Tutorial 7 - SS2017
Communication Systems and Protocols

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Task 1: Networks

Task 1.1: General Questions

A) Name the three components of a network on chip node in the basic setup and their respective task. 2

Network Interface: Mediating between Computing Unit and Network
Routing Unit: Embedded intelligence that decides on the direction of the data
Link : Physical communication channel between neighboring nodes. Computing Unit: Runs an application or part of an application

B) How do networks and busses differ from each other? 1

Bus: dedicated and fixed physical communication channel
Network: different and multiple communication channels are possible

C) Your task is to decide on which type of switching to be used in a network consisting of components in need of predictable latencies. Justify your decision. 1

Circuit Switching, easier to guarantee latency

D) Your task is to decide on which type of switching to be used in a network consisting of components that mainly communicate by streaming data, thus in need of high and guaranteed throughput. Justify your decision. 1

Task 1.2: Routing

Figure 1.1 shows a 4x4 meshed network with packet-switching communication.

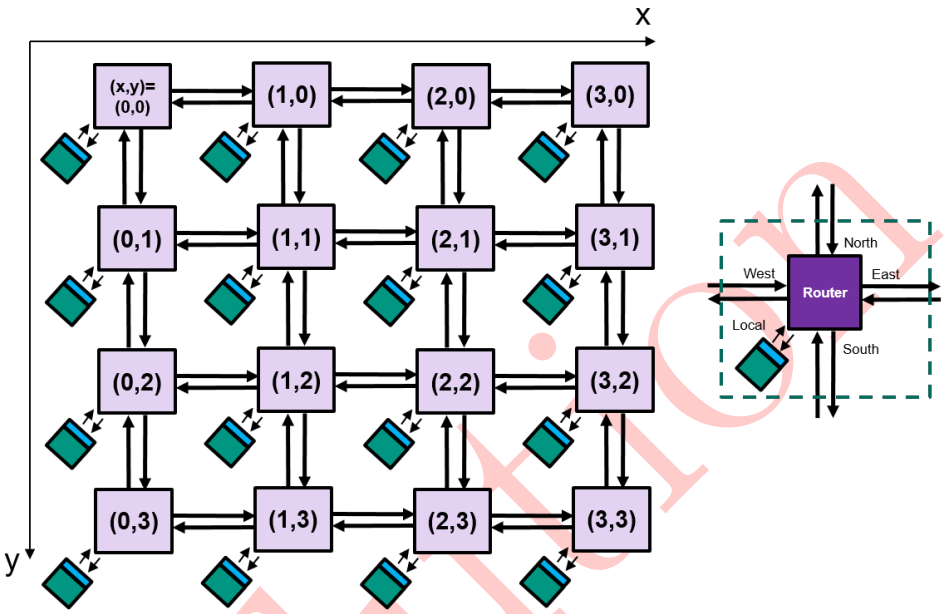

Figure 1.1: 4x4 meshed network

A) Which routers are passed by a packet sent from $(x, y) = (1, 0)$ to $(3, 3)$ using XY-Routing. Please provide the coordinates of the passed router in the order given by the transmission process. **1**

$(1,0)$, $(2,0)$, $(3,0)$, $(3,1)$, $(3,2)$, $(3,3)$

B) The routers $(1, 0)$ and $(2, 1)$ are experiencing heavy traffic towards their east port, such that packets have to wait before being forwarded. As an alternative "hot potato XY-Routing" is used. If a port is occupied the opposite dimension is used, so in case of X towards Y and in case of Y towards X. If no heavy traffic is present common XY Routing is used. Which routers are passed by a packet sent from $(x, y) = (1, 0)$ to $(3, 3)$ for that routing? **1**

$(1,0)$, $(1,1)$, $(2,1)$, $(2,2)$, $(3,2)$, $(3,3)$

C) Which classes of routing algorithms is hot potato XY-Routing associated with? **1**

Adaptive Routing: Since Ports are used depending on Traffic in Routers
Distributed Routing : Routing computations is done in the nodes Non-Minimal Routing: New routes can lead to non-minimal detours

D) Describe two scenarios: one in which common XY Routing is preferable and one in which "hot potato XY Routing". **2**

Balanced network traffic XY Routing will find the shortest Path
If heavy traffic is present at certain ports, hot potato XY can reduce the latency

E) Instead of XY-Routing, Flooding is considered for the given network. How many times is a packet forwarded when flooding is used, with router $(1, 0)$ being the origin and router $(2, 2)$ the destination? **2**

$4 \cdot 1 + 7 \cdot 2 + 3 \cdot 3 + 3 = 30$

F) How many times is a packet forwarded by routers, using Flooding with a time to live of 2, when router $(1, 0)$ is the origin and router $(2, 2)$ the destination? **1**

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G) What is the minimal time to live for a packet sent by router $(1, 0)$ to reach router $(2, 2)$? **1**

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Task 2: Dijkstra

In Figure 2.1 you can see a network of six nodes (A..F). The nodes each have a different number of ports, numbered from #1 to #4. Each connection between the tiles is annotated with the communication cost. Your task is to generate the routing tables for the individual nodes.

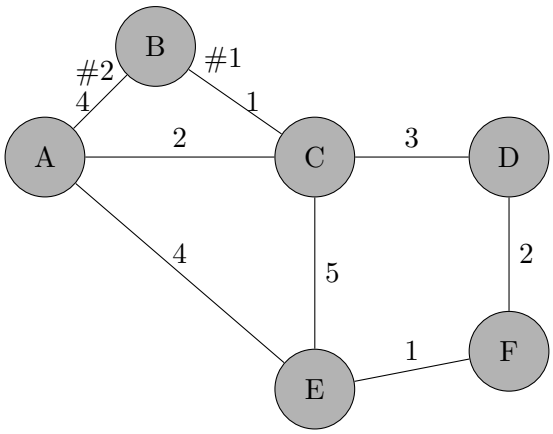

Figure 2.1: Given network topology

A) Determine the shortest path from node B to all other nodes using the Dijkstra-Algorithm. Make use of the tables 2.2 and 2.3. 5

B) Use the results from the previous task to generate the routing table of node B. 5

Destination	Port #
A	#1
B	-
C	#1
D	#1
E	#1
F	#1

Table 2.1: routing table of node B

node	step 1 **B**		step 2		step 3		step 4		step 5	
vertex	dist.	pred.	dist.	pred.	dist.	pred.	dist.	pred.	dist.	pred.
A	∞	-	4	B	3	C	3	C	3	C
B	∞	B	0	B	0	B	0	B	0	B
C	∞	-	1	B	1	B	1	B	1	B
D	∞	-	∞	-	4	C	4	C	4	C
E	∞	-	∞	-	6	C	6	C	6	C
F	∞	-	∞	-	∞	-	∞	-	6	D

Table 2.2: Dijkstra algorithm

node	step 6		step 7	
vertex	dist.	pred.	dist.	pred.
A	3	C	3	C
B	0	B	0	B
C	1	B	1	B
D	4	C	4	C
E	6	C	6	C
F	6	D	6	D

Table 2.3: Dijkstra algorithm