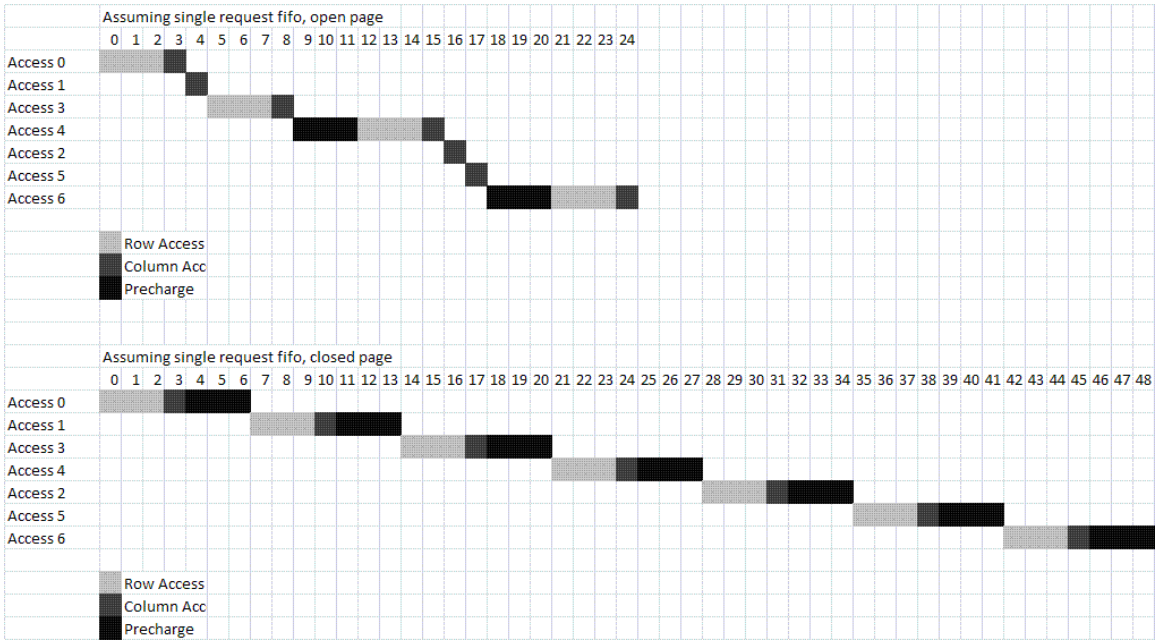
Problem 1 Solution

Current state	Local Read	Local Write	Local Eviction	Bus Read	Bus Write	Bus Upgrade	Bus Data
I	Issue bus read, if no sharers then s' = IE, else s' = IS	Issue bus write, s'=IM	S'=I	Do nothing	Do nothing	Do nothing	Error
IS	Stall	Stall	Stall	NAK	NAK	NAK	s'=S
IE	Stall	Stall	Stall	NAK	NAK	NAK	s'=E
IM	Stall	Stall	Stall	NAK	NAK	NAK	s'=M
S	Do nothing	Isssue bus upgrade, s'=M	s'=I	Respond shared	s'=I	s'=I	Error
E	Do nothing	s'=M	s'=I	Respond shared s'=S	s'=I	Error	Error
M	Do nothing	Do nothing	Write data back; s'=I	Respond dirty; Write data back; s'=MS	Respond dirty; Write data back; s'=MI	Error	Error
MI	Do nothing	Stall	Stall	NAK	NAK	NAK	s'=I
MS	Do nothing	Stall	Stall	NAK	NAK	NAK	s'=S

Problem 2 Solution

Step	Bus Event	Req Proc	P0 State	P1 State	P2 State
0 (Test)	BR	P0	E	I	I
1 (test 2)	none	P0	E	I	I
2 (set)	none	P0	M	I	I
3 (test)	BR	P1	S	S	I
4 (test)	BR	P2	S	S	S
5 (release)	BU	P0	M	I	I
6 (test)	BR	P1	S	S	I
7 (test 2)	none	P1	S	S	I
8 (set)	BU	P1	I	M	I
9 (test)	BR	P2	I	S	S
10 (release)	none	P1	I	M	I
11 (test)	BR	P2	I	S	S
12 (test2)	none	P2	I	S	S
13 (set)	BU	P2	I	I	M
14 (release)	none	P2	I	I	M

Problem 3



Problem 4

For each topology, a different number of wires are usable for single core-core communication.

For the mesh, the 256 wires are divided up into 64 in each direction (North,East,South,West) and of these 64 wires, 32 are dedicated in each direction.

For the crossbar, since the switching logic is buried in the interconnect, 128 bits are available for transmission, and 128 are used for received data at each node.

For the ring, 128 bits are used for communication with each side. And since it is bidirectional, 64 bits are available for transmission/reception.

The average # of hops to be traversed on a mesh network is 2.667.
The average # of hops to be traversed on a bidirectional ring (assuming minimum distance traveled) is 4.2667.

Mesh Latency

1024/32 = 32 flits per packet

Zero-Load Latency = 32*0.5ns + 2.667*(6ns+0.5ns) = 33.34ns

Ring Latency

1024/64 = 16 flits per packet

Zero-Load Latency = 16*0.5ns + 4.2667*(6+0.5ns) = 35.7 ns

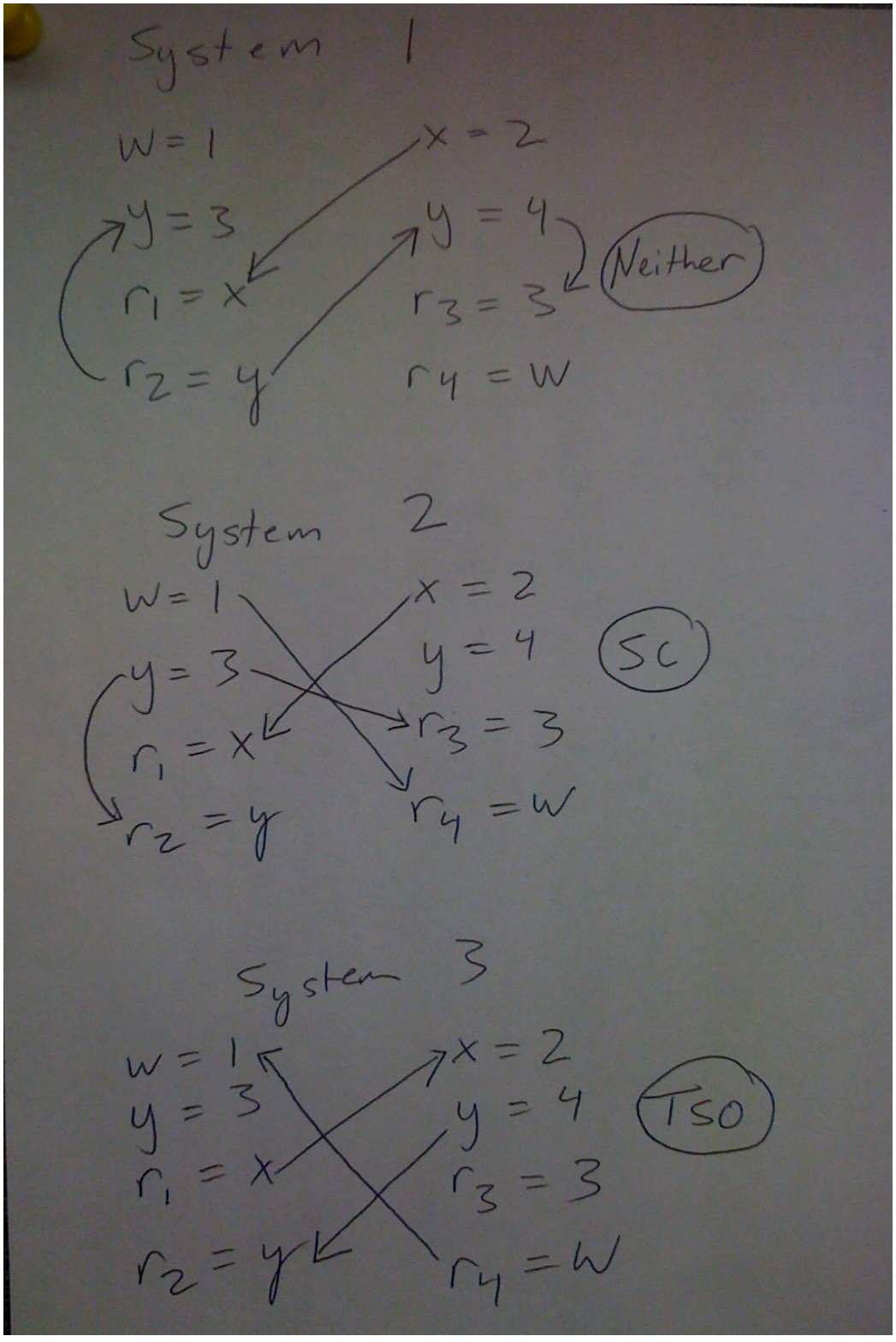
Crossbar Latency

1024/128 = 8 flits per packet

Zero-Load Latency = 8*0.5ns + 2.667*0.5ns = 5.33ns

Note: This solution did not assume processing time at the source/destinations additionally, but that is also acceptable and only adds a constant amount of time to each answer.

Problem 5


System 1
w = 1
x = 2
y = 3
y = 4
r1 = x
r3 = 3
r2 = y
r4 = w
Neither
System 2
w = 1
x = 2
y = 3
y = 4
r1 = x
r3 = 3
r2 = y
r4 = w
SC
System 3
w = 1
x = 2
y = 3
y = 4
r1 = x
r3 = 3
r2 = y
r4 = w
TSO