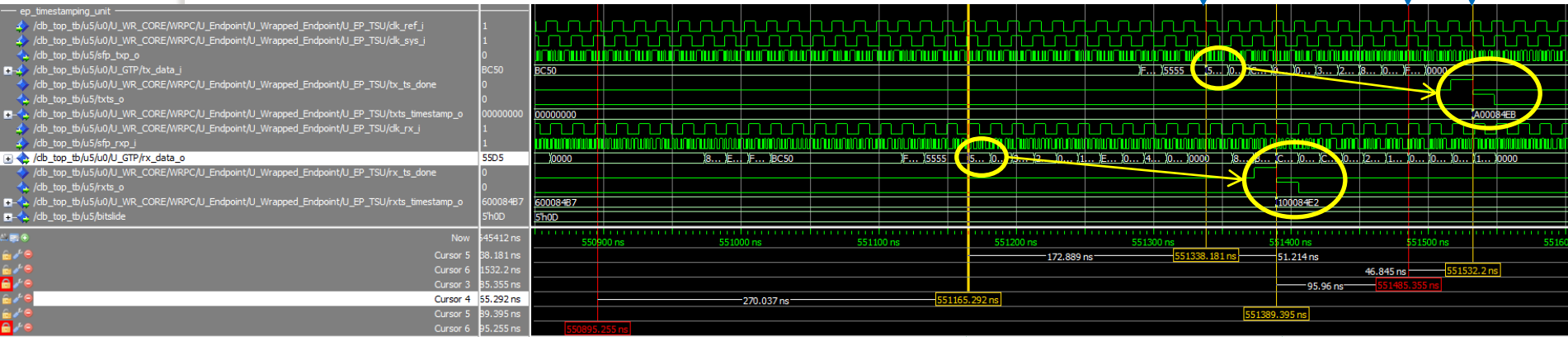
Calibration

Simulated timing

PCS-Tx
SFD <0x55D5>

txts_o debug pin on FPGA

```
sfp_tx_i:
Tx SFD <D21.6>
```



```
sfp_rx_i:
Rx SFD <D2I.6>
```

PCS-Rx
SFD <0x55D5>

rxts_o debug pin on FPGA

sfp_txp_i -> txts_o
Pin to pin delay: **46.845 ns**

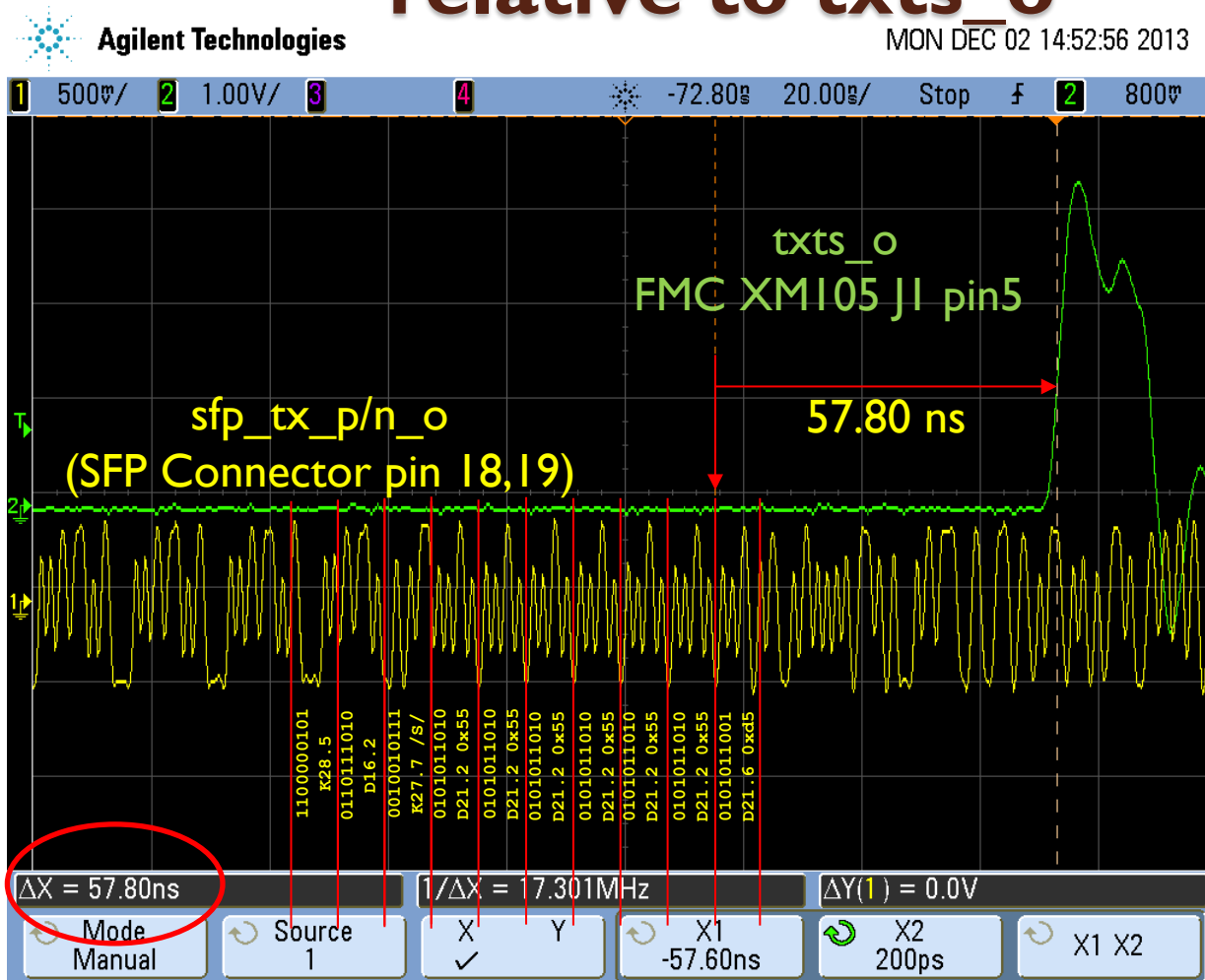
```
sfp_rxp_i -> rxts_o
```

Pin to pin delay: = **494,140 ns** (Note: bitslide = 0x0D = 13x800 ps = 10.4 ns)

Tx timestamp counter -> txts_o = 0 ns

Rx timestamp counter -> rxts_o = 0 ns

Example measured: sfp_tx_p/n_o relative to txts_o



$\Delta tx, \Delta rx$ measured

- Δtx

- (diff_probe sft_tx signal to txst_o) – (probe offset) – (txts_o propagation delay)
- = 57.80 - 2.21 - 3.82 = **51.77 ns**
- simulation (no PCB routing and buffer delays) = 46.85 ns
- Differs = 4.92 ns from measured value

- Δrx

- “(diff_probe sft_rx signal to rxst_o) – (probe offset) – (rxts_o propagation delay) – (bitslide value x 800 ps)
- = 497.97 - 2.21 - 3.82 – 4.0 = **487.94 ns**
- simulation (no PCB routing and buffer delays) = 494,14 ns
- Differs 6.2 ns from measured value