IBM Blue Gene/Q - JUQUEEN

Europe's most scalable supercomputer

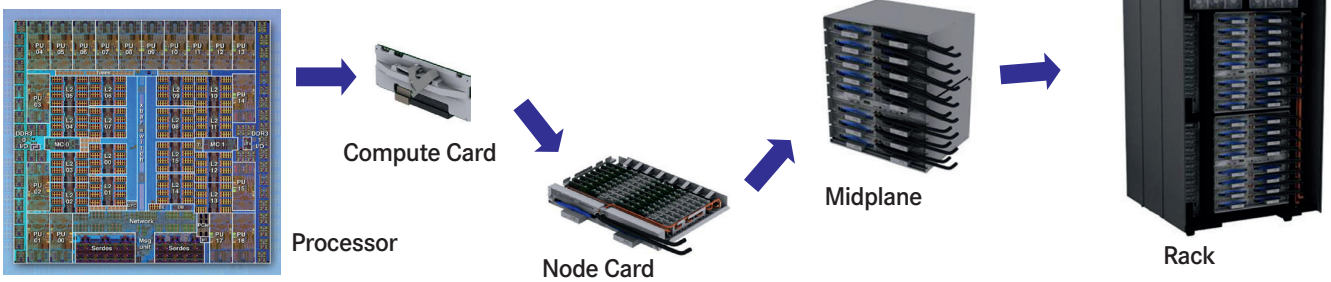
- Massively parallel architecture scaling up to 100 PFlops (peak)
- Based on a custom system-on-a-chip design
- 5-dimensional torus network
- 90% of heat removed by water
- One of the most power-efficient architectures

Node architecture

- Many-core processor
  - 16 compute cores, 1 core running OS
- Embedded processor core A2
  - 4-way simultaneous multi-threaded (SMT)
  - 1.6 GHz clock speed
- Auxiliary execution unit: quad floating-point unit
  - 1 multiply-add operation per pipeline and cycle
  - Permutation unit
- 32 MByte shared L2 cache, crossbar switch
- Two memory interfaces
  - 16 GByte, 42.7 GByte/s (nominal peak) bandwidth

Network architecture

- 5-dimensional torus topology
  - High cross-section bandwidth 112 TB/s (28 Racks)
- 11 bi-directional chip-to-chip links
  - 2 GByte/s bandwidth/link and direction, 40 ns latency
  - 11th link for connection to I/O node
- Hardware support of collective operations
  - Fast broadcast operations (suitable for fast synchronisation)
  - Reduction operations implemented in network unit
- Optical links outside compute boards



Application porting challenges

- Utilize multiple levels of parallelism
  - 4-way SIMD floating-point units
  - 16 cores per node, 1-4 threads per core
  - Many nodes
- Reduced bytes-per-flop ratio (compared to Blue Gene/P)

Jülich Blue Gene/Q installation

- 28 racks
  - 458,752 cores, 5.9 PFlops (peak)
  - 8-32 I/O nodes per rack
- Large capacity GPFS-GSS based storage (JUST4)
  - Capacity of 10 PBytes
  - Peak bandwidth of 160 GBytes/s

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