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**franck:bradley**

**options.dvi**

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lw3 / The Phoenix

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This document is a cut at describing our options for router design.  
Notes about Table 1.

- The Skinny-Cube requires two chips types.

Table 1: Router implementation considerations for various topologies.

Router Implementation Considerations for Various Topologies (4K nodes, 64 Bit msg, 32 nodes/board, 10ns/bit, packet switched)							
Topology	Channel Width	Pin Count		Long Wire?	Scalable?	Channel Grouping?	Messages Arriving per Tick
		Chip	Board				
Fat-Tree	4	64	500	T	T	Probably	6
Hypercube	1	24	900	T	NIL	T	12
Fat-Cube	5@4,7@1	54	900	T	NIL	T	12
2D-Torus	8	64	800	NIL	T	T	4
Skinny-Cube	4	48		T	T	T	6
chip 2	4	88	896				11

Notes for Table 2.

- In this Fat-Cube design the on-board wires run at 160ns/hop and the off-board wires run at 640ns/hop.

Table 2: General router performance for various topologies.

Router Performance for Various Topologies (4K nodes, 64 Bit msg, 32 nodes/board, 10ns/bit, packet switched)							
Topology	Latency (Unloaded)		Random Routing			scans	combining
	Worst Case	Avg Case	32 msgs/node	Marginal cost of one msg			
				observed	ideal		
Fat-Tree hop=160ns	12 hops 1.92 $\mu$ s	> 11 hops 1.80 $\mu$ s			12 hops 1.92 $\mu$ s	maps	8
Hypercube hop=640ns	12 hops 7.68 $\mu$ s	6 hops 3.84 $\mu$ s	32 hops 23 $\mu$ s	0.7 hops 0.45 $\mu$ s	0.5 hops 0.32 $\mu$ s	maps	14
Fat-Cube hop=160ns	12 hops 5.28 $\mu$ s	6 hops 2.64 $\mu$ s	106 hops 17 $\mu$ s	2.3 hops 0.37 $\mu$ s	2 hops 0.32 $\mu$ s	maps 5.28 $\mu$ s	14
2D-torus hop=80ns	64 hops 5.12 $\mu$ s	32 hops 2.56 $\mu$ s	336 hops 27 $\mu$ s	8.8 hops 0.70 $\mu$ s	8 hops 0.64 $\mu$ s	sort-of	6
Skinny-Cube hop=160ns	12 hops 1.92 $\mu$ s	$\simeq$ 10 hops 1.60 $\mu$ s				maps	6-8

Table 3 describes the performance of the various router topologies when running two and three dimensional grid problems. The VP value is the number of virtual processors per chip. Other notes for Table 3:

- The hypercube uses grey code news layout.
- The fat-cube uses grey code news layout on-board and the off-board layout depends on the VP-ratio. For VP ratio equal to one, the fat-cube uses the standard grey-code news layout. For VP-ratio bigger than one, the fat-cube uses a skewed layout in order to evenly load each of the off-board cube wires.

Table 3: Router NEWS Performance

Router NEWS Performance (4K nodes, 64 Bit msg, 32 nodes/board, 10ns/bit, packet switched)				
Topology	Two Dimensional News		Three Dimensional News	
	VP=1	VP=32*32	VP=1	VP=32*32*32
Fat-Tree	12 hops 1.92 $\mu$ s	26 hops 4.16 $\mu$ s	13 hops 2.08 $\mu$ s	75 hops 12.00 $\mu$ s
Hypercube	1 hops 0.64 $\mu$ s	32 hops 20.48 $\mu$ s	1 hops 0.64 $\mu$ s	32 hops 20.48 $\mu$ s
Fat-Cube	4 hops 0.64 $\mu$ s	64 hops 10.24 $\mu$ s	4 hops 0.64 $\mu$ s	64 hops 10.24 $\mu$ s
2D Torus	1 hop 0.16 $\mu$ s	32 hops 5.12 $\mu$ s	16 hops 2.56 $\mu$ s	512 hops 81.92 $\mu$ s