14th ANNUAL WORKSHOP 2018

USING OPEN FABRIC INTERFACE IN INTEL® MPI LIBRARY

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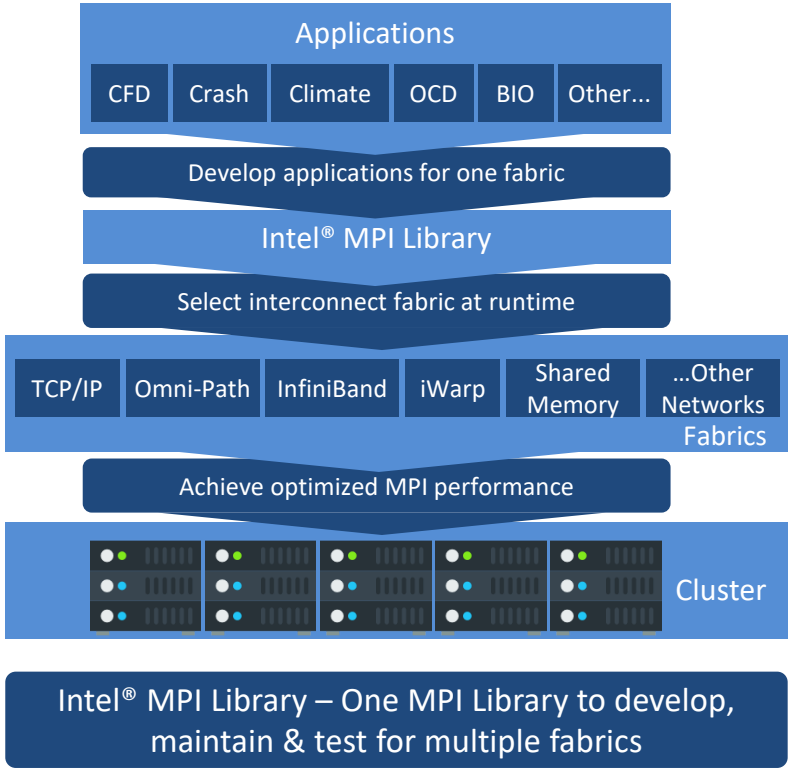
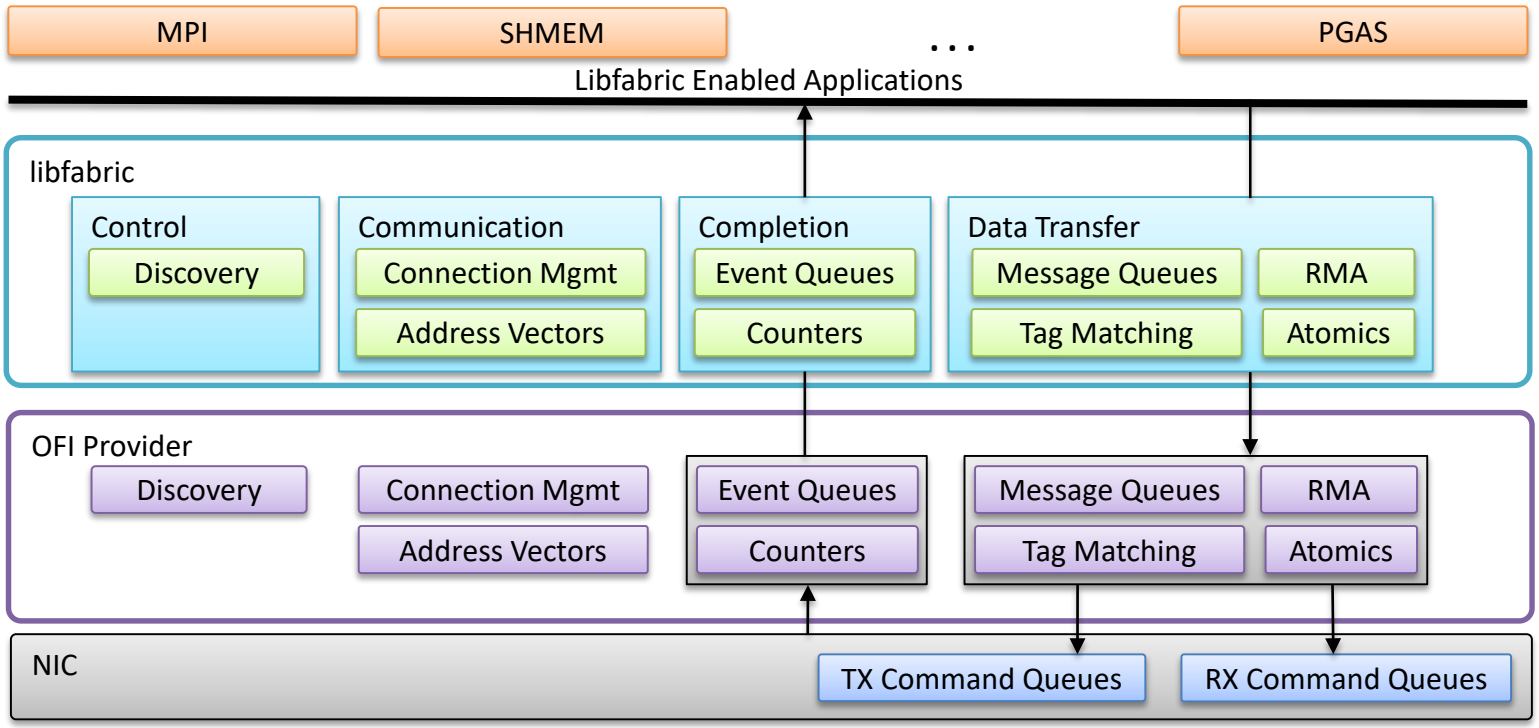
INTEL MPI LIBRARY

- **Optimized MPI application performance**
  - Application-specific tuning
  - Automatic tuning
  - Support for latest Intel® Xeon® Processor (codenamed Skylake) & Intel® Xeon Phi™ Processor (codenamed Knights Landing)
  - Support for Intel® Omni-Path Architecture Fabric, InfiniBand*, and iWarp and RoCe Ethernet NICs, and other Networks
- **Lower latency and multi-vendor interoperability**
  - Industry leading latency
  - Performance optimized support for the fabric capabilities through OpenFabrics*(OFI)
- **Faster MPI communication**
  - Optimized collectives
- **Sustainable scalability**
  - Native InfiniBand* interface support allows for lower latencies, higher bandwidth, and reduced memory requirements
- **More robust MPI applications**
  - Seamless interoperability with Intel® Trace Analyzer & Collector

Learn More: software.intel.com/intel-mpi-library



OPEN FABRIC INTERFACE

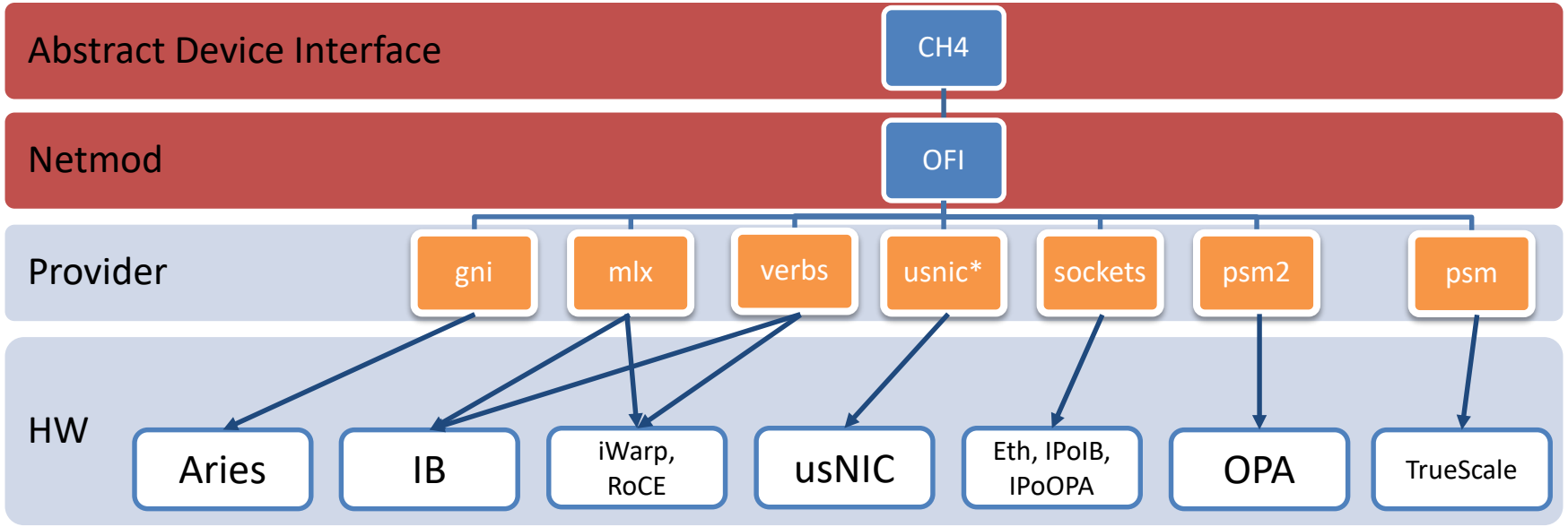


Learn More: https://ofiwg.github.io/libfabric/

OFI ADOPTION BY INTEL MPI

- **Year 2015: Early OFI netmod adoption in Intel MPI Library 5.1 (based on MPICH CH3)**
- **Year 2016: OFI is primary interface on Intel® Omni-Path Architecture in Intel MPI Library 2017**
- **Year 2017: OFI is the only interface in Intel MPI Library 2019 Technical Preview (based on MPICH CH4)**
- **Year 2018: Intel MPI Library 2019 Beta over OFI**
  - Intel OPA, Ethernet*, Mellanox*; Linux*/Windows*
  - vehicle for supporting other interconnects

INTEL MPI LIBRARY 2019 STACK/ECOSYSTEM



* - work in progress

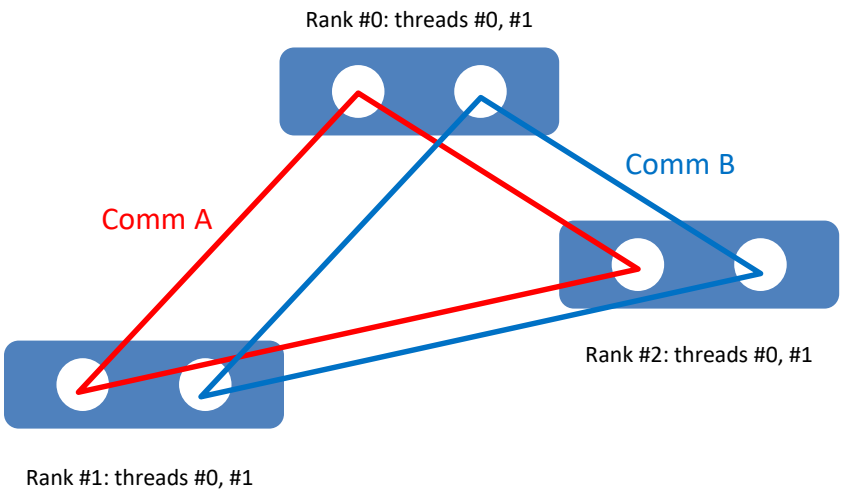
OFI FEATURES USED BY INTEL MPI

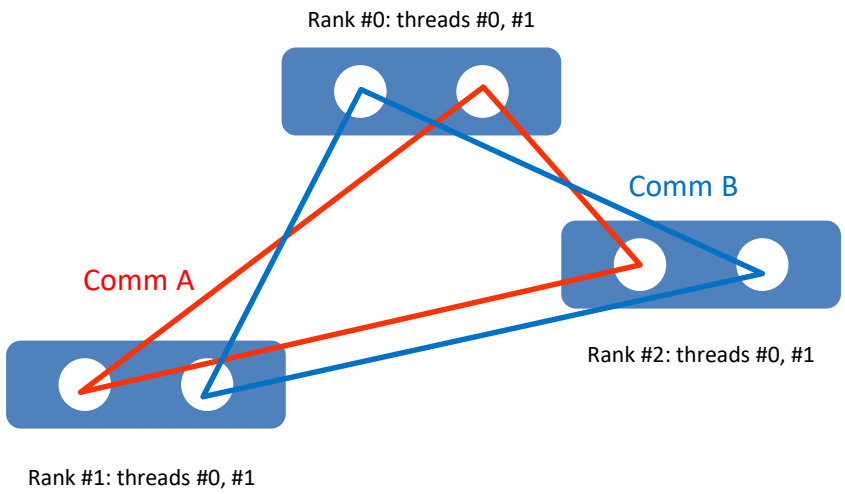
- **Connectionless endpoints FI_EP_RDM**
  - NEW: Scalable endpoints fi_scalable_ep() for efficient MPI-MT implementation
- **Tagged data transfer FI_TAGGED for pt2pt, collectives**
  - msg data transfer FI_MSG is a workaround if FI_TAGGED not supported
- **RMA data transfer FI_RMA for one-sided; FI_ATOMICS**
- **Threading level FI_THREAD_DOMAIN**
- **FI_MR_BASIC/FI_MR_SCALABLE**
- **FI_AV_TABLE/FI_AV_MAP**
- **RxM/RxD wrappers over FI_EP_MSG/FI_EP_DGRAM endpoints and FI_MSG transport**
  - for verbs, NetworkDirect support

OFI SCALABLE ENDPOINTS USE (1/2)

- **Scalable Endpoints allow almost the same level of parallelism on multi-threads vs. multi-processes with much less AV space**
- **Intel MPI leverages per-thread (thread-split) communicators tied to distinct TX/RX contexts of Scalable Endpoints and distinct CQs**
- **Intel MPI expects a hint from user that application satisfies thread-split programming model**
- **With the hint, it safely avoids thread locking while the provider may use FI_THREAD_ENDPOINT/FI_THREAD_COMPLETION level wrt MT optimization**

OFI SCALABLE ENDPOINTS USE (2/2)





CommA, CommB are associated with different RX/TX contexts, different CQs

As long as different threads don't access the same Scalable Endpoint context, they can be access in a lockless way with a provider supporting just FI_THREAD_ENDPOINT, or FI_THREAD_COMPLETION level

POTENTIALLY USEFUL OFI EXTENSIONS

- **Collectives API:**
  - Expose HW based collectives via OFI
  - Implement collectives on the lowest possible level for SW based collectives
  - Enrich multiple runtimes with easy collectives

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- **Collectives (Tier 1)**
  - handle = Coll(ep, buf, len, group, ..., sched = NULL)
  - Test(handle) / Wait(handle)
  - need 'group' concept introduction [and datatypes/ops for reductions]
  - might have optional 'schedule' argument describing the algorithm
- **Schedules (Tier 2)**
  - handle = Sched_op(ep, buf, len, group, ..., sched)
  - Test(handle) / Wait(handle)
  - graph-based algorithm for a collective operation (or any chained operation)

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THANK YOU

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