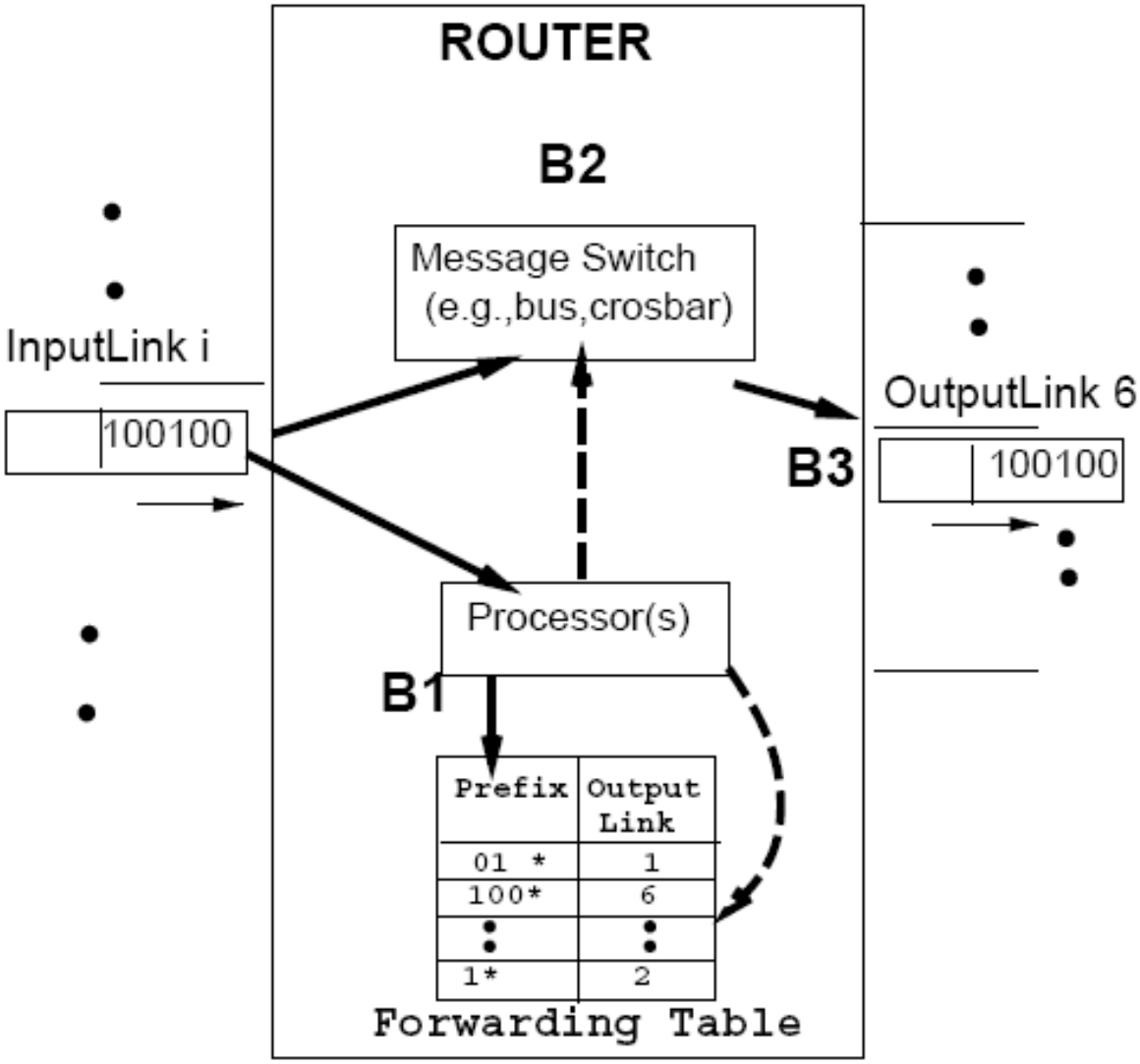
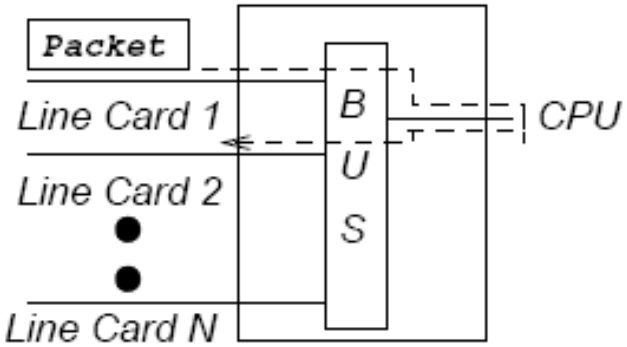
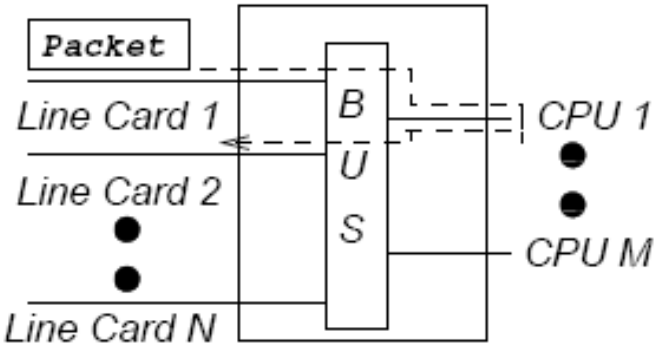
Packet Switching (basics)

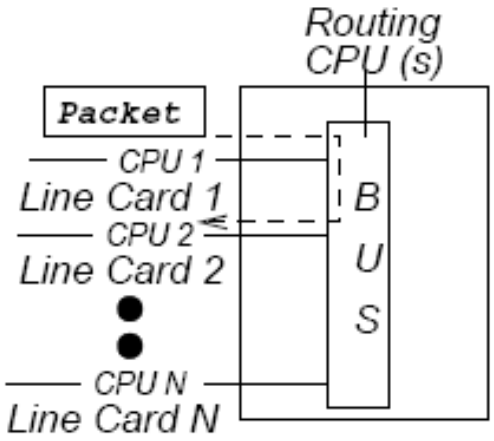

ROUTER
B2
Message Switch
(e.g.,bus,crosbar)
InputLink i
100100
OutputLink 6
100100
B3
Processor(s)
B1
Prefix
Output Link
01 *
1
100*
6
1*
2
Forwarding Table



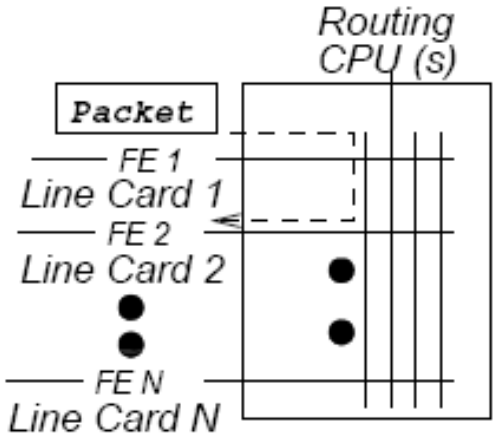
A) PALEOZOIC: BUS, SHARED CPU



B) PALEOLITHIC: BUS, SHARED CPUs

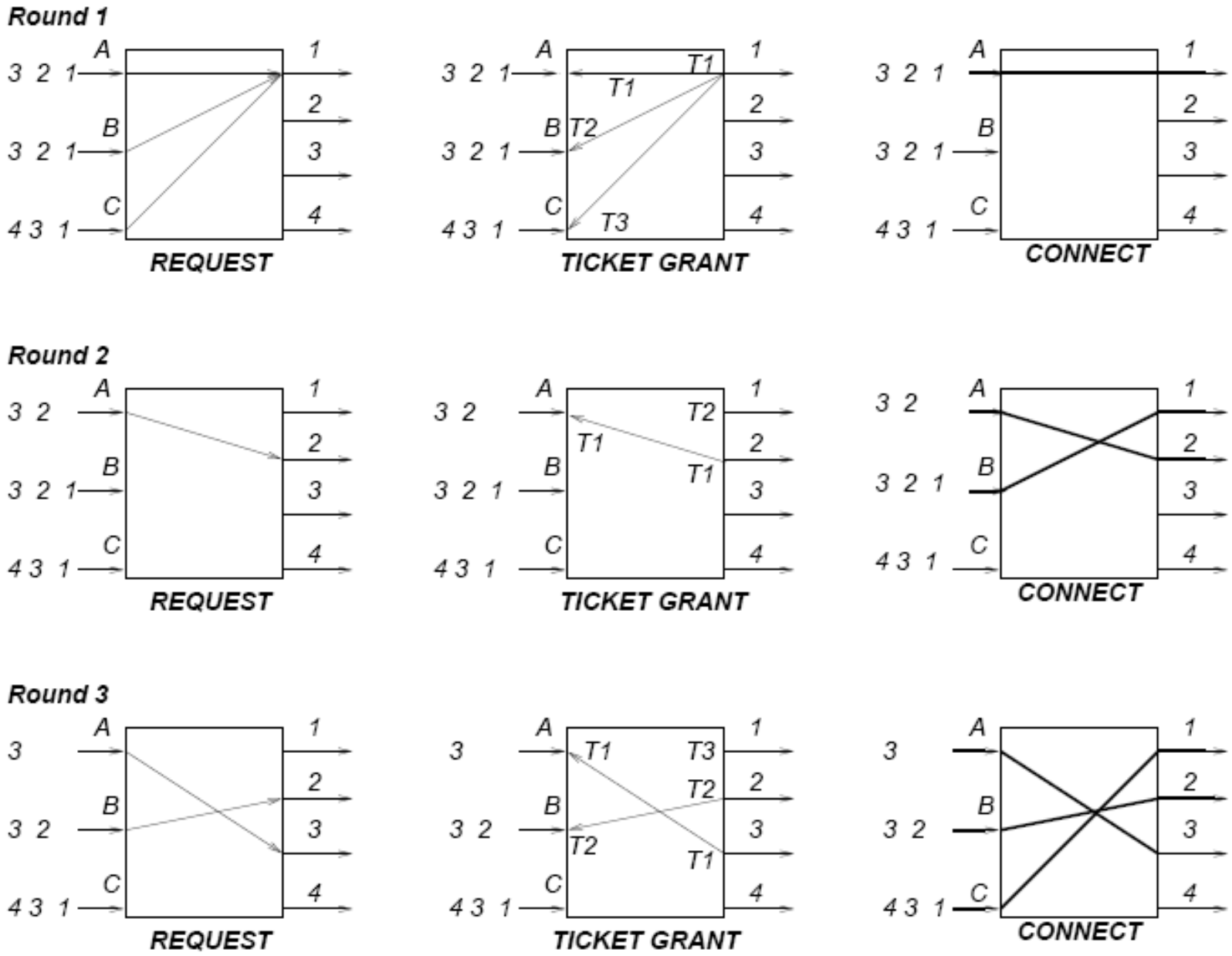


C) NEOLITHIC: BUS,
PER LINE CARD CPUs



D) MODERN: CROSSBAR,
PER LINE CARD FORWARDING ENGINES

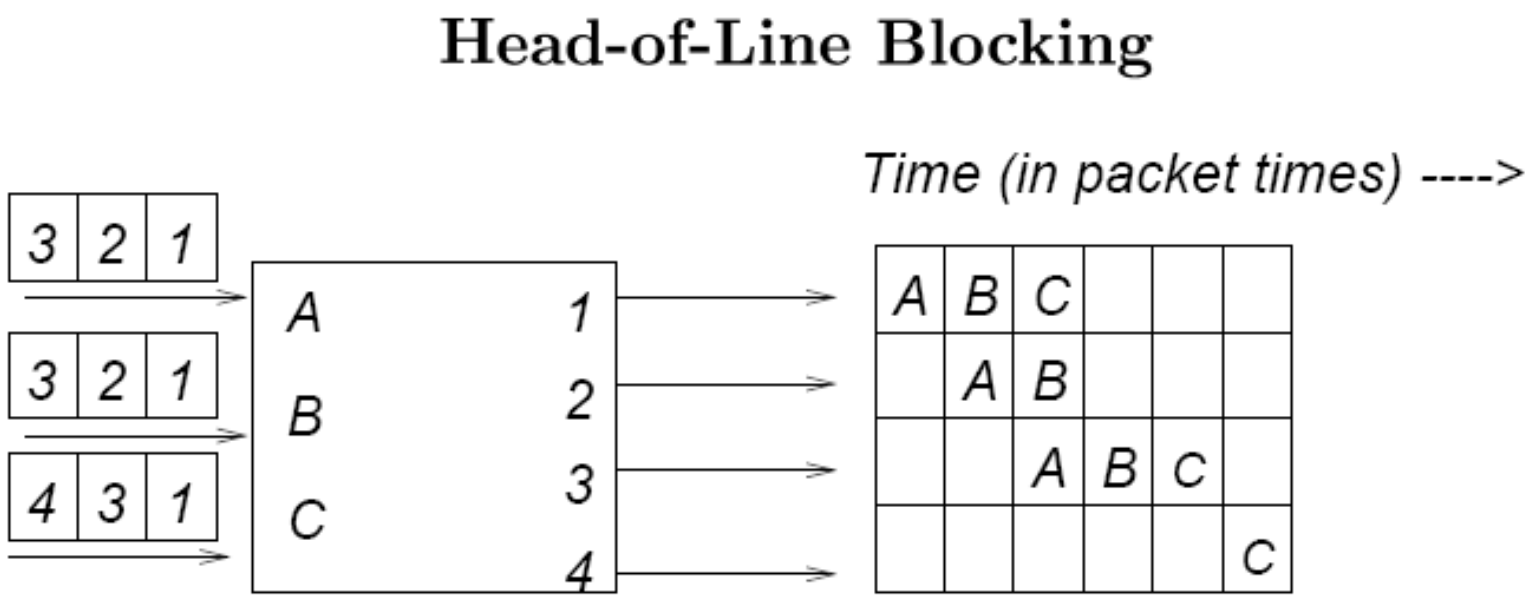
Crossbar scheduling: “Take-a-ticket”



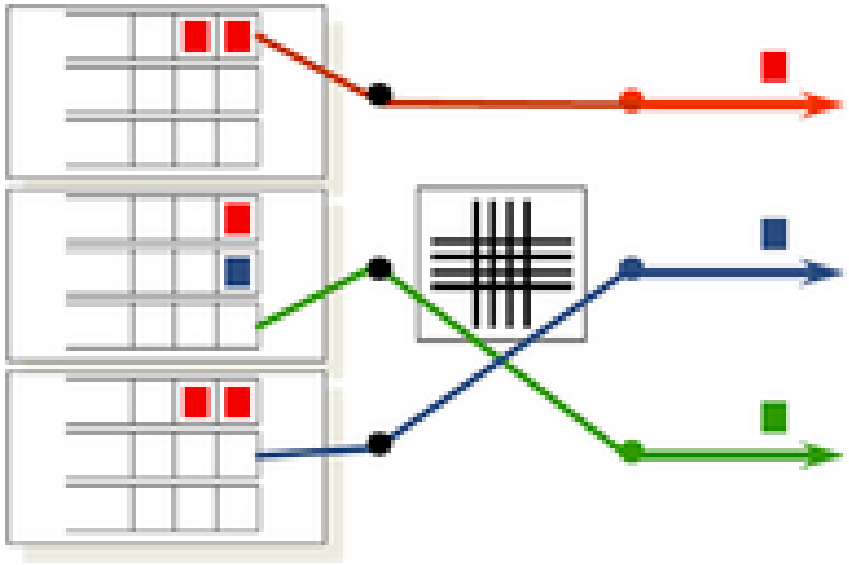
HOL

Probability that none of the N input ports chooses a given output port is $(1-1/N)^N \approx 37\%$

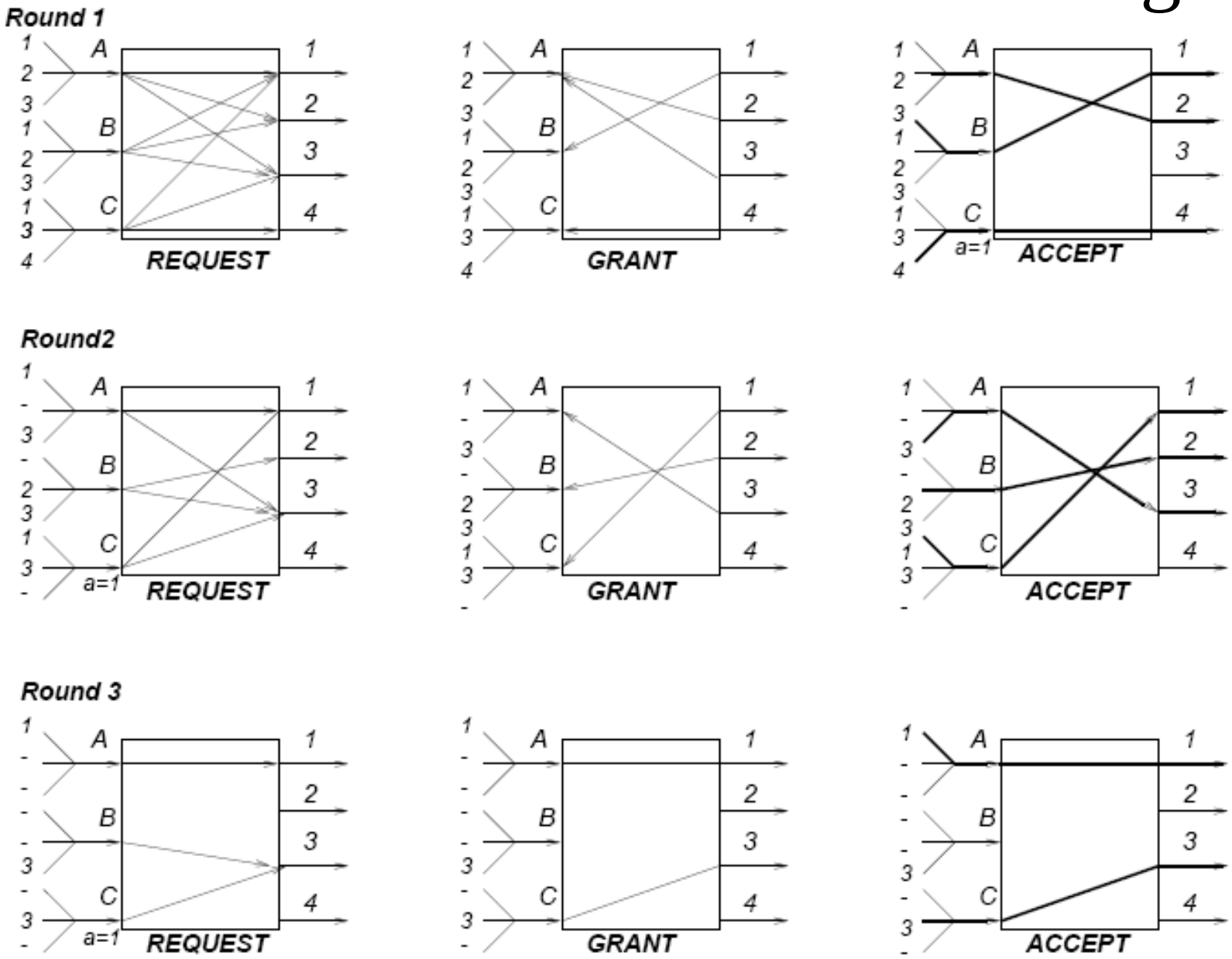
So, max throughput of this switch is: 63%



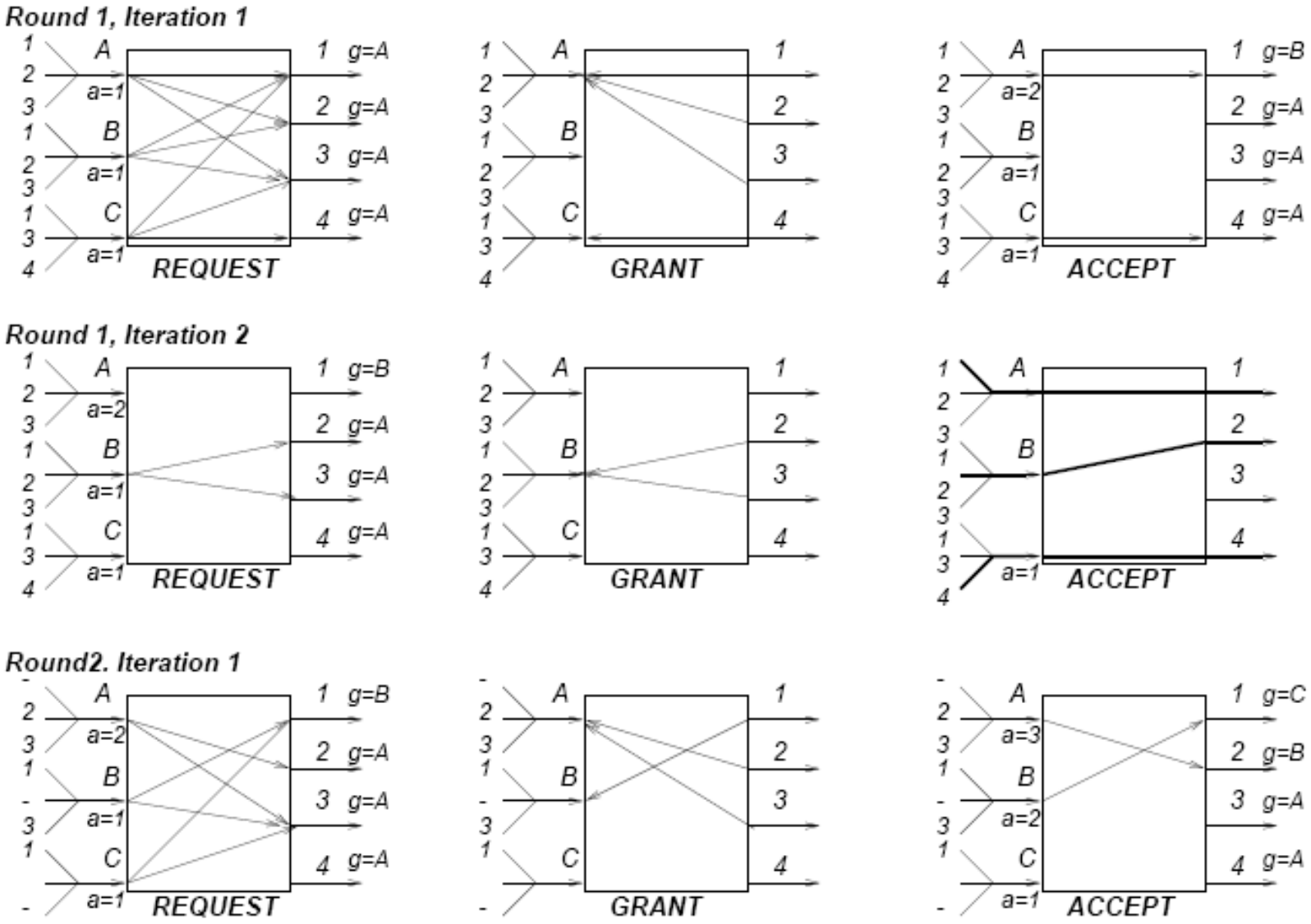
Avoid HOL-blocking with multiple input queues (one per output port)



PIM: Parallel Iterative Matching

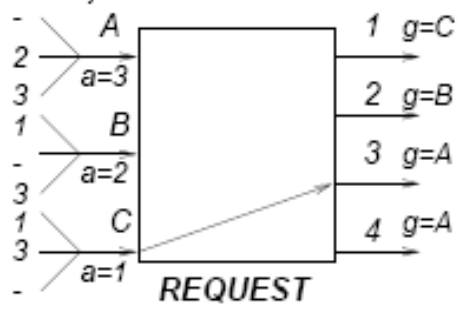


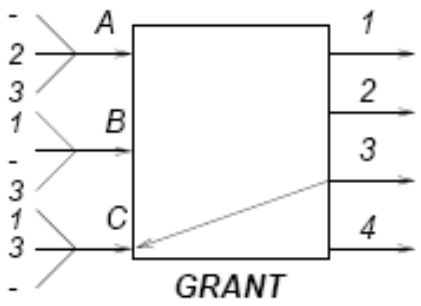
iSLIP (avoids randomization of PIM)

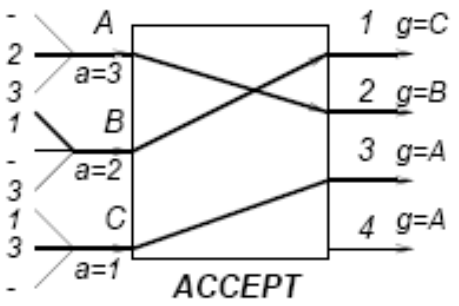


iSLIP (cont')

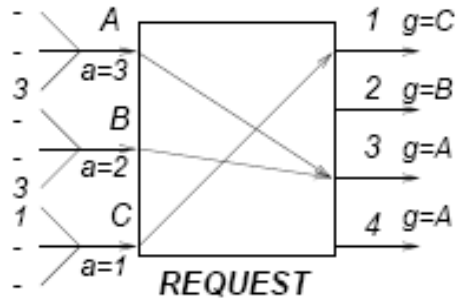
Round 2, Iteration 2

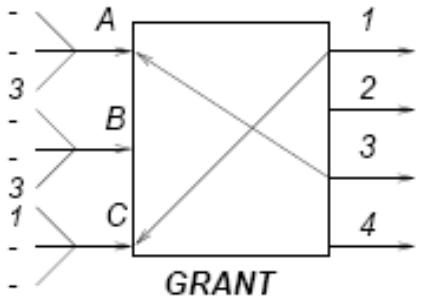


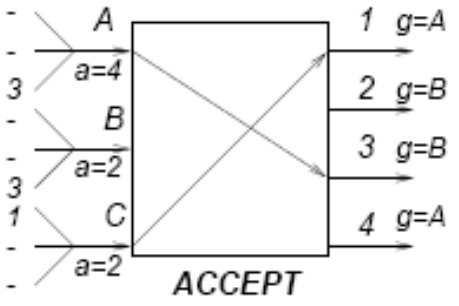




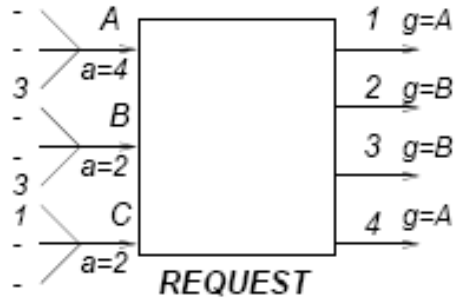
Round 3, Iteration 1

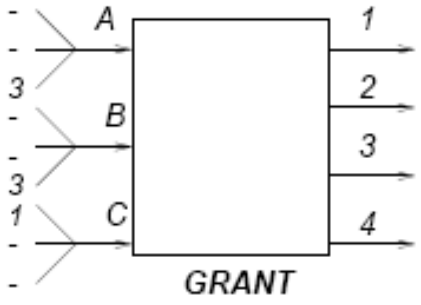


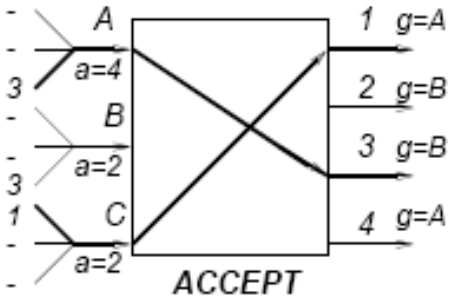




Round 3, Iteration 2

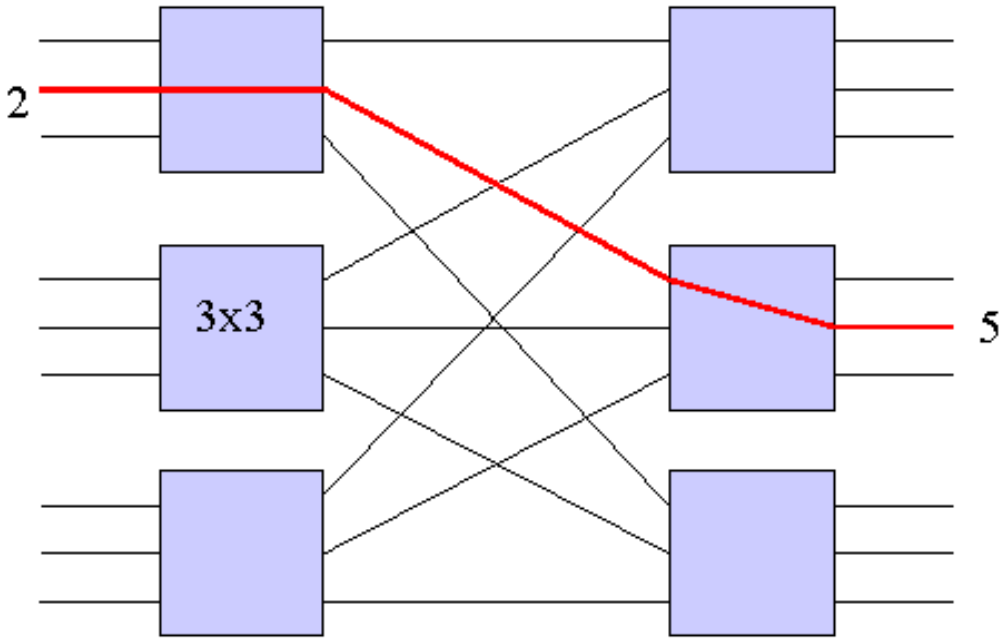






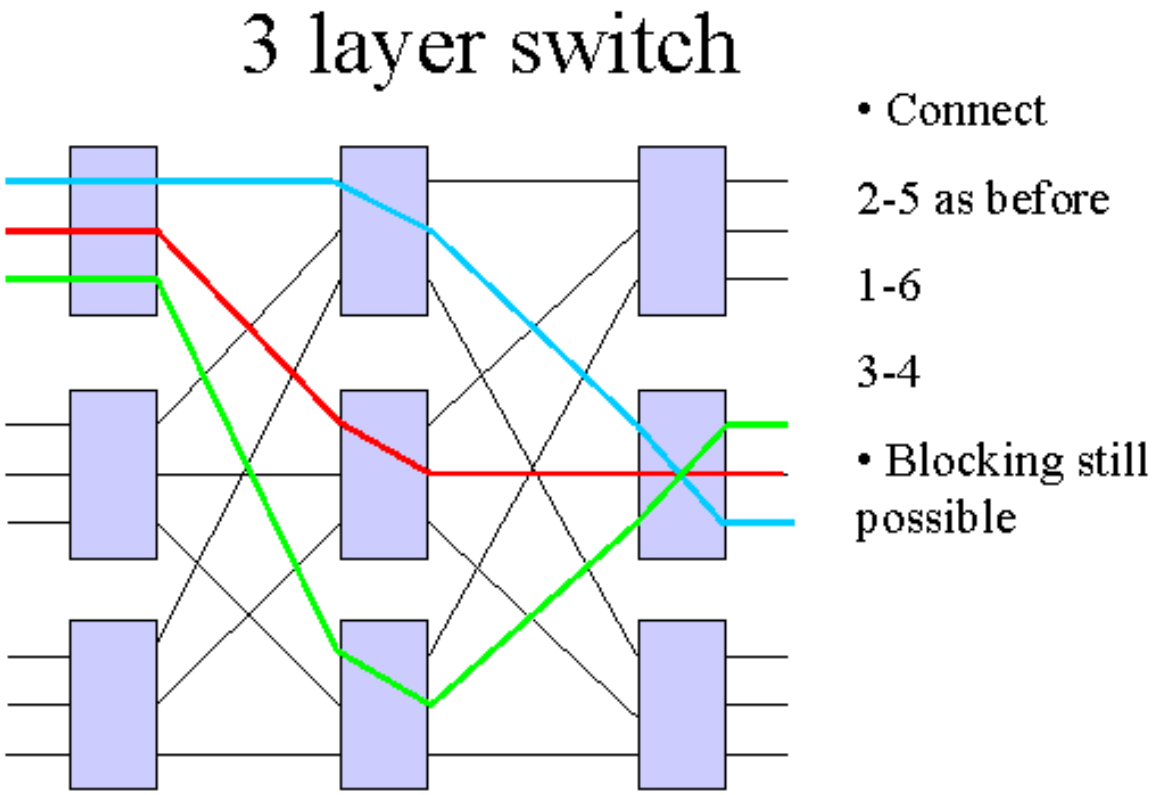
Multistage switching

2 layer switch

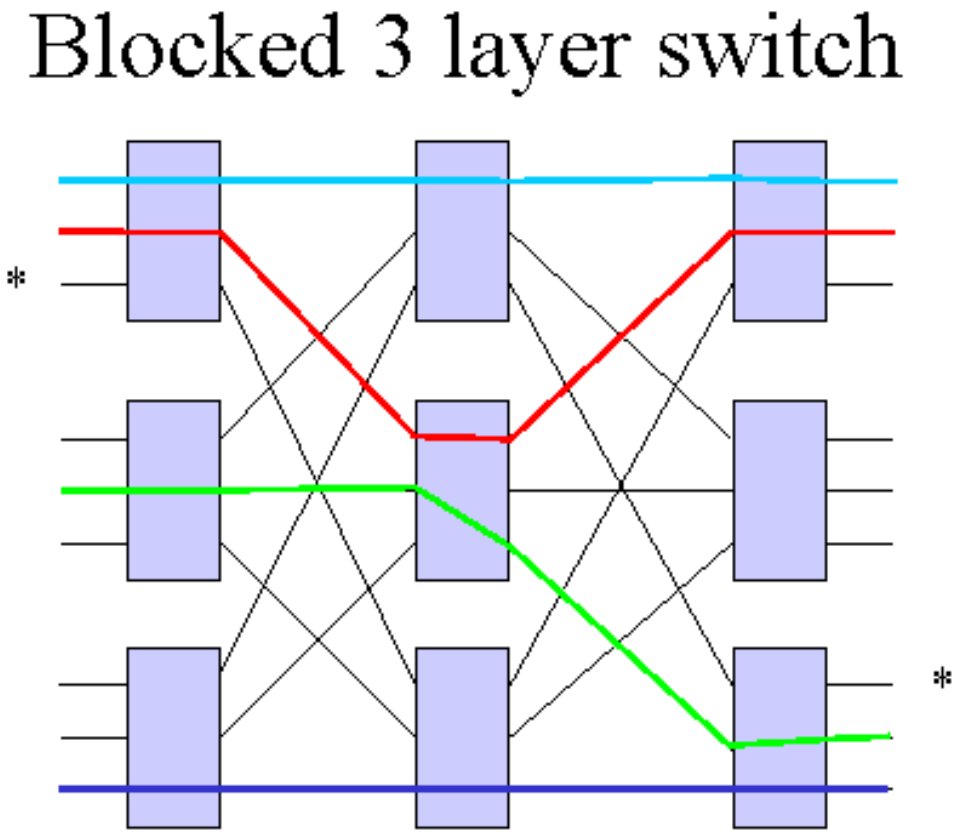


- only uses 6*9 = 54 crosspoints rather than 9*9 = 81
- penalty is loss of connectivity

Blocking vs non-blocking switching networks

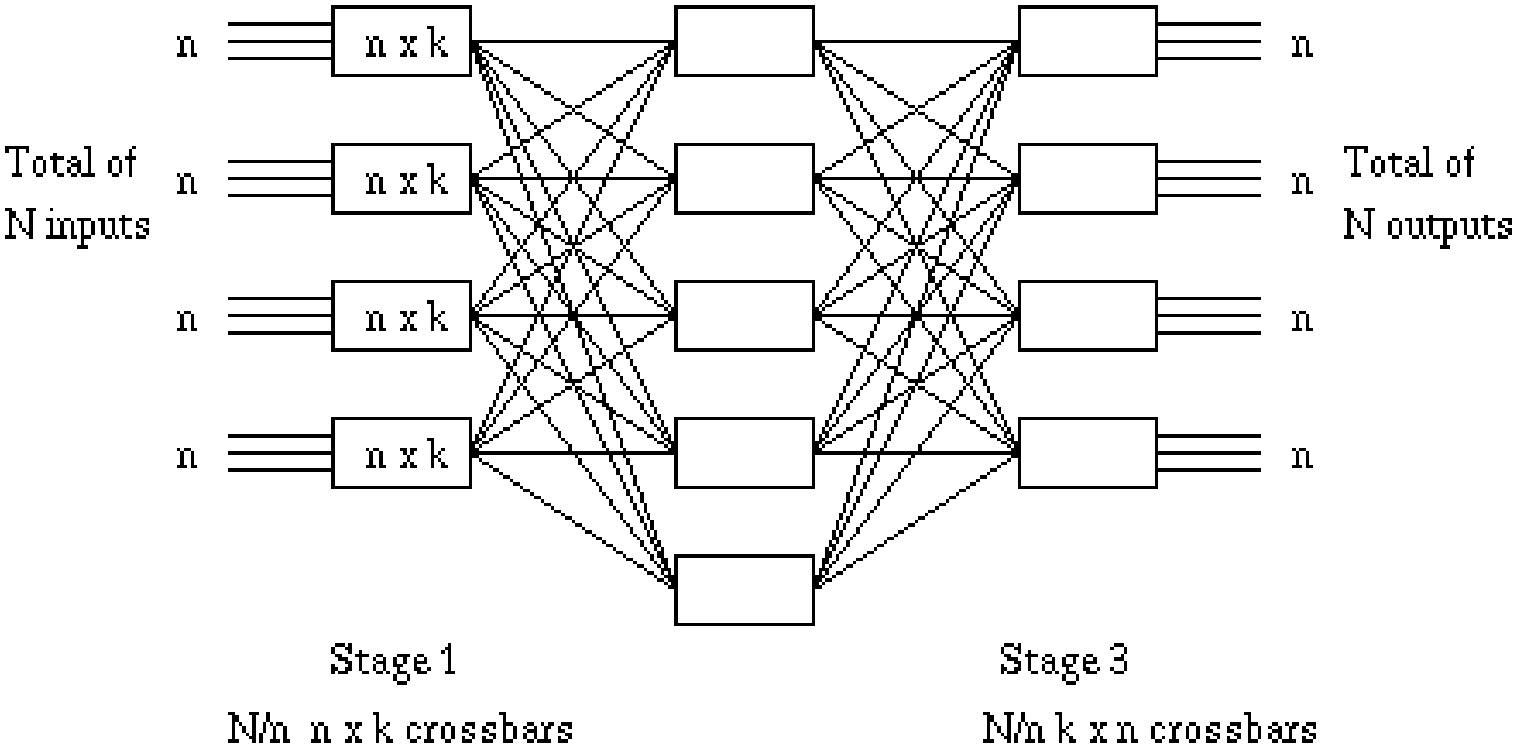


Blocking vs non-blocking switching networks



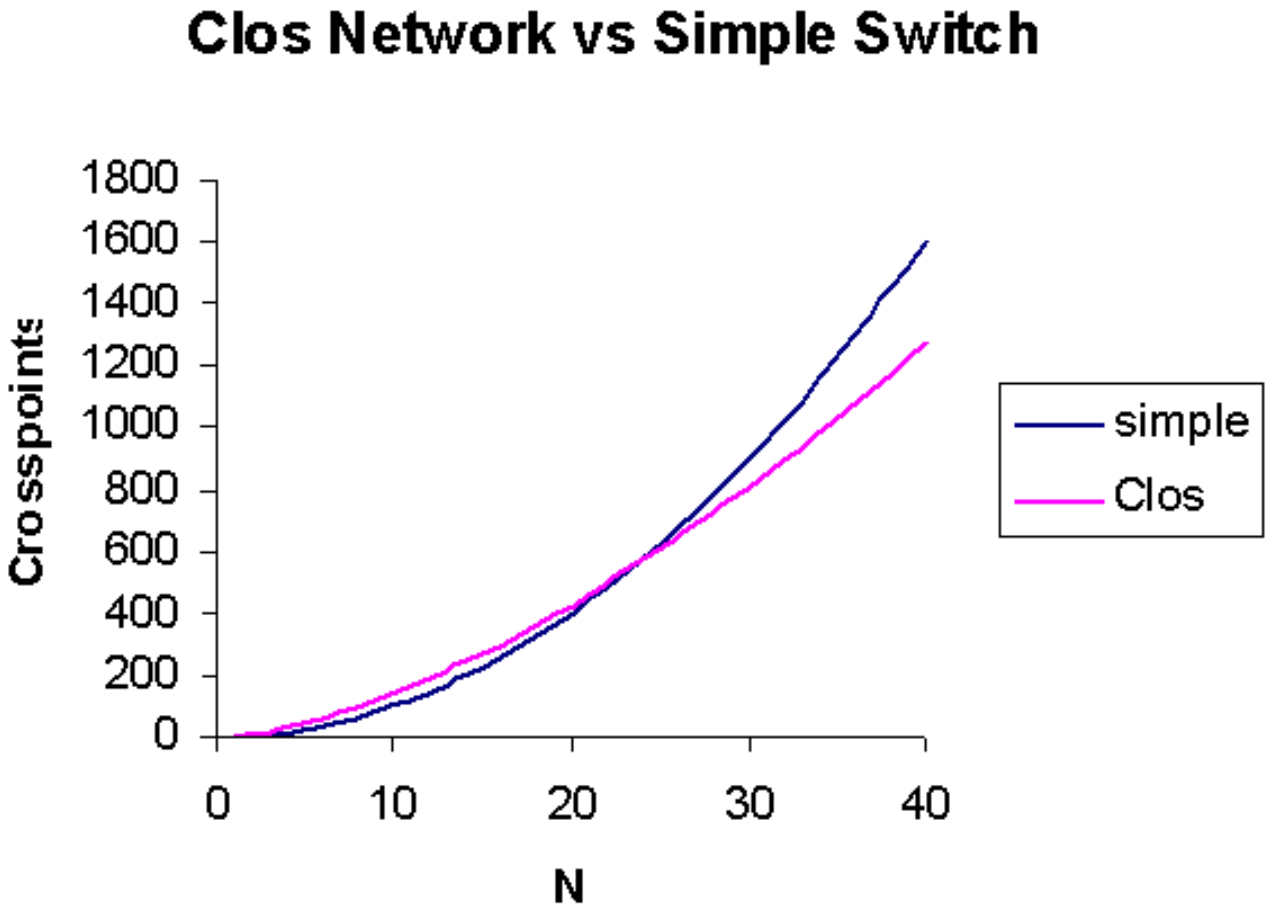
Clos network (N, n, k):

Non-blocking if k ≥2n-1 (Prove this!)

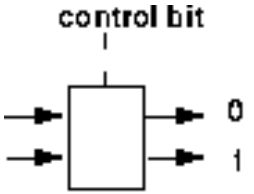


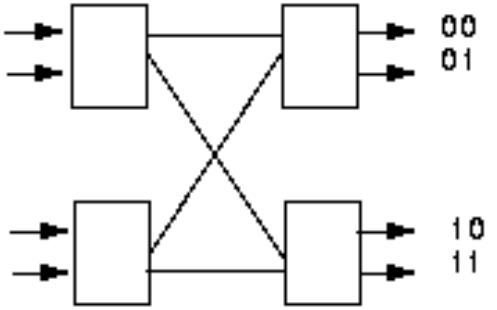
Clos network (N,n,k=2n-1):

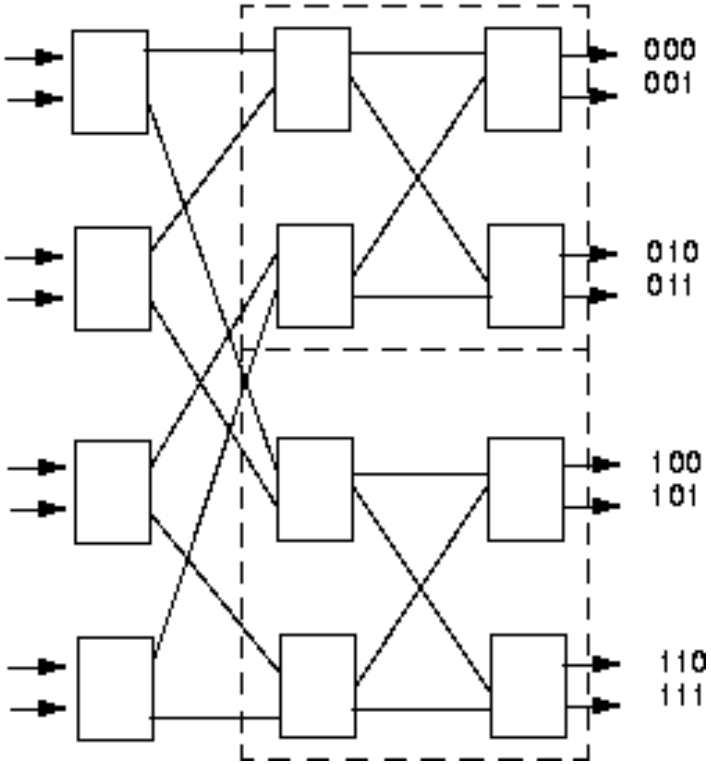
Prove that min number of crosspoints = $5.6N\sqrt{N}$
(for $n = \sqrt{(N/2)}$)



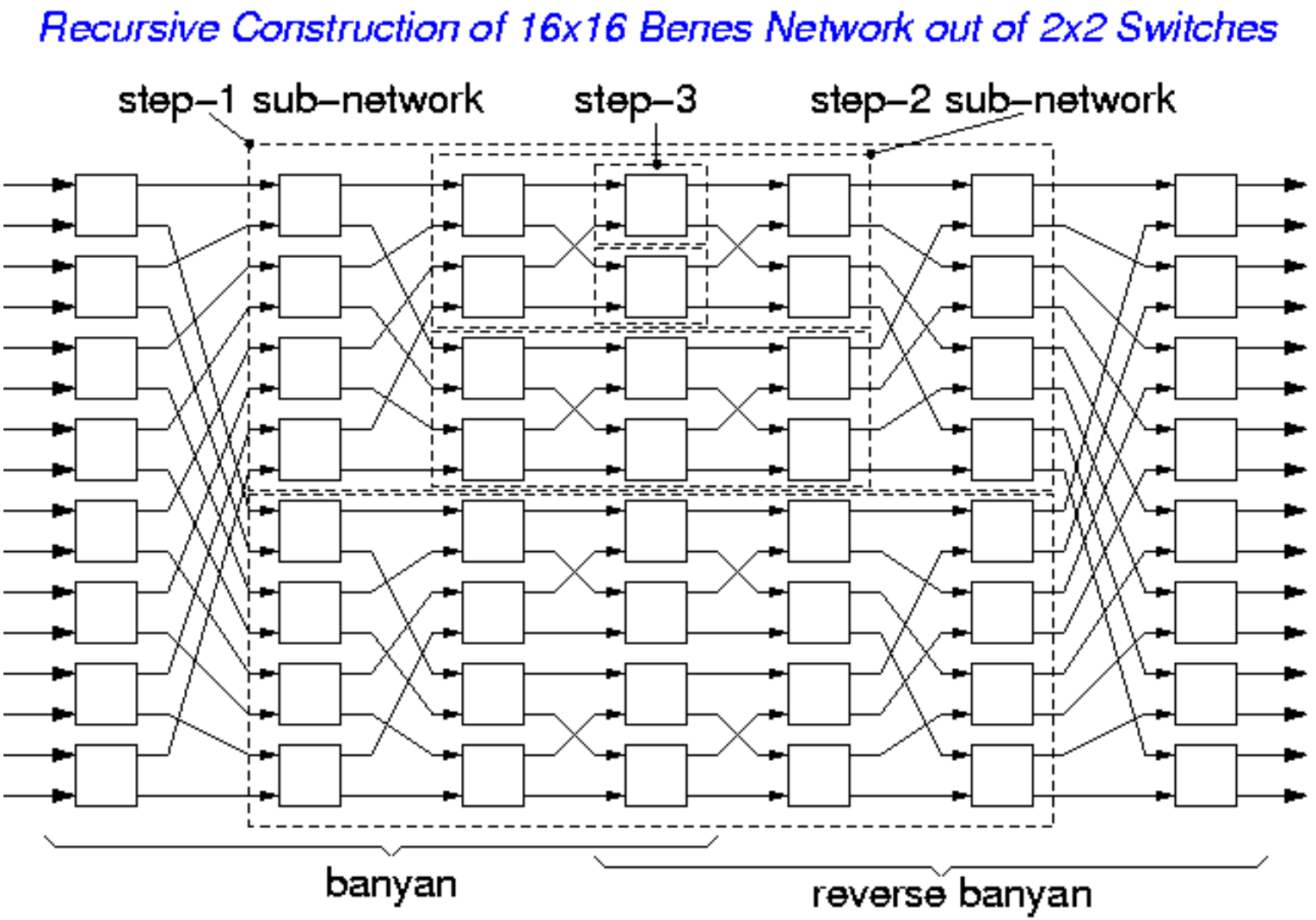
Banyan networks and the self-routing property



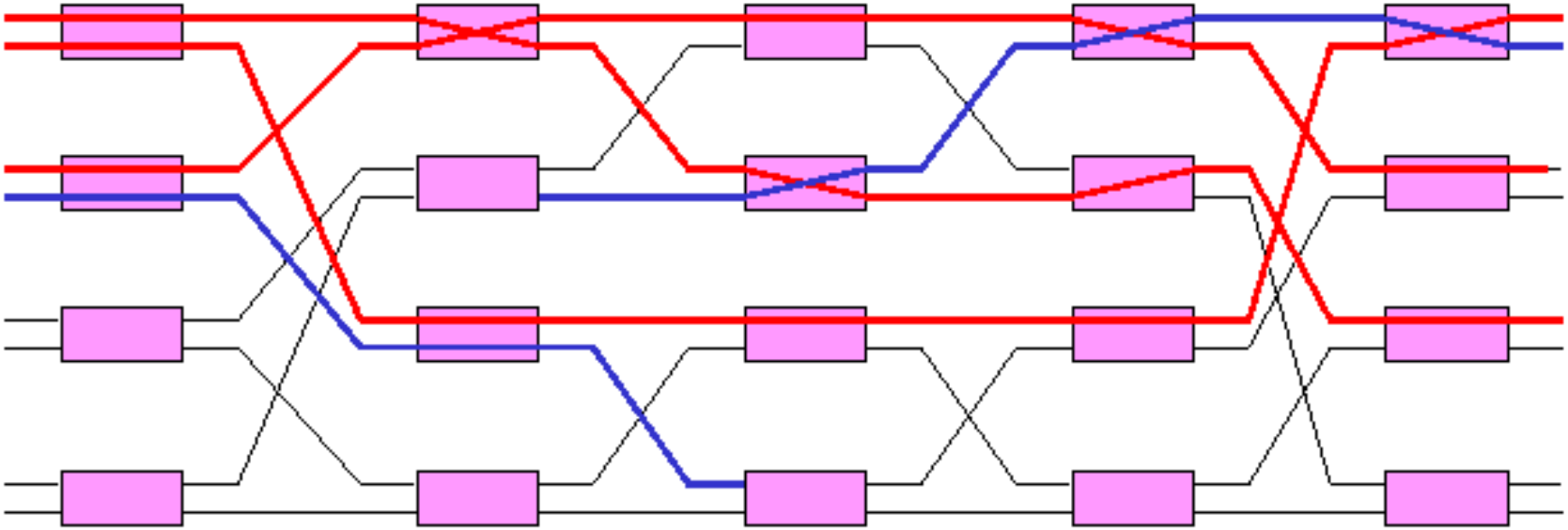




Benes network

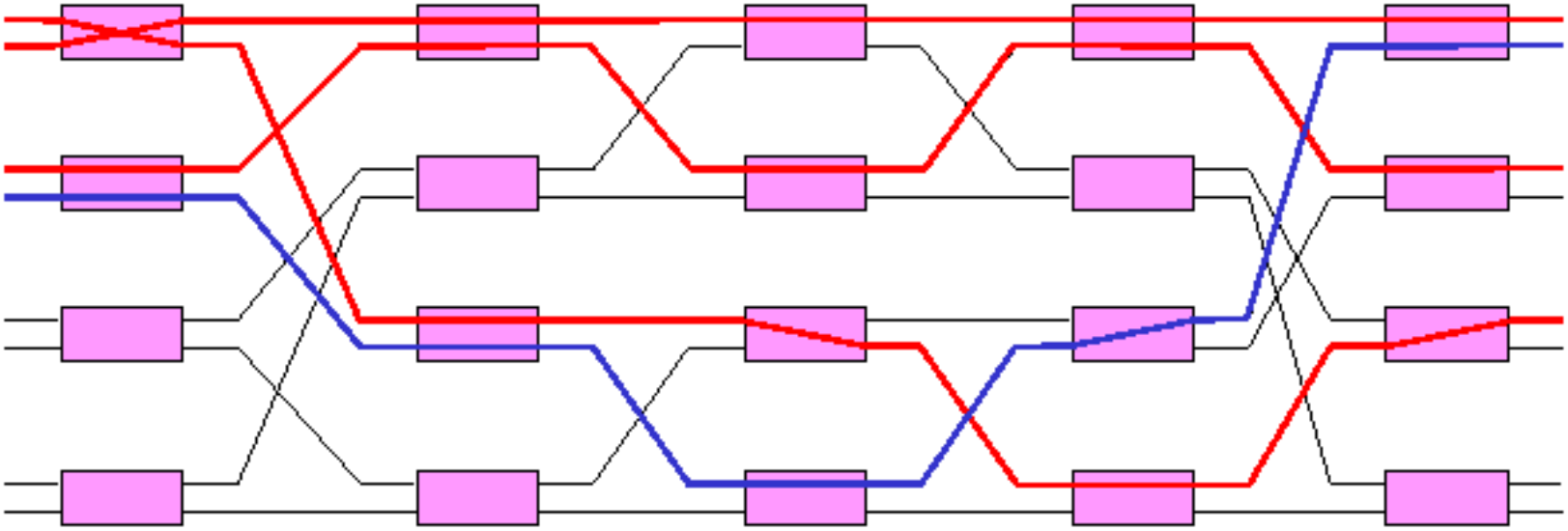


Benes Network



- Rearrangably non-blocking
- e.g. 2 to 1, 1 to 5, 3 to 3, 4 to 2

Benes Network



- Now use different connections
- e.g. 2 to 1, 1 to 5, 3 to 3, 4 to 2