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Fat H-Tree: A Cost-Efficient Tree-Based On-Chip Network

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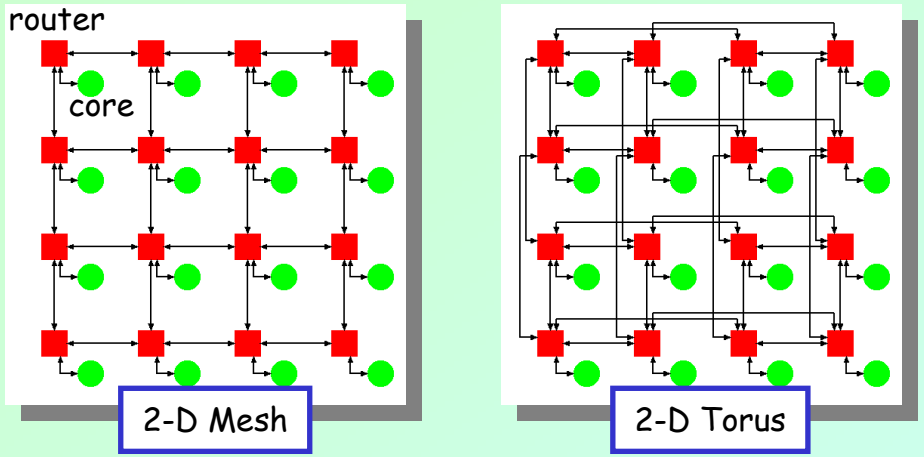
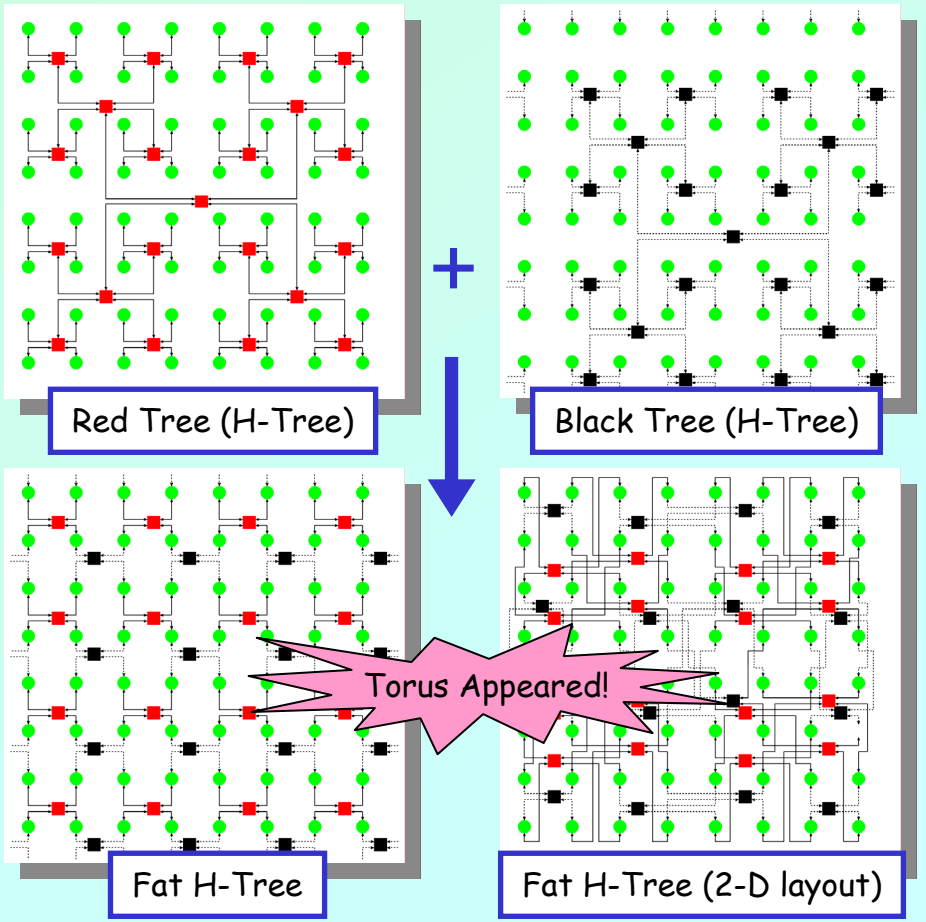
On-Chip Network Topologies



(#of upward links, #of downward links, #of ports each core has)

Fat H-Tree is combined with two H-Trees (red & black)



Fat H-Tree provides a torus structure, besides two H-Trees

Average hop count of Fat H-Tree is the shortest

	Routing	16-core	64-core	256-core
Fat Tree(2,4,1)	Tree	3.61	5.43	7.36
Fat Tree(2,4,2)	Tree	3.61	5.43	7.36
Fat H-Tree	Tree & torus	3.20	4.84	6.78
2-D Mesh	DOR	4.67	7.33	12.67
2-D Torus	DOR	4.14	6.06	10.03

Channel bisection of Fat H-Tree is larger than Fat Trees

	$N = 2^n \times 2^n$	16-core	64-core	256-core
Fat Tree(2,4,1)	2^{n+1}	8	16	32
Fat Tree(2,4,2)	2^{n+2}	16	32	64
Fat H-Tree	$2^{n+2}+8$	24	40	72
2-D Mesh	2^{n+1}	8	16	32
2-D Torus	2^{n+2}	16	32	64

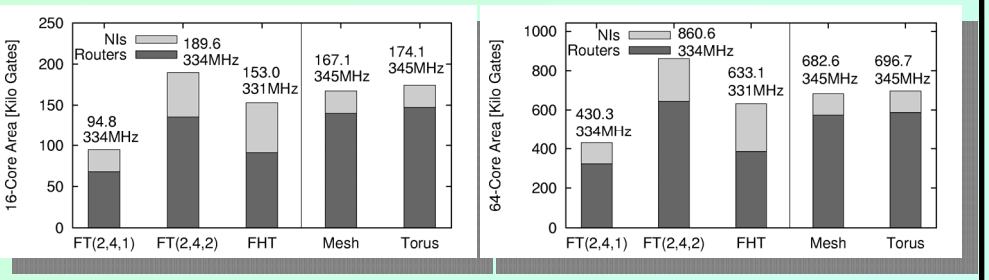
Router count of Fat H-Tree is less than Fat Tree(2,4,2)

	$N = 2^n \times 2^n$	16-core	64-core	256-core
Fat Tree(2,4,1)	$(4^n - 2^n)/2$	6	28	120
Fat Tree(2,4,2)	$4^n - 2^n$	12	56	240
Fat H-Tree	$2(4^n - 1)/3$	10	42	170
2-D Mesh	N	16	64	256
2-D Torus	N	16	64	256

Wire length of Fat H-Tree is almost same as FatTree(2,4,2)

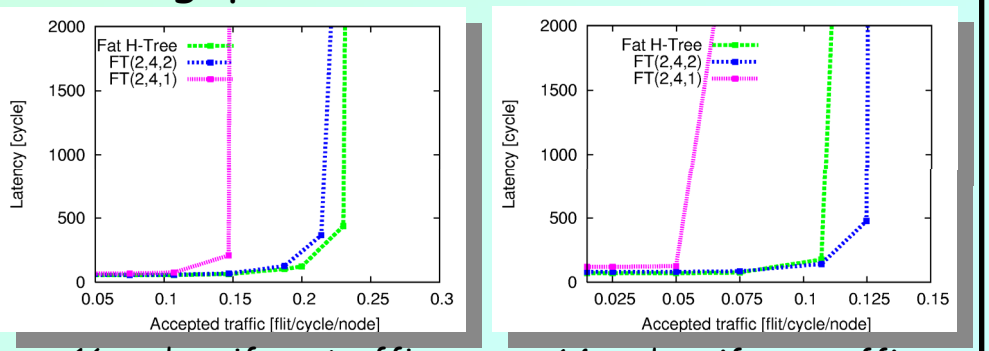
	$N = 2^n \times 2^n$	16-core	64-core	256-core
Fat Tree(2,4,1)	nN	32	192	1,024
Fat Tree(2,4,2)	$2nN$	64	384	2,048
Fat H-Tree	$8 + \frac{8N(2^{n-1}-1)}{2^{n-1}}$	72	392	1,800
2-D Mesh	$2(N - 2^n)$	24	112	480
2-D Torus	$4(N - 2^n)$	48	224	960

Network logic area (routers & NIs) of Fat H-Tree is smaller than Fat Tree(2,4,2)



(*) Network logic, which is consisted of wormhole routers and network interfaces (NIs), was synthesized with 0.18um

Throughput of Fat H-Tree is comparable to Fat Trees



16-node uniform traffic　　64-node uniform traffic

(*) Latency is 3-cycle/1-hop. Packet size is 16-flit(1-flit header)

Summary of Fat H-Tree

1) Smaller network logic area compared with Fat Tree(2,4,2)

2) Almost same wire resources of Fat Tree(2,4,2)

3) Short hop count, and comparable throughput of Fat Trees

Would you like to use Fat H-Tree instead of Fat Trees? - YES!