

# Spring 2014 Networking Area Qualifying Examination

## Computer Sciences, UW-Madison

### **A. Congestion Control Techniques**

TCP is the dominant protocol in the Internet that provides suitable congestion control for end-to-end flows.

- 1) Describe three factors that determine the end-to-end throughput of a single TCP flow, and explain how each factor potential impacts the actual throughput.
- 2) TCP is not considered suitable for paths with wireless hops. Explain why.
- 3) Describe one technique that can improve TCP's performance over paths with wireless hops.

### **B. Internet Architecture**

1) The core architectural decisions for today's Internet was formulated with the aim to connect heterogeneous networks in a federated fashion. The design was done in an era prior to commercial interests that prevail in the Internet today. Describe three design decisions of the core Internet architecture that seem incompatible with the current use cases of the Internet. Explain why you think they are incompatible.

2) Consider three hosts A, B, and C that are connected to different ISPs and Autonomous Systems and the three IP-level paths A-B, B-C, and A-C. (By IP level paths we mean the path that would be taken by IP traffic sent from a source to the destination.)

Do you think triangle inequality is violated on the Internet, i.e., can the latency of the A-C path be higher than the sum of the latencies of the A-B and B-C paths. If yes, explain why? If no, explain why it is unlikely.

3) There are two alternatives for sharing the same content from one source to many destinations --- IP-layer multicast and overlay multicast.

What are the advantages of overlay multicast when compared to IP-layer multicast.

### **C. Mobility in the Internet**

1) What aspect of current TCP/IP design limits seamless mobility in the Internet.

2) Describe one network-layer technique through which seamless mobility in the Internet can be implemented.

3) Ad-hoc routing protocols such as DSR and AODV was designed under the assumption that all nodes are mobile. Describe fundamental ways in which routing protocols in the static Internet is different from the routing methods adopted by such ad-hoc routing protocols.

#### **D. Availability in Packet Switched Networks**

Network availability is the notion that an infrastructure will provide a specified level of service over a specified period of time. Ensuring network availability is the number one priority of service providers.

1) Describe fundamental features of packet switched networks that enable intrinsic robustness and describe why these mechanisms are typically insufficient to achieve typical availability goals of service providers.

2) Give three examples of threats to network availability that pose significant challenges in day-to-day operations.

3) Give three examples of strategies that can be used by service providers to improve availability in their networks.

#### **E. Denial of Service Attacks**

There are a wide variety of threats in the Internet but few have had the longevity of denial of service (DoS) attacks. In the past year, there have been reports of major institutions being hit by DoS attacks, which have had a serious impact on their operations.

1) Describe the basic mechanisms of DoS attacks and strategies used to perpetrate attacks at scale.

2) Give three examples of how DoS attacks can be mitigated.

3) Are DoS attacks always going to be a threat in the Internet? Why or why not?

#### **F. Hypertext Transfer Protocol**

The original 0.9 version of the Hypertext Transfer Protocol (HTTP) was developed by Berners-Lee in the late 1980's. Since then, the protocol has been updated several times and there is now a 2.0 version under development.

1) Describe the basic mechanisms of HTTP. Given two strengths and weaknesses of the protocol.

2) Give three examples of how HTTP v0.9/v1.0 was enhanced in v1.1 which is now the most widely used version of the protocol.

3) Give two examples of how HTTP might be enhanced in future versions of the protocol.