

CENG 505

Parallel Computing

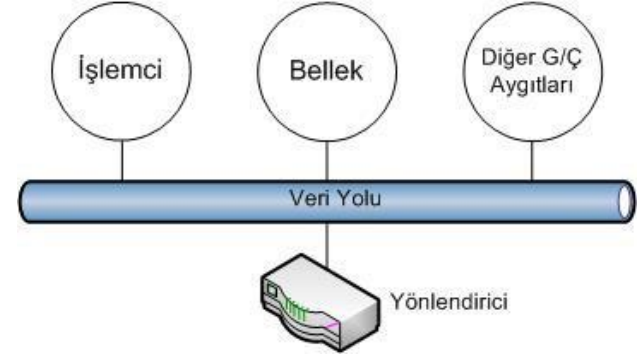
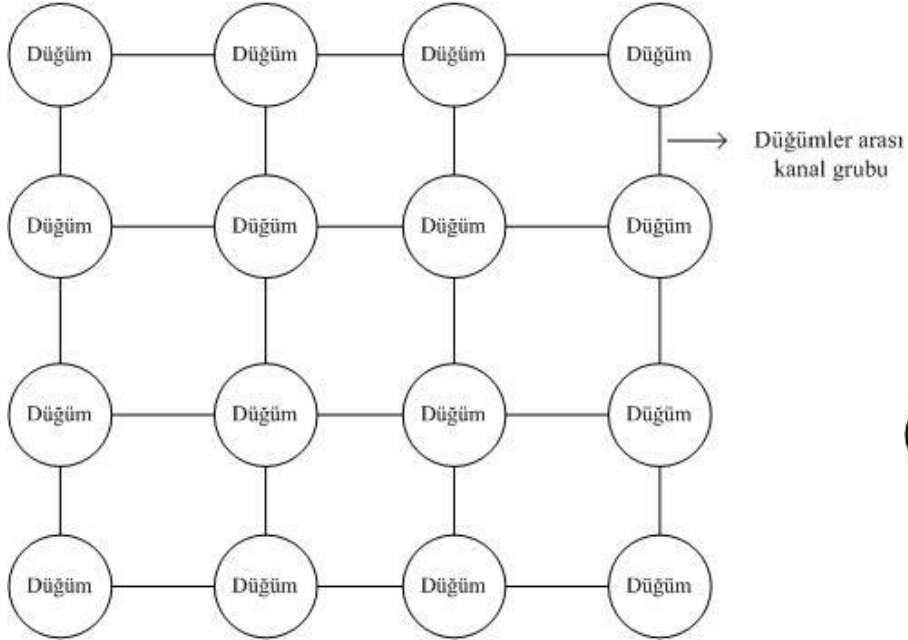
Lecture 6: Topologies

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ÇANKAYA ÜNİVERSİTESİ

Direct Networks



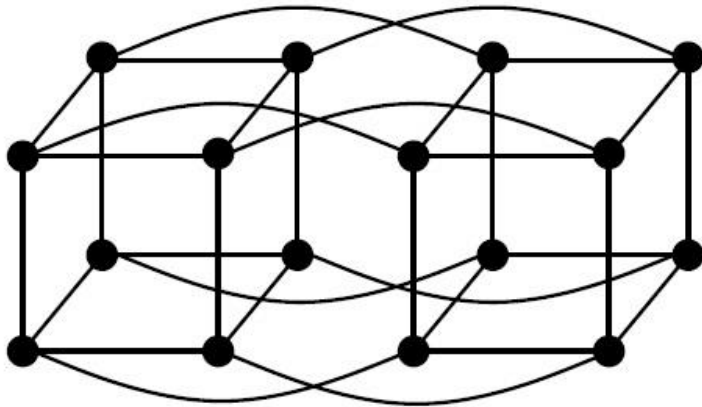
Direct Networks

- Direct Networks or Point-to-Point Networks are network models that include a high number of processors.
- Direct network-based parallel systems consist of the interconnection of subcomponents defined as **nodes**.
- In a direct network architecture, each node has a point-to-point or direct connection to a group of nodes around it.
- These nodes around the node are called adjacent nodes.
- Parallel computers implemented in the Direct Network architecture are programmed with the parallel programming model with **message passing**.
- Direct networks can be defined by a graph in the form of $G(N, C)$.
 - Vertices describe the set of handler nodes and the edges describe the set of communication channels between these nodes.

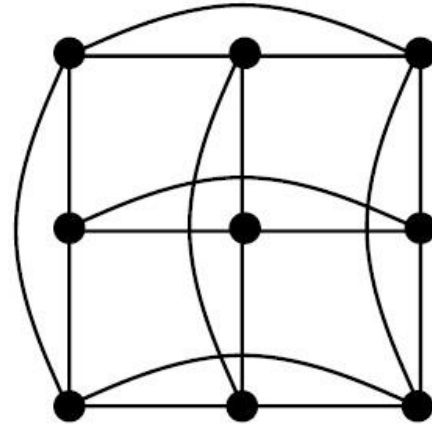
Direct Network Topologies

- Topology describes how to connect nodes within an interconnection network [Duato, 2002]
- For direct networks, the ideal topology is the network model in which all nodes are connected.
- k-ary n-cube topologies
- Mesh networks

k-ary n-cube topology



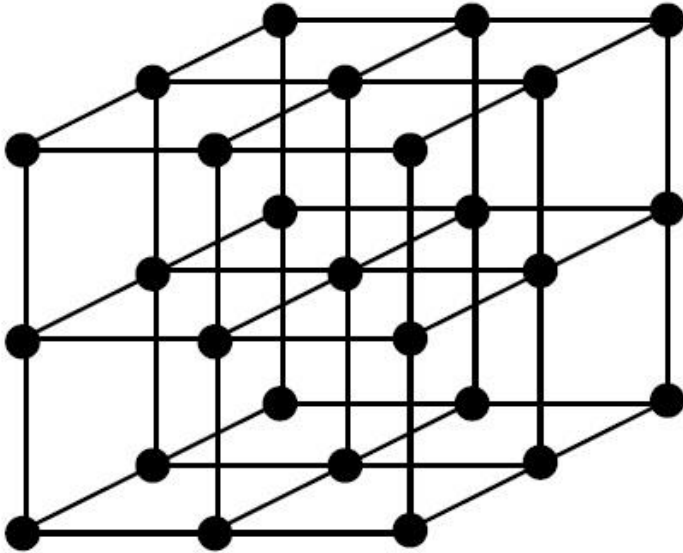
(a)



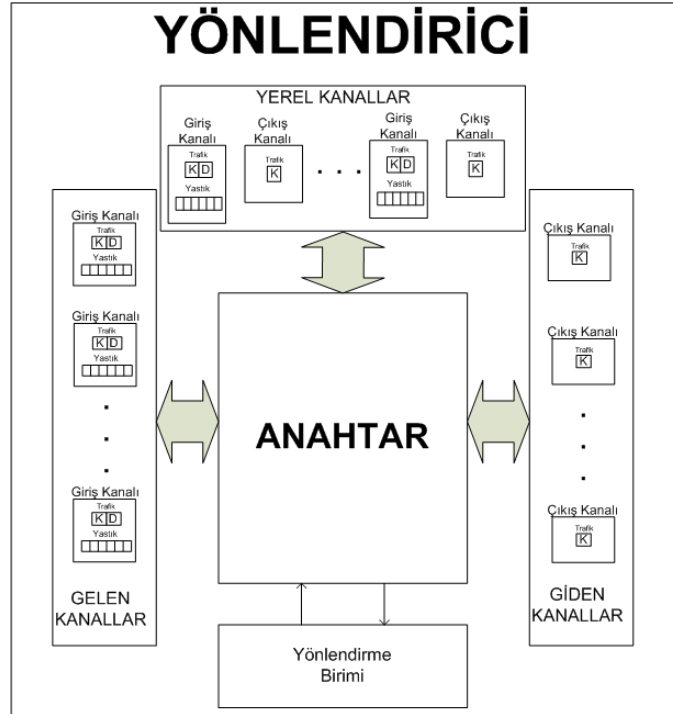
(b)

(a) 2-ary 4-cube, (b) 3-ary 2-cube [Duato, 2002]

Mesh Network



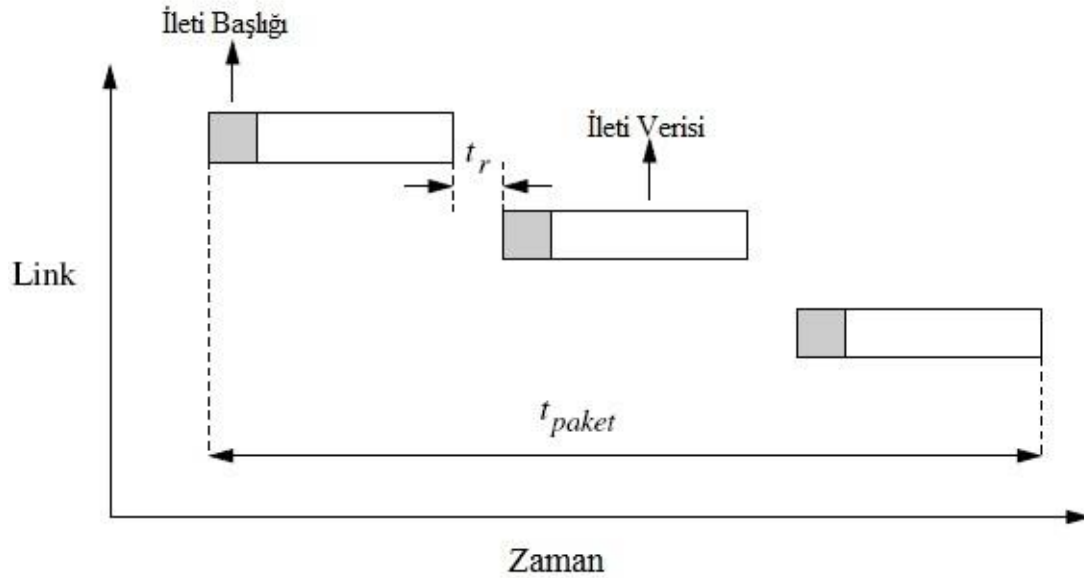
Direct Network



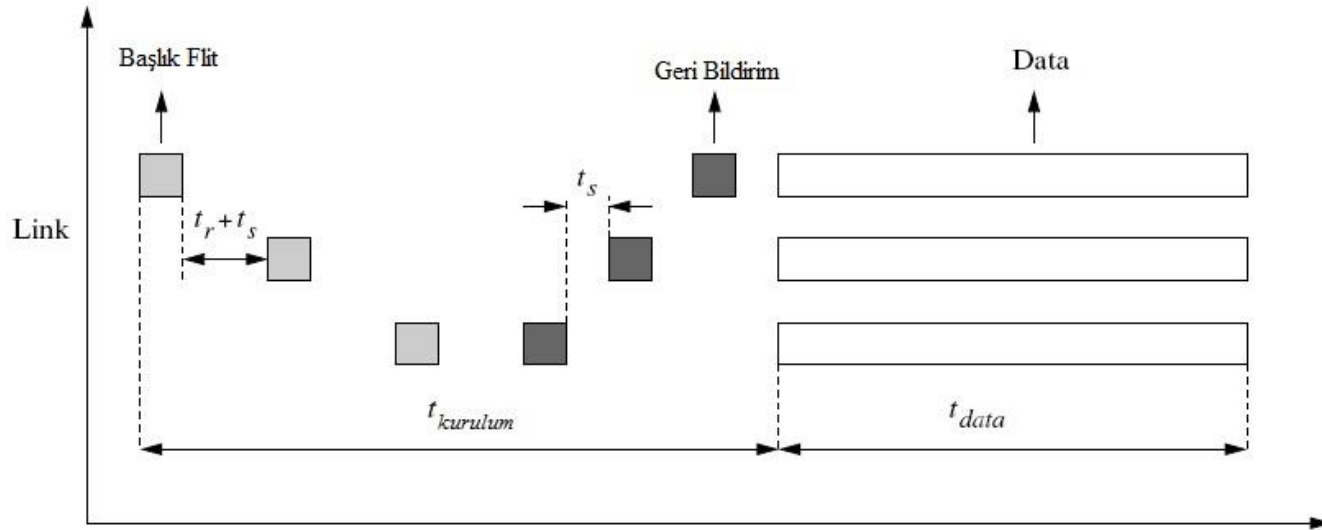
Direct Networks: Switching

- Packet Switching
- Circuit Switching
- Virtual Cut-through Switching
- Wormhole Switching

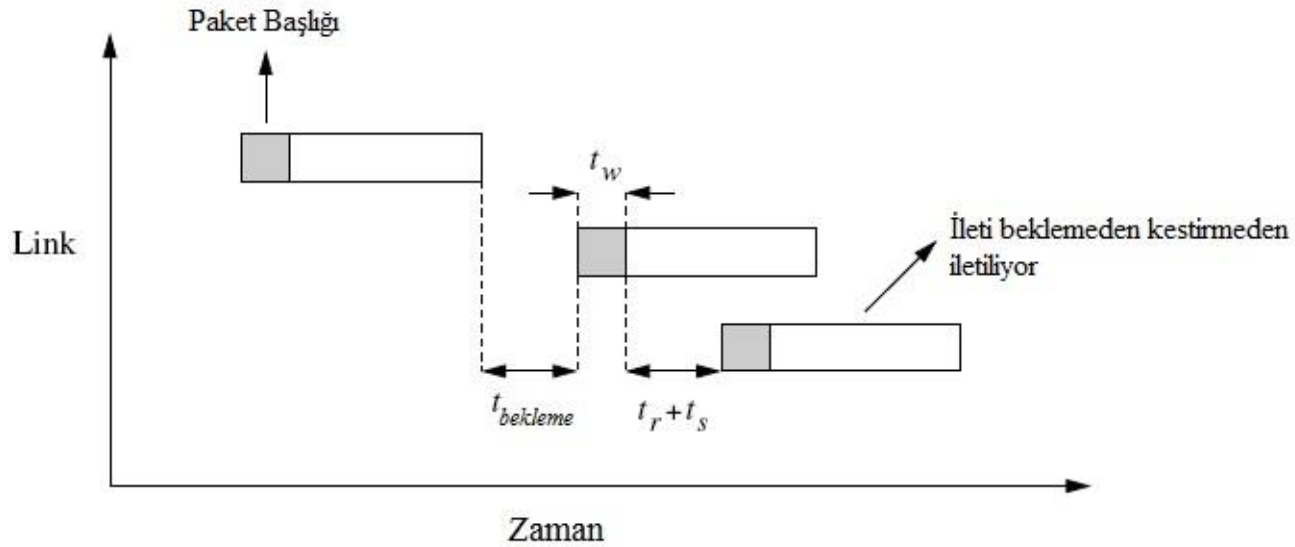
Packet Switching



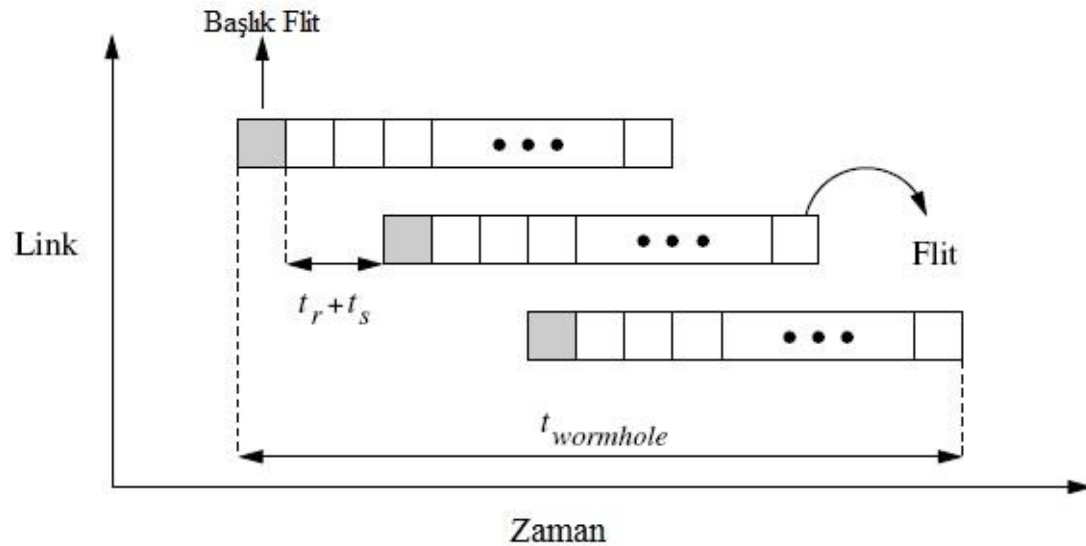
Circuit Switching



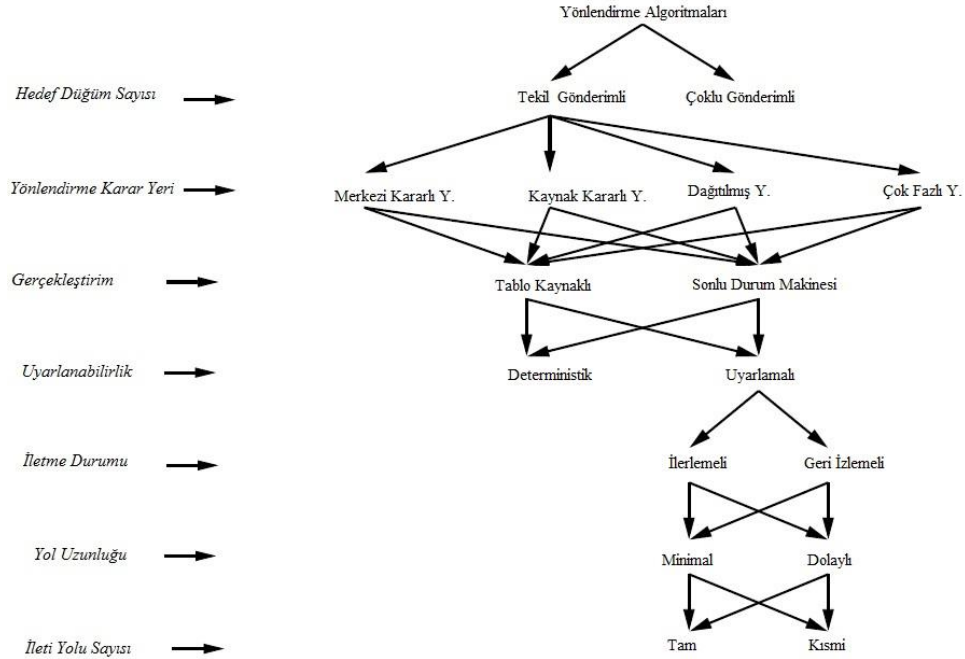
Virtual Cut-through Switching



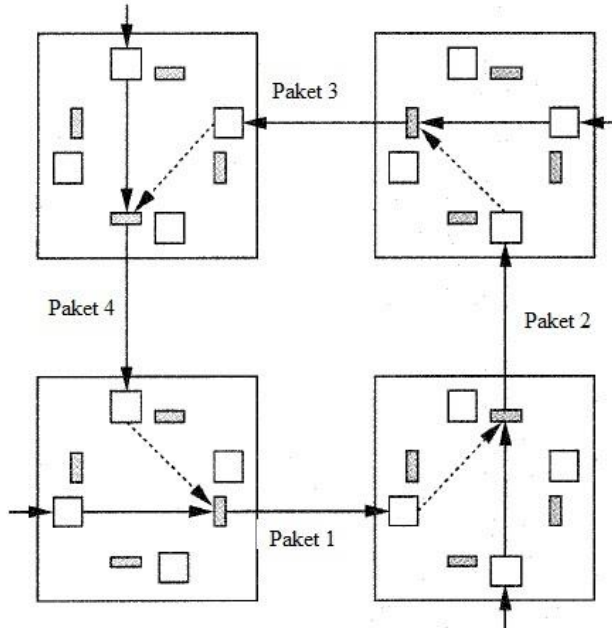
Wormhole Switching



Routing



Deadlock - Livelock



- A message is defined as **deadlock** when it holds the resource it needs.
- In the event of a **livelock**, the message travels in a cyclic motion in the network environment and cannot access the destination node that must be forwarded.

Flow Control - Credit based Flow Control

