Usporedba metoda osiguranja računalnih mreža

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Pula, 08. Rujna, 2022. godine

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Završni rad

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Pula, 08. Rujna, 2022. godine

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Student

Ivan Ninčević

U Puli, 08. Rujna, 2022.

IZJAVA O KORIŠTENJU AUTORSKOG DJELA

Ja, Ivan Ninčević dajem odobrenje Sveučilištu Jurja Dobrile u Puli, kao nositelju prava iskorištavanja, da moj Završni rad pod nazivom Usporedba metoda osiguranja računalnih mreža

koristi na način da gore navedeno autorsko djelo, kao cjeloviti tekst trajno objavi u javnoj internetskoj bazi Sveučilišne knjižnice Sveučilišta Jurja Dobrile u Puli te kopira u javnu internetsku bazu završnih radova Nacionalne i sveučilišne knjižnice (stavljanje na raspolaganje javnosti), sve u skladu s Zakonom o autorskom pravu i drugim srodnim pravima i dobrom akademskom praksom, a radi promicanja otvorenoga, slobodnoga pristupa znanstvenim informacijama.

Za korištenje autorskog djela na gore navedeni način ne potražujem naknadu.

U Puli, 08. Rujna, 2022.

Potpis

Ivan Ninčević

Sadržaj

1. Uvod

S trenutnom razinom tehnološkog razvoja, rijetke su kompanije i organizacije koje za potrebe svojeg poslovanja ne koriste računala. Kako bi bilo jednostavnije omogućiti komunikaciju među računalima unutar kompanije, inženjeri pojedina računala obuhvaćaju u mreže računala te na njima pokreću informacijski sustav ili sustave koje određenja kompanije koristi.

Svaki informacijski sustav, pa tako i mreža računala, mora biti osiguran na neki način. Ukoliko mreža nije osigurana, mogući su vanjski utjecaji na mrežu, krađe podataka ili čak pokretanje zloćudnih programa na računalima unutar mreže.

2018. godine, stupila je na snagu Opća uredba o zaštiti podataka kojom Europska Unija nastoji potaknuti sve kompanije na osiguravanje informacijskih sustava koji obrađuju podatke stanovnika Europske Unije.

Sigurnost mreže računala ključan je dio svake kompanije ili organizacije koja koristi računala u svojem poslovanju, ali prije uvođenja Opće uredbe o zaštiti podataka kompanije koje su se brinule o sigurnosti bile su rijetke. Nakon što je Opća uredba stupila na snagu, mnoge kompanije su počele sa ubrzanim poboljšavanjem sigurnosti svojeg sustava.

Za upravljanje sigurnošću informacijskih sustava i mreža računala postoje stručnjaci koji organiziraju mrežu računala te nad njom postavljaju određeni način osiguravanja te mreže.

Mrežu se može osigurati na više načina kojima se može regulirati koje vrste prometa imaju pravo pristupa računalu ili mreži računala, a koje to pravo nemaju.

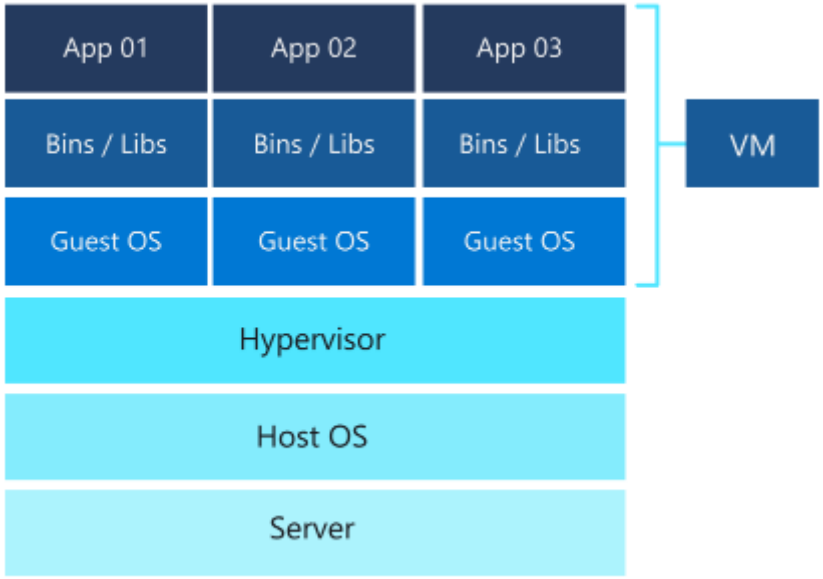
Ovaj rad obuhvaća proces stvaranja virtualne mreže računala te praćenje prometa nad tom mrežom bez zaštite i sa zaštitom.

2. Pokretanje virtualne mreže računala

U realnom poslovnom okruženju, računala su uglavnom fizička te su povezana u mreže fizičkih računala. Za svrhe ovog završnog rada, pokrenuta je virtualna mreža računala.

Kako bi bilo moguće pokrenuti virtualnu mrežu računala, potrebno je razumjeti što su virtualna računala i na koji način rade. Virtualno računalo je računalo čije su komponente softverom određene kao dijelovi fizičkih komponenti računala koje pokreće virtualno računalo, tako zvano *host* računalo. Kako bi se na fizičkom računalu moglo pokretati jedno ili više virtualnih računala, potrebno je na *host* računalu instalirati i pokrenuti softver *hypervisor*.

Virtualizacija računala radi tako da *hypervisor* pokrene samostalne, izolirane kopije realnog hardvera koji iskorištavaju određene resurse realnog, odnosno *host*, računala te pokreće operacijski sustav unutar te izolirane kopije kao što je prikazano na slici 1.



Slika 1. Način virtualizacije na računalu.

Trenutno postoje dva tipa *hypervisora*, *hypervisori* prvog tipa pokreću se na hardveru računala, dok se *hypervisori* drugog tipa pokreću na operacijskom sustavu *host* računala.

Neki od najčešće korištenih *hypervisora* tipa 2 su VMWare Workstation Player, VMWare Workstation Pro i VirtualBox. Dok su VMWare Workstation Player i VirtualBox besplatni, VMWare Workstation Pro je komercijalan. U nastavku ovog rada korišten je VirtualBox u svrhu svih potreba virtualizacije.

2.1 Stvaranje podmreže

Kako bi mreža korištena bila privatna, odnosno odvojena od samog *host* računala i vanjske mreže, potrebno je definirati podmrežu (eng. subnet). Iako se računanje raspona podmreža može izračunati ručno, postoje alati za računanje raspona podmreža i definiranje maske te mreže.

Svaka privatna mreža se spaja na *router* kako bi mogla pristupiti drugim mrežama tako da adresa te mreže može biti proizvoljno odabrana. U ovome radu, adresa korištena za mrežu je 10.20.10.0, s maskom 255.255.255.240, skraćeno 10.20.10.0/28. Maska mreže predstavlja koliko uređaja se može spojiti u tu mrežu. Na slici 2 je prikazan skup podataka koji se dobiju korištenjem Subnet Caculator alata sa zadanom mrežom 10.20.10.0/28.

IPv4 Subnet Calculator

Result

IP Address:	10.20.10.0
Network Address:	10.20.10.0
Usable Host IP Range:	10.20.10.1 - 10.20.10.14
Broadcast Address:	10.20.10.15
Total Number of Hosts:	16
Number of Usable Hosts:	14
Subnet Mask:	255.255.255.240
Wildcard Mask:	0.0.0.15
Binary Subnet Mask:	11111111.11111111.11111111.11110000
IP Class:	C
CIDR Notation:	/28
IP Type:	Private
Short:	10.20.10.0 /28
Binary ID:	00001010000101000000101000000000
Integer ID:	169085440
Hex ID:	0xa140a00
in-addr.arpa:	0.10.20.10.in-addr.arpa
IPv4 Mapped Address:	::ffff:0a14.0a00
6to4 Prefix:	2002:0a14.0a00::/48

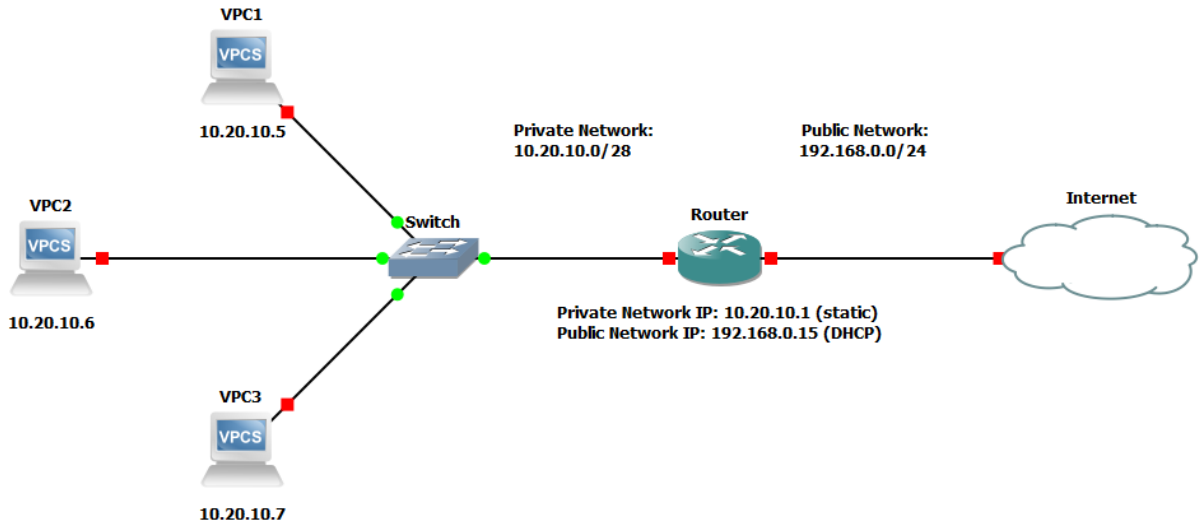
Slika 2. Izračun podataka o podmreži korištenjem kalkulatora za izračun podmreža

S ovako određenom podmrežom, moguće je osigurati da će računala spojena na nju imati samo jednu točku pristupa. Ta točka pristupa je *router* spojen na mrežu te se zbog takve konvencionalnosti *router* još naziva i pristupnik (eng. gateway). Konvencija rada s podmrežama je dodjela prve adrese u rasponu pristupniku, a ta adresa u ovoj mreži je 10.20.10.1. Korištenje ovog pravila osigurava da će svaki inženjer mreža računala moći na svakoj mreži jednostavno pronaći pristupnik.

2.2 Topologija mreže

Prilikom definiranja mreže, preporuča se skiciranje mreže kako bi se prilikom definiranja sučelja računala i spajanja računala na mrežu izbjegle nedoumice. Jedan

od jednostavnijih načina za stvaranje skice mreže je korištenjem GNS3 simulatora mreža. Na slici 3 je prikazana skica mreže stvorene u ovome radu.



Slika 3. Skica mreže računala stvorene u ovom radu.

Mreža pokrenuta za svrhu ovog rada sastoji se od tri virtualna računala koja se nalaze na privatnoj mreži s virtualnim *routerom*. Virtualni *router* omogućuje komunikaciju između virtualne mreže računala i vanjske mreže, odnosno interneta.

Pokrenuta mreža ima jednu razliku u odnosu na skicu, a to je Switch uređaj, odnosno preklopnik (eng. switch). Kako su virtualna računala pokretana korištenjem *hypervizora* VirtualBox, nije bilo potrebno stvoriti virtualni *switch* jer definirane privatne mreže unutar VirtualBoxa automatski vrše posao preklopnika.

2.3 Pokretanje virtualnih uređaja

Virtualna računala pokrenuta unutar VirtualBoxa na sebi imaju operacijski sustav Ubuntu 20.04. Ubuntu je jedan od mnogih operativnih sustava baziranih na Linux distribuciji te je jako često korišten u skladištima podataka i kompanijama.

Verzija 20.04 nije najnovija verzija Ubuntu operativnog sustava, ali kako postoji već dvije godine, skoro svi problemi unutar nje su riješeni. Ovu verziju Linux operativnog sustava može se besplatno preuzeti sa službenih stranica Ubuntu.

Nakon instalacije operativnog sustava, potrebno je obnoviti listu programskih paketa instaliranog operacijskog sustava i instalirati nove verzije već instaliranih komponenti. Te akcije pokrećemo sljedećim komandama.

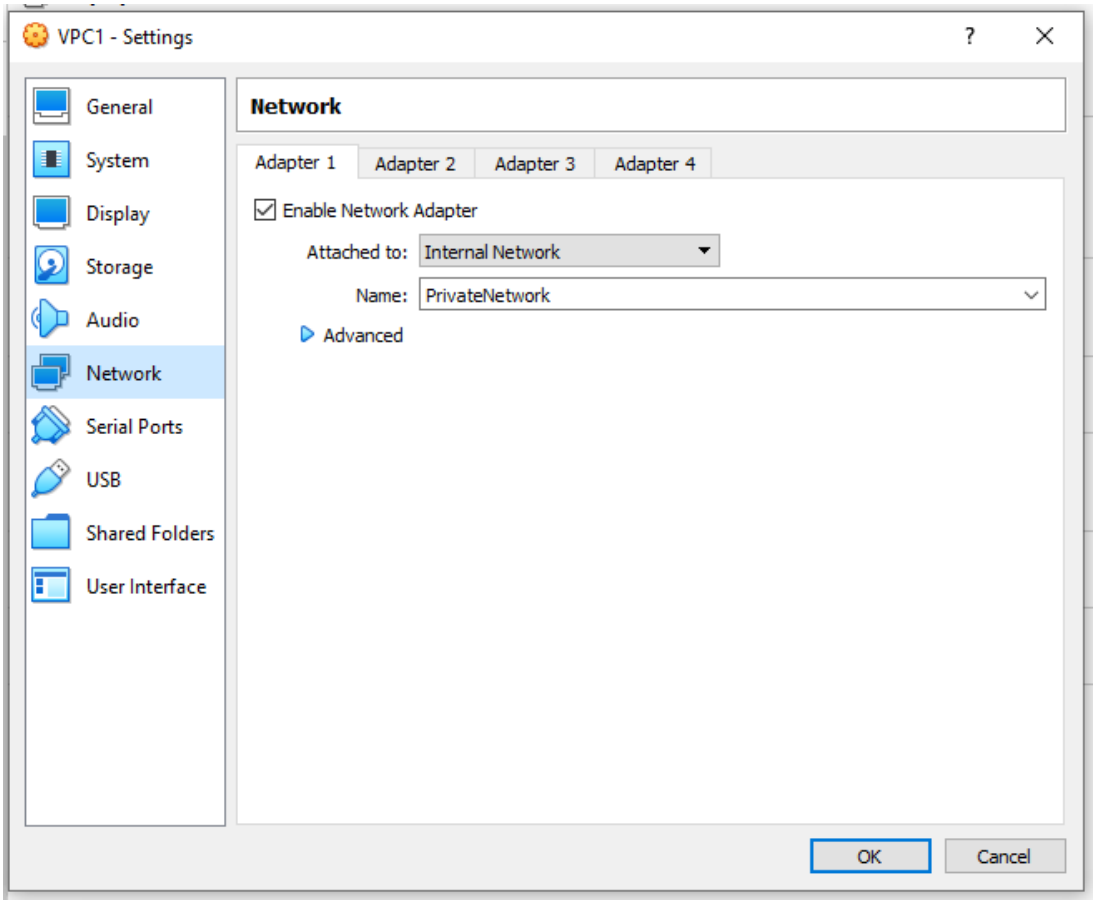
```
sudo apt-get update
sudo apt-get upgrade
```

Prije mijenjanja veze s javne mreže na privatnu, potrebno je još instalirati alate

za upravljanje mrežama unutar virtualne mašine. Tu instalaciju možemo pokrenuti slanjem sljedeće naredbe.

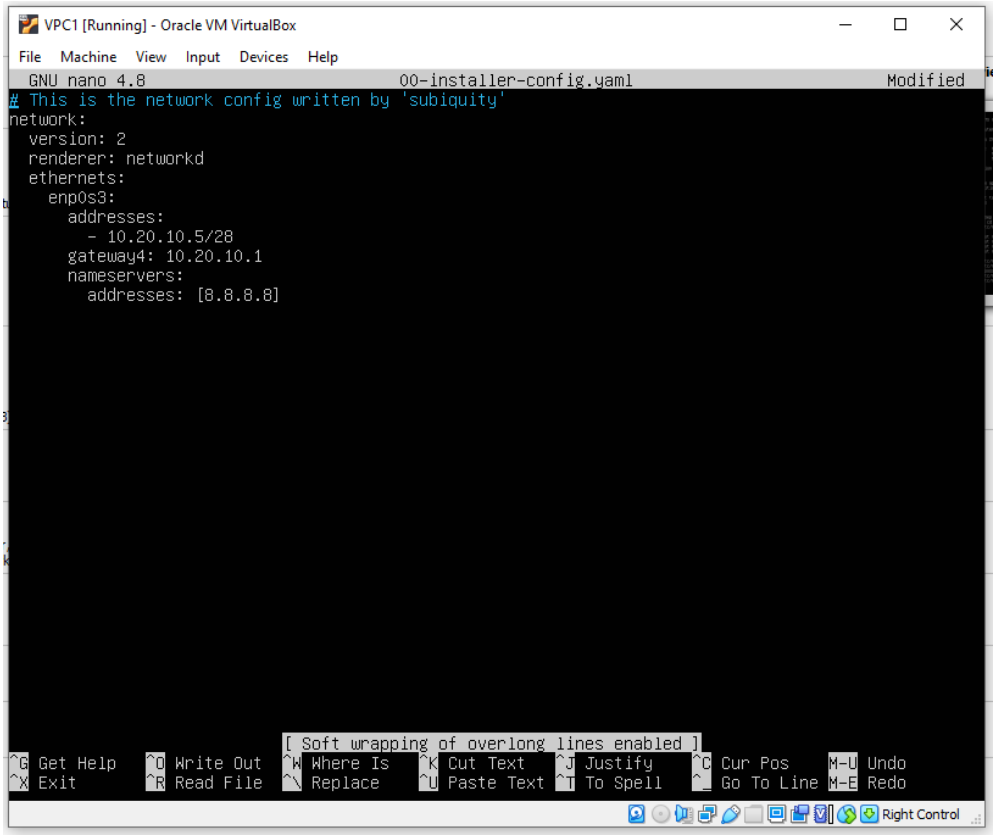
```
sudo apt-get install net-tools
sudo apt-get install telnetd
```

Nakon što su svi programski paketi instalirani, potrebno je ugasiti virtualno računalo i ući u postavke mrežnog adaptera virtualnog računala te odabrati privatnu mrežu. Izgled tih postavki prikazan je na slici 4.



Slika 4. Postavke mrežnog adaptera virtualnog računala

Kako bi sva virtualna računala pripadala u istu podmrežu, potrebno je paziti da su u „Name:“ dijelu svim računalima dana ista imena podmreže. Nakon odabira adaptera i davanja imena privatne mreže, potrebno je upaliti virtualno računalo te se pomaknuti u mapu /etc/netplan/. Unutar te mape nalazi se datoteka s imenom sličnim 00-installer-config.yaml. Korištenjem *nano* naredbe i lozinke administratora računala, moguće je pristupiti datoteci i mijenjati je. Kako bi bilo moguće računalu dati statičku adresu unutar privatne mreže, potrebno je promijeniti izgled datoteke u izgled prikazan na slici 5.

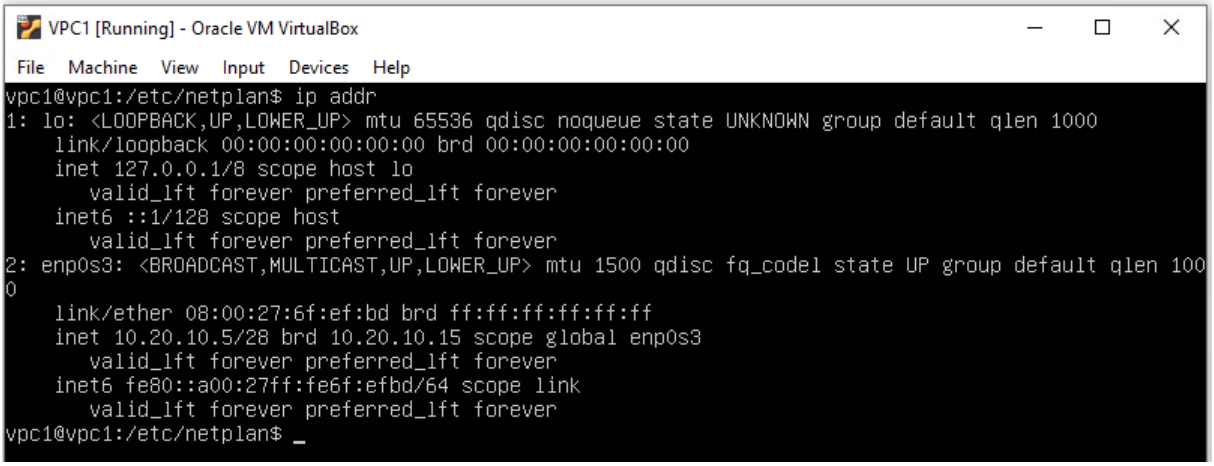


Slika 5. Prikaz konfiguracije statičke adrese
na virtualnom računalu

Nakon spremanja konfiguracije, potrebno je pokrenuti sljedeće naredbe kako bi virtualno računalo preuzelo adresu zadanu u datoteci 00-installer-config.yaml.

```
sudo netplan generate
sudo netplan apply
```

Ukoliko nije došlo do greške prilikom generiranja, provjera IP adrese virtualnog računala prikazuje podatke slične podatcima na slici 6.



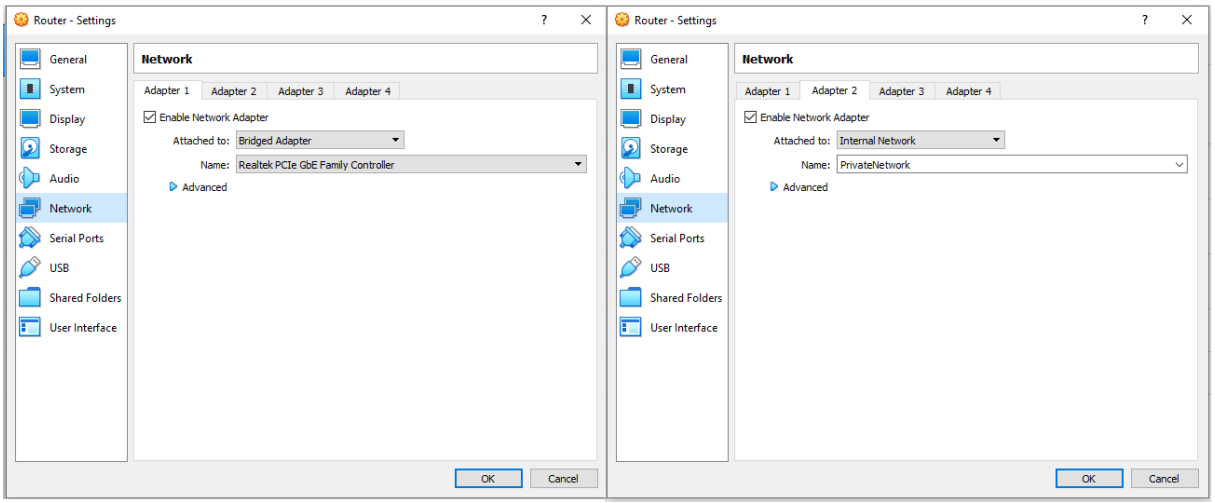
Slika 6. Prikaz IP adrese virtualnog računala s postavljenom statičkom adresom

Nakon postavljanja statičke adrese na virtualnim računalima, potrebno je

pokrenuti virtualni *router*. Virtualni *router* je u ovome radu virtualno računalo konfigurirano za preusmjeravanje prometa s jedne mreže na drugu, kao što to *router* radi. Virtualni *router* također koristi Ubuntu 20.04 za svoj operacijski sustav, te je i na *routeru* potrebno pokrenuti „update“ i „upgrade“ naredbe. Također, na virtualni *router* potrebno je instalirati dodatne alate korištenjem sljedećih naredbi.

```
sudo apt-get install net-tools
sudo apt-get install iptables
sudo apt-get install iptables-persistent
sudo apt-get install telnetd
```

Nakon instalacije potrebnih alata, potrebno je isključiti virtualnu mašinu te ući u postavke mrežnog adaptera virtualnog *routera*. Te postavke su prikazane na slikama 7.

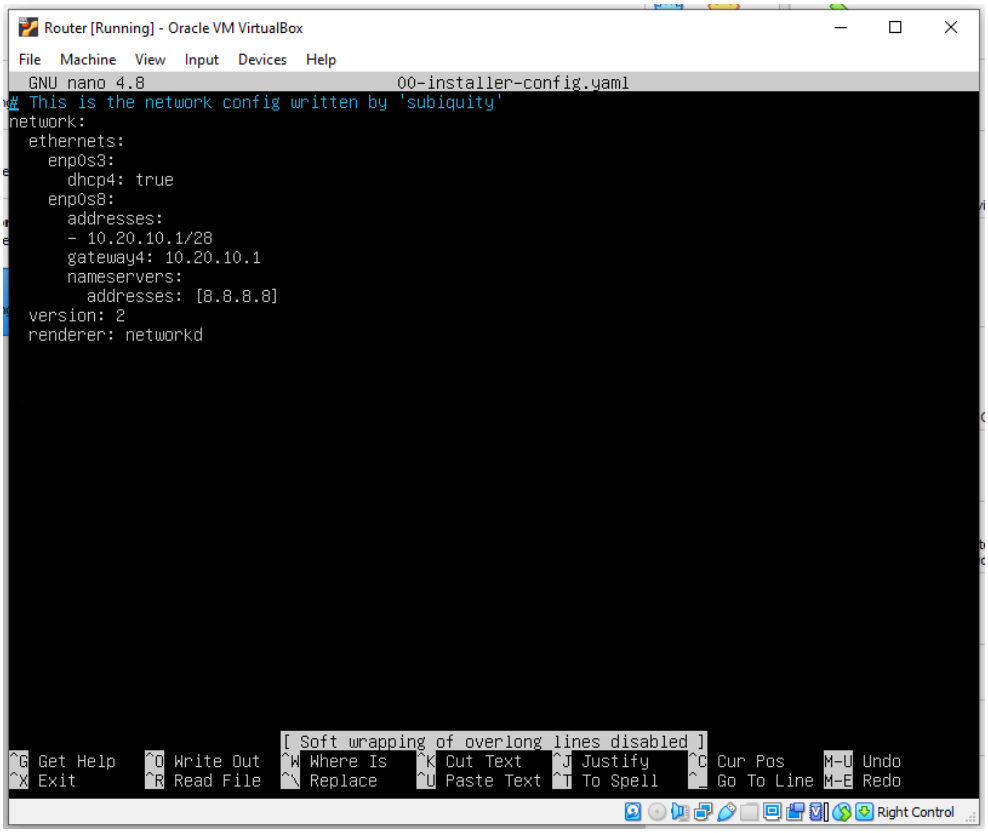


Slika 7. Prikaz postavki mrežnog adaptera virtualnog *routera*

Virtualni *router* mora imati dva mrežna adaptera kako bi se mogao povezati na dvije mreže i omogućiti komunikaciju među njima. Na adapteru koji je priključen na privatnu mrežu, potrebno je postaviti isto ime privatne mreže kao što je postavljeno na virtualnim računalima.

Nakon ponovnog paljenja virtualnog *routera* potrebno je pomaknuti se u /etc/netplan/ mapu i urediti datoteku 00-installer-config.yaml. Kako bi komunikacija na dva sučelja, odnosno preko dva adaptera, bila moguća, datoteka 00-installer-config.yaml mora izgledati kao što je prikazano na slici 8.

Preko sučelja enp0s3 virtualni *router* komunicira s vanjskom mrežom, tako da se na tom adapteru može dopustiti dinamička dodjela adresa, dok se na sučelju koje komunicira prema privatnoj mreži mora postaviti statička adresa, kako bi računala u mreži mogla koristiti virtualni *router* kao pristupnik prema vanjskoj mreži.



Slika 8. Prikaz konfiguracije mrežnih sučelja virtualnog *routera*

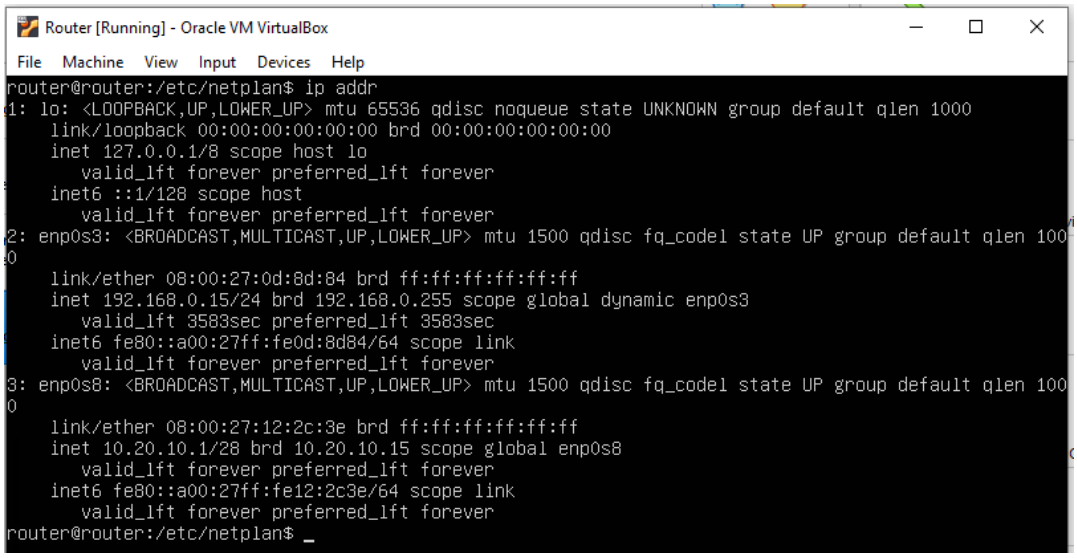
Nakon promjene datoteke, kao i na virtualnom računalu, potrebno je pokrenuti naredbe za generiranje i primjenu *netplana*.

```
sudo netplan generate
sudo netplan apply
```

Provjerom IP adresa virtualnog *routera*, vidimo da na sučelju enp0s3 *router* ima dinamički generiranu adresu koja je dio 192.168.0.0/24 mreže, a na sučelju enp0s8 ima adresu koju smo statički postavili. Na slici 9. prikazana su mrežna sučelja virtualnog *routera*.

Iako su ovim postupcima na virtualnom *routeru* omogućena oba sučelja, komunikacija s vanjskom mrežom još nije moguća. Razlog tome jest praksa u kojoj mrežna sučelja automatski stvaraju IP rute. IP ruta je putanja koju podatci prate pri prolasku među mrežama, kako bi stigli do svojega cilja.[14]

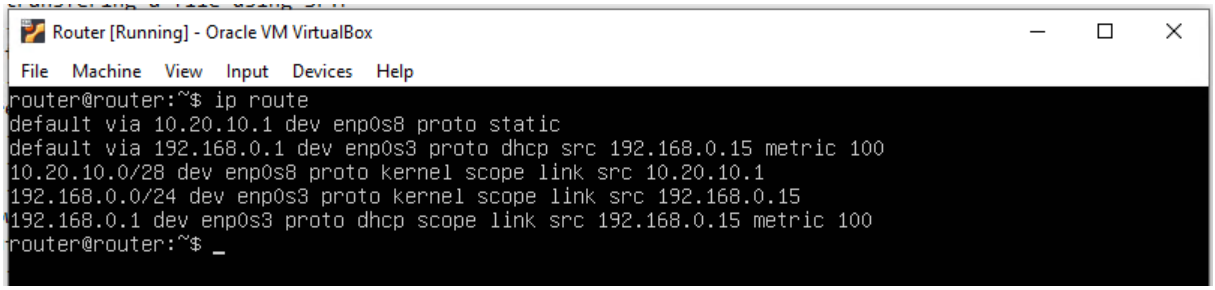
Kada jedna virtualna mašina ima više sučelja, može doći do slučaja u kojemu virtualna mašina ima više IP ruta koje stvaraju petlju. U toj petlji, virtualni *router*, ima zadano pravilo slanja svih podataka na dvije mreže, mrežu 10.20.10.0/28 i mrežu 192.168.0.0/24.



Slika 9. Prikaz mrežnih sučelja virtualnog *routera*

Na slici 10 su prikazane trenutno aktivne rute na virtualnom *routeru*. Sve trenutno aktivne IP rute mogu se prikazati korištenjem sljedeće naredbe.

```
ip route
```



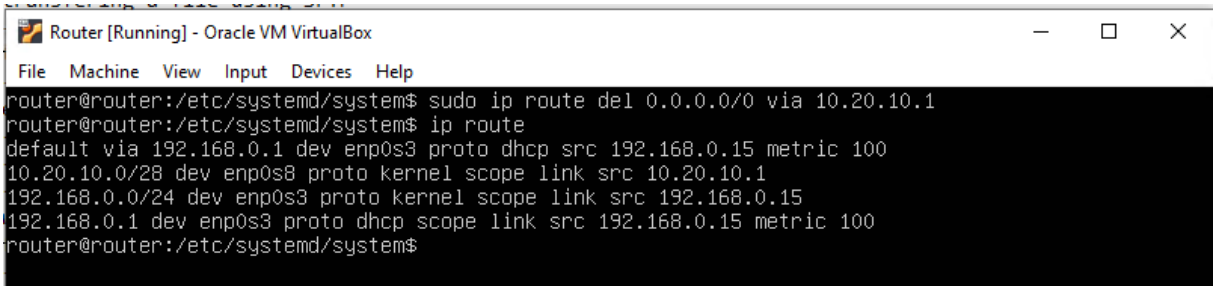
Slika 10. Prikaz IP ruta

U prikazu zadanih IP ruta postoje dvije zadane rute, koje si međusobno onemogućavaju rad. Kako bi se izbjegao ovaj problem, potrebno je pokrenuti sljedeću liniju koda.

```
sudo ip route del 0.0.0.0/0 via 10.20.10.1
```

Ovom naredbom se briše zadana ruta slanja svih podataka, neovisno o izvoru, preko adrese 10.20.10.1, odnosno na mrežu 10.20.10.0/28. Nakon ponovnog prikaza postojećih IP ruta na virtualnom *routeru*, postoji samo jedna zadana ruta, kao što je prikazano na slici 11.

Kako se pri svakom pokretanju virtualnog računala IP rute ponovno generiraju, potrebno je pokrenuti ranije navedenu liniju koda nakon svakog pokretanja računala. Najjednostavniji način za osigurati pokretanje naredbe je pisanje bash skripte koja se pokreće pri svakom pokretanju virtualnog *routera*.



Slika 11. Prikaz IP ruta nakon brisanja jedne od zadanih ruta

Kako bi se skripta pokretala prilikom pokretanja, potrebno je napraviti dvije datoteke, jednu sa .sh nastavkom, na primjer startup-script.sh, a drugu sa .service nastavkom, na primjer startup-script.service. Te datoteke je potrebno pohraniti u mapu /etc/systemd/system/. Datoteka u ranijem primjeru nazvana startup-script.sh prikazana je u nastavku.

```
#!/bin/bash

sudo ip route del 0.0.0.0/0 via 10.20.10.1
```

Kako bi se ta skripta mogla izvoditi potrebno ju je pretvoriti u izvršnu datoteku (eng. executable file). Naredba kojom se tako modificira datoteka je sljedeća.

```
sudo chmod +x startup-script.sh
```

U nastavku je prikazana startup-script.service datoteka, koja se sastoji od tri dijela. „Unit“ dio prikazuje generalne podatke o zadatku skripte, „Service“ dio sadrži zadatak skripte, a „Install“ dio omogućava pokretanje skripte kada se virtualno računalo pokrene.[15]

```
[Unit]
After=network.service

[Service]
ExecStart=/etc/system/system/startup-script.sh

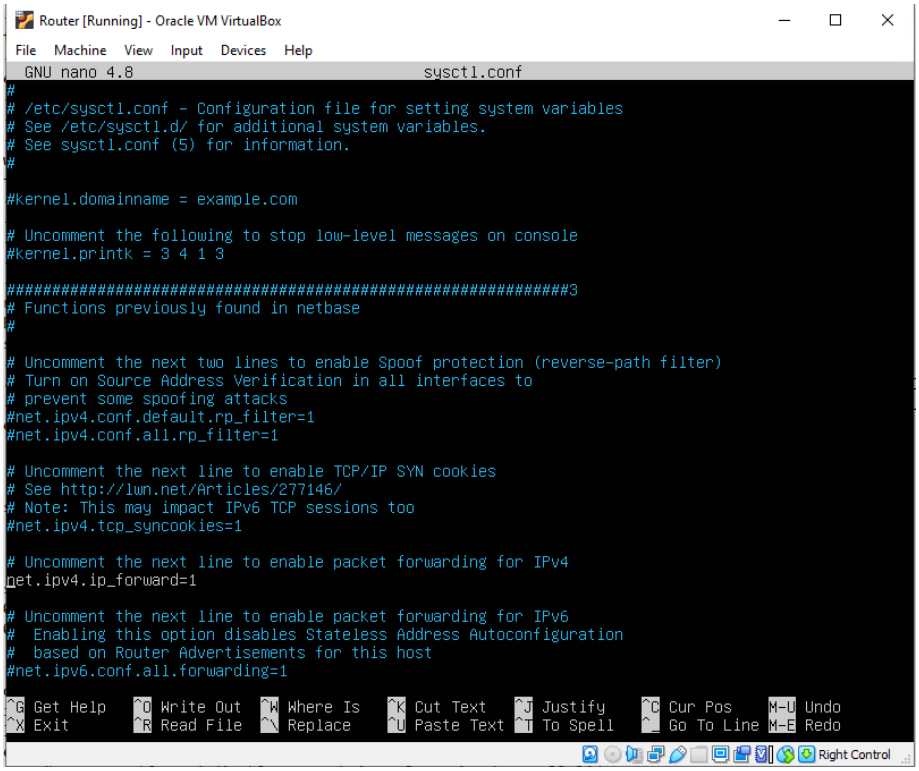
[Install]
WantedBy=default.target
```

Kako bi se navedeni servis mogao pokretati uz pokretanje virtualne mašine, nad servisom je potrebno pokrenuti sljedeće naredbe.

```
sudo chmod 644 /etc/system/system/startup-script.service
sudo systemctl enable startup-script.service
```

Nakon pripreme, i pokretanja ovih skripti, virtualni *router* će uvijek moći komunicirati i s privatnom i s javnom mrežom, ali još uvijek ne može prosljeđivati

podatke s jedne mreže na drugu. Kako bi prosljeđivanje bilo moguće, potrebno je maknuti komentar sa jedne linije u datoteci sysctl.conf, unutar /etc/ mape. Izgled datoteke nakon brisanja komentara prikazan je na slici 12.



Slika 12. Prikaz sysctl.conf datoteke nakon brisanja komentara na liniji get.ipv4.ip_forward=1

Potom je potrebno primijeniti promjene napravljene u datoteci. Za primjenu tih promjena koristi se sljedeća naredba.

```
sudo sysctl -p
```

Također, potrebno je u tablice IP prijenosa dodati pravilo za prosljeđivanje podataka. Za konfiguraciju tablica IP prijenosa koriste se „iptables“ naredbe, a naredba za omogućavanje prosljeđivanja podataka je sljedeća.

```
iptables -t nat -A POSTROUTING -j MASQUERADE
```

Nakon pokretanja svih navedenih naredbi, virtualni *router* može prosljeđivati podatke s privatne virtualne mreže, 10.20.10.0/28, na javnu mrežu, 192.168.0.0/24. Kako gore navedenu naredbu ne bi trebali pokretati prilikom svakog pokretanja virtualnog *routera*, moguće je spremiti postavke tablica IP prijenosa, korištenjem sljedeće naredbe.

```
iptables-save > /etc/iptables/rules.v4
```

3. Sigurnost računalne mreže

Cilj sigurnosti računalnih mreža je ograničavanje pristupa određenoj računalnoj mreži. Točno to ograničavanje pristupa je način na koji alati za osiguravanje računalnih mreža rade, zabranjujući pristup s određenog izvora ili preko određenog protokola. Svaki protokol za svoju komunikaciju koristi određeni *port*.

Kako bi se mogao postaviti referentni okvir za usporedbu načina osiguranja mreže, potrebno je ispitati sigurnost mreže računala prije postavljanja ikakve zaštite. Jedan od alata korištenih za snimanje prometa na mreži zove se Wireshark. Inženjeri računalnih mreža često koriste Wireshark za praćenje prometa na mreži. Naravno, uz alat za praćenje prometa, potrebni su alati za komunikaciju, a ti alati koriste razne protokole.

U ovome radu, alati za komunikaciju između vanjske mreže i računala unutar privatne mreže su WinSCP i PuTTY, a protokoli preko kojih se vrši komunikacija su SSH, SFTP i Telnet.

Secure Shell protokol, odnosno SSH protokol, je metoda sigurnog pristupa udaljenom računalu čak i preko neosigurane mreže.[18] Tu sigurnost se postiže enkripcijom komunikacije, a komunikacija se vrši preko *porta* 22.

SSH File Transfer Protocol, odnosno SFTP, trenutno je najkorišteniji protokol za razmjenu podataka među računalima, a za ugrađenu sigurnost koristi SSH protokol te je skoro u potpunosti zamijenio neosigurani FTP, *File Transfer Protocol*.

Telnet protokol je jedan od prvih protokola za komunikaciju s udaljenim računalom te sam po sebi nema ugrađenu nikakvu enkripciju podataka u komunikaciji. Zbog nedostatka ugrađene zaštite svatko tko prati promet mreže jednostavno može prikupiti podatke o korisničkim imenima i lozinkama te kasnije neovlašteno pristupiti računalu ili mreži. *Port* korišten za ovu vrstu komunikacije je *port* 23.

Promet koji se prati korištenjem Wiresharka je ostvaren između računala izvan privatne mreže računala i jednog od virtualnih računala unutar mreže, a naredbe korištene prilikom komunikacije sa svim protokolima su skoro iste.

3.1 Praćenje prometa na neosiguranoj mreži računala

3.1.1 Telnet promet

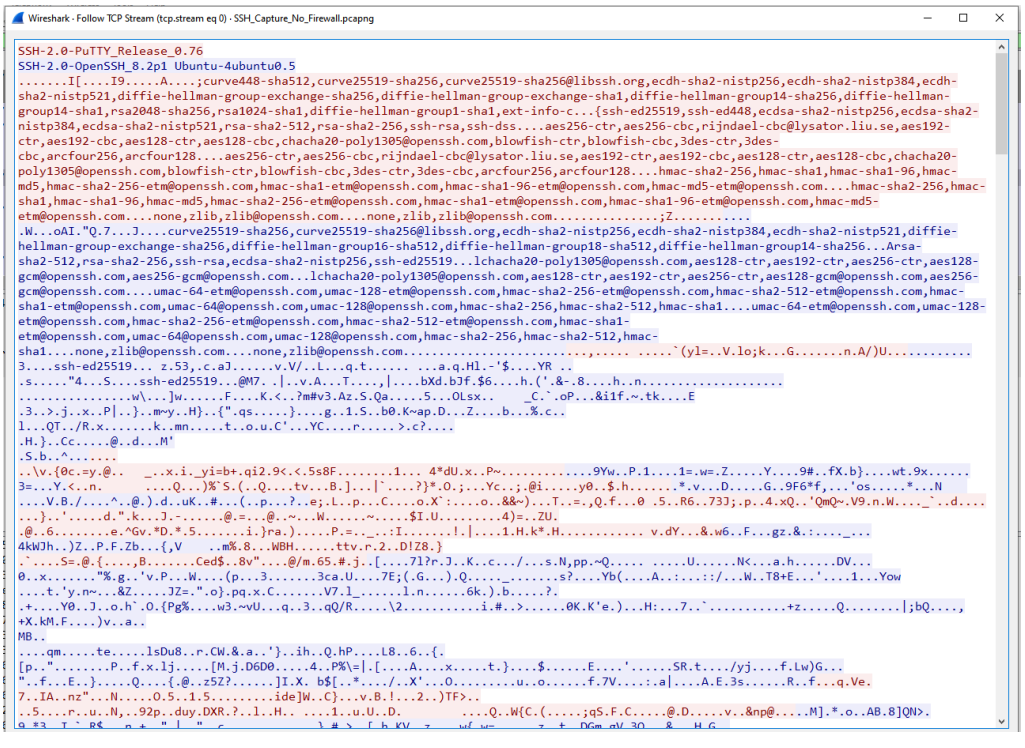
Prilikom praćenja prometa korištenjem Telnet protokola sve informacije i naredbe poslane s računala izvan privatne mreže su jasno vidljive i jednostavno čitljive u snimci prometa. Na slici 13 vidljiv je isječak prometa na mreži, a cijeli promet je

prikazan u Telnet dijelu Dodatka 1, na kraju ovog rada.

Slika 13. Isječak snimke Telnet prometa između računala izvan mreže i računala unutar nezaštićene mreže

3.1.2 SSH promet

Zahvaljujući ugrađenoj enkripciji podataka unutar SSH protokola, praćenjem prometa podatke nije moguće iščitati. Isječak prometa na mreži korištenjem SSH protokola prikazan je na slici 14, a cijeli promet je prikazan u SSH dijelu Dodatka 1, na kraju ovog rada.

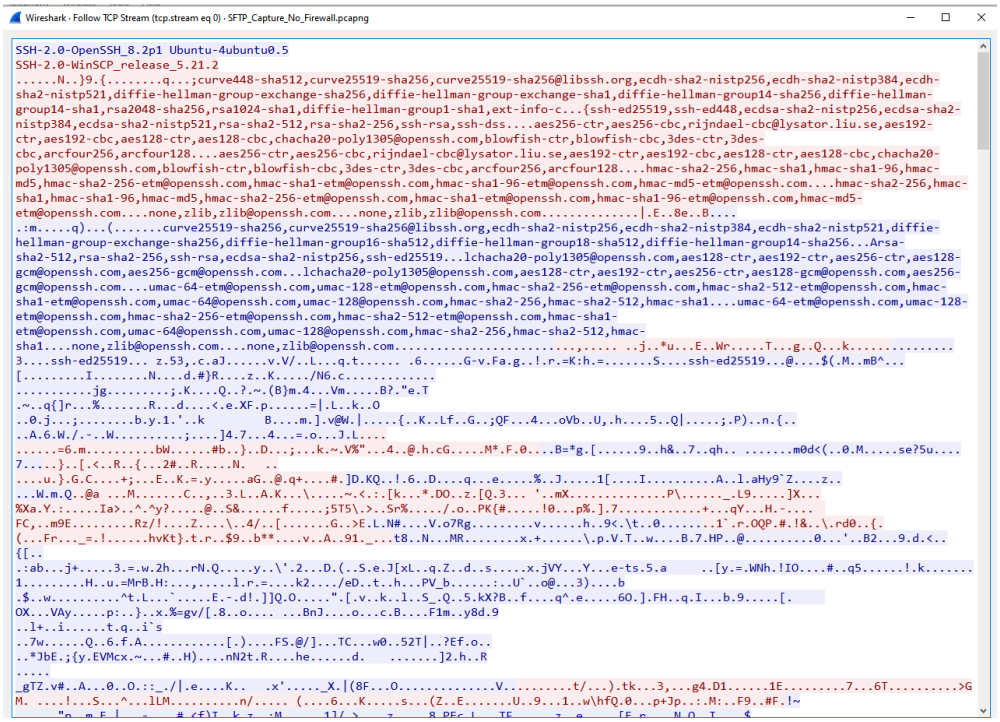


Slika 14. Isječak snimke SSH prometa između računala izvan mreže i računala unutar nezaštićene mreže

Prvih nekoliko linija komunikacije između računala prikazuje razmjenu ključa enkripcije te, nakon razmjene ključa, cijela komunikacije postaje kriptirana.

3.1.3 SFTP promet

Korištenjem alata za praćenje komunikacije između računala u različitim mrežama također je moguće pratiti i cijele datoteke koje se prenose. Najjednostavniji alat za prijenos datoteka je WinSCP, koji se korištenjem SSH i SFTP protokola i *portova* spaja na udaljeno računalo i omogućava razmjenu datoteka. Zahvaljujući SFTP protokolu, taj prijenos datoteka je kriptiran, a dio snimke prijenosa podataka prikazan je na slici 15. Snimka cijelog SFTP prometa je prikazana u SFTP dijelu Dodatka 1, na kraju ovog rada.



Slika 15. Isječak snimke SFTP prometa između računala
izvan mreže i računala unutar nezaštićene mreže

3.2 Osiguravanje mreže računala

Za osiguravanje pojedinog računala na njega se najčešće pokreće vatrozid (eng. firewall), a *firewall* se također često koristi i za osiguravanje mreža računala.

Firewall je alat koji štiti računalo ili privatnu mrežu računala tako da filtrira ulazni i izlazni promet podataka s obzirom na postavljena pravila. [21] Razlika između zaštite pojedinog računala i zaštite mreže računala *firewallom* je u tome gdje se *firewall* pokreće. Ukoliko želimo osigurati samo jedno računalo, potrebno je *firewall* pokrenuti na tom računalu, ali prilikom zaštite mreže računala, *firewall* je potrebno pokrenuti ili na *routeru* ili na *switchu*.

Ovisno o razini na kojoj pokrećemo *firewall*, nazivamo ga *firewall* prve razine, ako je pokrenut na računalu, *firewall* druge razine, ako je pokrenut na *switchu*, ili *firewall* treće razine, ako je pokrenut na *routeru*.

3.3 Vrste *Firewalla*

Iako većina *firewalla* vrši istu funkciju, postoje razlike u vrsti *firewalla* i načinu na koji osiguravaju računala ili mrežu računala. Po vrsti *firewalli* se dijele na softverske i hardverske, a po načinu osiguravanja mreže dijele se na *firewalle* bazirane na filtriranju paketa, *firewalle* bazirane na uspostavljanju sigurne veze, *firewalle* bazirane na maskiranju podataka, *firewalle* bazirane na praćenju prometa, *firewalle* iduće generacije.

Softverski *firewall* se također može nazvati *Host Firewallom* zato što se instalira na računalu. Prednost ove vrste *firewalla* je u tome što mogu dopuštati ili zabranjivati komunikaciju ovisno o tome koja aplikacija pokreće tu komunikaciju, nedostatak je što je potrebno ovakav *firewall* instalirati direktno na uređaj.

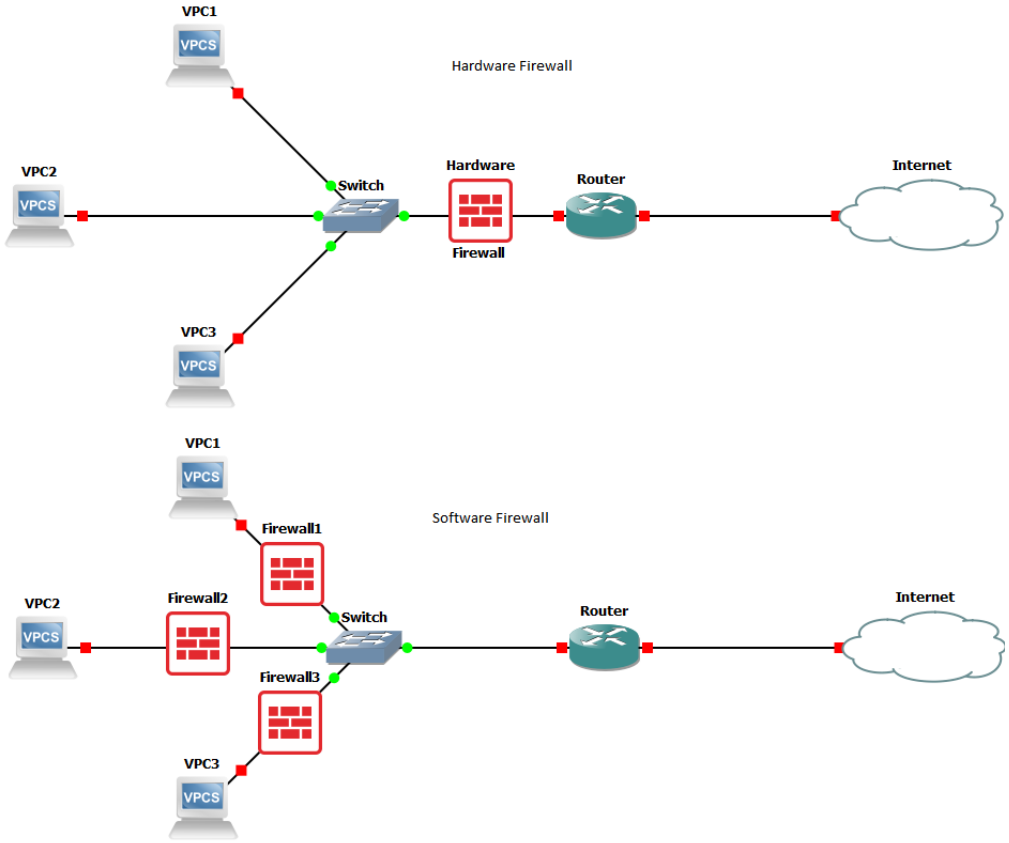
Hardverski *firewall* je zapravo uređaj koji je priključen na mrežu između routera i privatne mreže računala, često se koriste u većim kompanijama ili udrugama te se u njima postavljaju prije priključivanja na glavni router. Također je moguće podesiti *router* u način rada u kojemu radi posao hardverskog *firewalla*. Razlika između konfiguracije softverskog i hardverskog *firewalla* prikazana je na slici 16.

Firewalli bazirani na filtriranju paketa, odnosno „Packet-filtering firewalls“, najčešće su pokrenuti na *switchu* ili *routeru*, te na sebi imaju postavljenu listu pristupa. Kada određeni paket treba biti poslan u mrežu, ovaj *firewall* provjerava podatke o paketu te, uspoređujući podatke s listom pristupa, odlučuje da li prihvatiti ili odbaciti paket. [21] Ova vrsta *firewalla* nije najsigurnije rješenje, ali je jedan od preporučenih *firewalla* za zaštitu privatnih mreža računala.

Firewalli bazirani na uspostavi sigurne veze, odnosno „Circuit-level firewalls“, rade tako da promatraju sigurnost uspostavljene veze. Prilikom povezivanja korištenjem TCP i UDP protokola, odnosno „Transmission Control Protocola“ i „User Datagram Protocola“, veza se uspostavlja preko postupka zvanog „three-way handshake“.

Taj postupak se bazira na slanju sinkronizacijskog niza od računala koje započinje komunikaciju prema računalu s kojim komunicira korištenjem jednog od tih protokola. Nakon primanja sinkronizacijskog niza, drugo računalo odgovara vraćanjem istog sinkronizacijskog niza i potvrde o primanju, na što početno računalo odgovara

slanjem potvrde. Na slici 17 je prikazana snimka „three-way handshake“ postupka snimljena korištenjem Wireshark alata.



Slika 16. Razlika konfiguracija softverskog i hardverskog *firewalla*

```
    15 14.288275    192.168.0.77    10.20.10.5      TCP     66 53791 → 22 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=128 SACK_PERM=1
    16 14.291035    10.20.10.5      192.168.0.77    TCP     66 22 → 53791 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
    17 14.296787    192.168.0.77    10.20.10.5      TCP     54 53791 → 22 [ACK] Seq=1 Ack=1 Win=4194304 Len=0

Frame 15: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{EA246ADA-AE46-4C90-82F0-05DA87C4EDFE}, id 0
Ethernet II, Src: ASUSTekC_57:ad:ee (0c:9d:92:57:ad:ee), Dst: PcsCompu_0d:8d:84 (08:00:27:0d:8d:84)
Internet Protocol Version 4, Src: 192.168.0.77, Dst: 10.20.10.5
Transmission Control Protocol, Src Port: 53791, Dst Port: 22, Seq: 0, Len: 0
  Source Port: 53791
  Destination Port: 22
  [Stream index: 0]
  [Conversation completeness: Incomplete, DATA (15)]
  [TCP Segment Len: 0]
  Sequence Number: 0    (relative sequence number)
  Sequence Number (raw): 2848682876
  [Next Sequence Number: 1    (relative sequence number)]
  Acknowledgment Number: 0
  Acknowledgment number (raw): 0
  1000 .... = Header Length: 32 bytes (8)
v Flags: 0x002 (SYN)
    000. .... .... = Reserved: Not set
    ...0 .... .... = Nonce: Not set
    .... 0... .... = Congestion Window Reduced (CWR): Not set
    .... .0.. .... = ECN-Echo: Not set
    .... ..0. .... = Urgent: Not set
    .... ...0 .... = Acknowledgment: Not set
    .... .... 0... = Push: Not set
    .... .... .0.. = Reset: Not set
  > .... .... ..1. = Syn: Set
    .... .... ...0 = Fin: Not set
    [TCP Flags: ··········S·]
  Window: 65535
  [Calculated window size: 65535]
```

Slika 17. Snimka „three-way handshake“ postupka

Firewalli bazirani na uspostavi sigurne veze osiguravaju računalo ili mrežu računala provjeravajući ispravnost „three-way handshake“ postupka, čime osiguravaju sigurnost komunikacijskog tunela između dvaju računala ili dvije mreže. Ovaj tip

*firewall*a često je ugrađen u druge alate ili *firewalle*.

Firewalli bazirani na maskiranju podataka, također zvani „Proxy firewalls“, rade tako da zahtjeve poslane s originalnog računala maskiraju kao svoje zahtjeve. Time podatci originalnog računala nisu sadržani u zahtjevu kojega duga strana dobije i obrađuje. Ova vrsta *firewalla* se najčešće koristi za zaštitu servera web-aplikacija kako bi se izbjegli zlоćudni napadi direktno na servere koji pokreću aplikacije.

Firewalli bazirani na praćenju prometa, odnosno „Stateful inspection firewall“, se nadovezuje na *firewalle* bazirane na uspostavi sigurne veze tako da prati izvorišnu IP adresu, izvorišni *port*, odredišnu IP adresu i odredišni *port*, te dinamički generira pravila kako bi dopustio svu komunikaciju između dva računala ili dvije mreže računala. [21]

Firewalli iduće generacije (eng. Next-Generation Firewalls) uključuju funkcije više drugih oblika *firewalla*. Za razliku od ranije navedenih *firewalla*, *firewalli* iduće generacije provjeravaju sve segmente paketa, podatke o izvorištu paketa i podatke o sadržaju paketa. Ova vrsta *firewalla* je skupa, ali i najsigurnija verzija, a neki od najboljih primjera ovog oblika *firewalla* su Forcepoint NGFW, Barracuda CloudGen Firewall Series i Fortigate, proizvod firme Fortinet.

3.4 Instalacija sigurnosti na mrežu računala

Mreža računala 10.20.10.0/28 s pripadajućim *routerom* trenutno nije osigurana te je na njoj potrebno pokrenuti neku razinu osiguranja. Linux operacijski sustav ima unaprijed zadan *firewall* zvan „Uncomplicated Firewall“, odnosno ufw.

Kako bi cijela mreža računala bila zaštićena, potrebno je sigurnost pokrenuti na vezi između *routera* i privatne mreže računala, odnosno potrebno je pokrenuti hardverski *firewall*. S obzirom na to da je moguće *router* postaviti u način rada u kojemu izvršava posao hardverskog *firewalla*, moguće je koristiti ufw kao hardverski *firewall*.

3.4.1 Pokretanje ufw na routeru

Za pokretanje ufw na *routeru* potrebno je prvo definirati način na koji će se taj *firewall* ponašati. Kako bismo osigurali da je to ponašanje unaprijed zadano, potrebno je pokrenuti sljedeće naredbe.

```
sudo ufw default deny incoming
sudo ufw default allow outgoing
```

Nakon postavljanja zadanih postavki, moguće je dodatno definirati pravila komunikacije, na primjer, moguće je dopustiti SSH pristup ili zabraniti Telnet pristup.

Pokretanjem tih komandi direktna komunikacija s vanjskih računala na privatnu mrežu računala i dalje je moguća, ali je i sigurna. Komande za dopuštanje SSH pristupa i zabranu Telnet pristupa su sljedeće.

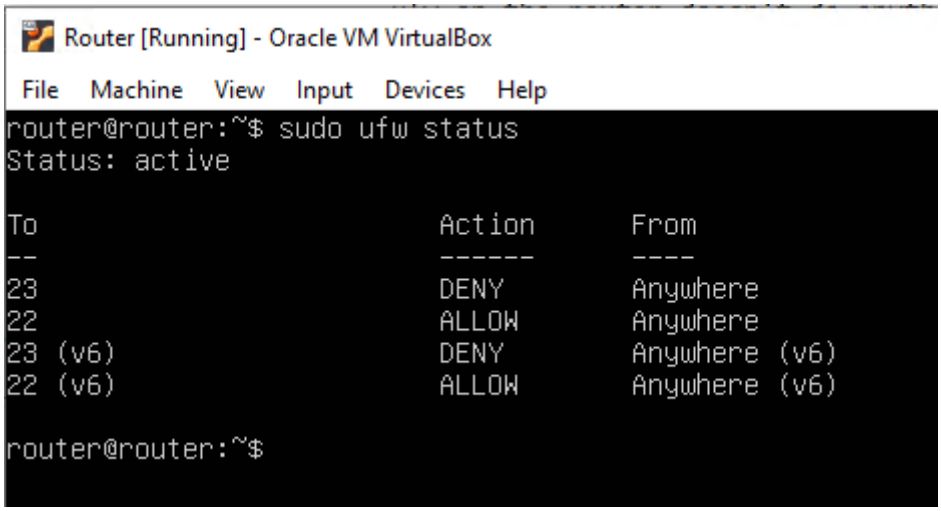
```
sudo ufw allow 22
sudo ufw deny 23
```

Kako bi mreža računala bila zaštićena, potrebno je pokrenuti *firewall* sljedećom naredbom.

```
sudo ufw enable
```

Moguće je provjeriti trenutno aktivna pravila pokrenuta na ufw korištenjem sljedeće naredbe, a izgled izlaza te naredbe prikazan je na slici 18.

```
sudo ufw status
```



Slika 18. Prikaz statusa Uncomplicated Firewalla

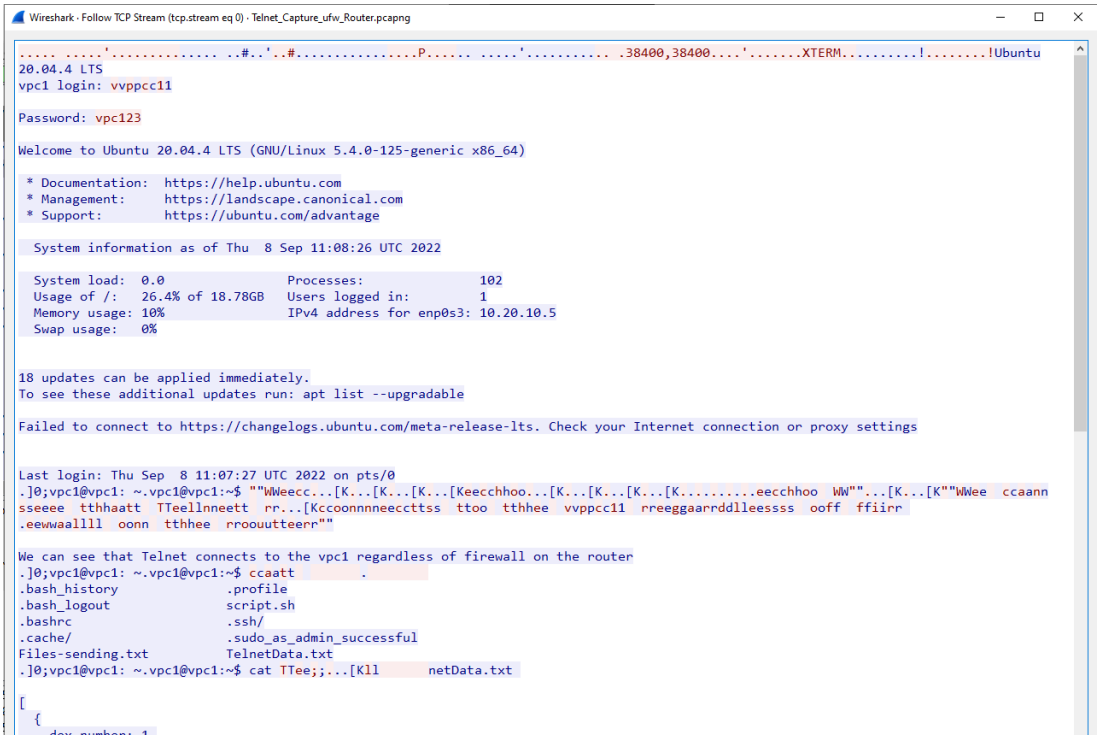
3.4.2 Promatranje komunikacije uz pokrenuti ufw

U nastavku slijede isječci snimki komunikacije između računala spojenog na vanjsku mrežu i računala na privatnoj mreži računala. Na slici 19. prikazan je isječak snimke Telnet komunikacije. Snimka cijele komunikacije je dostupna u Telnet dijelu Dodatka 2, na kraju ovog rada.

Iako je na *routeru* komunikacija korištenjem Telnet protokola zabranjena, komunikacija s računalom unutar mreže uspješno je uspostavljena i iščitljiva iz snimke prometa. Zahvaljujući toj komunikaciji, pokazano je da pravila postavljena na *routeru* unutar Uncomplicated Firewalla nisu primijenjena na komunikaciju koju router prosljeđuje prema unutrašnjosti mreže.

Kako je komunikacija korištenjem SSH i SFTP protokola dopuštena, snimke tih

komunikacija nije potrebno prikazivati zato što su i u ovakvom obliku komunikacije kriptirane. Snimke primjera komunikacije SSH i SFTP protokolima nalaze se u Dodatku 1, na kraju ovog rada.



Slika 19. Isječak snimke Telnet prometa između računala izvan mreže i računala unutar mreže zaštićene Uncomplicated Firewallom na *routeru*

3.4.3 Upravljanje prosljeđivanjem komunikacije

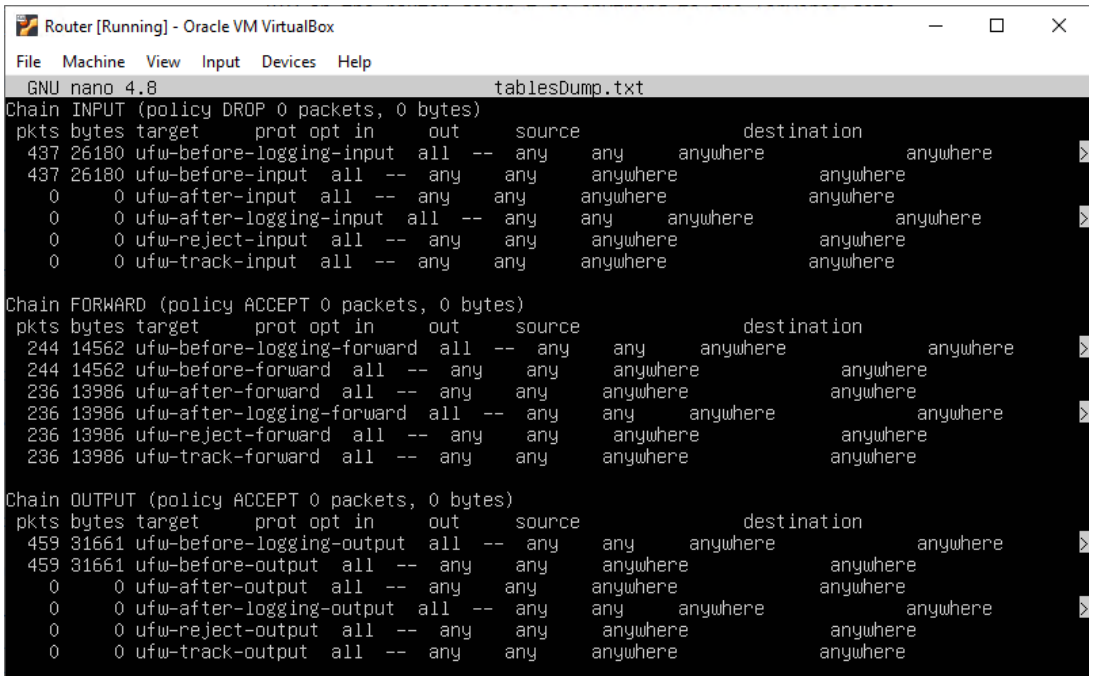
Iako Uncomplicated Firewall, odnosno ufw, radi na principu modifikacije IP tablica, pravila ne primjenjuje na dio tablice koji radi na prosljeđivanju podataka, što je zapravo glavna funkcija *routera*.

Kako bi se ta komunikacija osigurala, potrebno je pravila prihvaćanja ili odbijanja komunikacije dodavati direktno u dio IP tablica koji se bavi prosljeđivanjem podataka. Naredba za pregled stanja IP tablica slijedi u nastavku, a na slici 20 je prikazan izlaz te naredbe.

```
sudo iptables -L -v
```

Potrebno je dodati pravilo koje zabranjuje svu komunikaciju korištenjem Telnet protokola, odnosno korištenjem *porta* 23. To pravilo se može dodati korištenjem sljedeće naredbe.

```
sudo iptables -A FORWARD -p tcp --dport 23 -j DROP
```



Slika 20. Prikaz IP tablica bez pravila prosljeđivanja komunikacije

Prethodna naredba prestane biti u funkciji nakon ponovnog paljenja *routera*, tako da je potrebno pokretati ju pri svakom paljenju virtualnog *routera*. Kako bi se osiguralo pokretanje naredbe, potrebno je pokretanje te naredbe automatizirati. Najlakši način za automatizaciju pokretanja tog koda je dodavanje u skriptu napisanu ranije u ovom radu. Za modificiranje skripte potrebno je pokrenuti sljedeću naredbu.

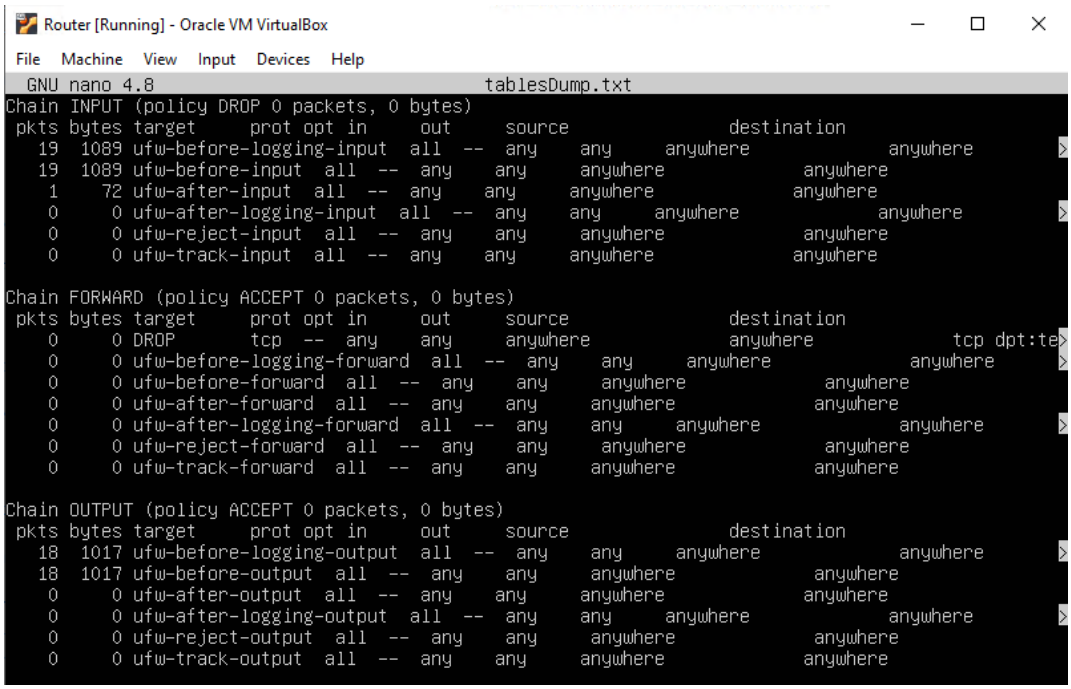
```
sudo nano /etc/system/system/startup-script.sh
```

Novi izgled skripte je sljedeći.

```
#!/bin/bash

sudo ip route del 0.0.0.0/0 via 10.20.10.1
sudo iptables -A FORWARD -p tcp --dport 23 -j DROP
```

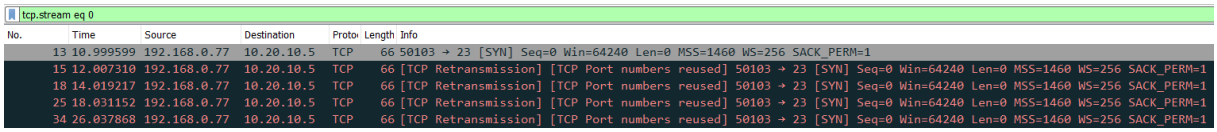
Pri ponovnoj provjeri pravila zapisanih u IP tablicama, novo dodano pravilo nalazi se u dijelu za prosljeđivanje. Prikaz IP tablica s dodanim pravilom prikazan je na slici 21.



Slika 21. Prikaz IP tablica nakon dodavanja pravila za odbijanje komunikacije korištenjem Telnet protokola

3.4.4 Promatranje komunikacije na osiguranoj mreži

Pokrene li se snimanje prometa na mreži s ovako definiranom zaštitom na *routeru*, komunikacija korištenjem Telnet protokola uopće više nije moguća. Snimka pokušaja komunikacije prikazana je na slici 22.



Slika 22. Snimka pokušaja komunikacije korištenjem Telnet protokola

Na slici 22 prikazano je pet pokušaja pristupanja virtualnom računalu unutar zaštićene mreže, ali, kako niti jedan pokušaj nije dobio odgovor, pokušaji komunikacije su prestali. Razlog nedostatka odgovora na pokušaje spajanja je činjenica da zahtjev za uspostavljanjem veze korištenjem Telnet protokola uopće nije stigao do virtualnog računala. Zbog pravila postavljenih u IP tablicama *routera*, pokušaji povezivanja korištenjem Telnet protokola su odbačeni.

3.5 Nedostatci u sigurnosti *firewalla*

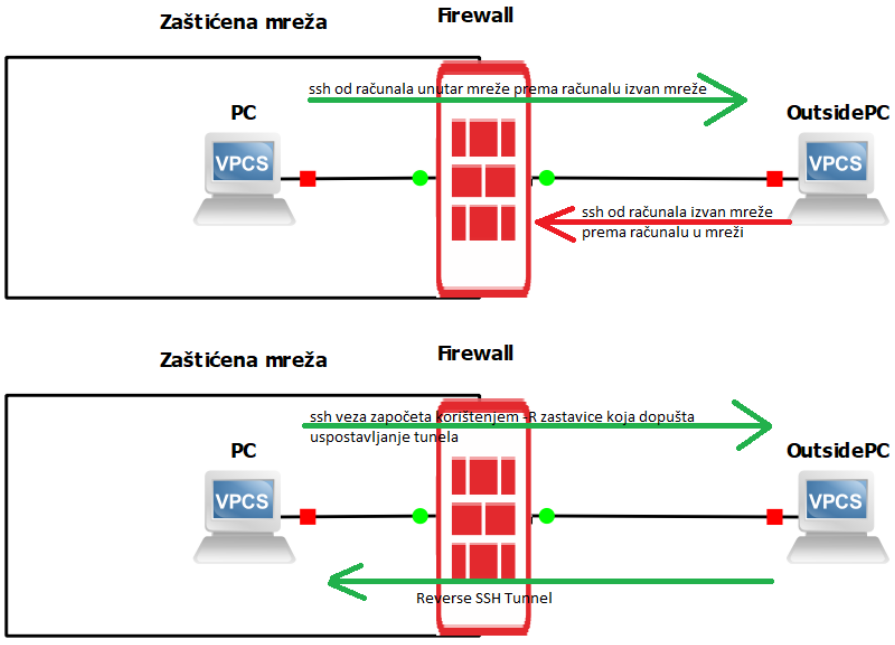
Neke vrste *firewalla* imaju neki oblik nedostataka koji onemogućava potpunu sigurnost računala ili mrežu računala. Takve vrste *firewalla* se koriste u slučajevima kada nije bitna potpuna sigurnost, već dovoljno dobra sigurnost.

Firewalli bazirani na filtriranu paketa, kao glavni problem, imaju činjenicu da provjeravaju samo zaglavlje paketa, odnosno izvor paketa, protokol kojim komunicira

i *port* kojim komunicira, ali ne provjerava sadržaje paketa. U sadržaju paketa se može nalaziti nekakav zloćudni kod koji se iz samog iščitavanja zaglavlja ne može uočiti.

Ipak veći problem imaju *firewalli* koji rade na nižim slojevima OSI model-a, do sloja 4 koji je također uključen u tu skupinu. Kao što je ranije navedeno, ovi oblici *firewalla* rade na principu omogućavanja komunikacije s drugim računalom, dok god je komunikaciju započelo računalo unutar mreže koju taj *firewall* štiti. Nažalost, postoje načini zaobilaženja ovog oblika sigurnosti, a jedan od oblika zaobilaženja se naziva „reverse tunneling“. Primjer koji će se ovdje obraditi je Reverse SSH tuneling.

Ovaj oblik komunikacije se bazira na tome da računalo unutar zaštićene mreže započne komunikaciju s drugim računalom SSH protokolom, korištenjem bilo kojeg porta osim 22. U tom trenutku, to drugo računalo započinje komunikaciju preko istog protokola i porta, otvarajući novi put prema računalu unutar zaštićene mreže. U suštini, unutar sigurnog tunela namijenjenog za komunikaciju, stvori se novi tunel koji sprječava zatvaranje početnog tunela. *Firewall* koji prati promet neće odbaciti ovaj oblik prometa zato što je istog oblika kao promet kojega je računalo koje štiti započelo, te je time sigurnost mreže računala narušena. Korištenjem veze suprotnog smjera, omogućeno je kroz SSH promet započet sa unutarnjeg računala zapravo vanjsko računalo kontrolira to unutarnje, neovisno o pravilima postavljenim na *firewallu*. Skica ovog principa rada je prikazana na slici 23.



Slika 23. Reverse SSH Tunnelling

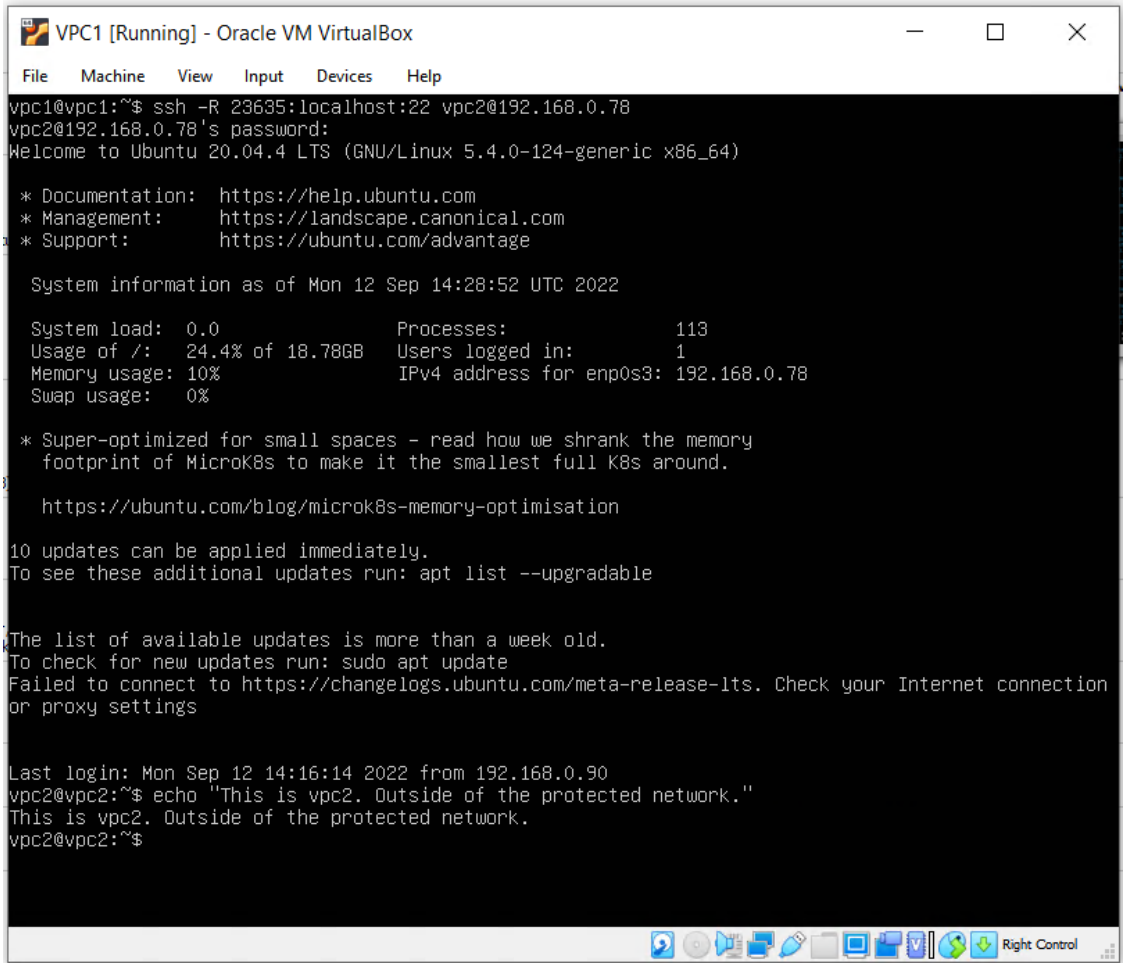
Kako bi se omogućilo otvaranje SSH puta u suprotnom smjeru potrebno je koristi posebne zastavice unutar naredbe za povezivanje putem SSH protokola. U

svrhu primjera otvaranja ovakvog puta računalo unutar mreže zvat će se vpc1 i bit će na IP adresi 10.20.10.5, a računalo izvan mreže zvat će se vpc2 s IP adresom 192.168.0.78.

Naredba kojom se uspostavlja SSH tunel suprotnog smjera je sljedeća. Ta naredba se pokreće na računalu unutar mreže koju štiti *firewall* baziran na praćenju prometa.

```
ssh -R 23635:localhost:22 vpc2@192.168.0.78
```

U ovoj naredbi 23635 označava jedan od nekorištenih *portova* na računalu, raspon nekorištenih *portova* najčešće je od *porta* 1024 do *porta* 65535. Nakon unosa lozinke računala vpc2, pojavi se izgled ekrana prikazan na slici 24.

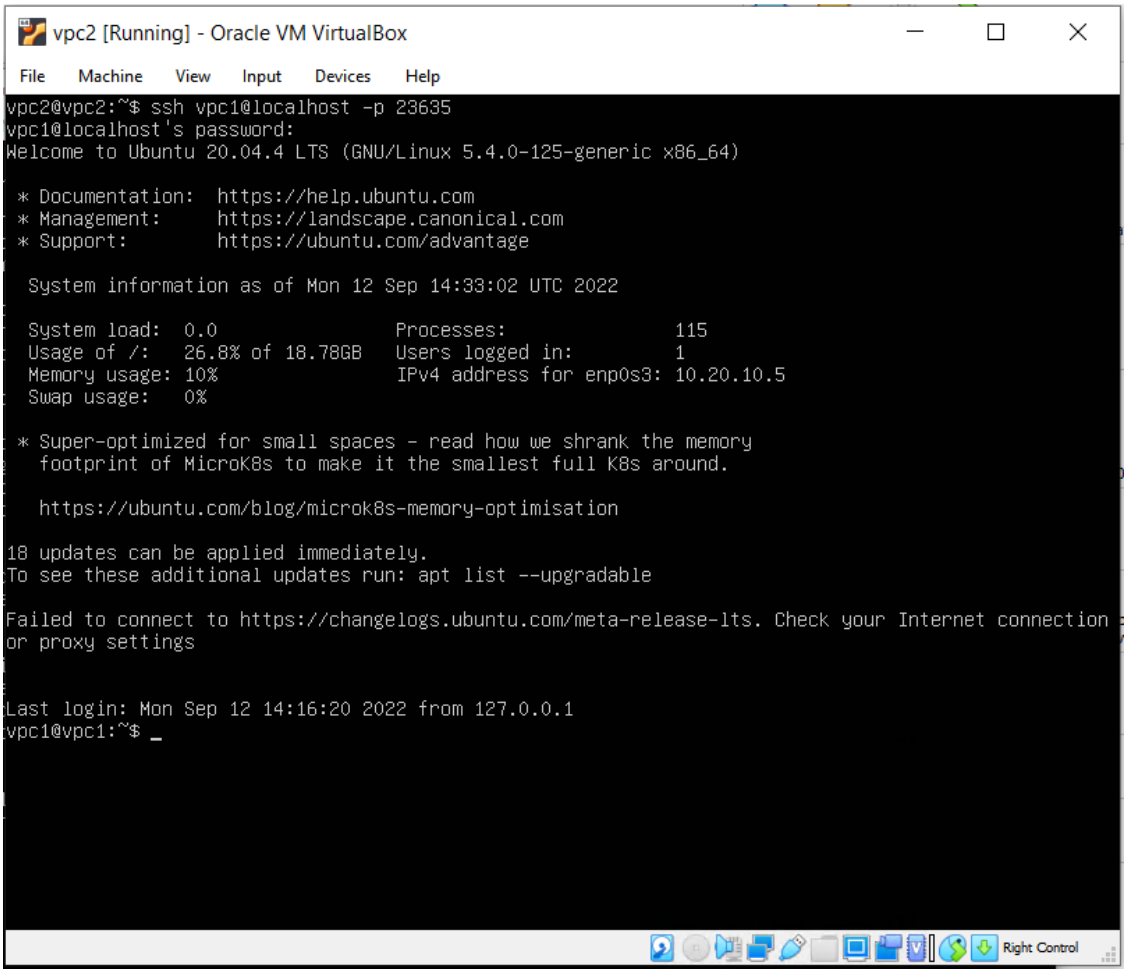


Slika 24. Prikaz otvaranja SSH tunela suprotnog smjera.

Dok god je put otvoren ranije navedenom naredbom otvoren, moguće je s računala vpc2 otvoriti SSH vezu na računalo vpc1, što inače *firewall* baziran na praćenju prometa ne bi dopustio. Taj put suprotnog smjera se otvara korištenjem sljedeće naredbe. Nakon pokretanja te naredbe i upisivanja lozinke računala vpc1 uspješno je uspostavljena SSH veza na računalo vpc1, koje se nalazi u zaštićenoj

mreži. Povezivanje na zaštićeno računalo korištenjem SSH puta suprotnog smjera prikazano je na slici 25.

```
ssh vpc1@localhost -p 23635
```



Slika 25. Stvaranje SSH veze korištenjem tunela suprotnog smjera

4. Zaključak

Nakon stvaranja mreže računala i pokretanja osnovne sigurnosti na toj mreži te promatranja dostupnih informacija korištenjem određenih protokola, jasno je da kvalitetnu sigurnost nije jednostavno postići bez iskustva i resursa koje se može iskoristiti za povećanje kvalitete mreže i sigurnosti na toj mreži.

Skoro svaki oblik *firewalla* ima nekakve nedostatke koje se s novijim oblicima *firewalla* pokušava ukloniti. Zahvaljujući tom trudu, *firewalli* iduće generacije imaju manje nedostataka od ranije stvorenih oblika *firewalla*.

U ranijim stupnjevima razvoja mreža računala i sigurnosti tih mreža, sama segmentacija mreže se nije u potpunosti iskorištavala, već se mreža dijelila na vanjsku mrežu, odnosno internet, i unutarnju mrežu, odnosno intranet.

Kako je razvoj sigurnosti napredovao, uz *firewall* za određivanje pravila komunikacije, segmentacija većih mreža na manje dijelove je postala sve češća. Sama segmentacija mreže povećava stupanj sigurnosti mreže zato što se korištenjem *firewalla* i dodatnih skupina pravila za komunikaciju među segmentima može dodatno regulirati sigurnost.

Tim postupcima osiguravamo da, čak i ako jedno računalo unutar mreže neke kompanije bude komprimirano, cijela mreža neće biti izložena riziku, odnosno prijetnja će ostati izolirana u određenom segmentu mreže.

Osobno smatram da sam kroz samostalno pokretanje mreže računala i njezino osiguravanje naišao na probleme koje nisam ni mogao zamisliti, ali zahvaljujući tome sada imam više iskustva i širi pogled na probleme s kojima ću se suočiti u poslovnom okruženju.

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Dodatak 1

U ovom dijelu prikazane su cijele snimke komunikacije na nezaštićenoj mreži korištenjem Telnet, SSH i SFTP protokola. Kako pojedina snimka komunikacije ne bi zauzimala više stranica, snimke će imati smanjenu veličinu slova.

Telnet komunikacija

Potpuna komunikacija

```
eecchhoo ""TThhiiss  ppaarrtt  iiss  bbeeiinngg  rreecc...[K...[K...[Kccaappttuurreedd  uussiinngg  WWiiiirr...[K...[Krreesshhaarrkk""

This part is being captured using Wireshark
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ ssuuddoo  nnaannoo  ssccrriipptt,,sshh...[K...[K...[K..sshh

.[?2004h.[?1049h.[22;0;0t.[1;24r.(B.[m.[4l.[?7h.[39;49m.[?1h.=.[?1h.=.[?25l.[39;49m.(B.[m.[H.[2J.[22;35H.(B.[0;7m[ New File ].(B.[m.[H.(B.[0;7m  GNU nano 4.8
script.sh                                .[1;79H.(B.[m
..[23d.(B.[0;7m^G.(B.[m Get Help  .(B.[0;7m^O.(B.[m Write Out .(B.[0;7m^W.(B.[m Where Is  .(B.[0;7m^K.(B.[m Cut Text  .(B.[0;7m^J.(B.[m Justify
.(B.[0;7m^C.(B.[m Cur Pos
..[24d.(B.[0;7m^X.(B.[m Exit.[14G.(B.[0;7m^R.(B.[m Read File .(B.[0;7m^\.(B.[m Replace   .(B.[0;7m^U.(B.[m Paste Text.(B.[0;7m^T.(B.[m To Spell
.(B.[0;7m^_.(B.[m Go To Line
..[22d.[2d.[39;49m.(B.[m.[?12l.[?25h.[200~#!/bin bash
.
.echo "[
.  {
.    "dex_number": "1",
.    "pokemon_name": "Bulbasaur",
.    "types": [{ "type_id": "628920910747fb84fa421611" }, {"type_id": "6289212e0747fb84fa421614"}],
.    "colours": [{ "colour_id": "628a03d8ae7dd8dd4a5b5c7c" }, { "colour_id": "628a03a3ae7dd8dd4a5b5c79" }],
.    "stage": "1",
.    "evolution_method": "62b1702d1500f67735a6f2b2",
.    "form": "628a0589ae7dd8dd4a5b5c92",
.    "dex_entry": "A strange seed was planted on its back at birth. The plant sprouts and grows with this POK..MON.",
.    "base_stat_total": "318"
.  },
.  {
.    "dex_number": "2",
.    "pokemon_name": "Ivysaur",
.    "types": [{"type_id": "628920910747fb84fa421611" }, {"type_id": "6289212e0747fb84fa421614"}],
.    "colours": [{ "colour_id": "628a03d8ae7dd8dd4a5b5c7c" }, { "colour_id": "628a03c8ae7dd8dd4a5b5c7a" }],
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.    "evolution_method": "628a0639ae7dd8dd4a5b5c96",
.    "form": "628a0589ae7dd8dd4a5b5c92",
.    "dex_entry": "When the bulb on its back grows large, it appears to lose the ability to stand on its hind legs.",
.    "base_stat_total": "405"
.  },
..[?25l  {
.    "dex_number": "3",
.    "pokemon_name": "Venusaur",
.    "types": [{ "type_id": "628920910747fb84fa421611" }, {"type_id": "6289212e0747fb84fa421614"}],
.    "colours": [{ "colour_id": "628a03d8ae7dd8dd4a5b5c7c" }, { "colour_id": "628a03c8ae7dd8dd4a5b5c7a" }],
.    "stage": "3",
.    "evolution_method": "628a0639ae7dd8dd4a5b5c96",
.    "form": "628a0589ae7dd8dd4a5b5c92",
.    "dex_entry": "The plant blooms when it is absorbing solar energy. It stays on the move to seek sunlight.",
.    "base_stat_total": "525"
.  },
.  {
..[22d.[K    "pokemon_name": "Charmander",
.    "types": [{ "type_id": "62891fce0747fb84fa42160d" }],
.    "colours": [{ "colour_id": "628a0424ae7dd8dd4a5b5c84" }, { "colour_id": "628a03d0ae7dd8dd4a5b5c7b" }],
.    "dex_entry": "Obviously prefers hot places. When it rains, steam is said to spout from the tip of its tail.",
.    "evolution_method": "62b1702d1500f67735a6f2b2",
.    "form": "628a0589ae7dd8dd4a5b5c92",
.    "stage": "1",
.    "base_stat_total": "309",
.    "dex_number": "4"
.  }," >> TelnetData.txt.[201~.[1;71H.(B.[0;7mModified.(B.[m.[2;3H.[32m{.[3;5H.(B.[0;1m.[33m"pokemon_name".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"Charmander".[39m.(B.[m,.[4;5H.(B.[0;1m.[33m"types".(B.[0m.[32m:.[39m.(B.[m .[32m[{.[39m.(B.[m .(B.[0;1m.[33m"type_id".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"62891fce0747fb84fa42160d".[39m.(B.[m .[32m}].[39m.(B.[m,.[5;5H.(B.[0;1m.[33m"colours".(B.[0m.[32m:.[39m.(B.[m .[32m[{.[39m.(B.[m
.(B.[0;1m.[33m"colour_id".(B.[0m.[32m:.[39m.(B.[m .(B.[0;1m.[33m"628a0424ae7dd8dd4a5b5c84".[39m.(B.[m .[32m}.[39m.(B.[m, .[32m{.[39m.(B.[m
.(B.[0;1m.[33m"colour_id".(B.[0m.[32m:.[39m.(B.[m .(B.[0;1m.[33m"62.[39m.(B.[0;7m>.[6;5H.(B.[0;1m.[33m"dex_entry".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"Obviously prefers hot places. When it rains, steam is said to.[39m.(B.[0;7m>.[7;5H.(B.[0;1m.[33m"evolution_method".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"62b1702d1500f67735a6f2b2".[39m.(B.[m,.[8;5H.(B.[0;1m.[33m"form".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"628a0589ae7dd8dd4a5b5c92".[39m.(B.[m,.[9;5H.(B.[0;1m.[33m"stage".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"1".[39m.(B.[m,.[10;5H.(B.[0;1m.[33m"base_stat_total".(B.[0m.[32m:.[39m.(B.[m
.(B.[0;1m.[33m"309".[39m.(B.[m,.[11;5H.(B.[0;1m.[33m"dex_number".(B.[0m.[32m:.[39m.(B.[m .(B.[0;1m.[33m"4".[12;3H.(B.[0m.[32m}.[39m.(B.[m,"
.[32m>>.[39m.(B.[m TelnetData.txt.[?12l.[?25h..[?25l
..[22d.(B.[0;7mSave modified buffer?                                .[23;1H Y.(B.[m Yes.[K
..[24d.(B.[0;7m N.(B.[m No  .[14G   .(B.[0;7m^C.(B.[m Cancel.[K.[22;23H.[?12l.[?25h..[?25l.[22;33H.[1K .(B.[0;7m[ Cancelled ].(B.[m.[K
..[23d.(B.[0;7m^G.(B.[m Get Help  .(B.[0;7m^O.(B.[m Write Out .(B.[0;7m^W.(B.[m Where Is  .(B.[0;7m^K.(B.[m Cut Text  .(B.[0;7m^J.(B.[m Justify
.(B.[0;7m^C.(B.[m Cur Pos
..[24d.(B.[0;7m^X.(B.[m Exit.[14G.(B.[0;7m^R.(B.[m Read File .(B.[0;7m^\.(B.[m Replace   .(B.[0;7m^U.(B.[m Paste Text.(B.[0;7m^T.(B.[m To Spell
.(B.[0;7m^_.(B.[m Go To Line
..[22d.[12;24H.[?12l.[?25h.OA.[?25l.[A...[?12l.[?25h.OA.[?25l.[10;24H.[?12l.[?25h.OA.[?25l.[9;18H.[?12l.[?25h.OA.[?25l.[8;24H.[?12l.[?25h.OA.[?25l.[A.[?12l.[?25h.
OA.[?25l.[A.[?12l.[?25h.OA.[?25l.[A.[?12l.[?25h.OA.[?25l.[A.[?12l.[?25h.OA.[?25l.[A.[?12l.[?25h.OA.[?25l.[A.[?12l.[?25h.OA.[?25l.[2;4H.[?12l.[?25h.OA.[?25l.7.[2;21r.8
..M.[1;24r.[2;3H.[32m}.[39m.(B.[m,.[?12l.[?25h.OA.[?25l.7.[2;21r.8
..M.[1;24r.[2;5H.(B.[0;1m.[33m"base_stat_total".(B.[0m.[32m:.[39m.(B.[m .(B.[0;1m.[33m"525".[24G.[39m.(B.[m.[?12l.[?25h.OA.[?25l.7.[2;21r.8
..M.[1;24r.[2;5H.(B.[0;1m.[33m"dex_entry".(B.[0m.[32m:.[39m.(B.[m .(B.[0;1m.[33m"The plant blooms when it is absorbing solar energy. It stays
.[39m.(B.[0;7m>.[2;24H.(B.[m.[?12l.[?25h.OA.[?25l.7.[2;21r.8
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the.[39m.(B.[0;7m>.[2;24H.(B.[m.[?12l.[?25h.OA.[?25l.7.[2;21r.8
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sp.[39m.(B.[0;7m>.[2;24H.(B.[m.[?12l.[?25h.OA.[?25l.7.[2;21r.8
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..[24d.(B.[0;7m N.(B.[m No  .[14G   .(B.[0;7m^C.(B.[m Cancel.[K.[22;23H.[?12l.[?25hy.[?25l
..[23d.(B.[0;7m^G.(B.[m Get Help.[23;21H.(B.[0;7mM-D.(B.[m DOS Format.[41G.(B.[0;7mM-A.(B.[m Append.[23;61H.(B.[0;7mM-B.(B.[m Backup File
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..[22d.(B.[0;7mFile Name to Write: script.sh
..(B.[m.[22;30H.[?12l.[?25h
.[?25l   .[1K .(B.[0;7m[ Writing... ].(B.[m.[K.[1;71H.(B.[0;7m        .(B.[m.[22;32H.(B.[0;7m[ Wrote 47 lines ].(B.[m
..[J.[24d.[?12l.[?25h.[24;1H.[?1049l.[23;0;0t
..[?1l.>.[?2004l.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ cchhmmoodddd  uu...[K...[K...[K  uu++xx  ssccrr                    ipt.sh

chmod: changing permissions of 'script.sh': Operation not permitted
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ .[Achmod u+x script.sh .[1~.....s.[1@su.[1@ud.[1@do.[1@o .[1@

.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ cclleeaarr

.[H.[2J.[3J.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ bbaasshh  ssccrriipptt..sshh

.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ llll

total 40
drwxr-xr-x 4 vpc1 vpc1 4096 Sep  7 13:43 .[0m.[01;34m..[0m/
drwxr-xr-x 3 root root 4096 Aug 24 12:52 .[01;34m...[0m/
-rw------- 1 vpc1 vpc1 3939 Sep  7 08:36 .bash_history
-rw-r--r-- 1 vpc1 vpc1  220 Feb 25  2020 .bash_logout
-rw-r--r-- 1 vpc1 vpc1 3771 Feb 25  2020 .bashrc
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drwx------ 2 vpc1 vpc1 4096 Aug 24 12:53 .[01;34m.ssh.[0m/
-rw-r--r-- 1 vpc1 vpc1    0 Aug 24 14:36 .sudo_as_admin_successful
-rw-rw-r-- 1 vpc1 vpc1 1870 Sep  7 13:43 TelnetData.txt
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    colours: [{ colour_id: 628a03d8ae7dd8dd4a5b5c7c }, { colour_id: 628a03a3ae7dd8dd4a5b5c79 }],
    stage: 1,
    evolution_method: 62b1702d1500f67735a6f2b2,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: A strange seed was planted on its back at birth. The plant sprouts and grows with this POK..MON.,
    base_stat_total: 318
  },
  {
    dex_number: 2
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    stage: 2,
    evolution_method: 628a0639ae7dd8dd4a5b5c96,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: When the bulb on its back grows large, it appears to lose the ability to stand on its hind legs.,
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  },
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    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: The plant blooms when it is absorbing solar energy. It stays on the move to seek sunlight.,
    base_stat_total: 525
  },
  {
    pokemon_name: Charmander,
    types: [{ type_id: 62891fce0747fb84fa42160d }],
    colours: [{ colour_id: 628a0424ae7dd8dd4a5b5c84 }, { colour_id: 628a03d0ae7dd8dd4a5b5c7b }],
    dex_entry: Obviously prefers hot places. When it rains, steam is said to spout from the tip of its tail.,
    evolution_method: 62b1702d1500f67735a6f2b2,
    form: 628a0589ae7dd8dd4a5b5c92,
    stage: 1,
    base_stat_total: 309,
    dex_number: 4
  },
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TTeellnnnneett...[K...[K...[Keett""

All data was clearly visible trough Telnet
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$
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Podatci slani od strane računala u mreži 10.20.10.0/24


```
echo "This part is being rec..[K..[K..[Kcaptured using Wiir..[K..[Kreshark"
This part is being captured using Wireshark
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ sudo nano script,sh..[K..[K..[K.sh
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script.sh                                .[1;79H.(B.[m
..[23d.(B.[0;7m^G.(B.[m Get Help  .(B.[0;7m^O.(B.[m Write Out .(B.[0;7m^W.(B.[m Where Is  .(B.[0;7m^K.(B.[m Cut Text  .(B.[0;7m^J.(B.[m Justify
.(B.[0;7m^C.(B.[m Cur Pos
..[24d.(B.[0;7m^X.(B.[m Exit.[14G.(B.[0;7m^R.(B.[m Read File .(B.[0;7m^\.(B.[m Replace   .(B.[0;7m^U.(B.[m Paste Text.(B.[0;7m^T.(B.[m To Spell
.(B.[0;7m^_.(B.[m Go To Line
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.(B.[0;1m.[33m"Obviously prefers hot places. When it rains, steam is said to.[39m.(B.[0;7m>.[7;5H.(B.[0;1m.[33m"evolution_method".(B.[0m.[32m:.[39m.(B.[m
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..[23d.(B.[0;7m^G.(B.[m Get Help  .(B.[0;7m^O.(B.[m Write Out .(B.[0;7m^W.(B.[m Where Is  .(B.[0;7m^K.(B.[m Cut Text  .(B.[0;7m^J.(B.[m Justify
.(B.[0;7m^C.(B.[m Cur Pos
..[24d.(B.[0;7m^X.(B.[m Exit.[14G.(B.[0;7m^R.(B.[m Read File .(B.[0;7m^\.(B.[m Replace   .(B.[0;7m^U.(B.[m Paste Text.(B.[0;7m^T.(B.[m To Spell
.(B.[0;7m^_.(B.[m Go To Line
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the.[39m.(B.[0;7m>.[2;24H.(B.[m.[?12l.[?25h.[?25l.7.[2;21r.8
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..[?1l.>.[?2004l.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ chmodd u..[K..[K..[K u+x script.sh
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.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ chmod u+x script.sh .....................[1@s.[1@u.[1@d.[1@o.[1@
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ clear
.[H.[2J.[3J.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ bash script.sh
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ ll
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drwxr-xr-x 3 root root 4096 Aug 24 12:52 .[01;34m...[0m/
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    form: 628a0589ae7dd8dd4a5b5c92,
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    evolution_method: 628a0639ae7dd8dd4a5b5c96,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: The plant blooms when it is absorbing solar energy. It stays on the move to seek sunlight.,
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    dex_entry: Obviously prefers hot places. When it rains, steam is said to spout from the tip of its tail.,
    evolution_method: 62b1702d1500f67735a6f2b2,
    form: 628a0589ae7dd8dd4a5b5c92,
    stage: 1,
    base_stat_total: 309,
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All data was clearly visible trough Telnet
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Podatci slani od strane računala sa vanjske mreže

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sudo nano script,sh....sh
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.    "form": "628a0589ae7dd8dd4a5b5c92",
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.    "form": "628a0589ae7dd8dd4a5b5c92",
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.    "evolution_method": "62b1702d1500f67735a6f2b2",
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bash script.sh
ll
cat Tel
eh.cho "All data sa..was clearly sh..vus..isible trough Telnnet...et"
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SSH komunikacija


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etm@openssh.com,hmac-md5-etm@openssh.com....none,zlib,zlib@openssh.com....none,zlib,zlib@openssh.com...............;Z...........
.W...oAI."Q.7...J....curve25519-sha256,curve25519-sha256@libssh.org,ecdh-sha2-nistp256,ecdh-sha2-nistp384,ecdh-sha2-nistp521,diffie-hellman-group-
exchange-sha256,diffie-hellman-group16-sha512,diffie-hellman-group18-sha512,diffie-hellman-group14-sha256...Arsa-sha2-512,rsa-sha2-256,ssh-rsa,ecdsa-sha2-
nistp256,ssh-ed25519...lchacha20-poly1305@openssh.com,aes128-ctr,aes192-ctr,aes256-ctr,aes128-gcm@openssh.com,aes256-
gcm@openssh.com...lchacha20-poly1305@openssh.com,aes128-ctr,aes192-ctr,aes256-ctr,aes128-gcm@openssh.com,aes256-gcm@openssh.com....umac-64-
etm@openssh.com,umac-128-etm@openssh.com,hmac-sha2-256-etm@openssh.com,hmac-sha2-512-etm@openssh.com,hmac-sha1-etm@openssh.com,umac-
64@openssh.com,umac-128@openssh.com,hmac-sha2-256,hmac-sha2-512,hmac-sha1....umac-64-etm@openssh.com,umac-128-etm@openssh.com,hmac-sha2-
256-etm@openssh.com,hmac-sha2-512-etm@openssh.com,hmac-sha1-etm@openssh.com,umac-64@openssh.com,umac-128@openssh.com,hmac-sha2-
256,hmac-sha2-512,hmac-sha1....none,zlib@openssh.com....none,zlib@openssh.com........................,..... .....`(yl=..V.lo;k...G.......n.A/)U............3....ssh-ed25519...
z.53,.c.aJ......v.V/..L...q.t...... ...a.q.Hl.-'$....YR ..
.s....."4...S....ssh-ed25519...@M7.           .|..v.A...T....,|....bXd.bJf.$6....h.('.&-.8....h..n...................
................w\...]w......F....K.<..?m#v3.Az.S.Qa.....5...OLsx..                 _C.`.oP...&i1f.~.tk....E
.3..>.j..x..P|..}..m~y..H}..{".qs.....}....g..1.S..b0.K~ap.D...Z....b...%.c..
l...QT../R.x.......k..mn.....t..o.u.C'...YC....r.....                  >.c?....
.H.}..Cc.....@..d...M'
.S.b..^.......
..\v.{0c.=y.@..                    _..x.i._yi=b+.qi2.9<.<.5s8F........1... 4*dU.x..P~.............9Yw..P.1....1=.w=.Z.....Y....9#..fX.b}....wt.9x......3=...Y.<..n.
                    ....Q...)%`S.(..Q....tv...B.]...|`....?}*.O.;...Yc..;.@i.....y0..$.h.......*.v...D.....G..9F6*f,...'os.....*...N
                    ....V.B./....^..@.).d..uK..#...(..p...?..e;.L..p...C....o.X`:....o..&&~)...T..=.,Q.f...0 .5..R6..73J;.p..4.xQ..'QmQ~.V9.n.W...._`..d....
...}..'.....d.".k...J.-......@.=...@..~...W......~.....$I.U.........4)=..ZU.
.@..6........e.^Gv.*D.*.5.......i.}ra.).....P.=.._..:I.......!.|....1.H.k*.H............                     v.dY...&.w6..F...gz.&.:...._...4kWJh..)Z..P.F.Zb...{,V
                    ..m%.8...WBH......ttv.r.2..D!Z8.}
.`....S=.@.{....,B.......Ced$..8v"....@/m.65.#.j..[....7l?r.J..K..c.../...s.N,pp.~Q.....
.....U......N<...a.h......DV...0..x......."%.g..'v.P...W....(p...3.......3ca.U....7E;(.G...).Q....._.......s?....Yb(....A..:...:/...W..T8+E...'....1...Yow
....t.'y.n~...&Z.....JZ=.".o}.pq.x.C.......V7.I_......l.n......6k.).b.....?.
.+....Y0..J..o.h`.O.{Pg%....w3.~vU...q..3..qQ/R.....\2...........i.#..>......0K.K'e.)...H:...7..`...........+z.....Q........|;bQ....,+X.kM.F....)v..a..
MB..
....qm.....te.....lsDu8..r.CW.&.a..'}..ih..Q.hP....L8..6..{.
[p.."........P..f.x.lj.....[M.j.D6D0.....4..P%\=|.[....A....x.....t.}....$......E....'......SR.t..../yj....f.Lw)G...
"..f...E..}.....Q....{.@..z5Z?......]I.X. b$[..*..../..X'...O.........u..o......f.7V....:.a|....A.E.3s......R..f...q.Ve.7..IA..nz"...N.....O.5..1.5.........ide]W..C}...v.B.!...2..)TF>..
..5....r..u..N,..92p..duy.DXR.?..l..H.. ....1..u.U..D.           ....Q..W{C.(.....;qS.F.C.....@.D.....v..&np@.....M].*.o..AB.8]QN>.9.*3..I.`.R$...n.+..".|..."..c.
..........}.#.>..[.h.KV_.z....w{.w=......z..t..DGm.gV.3O...&...H.G..[.i@.A..MC.T..@...ZI.G9..u.k....]l...y.].Z.h..}lf...k.e.XC...~[q5..#..`......F...E.U.FX.4..%=s.S...)........Y.A..j!&.
.B..,..J.l......'.. 2#q.2......X.6...'+.>.k....$..T..2>N..)e..
@.A.X.>.}D.
}....W......-...n....@.(.......&....L7...Z..8*&.OI.Y...".=...w.8G...U..
...]4........v.ZI.Z...@1...Q9..#..%`_Y....NCW..DWGM.)8.O........q.6...._ZQ.N.g+....E..v.f.}...._...GpP..TN...9.8.m..$...2.W.hs.x...K.....-i\o....vVc...}C7.......V
                    ....A.......3.....#k`..b.T....P.q...%.Skk.m..xF....8.........U.......(.....
..@\...^..c...9...R......<.[.......D...R.d..J.I.....;..Okt......w...b ...J..S.....WM;)....mm.2g..4..T......f....q......L*.......[. ....=._.i..g..r@.d.....UtC......
                    ..;..9a...`F....c..U3.....K..o..".FsI..... /..W.)..~6.U....3....B.}KpZFLE..Tl&.M.....|.|....'.I.c.k3jU..tE.`...0...
                    ..Yl4.r..z.FI.[.:.'...*.z$G......".z\.K>..'..\....dz....?b.........Z.a.@..!D..m5...1...
?5.%...j.fu..=...k.....(}.L..J[.gl..~O.Q9...F.../..3..7..]...@..+..z'V.q9....C.Ac....j+O.T[.;....1 ]H.|.apJ.>.i\..!...FG.....C....z^.......).aX,.H-H.....D.6
..D./..Y..."e......>.....83..7.YG.prF..32)M......{c..H1.
#.k.>....M.....q..yA..i....s.H6..3..B^.t$V....dV.?.1....YQ.......naaf'.}.....t.........!zB.^y.....X..x..r....oAP.?c
..b...U~..Q.}..B....0\&]..4..;.o.J...6Z.7.^.s.2........:4..R...a.X.:..(
....p..V..F.m..?.{.1......$...Cc..},....L....._"..~oZ.......Y.).......E.u$V..._%..#N....Rv..I......y.h..K4._I.......K....<]...!{(..wN..#M.....+..z.$nO.@$......../.
                    ...=.8..Y...7...D..s.
..._...+?Z`.....iU.....q.ia.............b.x..s..FS...:8F..B.....>c....M........=.m........5V\....p.P.*.$w..... !..}..m...4.{K..3..A
}I..K..r.....ki.O=a..Z.a.....)..".C.6...K+.b..}.?.....w...q.A_.3S&R.%.hc......
..d.z....X...a......%.O.8np.......U..wK...e8.W.d..1^<..z.F|..J...E......e6Z..g#......&....Pp62....x.zY9.Xh...z...FIr.Ye.I.v.......N...j_.v.6..h.#.yf8>g.B...!O.(=......K.@.t.'..O8....q..5'
+..%.....E.!L1[=.!...Y.T#.4f.sd.@0..cn.AO._..*D..s6.)......Wn.......ny..<s.9.. .M..."`.....C.e..Ut9T....4u...].+.;.3V.W..:.....k..3 w.>.(..t.-.k........h4..=......;.E.....F5h.c..:.
.5...;j.c.c...J9...-O.d..V...q.\.g.+......F..x..-..4.).jx.h....V...f./...4.
                    ....s...1...S.fj....U....^.5UU.1..b..N...n!...4.m..8...F....jF&7y.......$............f2.KBX_...Np...N..N.g..6...L...h#.tn..^.......z..`Q......>......xp...5...)x..Vp...B...{.e.x..w.o
.`.z.".D..4hlHY.,.*...*n.h..".$.X.........O..d.Z.J.......ue".8.c..A...D....u.#2.Q..A.-?.Pq..|S....{.".luZ;H.."Z..v956.+..9G....B..              0...L.n.pGv.9..I.M.9.....Z....
..c{.<)I......'....DD|.z.
../1..s>...J@$..+.,
S......o.(..i..w.:W../....
.\:.s..Q.......R.....z*..hx[.2T...*....@.f*.....%....w.~.-..&.v<....L..'D.Q.yh.T....."..O..7da..B.....(...B..@..,5...'U.R..iZ..I......o....7.z-..q.#^<l.Y..Us9t!Q......M?F..ft...m...`.x.
_..)...I.dh.{.$.....,'zf*.....W..X..=...f7T.Z+.=0                   L$.......Z."E..0<..n\.z.....u..b.L.d.G.....q.........J                .oJ..|..NOIz...Gn....KL..,9..+..G......../..
..4.Pi...l9'.uA...r.X......0.......t........p.......6G...8..Z91....o......N>&..pm...)Xz..R.p.IF.Jn.....U`>{Yow.......S-
.p....*<.N.n.$(^.....a.*......g..2.e...au[.....@..Q..y*..7_.x.P...)I.\..n..D%G..v.
.......(.?....%.....A$4....0....._.R.he......|.8....?                   .16\*..9P...@......D.....>....8..fVW.a6Y.V..u........Qv..0.....s..(].L.]D.... ..@X/5.p!>r4."......|.?.a.c.J...-
D.W..G.I..w..e......k..F.}.......{Z".K
!.{....w..u..._.....1z.1.3...+...m.                 .........LO...     r.1\e..M..1Z8}...R..].oI .%...hW...\e..1-
.\^..a...a...`..~.U.[......K.....w...|..d....G.......U......=.~6..'@xN....d..r..+dB67G..MA.B.....tHKl|K..Mcn...Z.E..I.;>......L.VWv...&.m.W.pG4...kO..I..........a.;...c.
]....JW.."...C9....P.@..B.F...Z.v.{.....RU..|..r_.ZP.G...l......??....`'/.3......N..'j...rUG..4..;_.7...=..Zo.._............kG...2.x.&.|17..k........3......w?.d...".,G..P...X....V8....?.l
"$.............z.....}......~..s...gF..........F..d..MP.....e2.~........A....4.f{y..D..K..n$.^.F...Y.D...}L%>..=9.....2...IJ....N.u.1...2x........>Q..`....K...2NfV.....Po9#.Z..[....U0~...ly....%...
....                P.
```

n.....K.k..WB.....@,.A.{@..4.....~..0..P.gH.
O.N"5.z.}....9.3...P#. ..F.?@.T!:.....x.........#....^/...VIGL.....j3..M
MF.@.j....O.x.v.2.r..VRen-.T.....]..F..o....T.c)P.....
.B.}.....<19.? ?....D....'·v.....Od....P.....Q^...f.g..Q.4...
D.1v.
.1ce...-)..el.d.H}..4.....i.u,?g.....|6)..a.k..il.&..;..?.
.....?eqN.....^v. "y.7[f}.NC

...I...UUB..~U....[6x`.U.P.7..B.....iv.0..2..\@.. .....K.s@.c}...}.....I.)...r..qh
&.....n.K..@....('·..xz.s...Bm.5._..@..%.Kfj.`..7V....L..]....mH.9[...
.clh.....]>.A.....<.bI\.@.:..z.....V.....J.n....j....9).%.p..'..\g..z.G[.._$Q&,*.f.-
L..45$..n.f.c*..oV:.r.je..$..MQ.f.fC.....n.6...^..OchJ.R./)..$.....j...d..`0y.$.....<5...5...M....*F..). ..tg..C.
OB..Z!.....9....U...j..E ..0g*].c.c.2 ..@yx...R.XyR5..Sw.."..[.D..
..s.....5;.Hw.M.'#....8.
...f.
..N"5..t..A...#....|..D.....E.....o(.....m.9.....U3?....cj...n...\h^.+.l..g.{-a.z...w[..."...#....M@..X=.[../.....C...r..^.O.=....b1v.X9..eo.TS..
....hC.W....$..}T...JTs).-....lt.;f/.. `.>kX.&4z.<.$+..,....]...N].H..N!..daG.>.p.p.....*..SP
  ..%D.G...P[.....@.....7|A&...W.....;..z....M.Gm.6..f...,.E.....x...&.`...~..~..m. .J..1....%..i/.r.2.qo.\
..R6p.}....u..jc.6nB].F...G}v...*..m*=V>n|0../`..v..../J..1..]p*.p
.@&.Ff....4z.0(G.....h..g.N.9.....A>.....n..V....ltI.Hj....C.u.h0.....pZ.-R.R..... .T...#(....y.M`OD..Z2../o....5.....w`...
..n...d#K+...n....^..-D6v...Z..c.d....C...".`4ml$#O....+.R>..OK..@P...v;W...?../.,..,p..J.>.uhR
(...qS.G.....F.
`.!.....1F.7....Iy.....;..2O..._8f....n.PW..<.`.....gb.,...oV ^...LU.....Uq.H....$.=....q....`..+....].n. ..
P.W.:....%...B.Kr..?}}}.....k.B.....G..U.....s?1...?.K...<n-E z8>.
lg.....99.....%b.C.(.....,... .....0s!..c\4o."......c..J...8..b.I....(..g;.zl..`.-..9..u...u'.....<."..G.....&...|.....
.*=.....D..a...}*.?V/Z..|..G..;..... ../.Tj..*zM..@.w...W`^...f3.)U..{.)7.....x..j@..#..VP.....
          -J]E.q...k...j%AS.
"...J...w.}D....70..)u!.Cy JOh+....X"..,.I...'r9 F..W.....C."..J.j.....0.../.>.H....
...7r2.N5E.....-
'.'".c.!.!..g....!..Dp....L.I.....sP<.......D&.Bx>|>W^.{...e3..#N..$.GLLA.L..P.....{..4..."~Q..M.NR.....Nh.X..=...."......XP8.x.u..,$.....,.............~.1.X...[D.n.....tr.v....j..].....G..p0..
R.\.....n...m<:..W..}....nK@.P..d..Qf...u...?1..=_~.............yF..'2....hBa.{(.3..Q...0..F:.{C...),7.....8.x.....K...=G.....S".....?...U...bl.W.....W}..t.....XA.y..l...9.S...
..'....cv.....,.........B(. O...b..k.(-g.Lf. ..F.....%.'...p....g{E..h.1F..v....[.Soi...aN.|6.x
;P@.b. ...7.....4%.u~.Q:9on4..%.....|S=J.....U.....@.
..m...X.V...Bi.k.....].....N.s.I..3*%..8.0.I.I....O.....!"....."..|{.|.Z/D...'..IMK=_.V.I...O9?~.....x.n.D..S.....Ldn.@#.!.tL.k...Z.+..%.....
.....@..j...6&...M.....a.....8.....+Fr~..m.o].>...7.
...W.ZKQ.JJTw%.M4..KD,j.>b....\.....
.B.<.s_\....-.kv.<..T..].}y)Yu.....Rn.J...=y$"...w1fDqV.m..!.
.0..T#..t{y.....Uv/XU.'.....x.'1...0T.....M....P.'/.{.....f"....I.....&...fK.y.e.....W....Y.E1....v..0...s..9/0...'.....!.L.O.?.7..a.D...`44.C/...1.Co..<..l..8AC`.M.]...g{..],vZ".M.../.?~H.
.;~....|FA6.....[.f.....5.]y.....z..J.q*.'f..\.....I.....].9.9D.BJU.U.....,
...[.h._.T..Z.m[.....s.....+...{m...mIC..w.i.k.....]'.A.....n%..<._..6.....Os.#.o.g=.....,(.....{$..D.....I.3..Hy...(AL.2..c'.C.$..V..n.....k*.....?..%.(.T..q.....e...E.r."..=$X..A.
.....6.....U.....X..w,...
....).t..f.....`.0^.b....-.. \....v..-
8.I..n..J...k?..&.E.....G_.&..jJ..^H.w...n....)`(.%.q..)c\....f.....;..p.<...>.....v._.Z./@K.....KL.....X.....1.h....3..p49J.4.....[N.R..;..c.....`.q.9..%.r^C.B.8?".....1.l.8.~..
.. ..=#x.... Rt...!^.r.U.U..?.A...w.
.
j..yG8..N.J...T.qjp...'...7..<k...6.v@.....!p.....5.....
.{.S....$....a..$...GL..X...{3..H`"s.e.[..s..n....kJ.h.....g7U....&.Y.....zv~.....]...s(.9..G....u!.o...^Zxd...~6..F._\..:...q.....3.....@.(*T...t.....:...h.....,.n.... ....c.D.y2.j..y.
X..}+j..o.P....O..}.{Um...}..%F,...E...j...X0.nz.....}..3.Sx.....Q.....{...O...WD.S....RzV=....
....t6..>....\.%^e.;.....2)..2.7.[8..6g..F.....@.....7K.d...N#.ny.....!.a3Mz.^.....X.e..4Z.?{...s..L.4.W.....b*.....m.t>..+|.a..l.....a.;.P.i....f..I..WC....U
.5....t'..!.....v..G>p4FVo.'ZxcP.............OI.T....->....;.+..\].QY.0.ph.)^...H
G.nt...M.....#.;O.=
..=i...8..p.O....~i..!&.|.<q.2}N....<....&.....0.... .d....f....,U/p..`..A~.o.v....Np.[.I.*...c....g.y..2...f..8.n.....x_....$.9e.1:...0..T.......5w.
Tm.\.rp.g._.g.P...p..W..
C...>...v]J{N...BU`XVR.......u.nT1.....
..2.kd..d..b@.3...t..zB.(b....s.y..'.....6.e_..../.6kD....t.<.ck.-b.r...UT*2.....\..2u.=7r..J...#.c.....4x...l...&
...R..$m..w..c.I.....j2XM...=..0...1..Me....\O.`.........O12..22.Xib.../.<....!..u.....C....Nr....c.)._... I$..............a.....c6UAb.|....d...W (.[.....6.~
          ..s.._....Y.w..%..CV.....-1e..'.N.-.;{...]...~.F.............V.X.`.r.O....[...r.+.....e.[.J.R.....|?V6Sy..l...x..8.p..N..M.%..u.]M.g8P...'..U,:?.....
..
..R.q...$.L..LY.,.zCU....B..?.S.....^...,U..
.....h.'..$S...k...qt{.4 ..... ?.%r.G,.....C....`.....0.j..._z.A}..`.K
..r+.e...WB...U.....BC..GR...Gx.....1.&....6.3P.B.a1.r....}ttj.z...S. ...N.z..%oiH.....3...X..=Z.avp.
..v.....".Ai$Y.J.#.....~Mq.....C....R.J....QM.-V.=.L....g..`..u..C3=.4 ...J.....=9c....<.M..jCSDvO.9o..~b.9W.F....8..F.|#..0P.'HAC.Qt."..
..<...m>].j.|....T..8d.xv.{.....B.F....gH..#r....y.....6.....i....?.....w&..I#.....f.LYa..f...G:..B..>.....&...rK.}z....K..a.FB...Yh.N_....I...RnG|...=G...7..71...
.A...0o..I..#..
W... ...QD. ..+4.0a.s....F7.*S..k.....".....9.B.2.K.....m..N.3.;au.N....".."...wk.....k..."....L.A.P.d.
..p..X.I0E...2.....>m..WiA....<N. o6.....%:w.q.D..S'C1....cg.t..79...T8Uz4W.....T...^.4`3.H..&...4`..2uOo....r.....Y....v2.j>..
.....X .B..?.....4.9.}!^xi..IbE..!....`.....!.<G4.D...BQ.k..C.k'..^..De.pd.....$:.d.B..r/2A.....U.\.L.A....ne#.
J....L...g....oc..+..%v?"..-.4..A5..!.....P0.}..1X.t...r.Ln...
..{.9...&..{|....-._....^O..p.:XI4....(...k..
M....X.r,d.2.P.....V.zD._.....%rB]0x....2n.H
....c9...."...l4TY..D..N@..
~.....l(....eT..H..m..my'.\.....b.z<..1y}C.s...d{...Y6F3+D.}.5.1..hy...U.6...D4.h....\or..Z2N..A2N....x...{..j........"..6f...W.....T(. .X5R}...^..%.4.....3.....V....
...!.....[&....2.,..P....`...cc.1*_BlQ.....l.....'.ts....p....l.....7....2.J.m..y....3^.|.H...Q...m.=...y.3...."....d<^F$.#}.C.2n5.....a.N9.....*...)G.Y.....7X4..7R}Y.b...
...@.VU#.....@..='u..U...x?...C..l.l..I....B.1Pyc.$..4WY.....k.M..t.{.uJy.....
..3}..sT.d=-.#.]..."7
.
.'N.....[W.b._J"\.
...mh..$i;.T*.5D.'.n<.."........P.x...4.....l..vA.t.6..".~.E
...l.....=..o.8.&...c.l=..n.Kor.W./5jW{.....q..|...N.=..?...Ya.r.....u.....Cy.|.@.....!,,..z.....=e.Z...s....8....S...EV=tx.-....q*..^T...
          K.}FM."u....V.o...V0..+Y"...!C0.....u.....5(.....`..9W[.
..>..T.._.....b..;#$....R...d....?..|98..(Y..^jKQ...._....C.....S....L.P.../t F?
V.;<B....5.....q.QS+.nR;
Y3..l.a.m.Y*.:$.E".Zh..6..B.....u...Qo.("..\.`..PR.....V...R..`.....%..-....Q..S..5E2q....R.j@m...V.3rD..B...=Sf...5..k.1....P.].....4... .<.....Z....>.D..@[
..$oG.;...Z...>.U3...'z|.5.U$..(....y...T=eJ.fi..B..J.q.s.;.t....I.....X..."p.
&J....M.w.J...;...K.;.i....x..C._.%w8.\^....gq...e.....F.e._=.^..#".q>.....^.....H.2..wFl%s_. .o
          ...#.S.x..0../..+.Q7.....VC..2....q.C..OX."..]..>sFj.M....8....r..'..
..D....o.H....B.A.%.6q....[.$....v....AyN3.q...8.....s.d.....#..A..x.%H...$}..{w..*.8.S"B...jC...+.%...>..F.....Ag.T.....D&..@.#.....;/T...xm..M.n.as;[v...*W.....]3+x.o.S.....=..
.....37}....b....H...r...N$....g@..?..:....K..y..B..]:....AZ....1Q.c:...I..|.X.I. %..wX..&..Q^...Me...b."..;6=....r..... .K.
.....E`..1.u.ED.SLI.z..|.otjo`....m..Bg...,....RcD..3TB..f.....(.^8.juu{O.Y.....*....#9(7.....y..aa... ...l.;T... ..?.a.....1.:.B...H..R.+.uP=.n."......\.s.,..Z.6
)....S.....................w...7.fT,....
          .....{...a%.e.fY.v...p....!...O....L...m.P..[.F.....WX...N...T...9..I..W.....v.....I.d.....Z.c.Z.O.,t.8.MH'.%.../.....Sd`.....3....S...]2o...!.....28kN|.~h.....X..9.`.F..f.....K-
..V6....[.Fh./...,..O.`.G.F+....#.....Z.C...+...0F,...dI.3..!..t...:..."..6O....k3_b:.p~..0&}..3q.,..>..c.w4~...F.%q.z^'x..+H]m....i...gi.O-
.....{.....`..y.....j).....5..}.....@..cS}..U.....[.....I.8..N$.....6....vbQ.w.z.-.h.r.Q.....=.ID....."g ;.Q.%.....C..I(...IEp.n.5.k..W..R.i#M..\..~g..H>1d...a..R..&...8...L@
..}.;...M4.+..J.#..K..3..Q.....,....w4.....t..(._.{d....W.PyE+HR.`...w.... P..OFW.....8.aNG..Q.D....&.m..1...K~C.S`.N.....E.S.....6...N9377|..
          .7....e"e..k.K.....#.....d.yo.`dn).....p0(.....t..... \.....
iX..:._+...Z...5Ah..6.....".r...^.l.qhCf:.....i..G.4.4...E...#.....H....V.....=.g.48Xx..^chI>!....a..J...*.@..b-9.....s%.Y.."6.
...y%...)JS.]2[...zw...q`..n.$..c.....E.m..5...vN..6cg}.....4... ...Q!.ul(.#.f..
          ...D...N.....e..T<....Q.....*Z...)".R...u.....X.1.....k1.....k[.".@.%.T'.>.....e.W...K..e1.Hca..z.....m..q.. ...&.PG.....N..'.\.3O.....F.#.@L.
F..9.?...=.y.9.....T.K1.(
....A.....q.....U....}Lm*FQ.IF...m..

```
....*..g.BE....J..>..1p..P.,__..v.w...+=.....9O..S5...;.:|.N...(.5..g.#..x[c.z...d...I_5.....jT.(..|9
;'...6{.....Y..f.5..)..*....]%.v.,.....\n..k           }@.Ty8....o..)'...:,u.v.f...bJA..Pt
.!%.....@...|.y.H}....X;{.K..*..c[ae.S..]Y1...1..q..5....B. ..A.%
u3....5Q...b..}.:.........4b.ve.f...@.5...s.=#~...v.">.@G.=.....                  lG,.\.ih.$.X}.....t...ZM...b..*
.......H...x.(WgX....9q.Z.;8.L.6..z_3oM.....<UTN\....`....f..I'.....TB...I@.\.H...b..x^fFN....d[].(B...S....LL
.FN.pP<.....yNi..WV..8.,q5V..xG.....+[cMrDI....v....e.........a.$.07.....w.d.P.@...I...KX...P$2...XL.u...(EF..[.>(!..\.%.JS8J.(e.^..f...-..>s.&.....-y.vww.@{
.........gh.*'}.I....<.............3..aB_xN4x>..%s.pp5^..zc....>....h.*....6E..[>.D.,               q{.#1U.....h......Md7q?...$Hr.v..8.....<.R/
                ...........ZF.....<?^..d:..].~......[:z}=P....|.~...b..22.....1..E
....XA+...M..p[~..".x.zx..p...C|.....Q\.%...r.U...|L1x@...~..B..u9c.s.t7@FB....G.U.....,.....W.....V...g...w....Y..j.(.s...<..q.g~.J..Q....Do...L.|l...+E2.#Gr4.@....5.~...nH..c.I..52)
h...                .p.*z..&.......K#4.*..6....<.U..~.0...W.(a.....,.x1p.E.....K y.9..e>.1).'.'....s..........              ...Z.d....)~.......RQt.qD.q.....U..
.tJ...[.....!...3..;N?e.;.].@.....p1..~.e.6|.4.%\.1,[,:.........d.I.;tSe,.7........s:".]....1...*.w.*t.:..3LA..^L.r.@..7.:29....}..3.  ...r...nh.......]....'e.....ne.
.8....A.......N...tP.F.....I.r....
.{.'....#..n.w.+..1..8XAO...{....'e.p....0U.2.....,..........>..=...a.|.9.e..w..a..y "..7..|...Z..n.e.+..._
/I..C#E.-..&{.M..X.....:.....sy.....F...<^..#.\...?e.I........k6....
y..K.-A._".Z...X..3m..pJ...e..?...f.L."...c\.9....
.o.O.U..E....@.....b.f7...S...\.e..5.....A...F.
.....I.........J...?....                2...+...Z...W   <..X .
.........mI.j*......"X..{I$BV.......`....(F...kC8..k.-.,,.}a..-."=.@R.....
3.....i...?.Ac..g....i.....[...=.cz.B..7.....v....Pc.22..-F.
...&O9....q..6]....^&...m}.....L.`N....n.........u.....LC"e~.yO...]..G).u...A...x..?GQh.+.....7.XMf.
>..W..-1.Z..y}Fp.......P.o....R.RA.......90w^.S.(t....hC.J1<.....                .....G.......V.j.... ..^h...I..Wp...SX...._).............U..c.`..Q..z&.....L{.......A}...qv...oHIa..nm./.s...*.<
..u...$.....8....Um.D.!.U.W......^.BEt2.....1Nn.x.d.e..6\A.....y.J....Ih...+F..}....A..Fy.F3.../..8..%.."...<!..bL.x..k.UN..v...._..'...{hn..Xv."....H.wvi.....0o.f.u..W...W=.....^.V..4.I.N
!c....5N.y..l{.Ap;.3.~.P.i..i.....p.t.[.. ..%.gdTFv..l.\....3h$q.k.%Q.9.,U.......e.2....E...&... +..y.....0.
.;.8.7a.=.U..j..bjZ...)H.K...)'..G["..B.~.............i.
&.R16s..H.....|4.....SZg....8...../V.........Q...4..^9.B`...V.............S/j.......%.oLD...I.,'@.....pK....+.(.Gz.&'.6..a.....2...9.7.=>J.{.AO.....,.81...a
..R.Ux..6b...P....'M....3.L..U.........W.HW..........?R@.    ..  ..Z@.....n
...+.bHQ....|.6P...J.....+.I..........K..x....*H..]y.w....k...am..K..4....PBA0..
.........j.Sh.EIx..p.... ba(.I..O...G{.N/..xz?a^<<(..
.5?.D..`.4...{..Q...|%I...I.....4q.s..........mi.O0......PJ........J.../b.r..j..Hc...h                  S]..._..Q.>..x.O...S....P.....%.eT/D...1..h......PP.RMf....>DM...B..L.....(.....k..Zo..
```

SFTP komunikacija

```
SSH-2.0-OpenSSH_8.2p1 Ubuntu-4ubuntu0.5
SSH-2.0-WinSCP_release_5.21.2
......N..}9.{.........q...;curve448-sha512,curve25519-sha256,curve25519-sha256@libssh.org,ecdh-sha2-nistp256,ecdh-sha2-nistp384,ecdh-sha2-nistp521,diffie-
hellman-group-exchange-sha256,diffie-hellman-group-exchange-sha1,diffie-hellman-group14-sha256,diffie-hellman-group14-sha1,rsa2048-sha256,rsa1024-
sha1,diffie-hellman-group1-sha1,ext-info-c...{ssh-ed25519,ssh-ed448,ecdsa-sha2-nistp256,ecdsa-sha2-nistp384,ecdsa-sha2-nistp521,rsa-sha2-512,rsa-sha2-
256,ssh-rsa,ssh-dss....aes256-ctr,aes256-cbc,rijndael-cbc@lysator.liu.se,aes192-ctr,aes192-cbc,aes128-ctr,aes128-cbc,chacha20-
poly1305@openssh.com,blowfish-ctr,blowfish-cbc,3des-ctr,3des-cbc,arcfour256,arcfour128....aes256-ctr,aes256-cbc,rijndael-cbc@lysator.liu.se,aes192-ctr,aes192-
cbc,aes128-ctr,aes128-cbc,chacha20-poly1305@openssh.com,blowfish-ctr,blowfish-cbc,3des-ctr,3des-cbc,arcfour256,arcfour128....hmac-sha2-256,hmac-
sha1,hmac-sha1-96,hmac-md5,hmac-sha2-256-etm@openssh.com,hmac-sha1-etm@openssh.com,hmac-sha1-96-etm@openssh.com,hmac-md5-
etm@openssh.com....hmac-sha2-256,hmac-sha1,hmac-sha1-96,hmac-md5,hmac-sha2-256-etm@openssh.com,hmac-sha1-etm@openssh.com,hmac-sha1-96-
etm@openssh.com,hmac-md5-etm@openssh.com....none,zlib,zlib@openssh.com....none,zlib,zlib@openssh.com.....|.E..8e..B....
.:m.....q)...(.......curve25519-sha256,curve25519-sha256@libssh.org,ecdh-sha2-nistp256,ecdh-sha2-nistp384,ecdh-sha2-nistp521,diffie-hellman-group-exchange-
sha256,diffie-hellman-group16-sha512,diffie-hellman-group18-sha512,diffie-hellman-group14-sha256...Arsa-sha2-512,rsa-sha2-256,ssh-rsa,ecdsa-sha2-
nistp256,ssh-ed25519...lchacha20-poly1305@openssh.com,aes128-ctr,aes192-ctr,aes256-ctr,aes128-gcm@openssh.com,aes256-
gcm@openssh.com...lchacha20-poly1305@openssh.com,aes128-ctr,aes192-ctr,aes256-ctr,aes128-gcm@openssh.com,aes256-gcm@openssh.com....umac-64-
etm@openssh.com,umac-128-etm@openssh.com,hmac-sha2-256-etm@openssh.com,hmac-sha2-512-etm@openssh.com,hmac-sha1-etm@openssh.com,umac-
64@openssh.com,umac-128@openssh.com,hmac-sha2-256,hmac-sha2-512,hmac-sha1....umac-64-etm@openssh.com,umac-128-etm@openssh.com,hmac-sha2-
256-etm@openssh.com,hmac-sha2-512-etm@openssh.com,hmac-sha1-etm@openssh.com,umac-64@openssh.com,umac-128@openssh.com,hmac-sha2-
256,hmac-sha2-512,hmac-sha1....none,zlib@openssh.com....none,zlib@openssh.com.....,.... ..|..*u...E..Wr.....T...g..Q...k.....3....ssh-ed25519...
z.53,.c.aJ.....v.V/..L...q.t..... .6.....G-v.Fa.g..!.r.=K:h.=.....S....ssh-ed25519...@....$(.M..mB^...[.....I.....N....d.#}R....z..K...../N6.c.....
.....jg.....;.K....Q..?.~.(B}m.4...Vm.....B?."e.T
.~..q{]r...%.....R....d....<.e.XF.p.....=|.L..k..O
..0.j...;.....b.y.1.'..k           B....m.].v@W.|....{..K..Lf..G..;QF...4...oVb..U,.h....5..Q|.....;.P)..n.{..
...A.6.W./.-..W.....;....]4.7...4...=.o...J.L....
.....=6.m.....bW.....#b..}..D...;...k.~.V%"...4..@.h.cG.....M*.F.0....B=*g.[.....9..h&..7..qh..  .....m0d<(..0.M.....se?5u....7.....}..[.<..R..{...2#..R.....N.        ..
....u.}.G.C....+;...E..K.=.y.....aG..@.q+....#.]D.KQ..!.6..D....q...e.....%.J.....1[....I.........A..l.aHy9`Z....z..
...W.m.Q..@a ...M.....C....3.L..A.K...\.....~.<.:.[k...*.DO..z.[Q.3...
'..mX.............P\.....`.L9.....]X...%Xa.Y.....Ia>..^.^y?.....@..S&.....f.....;5T5\.>..Sr%...../.o..PK{#.....!0...p%.].7.............+...qY...H.-....
                FC,..m9E.........Rz/!....Z....\..4/..[.......G..>E.L.N#....V.o7Rg.........v.....h..9<.\t..0.......1`.r.OQP.#.!&..\.rd0..{.(...Fr..._=.!.....hvKt}.t.r..$9..b**....v..A..91._...t8
..N...MR.....x.+.....\.p.V.T..w....B.7.HP..@..........0...'..B2...9.d.<..{[..
.:ab...j+.....3.=.w.2h...rN.Q.....y..\'.2...D.(..S.e.J[xL..q.Z..d..s.....x.jVY...Y...e-ts.5.a
                ..[y.=.WNh.!IO....#..q5.....!.k.....1.........H..u.=MrB.H:...,.....l.r.=....k2..../eD..t..h...PV_b.....:..U`..o@...3)....b
.$..w.........^t.L..`.....E.-.d!.]]Q.O.....".[.v..k..l..S._Q..5.kX?B..f....q^.e.....6O.].FH..q.l...b.9.....[.      OX...VAy.....p:..}..x.%=gv/[.8..o.... ...BnJ....o...c.B....F1m..y8d.9
..l+..i.....t.q..i`s
..7w.....Q..6.f.A.............[.)....FS.@/]...TC...w0..52T|..?Ef.o..
..*JbE.;{y.EVMcx.~...#..H)....nN2t.R....he.....d.                .....]2.h..R
.....
_gTZ.v#..A...0..O.::_./|.e....K..                  .x'....._X.|(8F...O.............V.........t/...).tk...3,...g4.D1.....1E.........7...6T.........>G M. ....!...S...^...lLM.........n/.....
(....6...K.....s...(Z..E.....U..9...1..w\hfQ.0...p+Jp...:M:..F9..#F.!~ ......"p..m.E.|...~....#.<f)I..k.z...M.....1]/.>....z.....8.PEc.L...TF.....z..e.....[E.r....N.Q..I....$
..P...BA..Y.[.D....*
F.^\..@..../3..=....1-..D,...!p.zy.....P.?1TZ.~zMQ...X.|.h*_.P.H..aO{..UJ.&y.~......E[9.r...._M.0....z...N.3.H1....O:'.Z.\.#.E...-
....sOQ...".._...~.Q~6~..8..............#o.<_.K..`.....i=.%,....j.....(p,X..u..+I....p...2.-..JK3...T.~..Qq&...@..
...4w...t/..d.Wl.......@..X.|.....3.|.....m....X.....!..\..T.}..ocvG...n%.....P.......EM.eJ1..=.*.....].....V..~.#...P._.a8%c...dyKy.Z...,g...I....8.aO..
=..r.....|.....i..-a..{:....$t!.$...J."D..Q..C....)wB.Y....              .A,.m]M...N.P=. *..9.^....?QV1..vI.u..8..K.$.........$..c.d1.h*7.....4...l{.iE.W.....K.W.d..6....Y
B..."/x~@.5...j...fn.....~.t...y.#.........E.\..}.....%....pf.%>...T.x.LY8.@51.=.u.....~....1.........
.~.'....M.;6.U.::..Kc...G...8f.Y..w.KJ.....sa.y:....oC!B...|..'...b.:.DG..    q.8.....
.=....n|D.1..H.....q.().,...C.Za...XN.....i.8...H...T..9.....Hq...3.-.?3..(Ypi...^...u...}....@B.NN+.....l,\.AO.........
..}co...#+..J...&.k.H....vni...B...!i}..O(V.pal.'9g..G...J<.............."T...q.`.=....[;h...(n&.....rd8y../.`...6.........5f*..][0..n.$t..pH...vY
.--
..*@N0r..8.U.j..>...I..'..V..3G.n..a....|\P.;.....&.>.?y.B.....v.....Z<...E..E.S....7)4.....K<2.....7..9.....!.I.'.I.....]...gb.AT...V..9Q1..W...q...?,.......(..Tf..<....;....W<$<#.&....).V3.
T*...........z~s."..G&...Q..N.D,.X9...}.....
F~.....^..e..U...Z..?M..c[..c(....#oo.....V..A./...G.r.........W.n..6[..;i.2.....G....TL.6/..Z..%`B.....n...z;..g.b.....zSUw..)..e...r..A..(#.L...Y#.6...w."..q.c.c..\..
w,.V.sh9...Z[...P.........T{_L...9e.{D|
.?.....C'.\..j.!7.8.p<...}....'J..8.8;..&.x]`..Xj...q.'jH.......uXu.........(.J._1..P....~F.w.......W..A.....c....<...Y...v.c..O.M.5..s7.,....f...........d_A?y..}._R+..S./A.#..cX+../...
                .....?r..[..}....}h:.V.Z.}.............. uM.@.My...  ...&.e..j$...M.
........,9...        .Ka.~...S#Yg.....9...r...T...D}.....W...4.........Rju..i..x.sUg.(....4...FV..X.S0aM%..1L.....F.eme.y..S).
                .E}/r..6..;L."M.(.}.2....B.i..~.LV.3l@|.U.....@^R....8..Bu.t....p.|.`G.~.....s.d'..#R..u@!2.C..i.^..7.!P.........@..R.3..nl...H...v.Z79kj`5...SY.5{.B.)..7.......J.N.)t..za]
Ug..?.*N../>`~c..a.....aJ..t.<G. #%
.H..0)..A...-W.....(.X.:D<>..kEx...2.n&%...A&d....F.7...n.qEKB4...$8o.....1....g."Y.O...u.              9H]_.....;.7.n.n.t#e|1..i.....>.Tks.>.[.......4...:...Z. ..e}|.J
..*.IDR....W..Md.$..d=..4e.(..H....,2.........Y..,W!O.OE.....1S.?S.{..+7...._..,\O..(...6~...WM.....V..i|.@...F.K
.m.Q..I...w.....o..@...4Z....^.~../.(C.C.A..4b.N.....5.@.......5uv:.........B...."28./z...b$.A.YkLZ;tiR;F[s..  c..Td
x3&5.Id.....[...7.J...D..(.a6..r.@.w...eiA.....9c..`8.F:8...~....%-I.).....f....W.1.....OD^.W..<.
;,(.....Z.ZZJ`........8A3s....u
..c..%.....WbC.0....f.....#.).Gj'."....s....v.........SGO..=..u.qw....N..V9..+...U|.j....a.(.^g....l#n.....h..!.............]..Q.>\!..2C.M$..%l{'..2..fu.n..a..=\7ET.v[9..  .v.............m...5..
```

```
.2\,...u...>.p.Gs...~..^.P.j...0^t.....&.0.I.v....\..~!...S=cN2.W...pji..K.i...!.G..W.dQ/n.*..b.O.j.....f.h`6..D._....cW.f.....F%...@mg.....~...6....  .7.rs.....E.I.fW..j
.....%F..W.NJ..7.y...F..}..ua).....a..n.TD....-o.z.H.....B.a.<.....  ...,....=..;%..U..m..=.
.-!bt.5.....H...#ySrLe.Q.....W4...^?.
.....UC..'..;&;..vS.~....".&{.....r.U.....).A._....0.(...f.....\~uf... ...........D.?
..q.C".....|.`..'R"..\.....A..e..|.s}....?...V.l:.1.u._.".2...p....g..$.P...R.A.....
.k.`5(.?):....._.....o..u...L...A.....2.`.....=|..w.g./.P..{.b:.<..K.....u.....-..1..0p.2~..?C...8j}e4a.I[.-
NL.P....rS.U.F...c'.....,..8..I18.*?.oS/...3....a..?.1.....>2.Tud..Q.....7..a=...1./
...  p...yX
...|..N.{6\k.)c.mr:..`|.y..g6.7.....9.C.X..@.\y.O V..y@p#.6(
......h.
1.w.8Xs....+.x...#y.....8#...u.....OQNRR.c.i.....2..\O.S..)..%..  .....\..x6.....".Fk...W._gx\B...d....B.7ow<r.#2a..{....i;....4...^..k.....Nj..[H.Z....e.]F,ph.....EE'.
..4.H..z(X....+7p.$gs..s~._N
.....2.u..  .u-
.....2S.o...]..E.&.1...0.....@.E....  t.y{....J...I..7.....{.{....q.....g..`./CS..u..N.'.=..XF..(..S....A.....[B.
..g.....W../?....._Hr.**.....F0...'}..b.[...L...  P..8eC..*.&. .|0...6La.....  ..O..`_Cl.g.4.bL...~lpy.j....k".@Q....T.j...N;.....c....k...g."..}.p O
.....fhz.^]...M...g...=..K..}.W.....d.F.4....Y.`..b..]}...<b.Q' .o...?U.R._).R.9u%D..n..=...*...5vq..V.....!=..
```

Dodatak 2

U ovom dijelu prikazana je cijela snimka komunikacije na mreži zaštičenoj Uncomplicated Firewallom korištenjem Telnet protokola. Kako snimka komunikacije ne bi zauzimala više stranica, snimka će imati smanjenu veličinu slova.

```
..... .....'.............. ..#..'..#.................P..... .....'.............. .38400,38400....'.......XTERM..........!.........!Ubuntu 20.04.4 LTS
vpc1 login: vvppcc11

Password: vpc123

Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.4.0-125-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Thu  8 Sep 11:08:26 UTC 2022

  System load:  0.0               Processes:              102
  Usage of /:   26.4% of 18.78GB   Users logged in:        1
  Memory usage: 10%               IPv4 address for enp0s3: 10.20.10.5
  Swap usage:   0%


18 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your Internet connection or proxy settings


Last login: Thu Sep  8 11:07:27 UTC 2022 on pts/0
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ ""WWeecc...[K...[K...[K...[Keecchhoo...[K...[K...[K...[K.........eecchhoo WW""...[K...[K""WWee ccaann sseeee tthhaatt
TTeellnneett rr...[Kccoonnnneeccttss ttoo tthhee vvppcc11 rreeggaarrddlleessss ooff ffiirr
.eewwaalllll oonn tthhee rroouutteerr""

We can see that Telnet connects to the vpc1 regardless of firewall on the router
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ ccaatt                    .
.bash_history           .profile
.bash_logout            script.sh
.bashrc                 .ssh/
.cache/                 .sudo_as_admin_successful
Files-sending.txt       TelnetData.txt
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ cat TTee;;...[Kll      netData.txt

[
  {
    dex_number: 1,
    pokemon_name: Bulbasaur,
    types: [{ type_id: 628920910747fb84fa421611 }, {type_id: 6289212e0747fb84fa421614}],
    colours: [{ colour_id: 628a03d8ae7dd8dd4a5b5c7c }, { colour_id: 628a03a3ae7dd8dd4a5b5c79 }],
    stage: 1,
    evolution_method: 62b1702d1500f67735a6f2b2,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: A strange seed was planted on its back at birth. The plant sprouts and grows with this POK..MON.,
    base_stat_total: 318
  },
  {
    dex_number: 2,
    pokemon_name: Ivysaur,
    types: [{type_id: 628920910747fb84fa421611 }, {type_id: 6289212e0747fb84fa421614}],
    colours: [{ colour_id: 628a03d8ae7dd8dd4a5b5c7c }, { colour_id: 628a03c8ae7dd8dd4a5b5c7a }],
    stage: 2,
    evolution_method: 628a0639ae7dd8dd4a5b5c96,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: When the bulb on its back grows large, it appears to lose the ability to stand on its hind legs.,
    base_stat_total: 405
  },
  {
    dex_number: 3,
    pokemon_name: Venusaur,
    types: [{ type_id: 628920910747fb84fa421611 }, {type_id: 6289212e0747fb84fa421614}],
```

```
    colours: [{ colour_id: 628a03d8ae7dd8dd4a5b5c7c }, { colour_id: 628a03c8ae7dd8dd4a5b5c7a }],
    stage: 3,
    evolution_method: 628a0639ae7dd8dd4a5b5c96,
    form: 628a0589ae7dd8dd4a5b5c92,
    dex_entry: The plant blooms when it is absorbing solar energy. It stays on the move to seek sunlight.,
    base_stat_total: 525
  },
  {
    pokemon_name: Charmander,
    types: [{ type_id: 62891fce0747fb84fa42160d }],
    colours: [{ colour_id: 628a0424ae7dd8dd4a5b5c84 }, { colour_id: 628a03d0ae7dd8dd4a5b5c7b }],
    dex_entry: Obviously prefers hot places. When it rains, steam is said to spout from the tip of its tail.,
    evolution_method: 62b1702d1500f67735a6f2b2,
    form: 628a0589ae7dd8dd4a5b5c92,
    stage: 1,
    base_stat_total: 309,
    dex_number: 4
  },
.]0;vpc1@vpc1: ~.vpc1@vpc1:~$ eexxiitt

logout
```

Sažetak

Svrha ovog završnog rada jest prikaz pokretanja mreže računala i analiza zaštićenosti mreže korištenjem različitih metoda zaštite. U radu su prikazani alati i naredbe potrebni za pokretanje virtualne mreže računala, informacije koje se mogu prikupiti prilikom praćenja prometa na računalnoj mreži i načini zaustavljanja praćenja prometa na mreži.

Ključne riječi: Računalna mreža, sigurnost računalne mreže, zaštita računalne mreže, virtualna mreža računala, praćenje prometa na mreži

Abstract

The point of this final thesis is to show the process of creating a computer network and analisys of it's protection when using different methods of protection. This thesis shows tools and commands needed for virtual computer network creation, information which can be extracted when tracking traffic on a certain computer network and ways of perventing data traffic tracking on a computer network.

Keywords: Computer network, computer network security, protecting a computer network, virtual computer network, tracking network traffic