KTH - Royal Institute of Technology

Bouncer

IK2213 Network Services and Internet-based Applications

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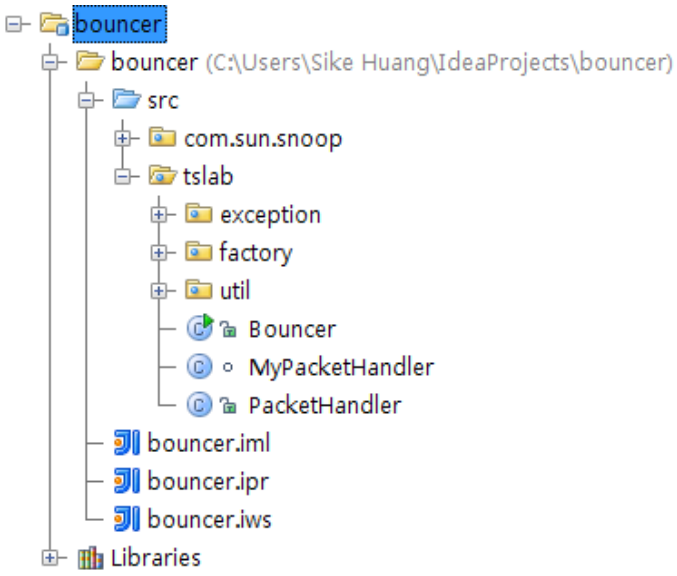
1. Project Structure



The project is composed of several packages:

com.sun.snoop is used for packet validation

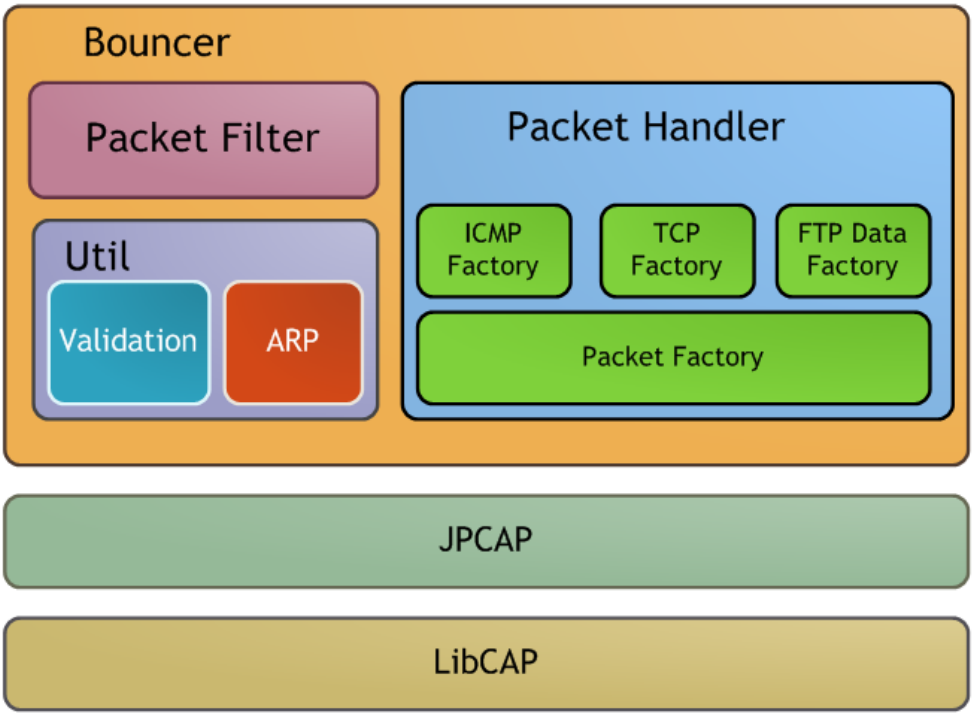
tslab.exception contains exceptions that might be thrown during packet creation

tslab.factory contains various classes to generate ICMP, TCP and FTP packets

tslab.util has common utilization code to support factory

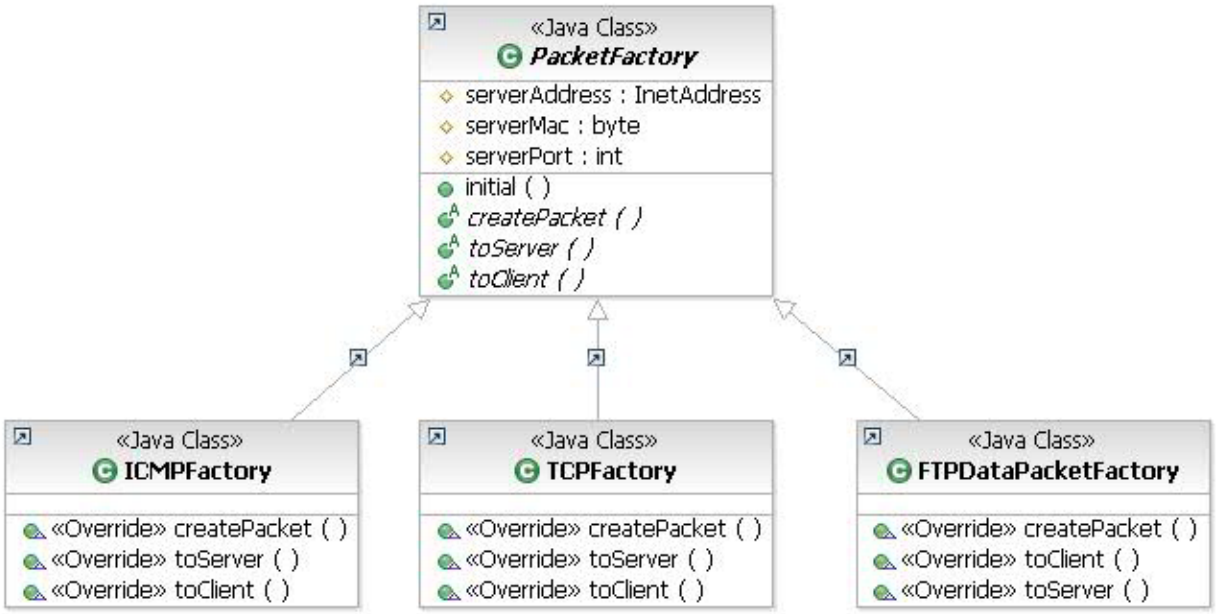
The entry point is **tslab.Bouncer**, which parses the command line arguments, then listens to the incoming packets by **tslab.(My)PacketHandler**, and creates corresponding outing packets using certain suitable factory.

2. Architecture



As shown in the figure above. Bouncer uses JpCap to capture packet. And it has a Packet Filter, a set of tools (Util) and Packet Handler. The Packet Handler handles the incoming packet, produces new packet according to it and sends the new packet out. The kernel of Packet Handler which is also the core of Bouncer is a set of Packet Factory.

3. Packet Factory



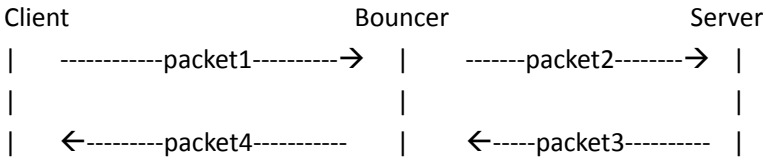
The whole packet producing system is based on Abstract Factory Design Pattern. That is the ICMPFactory, TCPFactory and FTPDataPacketFactory which extend PacketFactory. In the PacketFactory abstract class. We define three abstract methods createPacket(), toServer(), toClient() which are implemented separately by the three concrete factories. toServer() and toClient() method can be invoked directly by external class. While createPacket() is a high level method which invokes toServer() and toClient(). In createPacket() method, it will analyze the incoming packet first and call toServer() or toClient() according to the type of incoming packet. The product of the Factory is outgoing packet which can be sent directly from upper API.
Following table gives a brief introduction of factories.

PacketFactory	**The base Factory.** **Define abstract method** **Use initial() method to configure server properties**
ICMPFactory	Forward ICMP packet, use for ping
TCPFactory	Forword TCP packet, use for TCP an FTP command
FTPDataPacketFactory	Forword FTP Data packet.

Abstract Factory endorses maximum flexibility of switching different factories. Each and every packet is sent to certain factory according to its type, for example, a HTTP packet (TCPPacket) will be passed to TCPPacketFactory and the factory generates outgoing packet in accordance. Therefore, the process of creating and sending packet is factory-independent.
See class PacketHandler for detail.

4. Bounce rule

We define four paths as below:



Set routing table:

% route add **192.168.100.100** gw 10.8.0.50

4.1 IP level packet modification rule:

changed field	packet1	->	packet2
src.mac	client.mac	->	bouncer.mac
dst.mac	bouncer.mac	->	server.mac
src.ip	client.ip	->	packet1.dst.ip
dst.ip	192.168.100.100	->	server.ip

changed field	packet3	->	packet4
src.mac	server.mac	->	bouncer.mac
dst.mac	bouncer.mac	->	client.mac
src.ip	server.ip	->	packet3.dst.ip
dst.ip	192.168.100.100	->	client.ip

4.2 TCP level packet modification rule:

changed field	packet1	->	packet2
src.port	client.port	->	bouncer.outToServer.port
dst.port	packet1.dst.port	->	server.port

changed field	packet3	->	packet4
src.port	server.port	->	packet1.dst.port
dst.port	packet4.dst.port	->	client.port

4.3 Special rule for FTP port command:

An adjust value is used to make sequence number and ACK correct when bounce ftp port command. The adjust value is cumulative.

Formula:

Interval = outPacket.data.length – inPacket.data.length;

AdjustValue += Interval;

5. Command Line Argument

Our bouncer takes command line argument specific as following:

java tslab.Bouncer [interface] listen_ip:listen_port server_ip:server_port

interface is optional, it is the network device used to accept and forward packets, user can either specify it, such as eth0. Or the program will give a list of devices to be chosen, such as:

List of interfaces

0: \Device\NPF_{8C34DCC7-8F0C-475E-8F62-F159F050B026} [ip=/0.0.0.0]

1: \Device\NPF_{E09BD06A-3EBA-4364-9F94-0383CADD6DE1} [ip=null]

2: \Device\NPF_{B920C176-DC06-4740-886B-1051777BB8DE} [ip=/192.168.1.104]

3: \Device\NPF_{24234719-6C60-4BB4-A604-9600239CDFE5} [ip=/10.8.0.62]

Select one:

listen_ip and **server_ip** are mandatory.

listen_port and **server_port** are optional, and they behave in such a way:

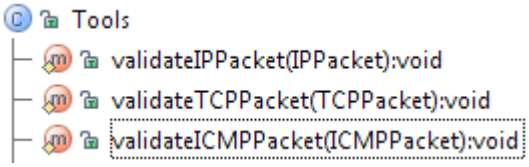
listern_port	server_port	Effect
Given	Given	Listen packets from given port, and forward to given port on server (TCP, FTP)
Not given	Not given	Listen packets from all ports, and forward to same port on server (ICMP, TCP, FTP)
Given	Not given	Listen packets from given port, and forward to same port on server (TCP, FTP)
Not given	Given	Listen packets from all ports, and forward to given port on server (TCP, FTP)

Please pay attention to these two points:

1) **ICMP** only works when there is neither listen_port nor server_port.
2) And in case of **FTP**, the data channel port on server is assumed to be the given server_port minus one, and on bouncer port 20 is always opened and used as data transmission channel towards client.

6. Packet Validation

Packet validation is conducted in class **tslab.util.Tools**. IP packet, ICMP packet and TCP packet are checked by **validateIPPacket**, **validateICMPPacket** and **validateTCPPacket**, respectively.



Upon receiving a packet from listening interface, application will first dispatch it to certain method mentioned above according to its type, for example, as shown in the snippet below, the same applies to **ICMPPacket** and **TCPPacket**.

```
//validate ip packet
if (packet instanceof IPPacket) {
    try {
```

```
            Tools.validateIPPacket((IPPacket) packet);
        } catch (ValidationFailedException e) {
            System.out.println(e.getMessage());
            return;
        }
    } else {
        return;
    }
```

If the packet is valid, then it will be passed into the factory to generate the corresponding outgoing packet, as explained in "**section 3. Packet Factory"**. Otherwise the packet is discarded, and the application continues to keep on listening and handling other incoming packets.

For an IPPacket, inside **validateIPPacket**, the actual validation process is delegated to **com.sun.snoop.IPv4Header.decodeIPv4Header**, which checks IP versions and header length, see the code for more details.

Then checksum is re-calculated using

org.savarese.vserv.tcpip.IPPacket.computeIPChecksum

And the value is compared with original one to determine the integrity, see the code for more details.

For an ICMPPacket, inside **validateICMPPacket**, first of all, the IP validation is conducted, later the code and type field in ICMP structure is checked, and then checksum is re-calculated using

Tools.computeChecksum

Last, value is compared with original one to determine the integrity, see the code for more details.

For a TCPPacket, inside **validateTCPPacket**, first of all, the IP validation is conducted.

In the TCP level, the actual validation process is delegated to

com.sun.snoop. TCPHeader. decodeTCPHeader,

Which checks the header length, see the code for more details.

Then checksum is re-calculated using

org.savarese.vserv.tcpip.TCPPacket. computeTCPChecksum

And the value is compared with original one to determine the integrity, see the code for more details.