Analyzing DPDK applications with eBPF

Sharpening the toolset

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Microsoft

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Introduction

Ancient wisdom

French proverb
Mauvés ovriers ne trovera ja bon hostill

Bad workers will never find a good tool

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Bad workers will never find a good tool

Chinese proverb
To do a good job, a craftsman must sharpen his tools.

Methodology

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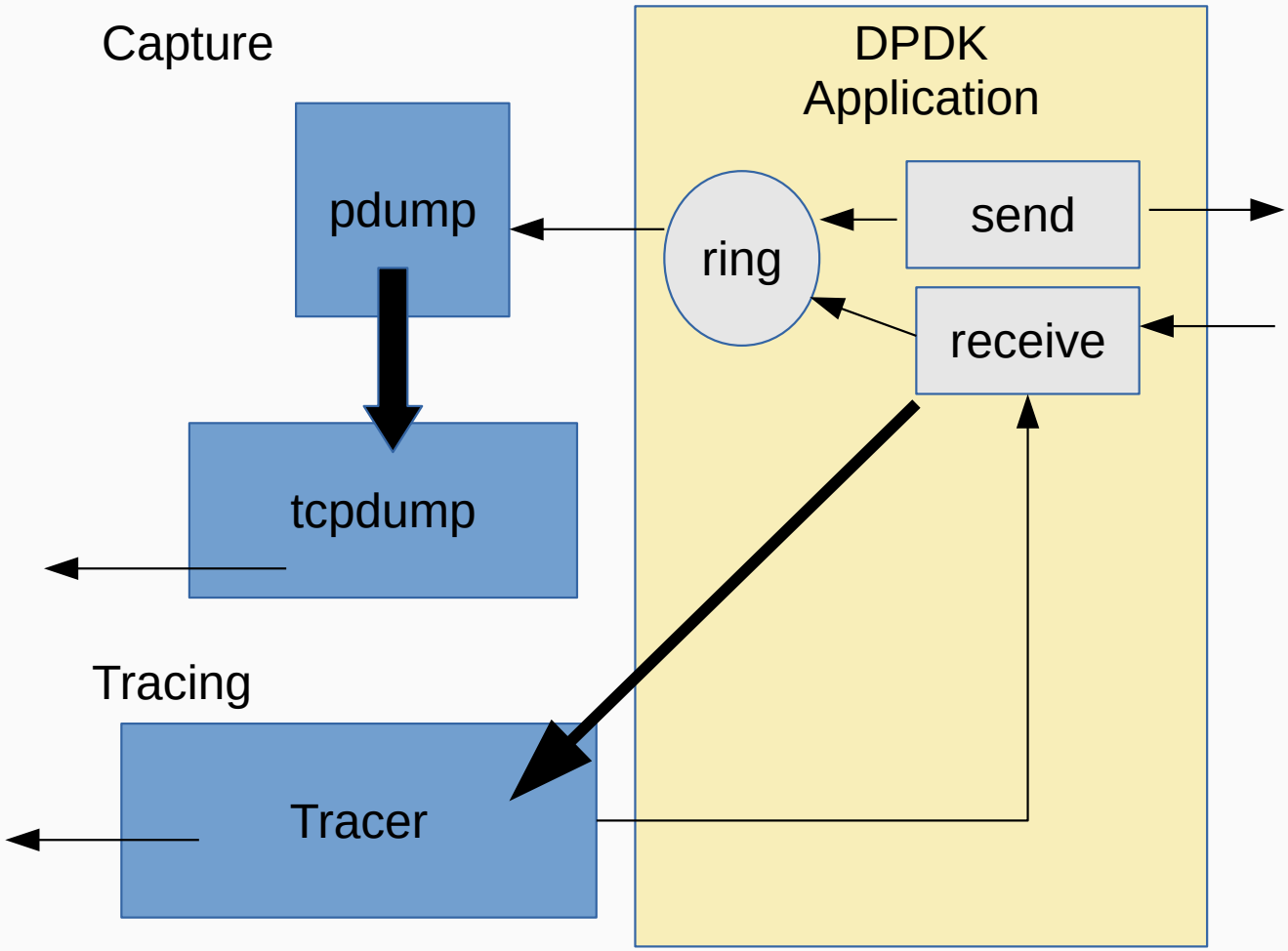
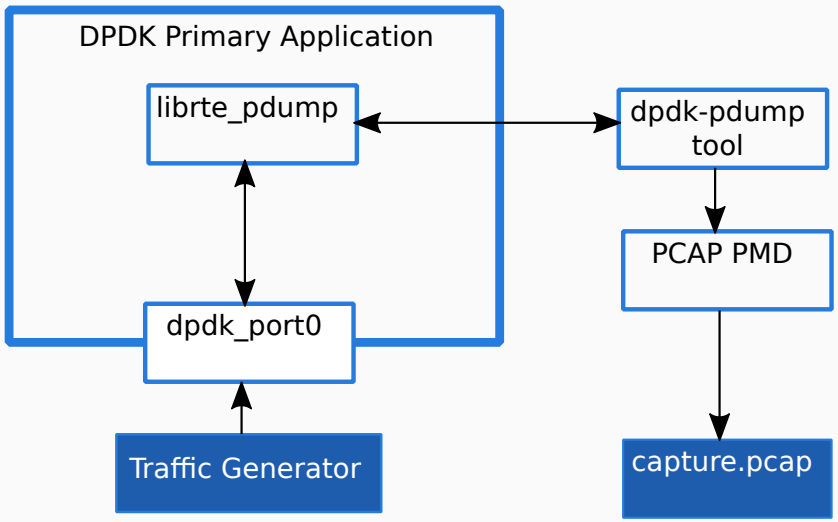
See Linux tracing talks (Brendan Gregg et al)

Capture vs Tracing



Packet Capture

DPDK pdump



- Packet copied and queued to ring
- Secondary process sends to libpcap
- Packets recorded in pcap format

Pdump limitations

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PCAP Next Generation

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PCAP Next Generation

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- Comments

Packet filtering with libpcap

PCAP filter string: ip dst fosdem.org

```
cBPF program (6 insns):
(000) ldh      [12]
(001) jeq      #0x800           jt 2    jf 5
(002) ld       [30]
(003) jeq      #0x1f16168c      jt 4    jf 5
(004) ret      #65535
(005) ret      #0
```

Packet filtering cBPF

Translated to eBPF

```
eBPF program (11 insns):
 L0:    xor r0, r0
 L1:    xor r7, r7
 L2:    mov r6, r1
 L3:    ldh r0, [12]
 L4:    jne r0, #0x800, L9
 L5:    ldw r0, [30]
 L6:    jne r0, #0x1f16168c, L9
 L7:    mov32 r0, #0xffff
 L8:    exit
 L9:    mov32 r0, #0x1
 L10:   exit
```

Tracing

Linux Trace toolkit

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- User Defined Trace Points

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Linux Trace toolkit

- Easy to use
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- Common Trace Format
- High performance

Adding lttng tracepoint

```
/* Send burst of packets on an output interface */
static inline int
send_burst(struct lcore_conf *qconf, uint16_t n, uint16_t port)
{
  struct rte_mbuf **m_table = qconf->tx_mbufs[port].m_table;
  uint16_t queueid = qconf->tx_queue_id[port];
  int ret;

  ret = rte_eth_tx_burst(port, queueid, m_table, n);
  tracepoint(l3fwd, tx_burst, port, queueid, n, ret);
  if (unlikely(ret < n))
  ^^lrte_pktmbuf_free_bulk(&m_table[ret], n - ret);
  return 0;
}
```

Using eBPF from userspace

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sys/sdt.h	systemtap-std-dev

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Adding DTRACE probes

```
static void
pkt_burst_receive(struct fwd_stream *fs)
{
  struct rte_mbuf  *pkts_burst[MAX_PKT_BURST];
  uint16_t i, nb_rx;

  /* Receive a burst of packets. */
  nb_rx = rte_eth_rx_burst(fs->rx_port, fs->rx_queue,
  ^^I^^I^^I  pkts_burst, nb_pkt_per_burst);

  DTRACE_PROBE1(testpmd, rx_burst, nb_rx);

  if (unlikely(nb_rx == 0))
 ^^I^^Ireturn;
```

Looking for USDT

Use bpftrace to look for tracepoints in application

```
$ sudo  bpftrace -l "usdt:./build/app/testpmd"
  usdt:./build/app/testpmd:testpmd:rx_burst
```

Running bpftrace

Build a histogram of the number of packets per loop

```
  $ sudo bpftrace -e 'usdt:./build/app/testpmd:rx_burst  { @ = hist(arg0); }'
Attaching 1 probe...
^C

@:
[0]              16001930 |@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@|
[1]                     0 |                                                          |
[2, 4)                  0 |                                                          |
[4, 8)                  0 |                                                          |
[8, 16)                 0 |                                                          |
[16, 32)                0 |                                                          |
[32, 64)          5333977 |@@@@@@@@@@@@@@@@@                                         |
```

Performance

Caveats

- Limited hardware - x85 with 25G NIC

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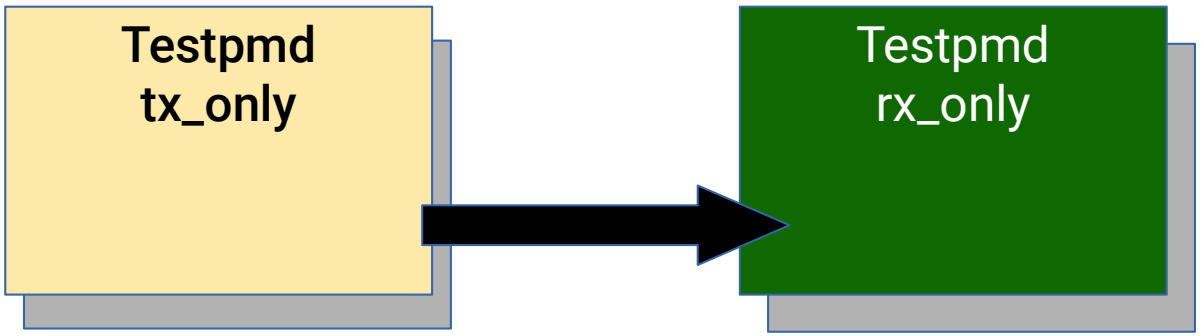
  - Current DPDK 19.11
  - Single queue active

Test configuration



- Sender tx-only
- Receiver rx-only
- Observe Receive packets/sec

Capture and Tracing Performance

Test	Disabled	Enabled
Pdump	0	-36.85
Pdump + eBPF	0	0
Lttng	-0.42	-0.02
bpftrace	-0.01	-56.72

Conclusion

Ongoing work

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  - dumpcap (tshark) syntax
- DPDK trace points

Thank you

- Questions
- Thanks
  - DPDK community
  - LTTng
  - eBPF developers
- Contact

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  @networkplumber