EECS578 – Prof. Bertacco
Fall 2015

Homework Quiz #1
Assigned: 9/27/2015 − Due: 10/2/2015

Name: _____ uniqname: _____

Paper: "Functional Correctness for CMP Interconnects" by R. Abdel-Khalek, R. Parikh, A. DeOrio, V. Bertacco, ICCD '11

Question 1 (2pts each). For each sentence, write "T" if it is true, or "F" if false.
(a) ____: SafeNoC can detect transient faults occurring in the primary network.
(b) ____: A signature for a packet is always different from that for other packets.
(c) ____: Signature calculations increase the average packet latency even when no error happens.
(d) ____: The proposed 5-step recovery process involves both hardware and software.

Question 2 (4pts). In a 4x4 mesh network with a uniformly random traffic, what is the average hop count (H) for signatures in the checker network? Choose the correct range for H.
☐ a. $0 \leq H < 4$
☐ b. $4 \leq H < 8$
☐ c. $8 \leq H < 12$
☐ d. $H \geq 12$

Question 3 (1pt each). When can a false error detection (*i.e.*, a false positive) occur? Choose all that apply.
☐ a. When delivery of a data packet in the primary network is significantly delayed.
☐ b. When delivery of a signature in the checker network is significantly delayed.
☐ c. When a data packet is corrupted.
☐ d. When a data packet is dropped.

Question 4 (1pt each). What type(s) of functional errors can SafeNoC detect? Choose all that apply.
☐ a. Deadlock.
☐ b. Livelock.
☐ c. Packet drop.
☐ d. Packet reordering in a system with deterministic routing (*i.e.*, a packet is delivered before another packet that was transmitted before it).

Paper: "Formally Enhanced Runtime Verification to Ensure NoC Functional Correctness" by R. Parikh and V. Bertacco, MICRO '11

Question 1 (2pts each). For each sentence, write "T" if it is true, or "F" if false.
(a) ____: The correctness of an NoC is easily verifiable if it has a regular topology.
(b) ____: ForEVeR formally verifies the operation of an entire network-on-chip unit.
(c) ____: The checker network performs signature matching to verify the integrity of packets.
(d) ____: Recovery from a functional bug usually takes a few thousand clock cycles.

Question 2 (1pt each). Which of the following is a goal of formal verification in ensuring the correctness of a **router**? Choose all that apply.
☐ a. A packet should not be duplicated.
☐ b. A packet should not be dropped.
☐ c. The delivery of a packet should be completed in a certain amount of time.
☐ d. The data of a packet should not be corrupted.

Question 3 (1pt each). Which of the statements below is correct about the use of counters in ForEVeR? Choose all that apply.
☐ a. A counter is increased when the router receives a notification packet.
☐ b. A counter is decreased when the router sends a notification packet.
☐ c. A counter's value is compared with zero at the end of every epoch.
☐ d. A counter's value indicates the expected number of packets at each destination.

Question 4 (1pt each). Which one is correct about ForEVeR's detection accuracy? Choose all that apply.
☐ a. False positives decrease as the check-epoch size increases.
☐ b. False negatives increase as the check-epoch size increases.
☐ c. A long check-epoch helps more in reducing false positives when the network is subjected to a high injection rate than when to a low injection rate.
☐ d. Detection latency increases as the check-epoch size increases.

Paper: "Brisk and Limited-Impact NoC Routing Reconfiguration" by D. Lee, R. Parikh and V. Bertacco, DATE '14

Question 1 (2pts each). For each sentence, write "T" if it is true, or "F" if false.
(a) ____: The proposed reconfiguration process is used to recover from transient faults.
(b) ____: For a fault-free 8x8 mesh, spanning segments in a breadth-first search (BFS) fashion with a root node at the corner of the mesh results in more than 49 segments.
(c) ____: If we do not apply the segmentation algorithm after each fault occurrence, in the best case scenario, BLINC can sustain one fault for each segment in the network.
(d) ____: BLINC uses a dedicated virtual channel to recover from deadlocks.

Question 2 (1pt each). Which one is correct about routing metadata? Choose all that apply.
☐ a. Port types (parent, child and intra-segment) are assigned based on the hierarchical tree for the segmented network.
☐ b. Each entry of the preference list indicates which input port is preferable to others.
☐ c. For a 10x10 mesh, each router requires 400 bits to store children sets.
☐ d. Routing metadata is generated through a software computation (*i.e.*, not in hardware).

Question 3 (1pt each). Which one is correct about the proposed online reconfiguration process? Choose all that apply.
☐ a. The process enables emergency routes, and disables invalid routes from routing tables.
☐ b. The reconfiguration process always impacts all routers in the network.
☐ c. The emergency routes are often non-minimal and thus non-optimal.
☐ d. Reconfiguration messages are delivered via a dedicated recovery network.

Question 4 (1pt each). Which one is correct about the application of BLINC that is discussed in Section IV-B of the paper ("Uninterrupted Availability with BLINC")? Choose all that apply.
☐ a. BLINC minimally increases packet latency even with an extremely aggressive testing scenario (*e.g.*, 100% testing rate) compared to the "Stall" solution described in the paper.
☐ b. BLINC can deliver packets even using links that are currently changing their routing metadata during reconfiguration.
☐ c. The goal of the aggressive testing is to predict upcoming faults in advance of their occurrence.
☐ d. The proposed aggressive testing switches routers off, one router at a time.

Paper: "ARIADNE: Agnostic Reconfiguration In A Disconnected Network Environment" by K. Aisopos, A. DeOrio, L.-S. Peh and V. Bertacco, PACT '11

Question 1 (2pts each). For each sentence, write "T" if it is true, or "F" if false.
(a) ____: Upon detection of a fault occurrence, a controller that monitors all network components triggers a routing reconfiguration.
(b) ____: ARIADNE uses logic-based route-computation hardware, but not routing tables.
(c) ____: ARIADNE allows only one output direction for a packet.
(d) ____: A root node is more likely to experience traffic congestion than a leaf node.

Question 2 (4pts). How long does ARIADNE take to reconfigure a 4x4 mesh network? Choose one.
☐ a. 16 cycles.
☐ b. 64 cycles.
☐ c. 256 cycles.
☐ d. 1024 cycles.

Question 3 (4pts). How does ARIADNE synchronize the transmission of flags during reconfiguration? Choose the option that best describes the process.
☐ a. A centralized controller arbitrates the order of flag transmission, allowing only one node at a time.
☐ b. Nodes are activated one-by-one, by increasing index order. (*i.e.*, Node 0 notifies its completion of transmission to node 1, node 1 notifies to node 2, etc.)
☐ c. Each node waits for its turn based on a global cycle counter.
☐ d. A node that detects a fault occurrence immediately starts broadcasting flags, notifying its neighbor node upon broadcasting completion, then the neighbor node starts broadcasting flags, etc.

Question 4 (1pt each). Which of the following route is **NOT** allowed? Choose all that apply.
☐ a. A route from a "down" link to a "down" link.
☐ b. A route from a "down" link to an "up" link.
☐ c. A route from an "up" link to a "down" link.
☐ d. A route from an "up" link to an "up" link.