Hawk Interconnect Network

Björn Dick (HLRS), Thomas Bönisch (HLRS), Bernd Krischok (HLRS)

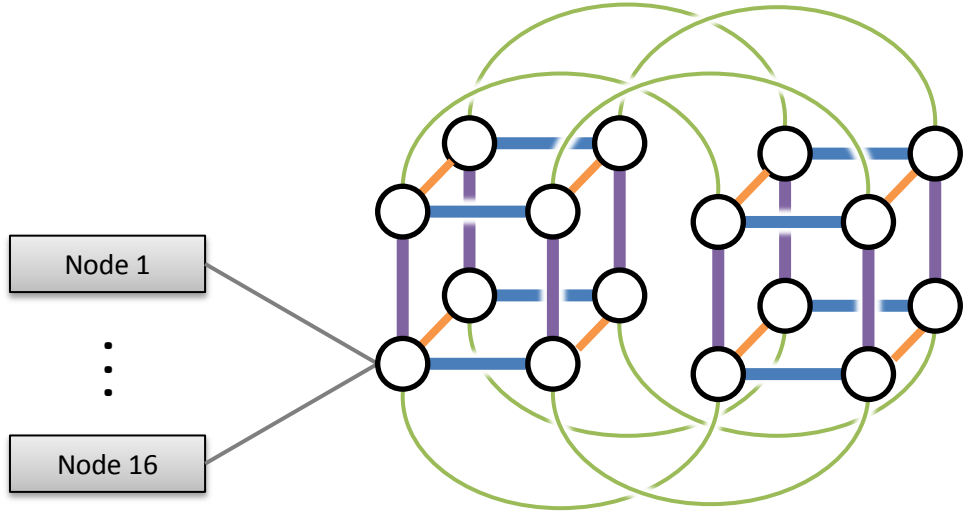
Hardware

- InfiniBand HDR
  - 200 Gbit/s bidirectional bandwidth per link,
    also individual nodes are connected to the network
    with 200 Gbit/s links!
  - MPI Latency ~1.3 µs (nearest neighbor)

- Per switch chip:
  - 40 Ports:
    - 16 nodes
    - 23 ports used to connect *switches* as a hypercube
    - *one* switch in a rack uses remaining port to attach filesystem

  → fully non-blocking communication among 16 attached nodes

Interconnect topology



1D	line	*4 links*
2D	square	*4 links*
3D	cube	*3 links*
4D	hypercube	*2 links*
. . .		*2 links*
9D	(partial) hypercube	*2 links*

= 1 rack

- 16 nodes connected to a common switch (represented by bullets)
- switches arranged as a (partial enhanced) 9D **hypercube**
- i.e. by iteratively
  1. doubling existing structures
  2. connecting corresponding nodes
- more links (→ enhanced B/W) on lower dimensions (thicker lines)

Remarks

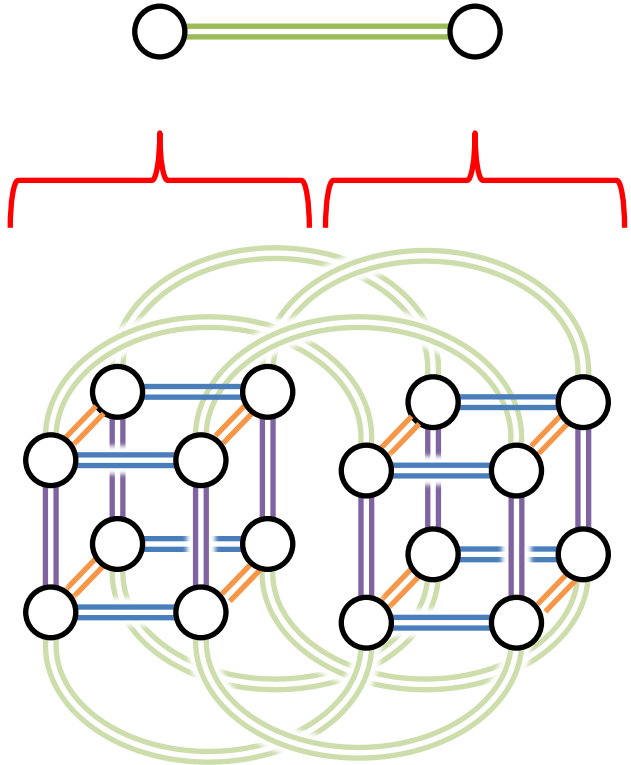
- On 3D computational domains, remaining 6 dimensions can be used to maintain proximity.

- We plan to deploy topology aware scheduling and MPI placement.

How to imagine higher dimensions?

- E.g. represent a 3D (hyper)cube by a single bullet.
- And also a 2nd 3D (hyper)cube.
- Connect the bullets in order to *represent* all the links between *corresponding* nodes of the 3D (hyper)cube.

- Now those “hyper”-nodes can be combined as seen before.



Only partial 9th dimension

- A bullet may represent a 5D hypercube.
- Then dimensions 6 to 8 can be visualized as a cube.
- Dimension 9 can connect 8192 compute nodes.
  However, Hawk incorporates 5632 nodes only.
  So the 9D hypercube is truncated.