IS2150/Tel2810 Introduction to Security
Final,
Thursday, December 13, 2007

Name:

Email:

Total Time : 2:15 Hours
Total Score : 100

Note that scores for each question may be different – *so spend time accordingly on each question*. Be precise and clear in your answers.

Good Luck!!

Total Score:

Part I:

Write T for *True* and F for *False* (Total Score 20)

1. [ ] IPSec can be used to create a virtual private network.

2. [ ] Multipartite virus infects either boot sectors or the executable files.

3. [ ] Encrypted virus is aimed towards preventing detection of a virus signature.

4. [ ] Macro viruses are application-independent and architecture-dependent.

5. [ ] Both confidentiality and integrity models can be used to prevent the spread of viruses.

6. [ ] Java is by design a safer language than C.

7. [ ] *Speaker verification* and *Speaker recognition* techniques refer to *recognition of speaker's voice characteristics* and *verbal information verification*, respectively.

8. [ ] In IPSec, if a packet needs to be dropped, it will be known from the Security Association Database.

9. [ ] TOCTTOU is an example of category stack smashing attack.

10. [ ] Security association indicates the bi-directional relationship between the peers and specifies the security services provided to the traffic carried on it.

11. [ ] One weakness of TCSEC is that it is based heavily on *integrity* requirements and ignores availability.

12. [ ] Common Criteria has a component that addresses country specific needs of some nations.

13. [ ] Arc injection is an attack that exploits vulnerability in the use of integer data types.

14. [ ] In two's complement arithmetic, a signed integer of n bits ranges from -2^{n-1} to $(2^{n-1}-1)$.

15. [ ] For race conditions to occur atleast two control flows must alter the state of the race object.

16. [ ] $D_k(E_k(D_k(y))) = E_k(D_k(E_k(\mathrm{z})))$ for $y = E_k(x)$ and $\mathrm{z} = (D_k(E_k(x)))$

17. [ ] The product of two relatively prime numbers is a prime number.

18. [ ] Cæsar is a *transposition* cipher and its key *weakness* is that the key is too short.

For 19 - 20, refer to the following exchange

$$\text{Alice} \xrightarrow{\{\mathrm{m}\}k_{\mathrm{s}} \,\|\, \{h(\mathrm{m})\}k_{\text{Alice}} \,\|\, \{k_{\mathrm{s}}\}k_{\text{Bob}}} \text{Bob}$$

19. [ ] k_{s} is the Interchange Key and k_{Alice} is the Data Encipherment Key

20. [ ] This protocol provides message confidentiality and integrity, as well origin integrity.

Part II

1. Recall that *X*<<*Y*>> represents *Y*'s certificate signed by *X*. Consider the following certificates and answer the following [5]
    - ○ *Cathy<<Alice>>*
    - ○ *Dan<<Bob>*
    - ○ *Dan<<Cathy>>*
    - ○ *Cathy<<Dan>>*

    (a) Show steps (or just write the *signature chain*) that Alice takes to validate Bob's certificate:

    (b) Show steps (or just write the *signature chain*) that Alice takes to validate Bob's certificate:

2. What is a *dictionary* attack? Briefly describe the two types of dictionary attack. [5]

Answer:

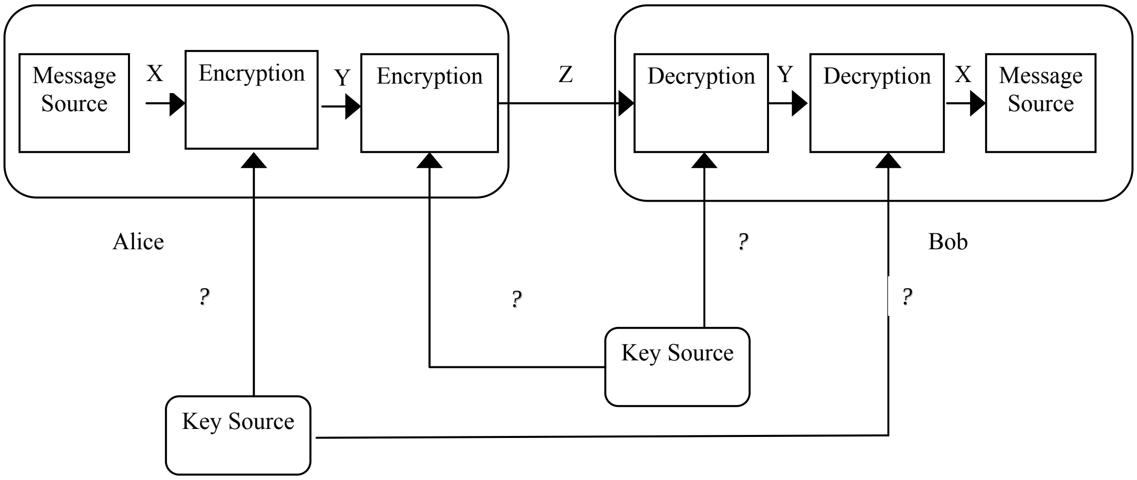
3. For the *S/Key* scheme for password authentication, write the following: [5].
   a. If *h* is the hash function used, and *k* is the seed used:
      (i) *n* keys k_1, k_2, .., k_n are generated as follows:

      (*ii*) & the keys are used in the following sequence:

      ----

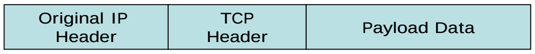
   b. Assuming that *h* cannot be inverted, the attacker cannot determine the next password because of the following reason:

4. Alice wants to send a message to Bob and she wants to ensure both the confidentiality and integrity. Indicate what encryptions/decryptions you would need to do in the four places indicated by question marks. Use (*pubA*, *privA*) as Alice's public-private key pairs and (*pubB*, privB) as Bob's. Use E_x and D_x to indicate encryption and decryption using key *x* (note *x* could be public or private key). [5]

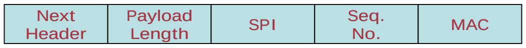


Answer:

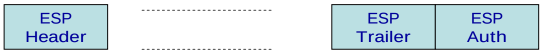
5. Draw diagrams to show the IPSec packets for the two IPSec protocols in both the models and indicate what security services are included in each. [5, 5]



Without IPSec



Authentication Header (AH) Parameter



Encapsulating Security Payload (ESP) components

Answer:

6. Describe the replay attack on the Needham-Schroeder key exchange protocol shown below. Assume that k_s is known to the attacker. State why it is possible. [5]

$$\text{Alice} \xrightarrow{\quad \text{Alice} \,\|\, \text{Bob} \,\|\, r_1 \quad} \text{Cathy}$$

$$\text{Alice} \xleftarrow{\quad \{\, \text{Alice} \,\|\, \text{Bob} \,\|\, r_1 \,\|\, k_s \,\|\{\, \text{Alice} \,\|\, k_s \,\}\, k_B \,\}\, k_A \quad} \text{Cathy}$$

$$\text{Alice} \xrightarrow{\quad \{\, \text{Alice} \,\|\, k_s \,\}\, k_B \quad} \text{Bob}$$

$$\text{Alice} \xleftarrow{\quad \{\, r_2 \,\}\, k_s \quad} \text{Bob}$$

$$\text{Alice} \xrightarrow{\quad \{\, r_2 - 1 \,\}\, k_s \quad} \text{Bob}$$

Answer:

7. Enumerate the key *Risk Assessment* steps [5]

Answer:

8. For the risks and the security mechanism indicated below, calculate and insert the values as per the given data: [5]
   - Risks:
     - disclosure of company confidential information,
     - computation based on incorrect data

   - Cost to correct data: $3,500,000

     - @20% liklihood per year: _________

     - Effectiveness of access control software: 60%: _________

     - Cost of access control software: +$55,000

     - Expected annual costs due to loss and controls: _________

     - Savings: _________

9. Write differences among *copyright*, *patent* and *trade secret*. [5]

Answer:

10. Define the following terms [5]

    Polymorphic virus:

Worm:

11. Write in the blank spaces [5]

    i. Two ways of *detecting* viruses are:

       [a] ______________________________

       [b] ______________________________

    ii. Two general ways to *defend* against a virus

       [a] ______________________________

       [b] ______________________________

12. Attempt any two of the following: [5]

a What is TEMPEST program? Name two ways of protecting against emanations.

b Indicate factors that need to be considered before disposing sensitive media.

c Identify two natural disasters and factors related to them in terms of protecting information system resources.

Attempt *Three* of the following (13, 14, 15, 16) [Total Score: 15]

13. Recall the buffer overflow program related to the attached program. Describe how the buffer overflow exploit works for the specialized input "“1234567890123456j▶*!”. The contents of the stack after this input has been given is shown below. [5].

```
bool IsPasswordOK(void) {
   char Password[12];            // Memory storage for pwd
   gets(Password);               // Get input from keyboard
   if (!strcmp(Password,"goodpass")) return(true); // Password Good
   else return(false);           // Password Invalid
}

void main(void) {
   bool PwStatus;                // Password Status
   puts("Enter Password:");      // Print
   PwStatus=IsPasswordOK();      // Get & Check Password
   if (PwStatus == false) {
         puts("Access denied");  // Print
         exit(-1);               // Terminate Program
   }
   else puts("Access granted");  // Print
}
```

Storage for Password (12 Bytes) “123456789012”
Caller EBP – Frame Ptr main (4 bytes) “3456”
Return Addr Caller – main (4 Bytes) “j▶*!”
Storage for **PwStatus** (4 bytes) “\0”
Caller EBP – Frame Ptr OS (4 bytes)
Return Addr of main – OS (4 Bytes)

Answer:

14. Recall the following example of a Trojan horse [5]

Perpetrator does the following

1. cat >/homes/victim1/ls <<eof
2. cp /bin/sh /tmp/.xxsh
3. chmod u+s,o+x /tmp/.xxsh
4. rm ./ls
5. ls $*
6. eof

Describe what happens when Victim1executes “ls” command while in the directory /homes/victim1/

Answer:

15. Consider the following program [5]:

```
1. char cresult1, cresult2, c1, c2, c3;
2. c1 = 100;
3. c2 = 90;
4. c3 = -120;
5. cresult1 = c1 + c2 + c3;
6. cresult2 = c1 + c2;
```

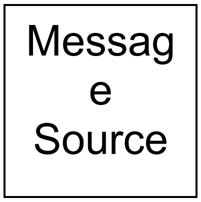
Note that char type uses 8 bit and two’s complement form for negative values. Also they are converted to integer types when they appear in an operations such as those on the right of lines 5 and 6. Will there be a problem in executing lines 5 and 6 – give reasons.

Answer:

16. Describe what you mean by a *race-condition*. For the following program indicate what is the race condition/window and how it can be exploited. [5]

```
int main(int argc, char *argv[]) {
      FILE *fd;
      if (access(“/some_file”, W_OK) == 0) {
            printf("access granted.\n");
            fd = fopen(“/some_file”, "wb+");
            /* write to the file */
            fclose(fd);
      }  else {
            err(1, "ERROR");
      }
      return 0;
}
```

Answer:



Messag
e
Source