EX.NO	DATE	NAME OF THE EXPERIMENT	PAGE NO	MARKS (10)	STAFF SIGNATURE
1(a)		Implementing symmetric key algorithms -DES			
1(b)		Implementing symmetric key algorithms - AES.			
2(a)		Implementing asymmetric key algorithms			
2(b)		Implementing Key exchange algorithms			
3		Calculate the message digest of a text using the SHA-1 algorithm.			
4		Implement the SIGNATURE SCHEME - Digital Signature Standard.			
5		Installation of Wire shark, tcpdump and observe data transferred in client-servercommunication using UDP/TCP and identify the UDP/TCP datagram.			
6		Check message integrity and confidentiality using SSL.			
7		Experiment Eavesdropping, Dictionary attacks, MITM attacks			
8		Experiment with Sniff Traffic using ARP Poisoning			
9		Demonstrate intrusion detection system using any tool.			
10		Explore network monitoring tools			
11		Study to configure Firewall, VPN	48		

Ex .No : 1a **Date :**	**Implementing symmetric key algorithms -DES**	**Page No : 1**

AIM:

To use Data Encryption Standard (DES) Algorithm for a practical application like User Message

Encryption.

ALGORITHM:

1. Create a DES Key.

2. Create a Cipher instance from Cipher class, specify the following information and separated by a

slash (/).

a. Algorithm name

b. Mode (optional)

c. Padding scheme (optional)

3. Convert String into Byte[] array format.

4. Make Cipher in encrypt mode, and encrypt it with Cipher.doFinal() method.

5. Make Cipher in decrypt mode, and decrypt it with Cipher.doFinal() method.

PROGRAM:

DES.java

```
import java.security.InvalidKeyException;

import java.security.NoSuchAlgorithmException;

import javax.crypto.BadPaddingException;

import javax.crypto.Cipher;

import javax.crypto.IllegalBlockSizeException;

import javax.crypto.KeyGenerator;

import javax.crypto.NoSuchPaddingException;

import javax.crypto.SecretKey;

public class DES

{

public static void main(String[] argv) {
```

```
try{
System.out.println("Message Encryption Using DES Algorithm\n------");
KeyGenerator keygenerator = KeyGenerator.getInstance("DES");
SecretKey myDesKey = keygenerator.generateKey();
Cipher desCipher;
desCipher = Cipher.getInstance("DES/ECB/PKCS5Padding");
desCipher.init(Cipher.ENCRYPT_MODE, myDesKey);
byte[] text = "Secret Information ".getBytes();
System.out.println("Message [Byte Format] : " + text);
System.out.println("Message : " + new String(text));
byte[] textEncrypted = desCipher.doFinal(text);
System.out.println("Encrypted Message: " + textEncrypted);
desCipher.init(Cipher.DECRYPT_MODE, myDesKey);
byte[] textDecrypted = desCipher.doFinal(textEncrypted);
System.out.println("Decrypted Message: " + new String(textDecrypted));
}catch(NoSuchAlgorithmException e){
e.printStackTrace();
}catch(NoSuchPaddingException e){
e.printStackTrace();
}catch(InvalidKeyException e){
e.printStackTrace();
}catch(IllegalBlockSizeException e){
e.printStackTrace();
}catch(BadPaddingException e){
e.printStackTrace();
}
}
}
```

OUTPUT:

```
Message Encryption Using DES Algorithm
Message [Byte Format] : [B@4dcbadb4
Message : Secret Information
Encrypted Message: [B@504bae78
Decrypted Message: Secret Information
```

RESULT:

Thus the java program for DES Algorithm has been implemented and the output verified successfully.

Ex .No : 1b Date :	**Implementing symmetric key algorithms - AES**	**Page No : 4**

AIM:

To use Advanced Encryption Standard (AES) Algorithm for a practical application like URL Encryption.

ALGORITHM:

1. AES is based on a design principle known as a substitution–permutation.
2. AES does not use a Feistel network like DES, it uses variant of Rijndael.
3. It has a fixed block size of 128 bits, and a key size of 128, 192, or 256 bits.
4. AES operates on a 4 × 4 column-major order array of bytes, termed the state

PROGRAM:

AES.java

```
import java.io.UnsupportedEncodingException;
import java.security.MessageDigest;
import java.security.NoSuchAlgorithmException;
import java.util.Arrays;
import java.util.Base64;
import javax.crypto.Cipher;
import javax.crypto.spec.SecretKeySpec;
public class AES {
private static SecretKeySpec secretKey;
private static byte[] key;
public static void setKey(String myKey) {
MessageDigest sha = null;
try {
key = myKey.getBytes("UTF-8");
sha = MessageDigest.getInstance("SHA-1");
key = sha.digest(key);
key = Arrays.copyOf(key, 16);
secretKey = new SecretKeySpec(key, "AES");
} catch (NoSuchAlgorithmException e) {
```

```
e.printStackTrace();
} catch (UnsupportedEncodingException e) {
e.printStackTrace();
}
}
public static String encrypt(String strToEncrypt, String secret) {
try {
setKey(secret);
Cipher cipher = Cipher.getInstance("AES/ECB/PKCS5Padding");
cipher.init(Cipher.ENCRYPT_MODE, secretKey);
return Base64.getEncoder().encodeToString(cipher.doFinal(strToEncrypt.getBytes("UTF-
8")));
} catch (Exception e) {
System.out.println("Error while encrypting: " + e.toString());
}
return null;
}
public static String decrypt(String strToDecrypt, String secret) {
try {
setKey(secret);
Cipher cipher = Cipher.getInstance("AES/ECB/PKCS5PADDING");
cipher.init(Cipher.DECRYPT_MODE, secretKey);
return new String(cipher.doFinal(Base64.getDecoder().decode(strToDecrypt)));
} catch (Exception e) {
System.out.println("Error while decrypting: " + e.toString());
}
return null;
}
public static void main(String[] args) {
final String secretKey = "annaUniversity";
String originalString = "www.annauniv.edu";
String encryptedString = AES.encrypt(originalString, secretKey);
String decryptedString = AES.decrypt(encryptedString, secretKey);
System.out.println("URL Encryption Using AES Algorithm\n-----------");
System.out.println("Original URL : " + originalString);
System.out.println("Encrypted URL : " + encryptedString);
System.out.println("Decrypted URL : " + decryptedString);
}
}
```

OUTPUT:

```
URL Encryption Using AES Algorithm
Original URL : www.annauniv.edu
Encrypted URL : vibpFJW6Cvs5Y+L7t4N6YWWe07+JzS1d3CU2h3mEvEg=
Decrypted URL : www.annauniv.edu
```

RESULT:

Thus the java program for AES Algorithm has been implemented for URL Encryption and the output verified successfully.

Ex .No : 2a **Date :**	**Implementing asymmetric key algorithms**	**Page No : 7**

AIM:

To implement RSA (Rivest–Shamir–Adleman) algorithm by using HTML and Javascript.

ALGORITHM:

1. Choose two prime number p and q

2. Compute the value of n and p

3. Find the value of e (public key)

4. Compute the value of d (private key) using gcd()

5. Do the encryption and decryption

a. Encryption is given as,

c = te mod n

b. Decryption is given as,

t = cd mod n

PROGRAM:

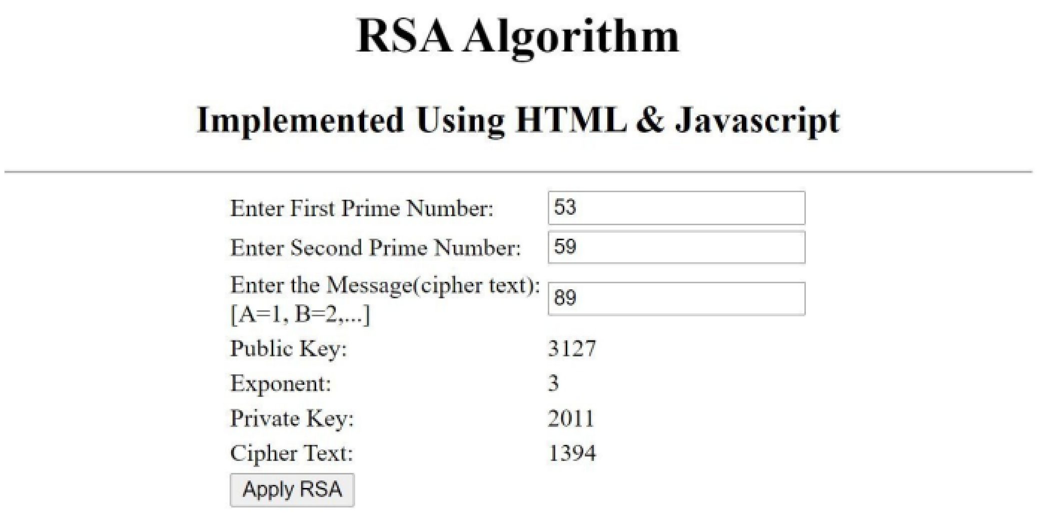
rsa.html

```
<html>
<head>
<title>RSA Encryption</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
</head>
<body>
<center>
<h1>RSA Algorithm</h1>
<h2>Implemented Using HTML & Javascript</h2>
<hr>
<table>
<tr>
<td>Enter First Prime Number:</td>
<td><input type="number" value="53" id="p"></td>
```

```
</tr>
<tr>
<td>Enter Second Prime Number:</td>
<td><input type="number" value="59" id="q"></p>
</td>
</tr>
<tr>
<td>Enter the Message(cipher text):<br>[A=1, B=2,...]</td>
<td><input type="number" value="89" id="msg"></p>
</td>
</tr>
<tr>
<td>Public Key:</td>
<td>
<p id="publickey"></p>
</td>
</tr>
<tr>
<td>Exponent:</td>
<td>
<p id="exponent"></p>
</td>
</tr>
<tr>
<td>Private Key:</td>
<td>
<p id="privatekey"></p>
</td>
</tr>
<tr>
```

```
<td>Cipher Text:</td>
<td>
<p id="ciphertext"></p>
</td>
</tr>
<tr>
<td><button onclick="RSA();">Apply RSA</button></td>
</tr>
</table>
</center>
</body>
<script type="text/javascript">
function RSA() {
var gcd, p, q, no, n, t, e, i, x;
gcd = function (a, b) { return (!b) ? a : gcd(b, a % b); };
p = document.getElementById('p').value;
q = document.getElementById('q').value;
no = document.getElementById('msg').value;
n = p * q;
t = (p - 1) * (q - 1);
for (e = 2; e < t; e++) {
if (gcd(e, t) == 1) {
break;
}
}
for (i = 0; i < 10; i++) {
x = 1 + i * t
if (x % e == 0) {
d = x / e;
break;
}
}
ctt = Math.pow(no, e).toFixed(0);
ct = ctt % n;
dtt = Math.pow(ct, d).toFixed(0);
dt = dtt % n;
document.getElementById('publickey').innerHTML = n;
document.getElementById('exponent').innerHTML = e;
document.getElementById('privatekey').innerHTML = d;
document.getElementById('ciphertext').innerHTML = ct;
}
</script>
</html>
```

OUTPUT:



RSA Algorithm

Implemented Using HTML & Javascript

Enter First Prime Number:	53
Enter Second Prime Number:	59
Enter the Message(cipher text): [A=1, B=2,...]	89
Public Key:	3127
Exponent:	3
Private Key:	2011
Cipher Text:	1394

RESULT:

Thus the RSA algorithm has been implemented using HTML & CSS and the output has been verified successfully.

Ex .No : 2b **Date :**	**Implementing Key exchange algorithms**	**Page No : 11**

AIM:

To implement the Diffie-Hellman Key Exchange algorithm for a given problem .

ALGORITHM:

1. Alice and Bob publicly agree to use a modulus p = 23 and base g = 5

(which is a primitive root modulo 23).

2. Alice chooses a secret integer a = 4, then sends Bob A = g

a mod p

o A = 5

4 mod 23 = 4

3. Bob chooses a secret integer b = 3, then sends Alice B = g

b mod p

o B = 5

3 mod 23 = 10

4. Alice computes s = B

a mod p

o s = 104 mod 23 = 18

5. Bob computes s = A

b mod p

o s = 4

3 mod 23 = 18

6. Alice and Bob now share a secret (the number 18).

PROGRAM:

DiffieHellman.java

```
class DiffieHellman {
public static void main(String args[]) {
int p = 23; /* publicly known (prime number) */
int g = 5; /* publicly known (primitive root) */
int x = 4; /* only Alice knows this secret */
int y = 3; /* only Bob knows this secret */
double aliceSends = (Math.pow(g, x)) % p;
double bobComputes = (Math.pow(aliceSends, y)) % p;
double bobSends = (Math.pow(g, y)) % p;
double aliceComputes = (Math.pow(bobSends, x)) % p;
double sharedSecret = (Math.pow(g, (x * y))) % p;
System.out.println("simulation of Diffie-Hellman key exchange algorithm\n-------------------------
");
System.out.println("Alice Sends : " + aliceSends);
System.out.println("Bob Computes : " + bobComputes);
System.out.println("Bob Sends : " + bobSends);
System.out.println("Alice Computes : " + aliceComputes);
System.out.println("Shared Secret : " + sharedSecret);
/* shared secrets should match and equality is transitive */
if ((aliceComputes == sharedSecret) && (aliceComputes == bobComputes))
System.out.println("Success: Shared Secrets Matches! " + sharedSecret);
else
System.out.println("Error: Shared Secrets does not Match");
}
}
```

OUTPUT:

```
simulation of Diffie-Hellman key exchange algorithm
Alice Sends : 4.0
Bob Computes : 18.0
Bob Sends : 10.0
Alice Computes : 18.0
Shared Secret : 18.0
Success: Shared Secrets Matches! 18.0
```

RESULT:

Thus the Diffie-Hellman key exchange algorithm has been implemented using Java Program and the output has been verified successfully

Ex .No : 3 **Date :**	**Calculate the message digest of a text using the SHA-1 algorithm.**	**Page No : 13**

AIM:

To Calculate the message digest of a text using the SHA-1 algorithm.

ALGORITHM:

1. Append Padding Bits
2. Append Length - 64 bits are appended to the end
3. Prepare Processing Functions
4. Prepare Processing Constants
5. Initialize Buffers
6. Processing Message in 512-bit blocks (L blocks in total message)

PROGRAM:

sha1.java

```
import java.security.*;
public class sha1 {
public static void main(String[] a) {
try {
MessageDigest md = MessageDigest.getInstance("SHA1");
System.out.println("Message digest object info:\n-----------------");
System.out.println("Algorithm=" + md.getAlgorithm());
System.out.println("Provider=" + md.getProvider());
System.out.println("ToString=" + md.toString());
String input = "";
md.update(input.getBytes());
byte[] output = md.digest();
System.out.println();
System.out.println("SHA1(\"" + input + "\")=" + bytesToHex(output));
input = "abc";
md.update(input.getBytes());
output = md.digest();
System.out.println();
System.out.println("SHA1(\"" + input + "\")=" + bytesToHex(output));
input = "abcdefghijklmnopqrstuvwxyz";
```

```
md.update(input.getBytes());
output = md.digest();
System.out.println();
System.out.println("SHA1(\"" + input + "\")=" + bytesToHex(output));
System.out.println();
} catch (Exception e) {
System.out.println("Exception:" + e);
}}
private static String bytesToHex(byte[] b) {
char hexDigit[] = { '0', '1', '2', '3', '4', '5', '6', '7', '8', '9', 'A', 'B', 'C', 'D', 'E', 'F' };
StringBuffer buf = new StringBuffer();
for (byte aB : b) {
buf.append(hexDigit[(aB >> 4) & 0x0f]);
buf.append(hexDigit[aB & 0x0f]);
}
return buf.toString();
}}
```
OUTPUT:
```
Message digest object info:
Algorithm=SHA1
Provider=SUN version 12
ToString=SHA1 Message Digest from SUN, <initialized>
SHA1("")=DA39A3EE5E6B4B0D3255BFEF95601890AFD80709
SHA1("abc")=A9993E364706816ABA3E25717850C26C9CD0D89D
SHA1("abcdefghijklmnopqrstuvwxyz")=32D10C7B8CF96570CA04CE37F2A19D84240D3A89
```
RESULT:

Thus the Secure Hash Algorithm (SHA-1) has been implemented and the output has been verified successfully

Ex .No : 4 Date :	Implement the SIGNATURE SCHEME - Digital Signature Standard.	Page No : 15

AIM:

To implement the SIGNATURE SCHEME - Digital Signature Standard.

ALGORITHM:

1. Create a KeyPairGenerator object.
2. Initialize the KeyPairGenerator object.
3. Generate the KeyPairGenerator. ...
4. Get the private key from the pair.
5. Create a signature object.
6. Initialize the Signature object.
7. Add data to the Signature object
8. Calculate the Signature

PROGRAM:

```
import java.security.KeyPair;
import java.security.KeyPairGenerator;
import java.security.PrivateKey;
import java.security.Signature;
import java.util.Scanner;
public class CreatingDigitalSignature {
public static void main(String args[]) throws Exception {
Scanner sc = new Scanner(System.in);
System.out.println("Enter some text");
String msg = sc.nextLine();
KeyPairGenerator keyPairGen = KeyPairGenerator.getInstance("DSA");
keyPairGen.initialize(2048);
KeyPair pair = keyPairGen.generateKeyPair();
PrivateKey privKey = pair.getPrivate();
Signature sign = Signature.getInstance("SHA256withDSA");
sign.initSign(privKey);
byte[] bytes = "msg".getBytes();
sign.update(bytes);
byte[] signature = sign.sign();
System.out.println("Digital signature for given text: "+new String(signature, "UTF8"));
}
}
```

OUTPUT:

```
Enter some text
Hi how are you
Digital signature for given text: 0=@gRD???-?.???? /yGL?i??a!?
```

RESULT:

Thus the Digital Signature Standard Signature Scheme has been implemented and the output has been verified successfully

Ex .No : 5 **Date :**	**Installation of Wire shark, tcpdump and observe data transferred in client-servercommunication using UDP/TCP and identify the UDP/TCP datagram.**	**Page No : 17**

Aim:

To installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.

Introduction:

The first part of the lab introduces packet sniffer, Wireshark. Wireshark is a free opensource network protocol analyzer. It is used for network troubleshooting and communication protocol analysis. Wireshark captures network packets in real time and display them in human-readable format. It provides many advanced features including live capture and offline analysis, three-pane packet browser, coloring rules for analysis. This document uses Wireshark for the experiments, and it covers Wireshark installation, packet capturing, and protocol analysis.

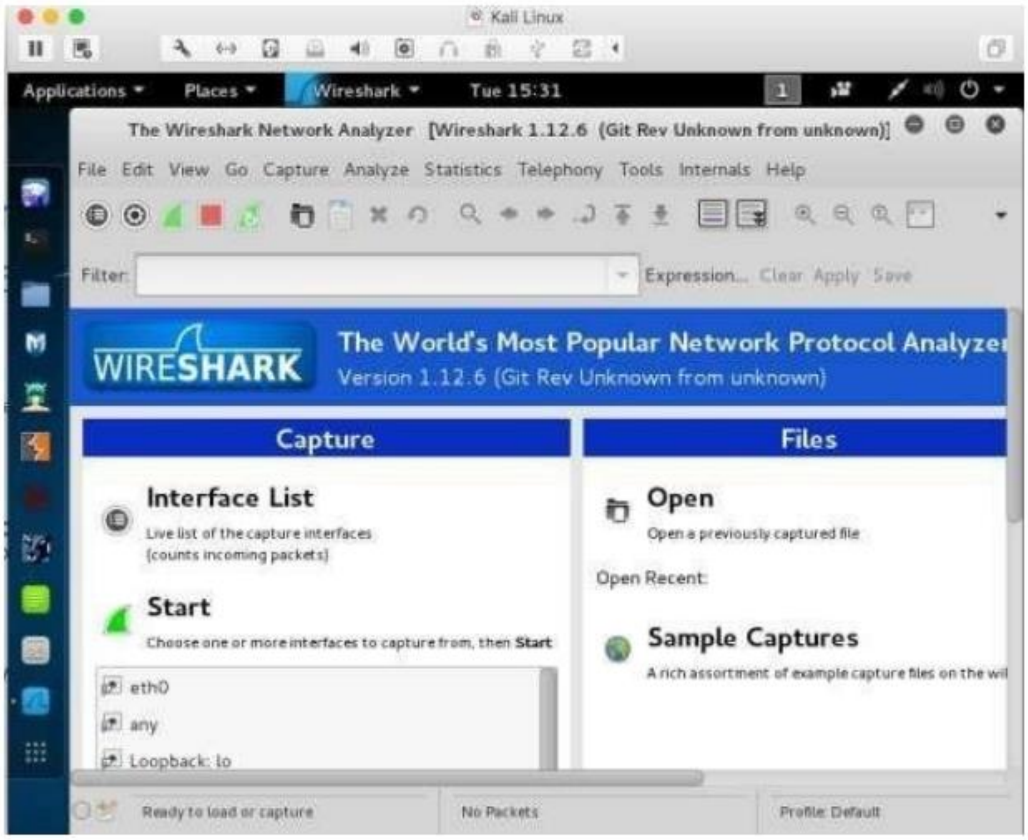

Kali Linux
Applications
Places
Wireshark
Tue 15:31
The Wireshark Network Analyzer [Wireshark 1.12.6 (Git Rev Unknown from unknown)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
WIRESHARK
The World's Most Popular Network Protocol Analyzer
Version 1.12.6 (Git Rev Unknown from unknown)
Capture
Interface List
Live list of the capture interfaces (counts incoming packets)
Start
Choose one or more interfaces to capture from, then Start
eth0
any
Loopback: lo
Files
Open
Open a previously captured file
Open Recent:
Sample Captures
A rich assortment of example capture files on the wiki
Ready to load or capture
No Packets
Profile: Default

Figure 1: Wireshark in Kali Linux

Background

TCP/IP Network Stack

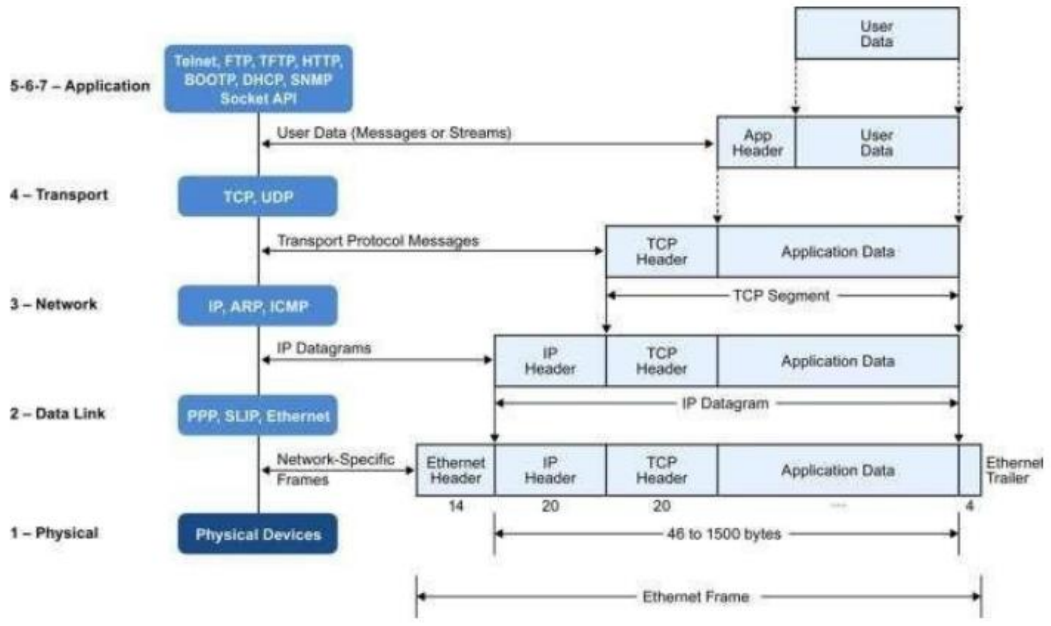


Figure 2: Encapsulation of Data in the TCP/IP Network Stack

In the CSC 4190 Introduction to Computer Networking (one of the perquisite courses), TCP/IP network stack is introduced and studied. This background section briefly explains the concept of TCP/IP network stack to help you better understand the experiments. TCP/IP is the most commonly used network model for Internet services. Because its most important protocols, the Transmission Control Protocol (TCP) and the Internet Protocol (IP) were the first networking protocols defined in this standard, it is named as TCP/IP. However, it contains multiple layers including application layer, transport layer, network layer, and data link layer.

- Application Layer: The application layer includes the protocols used by most applications for providing user services. Examples of application layer protocols are Hypertext Transfer Protocol (HTTP), Secure Shell (SSH), File Transfer Protocol (FTP), and Simple Mail Transfer Protocol (SMTP).
- Transport Layer: The transport layer establishes process-to-process connectivity, and it provides end-to-end services that are independent of underlying user data. To implement the process-to-process communication, the protocol introduces a concept of port. The examples of transport layer protocols are Transport Control Protocol (TCP) and User Datagram Protocol (UDP). The TCP provides flow- control, connection establishment, and reliable transmission of data, while the UDP is a connectionless transmission model.
- Internet Layer: The Internet layer is responsible for sending packets to across networks. It has two functions: 1) Host identification by using IP addressing system (IPv4 and IPv6); and 2) packets routing from source to destination. The examples of Internet layer protocols are Internet Protocol (IP), Internet Control Message Protocol (ICMP), and

Address Resolution Protocol (ARP).

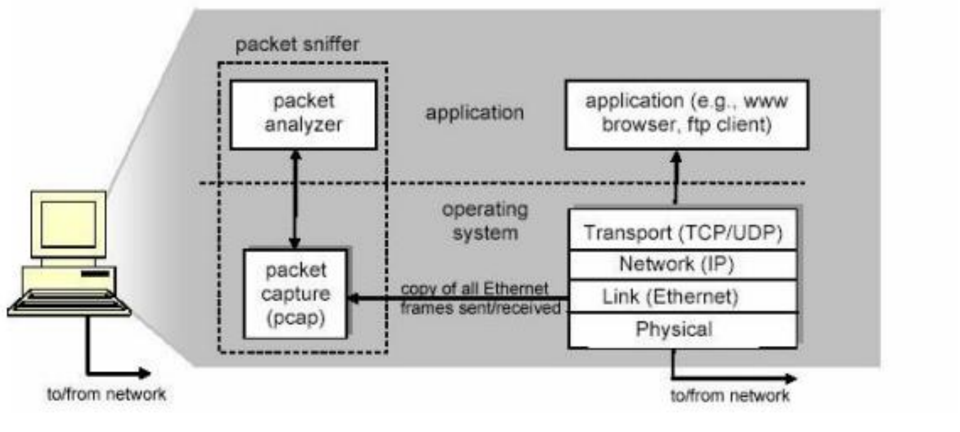
- Link Layer: The link layer defines the networking methods within the scope of the local network link. It is used to move the packets between two hosts on the same link. An common example of link layer protocols is Ethernet.

Packet Sniffer

Packet sniffer is a basic tool for observing network packet exchanges in a computer. As the name suggests, a packet sniffer captures (“sniffs”) packets being sent/received from/by your computer; it will also typically store and/or display the contents of the various protocol fields in these captured packets. A packet sniffer itself is passive. It observes messages being sent and received by applications and protocolsrunning on your computer, but never sends packets itself.

Figure 3 shows the structure of a packet sniffer. At the right of Figure 3 are the protocols (in this case, Internet protocols) and applications (such as a web browser or ftp client) that normally run on your computer. The packet sniffer, shown within the dashed rectangle in Figure 3 is an addition to the usual software in your computer, and consists of two parts. The packet capture library receives a copy of every link-layer frame that is sent from or received by your computer. Messages exchanged by higher layer protocols such as HTTP, FTP, TCP, UDP, DNS, or IP all are eventually encapsulated in link-layer framesthat are transmitted over physical media such asan Ethernet cable. In Figure 1, the assumed physical media is an Ethernet, and so all upper-layerprotocols are eventually encapsulated within an Ethernet frame. Capturing all link-layer framesthus gives you access to all messages sent/received from/by all protocols and applicationsexecuting in your computer.

The second component of a packet sniffer is the packet analyzer, which displays the contents ofall fields within a protocol message. In order to do so, the packet analyze



Packet Sniffer Structure

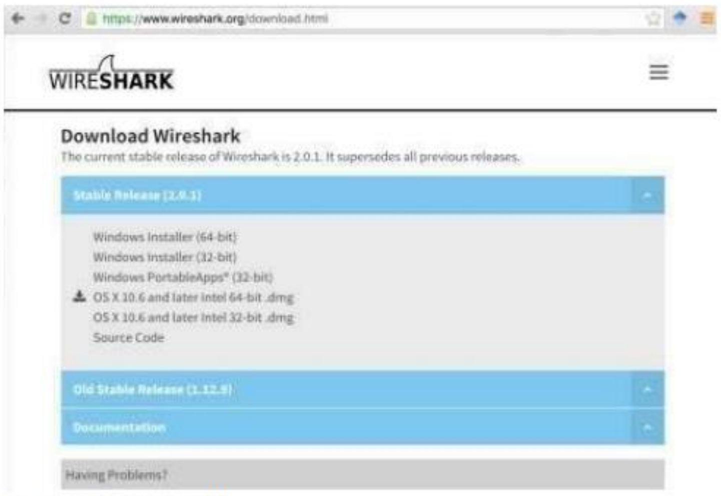
must “understand” the structure of all messages exchanged by protocols. For example, suppose we are interested in displaying the various fields in messages exchanged by the HTTP protocol in Figure 3. The packet analyzer understands the format of Ethernet frames, and so can identify the IP datagram within an Ethernet frame. It also understands the IP datagram format, so that it can extract the TCP segment within the IP datagram. Finally, it understands the TCP segment structure, so it can extract the HTTP message contained in the TCP segment. Finally, it understands the HTTP protocol and so, for example, knows that the first bytes of an HTTP message will contain the string "GET," "POST," or "HEAD".

We will be using the Wireshark packet sniffer [http://www.wireshark.org/] for these labs, allowing us to display the contents of messages being sent/received from/by protocols at different levels of the protocol stack. (Technically speaking, Wireshark is a packet analyzer that uses a packet capture library in your computer). Wireshark is a free network protocol analyzer that runs on Windows, Linux/Unix, and Mac computers.

Getting Wireshark

The Kai Linux has Wireshark installed. You can just launch the Kali Linux VM and open

Wireshark there.Wireshark can also be downloaded from here: www.wireshark.org/download.html



https://www.wireshark.org/download.html

Download Wireshark

The current stable release of Wireshark is 2.0.1. It supersedes all previous releases.

Stable Release (2.0.1)

Windows Installer (64-bit)
Windows Installer (32-bit)
Windows PortableApps® (32-bit)
OS X 10.6 and later Intel 64-bit .dmg
OS X 10.6 and later Intel 32-bit .dmg
Source Code

Old Stable Release (1.12.9)

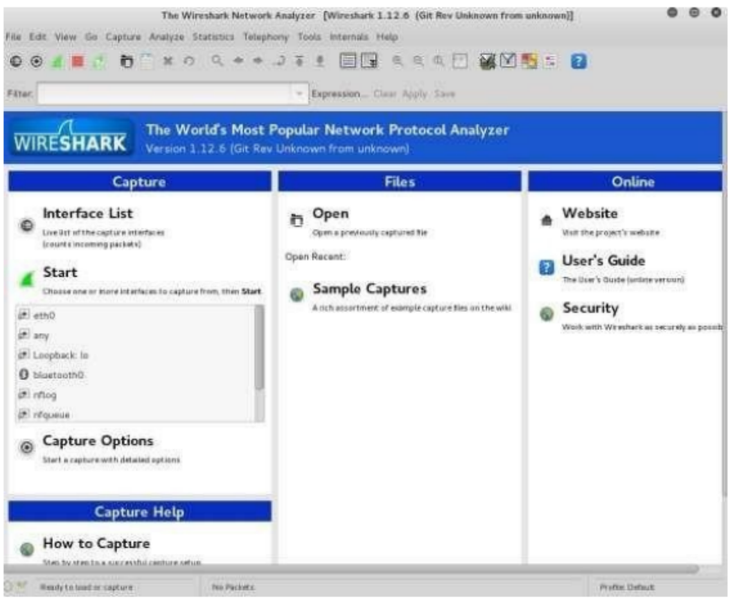
Documentation

Having Problems?

(Download Page of Wireshark)

Starting Wireshark:

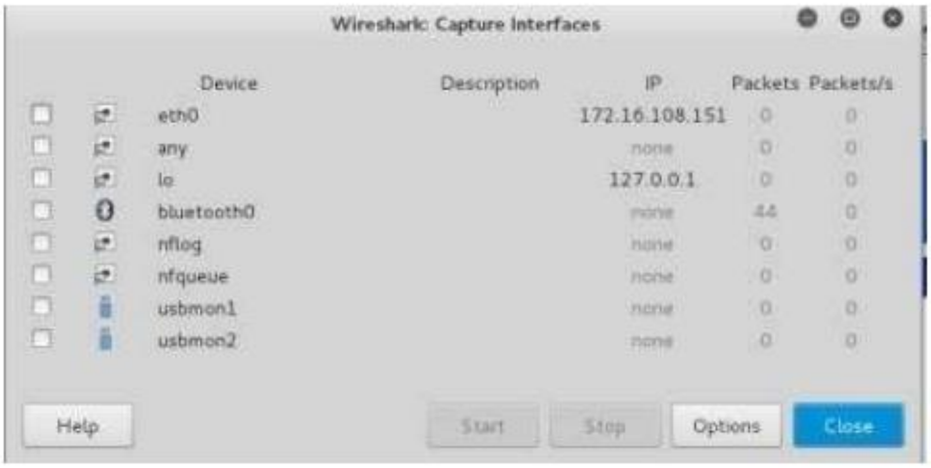
When you run the Wireshark program, the Wireshark graphic user interface will be shown as Figure 5.Currently, the program is not capturing the packets


The Wireshark Network Analyzer [Wireshark 1.12.6 (Git Rev Unknown from unknown)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
WIRESHARK
The World's Most Popular Network Protocol Analyzer
Version 1.12.6 (Git Rev Unknown from unknown)
Capture
Interface List
Live list of the capture interfaces (counts incoming packets)
Start
Choose one or more interfaces to capture from, then Start
eth0
any
Loopback: lo
bluetooth0
nflog
nfqueue
Capture Options
Start a capture with detailed options
Capture Help
How to Capture
Files
Open
Open a previously captured file
Open Recent:
Sample Captures
A rich assortment of example capture files on the wiki
Online
Website
Visit the project's website
User's Guide
The User's Guide (online version)
Security
Work with Wireshark as securely as possible
Ready to load or capture
No Packets
Profile: Default

Initial Graphic User Interface of Wireshark

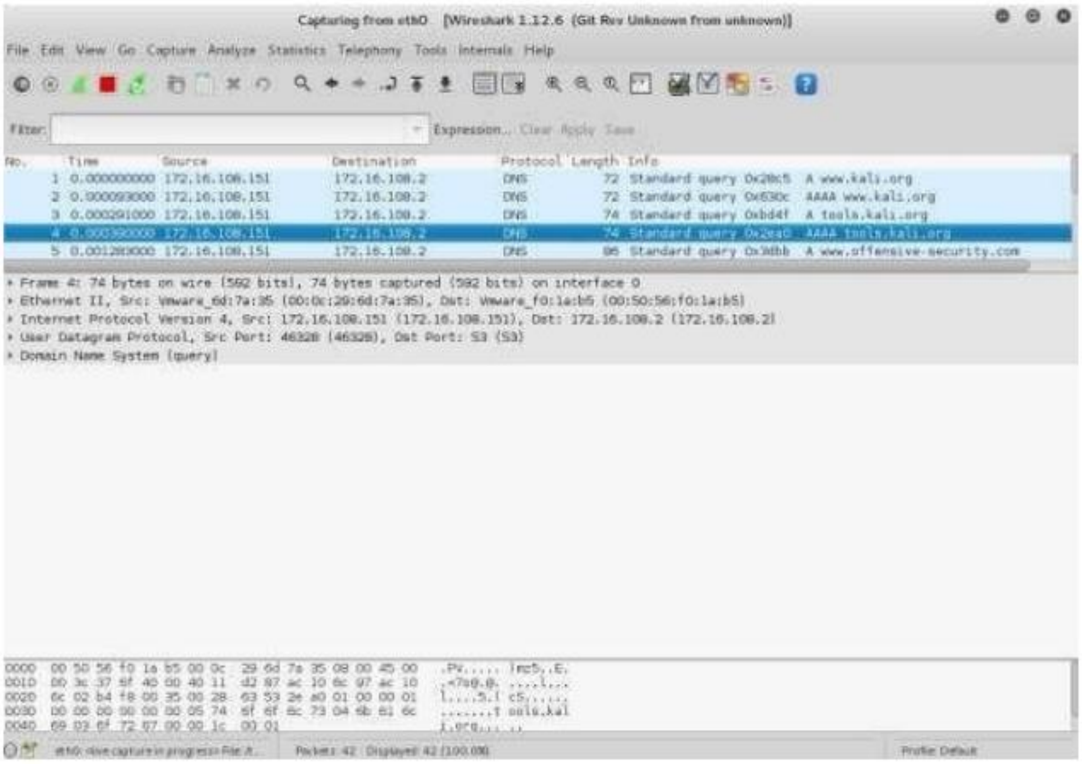
Then, you need to choose an interface. If you are running the Wireshark on your laptop, you need to select WiFi interface. If you are at a desktop, you need to select the Ethernet interface being used. Note that there could be multiple interfaces. In general, you can select any interface but that does not mean that traffic will flow through that interface. The network interfaces (i.e., the physical connections) that your computer has to the network are shown. The attached Figure 6 was taken from my computer.

After you select the interface, you can click start to capture the packets as shown in Figure 7.



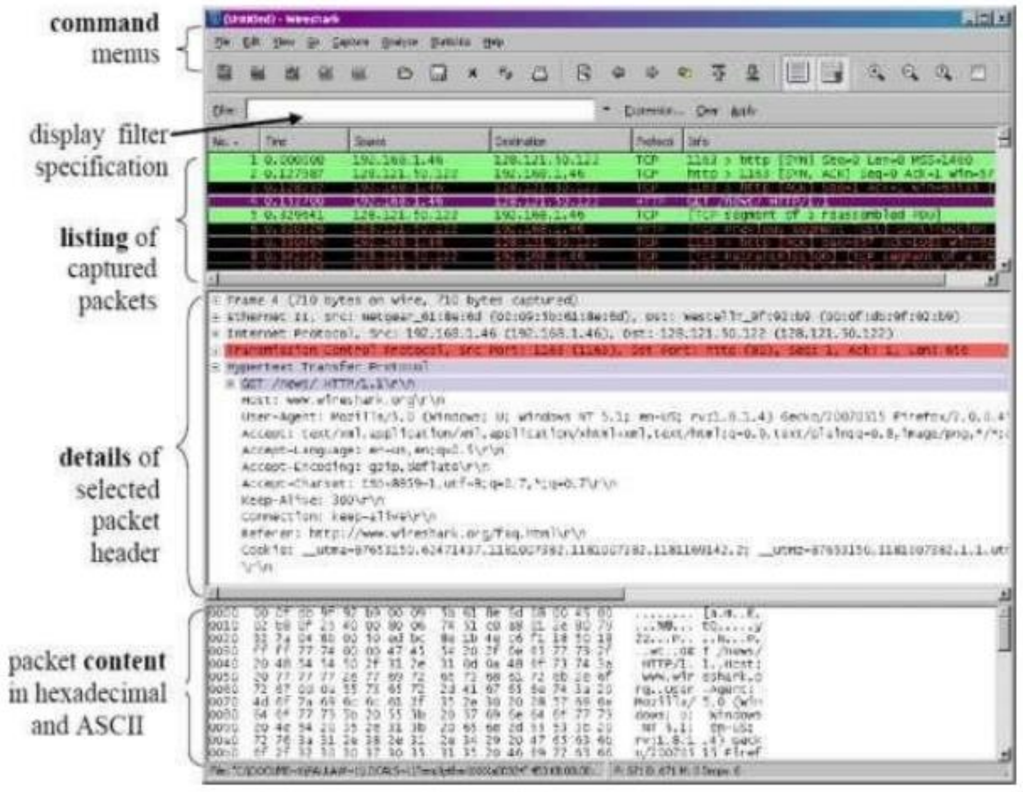
Device	Description	IP	Packets	Packets/s
eth0		172.16.108.151	0	0
any		none	0	0
lo		127.0.0.1	0	0
bluetooth0		none	44	0
nflog		none	0	0
nfqueue		none	0	0
usbmon1		none	0	0
usbmon2		none	0	0

Capture Interfaces in Wireshark


Capturing from eth0 [Wireshark 1.12.6 (Git Rev Unknown from unknown)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
eth0: <live capture in progress> File: /t...
Packets: 42 · Displayed: 42 (100.0%)
Profile: Default

```
No.   Time         Source          Destination    Protocol Length Info
    1 0.000000000  172.16.108.151  172.16.108.2   DNS          72 Standard query 0x20c5  A www.kali.org
    2 0.000093000  172.16.108.151  172.16.108.2   DNS          72 Standard query 0x630c  AAAA www.kali.org
    3 0.000291000  172.16.108.151  172.16.108.2   DNS          74 Standard query 0xbd4f  A tools.kali.org
    4 0.000390000  172.16.108.151  172.16.108.2   DNS          74 Standard query 0x2ea0  AAAA tools.kali.org
    5 0.001280000  172.16.108.151  172.16.108.2   DNS          86 Standard query 0x3dbb  A www.offensive-security.com

▸ Frame 4: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface 0
▸ Ethernet II, Src: Vmware_6d:7a:35 (00:0c:29:6d:7a:35), Dst: Vmware_f0:1a:b5 (00:50:56:f0:1a:b5)
▸ Internet Protocol Version 4, Src: 172.16.108.151 (172.16.108.151), Dst: 172.16.108.2 (172.16.108.2)
▸ User Datagram Protocol, Src Port: 46328 (46328), Dst Port: 53 (53)
▸ Domain Name System (query)

0000  00 50 56 f0 1a b5 00 0c  29 6d 7a 35 08 00 45 00   .PV..... )mz5..E.
0010  00 3c 37 5f 40 00 40 11  d2 87 ac 10 6c 97 ac 10   .<7_@.@. ....l...
0020  6c 02 b4 f8 00 35 00 28  63 53 2e a0 01 00 00 01   l....5.( cS......
0030  00 00 00 00 00 00 05 74  6f 6f 6c 73 04 6b 61 6c   .......t ools.kal
0040  69 03 6f 72 67 00 00 1c  00 01                     i.org.... ..
```

Capturing Packets in Wireshark


command menus
display filter specification
listing of captured packets
details of selected packet header
packet content in hexadecimal and ASCII
(Untitled) - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: Expression... Clear Apply

```
No. -  Time       Source          Destination     Protocol Info
     1 0.000000   192.168.1.46    128.121.50.122  TCP      1163 > http [SYN] Seq=0 Len=0 MSS=1460
     2 0.127987   128.121.50.122  192.168.1.46    TCP      http > 1163 [SYN, ACK] Seq=0 Ack=1 Win=5
     5 0.329941   128.121.50.122  192.168.1.46    TCP      [TCP segment of a reassembled PDU]

⊞ Frame 4 (710 bytes on wire, 710 bytes captured)
⊞ Ethernet II, Src: Netgear_61:8e:6d (00:09:5b:61:8e:6d), Dst: Westell_9f:92:b9 (00:0f:db:9f:92:b9)
⊞ Internet Protocol, Src: 192.168.1.46 (192.168.1.46), Dst: 128.121.50.122 (128.121.50.122)
⊞ Transmission Control Protocol, Src Port: 1163 (1163), Dst Port: http (80), Seq: 1, Ack: 1, Len: 656
⊟ Hypertext Transfer Protocol
  ⊞ GET /news/ HTTP/1.1\r\n
    Host: www.wireshark.org\r\n
    User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.8.1.4) Gecko/20070515 Firefox/2.0.0.4
    Accept: text/xml,application/xml,application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;
    Accept-Language: en-us,en;q=0.5\r\n
    Accept-Encoding: gzip,deflate\r\n
    Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7\r\n
    Keep-Alive: 300\r\n
    Connection: keep-alive\r\n
    Referer: http://www.wireshark.org/faq.html\r\n
    Cookie: __utma=87653150.62471437.1181007582.1181007582.1181169142.2; __utmz=87653150.1181007582.1.1.utm
    \r\n
```

(Wireshark Graphical User Interface on Microsoft Windows)

The Wireshark interface has five major components:

The command menus are standard pulldown menus located at the top of the window. Of interest to us now is the File and Capture menus. The File menu allows you to save captured packet data or open a file containing previously captured packet data, and exit the Wireshark application. The Capture menu allows you to begin packet capture.

The packet-listing window displays a one-line summary for each packet captured, including the packet number (assigned by Wireshark; this is not a packet number contained in any protocol's header), the time at which the packet was captured, the packet's source and destination addresses, the protocol type, and protocol-specific information contained in the packet. The packet listing can be sorted according to any of these categories by clicking on a column name. The protocol type field lists the highest- level protocol that sent or received this packet, i.e., the protocol that is the source or ultimate sink for this packet.

The packet-header details window provides details about the packet selected (highlighted) in the packet-listing window. (To select a packet in the packet-listing window, place the cursor over the packet's one- line summary in the packet-listing window and click with the left mouse button.). These details include information about the Ethernet frame and IP datagram that contains this packet. The amount of Ethernet and IP-layer detail displayed can be expanded or minimized by clicking on the right- pointing or down- pointing arrowhead to the left of the Ethernet frame or IP datagram line in the packet details window. If the packet has been carried over TCP or UDP, TCP or UDP details will also be displayed, which can similarly be expanded or minimized. Finally, details about the highest-level protocol that sent or received this packet are also provided.

The packet-contents window displays the entire contents of the captured frame, in both ASCII and hexadecimal format.

Towards the top of the Wireshark graphical user interface, is the packet display filter field, into which a protocol name or other information can be entered in order to filter the information displayed in the packet-listing window (and hence the packet-header and packet-contents windows). In the examplebelow, we'll use the packet-display filter field to have Wireshark hide (not display) packets except those that correspond to HTTP messages.

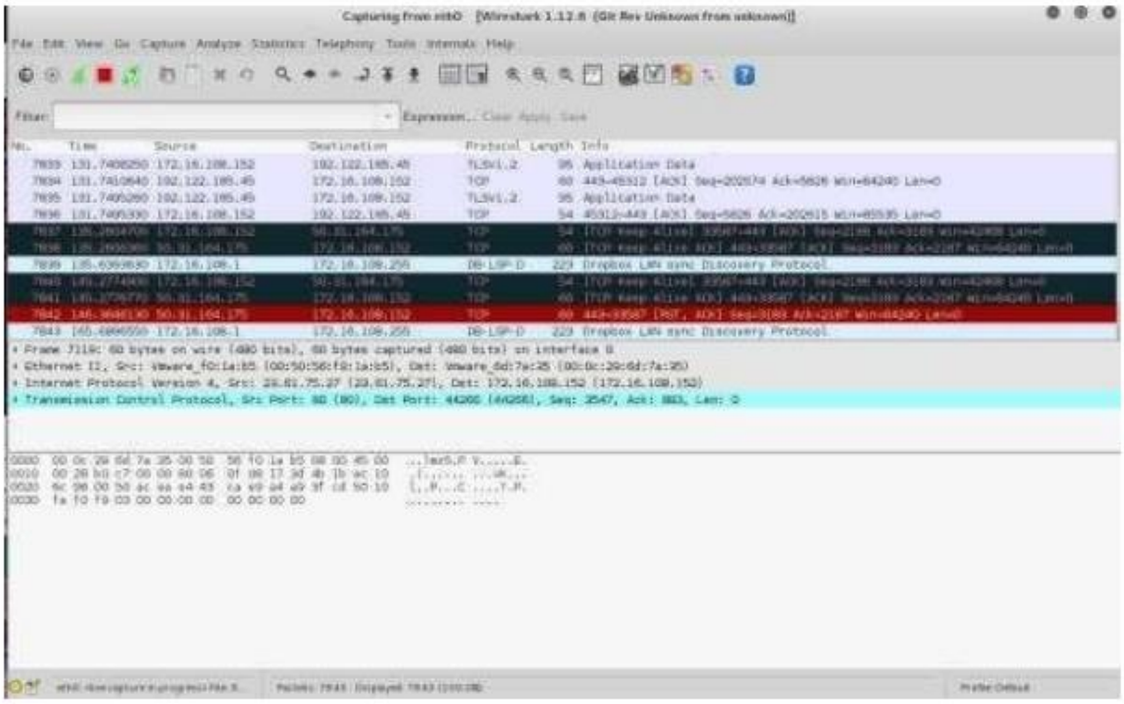
Capturing Packets

After downloading and installing Wireshark, you can launch it and click the name of an interface under Interface List to start capturing packets on that interface. For example, if you want to capture traffic on the wireless network, click your wireless interface.

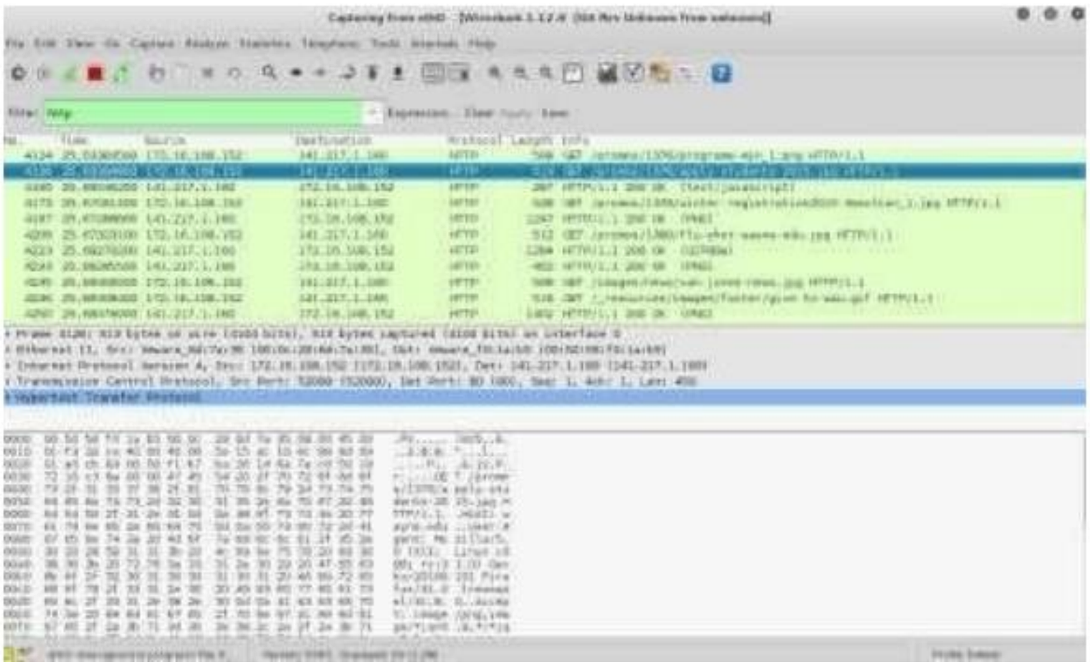
Test Run

Do the following steps:

1. Start up the Wireshark program (select an interface and press start to capture packets).
2. Start up your favorite browser (ceweasel in Kali Linux).
3. In your browser, go to Wayne State homepage by typing www.wayne.edu.
4. After your browser has displayed the http://www.wayne.edu page, stop Wireshark packet capture by selecting stop in the Wireshark capture window. This will cause the Wireshark capture window to disappear and the main Wireshark window to display all packets captured since you began packet capture see image below:



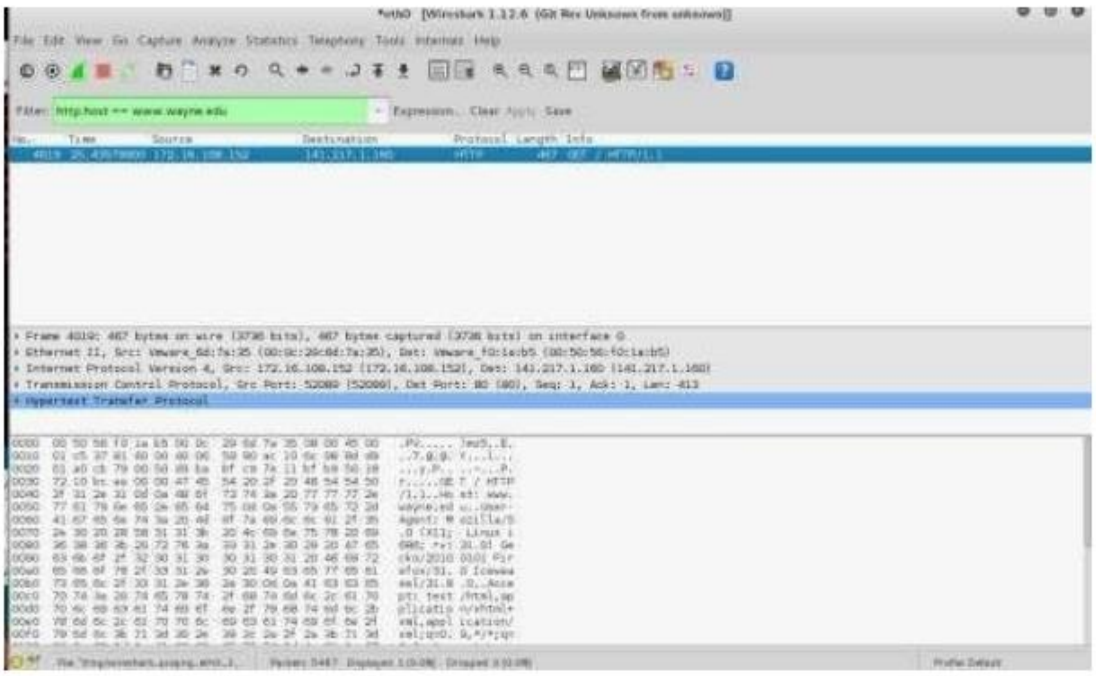
```
No.    Time          Source           Destination      Protocol Length Info
  7833 131.7408250   172.16.108.152   192.122.185.45   TLSv1.2    95   Application Data
  7834 131.7410640   192.122.185.45   172.16.108.152   TCP        60   443→45312 [ACK] Seq=202574 Ack=5826 Win=64240 Len=0
  7835 131.7405260   192.122.185.45   172.16.108.152   TLSv1.2    95   Application Data
  7836 131.7405330   172.16.108.152   192.122.185.45   TCP        54   45312→443 [ACK] Seq=5826 Ack=202615 Win=65535 Len=0
  7837 135.2604700   172.16.108.152   50.31.164.175    TCP        54   [TCP Keep-Alive] 33567→443 [ACK] Seq=2186 Ack=3189 Win=42808 Len=0
  7838 135.2606980   50.31.164.175    172.16.108.152   TCP        60   [TCP Keep-Alive ACK] 443→33567 [ACK] Seq=3189 Ack=2187 Win=64240 Len=0
  7839 135.6369830   172.16.108.1     172.16.108.255   DB-LSP-D  229   Dropbox LAN sync Discovery Protocol
  7840 145.2774800   172.16.108.152   50.31.164.175    TCP        54   [TCP Keep-Alive] 33567→443 [ACK] Seq=2186 Ack=3189 Win=42808 Len=0
  7841 145.2779770   50.31.164.175    172.16.108.152   TCP        60   [TCP Keep-Alive ACK] 443→33567 [ACK] Seq=3189 Ack=2187 Win=64240 Len=0
  7842 146.3646130   50.31.164.175    172.16.108.152   TCP        60   443→33567 [RST, ACK] Seq=3189 Ack=2187 Win=64240 Len=0
  7843 145.6866550   172.16.108.1     172.16.108.255   DB-LSP-D  229   Dropbox LAN sync Discovery Protocol
▸ Frame 7119: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
▸ Ethernet II, Src: Vmware_f0:1a:b5 (00:50:56:f0:1a:b5), Dst: Vmware_6d:7a:35 (00:0c:29:6d:7a:35)
▸ Internet Protocol Version 4, Src: 23.61.75.27 (23.61.75.27), Dst: 172.16.108.152 (172.16.108.152)
▸ Transmission Control Protocol, Src Port: 80 (80), Dst Port: 44266 (44266), Seq: 3547, Ack: 883, Len: 0

0000  00 0c 29 6d 7a 35 00 50  56 f0 1a b5 08 00 45 00   ..)mz5.P V.....E.
0010  00 28 b0 c7 00 00 80 06  0f 08 17 3d 4b 1b ac 10   .(...... ...=K...
0020  6c 98 00 50 ac ea e4 43  ca e9 a4 a9 5f cd 50 10   l..P...C ...._.P.
0030  fa f0 f9 03 00 00 00 00  00 00 00 00               ........ ....
```



5. Color Coding: You’ll probably see packets highlighted in green, blue, and black. Wireshark uses colors to help you identify the types of traffic at a glance. By default, green is TCP traffic, dark blue is DNS traffic, light blue is UDP traffic, and black identifies TCP packets with problems — for example, they could have been delivered out-of-order.

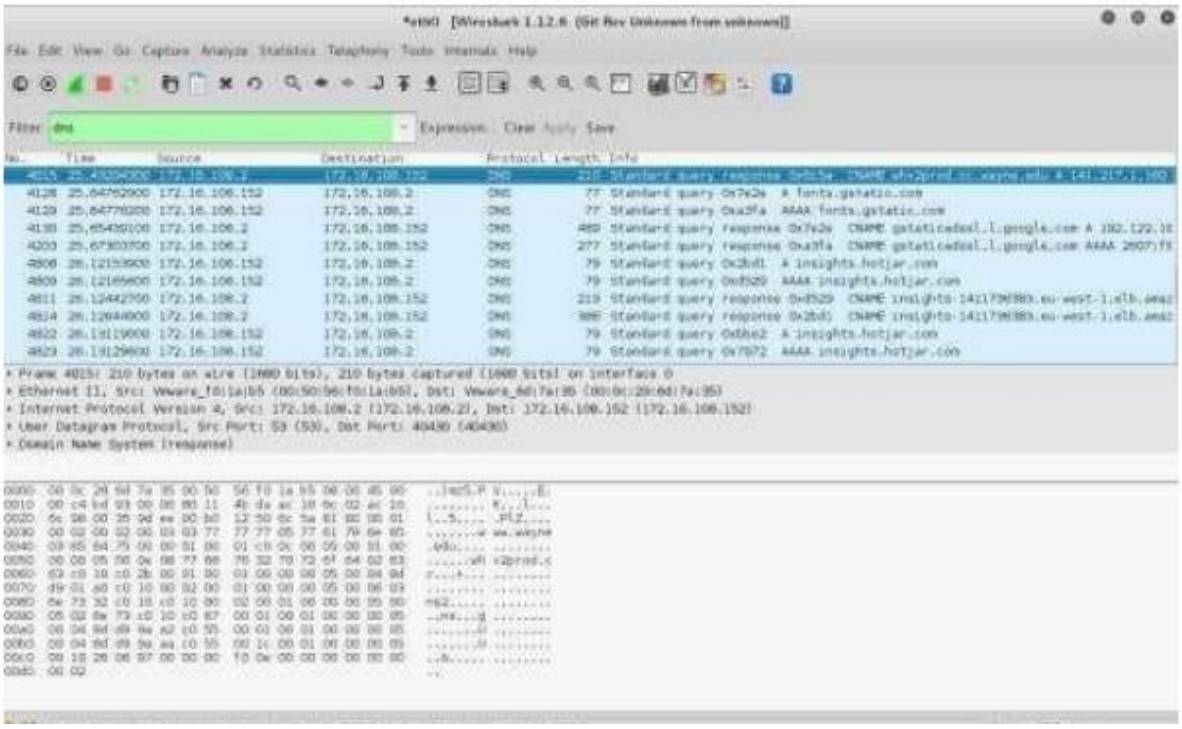
6. You now have live packet data that contains all protocol messages exchanged between your computer and other network entities! However, as you will notice the HTTP messages are not clearly shown because there are many other packets included in the packet capture. Even though the only action you took was to open your browser, there are many other programs in your computer that communicate via the network in the background. To filter the connections to the ones we want to focus on, we have to use the filtering functionality of Wireshark by typing “http” in the filtering field as shown below: Notice that we now view only the packets that are of protocol HTTP. However, we also still do not have the exact communication we want to focus on because using HTTP as a filter is not descriptive enough to allow us to find our connection to http://www.wayne.edu. We need to be more precise if we want to capture the correct set of packets.

7. To further filter packets in Wireshark, we need to use a more precise filter. By setting the http.host www.wayne.edu, we are restricting the view to packets that have as an http host the www.wayne.edu website. Notice that we need two equal signs to perform the match not just one. See the screenshot below:



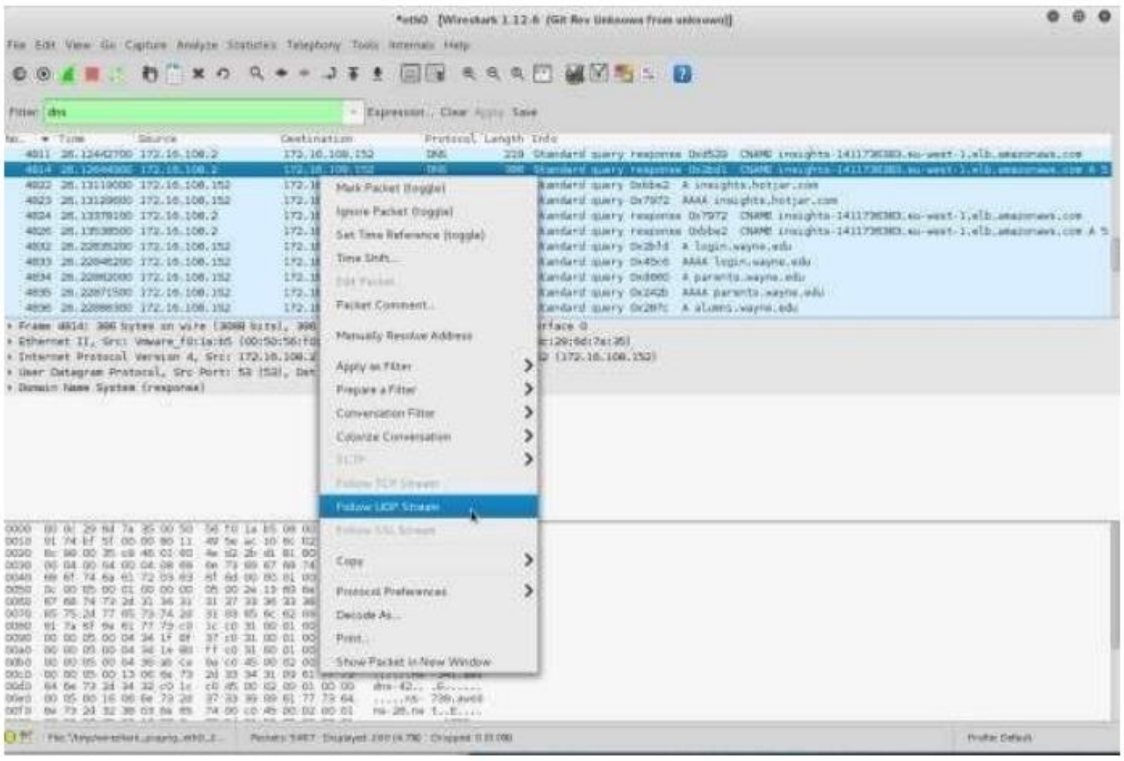
```
*eth0 [Wireshark 1.12.6 (Git Rev Unknown from unknown)]
Filter: http.host == www.wayne.edu
No.   Time          Source           Destination      Protocol Length Info
4019  25.43579000   172.16.108.152   141.217.1.160    HTTP     467    GET / HTTP/1.1

▸ Frame 4019: 467 bytes on wire (3736 bits), 467 bytes captured (3736 bits) on interface 0
▸ Ethernet II, Src: Vmware_6d:7a:35 (00:0c:29:6d:7a:35), Dst: Vmware_f0:1a:b5 (00:50:56:f0:1a:b5)
▸ Internet Protocol Version 4, Src: 172.16.108.152 (172.16.108.152), Dst: 141.217.1.160 (141.217.1.160)
▸ Transmission Control Protocol, Src Port: 52089 (52089), Dst Port: 80 (80), Seq: 1, Ack: 1, Len: 413
▸ Hypertext Transfer Protocol

[illegible]
```

8. Now, we can try another protocol. Let’s use Domain Name System (DNS) protocol as an example here



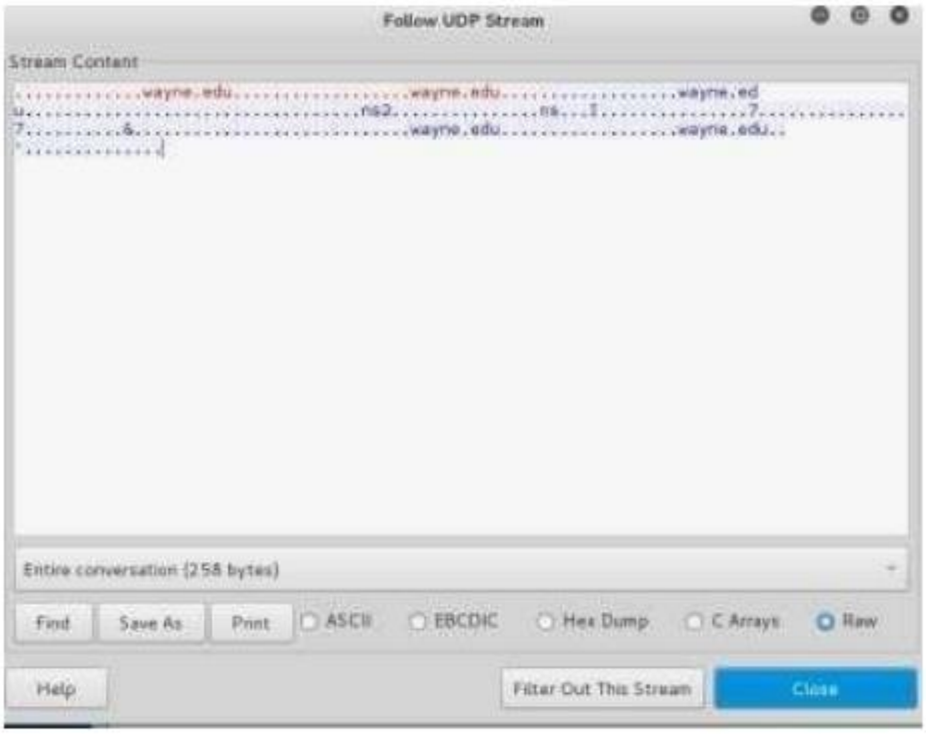
```
*eth0 [Wireshark 1.12.6 (Git Rev Unknown from unknown)]
Filter: dns
No.   Time          Source           Destination      Protocol Length Info
4015  25.43226000   172.16.108.2     172.16.108.152   DNS      210    Standard query response [illegible]
4128  25.64762900   172.16.108.152   172.16.108.2     DNS      77     Standard query 0x7e2e  A fonts.gstatic.com
4129  25.64778200   172.16.108.152   172.16.108.2     DNS      77     Standard query 0xa3fa  AAAA fonts.gstatic.com
4130  25.65439100   172.16.108.2     172.16.108.152   DNS      489    Standard query response 0x7e2e  CNAME gstaticadssl.l.google.com A 192.122.1[illegible]
4203  25.67303700   172.16.108.2     172.16.108.152   DNS      277    Standard query response 0xa3fa  CNAME gstaticadssl.l.google.com AAAA 2607:f[illegible]
4808  26.12153900   172.16.108.152   172.16.108.2     DNS      79     Standard query 0x2bd1  A insights.hotjar.com
4809  26.12165600   172.16.108.152   172.16.108.2     DNS      79     Standard query 0xd529  AAAA insights.hotjar.com
4811  26.12442700   172.16.108.2     172.16.108.152   DNS      219    Standard query response 0xd529  CNAME insights-1411790383.eu-west-1.elb.ama[illegible]
4814  26.12644900   172.16.108.2     172.16.108.152   DNS      386    Standard query response 0x2bd1  CNAME insights-1411790383.eu-west-1.elb.ama[illegible]
4822  26.13119000   172.16.108.152   172.16.108.2     DNS      79     Standard query 0xbbe2  A insights.hotjar.com
4823  26.13129600   172.16.108.152   172.16.108.2     DNS      79     Standard query 0x7872  AAAA insights.hotjar.com

▸ Frame 4015: 210 bytes on wire (1680 bits), 210 bytes captured (1680 bits) on interface 0
▸ Ethernet II, Src: Vmware_f0:1a:b5 (00:50:56:f0:1a:b5), Dst: Vmware_6d:7a:35 (00:0c:29:6d:7a:35)
▸ Internet Protocol Version 4, Src: 172.16.108.2 (172.16.108.2), Dst: 172.16.108.152 (172.16.108.152)
▸ User Datagram Protocol, Src Port: 53 (53), Dst Port: 40430 (40430)
▸ Domain Name System (response)

[illegible]
```

9. conversations (also called network flows), select one of the packets and press the right mouse button (if you are on a Mac use the command button and click), you should see something similar to the screen below:

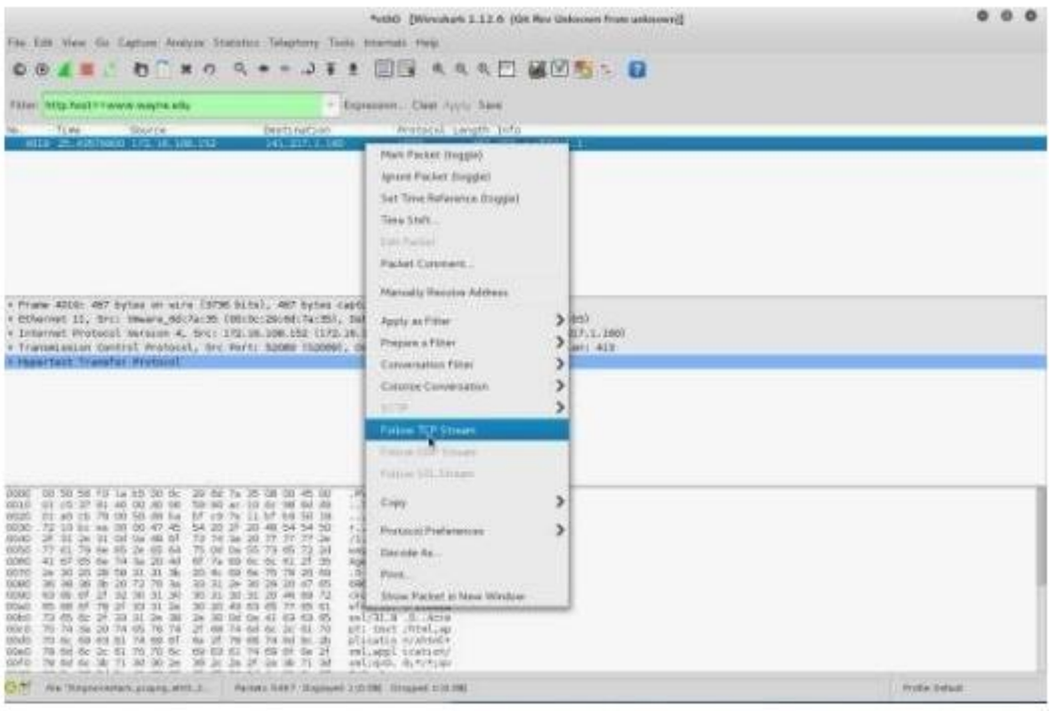


```
No.  ▾ Time          Source          Destination     Protocol Length Info
4811 28.12442700 172.16.108.2    172.16.108.152  DNS      219 Standard query response 0xd520  CNAME insights-1411730383.eu-west-1.elb.amazonaws.com
4814 28.12644300 172.16.108.2    172.16.108.152  DNS      306 Standard query response 0x2bd1  CNAME insights-1411730383.eu-west-1.elb.amazonaws.com A 5
4822 28.13110000 172.16.108.152  172.1                        Standard query 0xbbe2  A insights.hotjar.com
4823 28.13120600 172.16.108.152  172.1                        Standard query 0x7972  AAAA insights.hotjar.com
4824 28.13378100 172.16.108.2    172.1                        Standard query response 0x7972  CNAME insights-1411730383.eu-west-1.elb.amazonaws.com
4826 28.13538500 172.16.108.2    172.1                        Standard query response 0xbbe2  CNAME insights-1411730383.eu-west-1.elb.amazonaws.com A 5
4832 28.22835200 172.16.108.152  172.1                        Standard query 0x2b7d  A login.wayne.edu
4833 28.22848200 172.16.108.152  172.1                        Standard query 0x45c6  AAAA login.wayne.edu
4834 28.22862000 172.16.108.152  172.1                        Standard query 0xd060  A parents.wayne.edu
4835 28.22871500 172.16.108.152  172.1                        Standard query 0x242b  AAAA parents.wayne.edu
4836 28.22886300 172.16.108.152  172.1                        Standard query 0x207c  A alumni.wayne.edu
▸ Frame 4814: 306 bytes on wire (3048 bits), 306                   rface 0
▸ Ethernet II, Src: Vmware_f0:1a:b5 (00:50:56:f0                   c:29:6d:7a:35)
▸ Internet Protocol Version 4, Src: 172.16.108.2                   2 (172.16.108.152)
▸ User Datagram Protocol, Src Port: 53 (53), Dst
▸ Domain Name System (response)
```

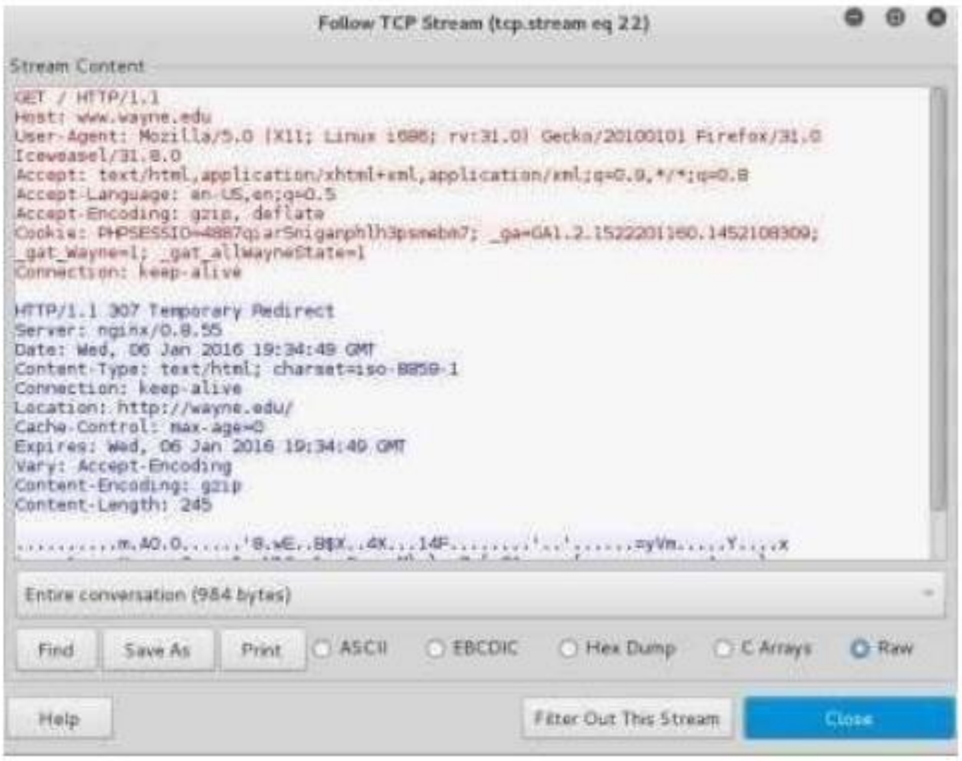
Click on **Follow UDP Stream,** and then you will see following screen.



```
..............wayne.edu....................wayne.edu...................wayne.ed
u.......................................ns2..............ns...I..............7...............
7..........&...............................wayne.edu....................wayne.edu..
...............
```



10. If we close this window and change the filter back to "http.hos ww.wayne.edu" and then follow a packetfrom the list of packets that match that filter, we should get the something similar to the following screens. Note that we click on Follow TCP Stream this time.


Follow TCP Stream (tcp.stream eq 22)

Stream Content

```
GET / HTTP/1.1
Host: www.wayne.edu
User-Agent: Mozilla/5.0 (X11; Linux i686; rv:31.0) Gecko/20100101 Firefox/31.0
Iceweasel/31.8.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Cookie: PHPSESSID=4887qiarSniganphlh3psmebm7; _ga=GA1.2.1522201160.1452108309;
_gat_Wayne=1; _gat_allWayneState=1
Connection: keep-alive

HTTP/1.1 307 Temporary Redirect
Server: nginx/0.8.55
Date: Wed, 06 Jan 2016 19:34:49 GMT
Content-Type: text/html; charset=iso-8859-1
Connection: keep-alive
Location: http://wayne.edu/
Cache-Control: max-age=0
Expires: Wed, 06 Jan 2016 19:34:49 GMT
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 245

..........m.AO.O......'8.wE..B$X..4X...14F.........'..'.......=yVm.....Y.....x
```

Entire conversation (984 bytes)

Result:
Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.

Ex .No : 6 **Date :**	**Check message integrity and confidentiality using SSL**	**Page No : 29**

Aim

SSL Session in Details

Handshaking - Ciphersuit Negotiation

Client sends a plaintext Client_Hello message and suggests some cryptographic parameters (collectively called ciphersuit) to be used for their communication session. The Client_Hello message also contains a 32-byte random number denoted as client_random. For example,

Client_Hello:

Protocol Version: TLSv1 if you can, else SSLv3.

Key Exchange: RSA if you can, else Diffe-Hellman.

Secret Key Cipher Method: 3DES if you can, else DES.

Message Digest: SHA-1 if you can, else MD5.

Data Compression Method: PKZip if you can, else gzip.

Client Random Number: 32 bytes.

The stronger method (in terms of security) shall precede the weaker one, e.g. RSA (1024-bit) precedes DH, 3DES precedes DES, SHA-1 (160-bit) precedes MD5 (128-bit).

Server responds with a plaintext Server_Helllo to state the ciphersuit of choice (server decides on the ciphersuit). The message also contains a 32-byte random number denoted as server_random. For example,

Server_Hello:

Protocol Version: TLSv1.

Key Exchange: RSA.

Secret Key Cipher Method: DES.

Message Digest: SHA-1.

Data Compression Method: PKZip.

Server Random Number: 32 bytes.

Handshaking - Key Exchange

The server sends its digital certificate to the client, which is supposedly signed by a root CA. The client uses the root CA's public key to verify the server's certificate (trusted root-CAs' public key are pre-installed inside the browser). It then retrieves the server's public key from the server's certificate. (If the server's certificate is signed by a sub-CA, the client has to build a digital certificate chain, leading to a trusted root CA, to verify the server's certificate.)

The server can optionally request for the client's certificate to authenticate the client. In practice, server usually does not authenticate the client. This is because:

 Server authenticates client by checking the credit card in an e-commerce transaction.

 Most clients do not have a digital certificate.

 Authentication via digital certificate takes time and the server may lose an impatient client.

The next step is to establish the Session Key:

1. The client generates a 48-byte (384-bit) random number called pre_master_secret, encrypts it using the verified server's public key and sends it to the server.
2. Server decrypts the pre_master_secret using its own private key. Eavesdroppers cannot decrypt the pre_master_secret, as they do not possess the server's private key.
3. Client and server then independently and simultaneously create the session key, based on the pre_master_secret, client_random and server_random. Notice that both the server and client contribute to the session key, through the inclusion of the random number exchange in the hello messages. Eavesdroppers can intercept client_random and server_random as they are sent in plaintext, but cannot decrypt the pre_master_secret.
4. In a SSL/TLS session, the session key consists of 6 secret keys (to thwart crypto-analysis). 3 secret keys are used for client-to-server messages, and the other 3 secret keys are used for server-to-client messages. Among the 3 secret keys, one is used for encryption (e.g., DES secret key), one is used for message integrity (e.g., HMAC) and one is used for cipher initialization. (Cipher initialization uses a random plaintext called Initial Vector (IV) to prime the cipher pump.)
5. Client and server use the pre_master_secret (48-byte random number created by the client and exchange securely), client_random, server_random, and a pseudo-random function (PRF) to generate a master_secret. They can use the master_secret, client_random, server_random, and the pseudo-random function (PRF) to generate all the 6 shared secret keys. Once the secret keys are generated, the pre_master_secret is no longer needed and should be deleted.
6. From this point onwards, all the exchanges are encrypted using the session key.
7. The client sends Finished handshake message using their newly created session key. Server responds with a Finished handshake message.

Message Exchange

Client and server can use the agreed-upon session key (consists of 6 secret keys) for secure exchange of messages.

Sending messages:

1. The sender compresses the message using the agreed-upon compression method (e.g., PKZip, gzip).
2. The sender hashes the compressed data and the secret HMAC key to make an HMAC, to assure message integrity.
3. The sender encrypts the compressed data and HMAC using encryption/decryption secret key, to assure message confidentiality.

Retrieve messages:

1. The receiver decrypts the ciphertext using the encryption/decryption secret key to retrieve the compressed data and HMAC.
2. The receiver hashes the compressed data to independently produce the HMAC. It then verifies the generated HMAC with the HMAC contained in the message to assure message integrity.
3. The receiver un-compresses the data using the agreed-upon compression method to recover the plaintext.

The following diagram shows the sequence of the SSL messages for a typical client/server session.

A SSL Session Trace

We could use OpenSSL's s_client (with debug option) to produce a SSL session trace.

> openssl s_client ?

(Display the available options)

The following command turns on the debug option and forces the protocol to be TLSv1:

```
> openssl s_client -connect localhost:443 -CAfile ca.crt -debug -tls1
Loading 'screen' into random state - done
CONNECTED(00000760)
write to 00988EB0 [009952C8] (102 bytes => 102 (0x66))
0000 - 16 03 01 00 61 01 00 00-5d 03 01 40 44 35 27 5c ....a...]..@D5'\
0010 - 5a e8 74 26 e9 49 37 e2-06 3b 1c 6d 77 37 d1 ae Z.t&.I7..;.mw7..
0020 - 44 07 86 47 98 fa 84 1a-8d f4 72 00 00 36 00 39 D..G.....r..6.9
0030 - 00 38 00 35 00 16 00 13-00 0a 00 33 00 32 00 2f .8.5.......3.2./
0040 - 00 07 00 66 00 05 00 04-00 63 00 62 00 61 00 15 ...f.....c.b.a..
```

```
0050 - 00 12 00 09 00 65 00 64-00 60 00 14 00 11 00 08 .....e.d.`......

0060 - 00 06 00 03 01 .....

0066 - <SPACES/NULS>

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))

0000 - 16 03 01 00 2a.......................................*

read from 00988EB0 [00990ABD] (42 bytes => 42 (0x2A))

0000 - 02 00 00 26 03 01 40 44-35 27 cc ef 2b 51 e1 b0 ...&..@D5'..+Q..

0010 - 44 1f ef c4 83 72 df 37-4f 9b 2b dd 11 50 13 87 D....r.7O.+..P..

0020 - 91 0a a2 d2 28 b9 00 00-16 ....(....

002a - <SPACES/NULS>

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))

0000 - 16 03 01 02 05 .....

read from 00988EB0 [00990ABD] (517 bytes => 517 (0x205))

0000 - 0b 00 02 01 00 01 fe 00-01 fb 30 82 01 f7 30 82 ..........0. .0.

0010 - 01 60 02 01 01 30 0d 06-09 2a 86 48 86 f7 0d 01 .`...0...*.H....
0020 - 01 04 05 00 30 4d 31 0b-30 09 06 03 55 04 06 13 ....0M1.0...U...

0030 - 02 55 53 31 10 30 0e 06-03 55 04 0b 13 07 74 65 .US1.0...U...te

0040 - 73 74 31 30 31 31 0c 30-0a 06 03 55 04 03 13 03 st1011.0...U....

0050 - 63 68 63 31 1e 30 1c 06-09 2a 86 48 86 f7 0d 01 chc1.0...*.H....

0060 - 09 01 16 0f 63 68 63 40-74 65 73 74 31 30 31 2e......chc@test101.

0070 - 63 6f 6d 30 1e 17 0d 30-34 30 32 32 36 30 36 35 com0. .040226065

0080 - 36 35 34 5a 17 0d 30 35-30 32 32 35 30 36 35 36 654Z 0502250656

0090 - 35 34 5a 30 3b 31 0b 30-09 06 03 55 04 06 13 02 54Z0;1.0...U....

00a0 - 55 53 31 0c 30 0a 06 03-55 04 03 13 03 63 68 63 US1.0...U...chc

00b0 - 31 1e 30 1c 06 09 2a 86-48 86 f7 0d 01 09 01 16 1.0...*.H.......

00c0 - 0f 63 68 63 40 74 65 73-74 31 30 31 2e 63 6f 6d .chc@test101.com

00d0 - 30 81 9f 30 0d 06 09 2a-86 48 86 f7 0d 01 01 01 0..0...*.H......

00e0 - 05 00 03 81 8d 00 30 81-89 02 81 81 00 cd e4 9e ......0.........

00f0 - 7c b6 d2 34 4e d3 53 46-25 c7 53 88 25 60 e6 46 |..4N.SF%.S.%`.F

0100 - db 64 3a 73 61 92 ac 23-92 cd 2c 94 a9 8f c6 7f .d:sa..#..,.....

0110 - 47 73 c0 d9 8d 34 b7 2c-dd c9 86 bd 82 6f ce ac Gs...4.,.....o..

0120 - d8 e2 ba 0f e5 f5 3a 67-2c 89 1a 1b 03 eb 21 85 ......:g,....!.

0130 - 28 e3 29 98 84 ed 46 75-82 fa 0f 30 a3 a9 a5 71 (.)...Fu...0. .q
0140 - 46 4c d6 0d 17 c4 19 fd-44 fb e2 18 46 a6 9d ab FL......D...F...
0150 - 91 de 6b a1 7f fe 30 06-28 5d d8 d3 29 00 c3 1d ..k...0.(]..)...
0160 - 4c 13 00 61 8f f3 85 51-f5 68 d8 69 25 02 03 01 L..a...Q.h.i%...
0170 - 00 01 30 0d 06 09 2a 86-48 86 f7 0d 01 01 04 05 ..0...*.H.......
0180 - 00 03 81 81 00 29 fd bf-5a ed 70 8f 53 a4 e9 14 .....)..Z.p.S...
0190 - 4c 5e ba 84 c6 54 1b f2-c0 3c c4 30 0f 7f 12 80 L^...T...<.0....
01a0 - 4e 01 b7 fd 39 50 f1 41-0d d8 aa 77 d9 87 25 1a N...9P.A...w..%.
01b0 - 1e e2 97 88 4f 53 75 c8-70 22 6a 01 61 0f 51 3e......OSu.p"j.a.Q>
01c0 - 13 19 9c 64 f2 76 14 e8-85 25 23 a2 11 c4 8c f8 ...d.v...%#.....
01d0 - 23 2c d1 c3 d3 71 3a e6-71 54 10 07 dc 72 ff ee #,...q:.qT...r..
01e0 - e8 3e cf 8e 77 73 e9 9f-f5 9a 90 60 4d a0 aa 03 .>..ws.....`M...
01f0 - 32 1f 11 6f 2e 9a 5f 3c-77 05 22 0c 81 bf 29 96 2..o.._ 5 (0x5))
0000 - 16 03 01 01 8d .....
read from 00988EB0 [00990ABD] (397 bytes => 397 (0x18D))
0000 - 0c 00 01 89 00 80 e6 96-9d 3d 49 5b e3 2c 7c f1...........=I[.,|.
0010 - 80 c3 bd d4 79 8e 91 b7-81 82 51 bb 05 5e 2a 20 ....y.....Q..^*
0020 - 64 90 4a 79 a7 70 fa 15-a2 59 cb d5 23 a6 a6 ef d.Jy.p...Y..#...
0030 - 09 c4 30 48 d5 a2 2f 97-1f 3c 20 12 9b 48 00 0e ..0H../..< ..H..
0040 - 6e dd 06 1c bc 05 3e 37-1d 79 4e 53 27 df 61 1e n....>7.yNS'.a.
0050 - bb be 1b ac 9b 5c 60 44-cf 02 3d 76 e0 5e ea 9b .....\`D..=v.^..
0060 - ad 99 1b 13 a6 3c 97 4e-9e f1 83 9e b5 db 12 51 .....<.N......Q
0070 - 36 f7 26 2e 56 a8 87 15-38 df d8 23 c6 50 50 85 6.&.V...8..#.PP.
0080 - e2 1f 0d d5 c8 6b 00 01-02 00 80 11 3f 5f fa e4 .....k......?_..
0090 - 79 9a 0b d9 e0 67 37 c4-2a 88 22 b0 95 b7 a7 be y....g7.*.".....
00a0 - 93 79 9d 51 ae 31 47 99-df 47 dd 80 5e 3d 2a 4a .y.Q.1G..G..^=*J
00b0 - 29 8b fd c1 63 5e 48 e8-e3 fd ac 95 1b 3a 5f 75 )...c^H.....:_u
00c0 - 98 2d 3c 9c ba 68 18 7b-be 38 2c 69 3d 41 b7 c3 .-<..h.{.8,i=A..
00d0 - 08 a1 da b0 a8 a4 fe 9a-d6 1e 56 ff 4c 8c 6e 6b............V.L.nk
00e0 - 18 f1 ec 9d 22 a9 90 27-c1 c6 2c 0e bd 0e 13 d4 ....".'..,.....
00f0 - fd b2 c9 8f 6f bb 8e 06-e0 b5 1f f7 87 03 5f a8 ....o........_.
0100 - 12 4f bb ce ba f1 76 fb-80 08 37 00 80 30 99 ad .O....v...7..0..
0110 - 9b fc 3a 14 6b a8 2c c5-fe 7b bd 1c 92 ec 19 a6 ..:.k.,..{......
```

```
0120 - 75 2d 69 4e f4 9f 74 60-5d d4 3e 06 97 38 bc b5 u-iN..t`].>..8..

0130 - 0e 3c 1f f2 99 e6 55 4a-36 42 a8 f2 b7 32 2a 1e .<....UJ6B. .2*.

0140 - a3 87 b3 f3 79 43 28 d1-7a 0d db 7c 11 26 f3 68 ....yC(.z..|.&.h

0150 - b1 73 b6 78 4b f3 22 20-e4 f7 27 08 ab 74 92 92 .s.xK." ..'..t..

0160 - 79 26 61 40 1e e9 90 11-e8 b1 cf 99 d9 9f c7 68 y&a@..........h

0170 - 48 e8 f2 a5 d5 d7 0e e1-88 9a bd 0f 40 85 af 2d H..........@..-

0180 - da 76 3a 10 6e b9 38 4d-37 9c 41 c8 9f .v:.n.8M7.A..

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))

0000 - 16 03 01 00 04 .....

read from 00988EB0 [00990ABD] (4 bytes => 4 (0x4))

0000 - 0e .

0004 - <SPACES/NULS>

write to 00988EB0 [00999BE0] (139 bytes => 139 (0x8B))

0000 - 16 03 01 00 86 10 00 00-82 00 80 63 c2 3c 69 26 ...........c...dU.....]n..

0030 - 05 f1 db 44 f3 13 a8 24-3a 76 0e 3e 1a 6e 55 0c ...D. .$:v.>.nU.

0040 - 31 9b 04 99 30 ff 8f d2-8d 8e 0d b1 67 ac 43 ee 1...0......g.C.

0050 - b2 3f d3 c7 c5 33 81 e1-3f d2 47 6f 5d 8a fb 4c .?...3..?.Go]..L

0060 - 62 c7 23 b3 f7 ad 3c a9-0c 87 4a 08 07 55 ba 06 b.#...<...J..U..

0070 - 34 18 0c 5f d9 35 f0 2b-90 9a 9d 6b 87 62 41 0f 4.._.5.+. .k.bA.

0080 - b3 47 74 5f 5b b8 59 5a-b2 21 dd .Gt_[.YZ.!.

write to 00988EB0 [00999BE0] (6 bytes => 6 (0x6))

0000 - 14 03 01 00 01 01 ......

write to 00988EB0 [00999BE0] (45 bytes => 45 (0x2D))

0000 - 16 03 01 00 28 0f 31 83-e0 f8 91 fa 33 98 68 46 ....(.1....3.hF

0010 - c0 60 83 66 28 fe d3 a5-00 f0 98 d5 df 22 72 2d .`.f(......."r0020 - e4 40 9b 96 3b 4c f9 02-13
a7 e7 77 74 .@..;L....wt

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))

0000 - 14 03 01 00 01 .....

read from 00988EB0 [00990ABD] (1 bytes => 1 (0x1))

0000 - 01 .

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))

0000 - 16 03 01 00 28.......................................(

read from 00988EB0 [00990ABD] (40 bytes => 40 (0x28))
```

```
0000 - d4 0b a6 b7 e8 91 09 1e-e4 1e fc 44 5f 80 cc a1 ...........D_...
0010 - 5d 51 55 3e 62 e8 0f 78-07 f6 2f cd f9 bc 49 8d ]QU>b..x../. .I.
0020 - 56 5b e8 b2 09 2c 18 52- V[...,.R
---
Certificate chain
0 s:/C=US/CN=chc/emailAddress=chc@test101.com
i:/C=US/OU=test101/CN=chc/emailAddress=chc@test101.com
---
Server certificate
-----BEGIN CERTIFICATE-----
MIIB9zCCAWACAQEwDQYJKoZIhvcNAQEEBQAwTTELMAkGA1UEBhMCVVMxEDAOB
gNV
BAsTB3Rlc3QxMDExDDAKBgNVBAMTA2NoYzEeMBwGCSqGSIb3DQEJARYPY2hjQHRl
c3QxMDEuY29tMB4XDTA0MDIyNjA2NTY1NFoXDTA1MDIyNTA2NTY1NFowOzELMAkG
A1UEBhMCVVMxDDAKBgNVBAMTA2NoYzEeMBwGCSqGSIb3DQEJARYPY2hjQHRlc3Q
x
MDEuY29tMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQDN5J58ttI0TtNTRiXH
U4glYOZG22Q6c2GSrCOSzSyUqY/Gf0dzwNmNNLcs3cmGvYJvzqzY4roP5fU6ZyyJ
GhsD6yGFKOMpmITtRnWC+g8wo6mlcUZM1g0XxBn9RPviGEamnauR3muhf/4wBihd
2NMpAMMdTBMAYY/zhVH1aNhpJQIDAQABMA0GCSqGSIb3DQEBBAUAA4GBACn9v1rt
cI9TpOkUTF66hMZUG/LAPMQwD38SgE4Bt/05UPFBDdiqd9mHJRoe4peIT1N1yHAi
agFhD1E+ExmcZPJ2FOiFJSOiEcSM+CMs0cPTcTrmcVQQB9xy/+7oPs+Od3Ppn/Wa
kGBNoKoDMh8Rby6aXzx3BSIMgb8plq3LOxiu
-----END CERTIFICATE-----
subject=/C=US/CN=chc/emailAddress=chc@test101.com
issuer=/C=US/OU=test101/CN=chc/emailAddress=chc@test101.com
---
No client certificate CA names sent
---
SSL handshake has read 1031 bytes and written 292 bytes
---
New, TLSv1/SSLv3, Cipher is EDH-RSA-DES-CBC3-SHA
```

```
Server public key is 1024 bit
SSL-Session:
Protocol : TLSv1
Cipher : EDH-RSA-DES-CBC3-SHA
Session-ID:
Session-ID-ctx:
Master-Key: 57FDDAF85C7D287F9F9A070E8784A29C75E788DA2757699B
20F3CA50E7EE01A66182A71753B78DA218916136D50861AE
Key-Arg : None
Start Time: 1078211879
Timeout : 7200 (sec)
Verify return code: 0 (ok)
---
GET /test.html HTTP/1.0
write to 00988EB0 [009952C8] (82 bytes => 82 (0x52))
0000 - 17 03 01 00 18 74 fa 45-35 2d b1 24 59 cf ad 96 .....t.E5-.$Y...
0010 - 34 30 01 7d be 8e 70 f9-41 62 11 f1 36 17 03 01 40.}..p.Ab..6...
0020 - 00 30 56 61 ba 2d d3 58-5d e6 6a 83 78 07 87 7a .0Va.-.X].j.x..z
0030 - db b2 a7 40 c7 6d c1 4a-20 3b 82 7d aa 15 e8 65 ...@.m.J ;.}...e
0040 - 3b 92 bd c8 20 e9 9d 41-f1 77 51 d9 ae 31 c4 2c ;... ..A.wQ..1.,
0050 - 32 5a 2Z
write to 00988EB0 [009952C8] (58 bytes => 58 (0x3A))
0000 - 17 03 01 00 18 39 2f df-43 75 91 13 34 1b 12 04 .....9/.Cu..4...
0010 - 7d ef 8d e1 86 54 4f 67-c8 1d cd 07 a4 17 03 01 }....TOg........
0020 - 00 18 53 d9 22 9d eb 6e-8b 79 f8 e4 82 2f ba ea ..S."..n.y.../..
0030 - 03 a5 3f 12 85 2e 9f 64-ff dc ..?....d..
read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))
0000 - 17 03 01 01 48.......................................H
read from 00988EB0 [00990ABD] (328 bytes => 328 (0x148))
0000 - bd eb 8b 9c 01 ac 73 30-8f ca a4 8b 2a 6f bd 02 ......s0....*o..
0010 - d7 fc 71 18 61 47 f2 1d-70 8b 10 7d 98 28 a4 50 ..q.aG..p..}.(.P
0020 - f3 0f 42 e8 c5 e1 3e 53-34 bd c7 62 34 1b 5e 8c ..B...>S4..b4.^.
```

```
0030 - 99 2d 89 c6 b3 f0 19 96-22 97 43 b8 8f 9d 76 42 .-......".C. .vB

0040 - 95 a5 7c db 3b 22 dd 57-29 8d e8 d4 28 3e 89 d8 ..|.;".W)...(>..

0050 - 46 e5 dc 35 51 56 f8 44-d1 82 44 a0 65 b0 93 22 F..5QV.D..D.e.."

0060 - 4b 0a eb 07 26 c9 2a e2-45 4c de 07 0c bb 3e c6 K...&.*.EL...>.

0070 - bc 37 94 cd ec 94 2f 35-76 37 13 4d 0f 88 9c b1 .7..../5v7.M....

0080 - d7 1c 58 8a 35 5b 32 bc-12 2b 9c e6 5b d4 86 bd ..X.5[2..+..[...

0090 - 39 fc 99 18 79 ec f7 53-db 59 74 49 da 07 69 54 9...y..S.YtI..iT

00a0 - f4 66 aa 36 34 39 f9 0b-87 50 9e 76 db 9f d0 44 .f.649...P.v. .D

00b0 - 0c 0d e7 65 80 9b b8 51-56 3d d0 db aa 55 ff ca ...e...QV=...U..

00c0 - 74 38 24 c1 8c d7 32 cf-ab 03 b3 59 29 0f 80 18 t8$...2....Y)...

00d0 - 6a d4 e0 7e fd 41 8c f7-1d 81 12 a7 00 b3 71 39 j..~.A.......q9

00e0 - 78 1e 3c 17 42 d4 99 22-69 7b 2d 09 ef d8 6e f4 x.<.B.."i{....n.

00f0 - 64 f6 61 34 72 8c 89 f5-a8 ea 1c b1 0d 08 ff 17 d.a4r..........

0100 - 51 3e 46 2b 38 75 61 6a-1e 34 f4 14 14 38 0d 5e Q>F+8uaj.4. .8.^

0110 - 6e ba db ef 83 88 ee a5-2c 18 5a 0c 27 e3 d9 19 n.......,.Z.'...

0120 - 6c a3 12 c0 a1 3d e1 14-96 d3 1a f9 c9 f2 aa d6 l....=..........

0130 - 12 d5 36 ae 36 f2 18 f5-df c6 ef 34 d7 7d 2b 70 ..6.6.....4.}+p

0140 - 99 88 47 93 91 09 56 b1- ..G...V.

HTTP/1.1 200 OK

Date: Tue, 02 Mar 2004 07:18:08 GMT

Server: Apache/1.3.29 (Win32) mod_ssl/2.8.16 OpenSSL/0.9.7c

Last-Modified: Sat, 07 Feb 2004 10:53:25 GMT

ETag: "0-23-4024c3a5"

Accept-Ranges: bytes

Content-Length: 35

Connection: close

Content-Type: text/html

<h1>Home page on main server</h1>

read from 00988EB0 [00990AB8] (5 bytes => 5 (0x5))
0000 - 15 03 01 00 18 .....

read from 00988EB0 [00990ABD] (24 bytes => 24 (0x18))

0000 - a5 47 51 bd aa 0f 9b e4-ac d4 28 f2 d0 a0 c8 fa .GQ.......(.....

0010 - 2c d4 e5 e4 be c5 01 85- ,.......
```

```
closed
write to 00988EB0 [009952C8] (29 bytes => 29 (0x1D))
0000 - 15 03 01 00 18 d4 19 b9-59 88 88 c0 c9 38 ab 5c ........Y...8.\
0010 - 98 8c 43 fd b8 9e 14 3d-77 5e 4c 68 03 ..C....=w^Lh.
```

Trace Analysis

The data to be transmitted is broken up into series of fragments. Each fragment is protected for integrity using HMAC. (more)

Each SSL record begins with a 5-byte header:

 Byte 0: Record Content Type. Four Content Types are defined, as follows:

Content Type	**Hex Code**	**Description**
Handshake	0x16	The record carries a handshaking message
Application_Data	0x17	Encrypted Application Data
Change_Cipher_Spec	0x14	To indicate a change in encryption methods.

Alert 0x15 To signal various types of errors

 Byte 1 & 2: SSL version (0x0301 for TLSv1, 0x0300 for SSLv3).

 Byte 3 & 4: The record length, excluding the 5-byte header.

Let us begin looking into the handshake message contained within a SSL record (of Content Type 0x16). The handshake message has a 4-byte header:

 Byte 0: Handshake Type, as follows:

Handshake Type	**Hex Code**
hello_request	0x00
client_hello	0x01
server_hello	0x02
certificate	0x0b
server_key_exchange	0x0c
certificate_request	0x0d
server_hello_done	0x0e
certificate_verify	0x0f
client_key_exchange	0x10

finished 0x14

 Byte 1 - 3: The message length, excluding the 3-byte header.
Hence, a client_hello record will begin with a 5-byte record header, followed by a 4-byte handshake message header. For example,

Client_Hello

The first handshake message is always sent by the client, called client_hello message. In this message, the client tells the server its preferences in terms of protocol version, ciphersuit, and compression method. The client also includes a 32-byte random number (client_random) in the message, which is made up of a 4-byte GMT Unix time (seconds since 1970), plus another 28 random bytes.

You must refer to RFC2246 for the structure of the Client_Hello message.

Bytes Len Value Description

00 1 16 Record Content Type - Handshake Message

01-02 2 03 01 SSL version - TLSv1

03-04 2 00 61 Record Length

05 1 01 Handshake Type - Client_Hello

06-08 3 00 00 5d Message Length (0x61-4 = 0x5d)

09-0A 2 03 01 Client preferred version (client_version) - TLSv1

0B-0E 4 40 44 35 27 GMT Time

0C-2A 28 5c ... 72 28 random bytes Client_Random

2B 1 00 Session ID Length 0 (for resuming the session)

2C-2D 2 00 36 Ciphersuit Length - 27 choices (2-byte each)

2E-63 54 .... The 27 Ciphersuits (See Table)

64 1 01 Compression Method Length - 1

65 1 00 Compression Method: NULL.

Ciphersuit Code used in Client_Hello and Server_Hello messages is tabulated as follows:

Cipher Suite Auth Key Exchange Encryption Hash Code

RSA_WITH_NULL_MD5 RSA RSA NULL MD 5 0001

RSA_WITH_NULL_SHA RSA RSA NULL SHA 0002

RSA_EXPORT_WITH_RC4_40_MD5 RSA RSA_EXPORT RC4_40 MD 5

RSA_WITH_RC4_128_MD5 RSA RSA RC4_128 MD 5 0003 0004

RSA_WITH_RC4_128_SHA RSA RSA RC4_128 SHA 0005

RSA_EXPORT_WITH_RC2_CBC_40_MD5 RSA RSA_EXPORT RC2_40_CBC MD 5 0006

Server_Hello

In response to the client_hello message, the server returns a server_hello message to tell the client its choice of protocol version, ciphersuit and compression method. The server also includes a

32-byte random number (server_random) in the message.

Bytes	**Len**	**Value**	**Description**
00	1	16	Record Content Type - Handshake Message
01-02	2	03 01	SSL version - TLSv1
03-04	2	00 2a	Record Length
05	1	02	Handshake Type - Server_Hello
06-08	3	00 00 26	Message Length
09-0A	2	03 01	Protocol Version Chosen - TLSv1
0B-0E	4	40 44 35 27	GMT Time (sec since 1970)
0C-2A	28	cc ... b9	28 random bytes Server_Random
2B	1	00	Session ID Length 0 (for resuming the session)
2C-2D	2	00 16	Ciphersuit Chosen: DHE_RSA_WITH_3DES_EDE_CBC_SHA
2E	1	00	Compression Method Chosen: NULL.

Certificate

The certificate message consists of a chain of X.509 certificates in the correct order. The first certificate belongs to the server, and the next certificate contains the key that certifies the first certificate (i.e., the server's certificate), and so on. The client uses the server's public key (contained inside the server's certificate) to either encrypt the pre_master_secret or verify the server_key_exchange, depending on which ciphersuit is used.

Bytes	**Len**	**Value**	**Description**
00	1	16	Record Content Type - Handshake Message
01-02	2	03 01	SSL version - TLSv1
03-04	2	02 05	Record Length
05	1	0b	Handshake Type - certificate
06-08	3	00 02 01	Message Length
09-0B	3	00 01 fe	Certificate Length

Certificates (to be traced)

The X.509 certificate structure can be found from the ITU recommendation X.509 "The directory - Authentication Framework".

Server_Key_Exchange

Server_Hello_Done

This is an empty message indicating that the server has sent all the handshaking messages. This is eeded because the server can send some optional messages after the certificate message.

Bytes	Len	Value	Description
00	1	16	Record Content Type - Handshake Message
01-02	2	03 01	SSL version - TLSv1
03-04	2	00 04	Record Length
05	1	0e	Handshake Type - Server_Hello_Done

(check the last 3 bytes)

Client_Key_Exchange

The client_key_exchange message contains the pre_master_secret when RSA key exchange

is used. The pre_master_secret is 48-byte, consists of protocol version (2 bytes) and 46 random

bytes.

Bytes	**Len**	**Value**	**Description**
00	1	16	Record Content Type - Handshake Message
01-02	2	03 01	SSL version - TLSv1
03-04	2	00 86	Record Length
05	1	10	Handshake Type - Client_Key_Exchange
06-08	3	00 00 82	Message Length

pre_master_secret (130 bytes): encrypted using server's public key

extracted from the server's certificate

Change_Cipher_Spec

Bytes	**Len**	**Value**	**Description**
00	1	14	Record Content Type - Change_Cipher_Spec
01-02	2	03 01	SSL version - TLSv1
03-04	2	00 01	Record Length
05	1	01	??

Certificate_Verify

Change_Cipher_Spec

Unknown Handshaking Message (D4) - to check

Application_Data

Client-to-Server - the HTTP request message: GET /test.html HTTP/1.0

Server-to-Client - the HTTP response message

Alert

Comparison of TLS v1, SSL v3 and SSL v2
The TLS v1 specification stated, "TLS v1 and SSL v3 are very similar". Some of minor differences include minor changes in HMAC calculation, ciphersuit support, and pseudo-random number generation. TLS v1 can be regarded as SSL v3.1.

SSL v2 has a big security hole in the negotiation of the ciphersuit (and should not be used). The attacker can convince the client and server to use a weaker encryption than what they are capable of. This is called "ciphersuit rollback" attack.

Result:

Thus the confidentiality and Integrity using SSL was verified.

Ex .No : 7 Date :	**Experiment Eavesdropping, Dictionary attacks, MITM attacks**	Page No : 43

Aim :

To experiment eavesdropping, Dictionary attacks, MIMT attacks

Visual Objective:

Introduction

Password cracking is a term used to describe the penetration of a network, system, or resource with or without the use of tools to unlock a resource that has been secured with a password. Password cracking tools may seem like powerful decryptors, but in reality are little more than fast, sophisticated guessing machines.

Types of password breaking

Dictionary attack

A simple dictionary attack is usually the fastest way to break into a machine. A dictionary file (a text file full of dictionary words) is loaded into a cracking application, which is run against user accounts located by the application.

Brute force attack

A brute force attack is a very powerful form of attack, though it may often take a long time to work depending on the complexity of the password. The program will begin trying any and every combination of numbers and letters and running them against the hashed passwords. Passwords that are composed of random letters numbers and characters are most vulnerableto this type of attack.

Hybrid attack

Another well-known form of attack is the hybrid attack. A hybrid attack will add numbers or symbols to the search words to successfully crack a password. Many people change their passwords by simply adding a number to the end of their current password. Therefore, this type of attack is the most versatile, while it takes longer then a standard dictionary attack it does not take as long as a brute force attack.

Cracking Process

Since a brute force attack is the most time consuming and is not likely to break any passwords that are not composed of random characters, the best plan is to use techniques that are computationally efficient compared to untargeted and unspecific techniques. By applying what is known about how users select passwords, an intruder can tremendously increase the odds in their favor of finding passwords. With the right techniques, some poor passwords can be cracked in under a second.

The real power of dictionary attacks come from understanding the ways in which most people vary names and dictionary words when attempting to create a password. By applying all the common transformations to every word in the electronic list and encrypting each result the number tested passwords multiplies rapidly. Cracking tools can often detect “clever” ways of manipulating words to hide their origin. For example, such cracking programs often subject each word to a list of rules. A rule could be anything, any manner in which a word might appear.

Typical rules might include

Alternate upper- and lowercase lettering.

Spell the word forward and then backward, and then fuse the two results (for example: cannac).

Add the number 1 to the beginning and/or end of each word.

Naturally, the more rules one applies to the words, the longer the cracking process takes. However, more rules also guarantee a higher likelihood of success.

Task 1 – Microsoft Office Password Recovery

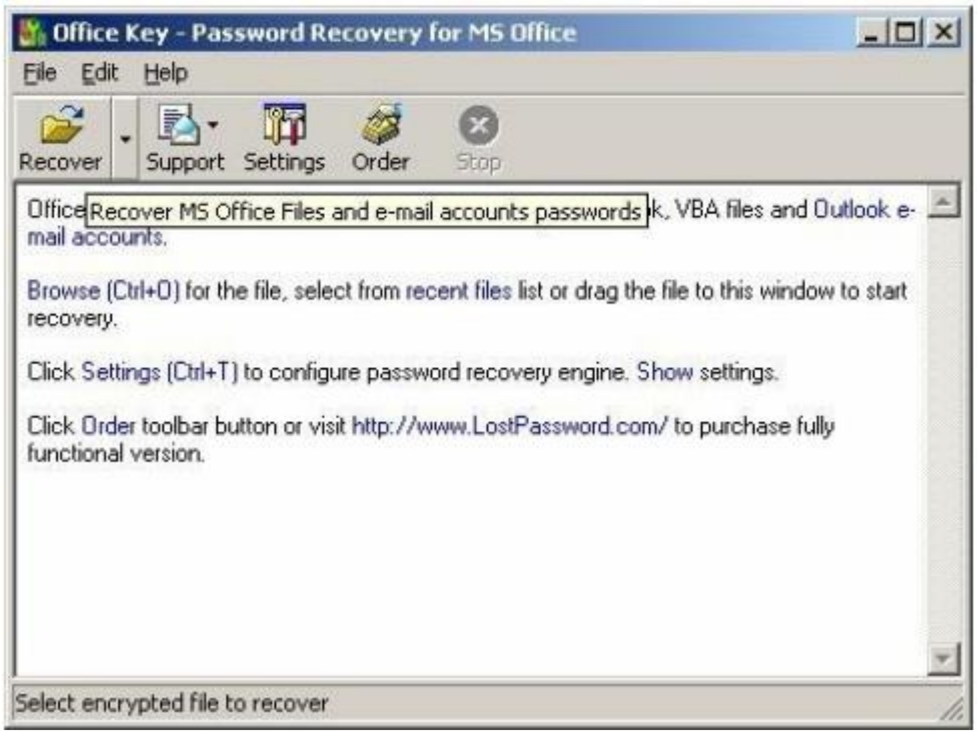
Many applications require you to establish an ID and password that may be saved and automatically substituted for future authentication. The password will usually appear on the screen as a series of asterisks. This is fine as long as your system remembers the password for you but what if it "forgets" or you need it for use on another system. Fortunately, many utilities have been written to recover such passwords. In this task, you will use OfficeKey to recover the password for a MS word document.

Step 1: Find the folder “Lab1” on your desktop, and open it.

You will find OfficeKey and a MS document in the folder.

Step 2: Open the Office Key – Password Recovery tool

Step 3: Press the “Recover” button in the upper left corner, or select File Recover


Office Key - Password Recovery for MS Office

Office Recover MS Office Files and e-mail accounts passwords k, VBA files and Outlook e-mail accounts.

Browse (Ctrl+O) for the file, select from recent files list or drag the file to this window to start recovery.

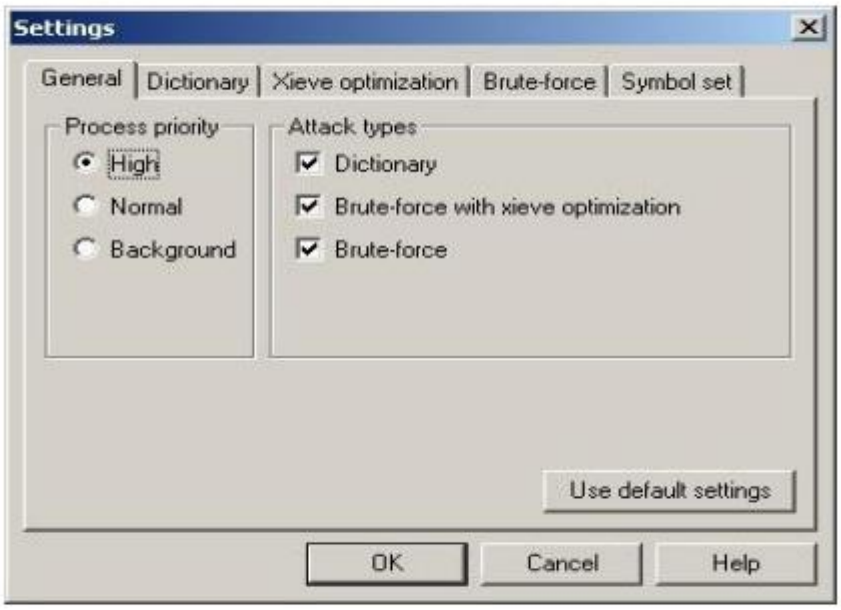
Click Settings (Ctrl+T) to configure password recovery engine. Show settings.

Click Order toolbar button or visit http://www.LostPassword.com/ to purchase fully functional version.

Select encrypted file to recover

Step 4: Choose the password protected MS Office File you have saved to the Desktop.

Step 5: After running the first password auditing session, check to see if Office key has cracked the password. If the password has not been cracked press the Settings button on the upper tool bar.


Settings

Process priority: [✓ High] Normal Background

Attack types:
- ✓ Dictionary
- ✓ Brute-force with xieve optimization
- ✓ Brute-force

Step 6: Once in the Settings menu you will be able to modify the search parameters and customize a more targeted search

Step 7: Repeat steps 3 and 4 until the password has been cracked and opens the MS Office File.

Step 8:Write down the contents of the MS word document and the password into your lab report and submit it to your TA.

Task 2 – Password Auditing (Windows platform):

The purpose of this task is to familiarize you with act of password cracking/recovery. Password cracking software uses a variety of approaches, including intelligent guessing, dictionary attacks and automation that tries every possible combination of characters. Given enough time the automated method can crack any password, but more effective passwords will last months before breaking.

When a password is entered and saved on a computer it is encrypted, the encrypted password becomes a string of characters called a “hash” and is saved to a password file. A password cannot be reverse-decrypted. So a cracking program encrypts words and characters given to it (wordlist or randomly generated strings of characters) and compares the results with hashed passwords. If the hashes match then the password has successfully been guessed or “cracked”. This process is usually performed offline against a captured password file so that being locked out of the account is not an issue, and guessing can go on continuously. Thus, revealing the passwords is simply a mater of CPU time and dictionary size

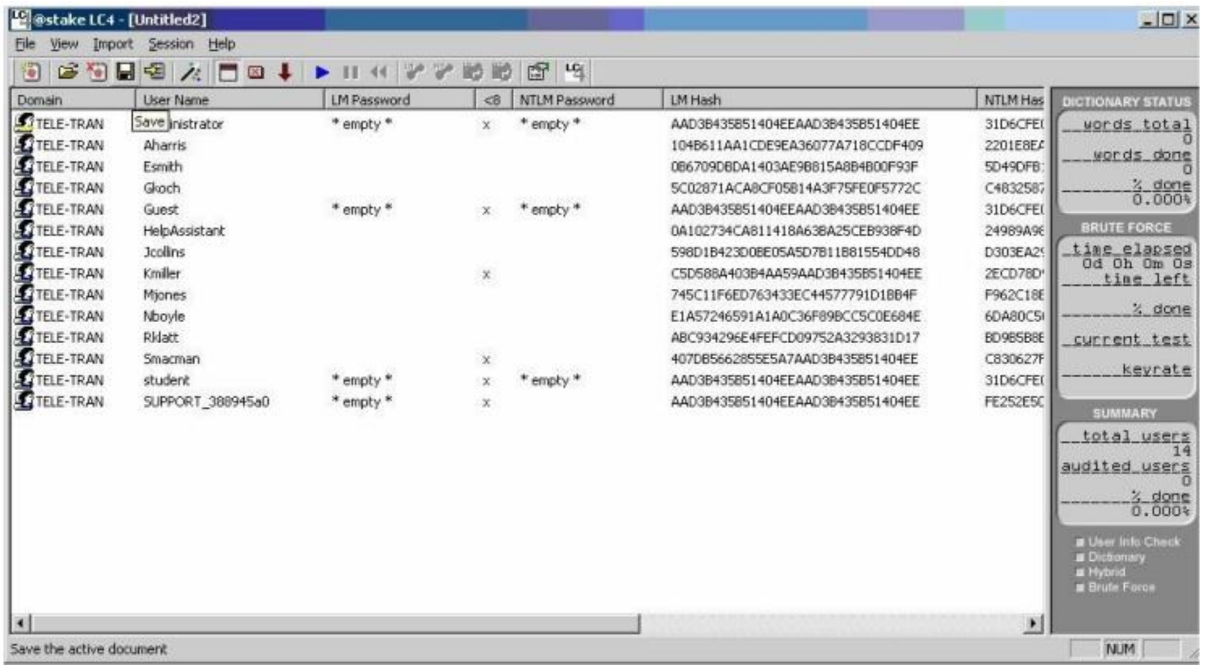
1. You obtain a dictionary file, which is no more than a flat file (plain text) list of words (commonly referred to as wordlists).
2. These words are fed through any number of programs that encrypt each word. Such encryption conforms to the DES standard.
3. Each resulting encrypted word is compared with the target password. If a match occurs, there is better than a 90 percent chance that the password was cracked.

Step 1: Go to Lab1 folder, and open LC4 to audit the passwords on your Windows system.

Select File New Session

Select Import Import from PWDUMP File (in the same folder)

Select the “Passwords” file that has been provided to you.



@stake LC4 - [Untitled2]

Domain	User Name	LM Password	<8	NTLM Password	LM Hash	NTLM Has
TELE-TRAN	Save nistrator	* empty *	x	* empty *	AAD3B435B51404EEAAD3B435B51404EE	31D6CFE(
TELE-TRAN	Aharris				104B611AA1CDE9EA36077A718CCDF409	2201E8EA
TELE-TRAN	Esmith				0B6709DBDA1403AE9B815A8B4B00F93F	5D49DFB:
TELE-TRAN	Gkoch				5C02871ACA8CF05B14A3F75FE0F5772C	C4832587
TELE-TRAN	Guest	* empty *	x	* empty *	AAD3B435B51404EEAAD3B435B51404EE	31D6CFE(
TELE-TRAN	HelpAssistant				0A102734CA811418A63BA25CEB938F4D	24989A96
TELE-TRAN	Jcollins				598D1B423D0BE05A5D7B11B81554DD48	D303EA2
TELE-TRAN	Kmiller		x		C5D588A403B4AA59AAD3B435B51404EE	2ECD78D'
TELE-TRAN	Mjones				745C11F6ED763433EC44577791D18B4F	F962C18E
TELE-TRAN	Nboyle				E1A57246591A1A0C36F89BCC5C0E684E	6DA80C5(
TELE-TRAN	Rklatt				ABC934296E4FEFCD09752A3293831D17	BD9B5B8E
TELE-TRAN	Smacman		x		407DB5662855E5A7AAD3B435B51404EE	C830627F
TELE-TRAN	student	* empty *	x	* empty *	AAD3B435B51404EEAAD3B435B51404EE	31D6CFE(
TELE-TRAN	SUPPORT_388945a0	* empty *	x		AAD3B435B51404EEAAD3B435B51404EE	FE252E5C

```
DICTIONARY STATUS
words total      0
words done       0
% done      0.000%
BRUTE FORCE
time elapsed
Od Oh Om Os
time left
% done
current test
keyrate
SUMMARY
total users     14
audited users    0
% done      0.000%
```

Save the active document

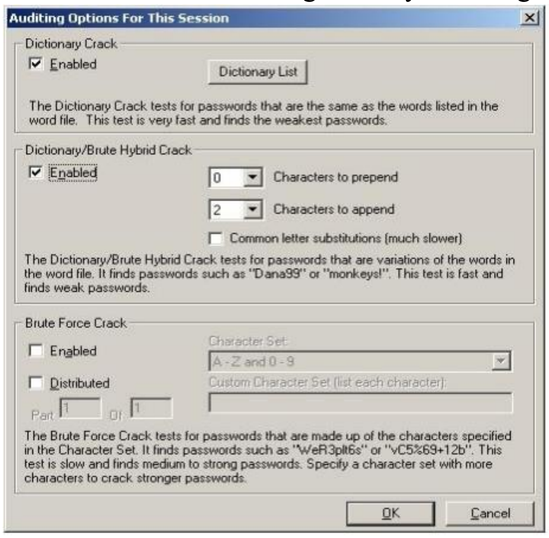
Objectives

This password file has been retrieved from a system that we must gain access to. To do this you must crack as many passwords as possible as quickly as possible. We have captured the user names and encrypted passwords for ten users. The user names follow a standard pattern of first initial and last name, but the passwords have no set standards. We do know that users of this system are encouraged to add numbers and other characters to the words they chose for passwords.

To aid you in cracking these passwords we have managed to collect some basic information about the users. This personal information may help you target your searches as to what the user's password may be.

Step 2: Select Session Session Options

Use this menu to customize your password search. Here you can add different word list for Dictionary attacks, change Hybrid attack features. Keep in mind you are working with a short dead line and more in depth searches will take longer then you have. You must use the information given to you to target your search most specifically at more likely passwords


Auditing Options For This Session

Dictionary Crack

☑ Enabled

Dictionary List

The Dictionary Crack tests for passwords that are the same as the words listed in the word file. This test is very fast and finds the weakest passwords.

Dictionary/Brute Hybrid Crack

☑ Enabled

0 Characters to prepend

2 Characters to append

☐ Common letter substitutions (much slower)

The Dictionary/Brute Hybrid Crack tests for passwords that are variations of the words in the word file. It finds passwords such as "Dana99" or "monkeys!". This test is fast and finds weak passwords.

Brute Force Crack

☐ Enabled

Character Set: A - Z and 0 - 9

☐ Distributed

Custom Character Set (list each character):

Part 1 Of 1

The Brute Force Crack tests for passwords that are made up of the characters specified in the Character Set. It finds passwords such as "WeR3pIt6s" or "vC5%69+12b". This test is slow and finds medium to strong passwords. Specify a character set with more characters to crack stronger passwords.

OK Cancel

Step 3: Select Session Begin "Audit" or Press the blue play button on the upper toolbar to start the password search.

Step 4: After the first search has run check your progress. Have some of the passwords been cracked all the way though or have some only been partially cracked. Use what you've learned from this first search to target your next few searches. You will need to search the internet and use the information you have been given about each user to find words they may have used as their password.

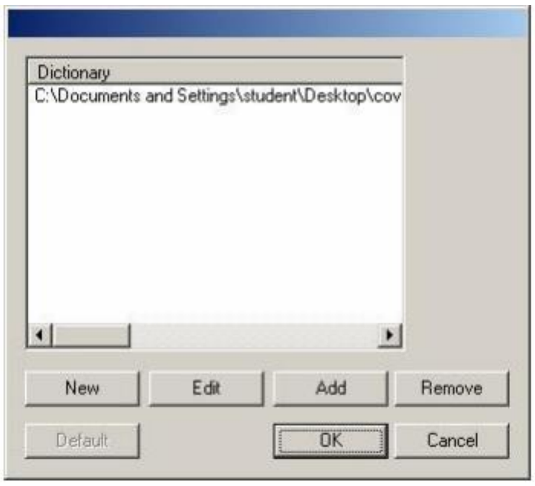
Note: The question marks in the partially cracked passwords do not necessarily represent the number of remaining undiscovered characters.

Step 5: Add words to your wordlist

Session Session Options

Press the 'Dictionary List' button in the Dictionary crack section. Here you can edit your current word list and add words by selecting the 'EDIT' button and entering each wordon a new line. You can also add multiple dictionaries and wordlist.

Step 6: You may chose to conduct dictionary attacks with other wordlists. You can find additional wordlist to use here: ftp://ftp.cerias.purdue.edu/pub/dict



C:\Documents and Settings\student\Desktop\cov

Step 7: Continue searching for possible passwords during the remainder of the lab. Repeatingsteps 3 and 4 each time you modify your search.

Step 8: Once you have cracked all the passwords in the file, write them down in your lab reportor once the lab time has ended, submit the passwords you were able to crack.

Result :

Thus the experiment for Eavesdropping, Dictionary attacks, MITM attacks was done succefully

Ex .No : 8 **Date :**	**Experiment with Sniff Traffic using ARP Poisoning**	**Page No : 50**

AIM

Perform an Experiment to Sniff Traffic using ARP Poisoning.

Description:

ARP is the acronym for Address Resolution Protocol. It is used to convert IP address to physical addresses [MAC address] on a switch. The host sends an ARP broadcast on the network, and the recipient computer responds with its physical address [MAC Address]. The resolved IP/MACaddress is then used to communicate. ARP poisoning is sending fake MAC addresses to the switch so that it can associate the fake MAC addresses with the IP address of a genuine computer on a network and hijack the traffic.

ARP Poisoning Countermeasures

Static ARP entries: these can be defined in the local ARP cache and the switch configured to ignoreall auto ARP reply packets. The disadvantage of this method is, it’s difficult to maintain on large networks. IP/MAC address mapping has to be distributed to all the computers on the network. ARP poisoning detection software: these systems can be used to cross check the IP/MAC address resolution and certify them if they are authenticated. Uncertified IP/MAC address resolutions can then be blocked.

Operating System Security: this measure is dependent on the operating system been used. The following are the basic techniques used by various operating systems.

 Linux based: these work by ignoring unsolicited ARP reply packets.

 Microsoft Windows: the ARP cache behavior can be configured via the registry. The following list includes some of the software that can be used to protect networks against sniffing;

 AntiARP– provides protection against both passive and active sniffing

 Agnitum Outpost Firewall–provides protection against passive sniffing

 XArp– provides protection against both passive and active sniffing

 Mac OS: ArpGuard can be used to provide protection. It protects against both active andpassive sniffing.

 Computers communicate using networks. These networks could be on a local area network LAN or exposed to the internet. Network Sniffers are programs that capture low-level package data that is transmitted over a network. An attacker can analyze this informationto discover valuable information such as user ids and passwords.

 In this article, we will introduce you to common network sniffing techniques and tools used to sniff networks.

What is network sniffing?

Computers communicate by broadcasting messages on a network using IP addresses. Once a message has been sent on a network, the recipient computer with the matching IP address responds with its MAC address.

Network sniffing is the process of intercepting data packets sent over a network. This can be done by the specialized software program or hardware equipment. Sniffing can be used to;

 Capture sensitive data such as login credentials

 Eavesdrop on chat messages

 Capture files have been transmitted over a networkThe following are protocols that are vulnerable to sniffing

 Telnet

 Rlogin

 HTTP

 SMTP

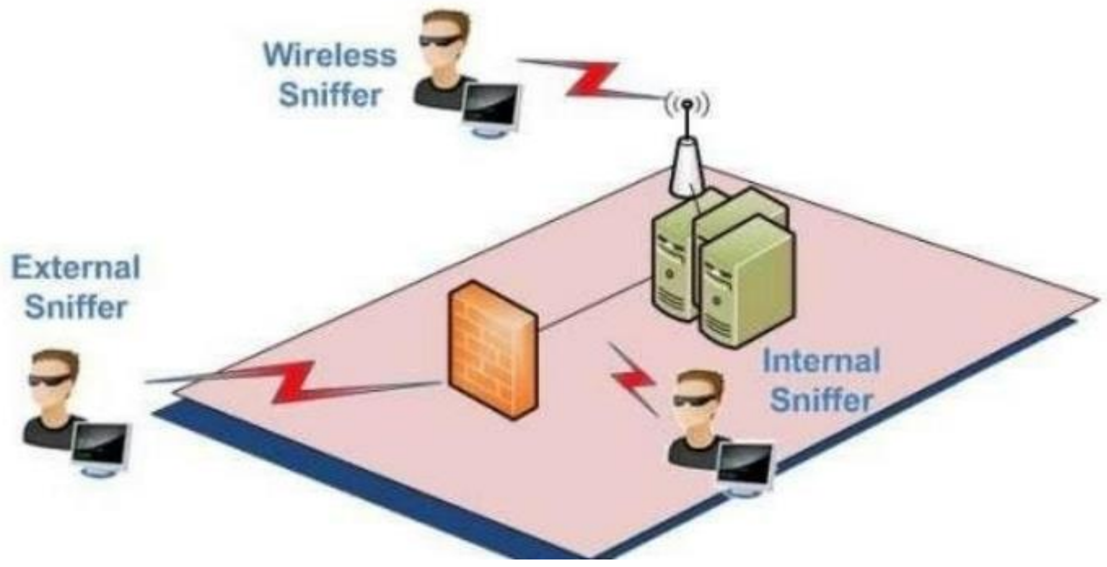
 NNTP

 POP

 FTP

 IMAP

The above protocols are vulnerable if login details are sent in plain text

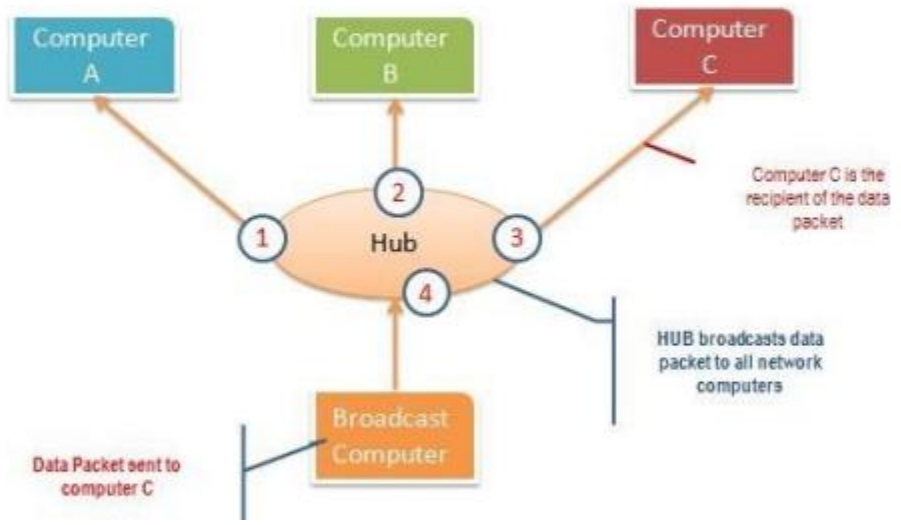


Passive and Active Sniffing

Before we look at passive and active sniffing, let’s look at two major devices used to network computers; hubs and switches.

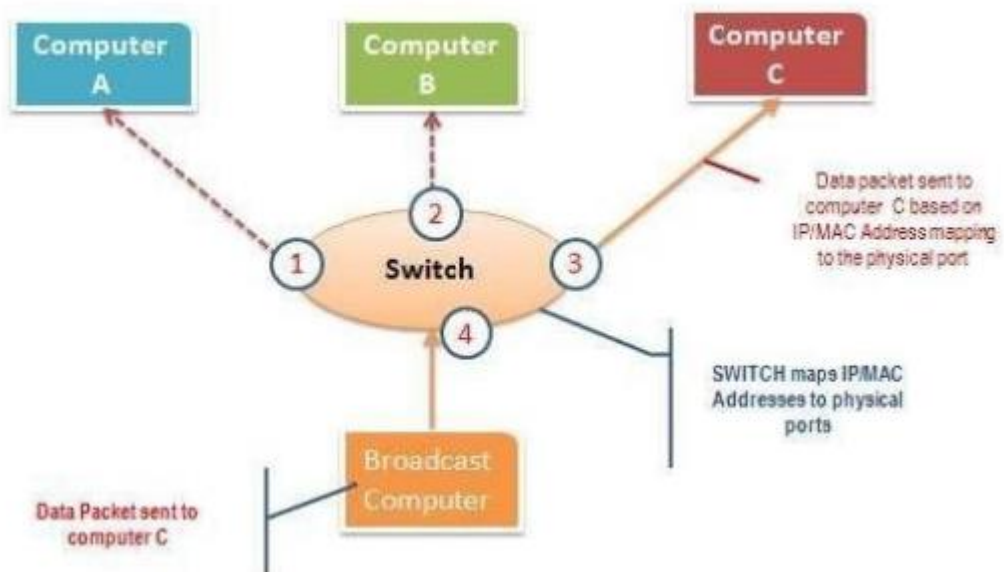
A hub works by sending broadcast messages to all output ports on it except the one that has sent the broadcast. The recipient computer responds to the broadcast message if the IP address matches. This means when using a hub, all the computers on a network can see the broadcast message. It operates at the physical layer (layer 1) of the OSI Model.

The diagram below illustrates how the hub works.


Computer A
Computer B
Computer C
Computer C is the recipient of the data packet
1
2
Hub
3
4
HUB broadcasts data packet to all network computers
Broadcast Computer
Data Packet sent to computer C

A switch works differently; it maps IP/MAC addresses to physical ports on it. Broadcast messages are sent to the physical ports that match the IP/MAC address configurations for the recipient computer. This means broadcast messages are only seen by the recipient computer. Switches operate at the data link layer (layer 2) and network layer (layer 3).

The diagram below illustrates how the switch works.

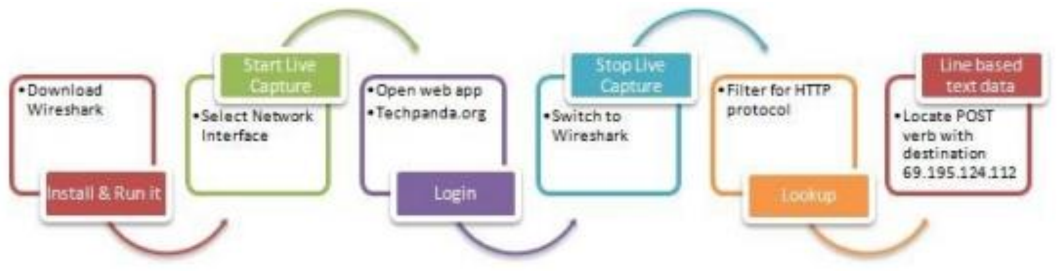

Computer A
Computer B
Computer C
Data packet sent to computer C based on IP/MAC Address mapping to the physical port
1
2
Switch
3
4
SWITCH maps IP/MAC Addresses to physical ports
Broadcast Computer
Data Packet sent to computer C

Passive sniffing is intercepting packages transmitted over a network that uses a hub. It is calledpassive sniffing because it is difficult to detect. It is also easy to perform as the hub sends broadcast messages to all the computers on the network.

Active sniffing is intercepting packages transmitted over a network that uses a switch. There are two main methods used to sniff switch linked networks, ARP Poisoning, and MAC flooding.

Sniffing the network using Wireshark

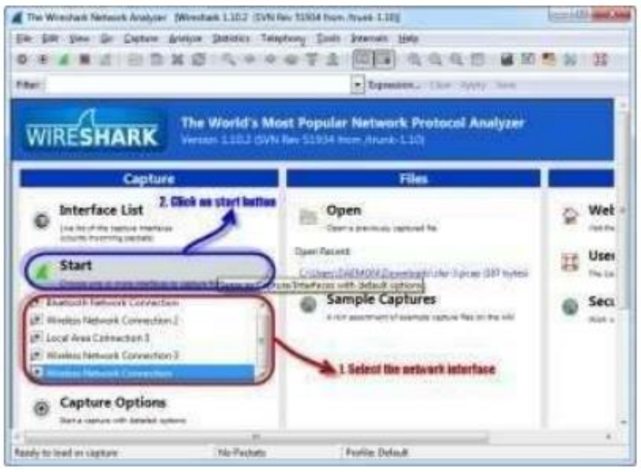
The illustration below shows you the steps that you will carry out to complete this exercise withoutconfusion



Download Wireshark from this link http://www.wireshark.org/download.html

 Open Wireshark

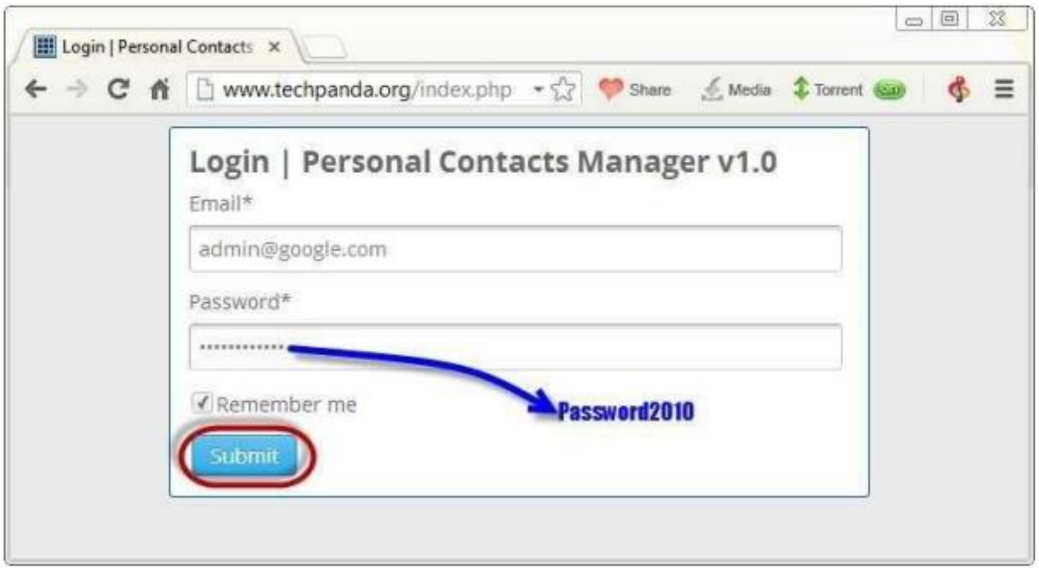
 You will get the following screen



Select the network interface you want to sniff. Note for this demonstration, we are using a wireless network connection. If you are on a local area network, then you should select the local area network interface.

 Click on start button as shown above

Open your web browser and type in http://www.techpanda.org/



Login | Personal Contacts

www.techpanda.org/index.php

Login | Personal Contacts Manager v1.0

Email*

admin@google.com

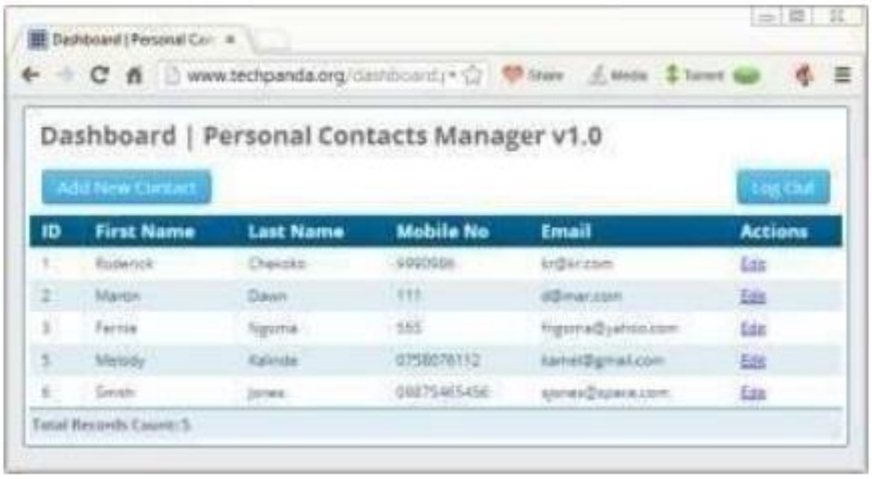
Password*

••••••••••••

✓ Remember me

Submit

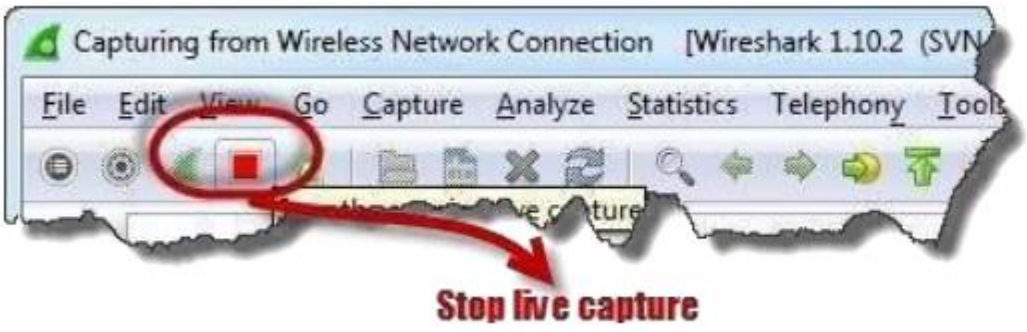
- The login email is admin@google.com and the password is Password2010
- Click on submit button
- A successful logon should give you the following dashboard


Dashboard | Personal Contacts Manager v1.0

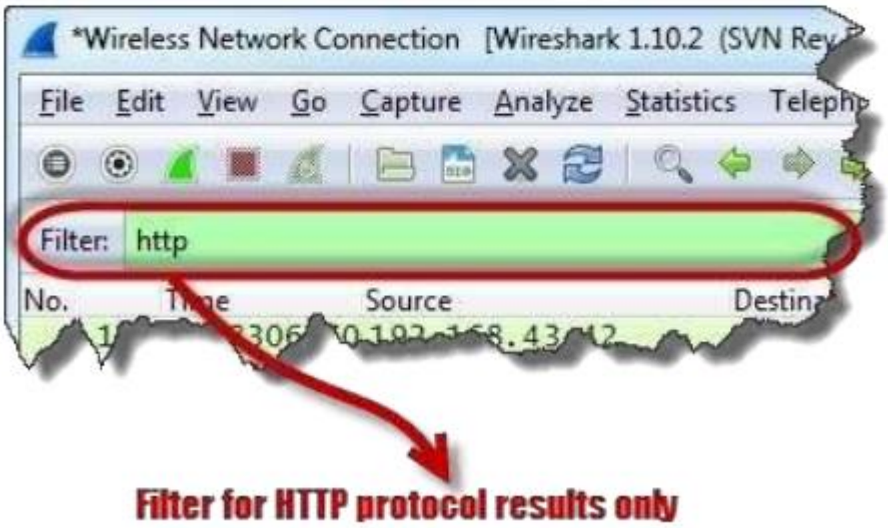
ID	First Name	Last Name	Mobile No	Email	Actions
1	Roderick	Chekoko	9990906	kr@kr.com	Edit
2	Marion	Dawn	111	d@mar.com	Edit
3	Fernie	Ngoma	555	fngoma@yahoo.com	Edit
5	Melody	Kalinde	0758078112	kamel@gmail.com	Edit
6	Smith	Jones	08875465456	sjones@space.com	Edit

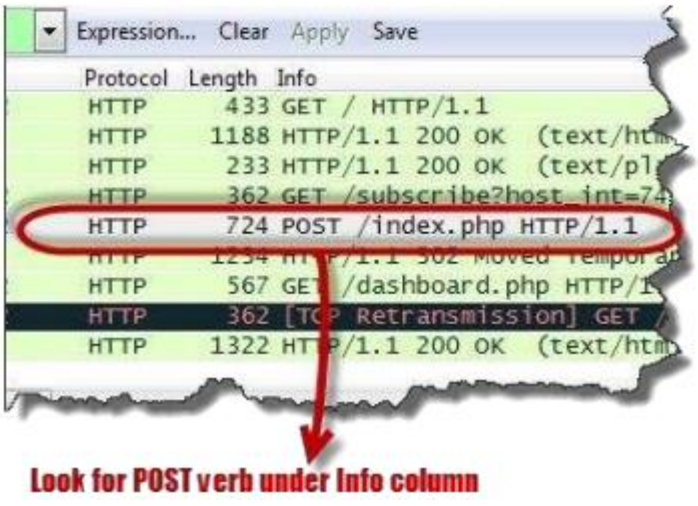
Total Records Count: 5

 Go back to Wireshark and stop the live capture


Capturing from Wireless Network Connection [Wireshark 1.10.2 (SVN
File Edit View Go Capture Analyze Statistics Telephony Tools
Stop live capture

 Filter for HTTP protocol results only using the filter textbox

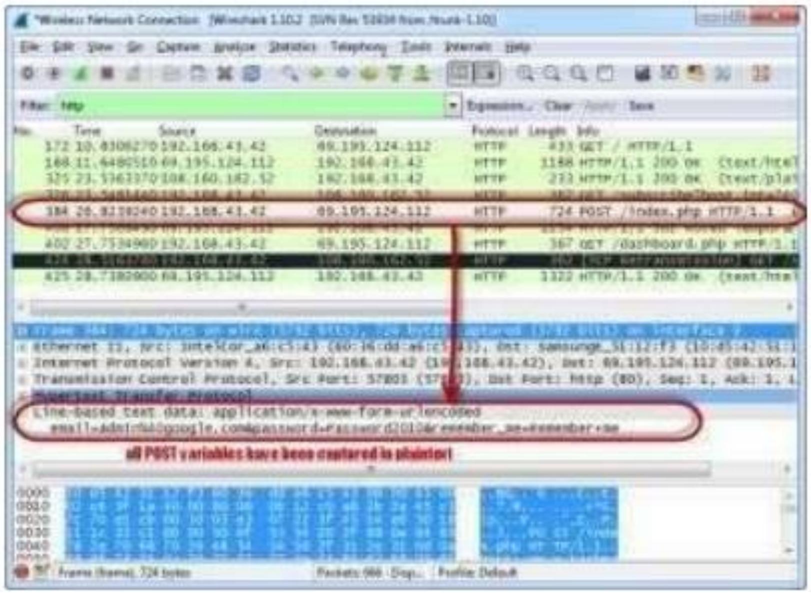

*Wireless Network Connection [Wireshark 1.10.2 (SVN Rev
File Edit View Go Capture Analyze Statistics Teleph
Filter: http
No. Time Source Destina
Filter for HTTP protocol results only


Expression... Clear Apply Save
Look for POST verb under Info column

```
Protocol Length Info
HTTP      433 GET / HTTP/1.1
HTTP     1188 HTTP/1.1 200 OK  (text/htm
HTTP      233 HTTP/1.1 200 OK  (text/pl
HTTP      362 GET /subscribe?host_int=74
HTTP      724 POST /index.php HTTP/1.1
HTTP     1234 HTTP/1.1 302 Moved Tempora
HTTP      567 GET /dashboard.php HTTP/1
HTTP      362 [TCP Retransmission] GET /
HTTP     1322 HTTP/1.1 200 OK  (text/htm
```

 Locate the Info column and look for entries with the HTTP verb POST and click on it

 Just below the log entries, there is a panel with a summary of captured data. Look for the summary that says Line-based text data: application/x-www-form-url encoded


Filter: http
Expression... Clear Apply Save
all POST variables have been captured in plaintext

```
No.  Time        Source          Destination     Protocol Length Info
172 10.8306270 192.168.43.42   69.195.124.112  HTTP      433 GET / HTTP/1.1
168 11.6480510 69.195.124.112  192.168.43.42   HTTP     1188 HTTP/1.1 200 OK  (text/html
325 23.5363370 108.160.162.52  192.168.43.42   HTTP      233 HTTP/1.1 200 OK  (text/plai
[illegible]
384 26.8239240 192.168.43.42   69.195.124.112  HTTP      724 POST /index.php HTTP/1.1
[illegible]
402 27.7534980 192.168.43.42   69.195.124.112  HTTP      367 GET /dashboard.php HTTP/1.1
[illegible]
425 28.7382900 69.195.124.112  192.168.43.42   HTTP     1322 HTTP/1.1 200 OK  (text/html

Frame 384: 724 bytes on wire (5792 bits), 724 bytes captured (5792 bits) on interface 0
Ethernet II, Src: IntelCor_a6:c5:43 (60:36:dd:a6:c5:43), Dst: Samsunge_51:12:f3 (10:d5:42:51:1
Internet Protocol Version 4, Src: 192.168.43.42 (192.168.43.42), Dst: 69.195.124.112 (69.195.1
Transmission Control Protocol, Src Port: 57803 (57803), Dst Port: http (80), Seq: 1, Ack: 1, L
Hypertext Transfer Protocol
Line-based text data: application/x-www-form-urlencoded
  email=admin%40google.com&password=Password2010&remember_me=remember+me
```

 You should be able to view the plaintext values of all the POST variables submitted to the server via HTTP protocol.

Result:

Thus the experiment to Sniff Traffic using ARP Poisoning was performed.

Ex .No : 9 **Date :**	**Implement Demonstrate intrusion detection system using any tool.key algorithms**	**Page No : 57**

AIM:

To demonstrate Intrusion Detection System (IDS) using Snort software tool.

STEPS ON CONFIGURING AND INTRUSION DETECTION:

1. Download Snort from the Snort.org website. (http://www.snort.org/snort-downloads)

2. Download Rules(https:// www.snort.org/snort-rules). You must register to get the rules. (You should

download these often)

3. Double click on the .exe to install snort. This will install snort in the “C:\Snort” folder.It is

important to have WinPcap (https:// www.winpcap.org/install/) installed

4. Extract the Rules file. You will need WinRAR for the .gz file.

5. Copy all files from the “rules” folder of the extracted folder. Now paste the rules into

“C:\Snort\rules” folder.

6. Copy “snort.conf” file from the “etc” folder of the extracted folder. You must paste it into “C:\

Snort\etc” folder. Overwrite any existing file. Remember if you modify your snort.conf file

and download a new file, you must modify it for Snort to work.

7. Open a command prompt (cmd.exe) and navigate to folder “C:\Snort\bin” folder. (at the Prompt,

type cd\snort\bin)

8. To start (execute) snort in sniffer mode use following command:

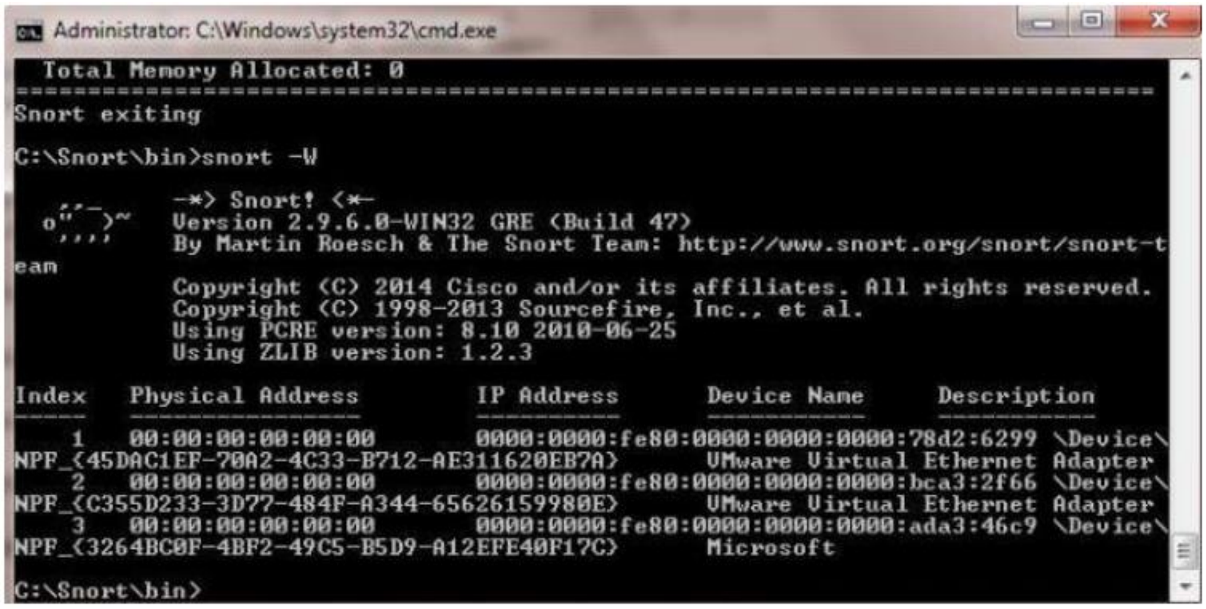
```
snort -dev -i 3
```

-i indicates the interface number. You must pick the correct interface number. In my case, it is 3.

-dev is used to run snort to capture packets on your network.

To check the interface list, use following command:

```
snort -W
```



```
Administrator: C:\Windows\system32\cmd.exe
  Total Memory Allocated: 0
================================================================================
Snort exiting

C:\Snort\bin>snort -W

   ,,_     -*> Snort! <*-
  o"  )~   Version 2.9.6.0-WIN32 GRE (Build 47)
   ''''    By Martin Roesch & The Snort Team: http://www.snort.org/snort/snort-t
eam
           Copyright (C) 2014 Cisco and/or its affiliates. All rights reserved.
           Copyright (C) 1998-2013 Sourcefire, Inc., et al.
           Using PCRE version: 8.10 2010-06-25
           Using ZLIB version: 1.2.3

Index   Physical Address        IP Address      Device Name     Description
-----   ----------------        ----------      -----------     -----------
    1   00:00:00:00:00:00       0000:0000:fe80:0000:0000:0000:78d2:6299 \Device\
NPF_{45DAC1EF-70A2-4C33-B712-AE311620EB7A}      VMware Virtual Ethernet Adapter
    2   00:00:00:00:00:00       0000:0000:fe80:0000:0000:0000:bca3:2f66 \Device\
NPF_{C355D233-3D77-484F-A344-65626159980E}      VMware Virtual Ethernet Adapter
    3   00:00:00:00:00:00       0000:0000:fe80:0000:0000:0000:ada3:46c9 \Device\
NPF_{3264BC0F-4BF2-49C5-B5D9-A12EFE40F17C}      Microsoft

C:\Snort\bin>
```

Finding an interface

You can tell which interface to use by looking at the Index number and finding Microsoft. As you can see in the above example, the other interfaces are for VMWare.

To run snort in IDS mode, you will need to configure the file “snort.conf” according to your network environment.

To specify the network address that you want to protect in snort.conf file, look for the following line.

var HOME_NET 192.168.1.0/24 (You will normally see any here)

You may also want to set the addresses of DNS_SERVERS, if you have some on your network.

Example:

example snort

Change the RULE_PATH variable to the path of rules folder.

var RULE_PATH c:\snort\rules

path to rules

Change the path of all library files with the name and path on your system. and you must change the path of snort_dynamicpreprocessorvariable.

C:\Snort\lib\snort_dynamiccpreprocessor

You need to do this to all library files in the “C:\Snort\lib” folder. The old path might be: “/usr/local/lib/…”. you will need to replace that path with your system path. Using C:\Snort\lib

Change the path of the “dynamicengine” variable value in the “snort.conf” file..

Example:

dynamicengine C:\Snort\lib\snort_dynamicengine\sf_engine.dll

Add the paths for “include classification.config” and “include reference.config” files.

include c:\snort\etc\classification.config

include c:\snort\etc\reference.config

Remove the comment (#) on the line to allow ICMP rules, if it is commented with a #.

include $RULE_PATH/icmp.rules

You can also remove the comment of ICMP-info rules comment, if it is

commented. include $RULE_PATH/icmp-info.rules

To add log files to store alerts generated by snort, search for the “output log” test in snort.conf and add the following line:

output alert_fast: snort-alerts.ids

Comment (add a #) the whitelist $WHITE_LIST_PATH/white_list.rules and the blacklist

Change the nested_ip inner , \ to nested_ip inner #, \

Comment out (#) following lines:

#preprocessor normalize_ip4

#preprocessor normalize_tcp: ips ecn stream

#preprocessor normalize_icmp4

#preprocessor normalize_ip6

#preprocessor normalize_icmp6

Save the “snort.conf” file.

To start snort in IDS mode, run the following command:

snort -c c:\snort\etc\snort.conf -l c:\snort\log -i 3

(Note: 3 is used for my interface card)

If a log is created, select the appropriate program to open it. You can use WordPard or NotePad++ to read the file.

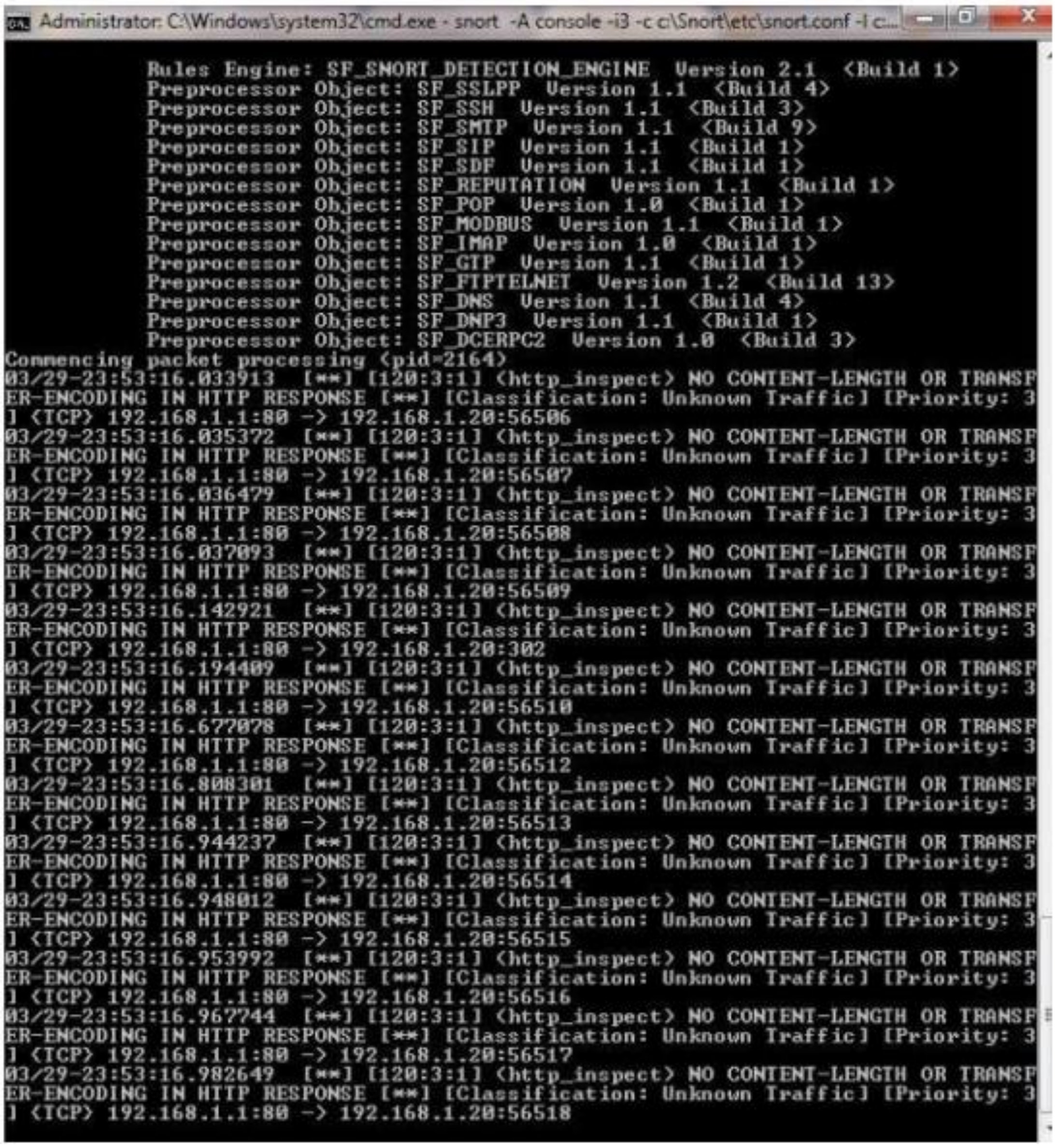
To generate Log files in ASCII mode, you can use following command while running snort in IDS mode:

snort -A console -i3 -c c:\Snort\etc\snort.conf -l c:\Snort\log -K ascii

Scan the computer that is running snort from another computer by using PING or NMap (ZenMap).

After scanning or during the scan you can check the snort-alerts.ids file in the log folder to insure it is logging properly. You will see IP address folders appear.

Snort monitoring traffic –



```
Administrator: C:\Windows\system32\cmd.exe - snort  -A console -i3 -c c:\Snort\etc\snort.conf -l c...
           Rules Engine: SF_SNORT_DETECTION_ENGINE  Version 2.1  <Build 1>
           Preprocessor Object: SF_SSLPP  Version 1.1  <Build 4>
           Preprocessor Object: SF_SSH  Version 1.1  <Build 3>
           Preprocessor Object: SF_SMTP  Version 1.1  <Build 9>
           Preprocessor Object: SF_SIP  Version 1.1  <Build 1>
           Preprocessor Object: SF_SDF  Version 1.1  <Build 1>
           Preprocessor Object: SF_REPUTATION  Version 1.1  <Build 1>
           Preprocessor Object: SF_POP  Version 1.0  <Build 1>
           Preprocessor Object: SF_MODBUS  Version 1.1  <Build 1>
           Preprocessor Object: SF_IMAP  Version 1.0  <Build 1>
           Preprocessor Object: SF_GTP  Version 1.1  <Build 1>
           Preprocessor Object: SF_FTPTELNET  Version 1.2  <Build 13>
           Preprocessor Object: SF_DNS  Version 1.1  <Build 4>
           Preprocessor Object: SF_DNP3  Version 1.1  <Build 1>
           Preprocessor Object: SF_DCERPC2  Version 1.0  <Build 3>
Commencing packet processing (pid=2164)
03/29-23:53:16.033913  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56506
03/29-23:53:16.035372  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56507
03/29-23:53:16.036479  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56508
03/29-23:53:16.037093  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56509
03/29-23:53:16.142921  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:302
03/29-23:53:16.194409  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56510
03/29-23:53:16.677078  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56512
03/29-23:53:16.808301  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56513
03/29-23:53:16.944237  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56514
03/29-23:53:16.948012  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56515
03/29-23:53:16.953992  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56516
03/29-23:53:16.967744  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56517
03/29-23:53:16.982649  [**] [120:3:1] (http_inspect) NO CONTENT-LENGTH OR TRANSF
ER-ENCODING IN HTTP RESPONSE [**] [Classification: Unknown Traffic] [Priority: 3
] {TCP} 192.168.1.1:80 -> 192.168.1.20:56518
```

RESULT:

Thus the Intrusion Detection System(IDS) has been demonstrated by using the Open Source Snort Intrusion Detection Tool.

Ex .No : 10 **Date :**	**Explore network monitoring tools**	**Page No : 61**

Aim :

To explore about Network monitoring tools

Network monitoring is an essential part of network management. It involves using various tools to monitor a system network and determine slowness and weak connections, among other issues. Knowing more about these tools can help you understand them better and use the right ones that suit your requirements. In this article, we define what network monitoring tools are, provide details about various tools and discuss about some tips that can help you choose the right tool for your requirements.

What Are Network Monitoring Tools?

Network monitoring tools are software that you can use to evaluate network connections. These software programs can help you monitor a network connection and identify network issues, which may

include failing network components, slow connection speed, network outage or unidentifiable connections. Network management and monitoring tools can also help you resolve these issues or establish solutions that prevent specific issues from occurring in the future.

Network Monitoring Tools

Here are eight monitoring tools along with their descriptions and features:

1. SolarWinds Network Performance Monitor

SolarWinds Network Performance Monitor is a multi-vendor monitoring tool. It allows users to monitor multiple vendors' networks at the same time. It also provides network insights for thorough visibility into the health of the networks. Some prominent features include network availability monitoring, intelligent network mapping, critical path visualisation, performance analysis and advanced alerting. SolarWinds also allows users to track VPN tunnel status. It prompts when a VPN tunnel is available to help users ensure a stable connection between sites. SolarWinds provides a seven-day free trial, after which users can choose a preferred subscription plan.

2. Auvik

Auvik is a network monitoring and management tool. It offers a quick implementation process that helps users to set up the tool easily. It also has a clean user interface that makes it easy to navigate and use. The tool provides in-depth network visibility that enables faster troubleshooting for network issues. Users can automate network visibility using Auvik. It provides real-time updates on network issues and configuration changes.

3. Datadog Network Monitoring

Datadog Network Monitoring offers services for on-premises devices and cloud networks. A highlighting feature of this tool is the visualisations. It offers various graphical representations of all the network connections on a system. It also allows users to track key metrics like network latency, connection churn and transmission control protocol (TCP) retransmits. Users can monitor the health of
a network connection at different endpoints at the application, IP address, port or process ID layers. Other prominent features include automated log collection and user interface monitoring.

4. Paessler PRTG Network Monitor

Paessler's network connection monitoring tool provides a clean user interface and network visibility on
multiple devices. Users can track the health of different connection types like local area networks (LAN), wide area network (WAN), servers, websites, applications and services. The tools also integrate with various technologies, which makes it easier to use it for different types of applications. It
provides distribute monitoring, allowing users to track network connections on devices in different locations. The tool also provides apps for mobile platforms that can help users to track network health on mobile phones.

5. ManageEngine OpManager

ManageEngine OpManager is a good network monitoring and managing tool for users that prefer indepth view of network health and issues. This tool provides over 2000 network performance monitors
that allow users to track and monitor their connections and perform detailed analyses on issues. It also provides over 200 dashboard widgets that can help users customise their dashboard to their own suitability. Other features include CPU, memory and disk utilisation monitoring on local and virtual machines. It also allows setting network performance threshold and notifies the user in case of a violation.

6. Domotz

Domotz is an expansive tool that provides a list of features for monitoring network connections. It allows users to customise their network monitoring preferences. Users can write scripts the retrieve the
data they wish to evaluate. It also allows connection to open ports on remote devices while ensuring network security. Users can also scan and monitor network connections globally. Domotz also allows

to backup and restore network configuration for switches, firewalls and access points and alerts when there is a change in the configuration.

7. Checkmk

Checkmk is a tool that allows users to automate it completely. You can customise its operations and enable it to perform tasks automatically. It also identifies network and security components without the
user requiring manual set up. For example, the tool can identify a firewall even if the user has not set it
up. Its Agent Bakery feature enables users to manage agents and automate agent updating. This reduces manual effort to monitor network connections. The tool also includes over 2000 plug-ins for enhancing network monitoring.

8. Progress Whatsup Gold

Progress Whatsup Gold is a basic network monitoring software. It provides a minimal user interface with essential features like device monitoring, application monitoring, analysing network traffic and managing configurations. The tool allows users to monitor cloud devices, inspect suspicious connections, automate configuration backups and identify, and resolve bandwidth issues.

Other Tools For Network Monitoring

Here are three additional tools for network monitoring:

 Fortra Intermapper: This tool enables users to monitor network connections using network maps, allowing them to get a holistic view of all the connections. It also provides various colour codes for different network status, along with real-time notifications through text, email and sound.

 Nagios Core: Nagios Core is a monitoring engine that works as the primary application for all Nagios projects, including the Nagios Network Analyser. It integrates with other Nagios applications and provides users with features like a visual dashboard, custom application monitoring, automated alert system, advanced user management and network security monitoring.

 Zabbix: Zabbix provides a thorough network monitoring solution with features like server monitoring, cloud monitoring, application monitoring and service monitoring. The tool also includes features like metric collection, business monitoring and root cause analyses of network issues, and allows users to establish a threshold for connection anomalies.

Tips To Choose A Network Monitoring And Management Tool

Here are some useful tips that you can consider while selecting a tool for network monitoring:

Understand the requirements

Understanding why you require network monitoring software is important in the process. Define what feature you want and for what purpose. This can help you identify the right tool for your use. It may also help you choose the correct subscription plan on paid tools.

Browse multiple tools

Once you identify the requirements, consider browsing multiple tools. Visit the websites of the tools and look for the features you require. Spend time studying the features and understand how they can be useful to your requirements. You can also identify a few tools and compare their features to each other.

Consider the budget

Some tools may be free to use, while some may require you to purchase a subscription plan. Paid tools typically offer a free trial period of up to 30 days. Once you identify which tool you may like to use, see if it is free or requires payment. If it is a paid tool, try exploring its features and efficiency during the trial period. Consider keeping a backup tool in case the tool that you choose does not fit your usage.

Result:

Thus the network monitoring tools was explored

Ex .No : 11 **Date :**	**Study to configure Firewall, VPN**	**Page No : 65**

AIM:

To study the features of firewall in providing network security and to set Firewall Security in windows.

Firewall in Windows 7

Windows 7 comes with two firewalls that work together. One is the Windows Firewall, and the other is Windows Firewall with Advanced Security (WFAS). The main difference between them is the complexity ofthe rules configuration. Windows Firewall uses simple rules that directlyrelate to a program or a service. The rules in WFAS can be configured based on protocols, ports, addresses and authentication. By default, both firewalls come with predefined set of rules that allow us to utilize network resources. This includes things like browsing the web, receiving e-mails, etc. Other standard firewall exceptions are File and Printer Sharing, Network Discovery, Performance Logs and Alerts, Remote Administration, Windows Remote Management, Remote Assistance, Remote Desktop, Windows Media Player, Windows Media Player Network Sharing Service

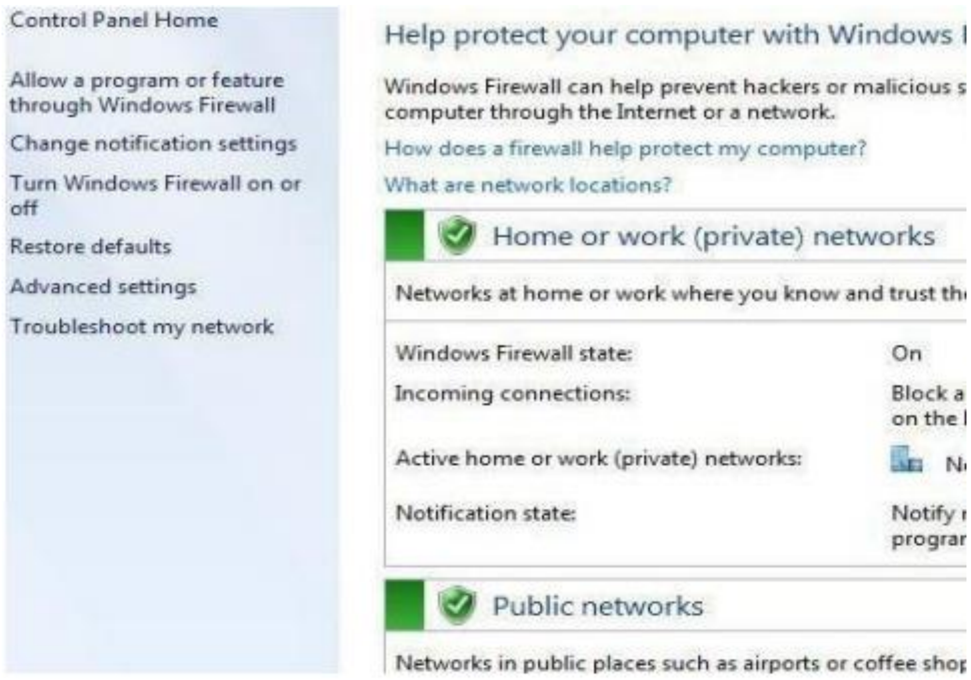
With firewall in Windows 7 we can configure inbound and outbound rules. By default, all outbound traffic is allowed, and inbound responses to that traffic are also allowed. Inbound traffic initiated from external sources is automatically blocked.

When we first connect to some network, we are prompted to select a network location. This feature is known as Network Location Awareness(NLA). This feature enables us to assign a network profile to the connection based on the location. Different network profiles contain different collections of firewall rules. In Windows 7, different network profiles can be configured on different interfaces. For example, our wired interface can have different profile than our wireless interface. There are three different network profiles available:

- Public
- Home/Work - private network
- Domain - used within a domain

Configuring Windows Firewall

To open Windows Firewall we can go to Start > Control Panel > Windows



Control Panel Home

Allow a program or feature through Windows Firewall

Change notification settings

Turn Windows Firewall on or off

Restore defaults

Advanced settings

Troubleshoot my network

Help protect your computer with Windows I

Windows Firewall can help prevent hackers or malicious s computer through the Internet or a network.

How does a firewall help protect my computer?

What are network locations?

Home or work (private) networks

Networks at home or work where you know and trust th

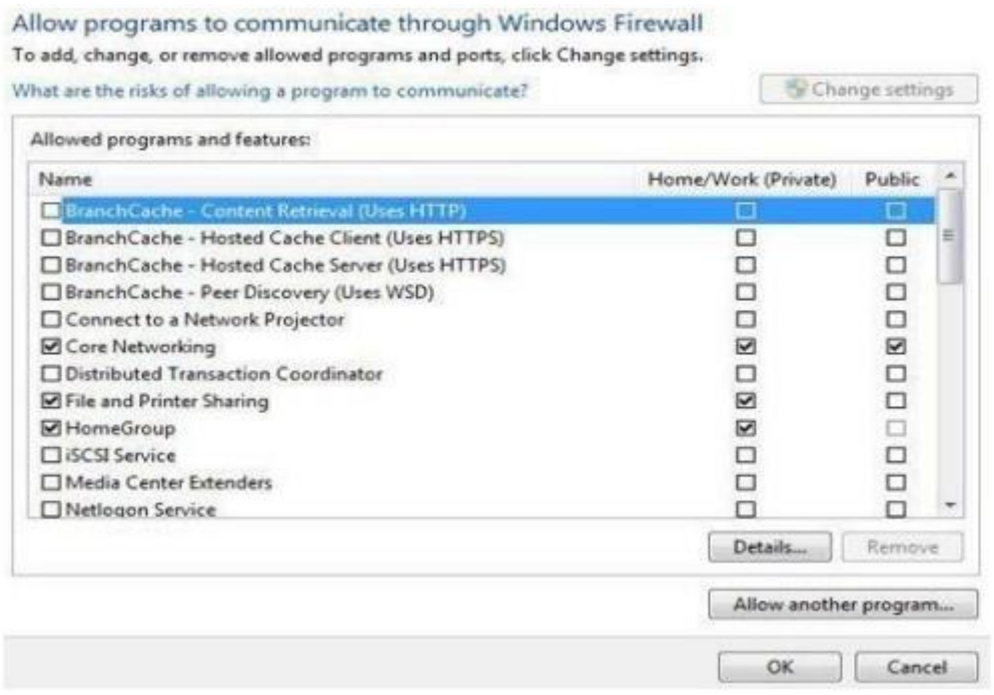
Windows Firewall state:	On
Incoming connections:	Block a on the l
Active home or work (private) networks:	N
Notification state:	Notify r prograr

Public networks

Networks in public places such as airports or coffee shop

Firewall.

By default, Windows Firewall is enabled for both private (home or work)and public networks. It is also configured to block all connections to programs that are not on the list of allowed programs. To configure exceptions we can go to the menu on the left and select "Allow a program or feature trough Windows Firewall" option.



Allow programs to communicate through Windows Firewall

To add, change, or remove allowed programs and ports, click Change settings.

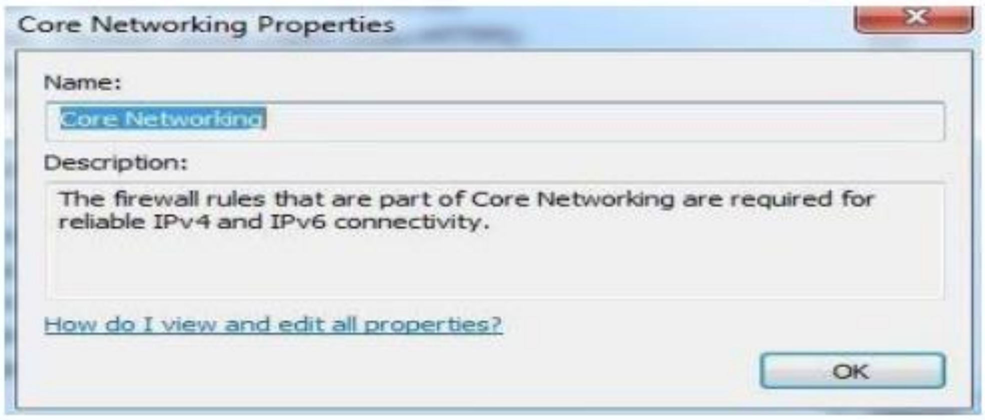
What are the risks of allowing a program to communicate?

Allowed programs and features:

Name	Home/Work (Private)	Public
☐ BranchCache - Content Retrieval (Uses HTTP)	☐	☐
☐ BranchCache - Hosted Cache Client (Uses HTTPS)	☐	☐
☐ BranchCache - Hosted Cache Server (Uses HTTPS)	☐	☐
☐ BranchCache - Peer Discovery (Uses WSD)	☐	☐
☐ Connect to a Network Projector	☐	☐
☑ Core Networking	☑	☑
☐ Distributed Transaction Coordinator	☐	☐
☑ File and Printer Sharing	☑	☐
☑ HomeGroup	☑	☐
☐ iSCSI Service	☐	☐
☐ Media Center Extenders	☐	☐
☐ Netlogon Service	☐	☐

Exceptions

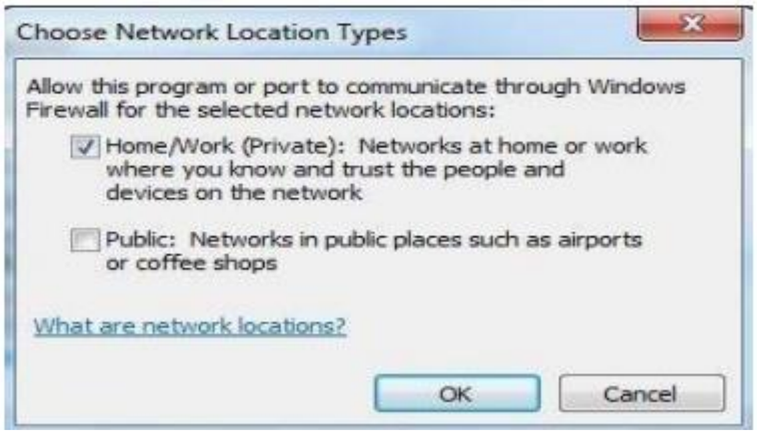
To change settings in this window we have to click the "Change settings" button. As you can see, here we have a list of predefined programs and features that can be allowed to communicate on private or public networks. For example, notice that the Core Networking feature is allowed on both private and public networks, while the File and Printer Sharing is only allowed on private networks. We can also see the details of the items in the list by selecting it and then clicking the Details button.



Core Networking Properties

Name: Core Networking

Description: The firewall rules that are part of Core Networking are required for reliable IPv4 and IPv6 connectivity.



Choose Network Location Types

Allow this program or port to communicate through Windows Firewall for the selected network locations:

[✓] Home/Work (Private): Networks at home or work where you know and trust the people and devices on the network

[ ] Public: Networks in public places such as airports or coffee shops

Details

If we have a program on our computer that is not in this list, we can manually add it by clicking on the "Allow another program" button.

Add a Program

Here we have to browse to the executable of our program and then click the Add button. Notice that we can also choose location types on which this program will be allowed to communicate by clicking on the "Network location types" button

Network Locations

Many applications will automatically configure proper exceptions in Windows Firewall when we run them. For example, if we enable streaming from Media Player, it will automatically configure firewall settings to allow streaming. The same thing is if we enable Remote Desktop feature from the system properties window. By enabling Remote Desktop feature we actually create an exception in Windows Firewall.

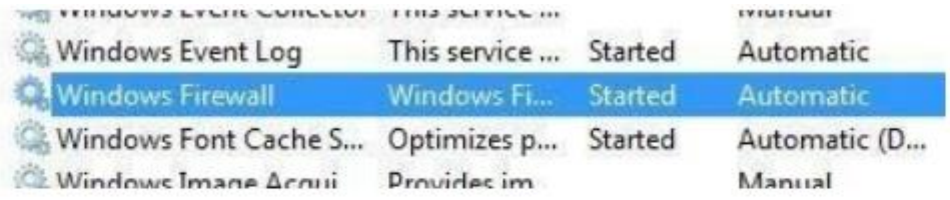
Windows Firewall can be turned off completely. To do that we can select the "Turn Windows Firewall on or off" option from the menu on the left.

Firewall Customization

Note that we can modify settings for each type of network location (private or public). Interesting thing here is that we can block all incoming connections, including those in the list of allowed programs.

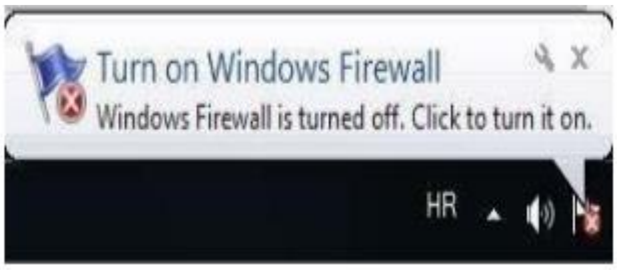
Windows Firewall is actually a Windows service. As you know, services can be stopped and started. If the Windows Firewall service is stopped, the Windows Firewall will not work.

Firewall Service



Windows Event Log	This service ...	Started	Automatic
Windows Firewall	Windows Fi...	Started	Automatic
Windows Font Cache S...	Optimizes p...	Started	Automatic (D...
Windows Image Acqui	Provides im		Manual

In our case the service is running. If we stop it, we will get a warning thatwe should turn on our Windows Firewall.



Turn on Windows Firewall
Windows Firewall is turned off. Click to turn it on.

Warning

Remember that with Windows Firewall we can only configure basic firewall settings, and this is enough for most day-to-day users. However, we can't configure exceptions based on ports in Windows Firewall any more. For that we have to use Windows Firewall with Advanced Security.

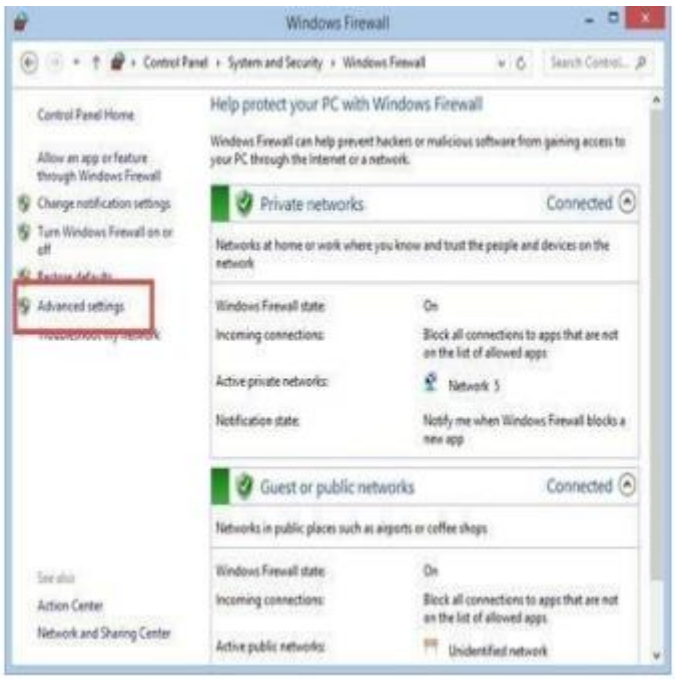
How to Start & Use the Windows Firewall with Advanced Security

The Windows Firewall with Advanced Security is a tool which gives you detailed control over the rules that are applied by the Windows Firewall. You can view all the rules that are used by the Windows Firewall, change their properties, create new rules or disable existing ones. In this tutorial we will share how to open the Windows Firewall with Advanced Security, how to find your way around it and talk about the types of rules that are available and what kind of traffic they filter.

How to Access the Windows Firewall with Advanced Security

You have several alternatives to opening the Windows Firewall with Advanced Security:

One is to open the standard Windows Firewall window, by going to "Control Panel -> System and Security -> Windows Firewall". Then, click or tap Advanced settings.


Windows Firewall
Control Panel › System and Security › Windows Firewall
Search Control...
Control Panel Home
Allow an app or feature through Windows Firewall
Change notification settings
Turn Windows Firewall on or off
Restore defaults
Advanced settings
Troubleshoot my network
See also
Action Center
Network and Sharing Center

Help protect your PC with Windows Firewall

Windows Firewall can help prevent hackers or malicious software from gaining access to your PC through the Internet or a network.

Private networks — Connected

Networks at home or work where you know and trust the people and devices on the network

Windows Firewall state:	On
Incoming connections:	Block all connections to apps that are not on the list of allowed apps
Active private networks:	Network 5
Notification state:	Notify me when Windows Firewall blocks a new app

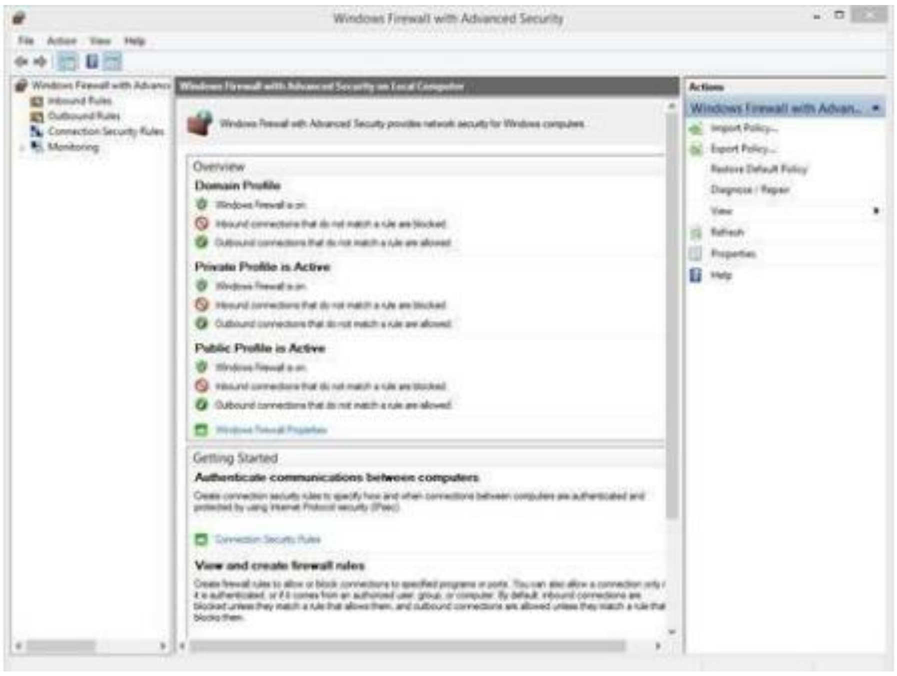
Guest or public networks — Connected

Networks in public places such as airports or coffee shops

Windows Firewall state:	On
Incoming connections:	Block all connections to apps that are not on the list of allowed apps
Active public networks:	Unidentified network

In Windows 7, another method is to search for the word firewall in the Start Menu search box and click the "Windows Firewall with Advanced Security" result.
In Windows 8.1, Windows Firewall with Advanced Security is not returned in search results and you need to use the first method shared above foropening it.

The Windows Firewall with Advanced Security looks and works the same both in Windows 7 and Windows 8.1. To continue our tutorial, we will use screenshots that were made in Windows 8.1.



Windows Firewall with Advanced Security provides network security for Windows computers.

Overview

Domain Profile

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Private Profile is Active

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Public Profile is Active

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Windows Firewall Properties

Getting Started

Authenticate communications between computers

Create connection security rules to specify how and when connections between computers are authenticated and protected by using Internet Protocol security (IPsec).

Connection Security Rules

View and create firewall rules

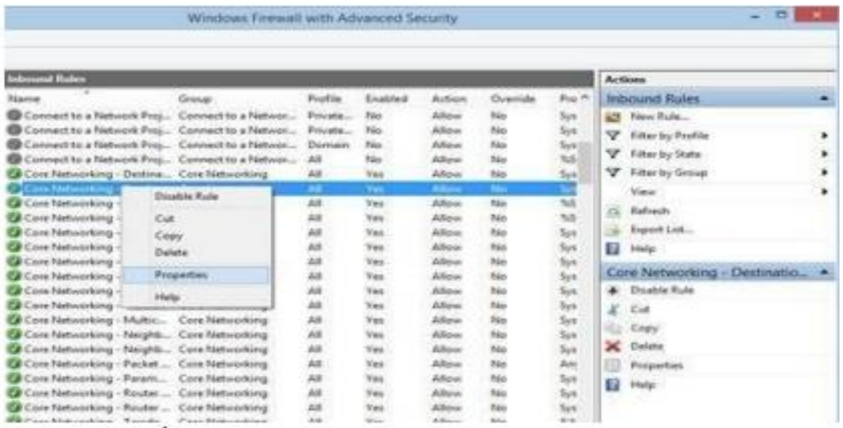
Create firewall rules to allow or block connections to specified programs or ports. You can also allow a connection only if it is authenticated, or if it comes from an authorized user, group, or computer. By default, inbound connections are blocked unless they match a rule that allows them, and outbound connections are allowed unless they match a rule that blocks them.

What Are The Inbound & Outbound Rules?

In order to provide the security you need, the Windows Firewall has a standard set of inbound and outbound rules, which are enabled depending on the location of the network you are connected to.

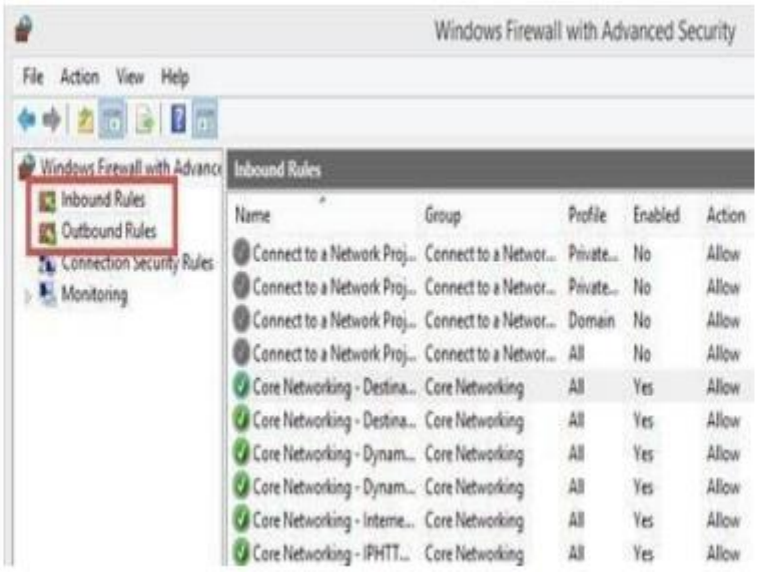
Inbound rules are applied to the traffic that is coming from the network and the Internet to your computer or device. Outbound rules apply to the traffic from your computer to the network or the Internet.

These rules can be configured so that they are specific to: computers, users, programs, services, ports or protocols. You can also specify to which type of network adapter (e.g. wireless, cable, virtual private network) or user profileit is applied to



Name	Group	Profile	Enabled	Action	Override	Pro
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	Domain	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	All	No	Allow	No	%S
Core Networking - Destina...	Core Networking	All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	%S
Core Networking -		All	Yes	Allow	No	%S
Core Networking -		All	Yes	Allow	No	%S
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking - Multic...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Neighb...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Neighb...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Packet ...	Core Networking	All	Yes	Allow	No	Am
Core Networking - Param...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Router ...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Router ...	Core Networking	All	Yes	Allow	No	Sys

In the Windows Firewall with Advanced Security, you can access all rulesand edit their properties. All you have to do is click or tap the appropriate unit in the left-side panel.

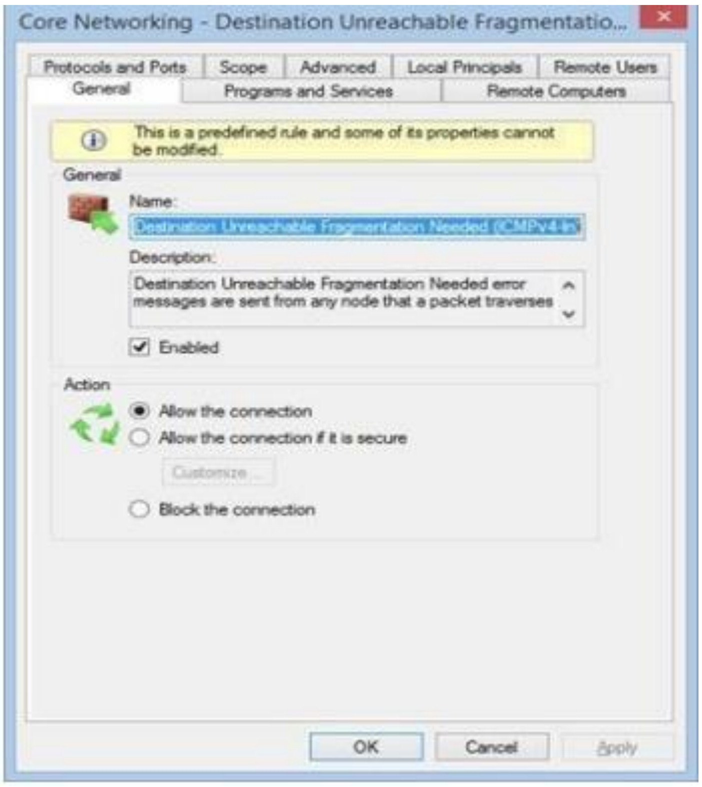

Windows Firewall with Advanced Security

Inbound Rules

Name	Group	Profile	Enabled	Action
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow
Connect to a Network Proj...	Connect to a Networ...	Domain	No	Allow
Connect to a Network Proj...	Connect to a Networ...	All	No	Allow
Core Networking - Destina...	Core Networking	All	Yes	Allow
Core Networking - Destina...	Core Networking	All	Yes	Allow
Core Networking - Dynam...	Core Networking	All	Yes	Allow
Core Networking - Dynam...	Core Networking	All	Yes	Allow
Core Networking - Interne...	Core Networking	All	Yes	Allow
Core Networking - IPHTT...	Core Networking	All	Yes	Allow

The rules used by the Windows Firewall can be enabled or disabled. The ones which are enabled or active are marked with a green check-box in the Name column. The ones that are disabled are marked with a gray check-box.

If you want to know more about a specific rule and learn its properties, right click on it and select Properties or select it and press Properties in thecolumn on right, which lists the actions that are available for your selection


Core Networking - Destination Unreachable Fragmentatio...

This is a predefined rule and some of its properties cannot be modified.

General

Name:
Destination Unreachable Fragmentation Needed (ICMPv4-In)

Description:
Destination Unreachable Fragmentation Needed error messages are sent from any node that a packet traverses

[✓] Enabled

Action

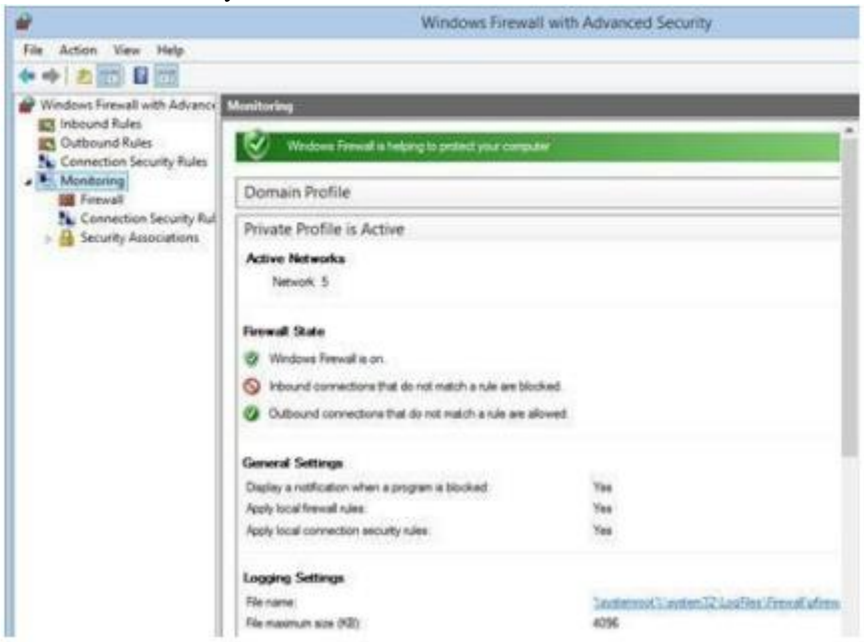
[● Allow the connection]
○ Allow the connection if it is secure
Customize...
○ Block the connection

What Are The Connection Security Rules?

Connection security rules are used to secure traffic between two computers while it crosses the network. One example would be a rule which defines that connections between two specific computers must be encrypted.

Unlike the inbound or outbound rules, which are applied only to one computer, connection security rules require that both computers have the same rules defined and enabled.

If you want to see if there are any such rules on your computer, click or tap "Connection Security Rules" on the panel on the left. By default, there are no such rules defined on Windows computers and devices. They are generally used in business environments and such rules are set by the network administrator.



Windows Firewall is helping to protect your computer

Domain Profile

Private Profile is Active

Active Networks

Network 5

Firewall State

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

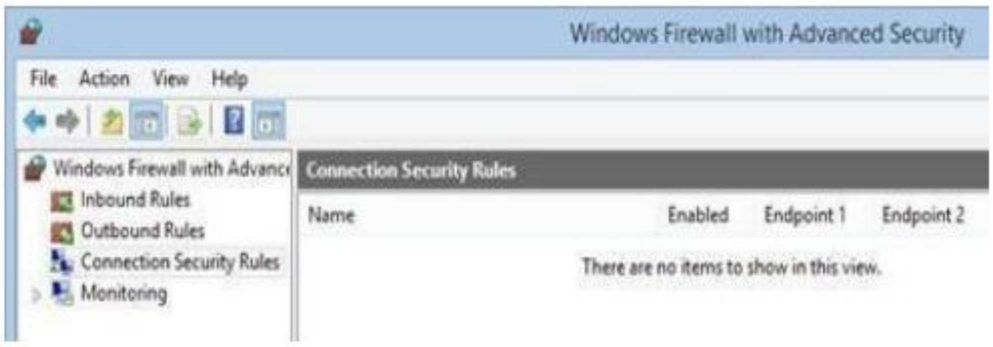
Outbound connections that do not match a rule are allowed.

General Settings

Display a notification when a program is blocked:	Yes
Apply local firewall rules:	Yes
Apply local connection security rules:	Yes

Logging Settings

File name:	%systemroot%\system32\LogFiles\Firewall\pfirew
File maximum size (KB):	4096


Windows Firewall with Advanced Security
File
Action
View
Help
Windows Firewall with Advanc
Inbound Rules
Outbound Rules
Connection Security Rules
Monitoring
Connection Security Rules

Name	Enabled	Endpoint 1	Endpoint 2

There are no items to show in this view.

What Does the Windows Firewall with Advanced Security Monitor?

The Windows Firewall with Advanced Security includes some monitoringfeatures as well. In the Monitoring section you can find the following information: the firewall rules that are active (both inbound and outbound),the connection security rules that are active and whether there are any active security associations.

You should note that the Monitoring section shows only the active rules for the current network location

used to determine the operating system running on the host machine. Another feature is "boot-time filtering". This feature ensures that the firewall is working at the same time when the network interface becomes active, which was not the case in previous versions of Windows.

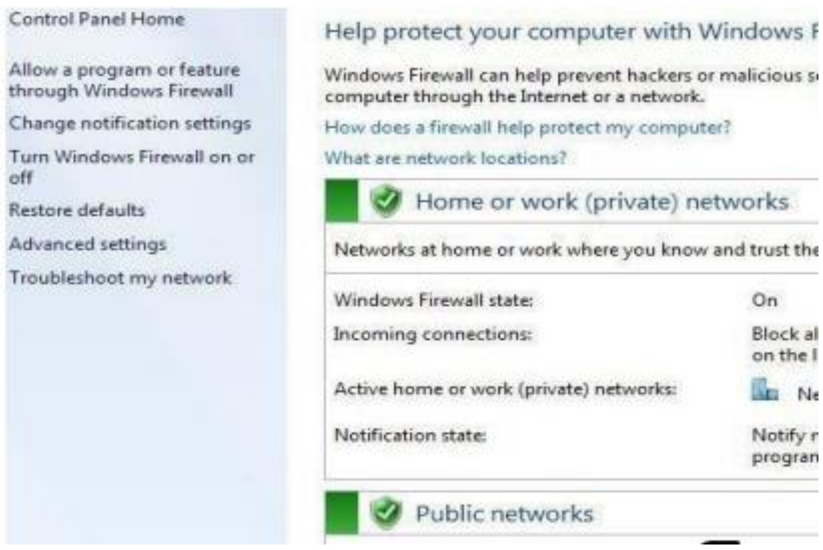
When we first connect to some network, we are prompted to select a network location. This feature is known as Network Location Awareness (NLA). This feature enables us to assign a network profile to the connection based on the location. Different network profiles contain different collections of firewall rules. In Windows 7, different network profiles can be configured on different interfaces. For example, our wired interface can have different profile than our wireless interface. There are three different network profiles available:

- Public
- Home/Work - private network
- Domain - used within a domain

We choose those locations when we connect to a network. We can always change the location in the Network and Sharing Center, in Control Panel. The Domain profile can be automatically assigned by the NLA service when we log on to an Active Directory domain. Note that we must have administrative rights in order to configure firewall in Windows 7.

2.1.1 Configuring Windows Firewall

To open Windows Firewall we can go to Start > Control Panel >


Control Panel Home

Allow a program or feature through Windows Firewall

Change notification settings

Turn Windows Firewall on or off

Restore defaults

Advanced settings

Troubleshoot my network

Help protect your computer with Windows F

Windows Firewall can help prevent hackers or malicious s computer through the Internet or a network.

How does a firewall help protect my computer?

What are network locations?

Home or work (private) networks

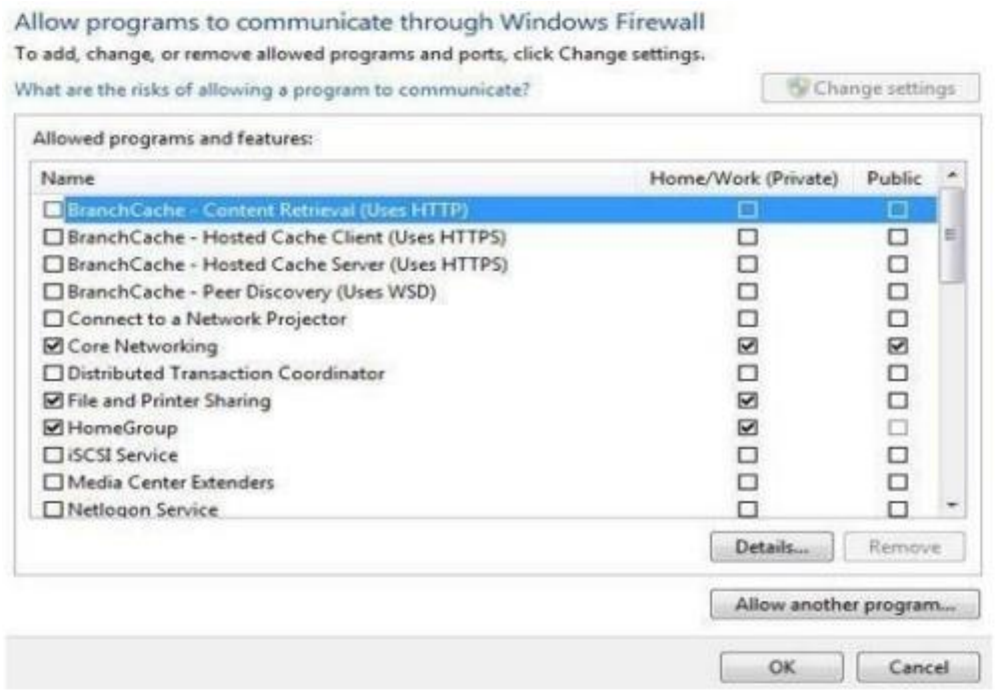
Networks at home or work where you know and trust the

Windows Firewall state:	On
Incoming connections:	Block al on the l
Active home or work (private) networks:	Ne
Notification state:	Notify r progran

Public networks

Windows Firewall.

By default, Windows Firewall is enabled for both private (home or work) and public networks. It is also configured to block all connections to programs that are not on the list of allowed programs. To configure exceptions we can go to the menu on the left and select "Allow a program or feature trough Windows Firewall" option.


Allow programs to communicate through Windows Firewall

To add, change, or remove allowed programs and ports, click Change settings.

What are the risks of allowing a program to communicate?

Allowed programs and features:

Name	Home/Work (Private)	Public
☐ BranchCache - Content Retrieval (Uses HTTP)	☐	☐
☐ BranchCache - Hosted Cache Client (Uses HTTPS)	☐	☐
☐ BranchCache - Hosted Cache Server (Uses HTTPS)	☐	☐
☐ BranchCache - Peer Discovery (Uses WSD)	☐	☐
☐ Connect to a Network Projector	☐	☐
☑ Core Networking	☑	☑
☐ Distributed Transaction Coordinator	☐	☐
☑ File and Printer Sharing	☑	☐
☑ HomeGroup	☑	☐
☐ iSCSI Service	☐	☐
☐ Media Center Extenders	☐	☐
☐ Netlogon Service	☐	☐

Exceptions

To change settings in this window we have to click the "Change settings" button. As you can see, here we have a list of predefined programs and features that can be allowed to communicate on private or public networks. For example, notice that the Core Networking feature is allowed on both private and public networks, while the File and

Printer Sharing is only allowed on private networks. We can also see the details of the items in the list by selecting it and then clicking the Details button.

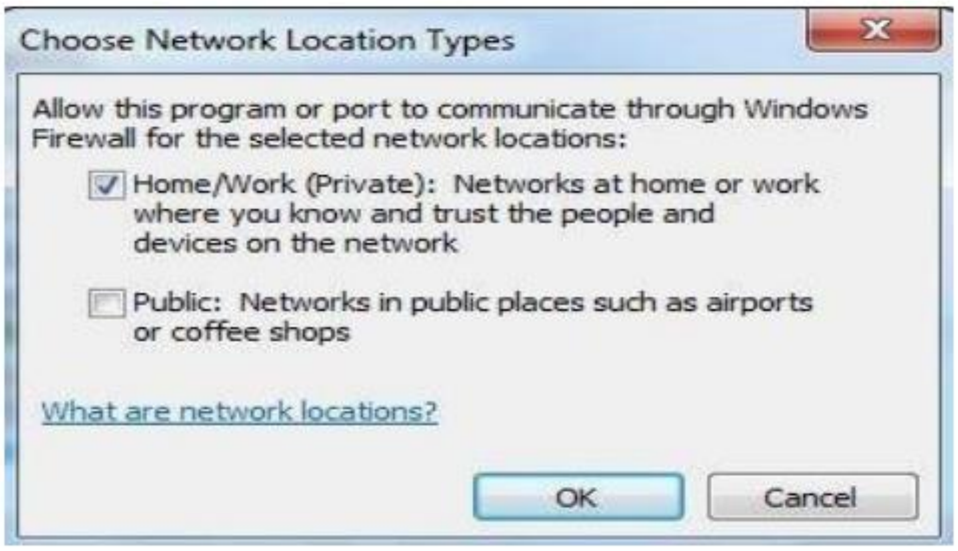
Details

If we have a program on our computer that is not in this list, we can manually add it by clicking on the "Allow another program" button.

Add a Program

Here we have to browse to the executable of our program and then click the Add button.

Notice that we can also choose location types on which this program will be allowed to communicate by clicking on the "Network location types" button.


Choose Network Location Types

Allow this program or port to communicate through Windows Firewall for the selected network locations:

[✓] Home/Work (Private): Networks at home or work where you know and trust the people and devices on the network

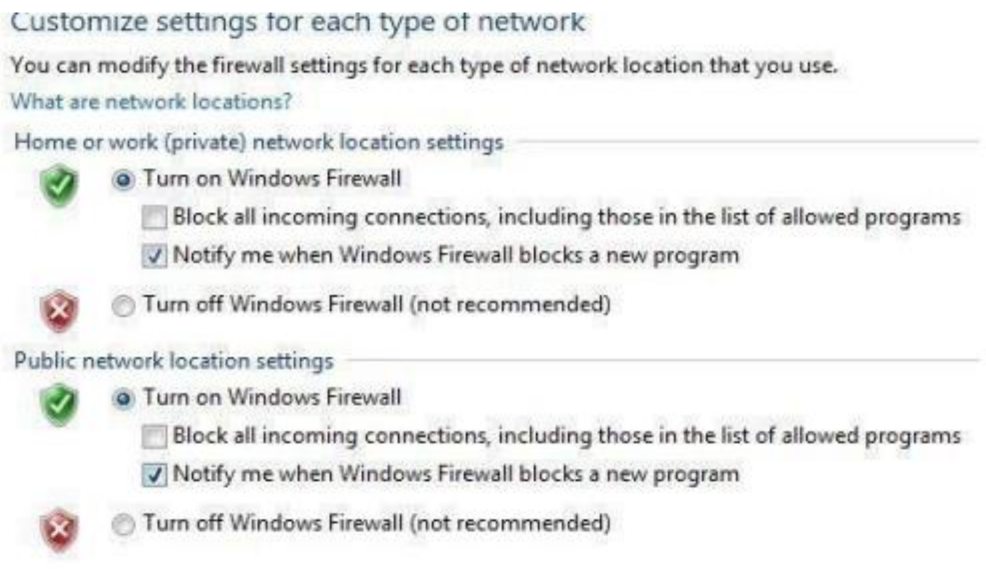
[ ] Public: Networks in public places such as airports or coffee shops

What are network locations?

Network Locations

Many applications will automatically configure proper exceptions in Windows Firewall when we run them. For example, if we enable streaming from Media Player, it will automatically configure firewall settings to allow streaming. The same thing is if we enable Remote Desktop feature from the system properties window. By enabling Remote Desktop feature we actually create an exception in Windows Firewall.

Windows Firewall can be turned off completely. To do that we can select the "Turn Windows Firewall on or off" option from the menu on the left.


Customize settings for each type of network

You can modify the firewall settings for each type of network location that you use.

What are network locations?

Home or work (private) network location settings

(●) Turn on Windows Firewall

[ ] Block all incoming connections, including those in the list of allowed programs

[✓] Notify me when Windows Firewall blocks a new program

( ) Turn off Windows Firewall (not recommended)

Public network location settings

(●) Turn on Windows Firewall

[ ] Block all incoming connections, including those in the list of allowed programs

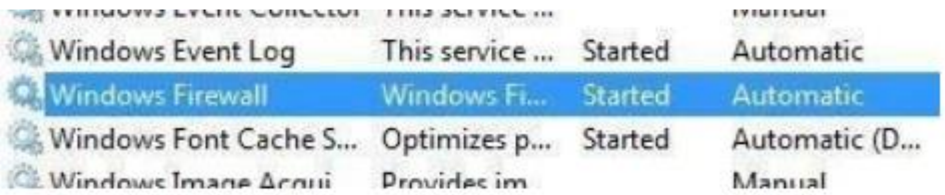
[✓] Notify me when Windows Firewall blocks a new program

( ) Turn off Windows Firewall (not recommended)

Firewall Customization

Note that we can modify settings for each type of network location (private or public). Interesting thing here is that we can block all incoming connections, including those in the list of allowed programs.

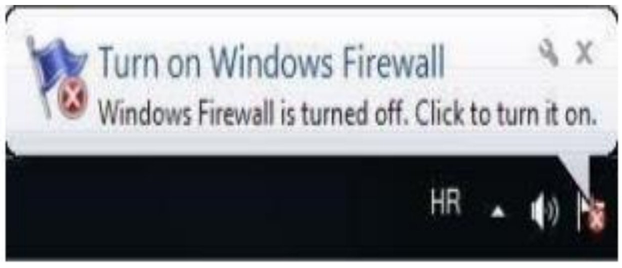
Windows Firewall is actually a Windows service. As you know, services can be stopped and started. If the Windows Firewall service is stopped, the Windows Firewall will not work.



Windows Event Log	This service ...	Started	Automatic
Windows Firewall	Windows Fi...	Started	Automatic
Windows Font Cache S...	Optimizes p...	Started	Automatic (D...

Firewall Service

In our case the service is running. If we stop it, we will get a warning thatwe should turn on our Windows Firewall.


Turn on Windows Firewall

Windows Firewall is turned off. Click to turn it on.

Warning

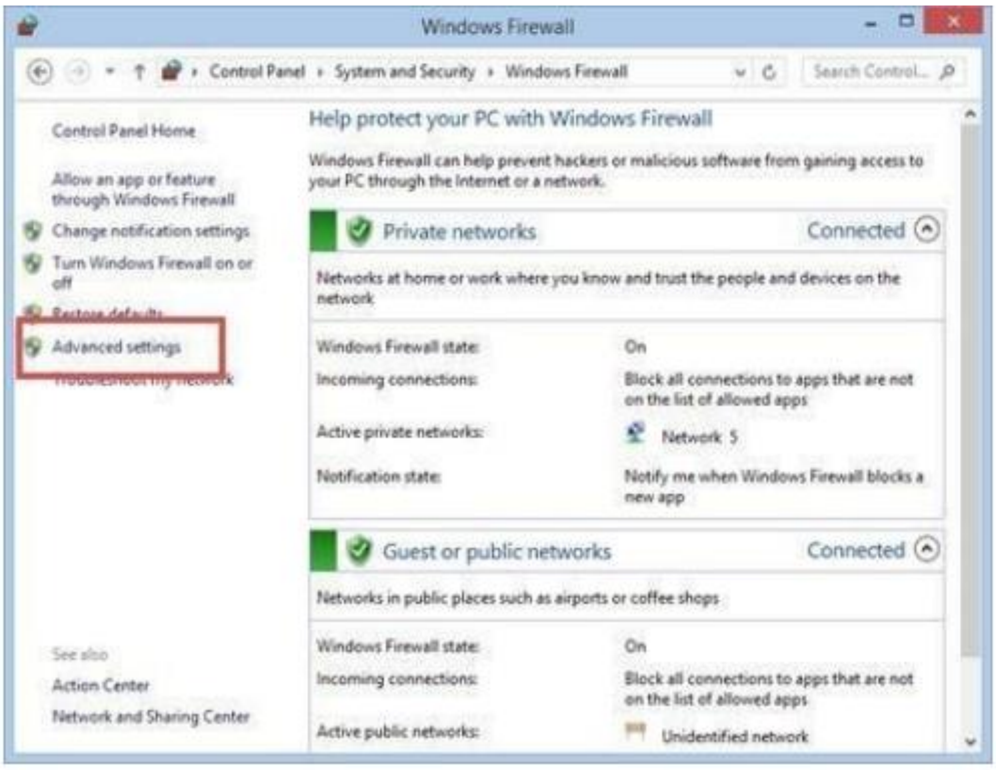
Remember that with Windows Firewall we can only configure basic firewall settings, and this is enough for most day-to-day users. However, we can't configure exceptions based on ports in Windows Firewall any more. For that we have to use Windows Firewall with Advanced Security.

How to Start & Use the Windows Firewall with Advanced Security

The Windows Firewall with Advanced Security is a tool which gives you detailed control over the rules that are applied by the Windows Firewall.You can view all the rules that are used by the Windows Firewall, change their properties, create new rules or disable existing ones. In this tutorial we will share how to open the Windows Firewall with Advanced Security, howto find your way around it and talk about the types of rules that are available and what kind of traffic they filter. How to Access the Windows Firewall with Advanced Security

You have several alternatives to opening the Windows Firewall with Advanced Security

One is to open the standard Windows Firewall window, by going to "Control Panel -> System and Security -> Windows Firewall". Then, click or tap Advanced settings.


Windows Firewall
Control Panel › System and Security › Windows Firewall
Search Control...
Control Panel Home
Allow an app or feature through Windows Firewall
Change notification settings
Turn Windows Firewall on or off
Restore defaults
Advanced settings
Troubleshoot my network
See also
Action Center
Network and Sharing Center

Help protect your PC with Windows Firewall

Windows Firewall can help prevent hackers or malicious software from gaining access to your PC through the Internet or a network.

Private networks Connected

Networks at home or work where you know and trust the people and devices on the network

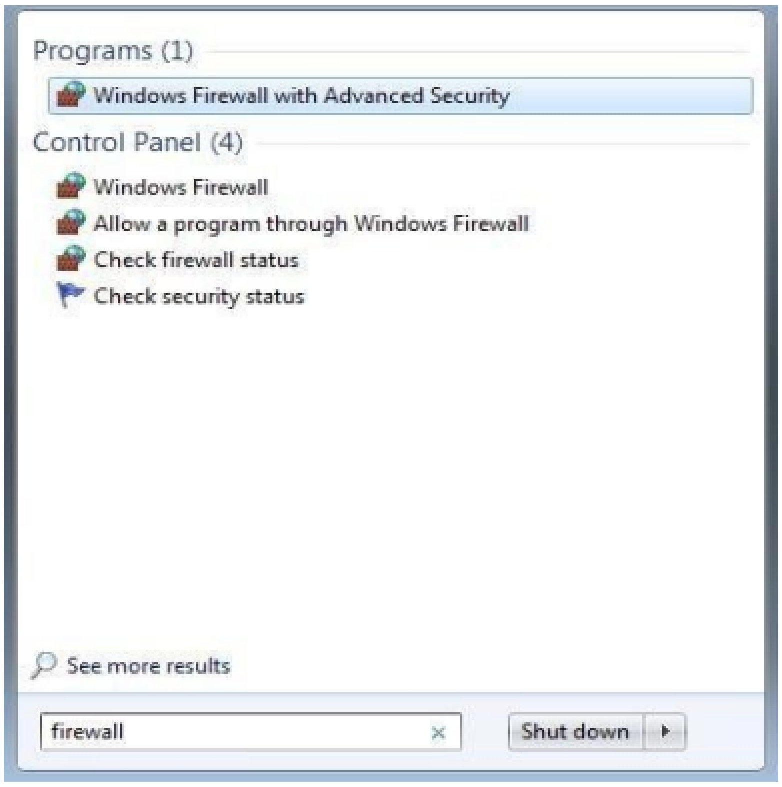
Windows Firewall state:	On
Incoming connections:	Block all connections to apps that are not on the list of allowed apps
Active private networks:	Network 5
Notification state:	Notify me when Windows Firewall blocks a new app

Guest or public networks Connected

Networks in public places such as airports or coffee shops

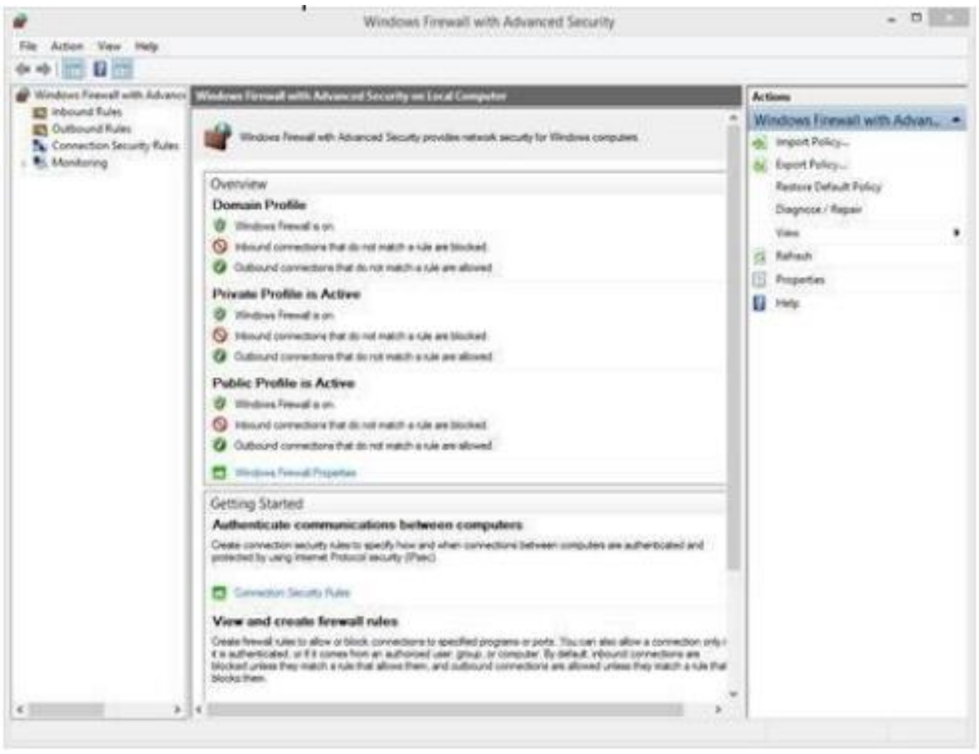
Windows Firewall state:	On
Incoming connections:	Block all connections to apps that are not on the list of allowed apps
Active public networks:	Unidentified network

In Windows 7, another method is to search for the word firewall in the Start Menu search box and click the "Windows Firewall with Advanced Security" result



In Windows 8.1, Windows Firewall with Advanced Security is not returned in search results and you need to use the first method shared above foropening it.

The Windows Firewall with Advanced Security looks and works the same both in Windows 7 and Windows 8.1. To continue our tutorial, we will use screenshots that were made in Windows 8.1.


Windows Firewall with Advanced Security
File Action View Help
Windows Firewall with Advanced Security
Inbound Rules
Outbound Rules
Connection Security Rules
Monitoring
Windows Firewall with Advanced Security on Local Computer
Actions
Windows Firewall with Advan...
Import Policy...
Export Policy...
Restore Default Policy
Diagnose / Repair
View
Refresh
Properties
Help

Windows Firewall with Advanced Security provides network security for Windows computers.

Overview

Domain Profile

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Private Profile is Active

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Public Profile is Active

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

Windows Firewall Properties

Getting Started

Authenticate communications between computers

Create connection security rules to specify how and when connections between computers are authenticated and protected by using Internet Protocol security (IPsec).

Connection Security Rules

View and create firewall rules

Create firewall rules to allow or block connections to specified programs or ports. You can also allow a connection only if it is authenticated, or if it comes from an authorized user, group, or computer. By default, inbound connections are blocked unless they match a rule that allows them, and outbound connections are allowed unless they match a rule that blocks them.

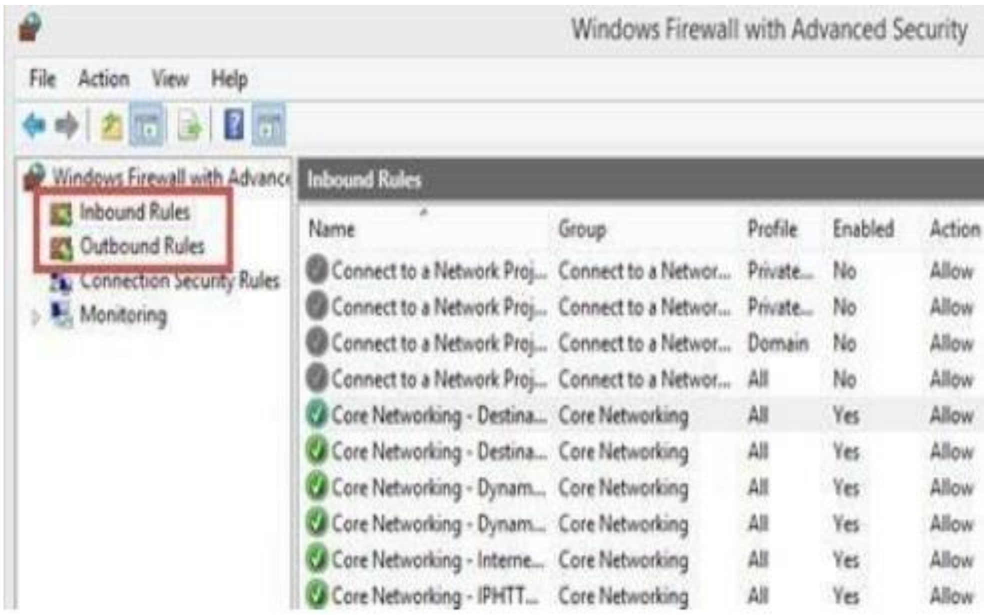
What Are The Inbound & Outbound Rules?

In order to provide the security you need, the Windows Firewall has a standard set of inbound and outbound rules, which are enabled depending on the location of the network you are connected to.

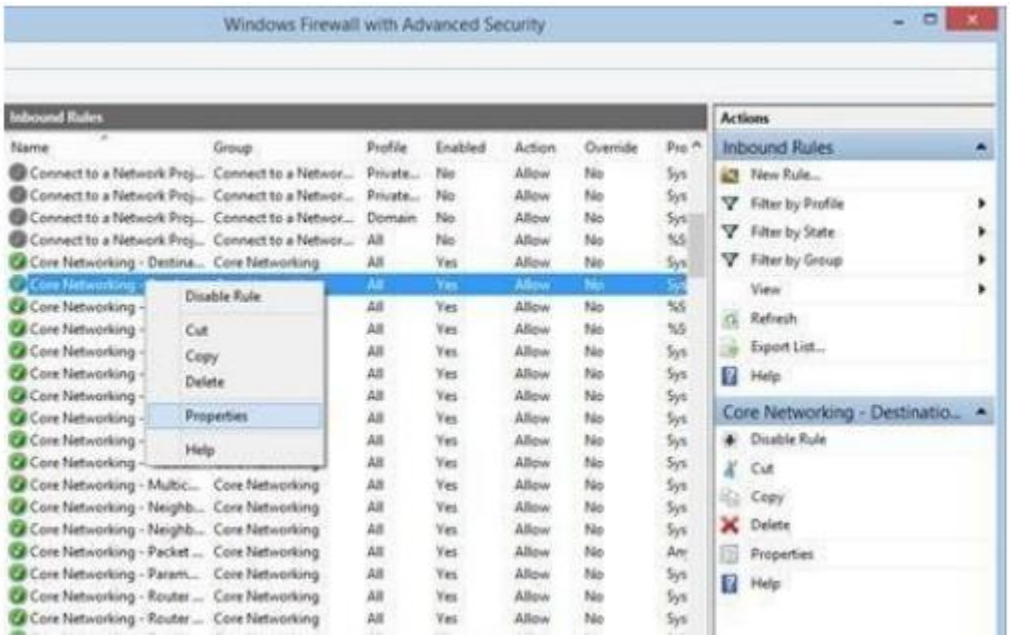
Inbound rules are applied to the traffic that is coming from the network and the Internet to your computer or device. Outbound rules apply to the traffic from your computer to the network or the Internet.

These rules can be configured so that they are specific to: computers, users, programs, services, ports or protocols. You can also specify to which type of network adapter (e.g. wireless, cable, virtual private network) or user profileit is applied to.

In the Windows Firewall with Advanced Security, you can access all rules and edit their properties. All you have to do is click or tap the appropriate unit in the left-side panel.

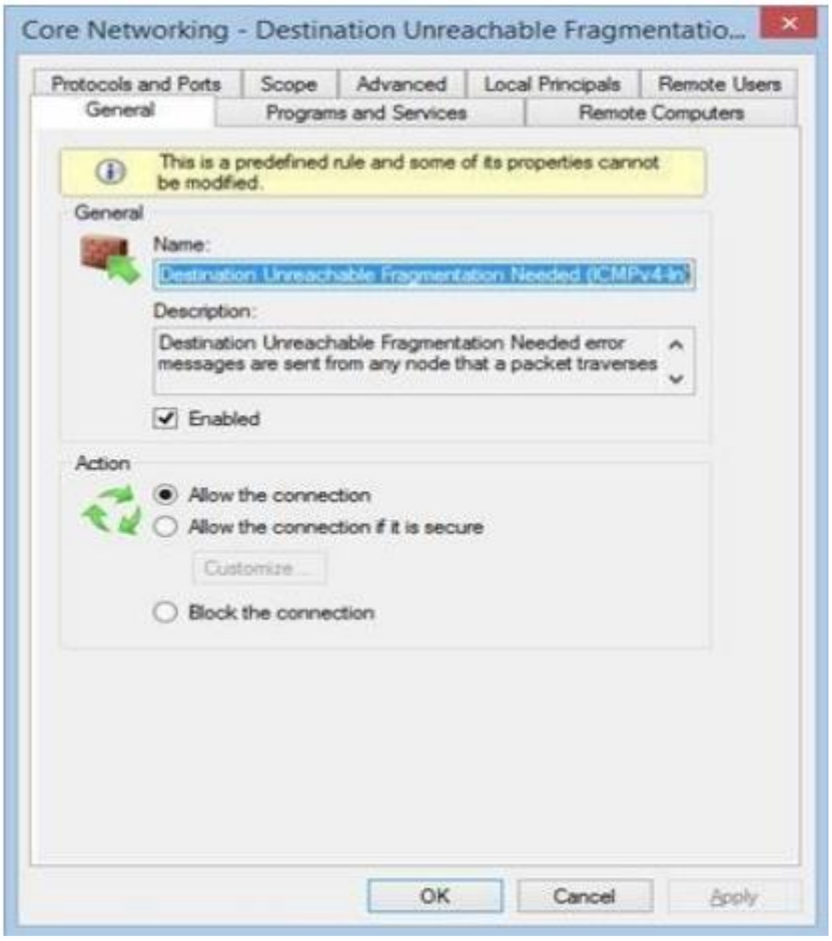

Windows Firewall with Advanced Security
File
Action
View
Help
Windows Firewall with Advance
Inbound Rules
Outbound Rules
Connection Security Rules
Monitoring
Inbound Rules

Name	Group	Profile	Enabled	Action
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow
Connect to a Network Proj...	Connect to a Networ...	Domain	No	Allow
Connect to a Network Proj...	Connect to a Networ...	All	No	Allow
Core Networking - Destina...	Core Networking	All	Yes	Allow
Core Networking - Destina...	Core Networking	All	Yes	Allow
Core Networking - Dynam...	Core Networking	All	Yes	Allow
Core Networking - Dynam...	Core Networking	All	Yes	Allow
Core Networking - Interne...	Core Networking	All	Yes	Allow
Core Networking - IPHTT...	Core Networking	All	Yes	Allow



Name	Group	Profile	Enabled	Action	Override	Pro
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	Private...	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	Domain	No	Allow	No	Sys
Connect to a Network Proj...	Connect to a Networ...	All	No	Allow	No	%S
Core Networking - Destina...	Core Networking	All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	%S
Core Networking -		All	Yes	Allow	No	%S
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking -		All	Yes	Allow	No	Sys
Core Networking - Multic...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Neighb...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Neighb...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Packet ...	Core Networking	All	Yes	Allow	No	Any
Core Networking - Param...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Router ...	Core Networking	All	Yes	Allow	No	Sys
Core Networking - Router ...	Core Networking	All	Yes	Allow	No	Sys

The rules used by the Windows Firewall can be enabled or disabled. The ones which are enabled or active are marked with a green check-box in the Name column. The ones that are disabled are marked with a gray check-box.If you want to know more about a specific rule and learn its properties, right click on it and select Properties or select it and press Properties in the column on right, which lists the actions that are available for your selection.


Core Networking - Destination Unreachable Fragmentatio...

This is a predefined rule and some of its properties cannot be modified.

General

Name: Destination Unreachable Fragmentation Needed (ICMPv4-In)

Description: Destination Unreachable Fragmentation Needed error messages are sent from any node that a packet traverses

☑ Enabled

Action

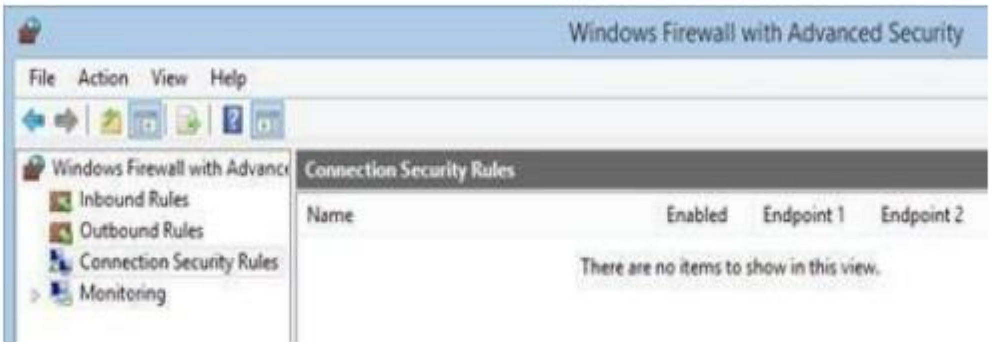
● Allow the connection
○ Allow the connection if it is secure
○ Block the connection

2.1.1.1 What Are The Connection Security Rules?

Connection security rules are used to secure traffic between two computers while it crosses the network. One example would be a rule which defines that connections between two specific computers must be encrypted.

Unlike the inbound or outbound rules, which are applied only to one computer, connection security rules require that both computers have thesame rules defined and enabled.

If you want to see if there are any such rules on your computer, click or tap "Connection Security Rules" on the panel on the left. By default, there are no such rules defined on Windows computers and devices. They are generally used in business environments and such rules are set by the network administrator.

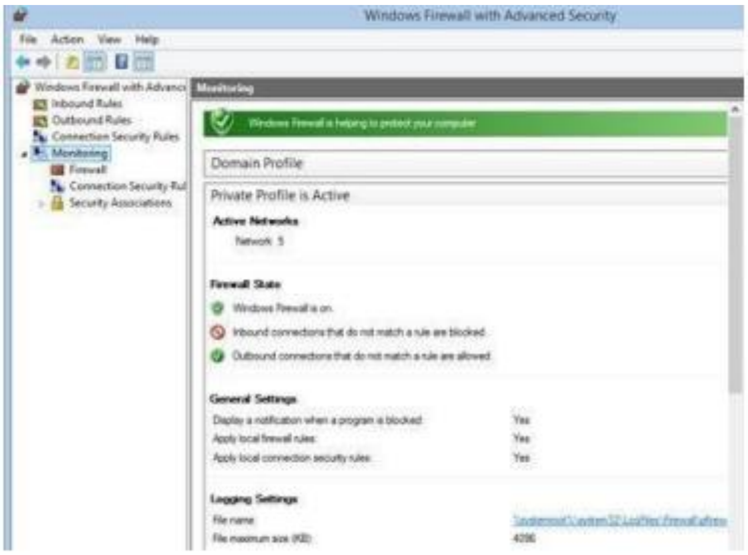

Windows Firewall with Advanced Security
File
Action
View
Help
Windows Firewall with Advanc
Inbound Rules
Outbound Rules
Connection Security Rules
Monitoring
Connection Security Rules

Name	Enabled	Endpoint 1	Endpoint 2

There are no items to show in this view.

2.1.1.2 What Does the Windows Firewall with Advanced Security Monitor?

The Windows Firewall with Advanced Security includes some monitoring features as well. In the Monitoring section you can find the following information: the firewall rules that are active (both inbound and outbound), the connection security rules that are active and whether there are any active security associations.



Windows Firewall is helping to protect your computer

Domain Profile

Private Profile is Active

Active Networks

Network 5

Firewall State

Windows Firewall is on.

Inbound connections that do not match a rule are blocked.

Outbound connections that do not match a rule are allowed.

General Settings

Display a notification when a program is blocked:	Yes
Apply local firewall rules:	Yes
Apply local connection security rules:	Yes

Logging Settings

File name:	[illegible]
File maximum size (KB):	4096

You should note that the Monitoring section shows only the active rules for the current network location.

Result:

study of the features of firewall in providing network security and to set Firewall Security in windows .