



VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

Fakulta informačních technologií

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IPK Projekt 2 Dokumentácia

Varianta ZETA- Sniffer paketov

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1 Úvod do problematiky

1.1 Packet sniffer

Analyzátor paketov, tiež známy ako paketový sniffer, je počítačový program pomocou ktorého je možné zachytávať a zaznamenávať komunikáciu v počítačovej sieti alebo v jej časti. V okamihu, keď dátové prúdy tečú cez sieť, tak analyzátor paketov zachytáva každý paket. Ten je potom v prípade potreby dekodovaný na surové dáta paketu, ktoré ukazujú hodnoty rôznych polí v pakete. Ďalej je analyzovaný jeho obsah na základe príslušnej RFC prípadne inej špecifikácie. [1].

1.2 TCP

Transmission Control Protocol (TCP) je najpoužívanejším protokolom transportnej vrstvy v sade protokolov TCP/IP používaných v sieti Internet. Špecifikovaný bol v RFC 793. Použitím TCP môžu aplikácie na počítačoch prepojených do siete vytvoriť medzi sebou spojenie, cez ktoré môžu obojsmerne prenášať dáta. Protokol garantuje spoľahlivé doručovanie a doručovanie v správnom poradí. TCP tiež umožňuje rozlišovať a rozdeľovať dáta pre viac aplikácií (napr. webový server a emailový server) bežiacich na jednom počítači. [2]

Obrázek 1: TCP paket

Bity	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	zdrojový port																cílový port															
32																	pořadové číslo															
64																	potvrzovací číslo															
96	offset dat				rezervováno				příznaky				okénko																			
128	kontrolní součet																Urgent Pointer															
160	volby (volitelné)																															
192	volby (pokračování)																								výplň (do 32)							
224	data																															

[2]

1.3 UDP

UDP protokol je protokol transportnej vrstvy orientovaný na správy a bol uvedený v RFC 768. V sade protokolov Internetu poskytuje UDP veľmi jednoduché rozhranie medzi sieťovou vrstvou pod a aplikačnou vrstvou nad. UDP neposkytuje žiadne záruky doručenia a odesielateľ UDP vrstva si u raz už odoslaných správ neudržiava žiadny stav. UDP iba pridáva kontrolné súčty a schopnosť roztriediť UDP pakety medzi viac aplikácií bežiacich na jednom počítači. [3]

Obrázek 2: UDP paket

+	bity 0 - 15	16 - 31
0	zdrojový port	cílový port
32	délka	kontrolní součet
64	data	

[3]

2 Implementácia

2.1 Jazyk implementácie a použité nástroje

Pre implementáciu som zvolil jazyk C s použitím doporučenej knižnice libpcap a deklaráci štruktúr a konštánt v hlavičkových súboroch netinet GNU C Library ktoré boli využité pri parsovaní paketu.

2.2 Podporované protokoly

Packet sniffer bol implementovaný v "obmedzenej" verzii z hľadiska podpory jednotlivých sieťových protokolov tj. z hľadiska transportnej vrstvy sú podporované protokoly TCP a UDP a z hľadiska sieťovej vrstvy protokol IP (IPv4 a IPv6) a z hľadiska linkovej vrstvy Ethernet + Linux cooked header.

2.3 Odchytyvanie paketov

Pakety sú odchytyvané v režii knižnice pcap kde po otvorení zariadenia na ktorom sa má ochytávať (zadané v argumentoch) je spustený pcap_loop ktorý zabezpečí zachytenie zadaného počtu paketov a zavolanie callback funkcie pre každý takto zachytený paket kde je následne prevádzané jeho spracovanie (tj. parsovanie a výpis obsahu).

2.4 Filtrovanie paketov

Filtrovanie packetov na základe protokolu a portu je zabezpečené tak že sa podľa argumentov programu zostaví textový reťazec reprezentujúci tento filter podľa syntaxe pcap, následne sa skompiluje (pcap_compile) a je aplikovaný použitím pcap_setfilter nad daným zariadením.

2.5 Výpis paketu

Mimo záväzných prvkov výpisu špecifikovaných v zadaní som výpisom porovnával s výpisom toolu tcpdump. Výpis paketu má nasledujúci formát:

```
ČAS SOURCE_IP: SOURCE_PORT > DEST_IP:DEST_PORT
```

```
    počet_vypísaných_bajtov:  výpis_bajtov_hexa výpis_bajtov_ASCII
```

Výpis bajtov hexa je vypisovaný po bajtoch oddelených medzerou a obsahuje výpis obsahu celého paketu. V ASCII výpise sú netlačiteľné znaky nahradené zankom '.' pričom o tlačiteľnosti jednotlivých znakov sa rozhoduje na základe funkcie isprint.

2.6 Správanie v prípade chýb

V prípade že nastane chyba - (tj. napríklad chyba požadovaný argument, nepodarilo sa otvoriť zariadenie na ktorom sa majú zachytávať pakety) program vypíše na stderr informácie o chybe ktorá nastala a následne sa ukončí s nenulovým návratovým kódom. V prípade že sa jednalo o chýbajúci argument o rozhraní alebo zlyhalo otvorenie zariadenia, sú vypísané dostupné rozhrania. Vyhľadanie dostupných zariadení je realizované funkciou pcap_find_all_devs().

3 Testovanie

Program bol testovaný porovnaním príslušných častí výstupu s toolom tcpdump. Testované boli kombinácie odchytyvanie paketov na rôznych rozhraniach bez prídavných filtrov aj s nimi (podľa portu, prípadne štandardu - TCP aj UDP pakety. Z hľadiska protokolu IP bola testovaná IPv4 aj IPv6.

Obrázek 3: IPv6 paket výstup ipk-snifferu

```
(base) [adam@localhost projekt2]$ sudo ./sniffer -i lo
14:40:05.345556 ::1 : 45226 > ::1 : 80

    0x0000  00 00 00 00 00 00 00 00 00 00 00 00 86 dd 60 07  .....`
    0x0010  98 84 00 28 06 40 00 00 00 00 00 00 00 00 00 00  ...(.@.....
    0x0020  00 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00  .....
    0x0030  00 00 00 00 00 01 b0 aa 00 50 78 d8 7b ec 00 00  .....Px.{...
    0x0040  00 00 a0 02 ff c4 00 30 00 00 02 04 ff c4 04 02  .....0.....
    0x0050  08 0a 56 87 d2 f7 00 00 00 00 01 03 03 07  .....V.....
(base) [adam@localhost projekt2]$
```

Obrázek 4: IPv6 paket výstup tcp-dump

```
(base) [adam@localhost projekt2]$ sudo tcpdump -XX -i lo -c 1 -n -c 1
dropped privs to tcpdump
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on lo, link-type EN10MB (Ethernet), capture size 262144 bytes
14:40:05.345555 IP6 ::1.45226 > ::1.http: Flags [S], seq 2027453420, win 65476, options [mss 65476,sackOK,TS val 1451741943 ecr 0,nop,wscale 7], length 0
    0x0000:  0000 0000 0000 0000 0000 0000 86dd 6007  .....`
    0x0010:  9884 0028 0640 0000 0000 0000 0000 0000  ...(.@.....
    0x0020:  0000 0000 0001 0000 0000 0000 0000 0000  .....
    0x0030:  0000 0000 0001 b0aa 0050 78d8 7bec 0000  .....Px.{...
    0x0040:  0000 a002 ffc4 0030 0000 0204 ffc4 0402  .....0.....
    0x0050:  080a 5687 d2f7 0000 0000 0103 0307  .....V.....
```

Obrázek 5: IPv4 paket výstup ipk-snifferu

```
(base) [adam@localhost projekt2]$ sudo ./sniffer -i wlp4s0
14:56:28.582899 192.168.100.37 : 55514 > 162.159.136.234 : 443

    0x0000  18 c5 8a fd f0 d4 44 85 00 f1 8e 34 08 00 45 00  .....D....4..E.
    0x0010  00 55 e4 ca 40 00 40 06 05 81 c0 a8 64 25 a2 9f  .U..@.....d%..
    0x0020  88 ea d8 da 01 bb ac 7e 33 a6 a7 2b e5 0e 50 18  .....~3..+..P.
    0x0030  01 f5 53 8e 00 00 17 03 03 00 28 e5 1d e0 25 b4  ..S.....(...%.
    0x0040  7d 12 8b 09 92 7f 44 e8 6e cc a0 37 70 d7 35 93  }. ....D.n..7p.5.
    0x0050  9f a0 05 82 a2 a4 b9 99 0b 35 49 1e 7b 6d cb b4  .....5I.{m..
    0x0060  dc 89 2e  ....
    0x0070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x00f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0150  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0160  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0170  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0190  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0280  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0290  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x02f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0300  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0320  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0330  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0340  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0350  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0360  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0370  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0380  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0390  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x03f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0400  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0410  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0420  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0430  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0440  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0450  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0460  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0470  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0480  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0490  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x04f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0500  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0510  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0520  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0530  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0540  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0550  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0560  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0570  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0580  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0590  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x05f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0600  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0610  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0620  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0630  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0640  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0650  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0660  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0670  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0680  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0690  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x06f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0700  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0710  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x0740  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0750  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0760  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0770  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0780  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x07a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x07f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x08e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x08f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x0a00  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0a10  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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    0x0a60  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0a70  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0a80  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0a90  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0aa0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0ab0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0ac0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0ad0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0ae0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0af0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b00  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b10  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b20  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b30  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b40  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b50  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b60  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b70  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    0x0b80  
```

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