

PTP OC and BC with Linuxptp

29.11.2022

<https://www-acc.gsi.de/wiki/Timing/RunOrdinaryBoundaryClocksUsingLinuxptp>

PTP OC and BC with Linuxptp

- Topic
 - Linuxptp
 - Netzwerkkarte
 - Run OC and BC
 - Evaluation

PTP OC and BC with Linuxptp

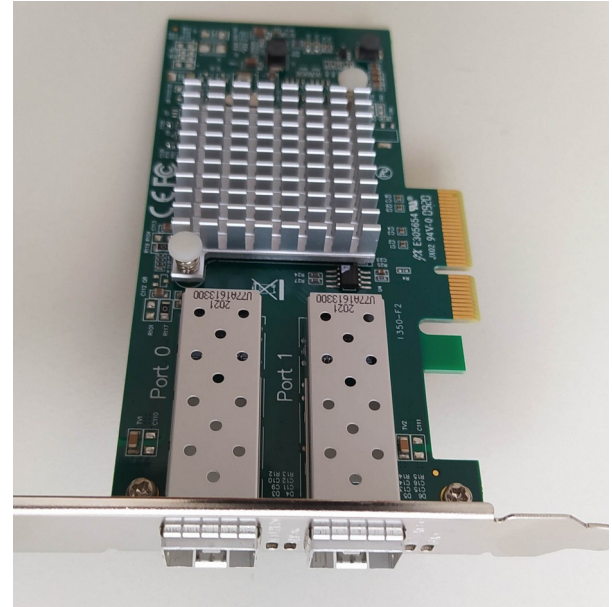
- Linuxptp
 - PTPv2 protocol stack for Linux
 - use kernel features (SO_TIMESTAMPING, PHC subsystem, device driver)
 - ordinary, boundary, transparent clocks
 - ptp4l, phc2sys, phc_ctl, timemaster, pmc

PTP OC and BC with Linuxptp

- Linuxptp
 - ptp4l
 - clock servo (PI, linreg)
 - delay mechanism (E2E, P2P)
 - transport protocol (802.3 Ethernet, UDP/IPv4/6)
 - phc2sys
 - synchronize clocks (PHC, system)
 - phc_ctl
 - control PHC devices

PTP OC and BC with Linuxptp

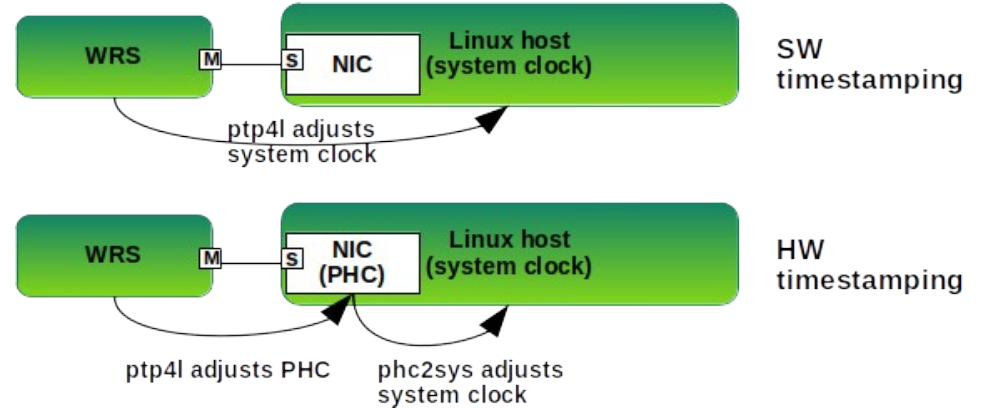
- BlueLAN CNA i350-f2
 - CNA = GbE + FCoE
 - HW/SW timestamping
 - `ethtool -T <interface_name>`
 - igb Linux driver
 - 2x 1Gb SFP ports



PTP OC and BC with Linuxptp

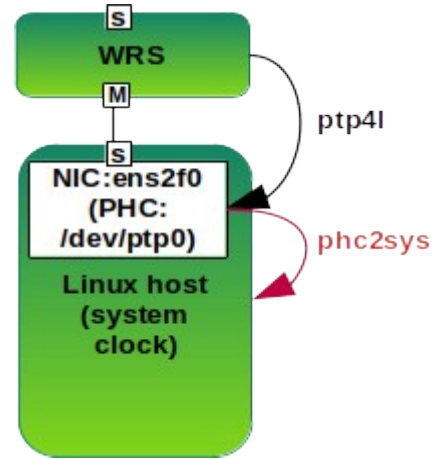
- Linuxptp
 - HW/SW timestamping

```
$ ethtool -T ens2f0
Time stamping parameters for ens2f0:
Capabilities:
  hardware-transmit
  software-transmit
  hardware-receive
  software-receive
  software-system-clock
  hardware-raw-clock
PTP Hardware Clock: 0          # PHC is /dev/ptp0
Hardware Transmit Timestamp Modes:
  off
  on
Hardware Receive Filter Modes:
  none
  all
```



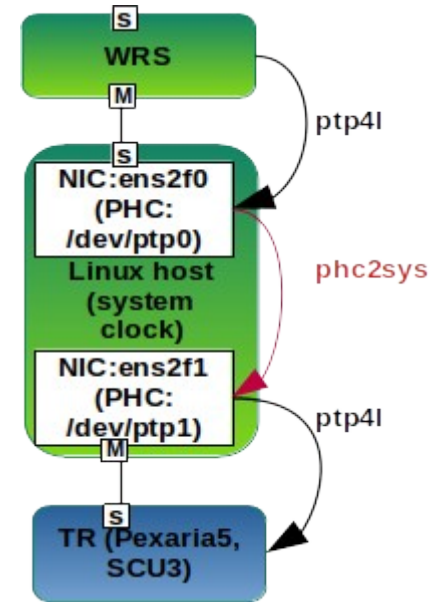
PTP OC and BC with Linuxptp

- OC (slave)
 - NIC
 - one interface (ie., ens2f0)
 - disable local time synchronization
 - timesyncd, ntpd
 - Linuxptp (HW timestamping)
 - slave: `ptp4l -i ens2f0 -s -E -2`
 - `ptp4l[9246.419]: port 1: UNCALIBRATED to SLAVE on MASTER_CLOCK_SELECTED`
 - `ptp4l[9247.586]: master offset -12437 s2 freq +18784 path delay 478`
 - `phc2sys -s ens2f0 -w`
 - `phc2sys[9283.292]: CLOCK_REALTIME phc offset 3199 s2 freq +32790 delay 233993`
 - `phc_ctl ens2f0 -- get`
 - `phc_ctl[14405.321]: clock time is 1587506971.943044312 or Wed Apr 22 00:09:31 2020`



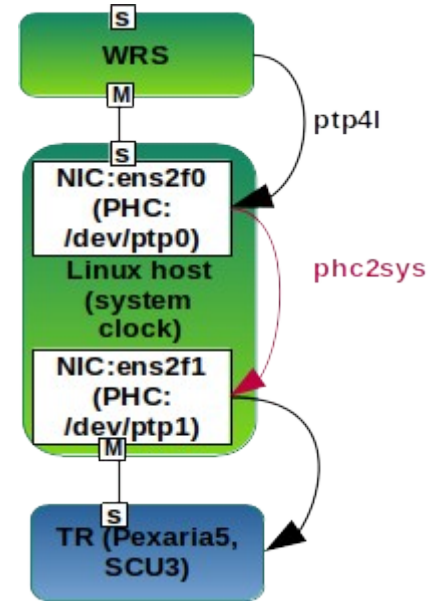
PTP OC and BC with Linuxptp

- BC (slave & master, manual)
 - NIC
 - both interfaces (ens2f0/1)
 - Linuxptp (HW timestamping)
 - slave: `ptp4l -i ens2f0 -E -2 -s`
 - master: `ptp4l -i ens2f1 -E -2`
 - `phc2sys -s ens2f0 -c ens2f1 -w`



PTP OC and BC with Linuxptp

- BC (slave & master, auto)
 - NIC
 - both interfaces (ens2f0/1)
 - Linuxptp (HW timestamping)
 - `ptp4l -f <configuration>`
 - specify interfaces and their clock modes: `slaveOnly`, `masterOnly*`
 - BC-relevant: `boundary_clock_jbod`, `BMCA*`
 - `phc2sys -a`



PTP OC and BC with Linuxptp

- Sync accuracy
 - options
 - timestamping (HW, SW)
 - clock servo (PI, linreg)
 - step_threshold, ...
 - manual vs. configuration/auto

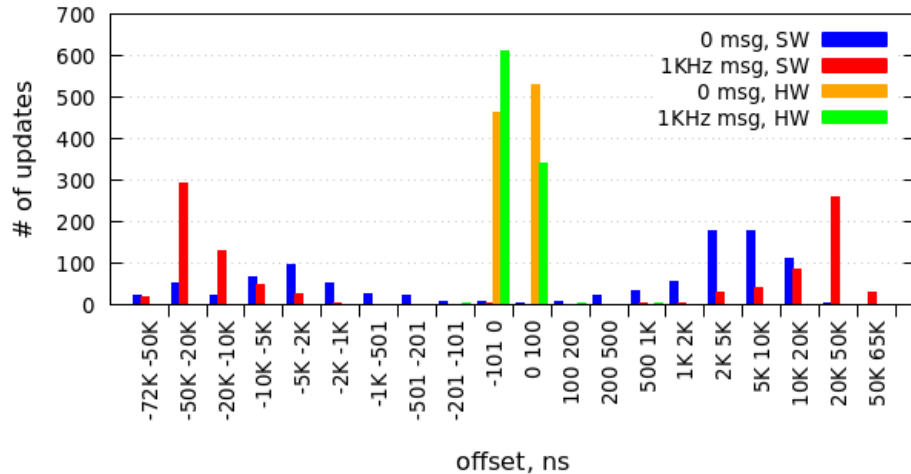
PTP OC and BC with Linuxptp

- Sync accuracy

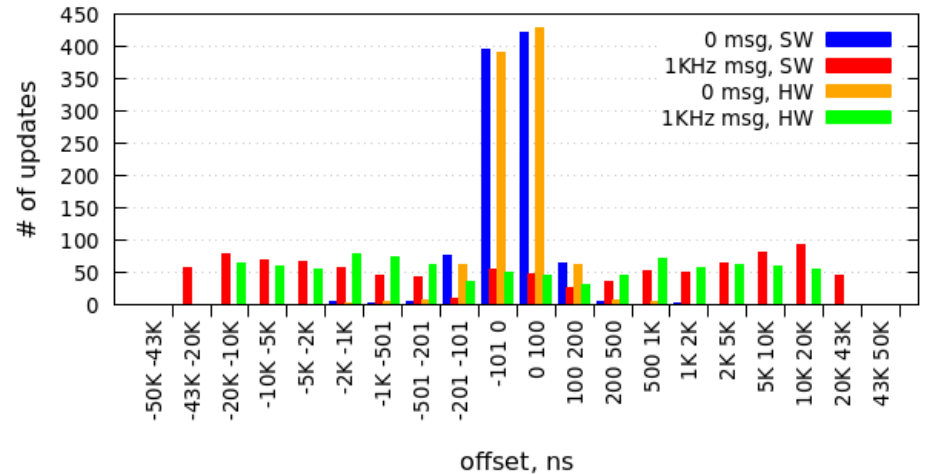
- offset, ns (log output)

- ptp4l[7499.191]: master offset **-11** s2 freq +22524 path delay 443
 - phc2sys[7494.425]: ens0f1 phc offset **30** s2 freq +22570 delay 127517

Slave offset, ptp4l

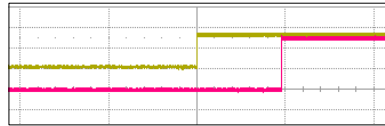


Sync offset, phc2sys

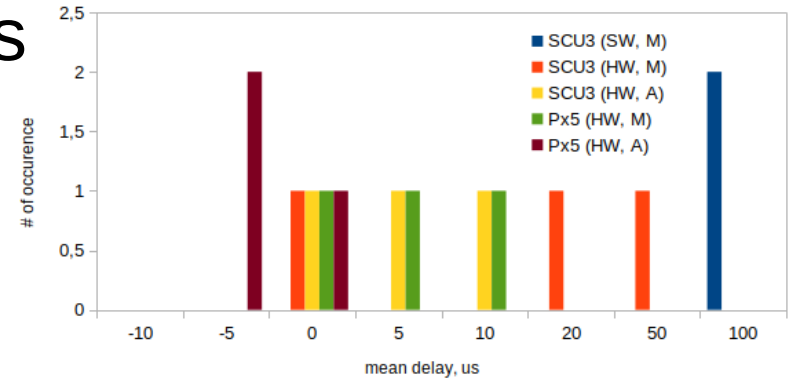


PTP OC and BC with Linuxptp

- Sync accuracy
 - delay between PPS pulses, us
 - **WRS** <----> BC <----> **TR**



Mean delay between PPS pulses, us



statistics	SCU3						Pexaria5							
	BC (manual, SW)		BC (manual, HW)			BC (auto, HW)	BC (manual, HW)			BC (auto, HW)				
mean, us	136,7	113,9	46,1	-0,4	20,3	12,8	-0,3	6,6	11,2	0,7	6,2	-5	-0,1	-5,7
min, us	-30,2	-59,4	-71,2	-18,1	-4,5	-3,5	-8,7	-5,8	-18,3	-2,9	-23,2	-21,9	-4,9	-22,0
max, us	479,3	419,1	144,7	9,7	67,1	70,9	9,2	26,1	28,8	3,5	0,9	1,5	2,3	1,6
sdev, us	110,2	103,9	43,7	5,3	17,9	14,3	3,1	6,7	8,8	1,1	5,3	5,1	1,0	5,1

PTP OC and BC with Linuxptp

- Snoop timing messages
 - SFP transceivers: fiber, TP
 - Wireshark capture
 - un-aware of RADIUS, VLAN

4	1668517605.491822...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
5	1668517606.515885...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
6	1668517607.539768...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
7	1668517608.563789...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
8	1668517609.587894...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
9	1668517610.611750...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
10	1668517611.635643...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
11	1668517612.659846...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
12	1668517613.683675...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
13	1668517614.707647...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
14	1668517615.731705...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5
15	1668517616.755574...	Dell_5f:b7:6f	Broadcast	ARP	60	Who has 192.168.131.1?	Tell 192.168.131.5

```
+ Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface eth1, id 0
+ Ethernet II, Src: Dell_5f:b7:6f (c8:f7:50:5f:b7:6f), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
- 802.1Q Virtual LAN, PRI: 0, DEI: 0, ID: 3000
  000. .... = Priority: Best Effort (default) (0)
  ...0 .... = DEI: Ineligible
  ... 1011 1011 1000 = ID: 3000
Type: ARP (0x0806)
Padding: 00000000000000000000000000000000
- Address Resolution Protocol (request)
  Hardware type: Ethernet (1)
  Protocol type: IPv4 (0x0800)
  Hardware size: 6
  Protocol size: 4
  Opcode: request (1)
  Sender MAC address: Dell_5f:b7:6f (c8:f7:50:5f:b7:6f)
  Sender IP address: 192.168.131.5
  Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)
  Target IP address: 192.168.131.1
```