Net3006A Network Management and Measurements (Winter 2025)

Assignment 1 (covering Lectures 2, 3 and 4) **–** Due by 11:59pm, Jan. 31

Please submit **a single PDF file** on Brightspace ("Tools/Assignments/Assignment 1")

Q1. [0.8 Points] Answer the following questions in one or two sentences.

a. Why is a network's status time-varying? You can explain with an example if that helps.

Network status is time-varying as outside conditions, performance of hardware and more would change over time.

b. What is a "content provider network"?

Private network that connects data centers to the internet.

c. Briefly explain what a management information base (MIB) is.

Conceptual data store that contains a management view of the device being managed.

d. What are the benefits of having a distributed network management system?

1. Scalable
2. Robust (If one fails, NMS still runs)
3. Delay and overhead – Can manage from a location close to a local network

Q2. [0.8 Points] Answer True or False for each of the statements below and briefly explain why in one or two sentences.

a. A network equipment (i.e., managed device) can have multiple management interfaces.

True as a network device can have multiple agents for different functions for management.

b. High end-to-end throughput implies low end-to-end delay.

False because even if there is a high throughput, factors such as congestion and a long distance of the connection between nodes will create a delay.

c. The "configuration management" as defined by the International Standards Organization is a concern of network provisioning and network operations, but not network administration or network maintenance

False as configuration management also involves network administration and maintenance with regards to tracking, managing and updating network configuration.

d. A network device cannot play an agent role and a manager role at the same time.

False , a network device is able to play both roles at the same time if it is acting as a management proxy

Q3. [0.4 Points] Suppose that the maximum packet *departure rate* of a router (determined by how fast it can process packets) is w packets/second, which includes every packet it can send out (aggregated over all outbound links) in a second. Consider two types of packet arrival with the same aggregated packet *arrival rate* from all inbound links is v packets/second (where $v < w$): deterministic periodical arrival and (possibly bursty) random arrival. Given an empty queue at the beginning, which arrival type will yield a smaller maximum queueing delay among all arriving packets? Why? (Note: in the case of random arrival, you can consider v as the aggregated packet arrival rate averaged over time).

Periodic:

- Yields smaller maximum queuing delay as packets arrive in equal intervals
- Allows router to process these packets without causing a buildup

Q4. [1 Point]. Consider two hosts, A and B, connected by a single link of rate R kbits/second (kbps). Suppose that the two hosts are separated by m meters, and the propagation speed along the link is s meters/second (m/s). Host A is to send a packet of size L bits to Host B.

a. Express the propagation delay, d_{prop}, in terms of m and s.
   - $d_{prop} = \frac{m}{s}$

b. Determine the transmission time of the packet, d_{trans}, in term of L and R.
   - $d_{trans} = \frac{L}{R}$

c. Suppose Host A begins to transmit the packet at time $t = 0$. At time $t = d_{trans}$, where is the last bit of the packet?
   - Last bit was just transmitted from host A, and hasn't arrived to host B yet.

d. Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?
   - At time $t = d_{trans}$, the first bit will still be in transit between host A and B

e. Suppose $s = 2.5 \times 10^8$ m/s, $L = 120$ bits, and R = 56 kbps. Find the distance m so that d_{prop} equals d_{trans}.

   $d_{prop} = \frac{m}{s}$ And $d_{trans} = \frac{L}{R}$ → Expression for m so that $d_{prop} = d_{trans}$ is $m = s * \frac{L}{R}$

Q5. [1 Point]. Compare in-band and out-of-band (OOB) management networks and answer the following questions.

a. [0.3 points] What are the pros and cons of an OOB manage network?

Pros:

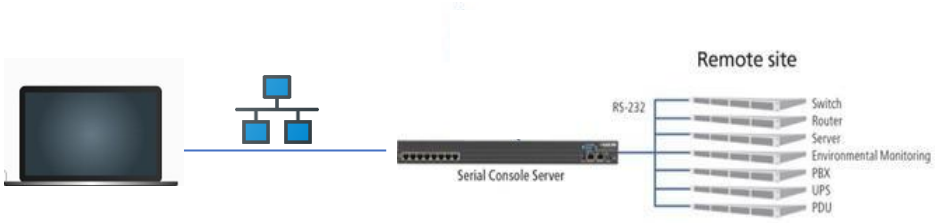
- Reliability as production and management traffic is separated
- Quality of service (QoS)

Cons:

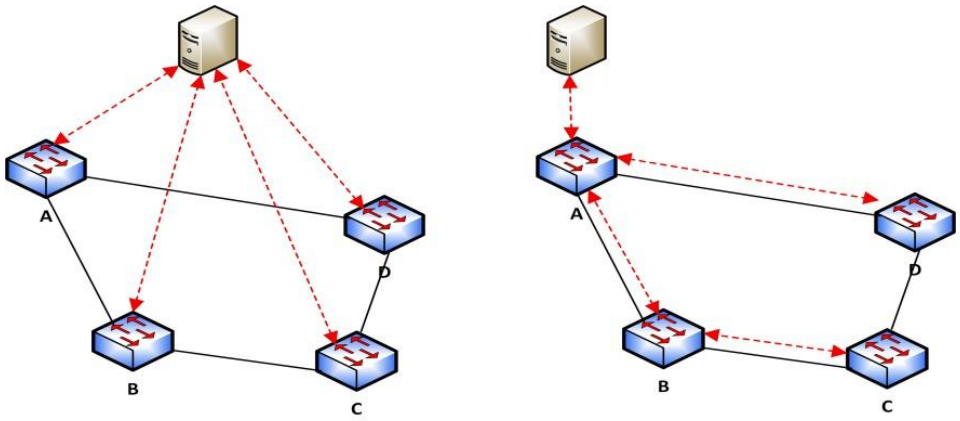
- More Expensive
- Difficult to implement at scale

b. [0.2 points] Would you consider the management network below in-band or OOB?

In-band as the main device being used for configuration is connecting to all the devices on the site remotely via a server.



c. [0.3 points] Software-defined networking (SDN) is a relatively new technology that aims to make a network more flexible and configurable. In a conventional network, each router makes its routing tables locally based on information from and interactions with other routers. In SDN, every switch needs to have a logical connection with an SND controller, which collects global information and makes routing decisions for all routers. The logical connections can be made in either an in-band or an OOB manner, as illustrated below using red dashed lines with arrowheads. Discuss what would be the impact on the logical connections if router A fails in the in-band and the OOB cases, respectively.



Out-of-band Controller Architecture

In-band Controller Architecture

In-band:

- Routers B, C and D would not be accessible from the SDN controller meaning they won't know specific routes.

OOB:

- There would be no impact as each router is capable of receiving updates from the SDN controller so only router A would not not receive updates from the controller.

d. [0.2 points] If we must use the in-band approach to implement SDN, can you think of an idea to reduce the impact on other nodes when a single node failure as described in sub-question c happens? Here, instead of the small network in the figure, consider a practical network in which at least several nodes can directly connect to the controller.

One could counteract a single node failure by implementing more router's that would do the same job as router A connected to the same controller to provide a form of resiliency.