Intel® MPI Library:
Implementation for Intel® Xeon Phi™ Based Clusters

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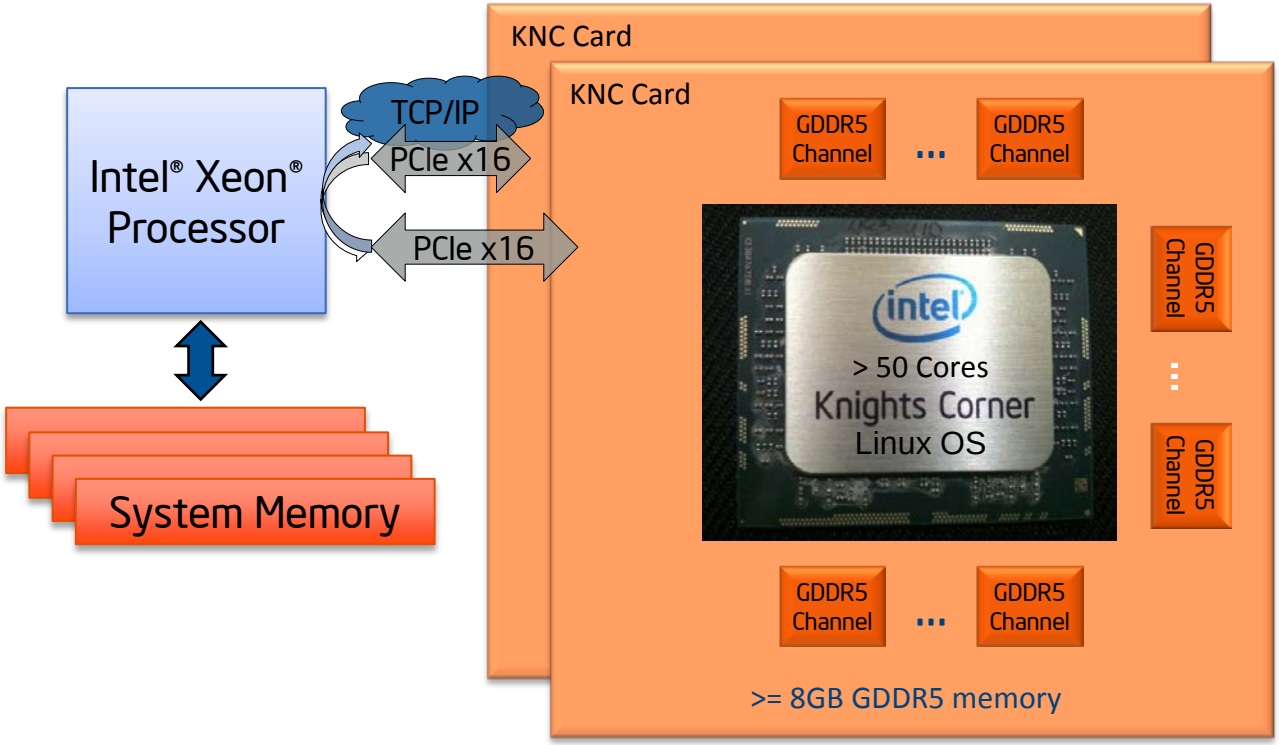
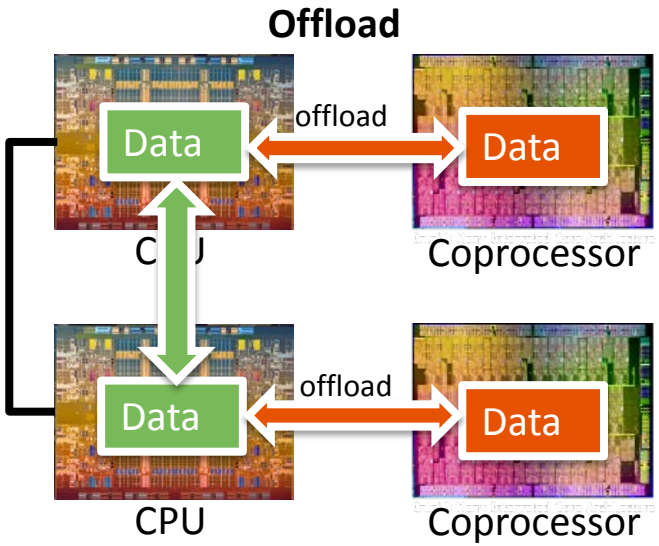
#OFADevWorkshop

Intel® Xeon Phi™ Coprocessor (codenamed Knights Corner)



Intel® Xeon Phi™ Coprocessor-based Clusters

Multiple Programming Models

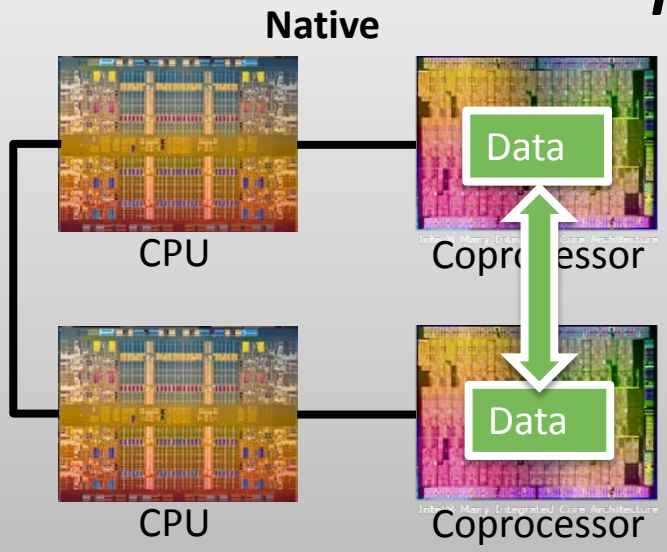


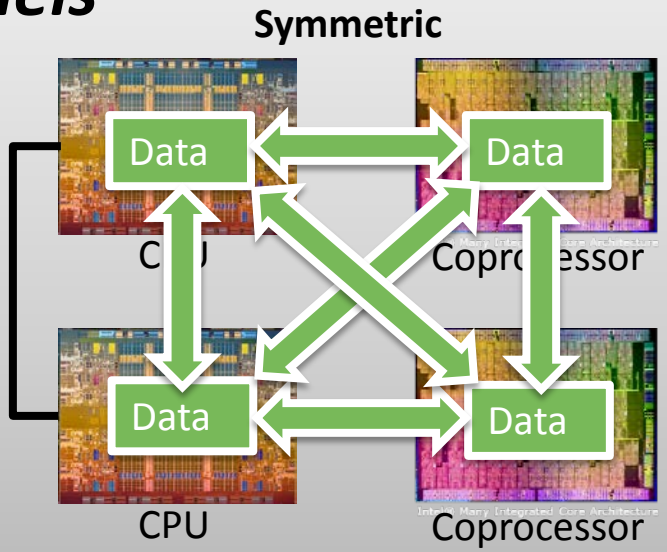
Pthreads, OpenMP*, Intel® Cilk™ Plus, Intel® Threading Building Blocks used for parallelism within MPI processes

MPI Messages

Offload data transfers

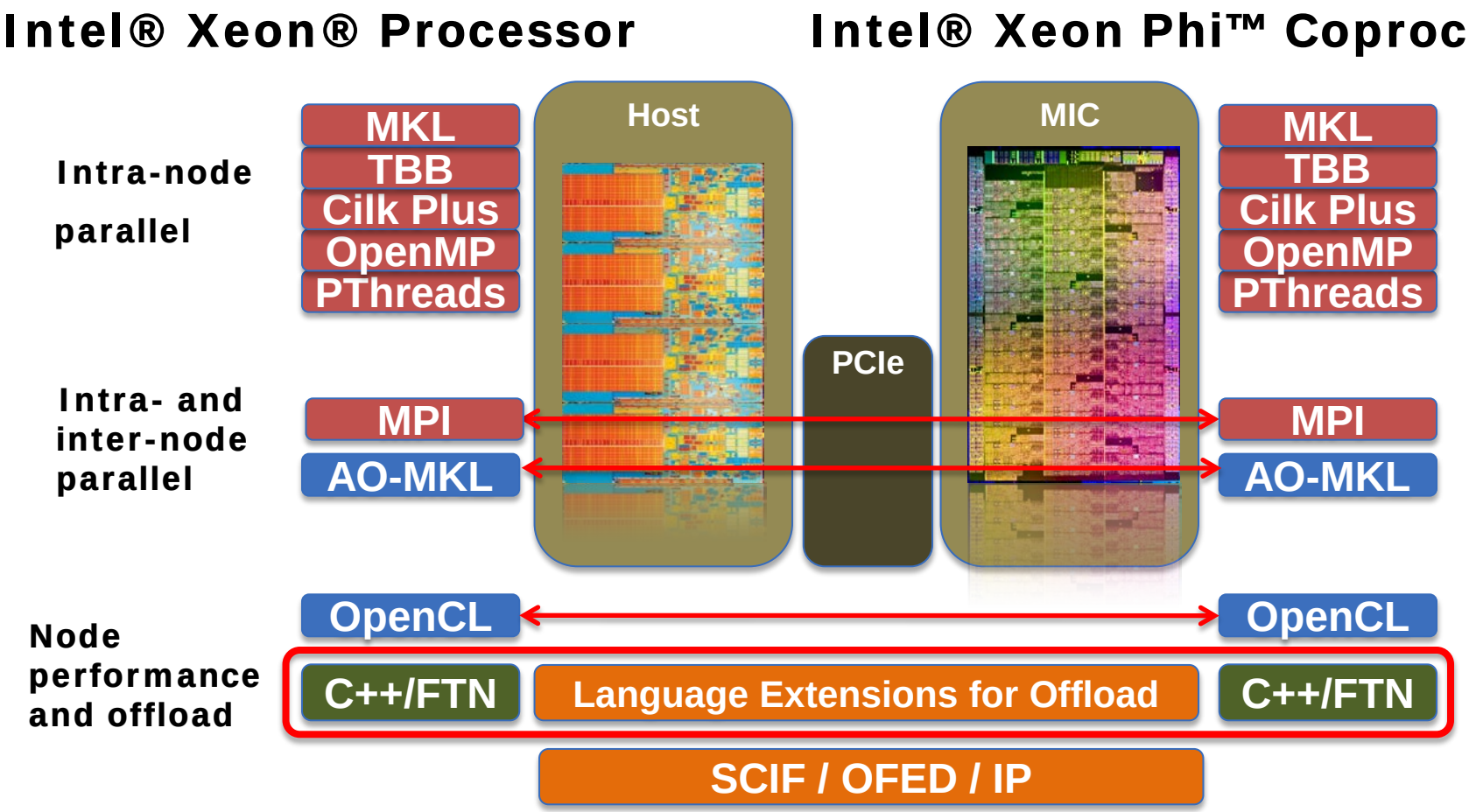
New models





* Denotes trademarks of others

Multi- and Many-Core Parallel Programming



Maximizes reuse of standard programming models (and code)

Porting and Running MPI on a Cluster with Intel® Xeon Phi coprocessors

OPENFABRICS ALLIANCE

Standard CPU-based cluster

Build

```
$ mpiicc -o hello hello.c
```

Run

```
$ mpirun -n 64 -hostfile myhosts
./hello
```

myhosts:

```
host1
host2
```

Cluster with CPUs and co-processors

Build

```
$ mpiicc -o hello hello.c
$ mpiicc -mmic -o hello.mic
hello.c
```

Run(*)

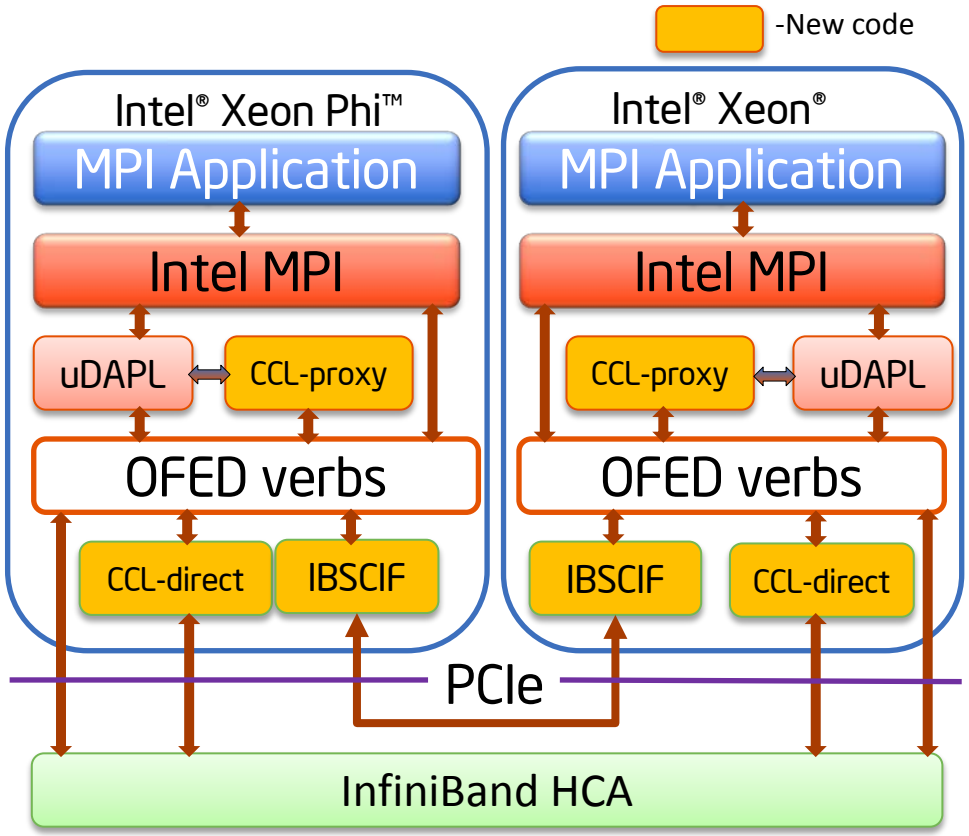
```
$ export I_MPI_MIC=on
$ export I_MPI_MIC_POSTFIX=.mic
$ mpirun -n 64 -hostfile myhosts
./hello
```

myhosts:

```
host1
host2-mic1
```

Inter-node communication

- **Available Fabrics**
  - Sockets (TCP/IP)
  - Fast Fabrics: DAPL, OFA, TMI
- Fast fabrics access through OFA APIs
- PCIe connection is accessed through OFA APIs (IBSCIF virtual network)



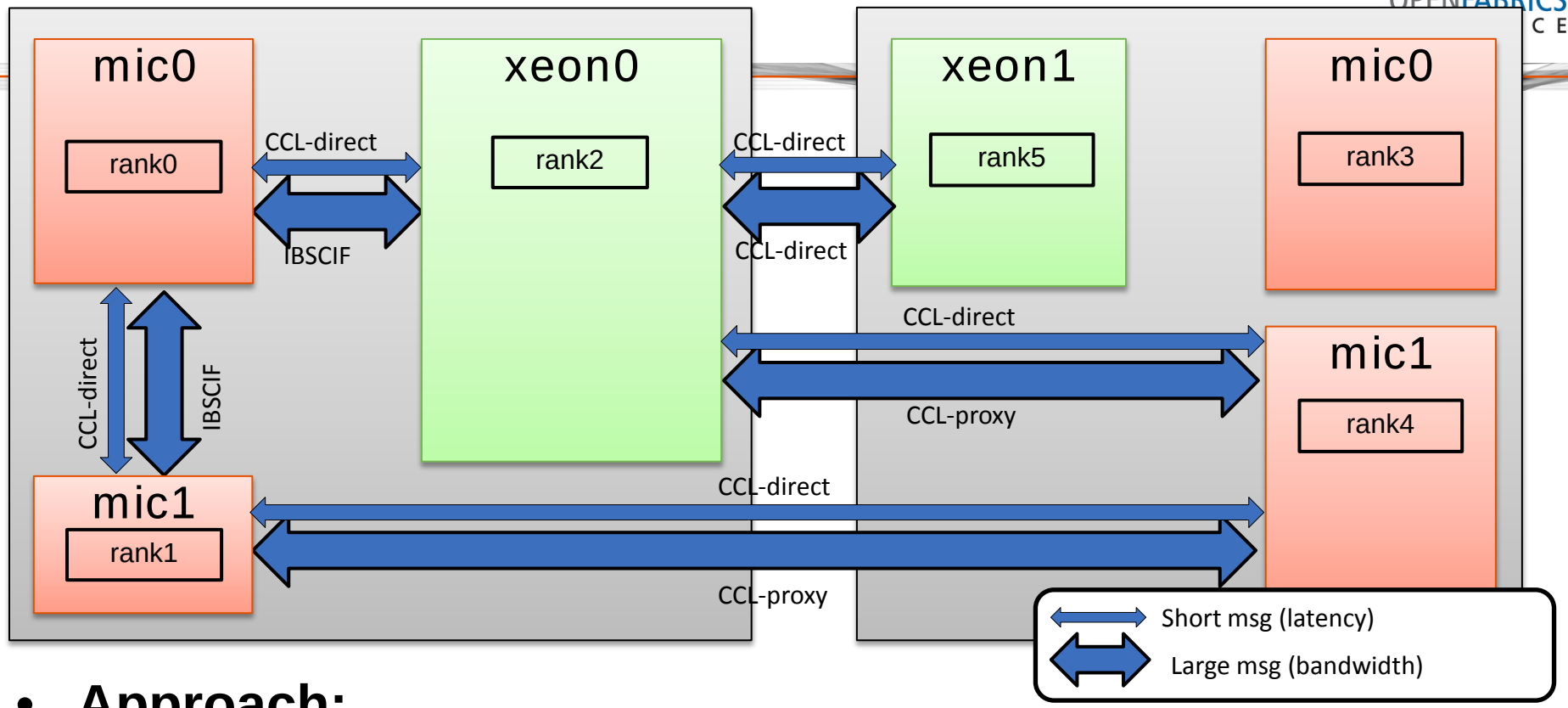
Multiple DAPL providers:

Intel ® Xeon Phi ™ Coprocessor Communication Link Direct (**CCL-direct**)
-Direct access to InfiniBand HW
-Lowest latency data path
-All network segments available

RDMA over SCIF (**IBSCIF**) – RDMA over PCIe (host and its coprocessors)
-High bandwidth data path inside one server

CCL-proxy is hybrid provider, pipes CCL-direct and IBSCIF
-Higher bandwidth data path
-All network segments available but especially effective on cross-box communications

Multiple Communication Path Support



- **Approach:**
- Select the best fabric for every given network segment, depending on message size
- Large messages transfer utilizes two providers simultaneously

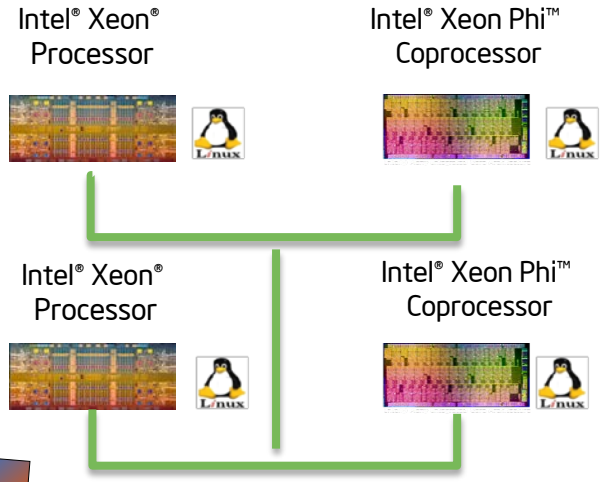
Summary

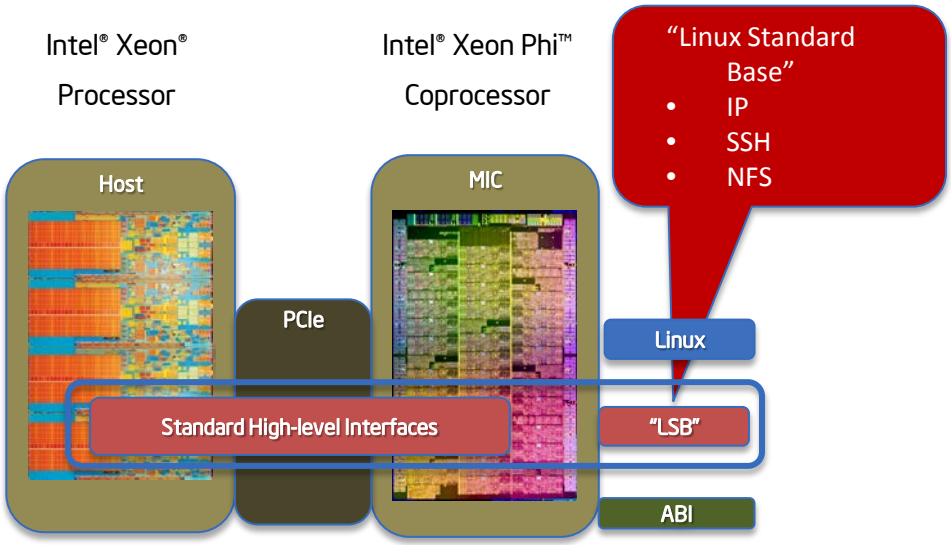
- Combination of several technologies allows direct programming of Intel® Xeon Phi™ coprocessor based systems as heterogeneous clusters:
  - LSB-compliant Linux* OS on coprocessors
  - Abstraction of PCIe* connection as OFA fabric
  - Direct access to fast fabrics from coprocessor
  - Simultaneous support for multiple fabrics in Intel® MPI Library

Thank You

Intel® MPI Library Overview

- Provides optimized MPI application performance and flexible tuning process
- Delivers industry leading performance and multi-vendor interoperability
- Allows scalability beyond 120K processes
- Supports seamless interoperability with Intel® Trace Analyzer and Collector.





Intel® MPI Library for Intel® Xeon Phi™ coprocessor clusters:

Direct port to LSB-based SW stack

Coprocessor as autonomous node

Heterogeneous cluster with CPU- and coprocessor-based network nodes

First support in version v4.1

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