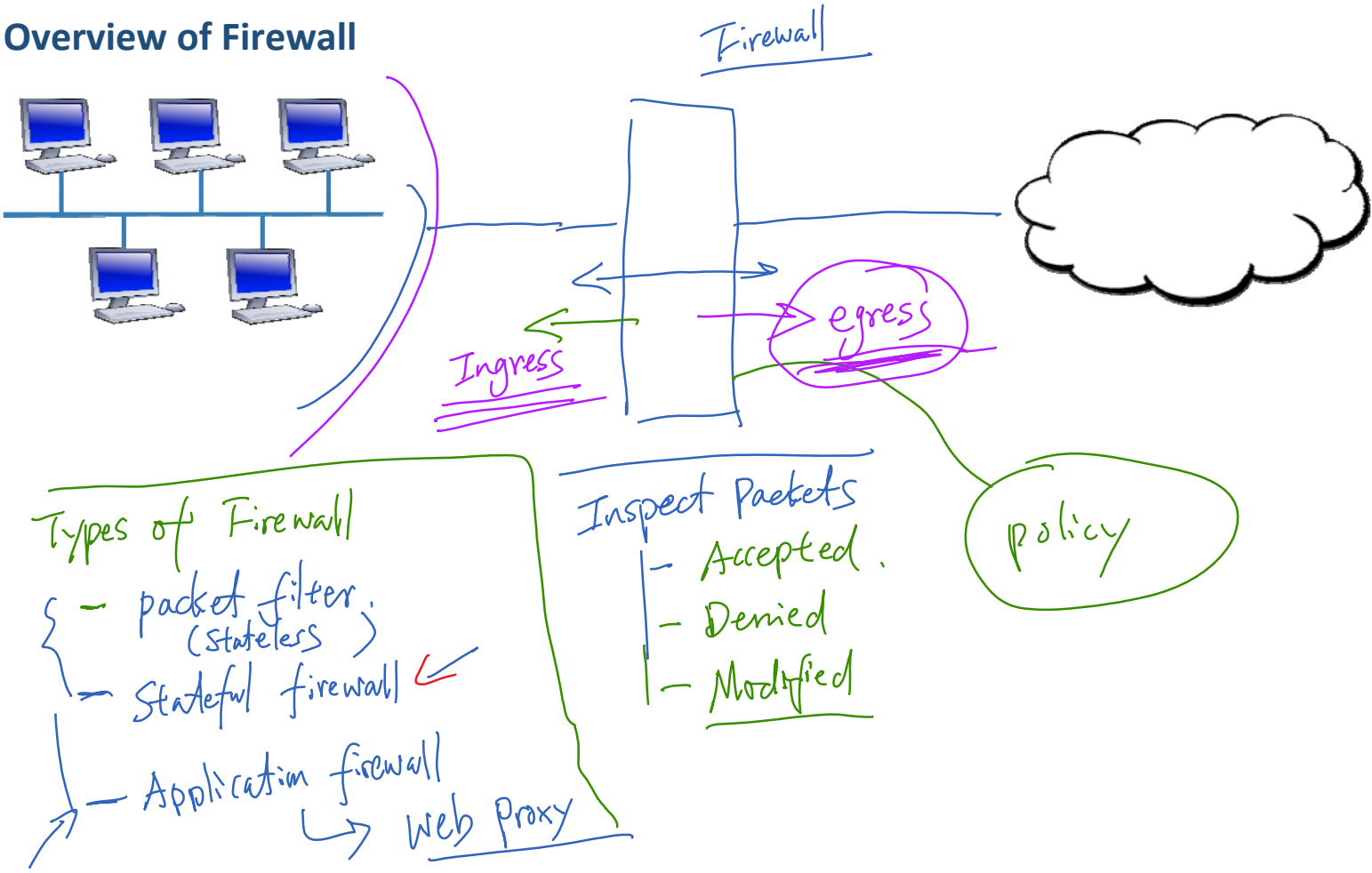
Overview of How Firewall Works

Overview of Firewall



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Linux Firewall Implementation

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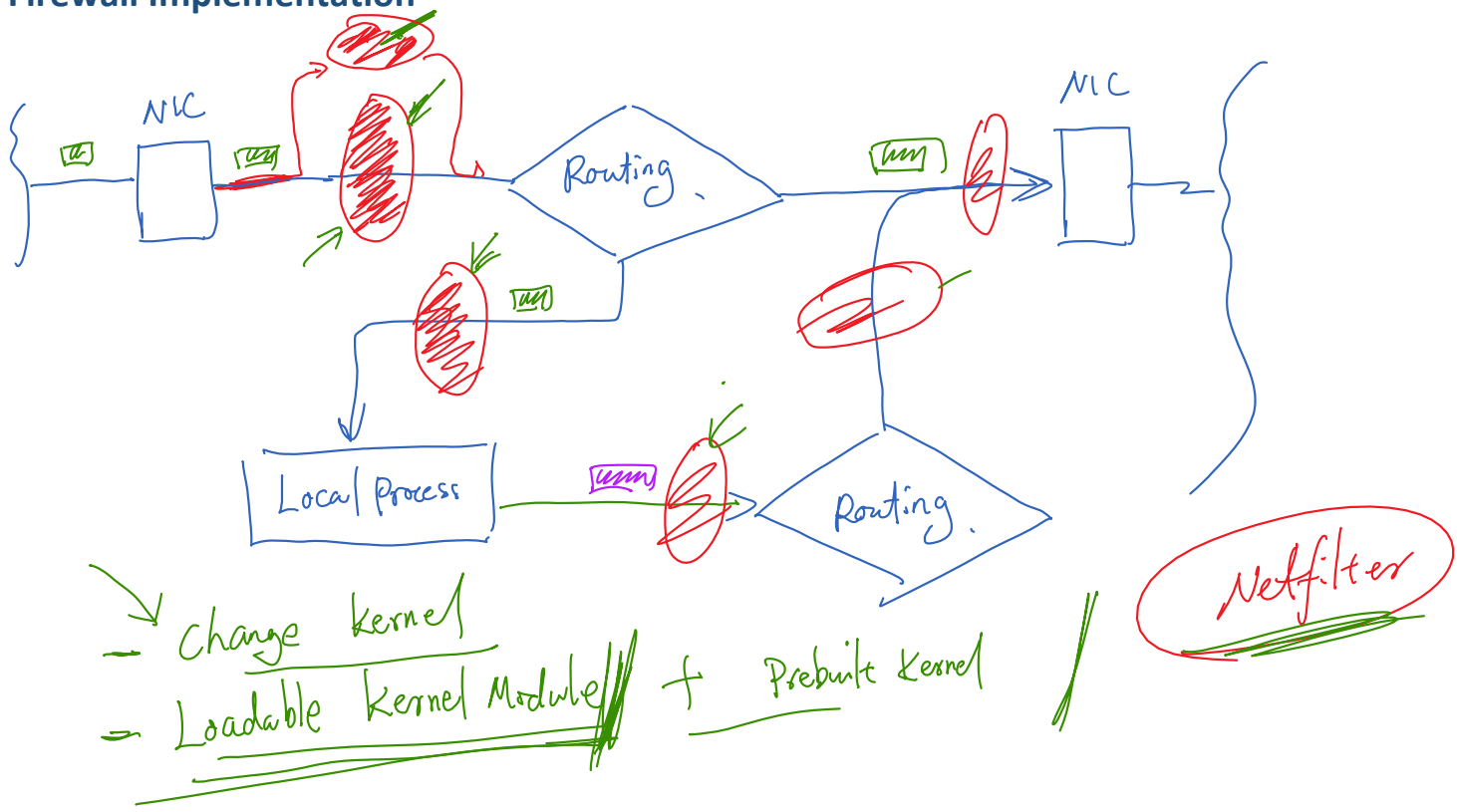
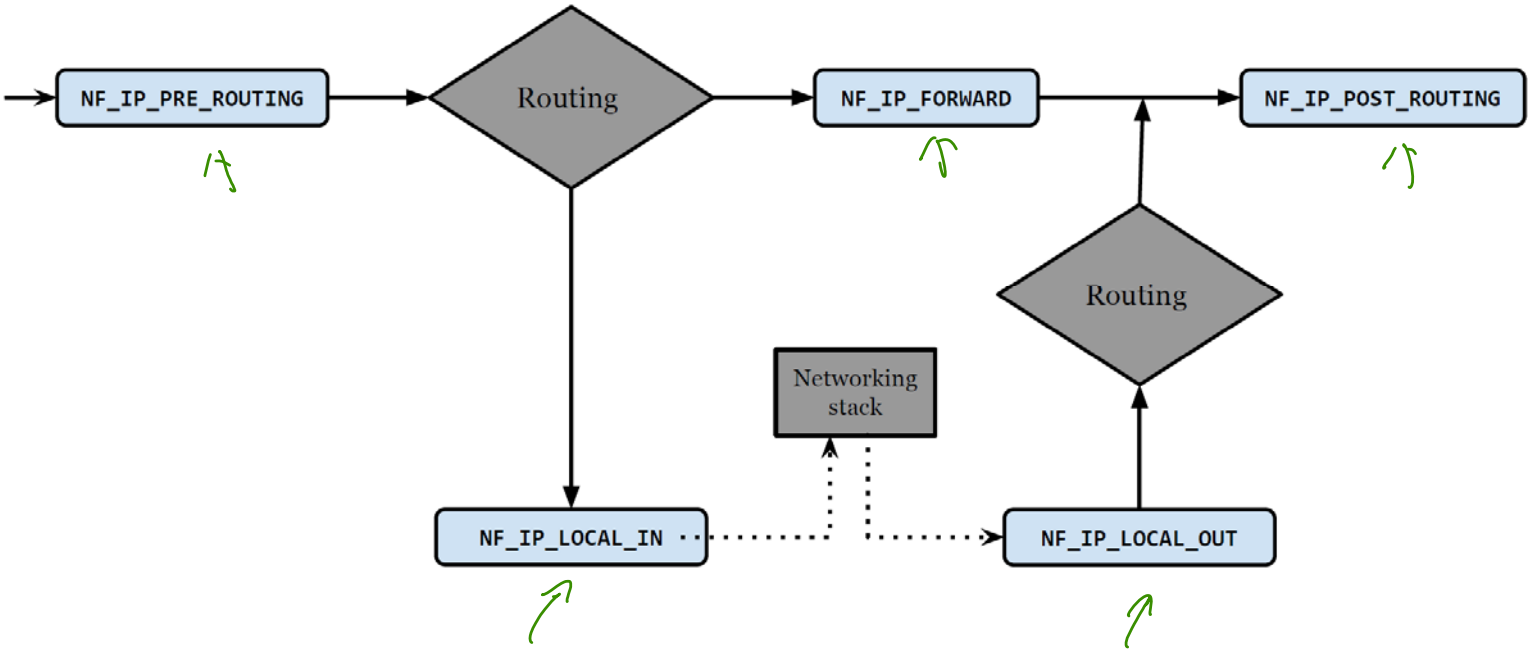
Linux Firewall Implementation



Netfilter Hooks



Netfilter: Implement a Simple Firewall (`minifirewall`)

❖ Hooking filter code to one of the netfilter hooks

```c
static struct nf_hook_ops telnetFilterHook;

int setUpFilter(void) {
    printk(KERN_INFO "Registering a Telnet filter.\n");
    telnetFilterHook.hook = telnetFilter;
    telnetFilterHook.hooknum = NF_INET_POST_ROUTING;
    telnetFilterHook.pf = PF_INET;
    telnetFilterHook.priority = NF_IP_PRI_FIRST;
    nf_register_hook(&telnetFilterHook);
    return 0;
}

void removeFilter(void) {
    printk(KERN_INFO "Telnet filter is being removed.\n");
    nf_unregister_hook(&telnetFilterHook);
}

module_init(setUpFilter);
module_exit(removeFilter);
```

❖ Implementation of the filter

```c
unsigned int telnetFilter(unsigned int hooknum, struct sk_buff *skb,
        const struct net_device *in, const struct net_device *out,
        int (*okfn)(struct sk_buff *)) {
    struct iphdr *iph;
    struct tcphdr *tcph;

    iph = ip_hdr(skb);
    tcph = (void *)iph+iph->ihl*4;

    if (iph->protocol == IPPROTO_TCP && tcph->dest == htons(23)) {
        printk(KERN_INFO "Dropping telnet packet to %d.%d.%d.%d\n",
                ((unsigned char *)&iph->daddr)[0],
                ((unsigned char *)&iph->daddr)[1],
                ((unsigned char *)&iph->daddr)[2],
                ((unsigned char *)&iph->daddr)[3]);
        return NF_DROP;
    } else {
        return NF_ACCEPT;
    }
}
```

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Iptables and UFW

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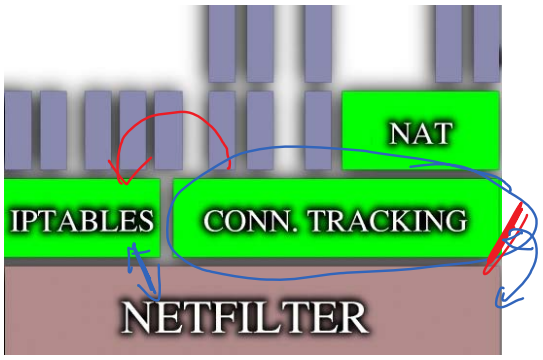
Iptables and Uncomplicated Firewall (UFW)



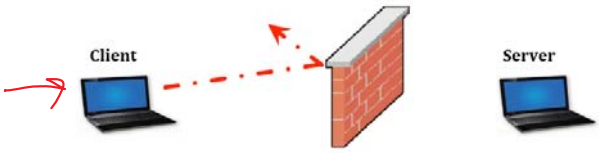
iptables — { firewall impl.
user-level prog.

→ several tables
- filter : filtering
- nat : modification : src/dest addr.
- ---
- mangle : modify contents

UFW: Using UFW to Set up Firewall Rules

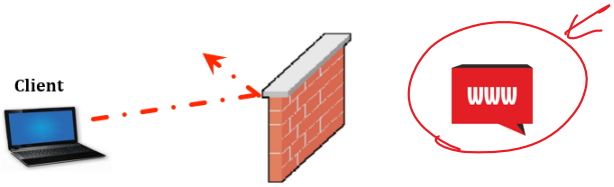
```
ufw <action> <direction> <service>
ufw (allow | deny) (in | out) from (src) to (dest) port (portNo)
```

#1 *"Prevent client machine from telnetting to any external machine"*




```
sudo ufw deny out from Client_IP to any port 23
```

#2 *"Prevent client machine from accessing a website"*



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Bypassing Firewall Using SSH Tunnel

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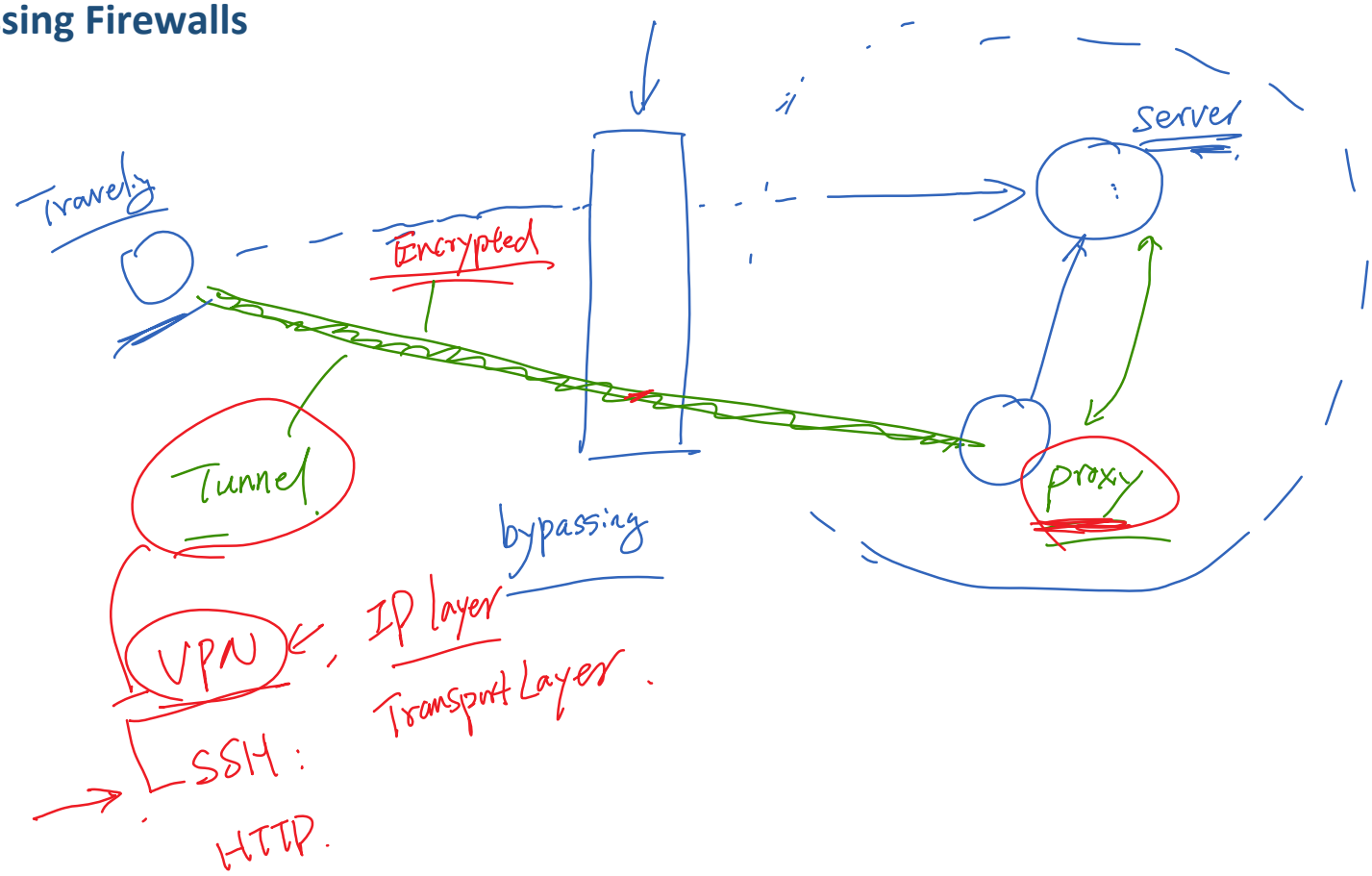
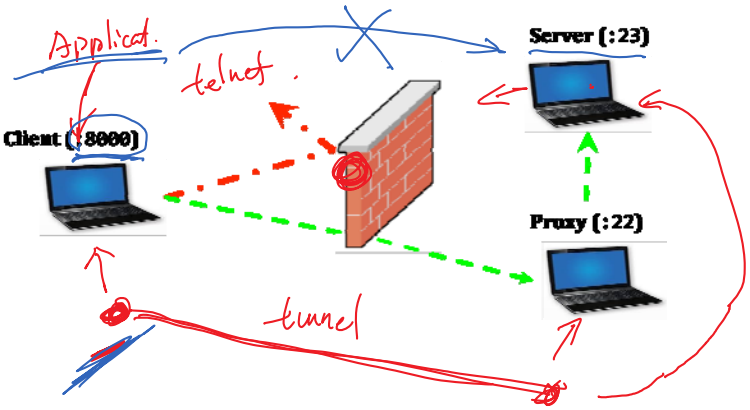
Bypassing Firewalls

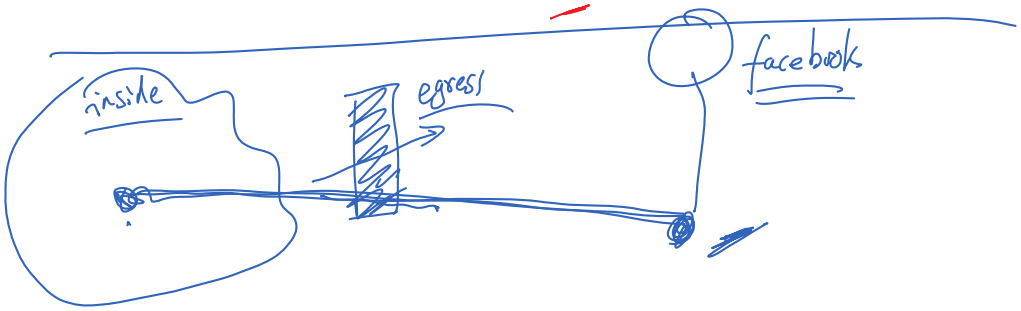


SSH Tunnel: Static Port Forwarding

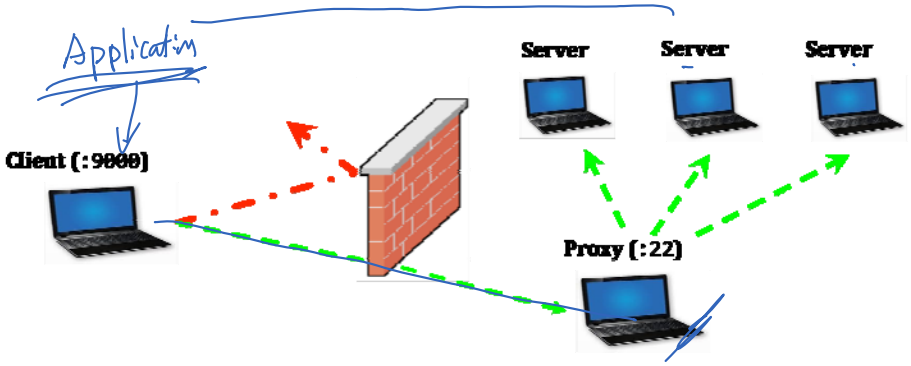


- ssh -L 8000 : server : 23 proxy

- telnet localhost 8000



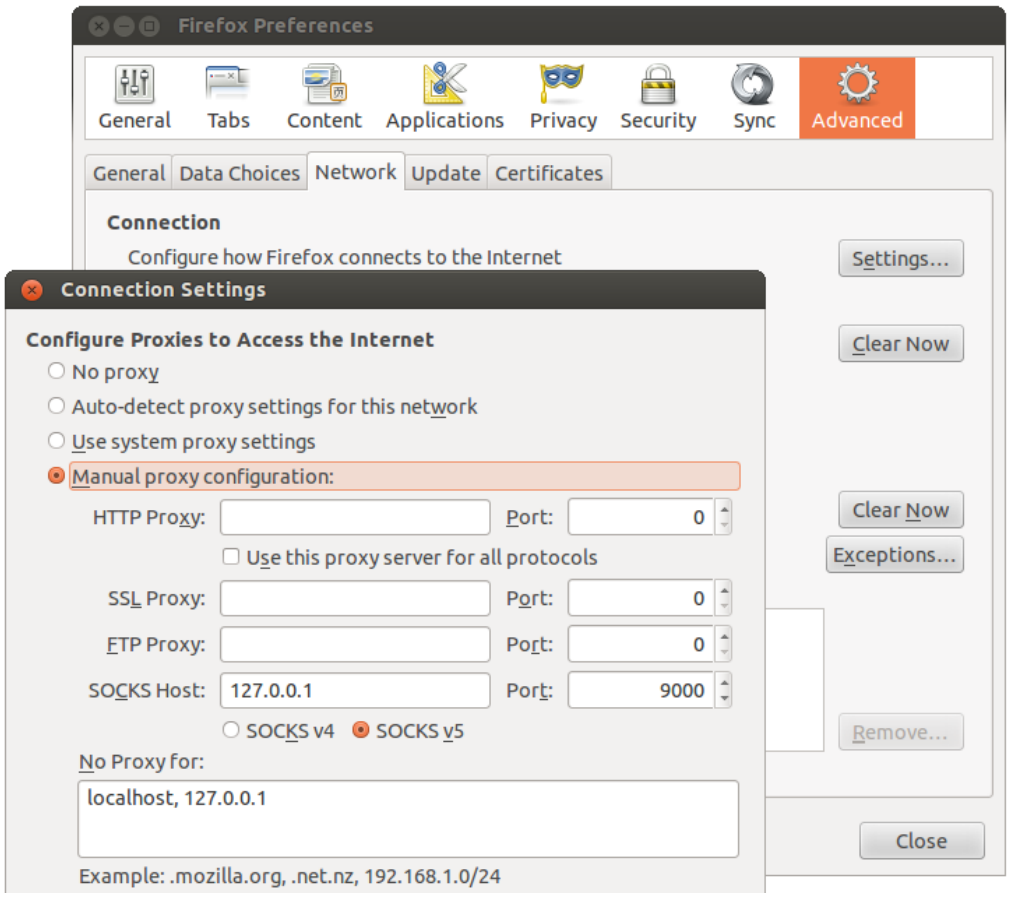
SSH Tunnel: Dynamic Port Forwarding



8000 : server : 23
target

- ssh -D 9000 -C proxy

Configuring Browser to use Dynamic Port Forwarding



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Web Proxy

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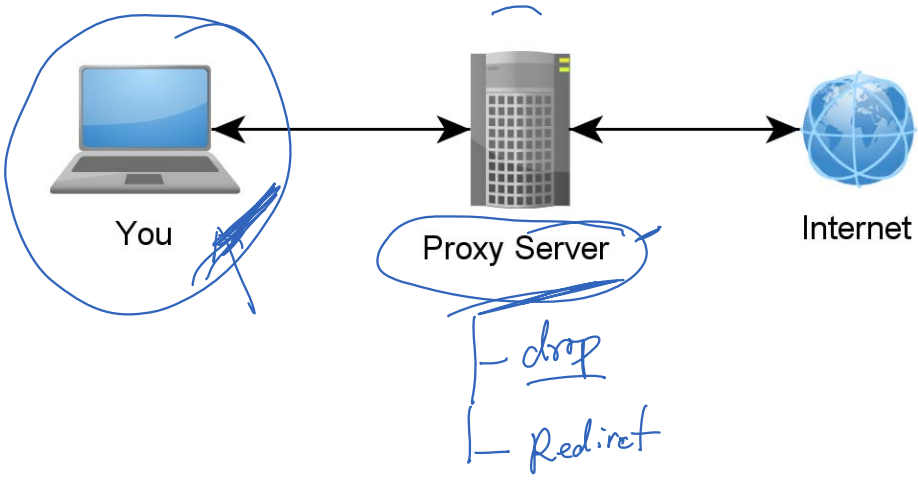
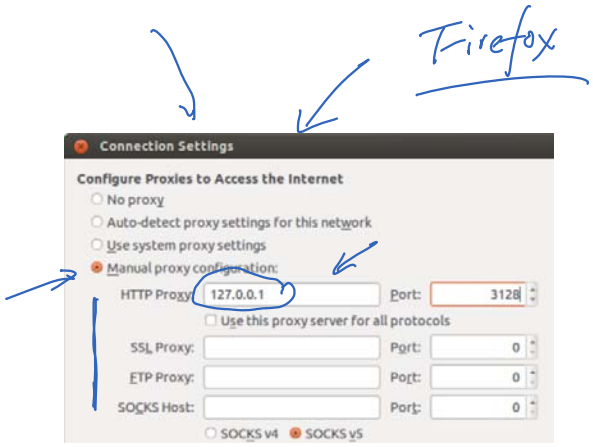
Web Proxy: Application Firewall

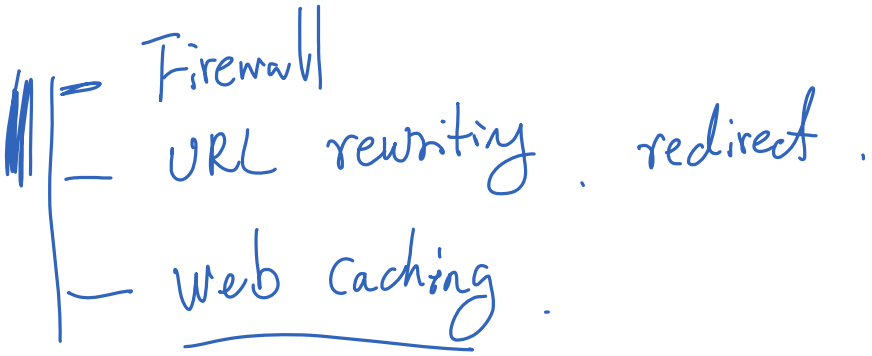




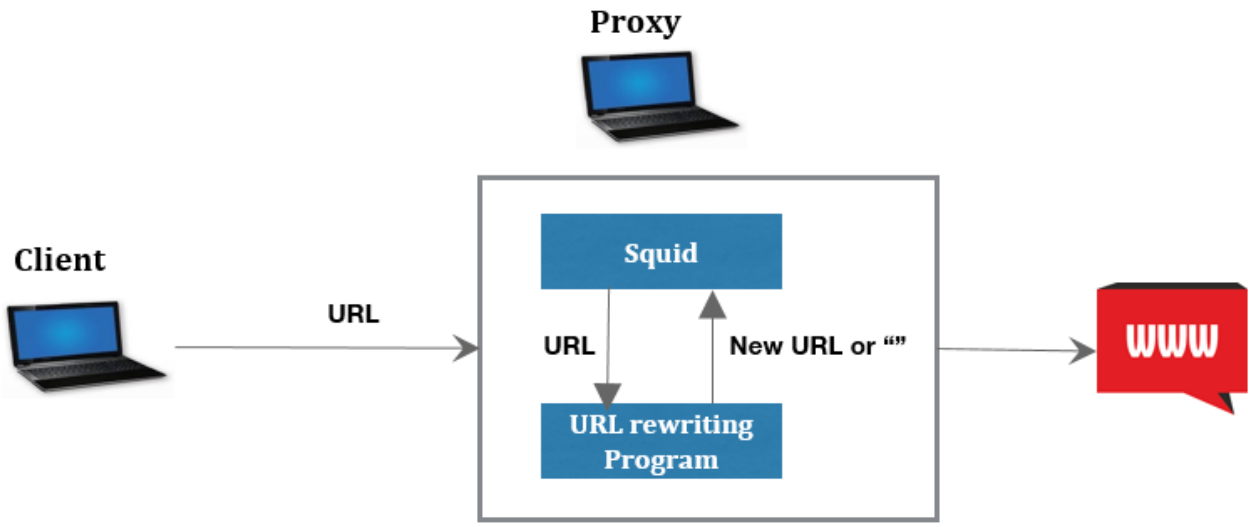
Web Proxy: Squid

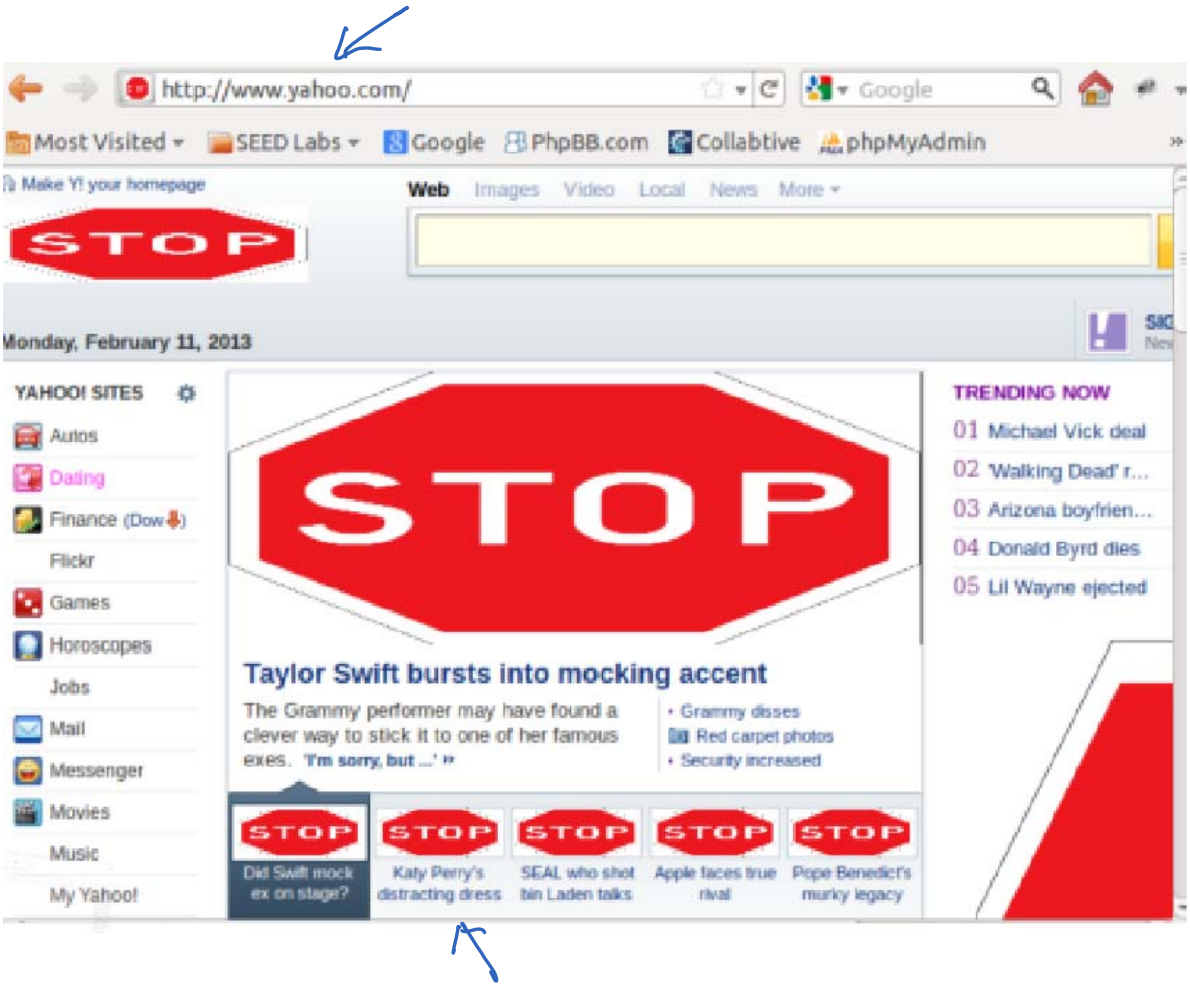
What is Squid?

Squid is a fully-featured HTTP/1.0 proxy which is almost (but not quite - we're getting there!) a fully-featured HTTP/1.1 proxy. Squid offers a rich access control, authorization and logging environment to develop web proxy and content serving applications. Squid offers a rich set of traffic optimization options, most of which are enabled by default for simpler installation and high performance.



Squid: Redirect Traffic

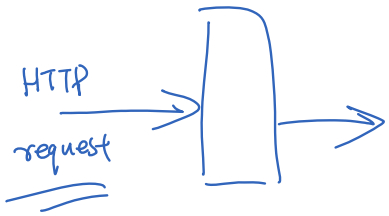




Squid: URL Rewriting Code

```
#!/usr/bin/perl -w
use strict;
use warnings;
# Forces a flush after every write or print on the STDOUT
select STDOUT; $| = 1;
# Get the input line by line from the standard input.
# Each line contains an URL and some other information.
while (<>) {
    my @parts = split;
    my $url = $parts[0];
    # If you copy and paste this code from this PDF file,
    # the ~(tilde) character may not be copied correctly.
    # Remove it, and then type the character manually.
    if ($url =~ /\.(jpg|bmp|gif|jpeg)/) {

        # URL Rewriting
        print "http://mars.syr.edu/html/seed/stopsign.png\n";
    }
    else {
        # No Rewriting.
        print "\n";
    }
}
```



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Summary

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Summary

- Concepts of firewall
- Firewall implementation (simple packet filter)
- Netfilter and iptables
- Evading firewall using SSH tunnel
- Web proxy firewall

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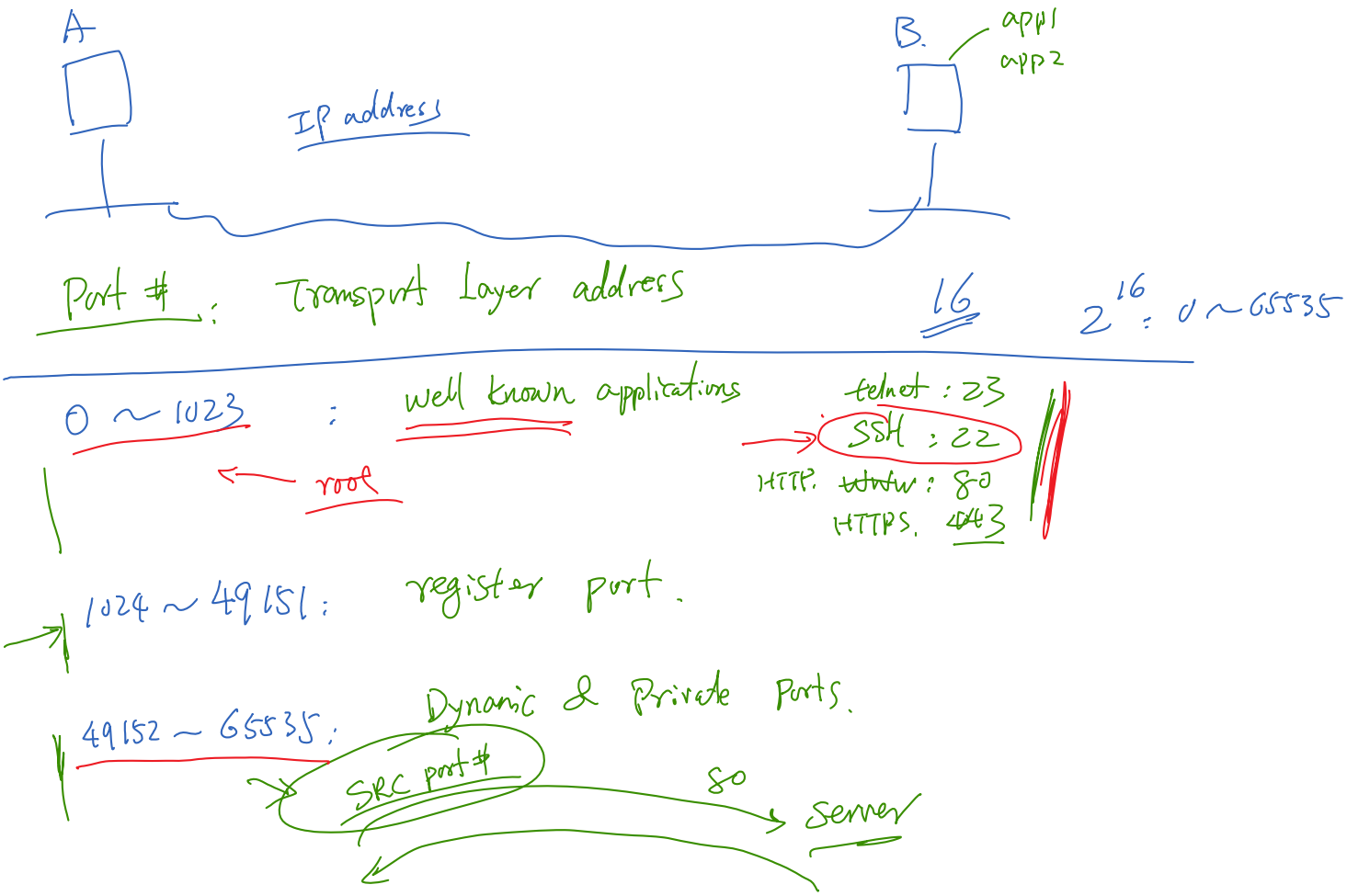
UDP Overview

Transport Layer and Port Numbers



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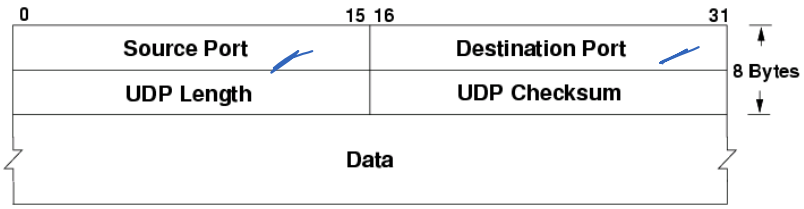
UDP Header and Protocol

UDP Header and Protocol



TCP UDP.

UDP:
light-weight

TCP

IP: best effort delivery
packet loss
1 2 3
3 1

UDP Client/Server Programs

❖ UDP client

a. Create socket:

```
sockfd = socket(AF_INET, SOCK_DGRAM, IPPROTO_UDP)
```

b. Send data:

```
sendto(sockfd, buffer, …, (struct sockaddr *)&servaddr …)
```

c. Receive data:

```
recvfrom(sockfd, rec_buffer, …, &from_addr, ...);
```

❖ UDP server

a. Create socket:

```
sockfd = socket(AF_INET, SOCK_DGRAM,  IPPROTO_UDP)
```

b. Bind the socket to a port:

```
bind(sockfd, &si_me, ...)
```

c. Receive data:

```
recvfrom(sockfd, rec_buffer, …, &from_addr, ...)
```

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UDP Applications

UDP Applications

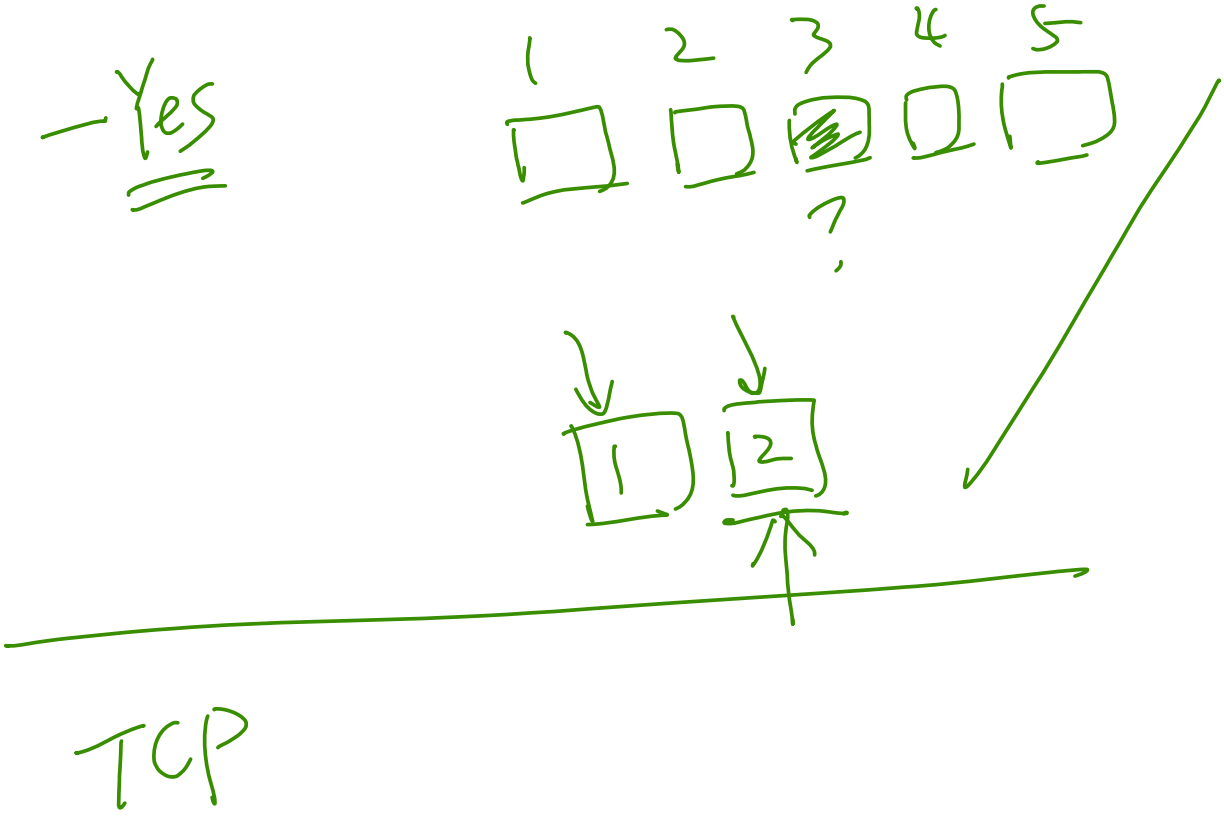
- DNS Protocol
- Video/Audio Streaming
- Real-Time Applications

– { real time : UDP
  video : TCP.

UDP
- Light weight
- packet loss

Question

UDP does not preserve order and does not handle packet loss. If an application does care about packet loss and order, can it still use UDP? Please explain.



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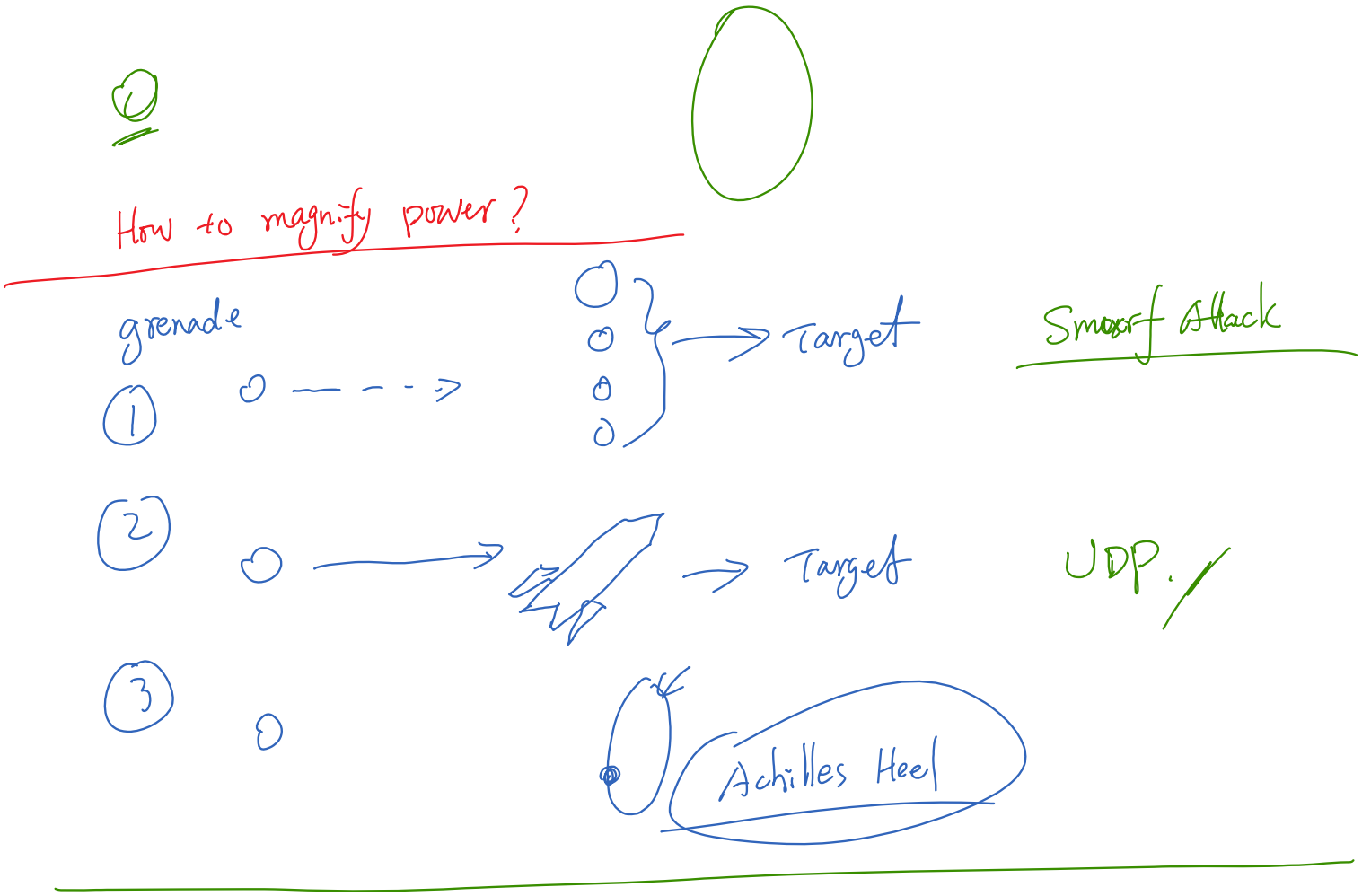
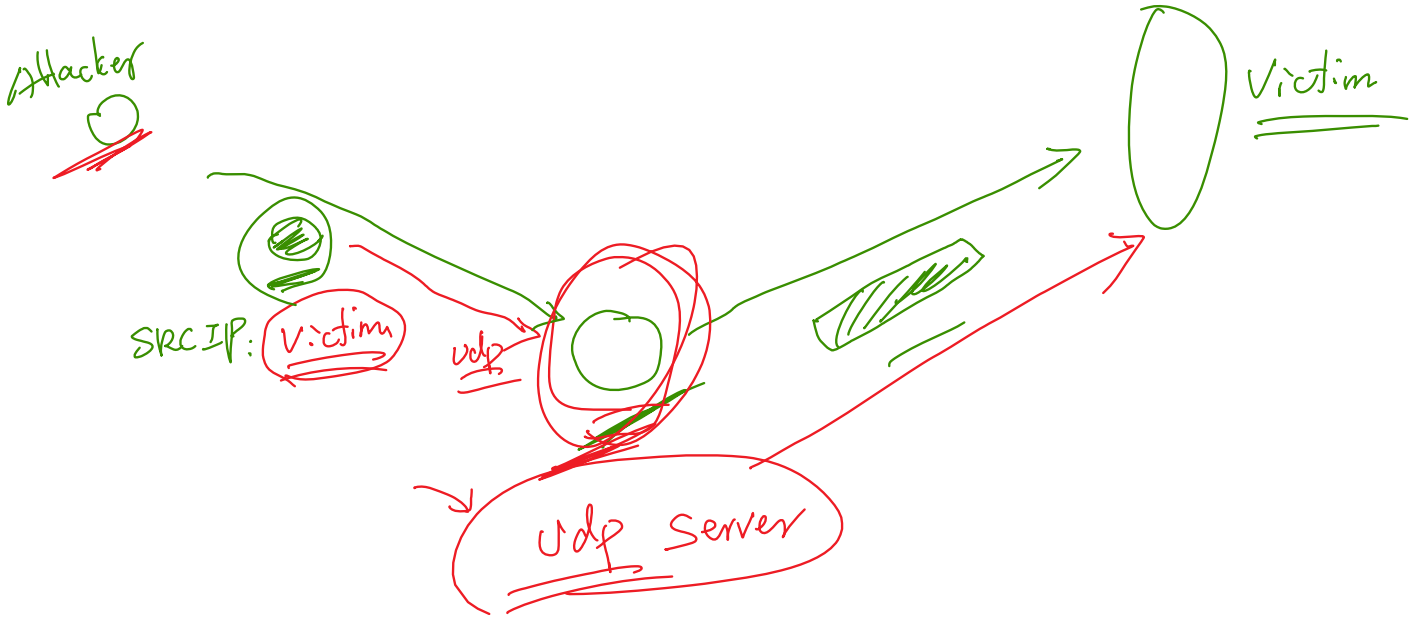
Attacks on UDP

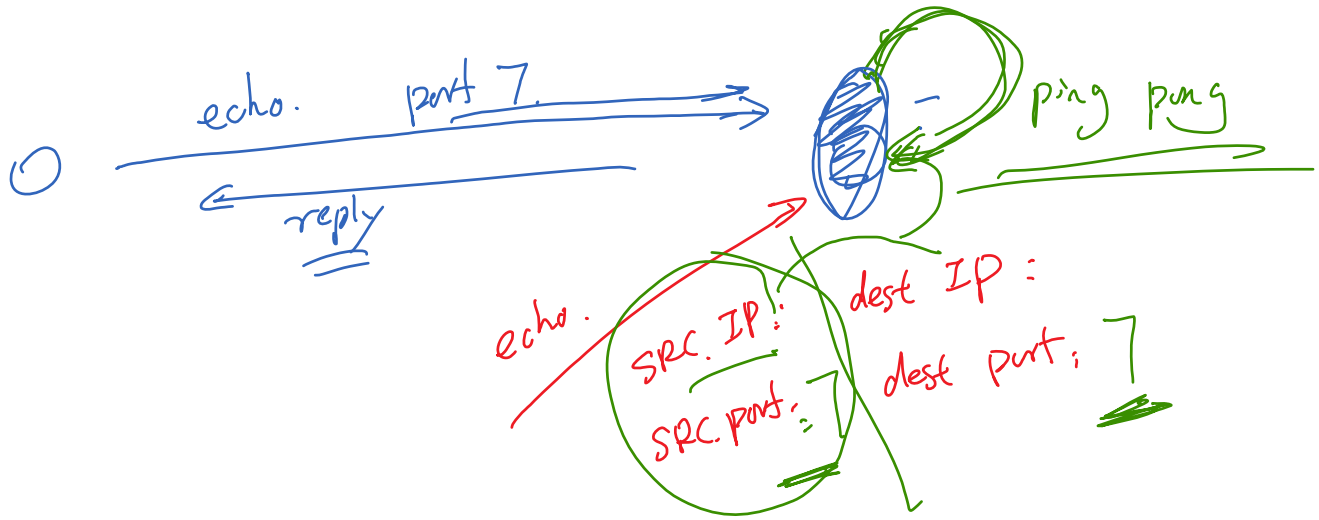
Causing Great Damage Using a Grenade





Turn a Grenade Into a Missile

Target Achilles Heel: UDP Ping-Pong



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Summary

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Summary

- Transport layer
- Port number
- UDP protocol and header
- UDP applications
- Attacking strategy: magnify power
- Attack on or using UDP

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