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The 6D Mesh/Torus Interconnect of K Computer

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Interconnect of K computer

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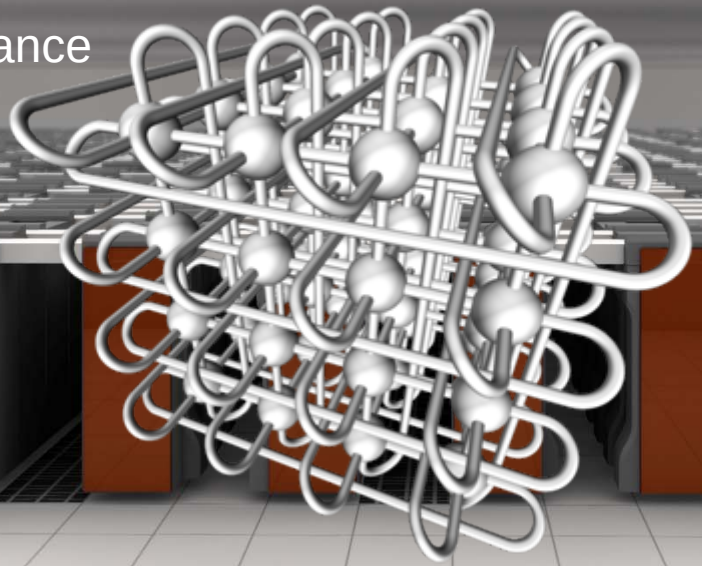
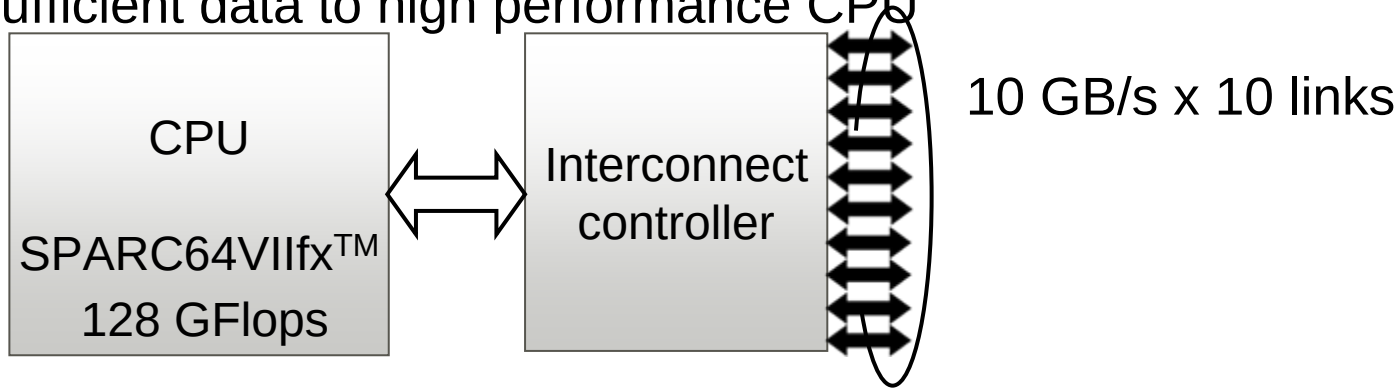
- Tofu: Fujitsu's original 6D mesh/torus interconnect
  - High communication performance
  - High system scalability
  - High fault-tolerance



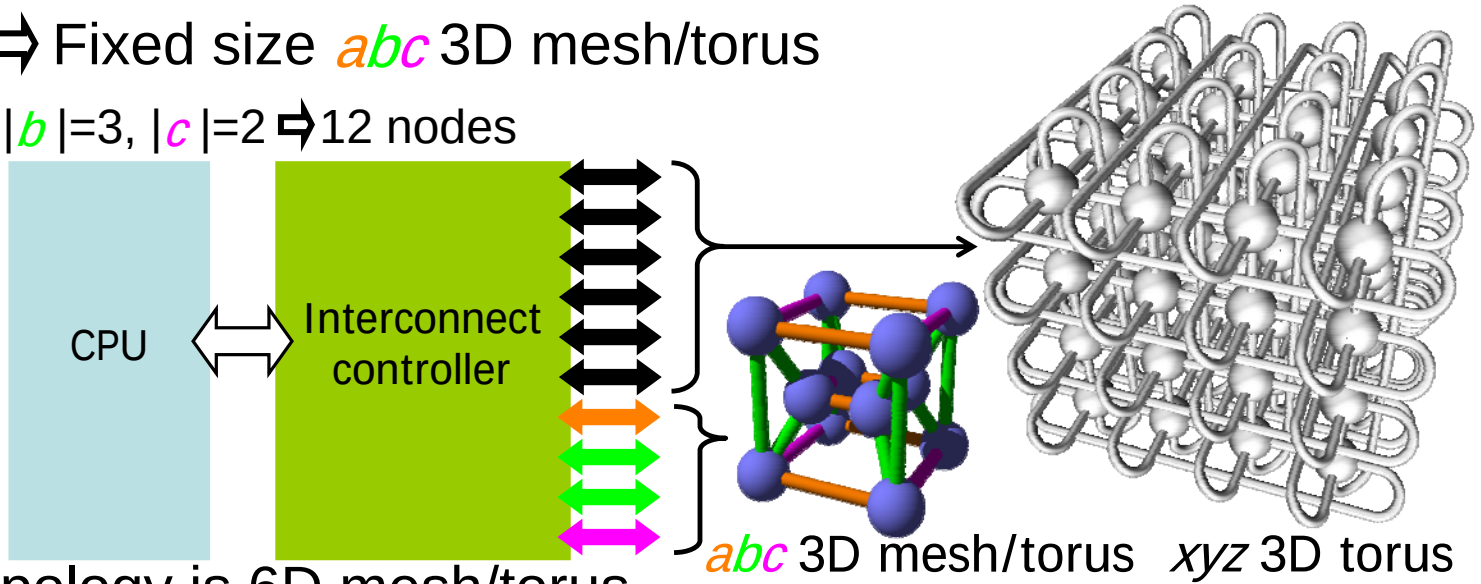
Node construction

- Single CPU and single interconnect controller
- 10 links for inter-node connection
- 10GB/s per link
- Total 100GB/s of off-chip bandwidth
  - Feeds sufficient data to high performance CPU



Network construction

- 6 links ⇨ Scalable *xyz* 3D torus
- 4 links ⇨ Fixed size *abc* 3D mesh/torus
  - |*a*|=2, |*b*|=3, |*c*|=2 ⇨ 12 nodes



- Total topology is 6D mesh/torus
  - Cartesian product of *xyz* and *abc* mesh/torus

Network construction cont.

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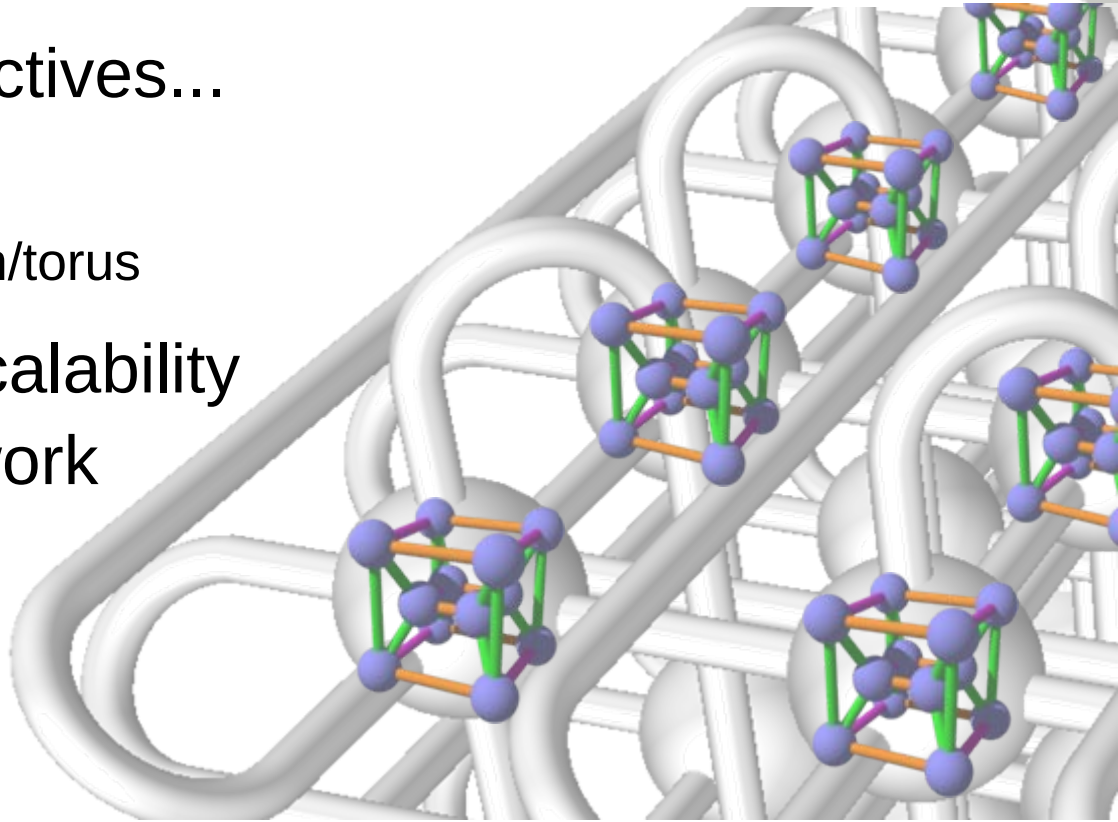
- From the other perspectives...
  - Overlaid twelve *xyz* torus
  - X x Y x Z array of *abc* mesh/torus
- Twelve times higher scalability than the 3D torus network



Network construction cont.

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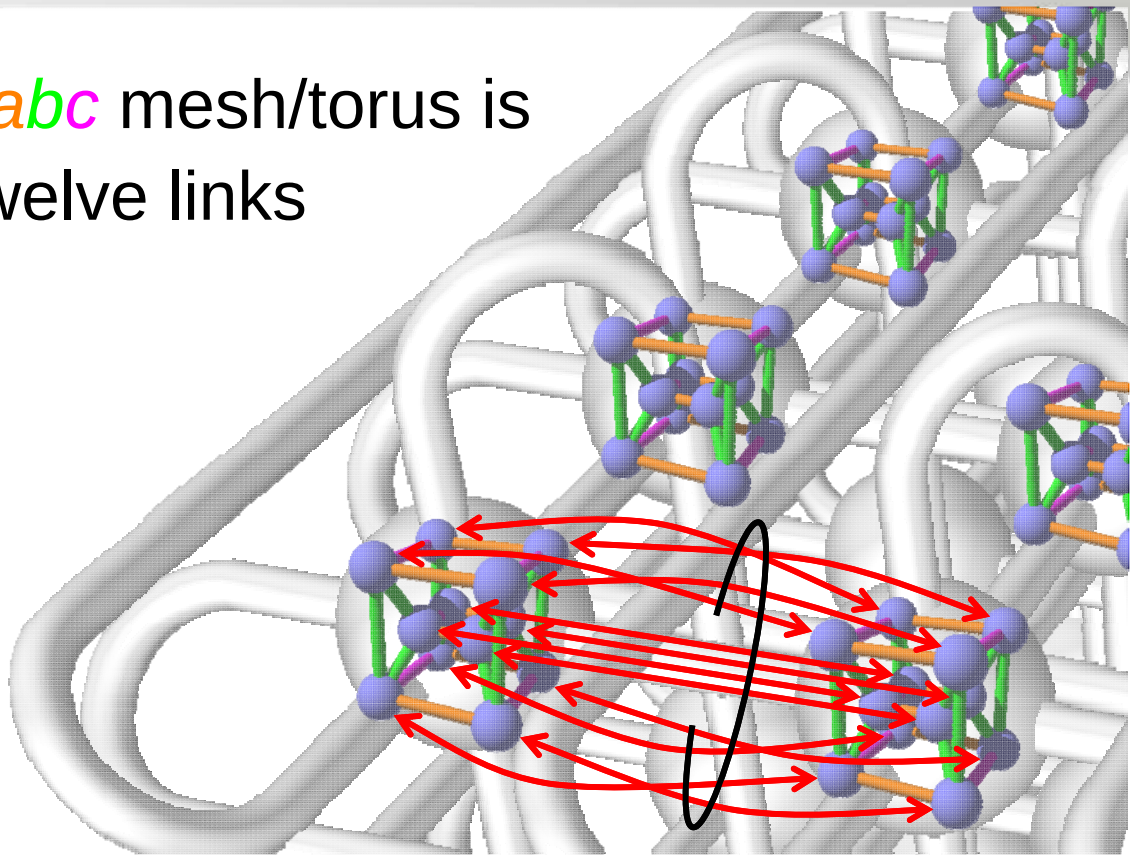
- Each pair of adjacent *abc* mesh/torus is interconnected with twelve links



Routing algorithm

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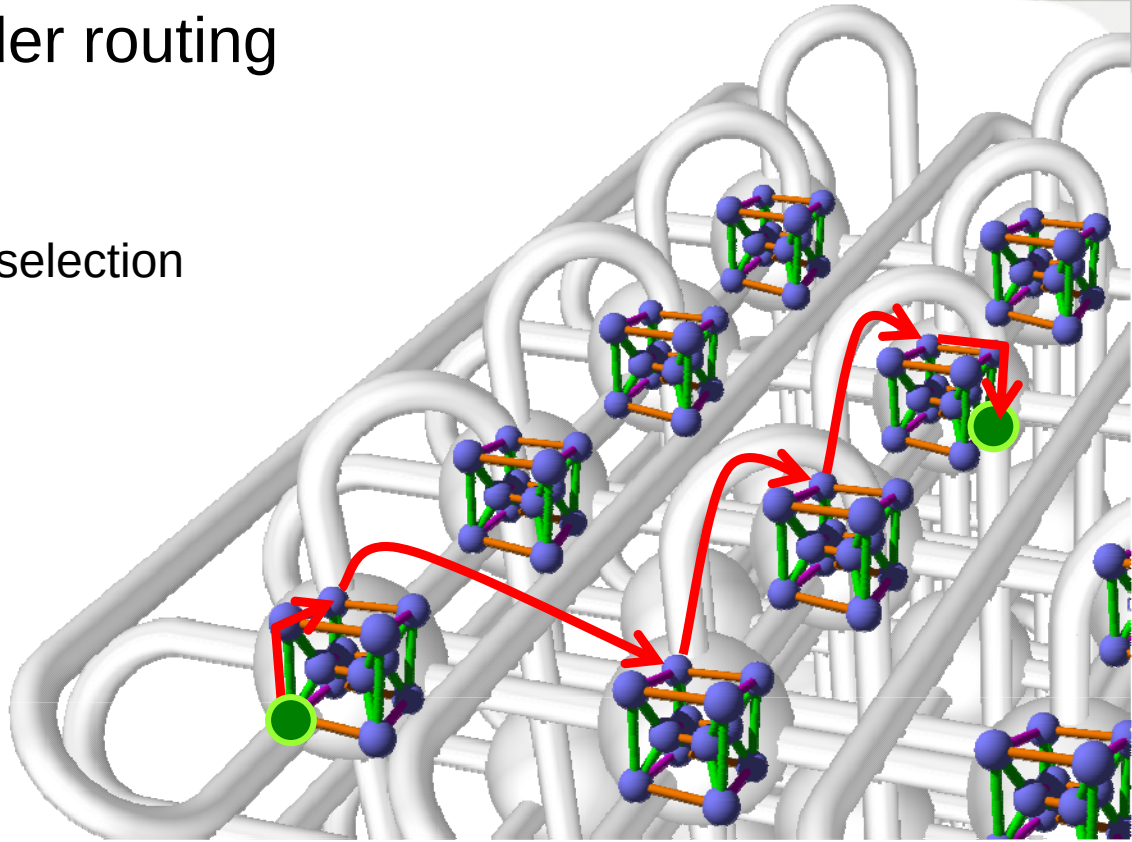
- Extended dimension order routing
  - Additional *abc* traversal
  - *abc* ⇨ *xyz* ⇨ *abc*
  - The first *abc* traversal is path selection



Video Demonstration

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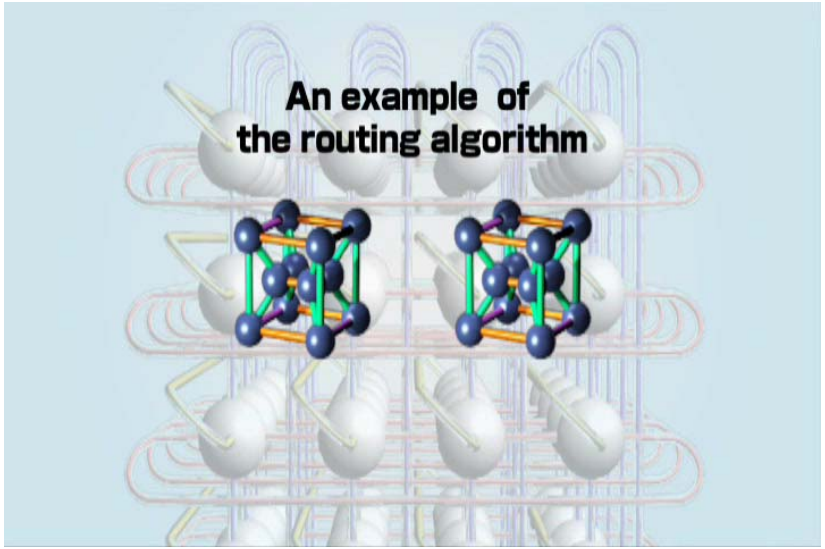
- Example routing
  - Routing from (x=0,y=0,z=0, a=0,b=0,c=0) to (3,2,1, 1,1,1)
  - Traverses + *b*, + *a*, +*x* *3, +*y* *2, +*z*, + *c*



Detouring faulty nodes

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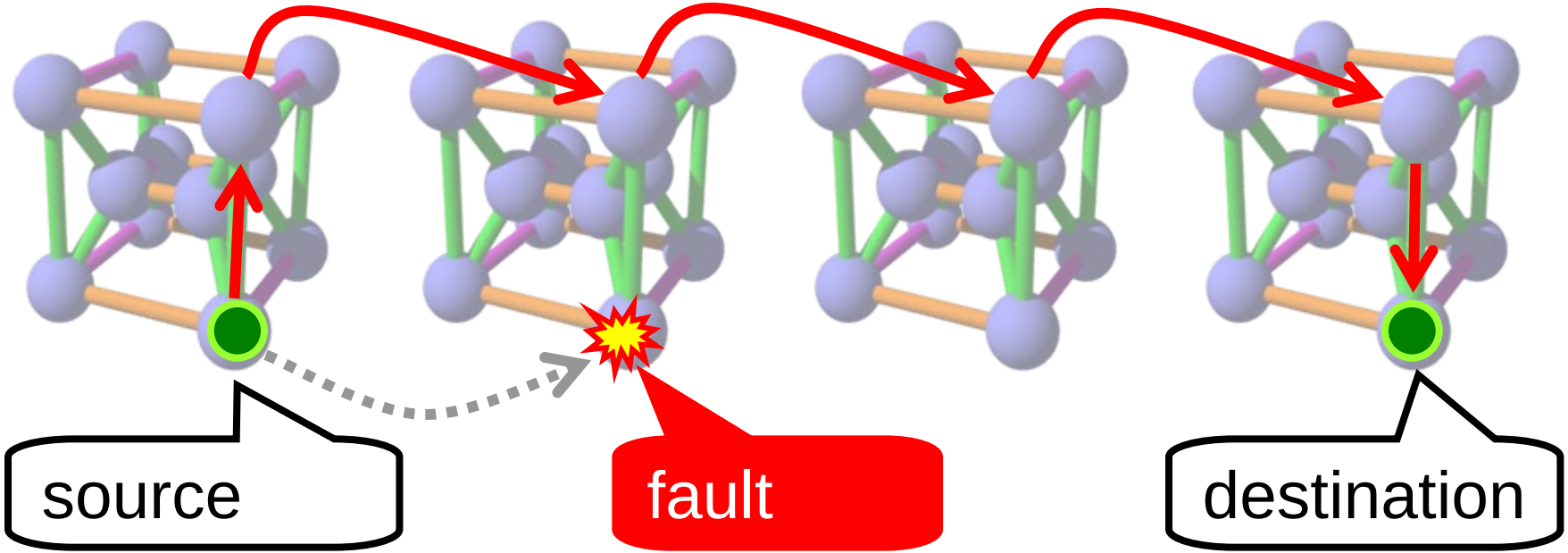
- Multipath routing allows to detour faulty nodes



Conclusion

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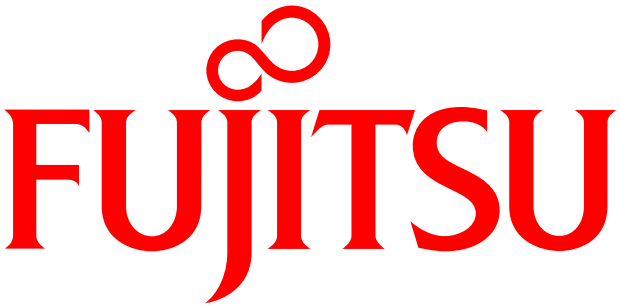
- Tofu: 6D mesh/torus interconnect architecture

- High communication performance
  - 100GB/s off-chip bandwidth feeds enough data to high performance CPU
- High system scalability
  - 12x higher scalability compared with 3D torus
- High fault-tolerance
  - Multipath routing algorithm allows to detour faulty nodes



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