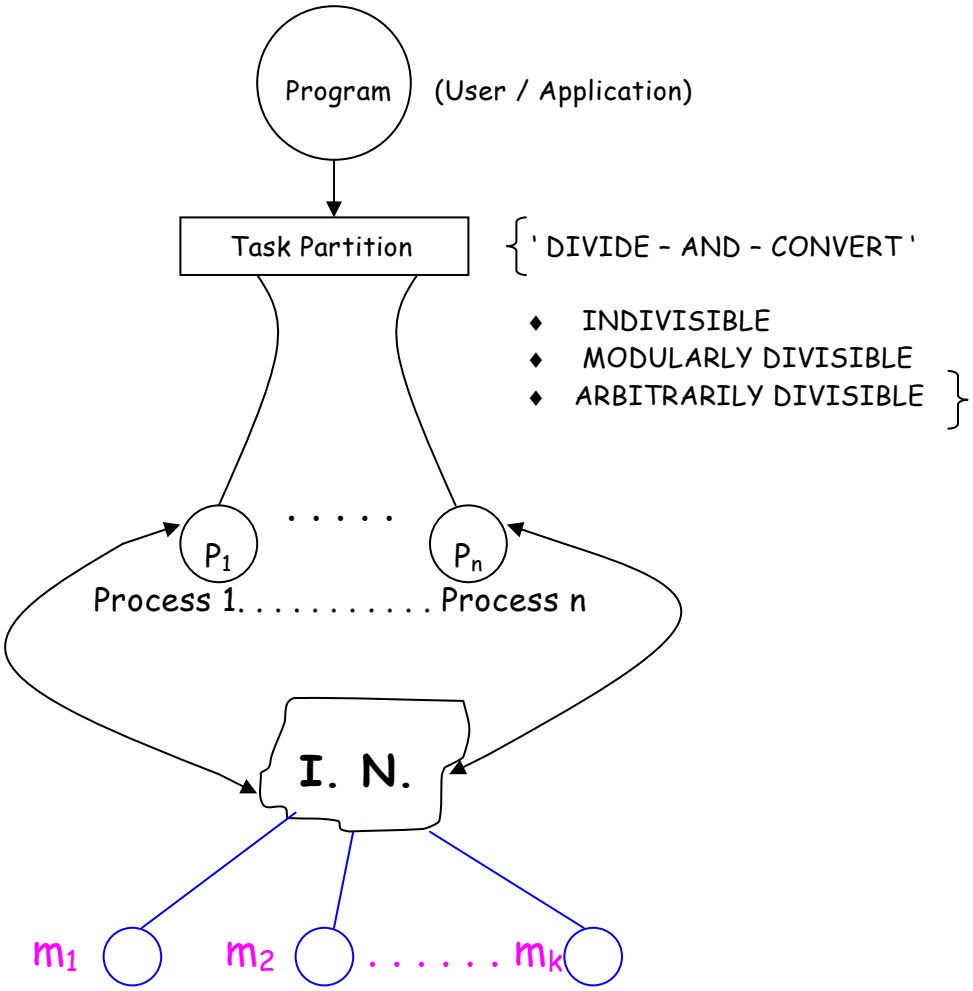
INTERCONNECTION NETWORKS

MOTIVATION : CONCURRENT PROCESSING
(e.g. one billion flop instructions per second)



Architecture choice :

a) Operation
b) Control Strategy
c) Switching Strategy
d) Network Topology

Operation : Asynchronous & Synchronous

Control Strategy : Setting Control on Switching Elements
(Centralized or De-Centralized)

Switching Strategy : Ckt. & Pkt. Switching

NETWORK TOPOLOGY :

a. Static
b. Dynamic

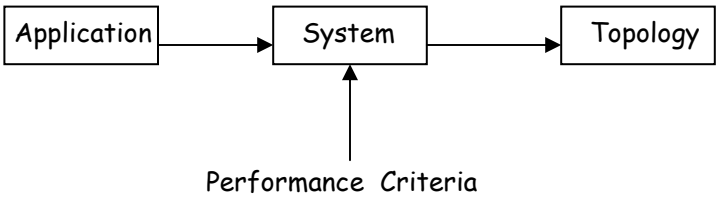
} Based on Re-configuration

S = Space for Interconnection Networks evolves due to
{Operation Mode} X {Control Strategy}X {Switching Strategy} X {Network Strategy}

- What is important in terms of performance is in the choice of an apt topology for different applications.

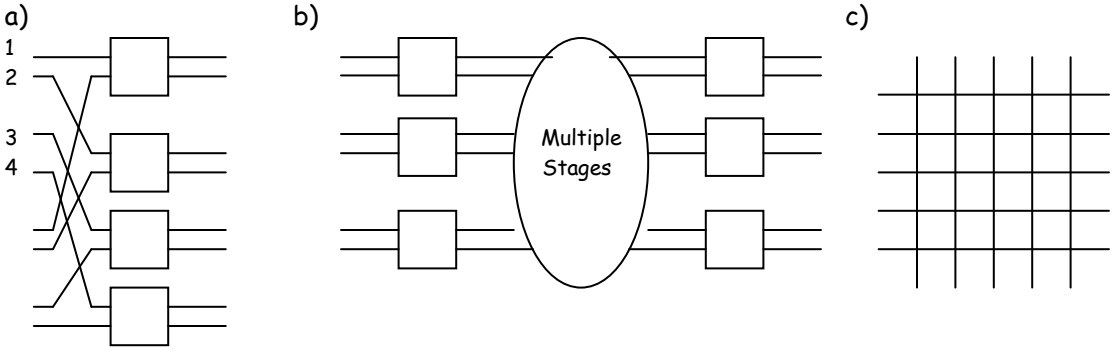
STATIC

Linear Array, Star, Bus, Ring, Tree, Mesh, Systolic Arrays, Complete Graphs, n-cube



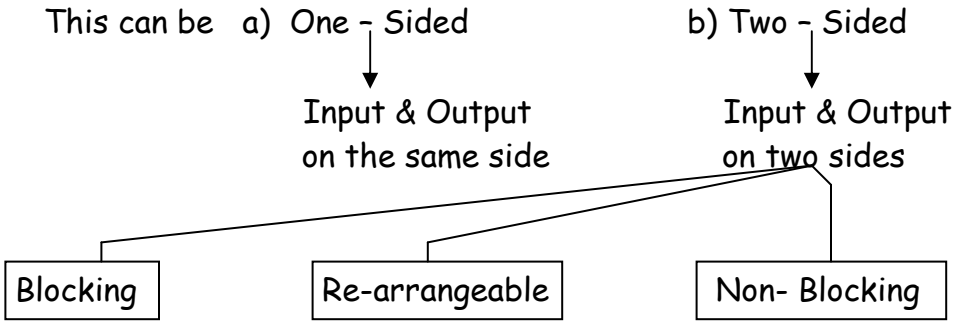
Dimensional Aspect : one, two and three..... are possible

DYNAMIC a) Single Stage b) Multi Stage c) Cross Bar



Single Stage : e.g. Shuffle Exchange Network –
Data may have to recirculate many times before it can reach its destination (recirculating networks

Multi Stage : Capable of connecting an arbitrary input terminal to an arbitrary Output terminal.



Blocking : Simultaneous connections of more than one terminal pair may result in conflicts in the use of network resources (Common links, etc..) eg. Baseline, Omega, Binary n-cube

Rearrangeable : Referred to as "rearrangeably non-blocking "
It can perform all possible connections between inputs and Outputs by rearranging the existing connections
eg. Benes network

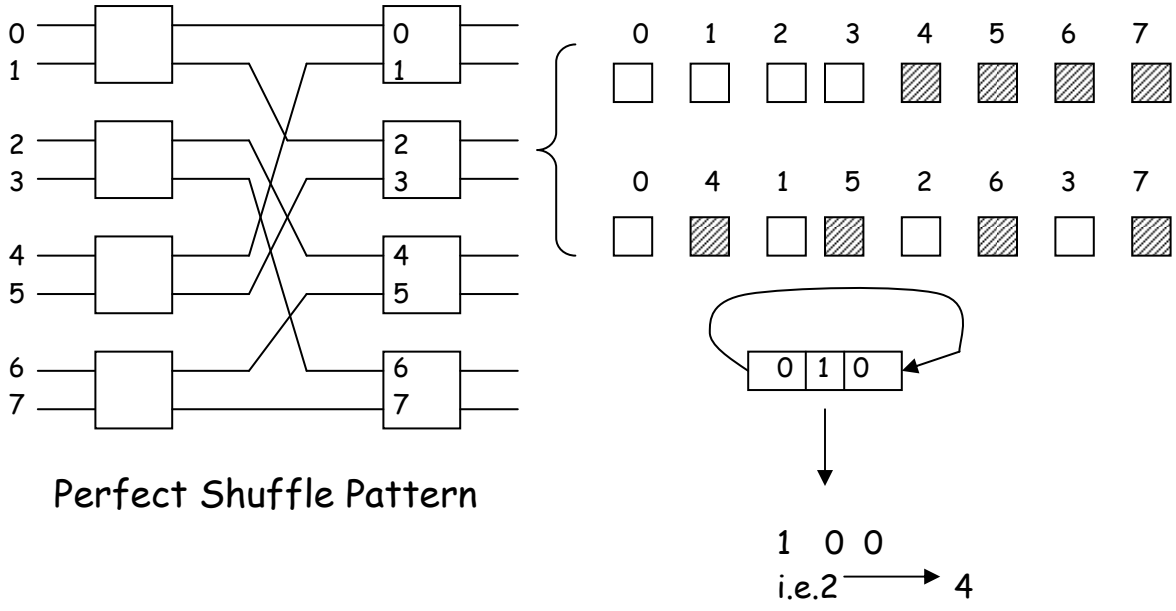
Non-Blocking : This can handle all possible connections without blocking
eg. Clos Networks

OTHER ISSUES : Communication Protocols, Routing Techniques, Data Distbn. Strategy(Scheduling Policies), Reliability and Fault Tolerance.

SHUFFLE EXCHANGE NETWORKS

Principle : Based on perfect shuffling of playing cards .

The interconnection pattern is as follows :



Perfect Shuffle Pattern

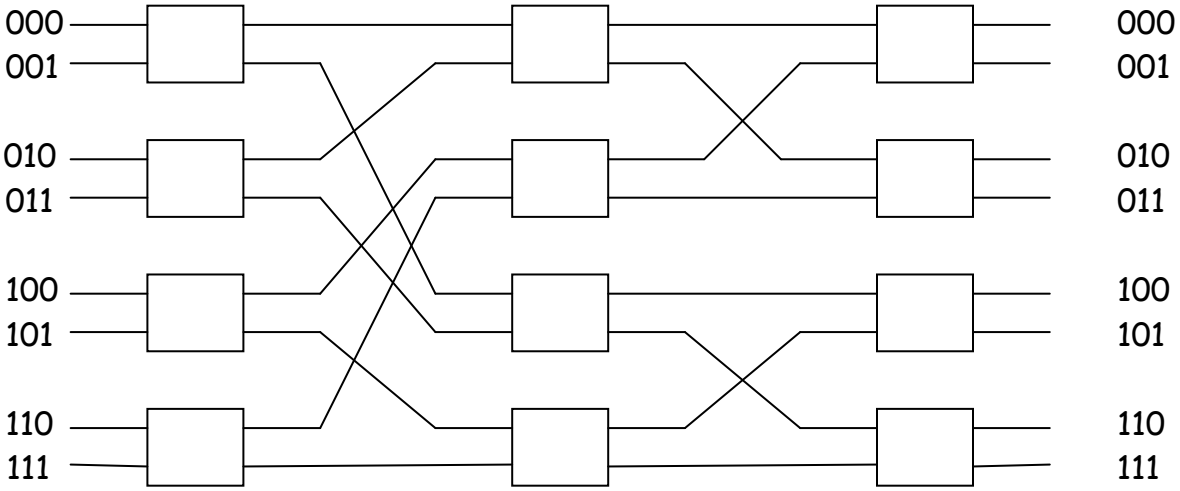
Shuffle $(x_{n-1}, x_{n-2}, \ldots\ldots x_1, x_0) = x_{n-2}\ldots\ldots x_1, x_0, x_{n-1}$

Exchange $(x_{n-1}, x_{n-2}, \ldots\ldots x_1, x_0) = x_{n-1}\ldots\ldots x_1, \overline{x_0}$

Meant for re-circulation until desired connection is achieved

BASE LINE NETWORK

* - Self-routing ability

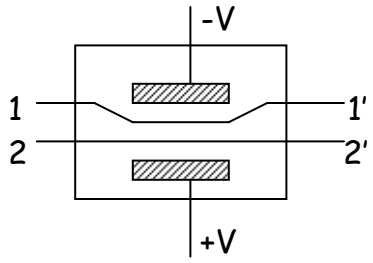


Self- routing based on address tags

For each stage we have a switching control defined by a bit position
Stage 1 (MSB) to Stage N(LSB)

Switchable for Pkt. Switch Networks

Self-routing optical networks are quite popular
(Use of CDMA Techniques for Self-routing)

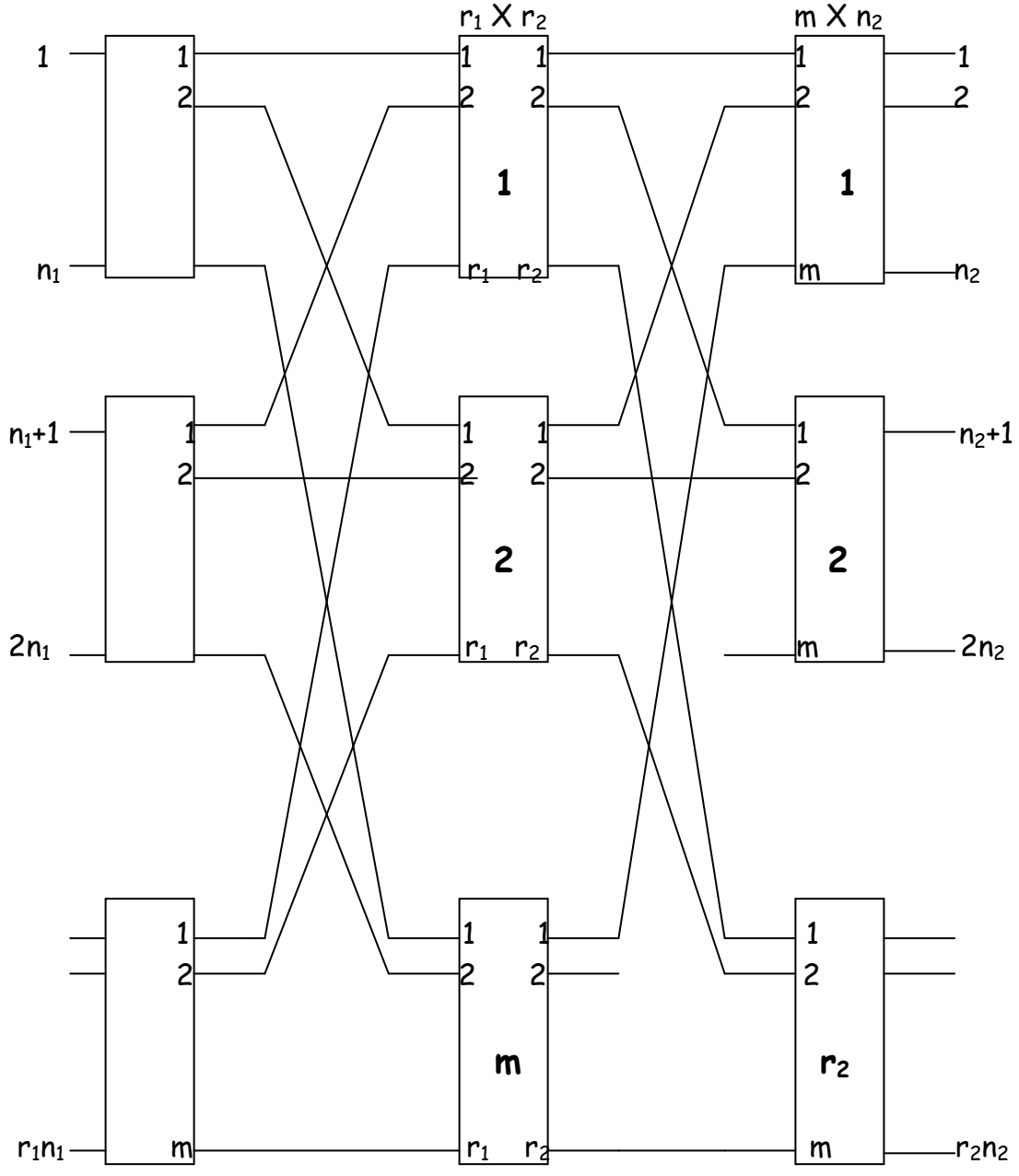


Destination :

0 ⟶ 1 ⟶ 0

0 – Up ; 1 - Down

CLOS NETWORK



- Any one input has a parth to any output

- Non- Blocking or not depends on the # of elements in the middle stage

Lemma : **Non-Blocking, if $m \geq n_2 + n_1 - 1$ where m is the # of middle Stage switching elements**