Vysoké Učení Technické v Brně

Fakulta informačních technologií

Documentation for IPK - Project 2

Packet sniffer Implementation

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Contents

1 Preface

Documentation for packet sniffer implemented in C++ language with libraries for manipulating with packets, for neccessary header structures such as ethernet header, ip header tcp header etc., namely **pcap.h, netinet/ip.h, netinet/ip6.h, netinet/tcp.h** etc.. Programme is sniffing packets using IPv4/IPv6 and UDP/TCP protocol on various ports.

2 Theory

Transport layer

Is 4th layer which transports application-layer messages between application endpoints using TCP and UDP protocols(in the internet). It breaks application messages into segments i.e. packets and sends them into internet layer where the recieving side reassembles them and passes to application layer.

Packet

Packet is an unit that carries data over network, it represents the smallest amount of data that can be transferred over a network at once. It contains control information(source destination addresses, error detection and correction etc.) and the data it is carrying. User data are encapsulated between header and trailer where control information are carried.

TCP

It is connection-oriented protocol in which the connection between client and server is established before any data is sent. TCP uses three way handshake for better error detection and reliability but adds on latency. The minimum size of header is 20 bytes and maximum 60 bytes where main segments used in this project where *source port* and *destination port*, each of them takes 16 bits.

UDP

UDP is another transport layer protocol but is unreliable and connectionless unlike TCP. It does not use three way handshake because there is no need to establish connection before data transfer. Using UDP performance is heigher it does not check for errors, drops delayed packets and hase better latency than TCP. It is highly used in pc gaming or video communication. UDP header has fixed length to 8 bytes and contains neccessary information for this project such as *source port* and *destination port* with same 16 bits length as TCP.

3 Implementation

Sniffer is implemented in one file ipk-sniffer, whole program is divided into few functions and main function. Compilation and how to run the sniffer is

3.1 Main

First part of main function is for parsing given arguments using check_args function.If interface was not given as argument all interfaces are printed in loop. If program got interface (or other optional arguments such as port, tcp, etc.) Firstly opens given interface for sniffing using pcap _open _live, on success compile given filter composed from given program arguments - tcp, udp, port. If compiled successfuly filter is applied on interface handler. For actual sniffing pcap _loop function is used with arguments interface handler, number of packets to be sniffed (stored int argument structure), callback function (documented below). There is no time limit in which packet has to be sniffed, because if user wants to sniffed eg. 2 packets program will run until 2 packets are sniffed. After wanted number of packets is sniffed programme closes interface handler and frees allocated memory. Otherwise if interface where tcp/udp packets could be sniffed were given sniffer will run infinitely until interuption (eg.: with CTRL+C).

3.2 CHECK _ARGS

Verify arguments given to program using getopt, in case of -p (port filter) convert port number into integer and checks its correct value which has to be between 0 and 65535.
CREATE _FILTER Creates a string filter using tcp, udp, port number from values given as programme arguments eg.: "port 80", "tcp", "udp port 5353" etc. Because programme is sniffing only tcp or udp packets filter "tcp udp" is same as none.

3.3 CALLBACK

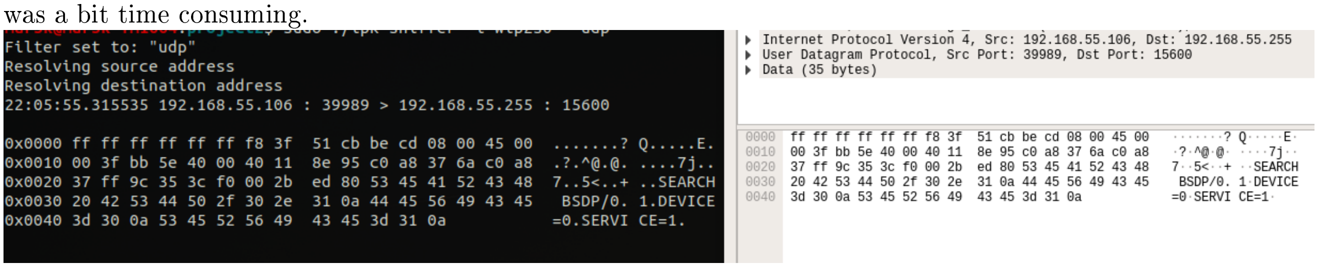
Function passed into pcaploop called for every packet sniffed. Is responsible for parsing packet to get necessary information such as: time, protocol of packet, source and destination ports and ip addresses; resolving ip addresses into names and printing these information and whole packet on standard output.

4 Testing

For testing purpose **Wireshark** application was used. Sniffer was tested only manually, filters number of packets etc., no automated testing was involved, for different configuration. Output of implemented ipk-sniffer was compared with the same packet in Wireshark for same time, source and destination ports and addresses length and data of packet.

4.1 Basic filter testing

This involved testing differen configuration of filter i.e. combination of **tcp, udp** and **port number**. Also manually added in code filter for IPv6 but IPv6 address did not occure that often in ethernet traffic so that was a bit time consuming.



4.2 Name resolving with cache

When resolving FQDN from ip address using *getaddrinfo()* and *getnameinfo()* additional packets are sent. This fact with combination of more packet sniffing e.g.: argument -n 10 can result into repeatedly sniffing only these packet for name resolving.
Examples are run with ***-n 20*** configuration

- **without cache**

10…	2020-05-02 22:19:39.5140019…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0x973c PTR 101.55
10…	2020-05-02 22:19:39.5318101…	192.168.55.1	192.168.55.101	DNS	147	Standard query response 0x973c N
10…	2020-05-02 22:19:39.5319949…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0x973c PTR 101.55
10…	2020-05-02 22:19:39.5373011…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0x973c N
10…	2020-05-02 22:19:39.5383296…	192.168.55.101	192.168.55.1	DNS	97	Standard query 0x871b PTR 7.113.
10…	2020-05-02 22:19:40.3411516…	192.168.55.101	192.168.55.1	DNS	97	Standard query 0x871b PTR 7.113.
10…	2020-05-02 22:19:40.3521483…	192.168.55.1	192.168.55.101	DNS	157	Standard query response 0x871b N
10…	2020-05-02 22:19:40.3521694…	192.168.55.1	192.168.55.101	DNS	97	Standard query response 0x871b N
10…	2020-05-02 22:19:40.3522654…	192.168.55.101	192.168.55.1	DNS	86	Standard query 0x871b PTR 7.113.
10…	2020-05-02 22:19:40.3531691…	192.168.55.101	192.168.55.1	DNS	97	Standard query 0xc993 PTR 7.113.
10…	2020-05-02 22:19:40.3567809…	192.168.55.1	192.168.55.101	DNS	86	Standard query response 0x871b N
10…	2020-05-02 22:19:40.3567978…	192.168.55.101	192.168.55.1	ICMP	114	Destination unreachable (Port un
10…	2020-05-02 22:19:40.3600256…	192.168.55.1	192.168.55.101	DNS	97	Standard query response 0xc993 N
10…	2020-05-02 22:19:40.3601365…	192.168.55.101	192.168.55.1	DNS	86	Standard query 0xc993 PTR 7.113.
10…	2020-05-02 22:19:40.3665340…	192.168.55.1	192.168.55.101	DNS	86	Standard query response 0xc993 N
10…	2020-05-02 22:19:40.3673009…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0x60b6 PTR 101.55
10…	2020-05-02 22:19:40.3864536…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0x60b6 N
10…	2020-05-02 22:19:40.3866987…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0x60b6 PTR 101.55
10…	2020-05-02 22:19:40.3899677…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0x60b6 N
10…	2020-05-02 22:19:40.5370740…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0x9409 PTR 101.55
10…	2020-05-02 22:19:40.6677574…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0x9409 N
10…	2020-05-02 22:19:40.6679112…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0x9409 PTR 101.55
10…	2020-05-02 22:19:40.6793950…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0x9409 N
10…	2020-05-02 22:19:40.6799056…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0xf26c PTR 1.55.1
10…	2020-05-02 22:19:40.7015813…	192.168.55.1	192.168.55.101	DNS	145	Standard query response 0xf26c N
10…	2020-05-02 22:19:40.7016886…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0xf26c PTR 1.55.1
10…	2020-05-02 22:19:40.7062139…	192.168.55.1	192.168.55.101	DNS	85	Standard query response 0xf26c N
10…	2020-05-02 22:19:40.7071959…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0x3765 PTR 1.55.1
10…	2020-05-02 22:19:40.7117076…	192.168.55.1	192.168.55.101	DNS	96	Standard query response 0x3765 N
10…	2020-05-02 22:19:40.7119042…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0x3765 PTR 1.55.1
10…	2020-05-02 22:19:40.7167133…	192.168.55.1	192.168.55.101	DNS	85	Standard query response 0x3765 N
10…	2020-05-02 22:19:40.7171288…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0xdeab PTR 101.55
10…	2020-05-02 22:19:40.7226164…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0xdeab N
10…	2020-05-02 22:19:40.7227616…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0xdeab PTR 101.55
10…	2020-05-02 22:19:40.7272998…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0xdeab N
10…	2020-05-02 22:19:40.7278548…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0xf502 PTR 101.55
10…	2020-05-02 22:19:40.7371392…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0xf502 N
10…	2020-05-02 22:19:40.7372510…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0xf502 PTR 101.55
10…	2020-05-02 22:19:40.7422759…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0xf502 N
10…	2020-05-02 22:19:40.7429984…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0xf458 PTR 1.55.1
10…	2020-05-02 22:19:40.7475254…	192.168.55.1	192.168.55.101	DNS	96	Standard query response 0xf458 N
10…	2020-05-02 22:19:40.7477405…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0xf458 PTR 1.55.1
10…	2020-05-02 22:19:40.7515337…	192.168.55.1	192.168.55.101	DNS	85	Standard query response 0xf458 N
10…	2020-05-02 22:19:40.7525163…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0xc726 PTR 1.55.1
10…	2020-05-02 22:19:40.7593920…	192.168.55.1	192.168.55.101	DNS	96	Standard query response 0xc726 N
10…	2020-05-02 22:19:40.7597689…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0xc726 PTR 1.55.1
10…	2020-05-02 22:19:40.7646906…	192.168.55.1	192.168.55.101	DNS	85	Standard query response 0xc726 N
10…	2020-05-02 22:19:40.7660800…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0xfd59 PTR 101.55
10…	2020-05-02 22:19:40.7702210…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0xfd59 N
10…	2020-05-02 22:19:40.7705471…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0xfd59 PTR 101.55
10…	2020-05-02 22:19:40.7751876…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0xfd59 N
10…	2020-05-02 22:19:40.7772421…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0x36a5 PTR 101.55
10…	2020-05-02 22:19:40.7809183…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0x36a5 N
10…	2020-05-02 22:19:40.7812733…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0x36a5 PTR 101.55
10…	2020-05-02 22:19:40.7855517…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0x36a5 N
10…	2020-05-02 22:19:40.7871985…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0x3abc PTR 1.55.1
10…	2020-05-02 22:19:40.7916013…	192.168.55.1	192.168.55.101	DNS	96	Standard query response 0x3abc N
10…	2020-05-02 22:19:40.7920301…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0x3abc PTR 1.55.1

- **using cache**

11…	2020-05-02 22:22:47.0306554…	192.168.55.1	192.168.55.101	DNS	142	Standard query response 0x7864 P
11…	2020-05-02 22:22:47.0311667…	192.168.55.101	192.168.55.1	DNS	98	Standard query 0xb0a6 PTR 101.55
11…	2020-05-02 22:22:47.0389344…	192.168.55.1	192.168.55.101	DNS	98	Standard query response 0xb0a6 N
11…	2020-05-02 22:22:47.0390677…	192.168.55.101	192.168.55.1	DNS	87	Standard query 0xb0a6 PTR 101.55
11…	2020-05-02 22:22:47.0415917…	192.168.55.1	192.168.55.101	DNS	87	Standard query response 0xb0a6 N
11…	2020-05-02 22:22:47.6780748…	192.168.55.101	192.168.55.1	DNS	86	Standard query 0x9d08 A live.git
11…	2020-05-02 22:22:47.9928247…	192.168.55.101	192.168.55.1	DNS	96	Standard query 0xd447 PTR 1.55.1
11…	2020-05-02 22:22:48.0087703…	192.168.55.1	192.168.55.101	DNS	102	Standard query response 0x9d08 A
11…	2020-05-02 22:22:48.0087895…	192.168.55.1	192.168.55.101	DNS	96	Standard query response 0xd447 N
11…	2020-05-02 22:22:48.0089786…	192.168.55.101	192.168.55.1	DNS	85	Standard query 0xd447 PTR 1.55.1
11…	2020-05-02 22:22:48.0090875…	192.168.55.101	140.82.113.25	TCP	74	47514 → 443 [SYN] Seq=0 Win=6424
11…	2020-05-02 22:22:48.0125807…	192.168.55.1	192.168.55.101	DNS	85	Standard query response 0xd447 N

5 References

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