SMU School of Engineering

Advanced Computer Architecture

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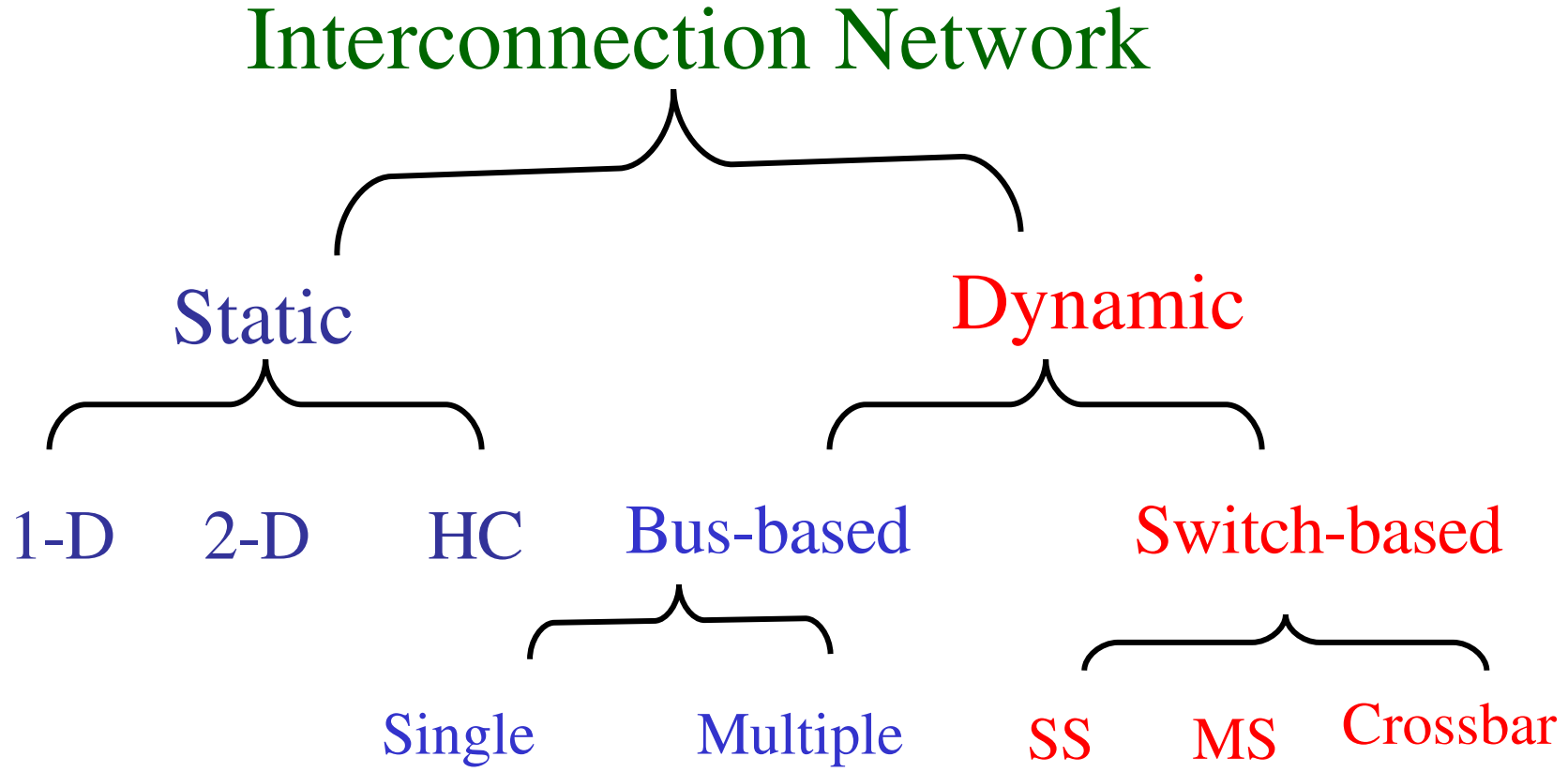
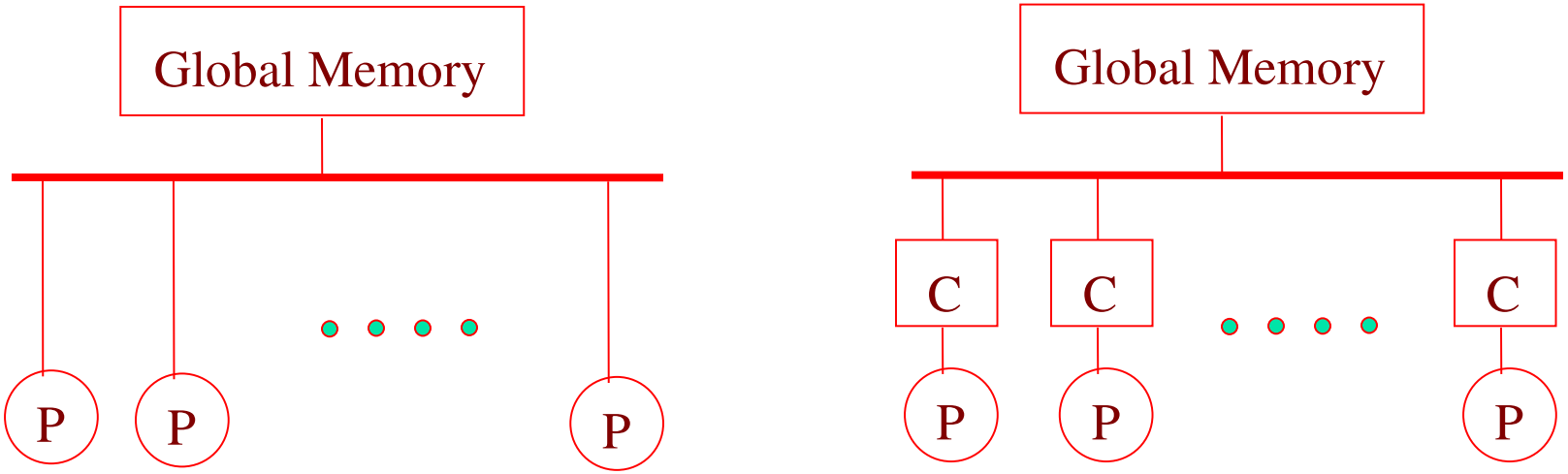


Dynamic Network Analysis

Parameters:

- **Cost**
- **Delay: latency**
- **Blocking characteristics**
- **Fault tolerance**

Bus Based IN



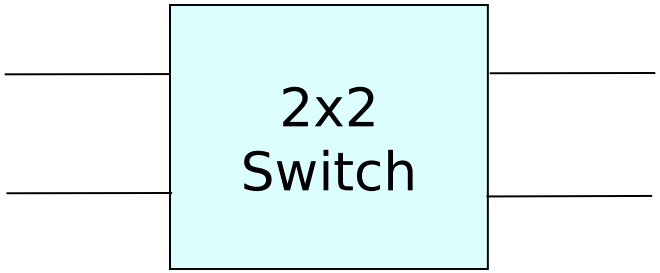
Dynamic Interconnection Networks

- **Communication patterns are based on program demands**
- **Connections are established on the fly during program execution**
- **Multistage Interconnection Network (MIN) and Crossbar**

Switch Modules

- A x B switch module
- A inputs and B outputs
- In practice, A = B = power of 2
- Each input is connected to one or more outputs (conflicts must be avoided)
- One-to-one (permutation) and one-to-many are allowed

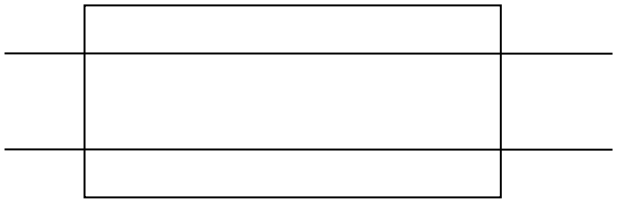
Binary Switch



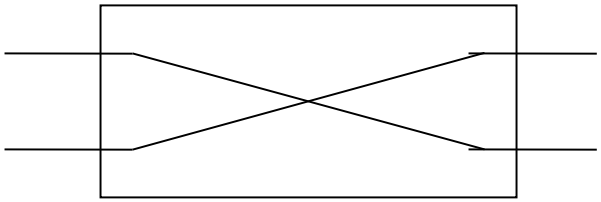
Legitimate States = 4

Permutation Connections = 2

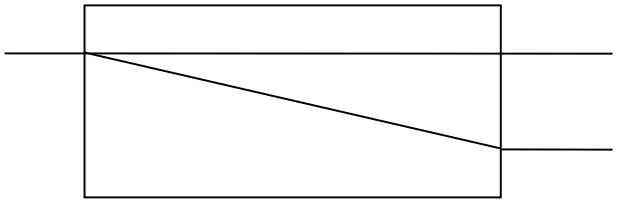
Legitimate Connections



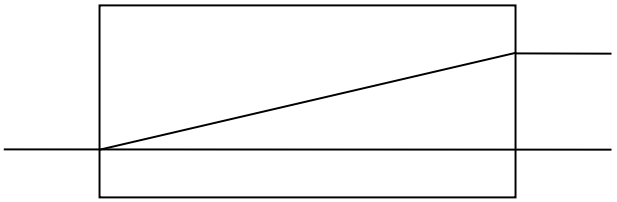
Straight



Exchange



Upper-broadcast

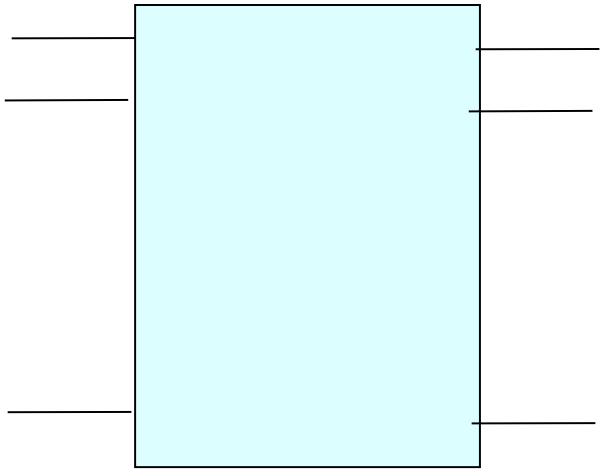


Lower-broadcast

The different setting of the 2X2 SE

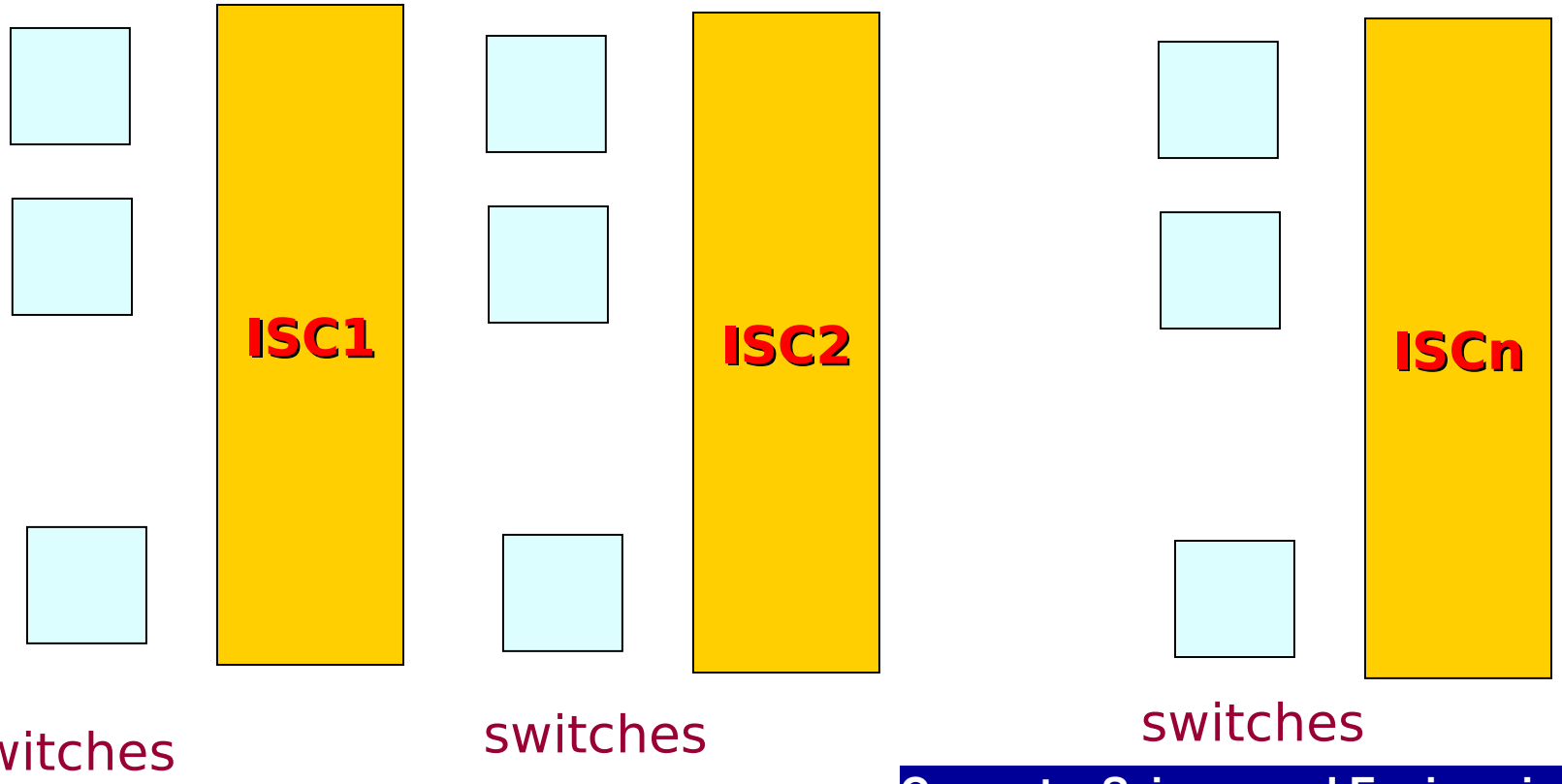
Group Work

General Case ??

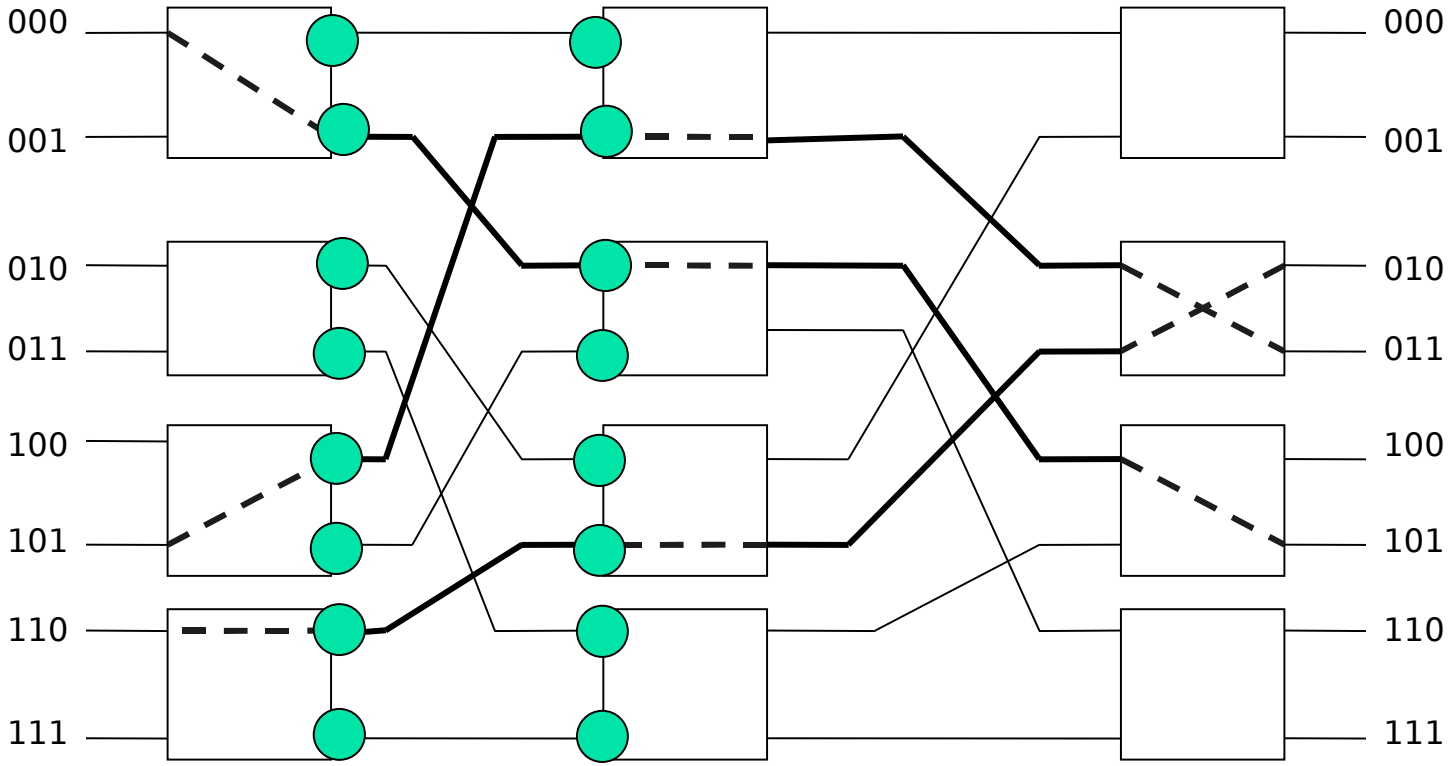


Multistage Interconnection Networks

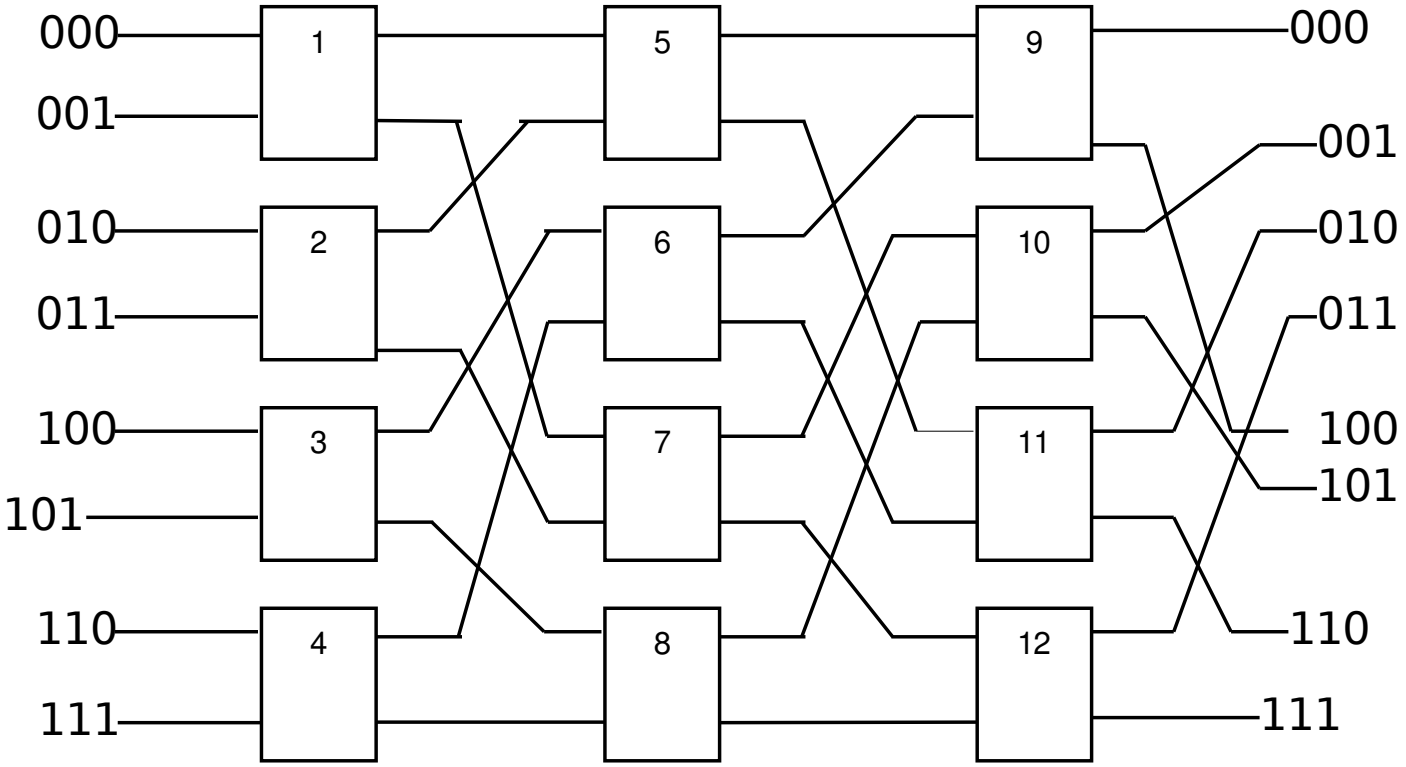
ISC → Inter-stage Connection Patterns



Multi-stage network

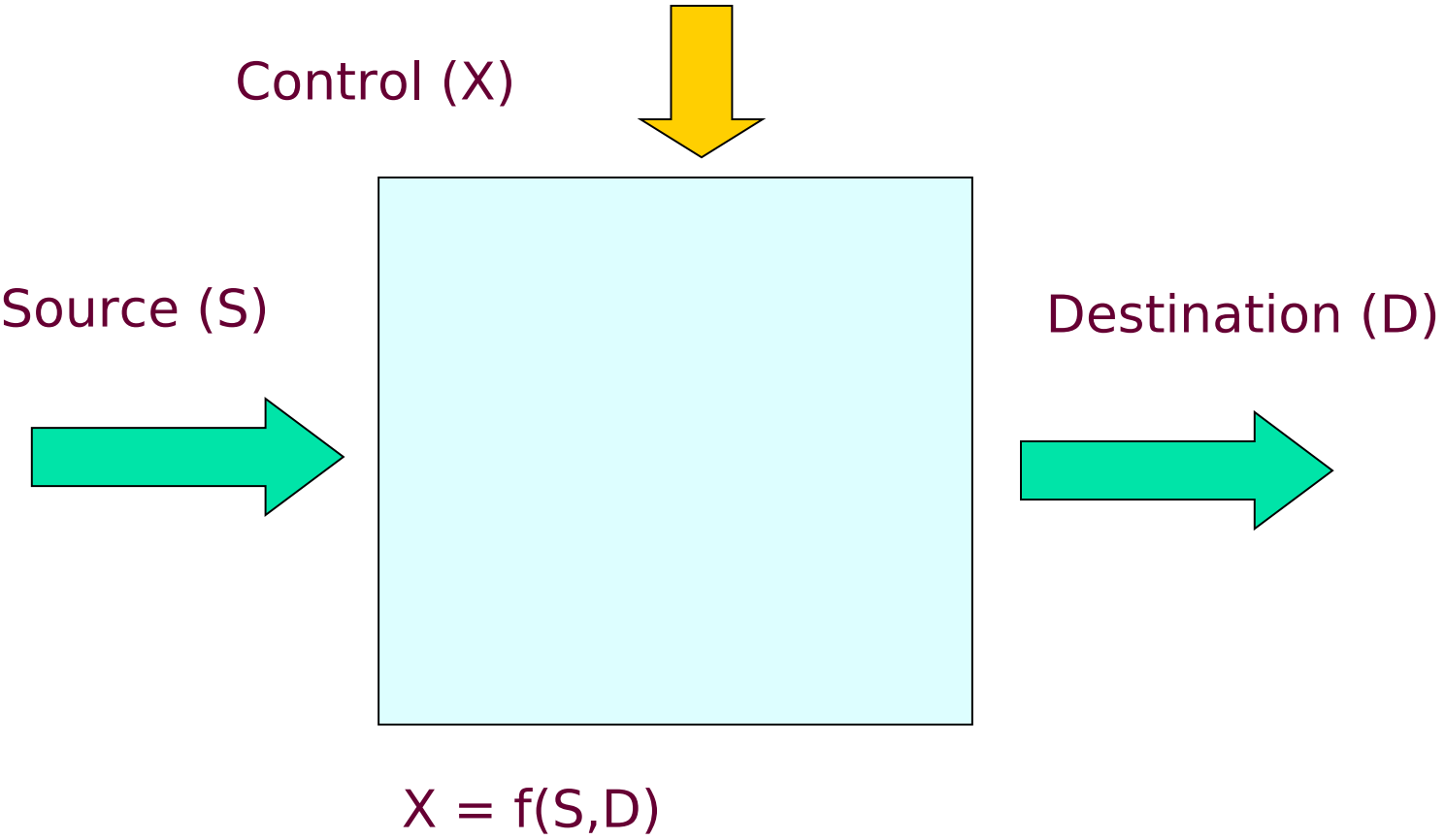


MIN (cont.)

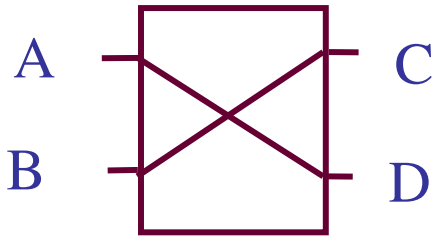


An 8X8 Banyan network

Min Implementation

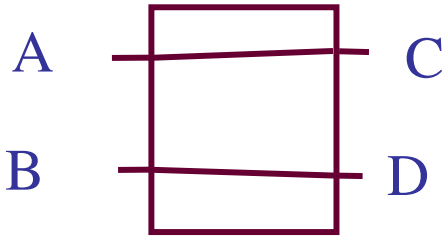


Example



X = 0

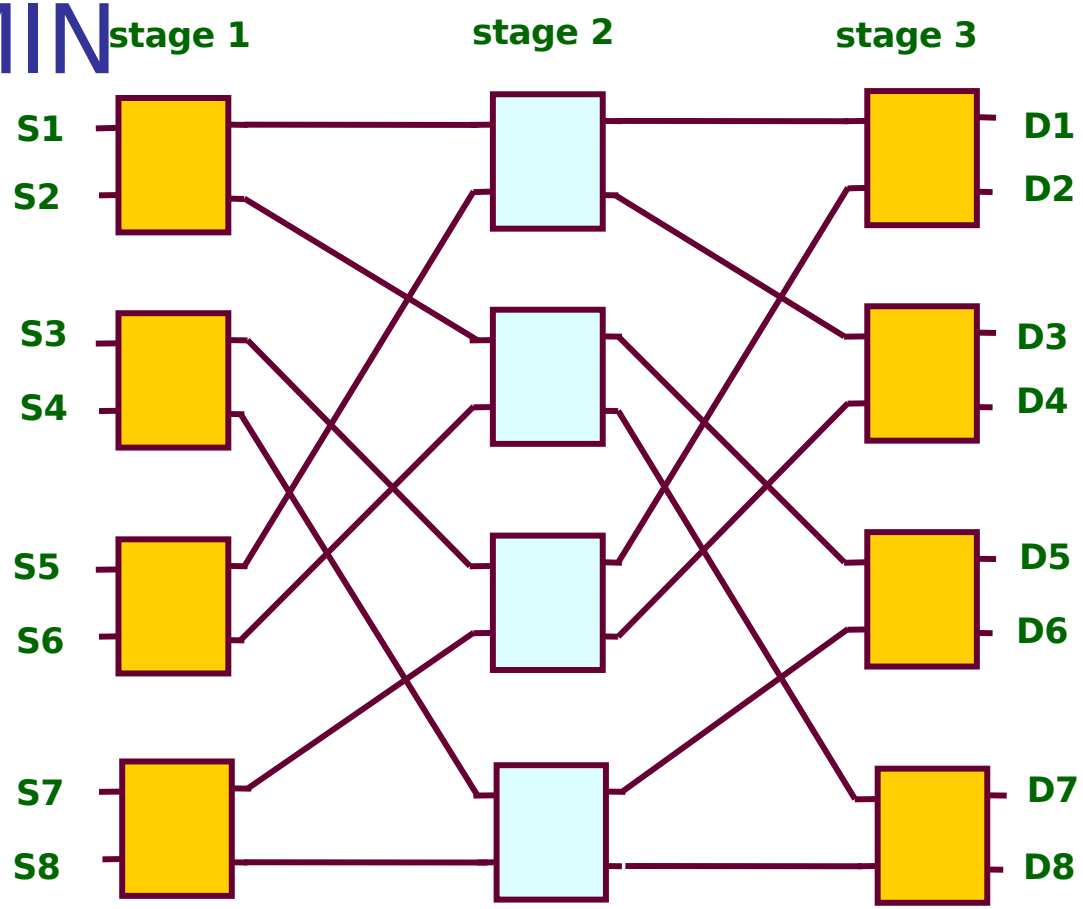
(crossed)



X = 1

(straight)

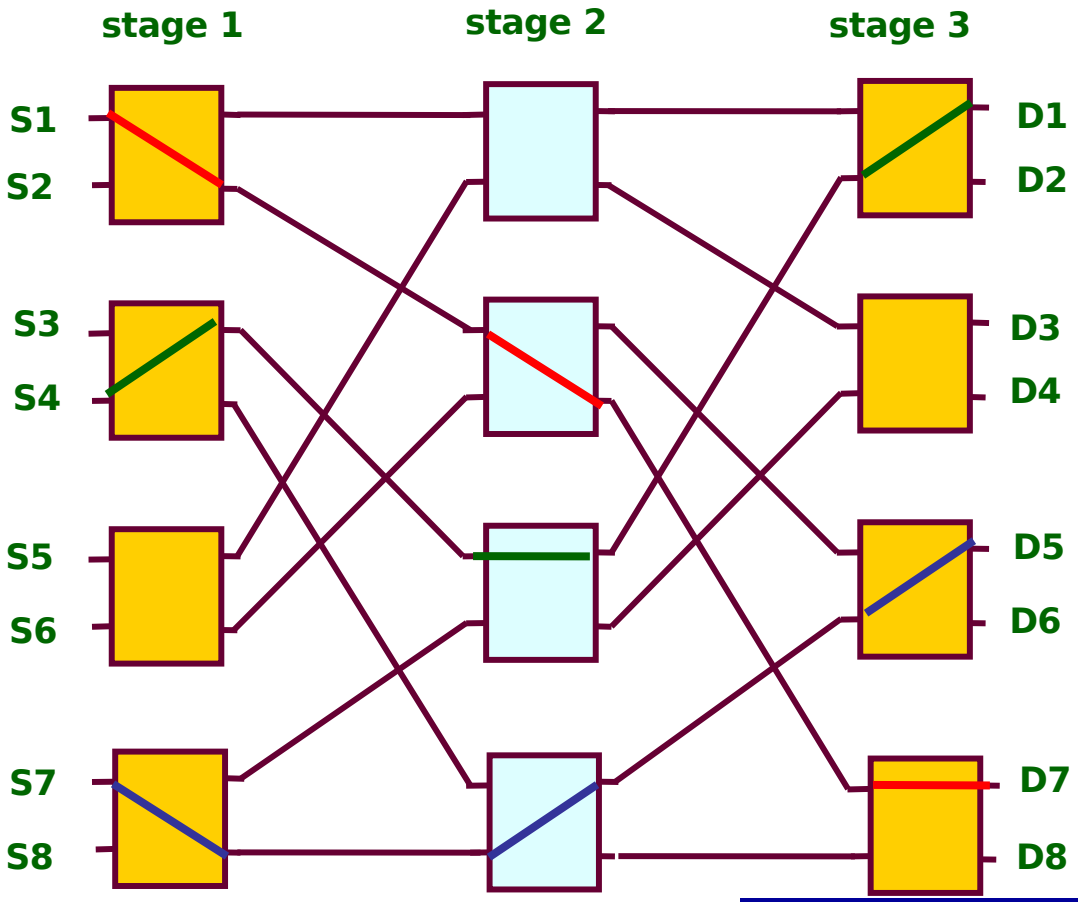
Consider this MIN



Example (Cont.)

- Let control variable be *X1, X2, X3*
- Find the values of *X1, X2, X3* to connect:
  - S1 → D6
  - S7 → D5
  - S4 → D1

The 3 connections

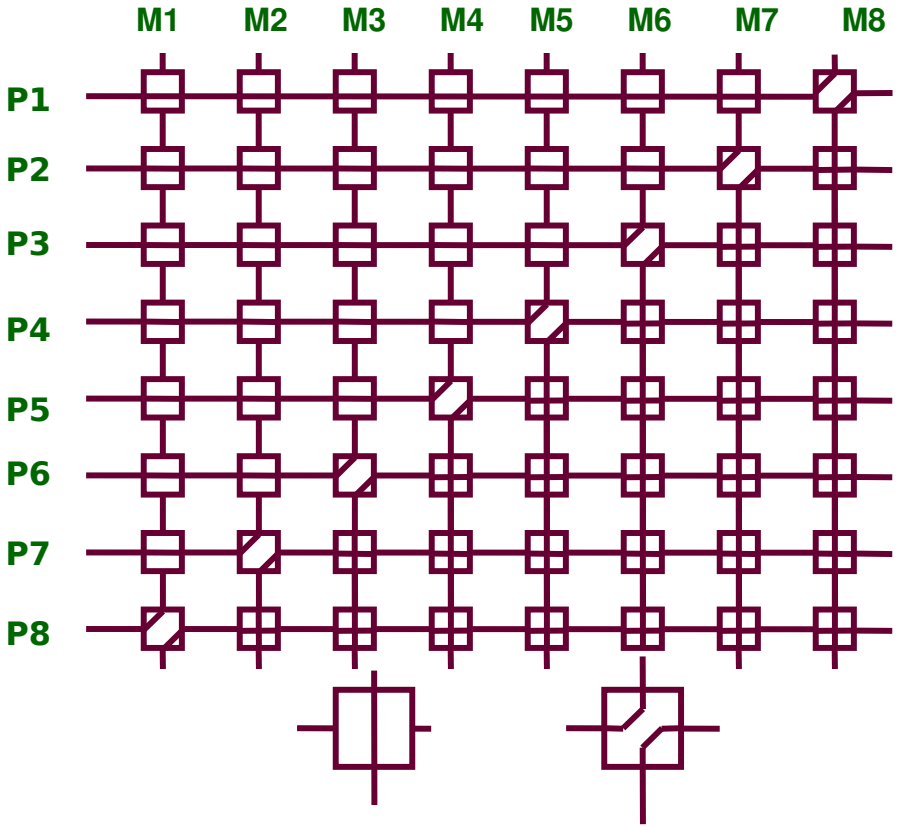


Boolean Functions

- $X = x_1, x_2, x_3$
- $S = s_2, s_2, s_3$
- $D = d_1, d_2, d_3$

- Find $X = f(S,D)$

Crossbar Switch



Analysis and performance metrics

dynamic networks

Networks	Delay	Cost	Blocking	Degree of FT
Bus	O(N)	O(1)	Yes	0
Multiple-bus	O(mN)	O(m)	Yes	(m-1)
MIN	O(logN)	O(NlogN)	Yes	0
Crossbar	O(1)	$O(N^2)$	No	0