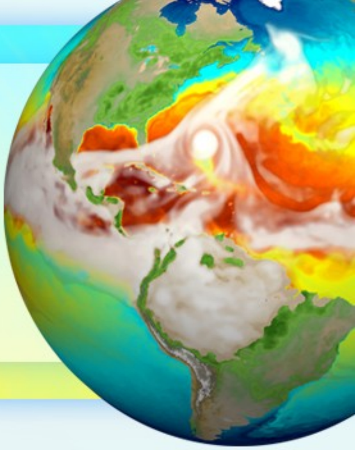

Task Placement for Reduced Communication Costs

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E3SM All Hands Meeting

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E3SM Energy Exascale Earth System Model

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Dragonfly Task Placement Background

Objective: Minimize *distance* messages must travel by “mapping” frequently communicating MPI tasks to nearby nodes in allocation.

Contributions:

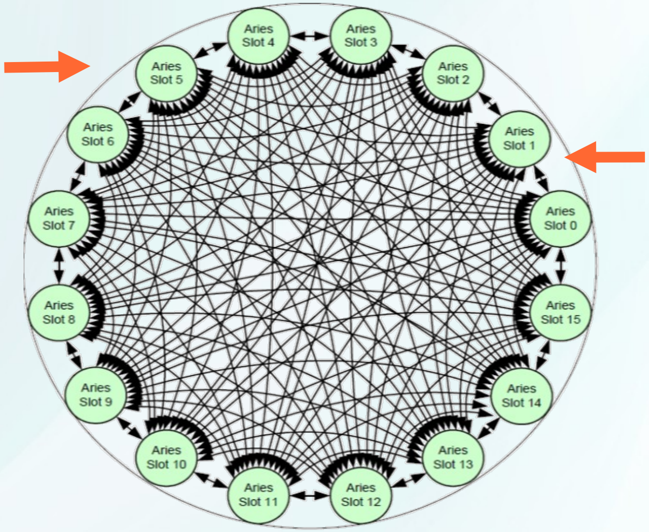
New dragonfly task placement algorithm inside Trilinos’ Zoltan2 package.

- Use high dimensional coordinate transformation to represent all-to-all connections
- Use coordinate stretching to match bandwidths and common congestion.

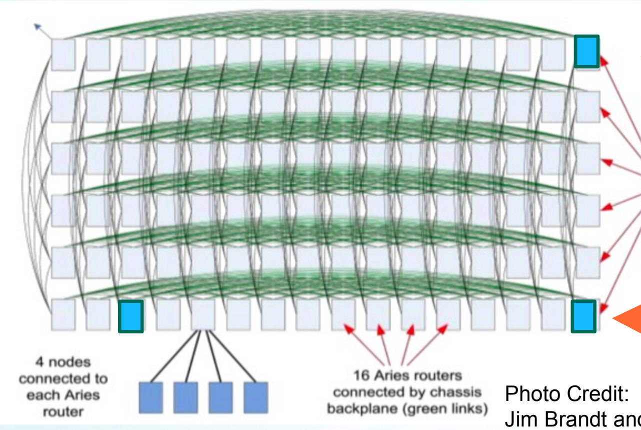
Added new capabilities to Trilinos Zoltan2’s Multi-Jagged(MJ) geometric coordinate partitioner.

- Will compute a nonuniform partitioning based on a user provided distribution
- Ensures the “group” dimension is fully partitioned first

All-to-all between “groups”



First partition highest level fully

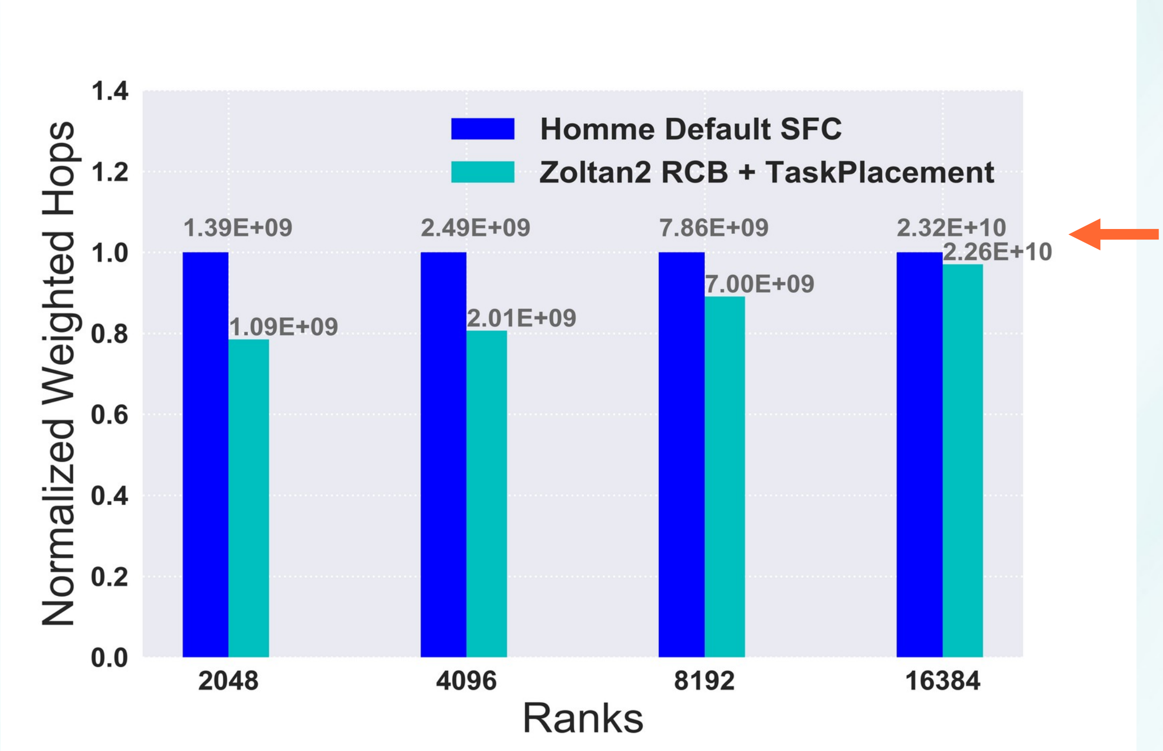

6 chassis connected by cables (black links) to form a two-cabinet group
4 nodes connected to each Aries router
16 Aries routers connected by chassis backplane (green links)

All-to-all in rows and cols

MPI messages travel “hops” through the network

Photo Credit:
Jim Brandt and Ann Gentile, SNL

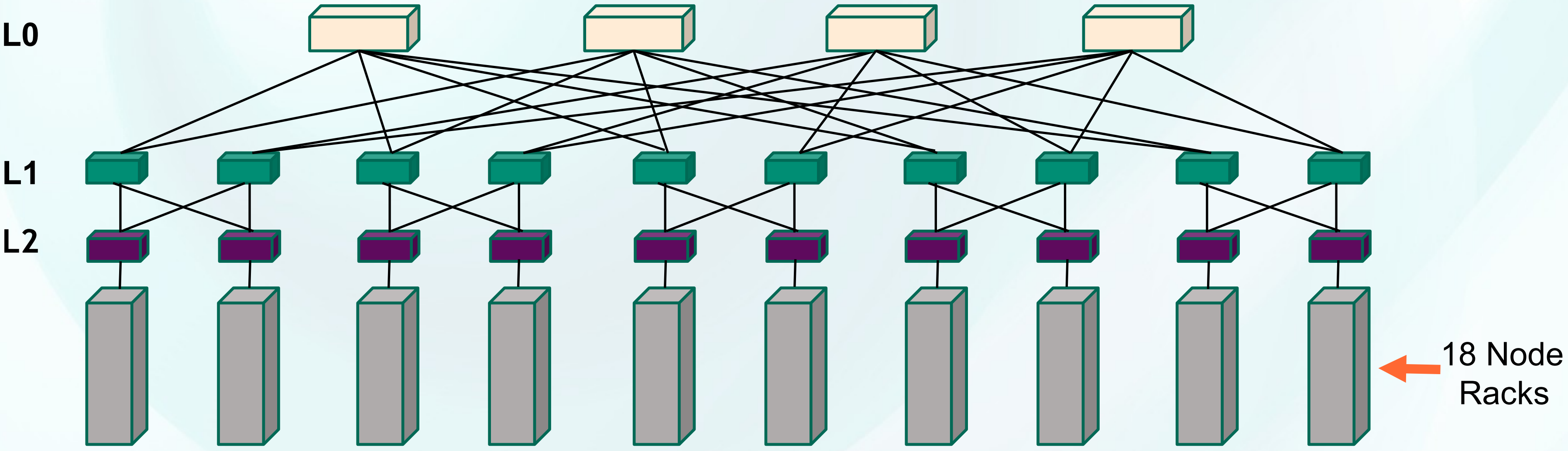
Preliminary Numerical Results from Theta



Near strong scaling limit for ne120

- **Test Case**: ALCF's Theta machine, HOMME v1 ne120 benchmark, 16 ranks per node
- Geometric task placement increases task locality in the network, decreasing distances messages must travel
- Weighted hops decreases by **up to 20%**
- Observed decreased runtime variability (50% on Cori, harder to quantify on Theta)

Future Work: Fat Tree Task Placement on Summit



Row Col Node

- Obtain Summit node floor location using gethostname(): **[A-H][01-36]n[01-18]**
- Transform floor coordinates to network **switch** “neighborhoods”
  - Ex. All nodes in **A01**-**A18** connected in a 3-hop neighborhood, **A19**-**A36** are a separate 3-hop neighborhood
- Use recursive 2-level nonuniform MJ partitioning (L1 → L2)
- Targeting full system scale runs for HOMMEXX

Thank you!

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