

ECE/CS 4984: Wireless Networks and Mobile Systems

Take Home Midterm Exam

Examination

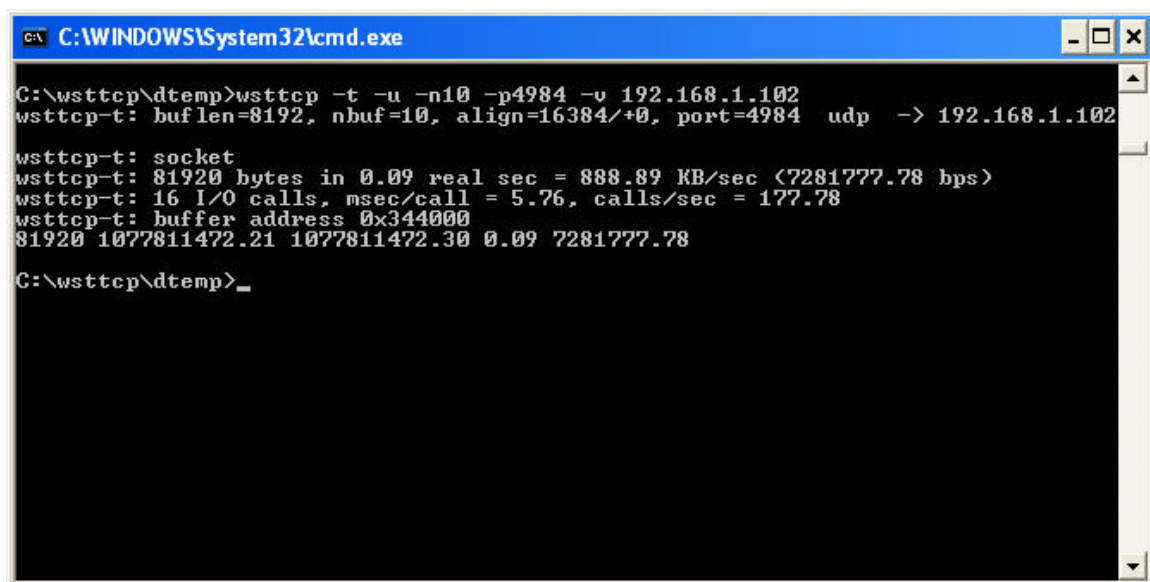
There are six questions in total. The point value of each is specified. The total number of points is 100.

Please adhere to the following instructions in preparing your answers.

- Your answers must be specific and precise.
- Your answers should be clearly numbered, neat, easily read, presented in order, and concise, but complete.
- You must adhere to any stated page limits. Text beyond the specified limit may be ignored.
- Use an 11-point font or larger for all text. Use 1-inch margins. You may use single or double spacing.
- Partial credit may be given, but can only be given if your work is shown clearly.

Three supplemental files, `observer_trace.txt`, `TemperatureService.wsdl`, and `projector-scpd.xml` are provided.

1. [30 points] File *observer_trace.txt* contains a trace, captured with Observer™, of 802.11b frames exchanged between a wireless station (WS) and an access point (AP). Analyze the trace to answer the following questions.
- (a) What is the SSID of this infrastructure-based WLAN? Provide the packet number in which the WS first learns this SSID. Is the SSID encrypted when sent by the AP?
 - (b) What is the MAC address of the WS? Of the AP?
 - (c) Authentication is done using a shared key. Identify the number of the packet in which the AP issues the challenge for authentication.
 - (d) Consider packet 56. Who is sending that frame, and what information does it convey?
 - (e) The following are some of the events that can be observed in this trace. Order the events in the order in which they appear in the trace and list the number(s) of one or more packets associated with each event.
 - WS requests the MAC address associated with a given IP address
 - AP responds to a probe request by the WS
 - AP responds to an association request by the WS
 - WS requests an IP address to be assigned dynamically by the AP
 - WS issues an authentication request to the AP
 - (f) The WS obtains an IP address using DHCP. What are the well-known ports used by DHCP? Provide the number of one packet where these port numbers appear and transcribe the line in the trace in which they appear.
2. [10 points] The following are screen captures of a *ttcp* exchange for measuring throughput.



```
C:\WINDOWS\System32\cmd.exe
C:\wsttcp\dtemp>wsttcp -t -u -n10 -p4984 -v 192.168.1.102
wsttcp-t: buflen=8192, nbuf=10, align=16384/+0, port=4984  udp  -> 192.168.1.102
wsttcp-t: socket
wsttcp-t: 81920 bytes in 0.09 real sec = 888.89 KB/sec (7281777.78 bps)
wsttcp-t: 16 I/O calls, msec/call = 5.76, calls/sec = 177.78
wsttcp-t: buffer address 0x344000
81920 1077811472.21 1077811472.30 0.09 7281777.78
C:\wsttcp\dtemp>_
```

```
C:\WINNT\system32\cmd.exe
C:\WMSD\Labs\Lab_1>wsttcp -r -u -p4984
wsttcp-r: buflen=8192, nbuf=2048, align=16384/+0, port=4984 udp
wsttcp-r: socket
wsttcp-r: bind
wsttcp-r: 81920 bytes in 0.33 real sec = 241.69 KB/sec (1979939.58 bps)
wsttcp-r: 12 I/O calls, msec/call = 28.25, calls/sec = 36.25
81920 1077811434.95 1077811435.28 0.33 1979939.58
C:\WMSD\Labs\Lab_1>
```

- (a) What is the throughput measured at the client?
 - (b) What is the throughput measured at the server?
 - (c) Assume an MTU of 1500 bytes. Estimate the number of IP datagrams that were generated during this measurement. Show your work.
3. [10 points] In previous assignments, you examined middleware-based designs for a pizza order service based on web services and UPnP. An alternative approach is to not use middleware at all but, rather, to design a customized application layer protocol that uses TCP or UDP directly. For this problem, the primary objective of the design should be to minimize traffic between the client and server.
- (a) Specify the message format for order messages sent by the client to the server. Show a diagram of the message layout for the order message and specify a corresponding structure using C, C++, or C# syntax.
 - (b) Specify the message format for response messages sent by the server to the client. Show a diagram of the message layout for the response message and specify a corresponding structure using C, C++, or C# syntax.
4. [20 points] Consider the three techniques to implement the pizza order services: (i) as a web service, (ii) using UPnP; and (iii) as a customized application protocol as in the previous problem.
- (a) Estimate the amount of data that needs to be transferred from the client (control point) to the server (device) for each of the three schemes. Consider only transport layer payload. Do not consider headers at the transport layer and below. You may want to refer to data collected for in-class and at-home exercises. State any assumptions.
 - (b) Estimate the amount of data that needs to be transferred from the server (device) to the client (control point) for each of the three schemes. Consider only transport layer

payload. Do not consider headers at the transport layer and below. You may want to refer to data collected for in-class and at-home exercises. State any assumptions.

- (c) Discuss the relative strengths and weaknesses of the three schemes with respect to network loading. Be as specific as possible. Be sure to compare the schemes instead of just discussion each in isolation. Limit your answer to no more than one-half page.
 - (d) Discuss the relative strengths and weaknesses of the three schemes with respect to ease of software development. Again, be as specific as possible and be sure to compare the schemes. Limit your answer to no more than one-half page.
 - (c) Discuss the relative strengths and weaknesses of the three schemes with respect to interoperability (e.g., working across different types of networks and working on different client or control point devices). Be as specific as possible and be sure to compare the schemes. Limit your answer to no more than one-half page.
5. [20 points] Consider the WSDL file `TemperatureService.wsdl` that is provided with this exam.
- (a) List the names of all of the operations that are offered by this service.
 - (b) List the names of all of the message types that are defined in this file.
 - (c) List the names of all of the input parameters for the `getTemp` operation.
 - (d) List the names of all of the output parameters for the `getTemp` operation.
 - (e) What is (are) the basic data type(s) of the input parameter(s) listed for part c?
 - (f) What is (are) the basic data type(s) of the output parameter(s) listed for part d?
 - (g) Assume HTTP is used to send the SOAP message below to the web server. What URL is specified in the HTTP message sent from the client to the server to invoke the `getTemp` operation?

```
<soap:Envelope
  xmlns:n="urn:xmethods-Temperature"
  xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soap:Body soap:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
    <n:getTemp>
      <zipcode xsi:type="xs:string">40383</zipcode>
    </n:getTemp>
  </soap:Body>
</soap:Envelope>
```

- (h) What is the input parameter value specified in the message above?
- (i) The server sends back a SOAP message. Complete the body of the SOAP message below by specifying `VALUE_1`, `VALUE_2`, `VALUE_3`, and `VALUE_4` in your solutions.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <SOAP-ENV:Body>
    <ns1:VALUE_1 SOAP-ENV:encodingStyle="VALUE_2"
      xmlns:ns1="urn:xmethods-Temperature">
      <return xsi:type="VALUE_3">30.0</return>
    </ns1:VALUE_4>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

(j) What is the output parameter value specified in the response message above?

6. [10 points] File `projector-scpd.xml` gives part of a service description file for a projector control service. Give an updated version of the file with the following additions. Add a state variable `Slideno`. `Slideno` is an integer that indicates the current slide that is being projected. The default value of `Slideno` should be 1. Also, add the following actions that operate on `Slideno`.

- Advance (increment `Slideno` by one)
- Back (decrement `Slideno` by one)
- SetSlide (set `Slideno` to an integer N)
- GetSlide (return the value of `Slideno`)