Some thoughts on optical networks

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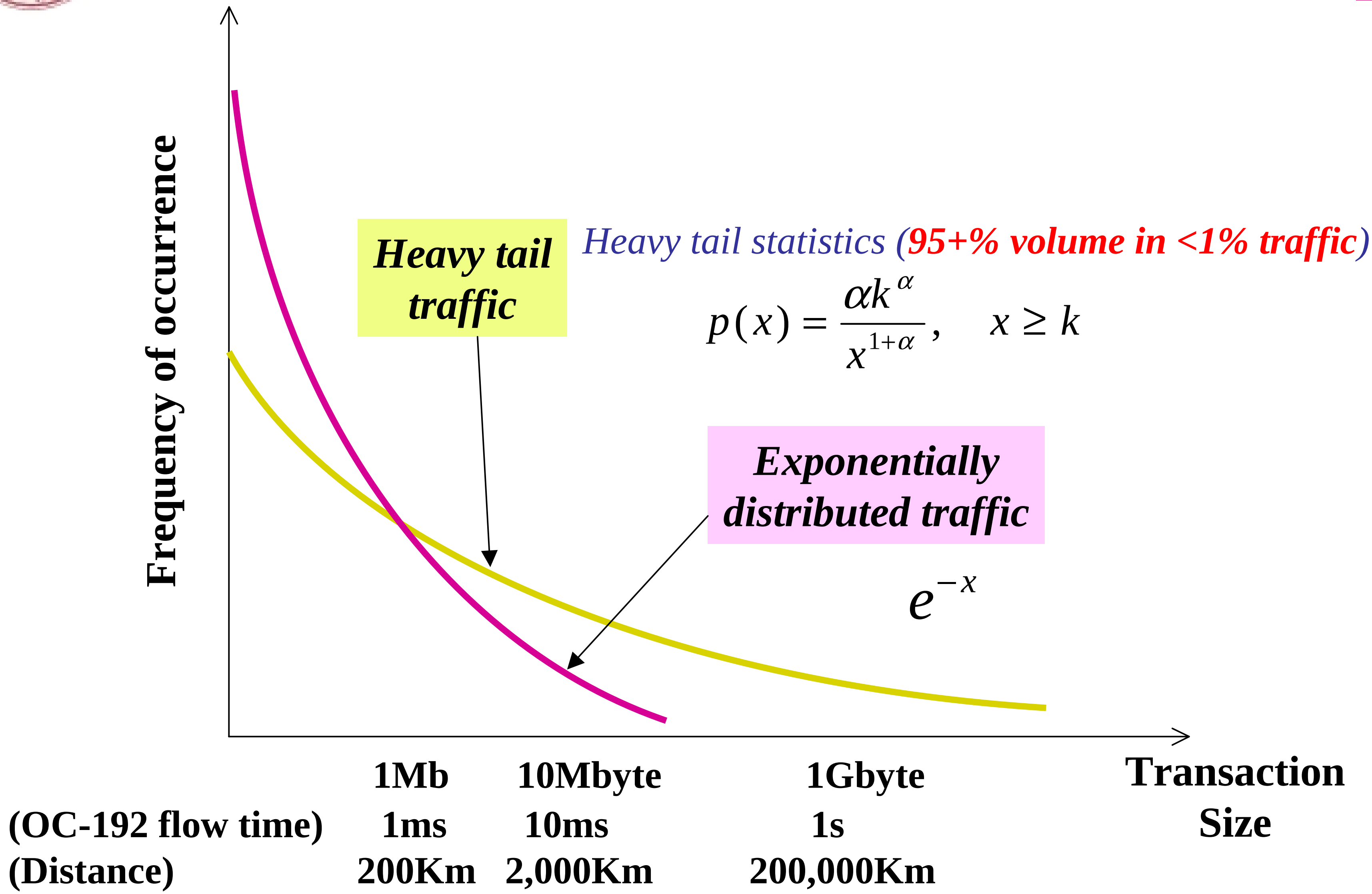
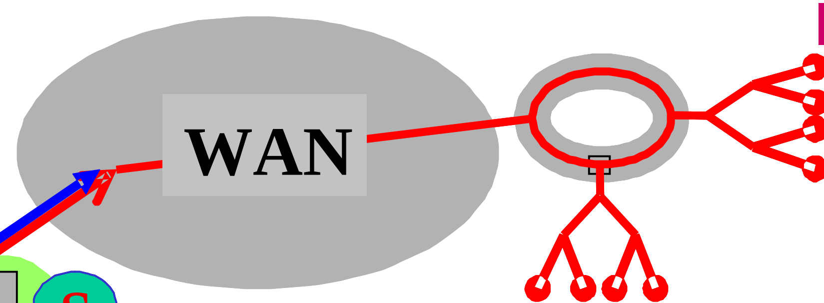
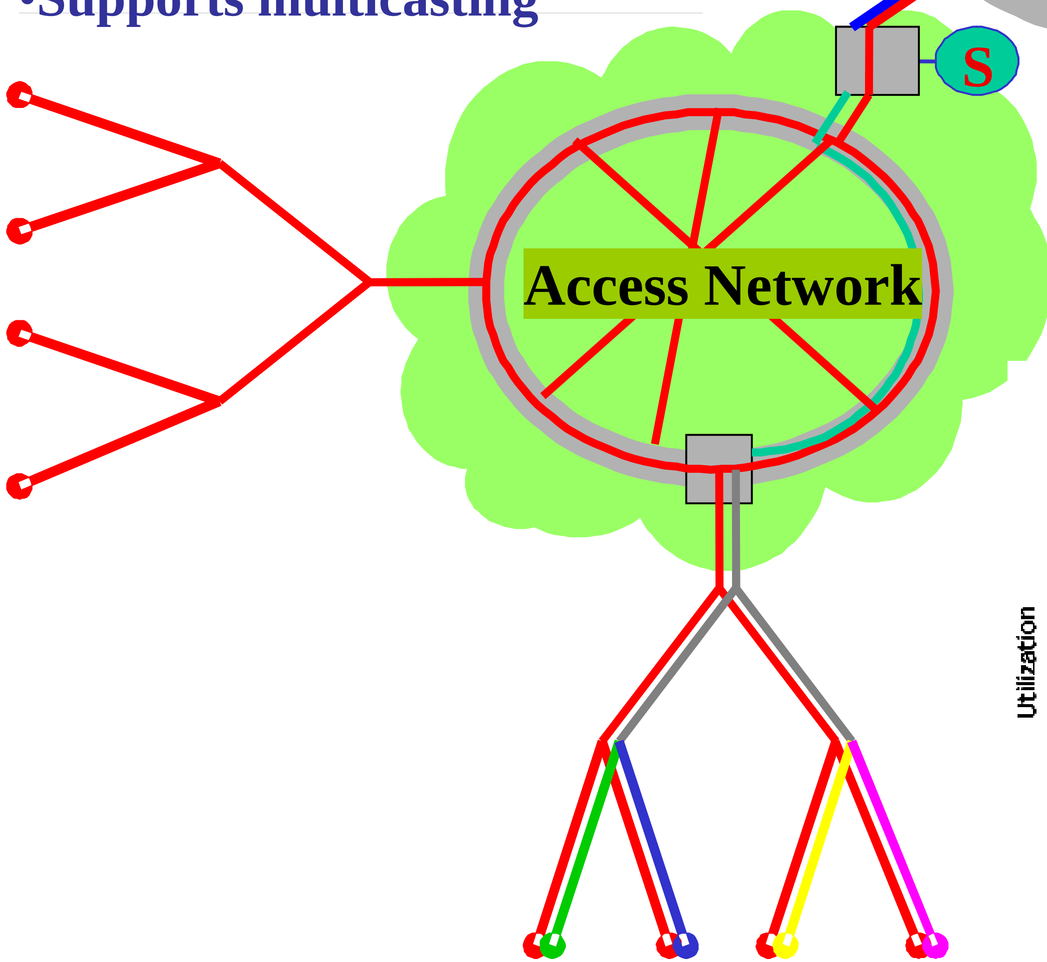
Transaction size



Asynchronous transaction on demand –flow switching

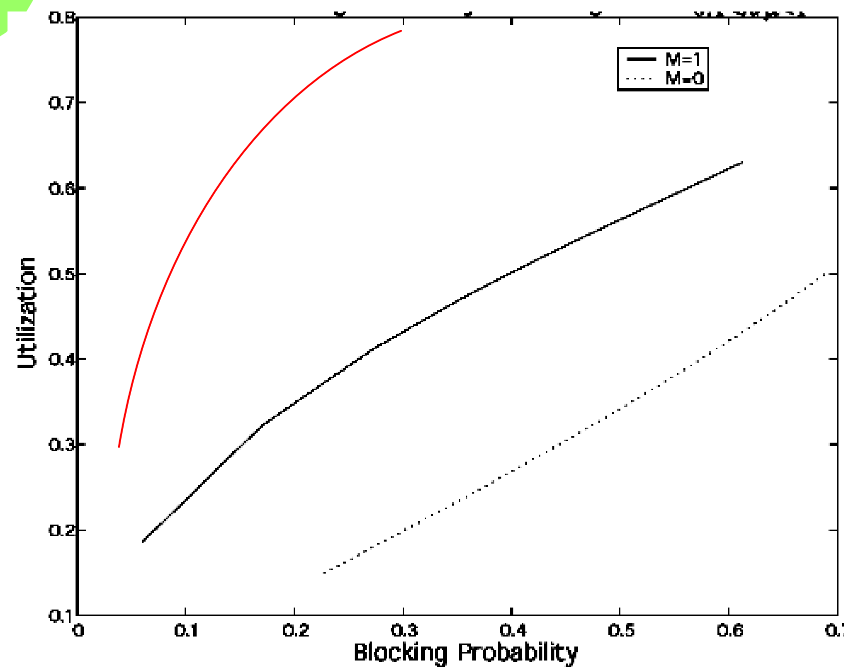
- **Fast access network MAC**
- **Slower WAN adaptation**
- **Supports multicasting**



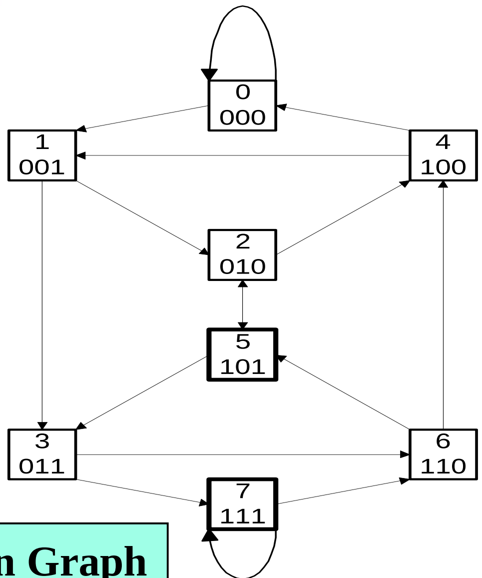


End-to end flow of file bypassing routers

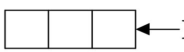
- *> 0.1 S duration*
- *MAC protocol for reservation request*
- *Scheduling time < 100 mS*



Regular network topology on irregular infrastructure

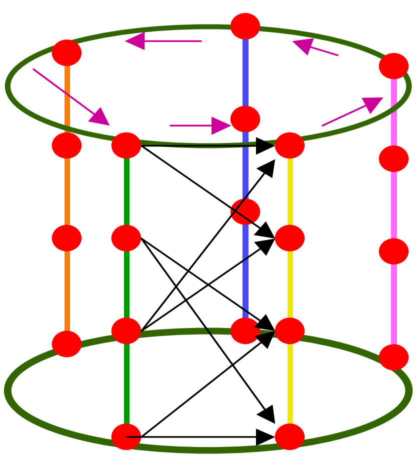


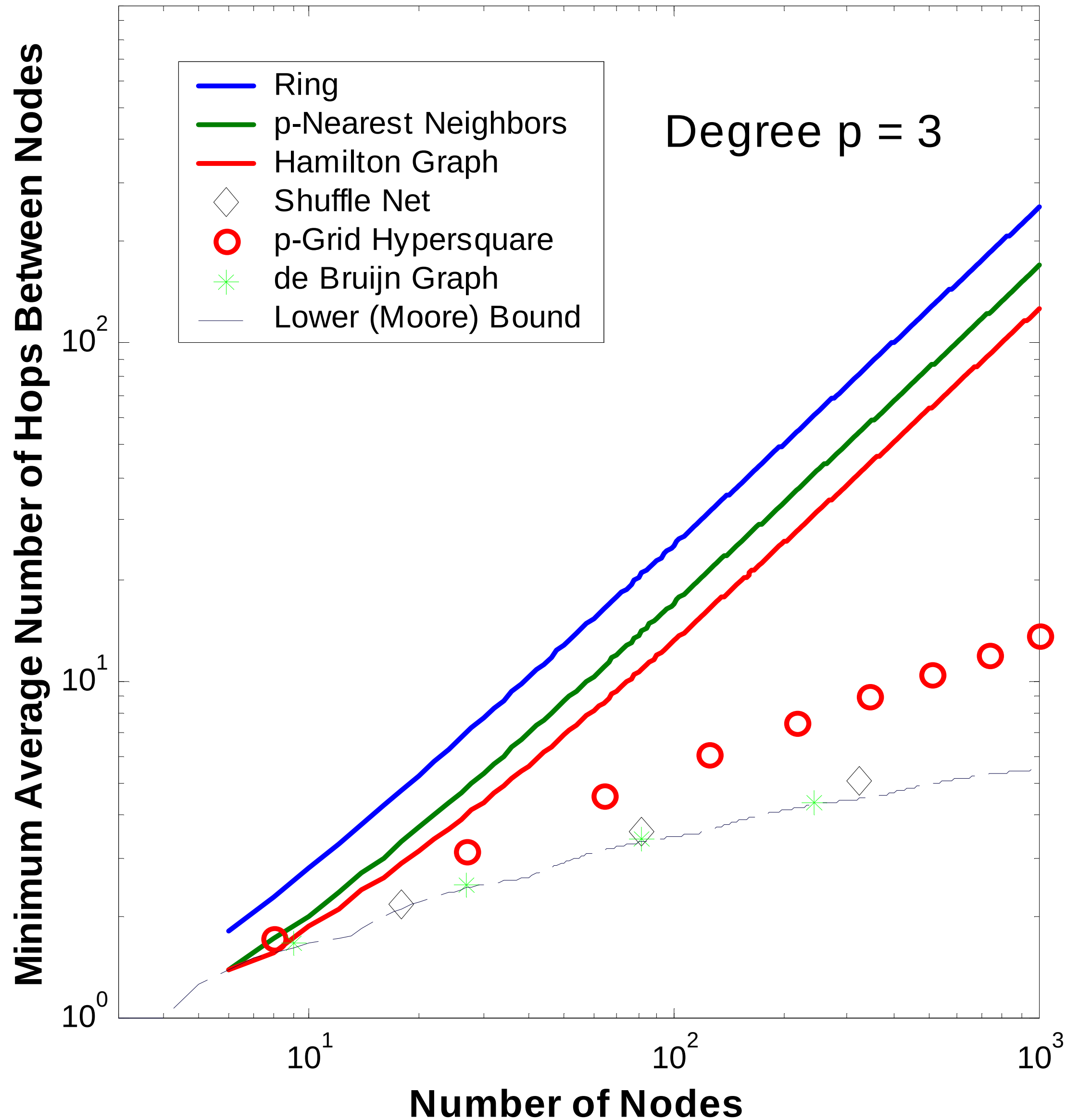
deBruijn Graph



p-ary shift register of D stages

ShuffleNet
p=2
k=2
$N=k \bullet p^k$





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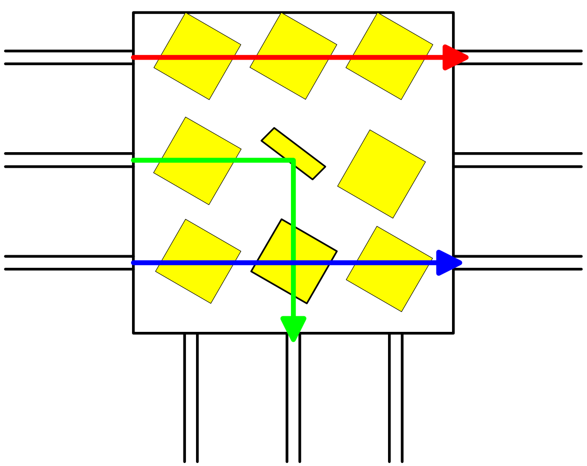
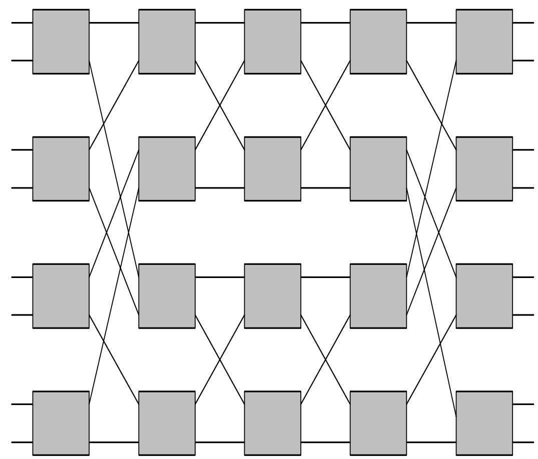
First Order Cost Models

- **Fiber Cost:** $Cost_{fiber} = \alpha \cdot N \cdot p$
- **Ports Required:** $K(N,p) = (N-1) \cdot H_{\min}(N,p)$
- **Switching Cost:** $Cost_{switch} = \beta \cdot N \cdot F[K(N,p)]$
- **Total Cost:** $Cost_{norm} = \alpha \cdot p + \beta \cdot F\left[K(N,p)\right]$



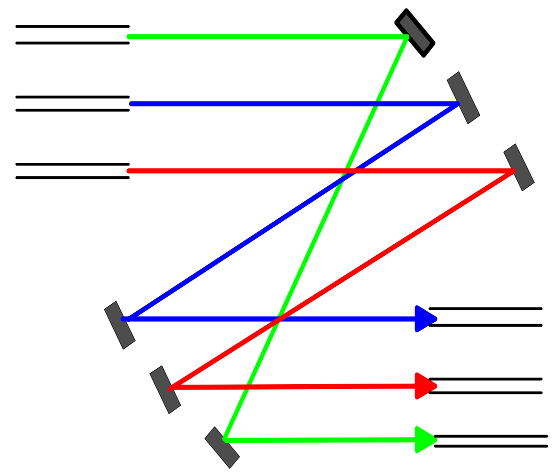
$$F(K) \propto K^{2+\delta}$$

Example: 2D MEMS



$$F(K) \propto K \log K$$

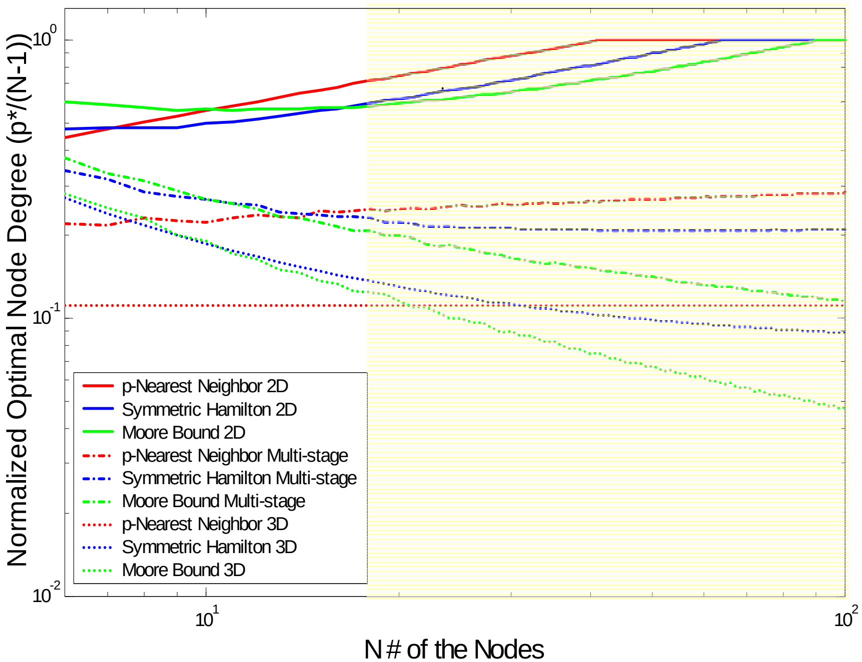
Example: Multi-stages



$$F(K) \propto K^{1+\gamma}$$

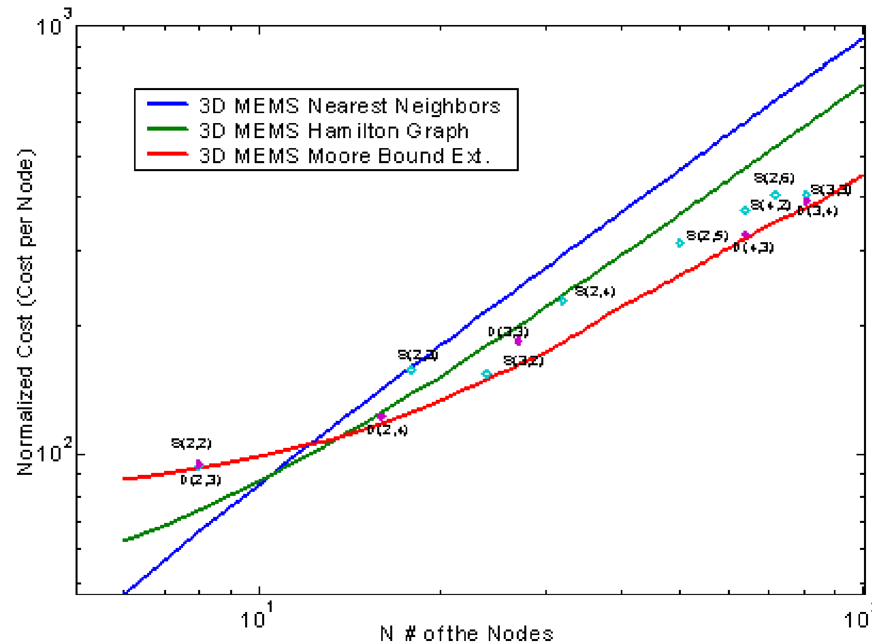
Example: 3D MEMS

Optimal Node Connectivity



Normalized node degree as functions of *N* for 3 topologies. α/β = 40

Normalized cost of network



α/β = 40. 3-D switching fabric
S =shuffle net, D = de Brujin graph

- Good optical switch designs lowers network costs
- Good topologies minimizes network cost
- Optimum node design architecture depends on traffic and technology
- Stochastic and asymmetric traffic
- RWA
- Some topologies have much higher reliability