HIGH PERFORMANCE COMPUTER ARCHITECTURE 27-11-2023 MATRICULATION NO._____

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FIRST NAME_____

Consider a bus-based multicore that supports a new cache-coherence protocol called MOESI. Compared to the well-known MESI protocol, the MOESI protocol adds a 5th state called O (Owned). A copy in O state is like a SM copy in Dragon: the owned copy is modified and the "owner cache" has the responsibility to provide the copy once a BusRd transaction involves that copy; at the same time, the M state is now simplified, as it doesn't have to update memory on Flush (only Flush* transactions appear in this protocol). A copy enters the O state if another cache needs a copy (for reading) while that copy is in M state; on a local read, local write or other bus transactions, the O copy behaves like an S copy.

1a) [Points 8/30] Draw the diagram of the MESIF protocol according to the above description.

1b) [Points 22/30] Assuming a cost of 1cc (1 clock-cycle) for read/write operations, 90cc for BusRd or BusRdx transactions, 60cc for BusUpgr, 20 cc for Flush* and 30cc for Flush. Evaluate the total cost (in clock-cycles) for the following streams:

stream-1 MOESI

Core Operation	C1	C2	C3	Bus Transaction	Data from	Cycles
PrRd1						
PrWr1						
PrRd1						
PrWr1						
PrRd2						
PrWr2						
PrRd2						
PrWr2						
PrRd3						
PrWr3						
PrRd3						
PrWr3						
TOTAL						

stream-2 MOESI

Core Operation	C1	C2	C3	Bus Transaction	Data from	Cycles
PrRd1						
PrRd2						
PrRd3						
PrWr1						
PrWr2						
PrWr3						
PrRd1						
PrRd2						
PrRd3						
PrWr3						
PrWr1						
TOTAL						

stream-3 MOESI

Core Operation	C1	C2	C3	Bus Transaction	Data from	Cycles
PrRd1						
PrRd2						
PrRd3						
PrRd3						
PrWr1						
PrWr1						
PrWr1						
PrWr1						
PrWr2						
PrWr3						
TOTAL						