OPENFABRICS ALLIANCE

2023 OFA Virtual Workshop

Libfabric OPX Provider

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Cornelis Networks

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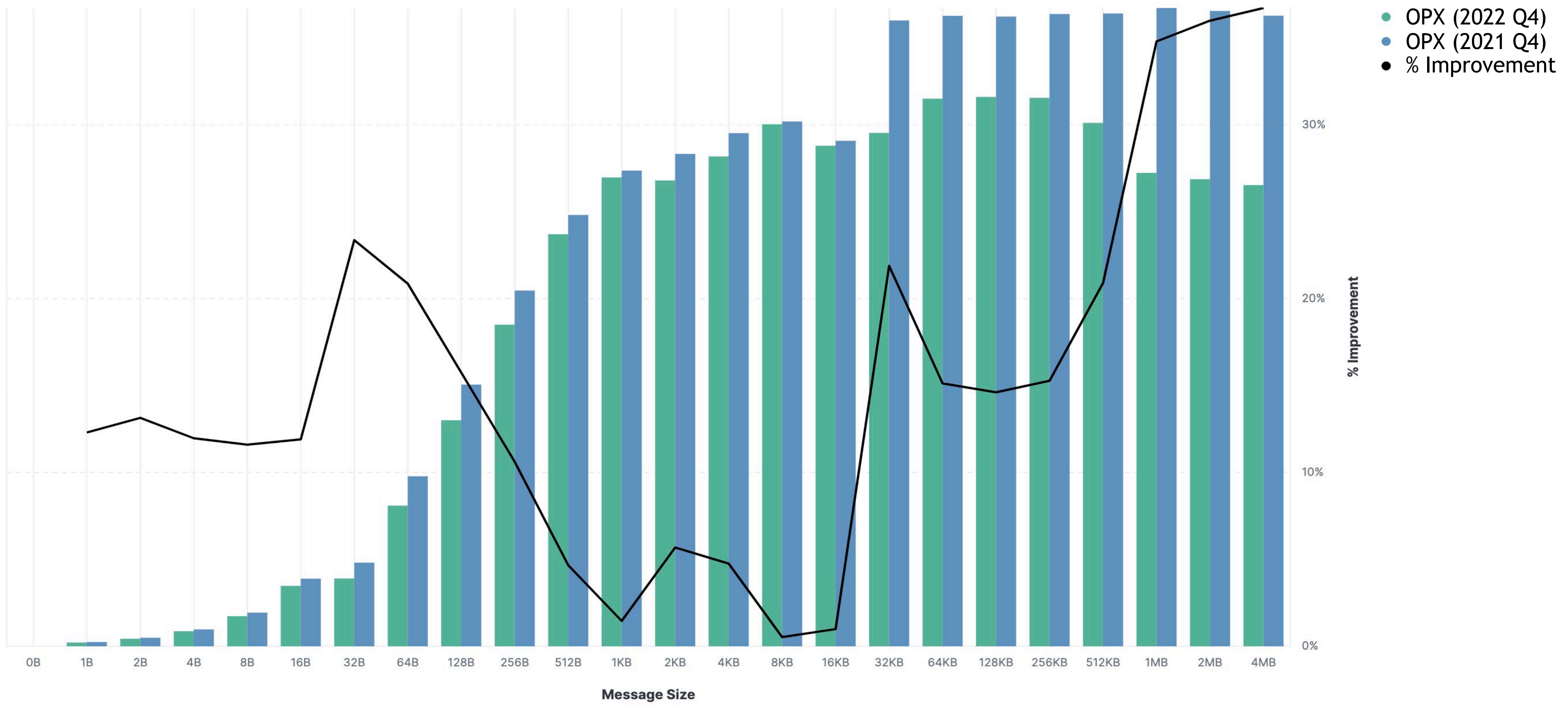
Introduction

- Who is Cornelis Networks?
  - Omni-Path Architecture (OPA)
  - Third year of talks in this workshop
  - Spun out of Intel
- What is OPX?
  - Labfabric provider for Cornelis and Omni-Path fabrics
  - User-space part of hfi1 device driver/hardware interfaces
  - Started as a clone of the BGQ provider
  - Supports 100Gbps and 400Gbps (upcoming) fabrics
- Who am I?
  - User-space Senior Software Engineer Cornelis Networks

Past Year's Progress

- Bulk Transfer Tx (offloads Tx PIO interface)
- Additional feature: Auto progress
- Additional feature: AV_TABLE
- Enhanced feature: Tag matching at scale
- DAOS progress (coming in version 2.4)
- Reliability enhancements for HPC apps at scale
- One-sided MPI and OpenSHMEM support
- Observability
- Performance has increased for vast majority of workloads and message sizes

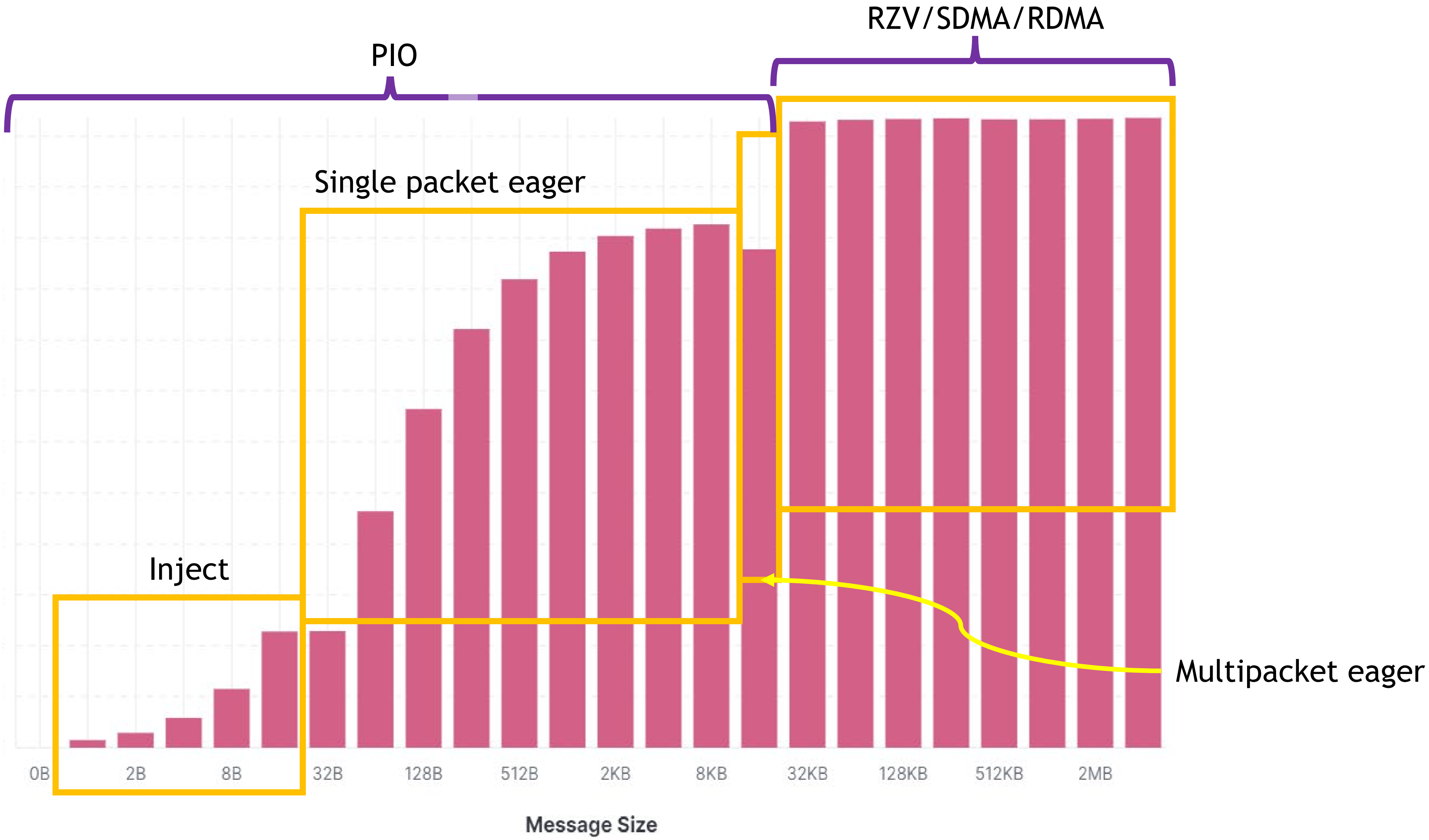
2022 Performance improvement



In Progress

- RDMA - Expected Receive
  - Eliminates Rx bounce buffers and offloads Rx Eager Ring
  - Requires hardware mapping/pinning of HPC application memory pages
  - Extra overhead makes this non-performant for ‘small’ messages
  - Buffer fragmentation adds to headaches
  - HPC app behavior affects performance (re-map buffers vs re-use)
- DAOS support
  - Internode and Intranode durable connection resume support
  - Eventually will need Scalable Endpoints
  - Alternative to IB_verbs for HPC storage
- GPU support
  - GPUs have their own non-standard APIs, need to use these for best performance
  - Testing base support for CUDA, intranode and internode traffic
  - Avoiding vendor lock-in creates more testing and more design requirements
- CN5000 – 400 Gbps adapters, more fabric features for scalability
- Programmer creature comforts: Observability and Debuggability

Message length thresholds



Upstream First

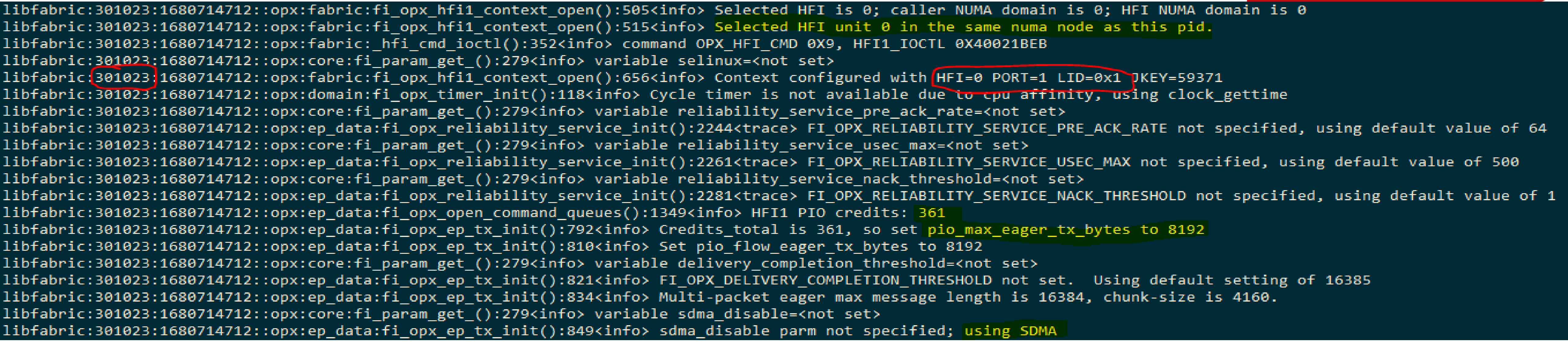
- Similar points Dennis mentioned for the hfi1 device driver
- User space HPC community easier to work with than Linux Kernel
- Testing before upstream, SO MANY VARIATIONS, CI not 100% coverage
- There’s also test case and debug code that is #ifdef out
- Plan Cornelis software releases around upstream project releases whenever possible
- Official support is still Cornelis Networks software releases of ‘OPXS’ (used to be called IFS)
- Libfabric CI on upstream PRs

Extended testing

- How does a developer know if their changes affected performance?
    - Microbenchmarks don’t tell the whole story
    - Testing at scale, what is ‘big’ in HPC?
- Developers need tooling, emulators, and hardware
    - Hardware counters, processor, PCIe, and hfi1 driver
    - Tools like Intel SDE and vTune
    - Instrumented testing with asserts, debug-builds, and testing code
    - Hard to automate this type of testing
- Amount of extended testing is limited by Developer’s time

Observability

- Means that anyone (a dev or a user) can see granular details about how the hardware under their job is configured
- With HPC performance constraints, a re-compile of Libfabric/Opx may be needed for extra logs and counters. Debug builds are prohibitively verbose currently.
- User can enable/configure more logging with #define and re-compile…
- Set ENV FI_LOG_LEVEL=info with any build of Libfabric to see SOME things, especially useful on HPC job startup.



```
libfabric:301023:1680714712::opx:fabric:fi_opx_hfi1_context_open():505<info> Selected HFI is 0; caller NUMA domain is 0; HFI NUMA domain is 0
libfabric:301023:1680714712::opx:fabric:fi_opx_hfi1_context_open():515<info> Selected HFI unit 0 in the same numa node as this pid.
libfabric:301023:1680714712::opx:fabric:_hfi_cmd_ioctl():352<info> command OPX_HFI_CMD 0X9, HFI1_IOCTL 0X40021BEB
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable selinux=<not set>
libfabric:301023:1680714712::opx:fabric:fi_opx_hfi1_context_open():656<info> Context configured with HFI=0 PORT=1 LID=0x1 PKEY=59371
libfabric:301023:1680714712::opx:domain:fi_opx_timer_init():118<info> Cycle timer is not available due to cpu affinity, using clock_gettime
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable reliability_service_pre_ack_rate=<not set>
libfabric:301023:1680714712::opx:ep_data:fi_opx_reliability_service_init():2244<trace> FI_OPX_RELIABILITY_SERVICE_PRE_ACK_RATE not specified, using default value of 64
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable reliability_service_usec_max=<not set>
libfabric:301023:1680714712::opx:ep_data:fi_opx_reliability_service_init():2261<trace> FI_OPX_RELIABILITY_SERVICE_USEC_MAX not specified, using default value of 500
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable reliability_service_nack_threshold=<not set>
libfabric:301023:1680714712::opx:ep_data:fi_opx_reliability_service_init():2281<trace> FI_OPX_RELIABILITY_SERVICE_NACK_THRESHOLD not specified, using default value of 1
libfabric:301023:1680714712::opx:ep_data:fi_opx_open_command_queues():1349<info> HFI1 PIO credits: 361
libfabric:301023:1680714712::opx:ep_data:fi_opx_ep_tx_init():792<info> Credits_total is 361, so set pio_max_eager_tx_bytes to 8192
libfabric:301023:1680714712::opx:ep_data:fi_opx_ep_tx_init():810<info> Set pio_flow_eager_tx_bytes to 8192
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable delivery_completion_threshold=<not set>
libfabric:301023:1680714712::opx:ep_data:fi_opx_ep_tx_init():821<info> FI_OPX_DELIVERY_COMPLETION_THRESHOLD not set.  Using default setting of 16385
libfabric:301023:1680714712::opx:ep_data:fi_opx_ep_tx_init():834<info> Multi-packet eager max message length is 16384, chunk-size is 4160.
libfabric:301023:1680714712::opx:core:fi_param_get_():279<info> variable sdma_disable=<not set>
libfabric:301023:1680714712::opx:ep_data:fi_opx_ep_tx_init():849<info> sdma_disable parm not specified; using SDMA
```

Debuggability

- OPX observability and debug logs COULD sometimes help users debug their own code…but probably not much help

- Users need help/hints about their own bugs like hangs and performance issues

- OPX can provide counters and 'current status', like how many unmatched messages are sitting in the match queues

- **What information from the provider/fabric do users want to help their own debug?**

Thank You

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