嗅探器

一、捕获数据包

1.1 定义各种协议头部格式结构体

包含：以太网帧(Ethernet), IPV4(Internet Protocol Version 4), TCP(Tranmission Control Protocol), UDP(User Data Protocol), Http(Hypertext), DNS()

①macAddress 结构体

```
// MAC address structure
struct MACAddress {
    u_char b1, b2, b3, b4, b5, b6;
    MACAddress(){}
    MACAddress(const u_char B1, const u_char B2, const u_char B3, const u_char B4, const u_char B5, const u_char B6){
        b1 = B1;
        b2 = B2;
        b3 = B3;
        b4 = B4;
        b5 = B5;
        b6 = B6;
    }
};
```

②IP 结构体

```
// IP address structure
struct IPAddress {
    u_char b1, b2, b3, b4;
};
```

③以太网帧结构体

```
// Ethernet header structure
struct EthernetHeader {
    MACAddress destAddress;
    MACAddress srcAddress;
    u_short type;
};
```

④IPV4 头部结构体

```
// IP header structure
struct IPHeader {
    u_char ver_ihl, tos;
    u_short len, id, flags_offset;
    u_char ttl, proto;
    u_short checksum;
    IPAddress srcAddress, destAddress;
};
```

⑤UDP 头部结构体

```
// UDP header structure
struct UDPHeader {
    u_short srcPort, destPort, len, checksum;
};
```

⑥TCP 头部结构体

```
// TCP header structure
struct TCPHeader {
    u_short srcPort, destPort;
    u_int sequenceNum, ackNum;
    u_short flags, window, checksum, urgentPointer;
};
```

⑦DNS 头部结构体

```
// DNS header structure
struct DNSHeader {
    u_short id, flags, questCount, ansCount, authRecordCount, addRecordCount;
};
```

1.2 通过 winpcap 查看本地网络接口

```
//获取设备接口列表
pcap_if_t *alldevs;
char errbuf[PCAP_ERRBUF_SIZE];
if (pcap_findalldevs(&alldevs, errbuf) == -1) {
    return;
}
int pos = 0;
for (pcap_if_t *dev = alldevs; dev != nullptr; dev = dev->next) {
    QString device = QString::number(++pos) + ". " + QString::fromStdString(dev->name)
                     + "(" + QString::fromStdString(dev->description) + ")";
    QAction *action = menuInterfaces->addAction(device);
    action->setCheckable(true);
    action->setData(QVariant::fromValue(MenuItemDevice(dev->name,dev->description)));
    actionGroup->addAction(action);
}
//设置触发器
connect(actionGroup, &QActionGroup::triggered, this, &MainWindow::onInterfaceSelected);
connect(stopMenu, &QMenu::aboutToShow, this, &MainWindow::onClickedStopMenu);
//释放接口权柄
pcap_freealldevs(alldevs);
```

1.3 通过 winpcap 捕获本地某个网络接口的数据包

```
void PacketCaptureThread::run()
{
    /* deviceName是接口名称 */
    char errbuf[PCAP_ERRBUF_SIZE];
    pcap_t *handle=pcap_open(deviceName.toStdString().c_str(),
                             65536,
                             PCAP_OPENFLAG_PROMISCUOUS,
                             1000,
                             NULL,
                             errbuf);
    if (handle == nullptr)  return;
    if(pcap_datalink(handle) != DLT_EN10MB) return;
    struct bpf_program fp; // The compiled filter
    char filter_exp[] = "ip and (tcp or udp) and (port 53 or port 80 or port 443)";

    // Compile and set the filter
    if (pcap_compile(handle, &fp, filter_exp, 0, 0) == -1)  return;
    if (pcap_setfilter(handle, &fp) == -1)  return;

    //共享变量
    handleShare = handle;
    (StopCapture::timer).start();

    pcap_loop(handle, 0, packetHandler, reinterpret_cast<u_char*>(this)); // 0 means loop forever
    pcap_close(handle);
}
```

二、 解析数据包

2.1 解析以太网帧

通过调用 processEthernet(EthernetHeader*)函数来解析以太网帧，其中

```
EthernetHeader *ethernetHeader = (EthernetHeader*) (packet)
```

```
void MainWindow::processEthernet(const EthernetHeader *ethernetHeader){
    //目的MAC地址
    QString destMac = MacToQStr(ethernetHeader->destAddress);
    //源MAC地址
    QString srcMac = MacToQStr(ethernetHeader->srcAddress);
    //帧类型
    unsigned short macType = ntohs(ethernetHeader->type);
```

2.2 解析 IP 数据包

调用 processIP(IPHeader*)来解析 IP 数据包，其中

```
IPHeader *ipHeader = (IPHeader*)((u_char*)ethernetHeader + ETHER_HEADER_SIZE);
```

ETHER_HEADER_SIZE 为以太网帧首部长度(14)(偏移量)

```
void MainWindow::processIp(const IPHeader *ipHeader){
    /* 处理IP数据包 */
    u_int ipHeaderLen = (ipHeader->ver_ihl & 0xf) * 4;      //ip头部长度
    u_char ipVersion = (ipHeader->ver_ihl & 0xf0)>>4;          //ip版本号
    u_char ipServiceType = ipHeader->tos;                       //ip服务类型
    unsigned short ipLength = ntohs(ipHeader->len);                //ip数据包总长度
    u_short ipIdentify = ntohs(ipHeader->id);                      //标识
    u_short ipFragments = (ntohs(ipHeader->flags_offset))>>13;    //切片标志位
    u_short ipOffset = (ntohs(ipHeader->flags_offset) & 0x1FFF);       //片偏移
    u_char TTL = ipHeader->ttl;                                 //生存时间
    QString Protocol = protocolNameFromNumber(ipHeader->proto);                          //协议
    u_short ipChecksum = ntohs(ipHeader->checksum);                //校验和
    //源IP地址
    QString srcIp = IpToQStr(ipHeader->srcAddress);
    //目的IP地址
    QString destIp = IpToQStr(ipHeader->destAddress);
```

2.3 解析传输层数据包

2.3.1 解析 TCP 数据包

通过调用 processTcp(TCPHeader*)函数来解析 TCP 数据包，而

```
TCPHeader* tcpHeader = (TCPHeader*)((u_char*)ipHeader + ipHeaderLen);      //获得tcp头部指针
```

其中 ipHeaderLen 为 IPV4 数据包头长度

```
void MainWindow::processTcp(const TCPHeader *tcpHeader){
    //解析tcp数据包
    u_short srcPort = ntohs(tcpHeader->srcPort);               //源端口
    u_short destPort = ntohs(tcpHeader->destPort);             //目的端口
    u_int sequenceNum = ntohl(tcpHeader->sequenceNum);         //序号
    u_int ackNum = ntohl(tcpHeader->ackNum);                   //确认号
    u_short tcpHeaderLen = ((ntohs(tcpHeader->flags) & 0xF000)>>12) * 4;        //tcp头部长度
    u_char tcpRemain = (ntohs(tcpHeader->flags) & 0x0FC0);             //6位保留
    u_char tcpFlags = u_char(ntohs(tcpHeader->flags) & 0x003F);        //6位标志位(ACK、SYN……)
    u_short tcpWindows = ntohs(tcpHeader->window);                     //窗口大小
    QString tcpChecksum = QString::number(ntohs(tcpHeader->checksum),16).toUpper();       //校验和
    u_short tcpUrgentPoint = ntohs(tcpHeader->urgentPointer);          //紧急指针
```

2.3.2 解析 UDP 数据包

通过调用 processUDP(UDPHeader*)函数来解析 UDP 数据包，而

```
UDPHeader* udpHeader = (UDPHeader*)((u_char*)ipHeader + ipHeaderLen);
```

其中 ipHeaderLen 为 IPV4 数据包头长度

```
void MainWindow::processUdp(const UDPHeader *udpHeader){
    //解析UDP数据包
    u_short srcPort = ntohs(udpHeader->srcPort);        //源端口
    u_short destPort = ntohs(udpHeader->destPort);      //目的端口
    u_short udpLength = ntohs(udpHeader->len);          //udp数据包总长度
    u_short udpChecksum = ntohs(udpHeader->checksum);       //校验和
```

2.4 解析应用层数据包

2.4.1 解析 Http 数据包

通过调用库函数 httpData 来解析 http 数据包，其中 httpHeaderOffset 为 http 数据包开始出指针，httpLength 为 http 数据包长度

```
void MainWindow::processHTTP(const u_char *httpHeaderOffset, u_int httpLength){
    const char* httpOffset = reinterpret_cast<const char*>(httpHeaderOffset);
    QByteArray httpData(httpOffset, httpLength);
    QString httpString(httpData);
```

2.4.2 解析 DNS 数据包

```
void MainWindow::processDNS(const DNSHeader *dnsHeader){
    u_short dnsIdentifier = ntohs(dnsHeader->id);
    u_short dnsFlags = ntohs(dnsHeader->flags);
    u_short dnsQuestCount = ntohs(dnsHeader->questCount);
    u_short dnsAnsCount = ntohs(dnsHeader->ansCount);
    u_short dnsAuthCount = ntohs(dnsHeader->authRecordCount);
    u_short dnsAddCount = ntohs(dnsHeader->addRecordCount);
```

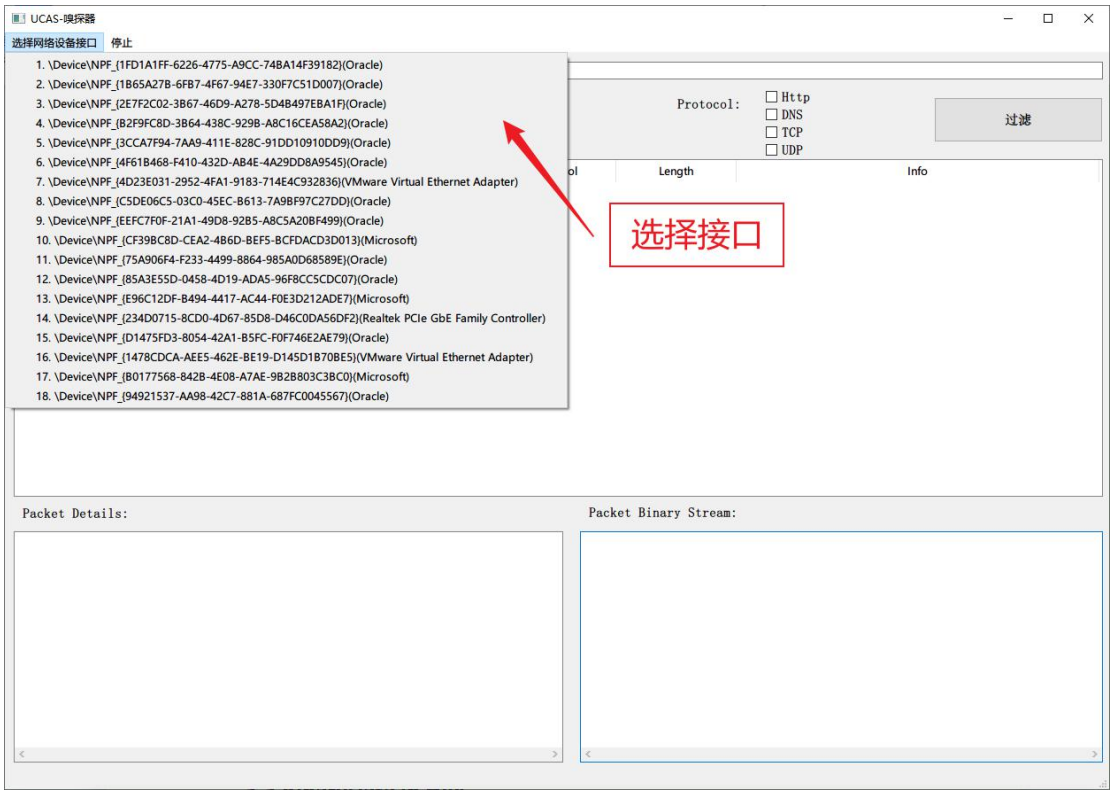
2.5 过滤

PacketList 在 QT 中用 TableView 展示，过滤规则在自定义的 CustomFilterProxyModel 过滤模型中定义的，过滤规则就是比较输入的 IP 地址、端口号、以及选择的协议（若没有输入则默认是选择全部）

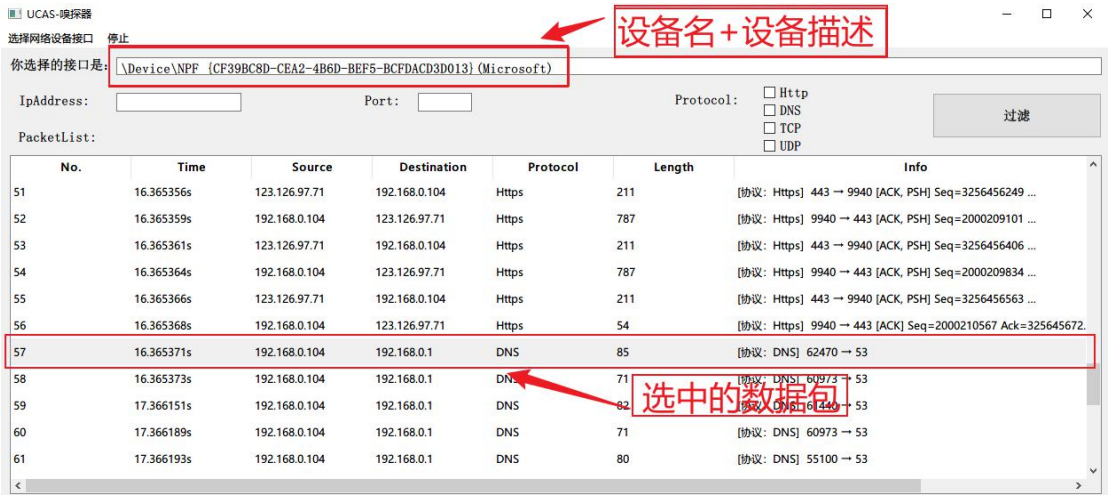
```
// 获取数据
QString srcIp = sourceModel()->data(index2).toString();      //源IP
QString destIp = sourceModel()->data(index3).toString();     //目的IP
QString protocol = sourceModel()->data(index4).toString();  //协议
QString srcPort = sourceModel()->data(index7).toString();    //源端口
QString destPort = sourceModel()->data(index8).toString();   //目的端口
int tcp_or_udp = sourceModel()->data(index9).toInt();        //传输层协议 tcp|udp|其他

bool addr=false,por=false,proto=false;
if(address=="")    addr=true;
else if(address==srcIp||address==destIp) addr=true;
else    addr=false;
if(port=="") por=true;
else if(port==srcPort||port==destPort)   por=true;
else    por=false;
if(!tcp && !udp && !http && !dns)   proto=true;
if(protocol=="Http" && http)    proto=true;
if(protocol=="DNS" && dns)    proto=true;
if((tcp_or_udp==0) && tcp)    proto=true;
if((tcp_or_udp==1) && udp)    proto=true;
if (addr && por && proto) {
    return true;
} else {
    return false;
}
```

三、捕获结果

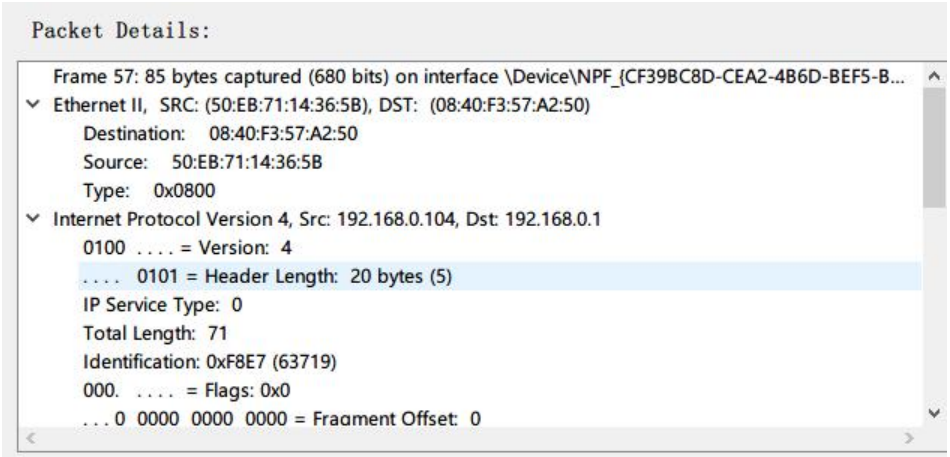
3.1 DeviceList

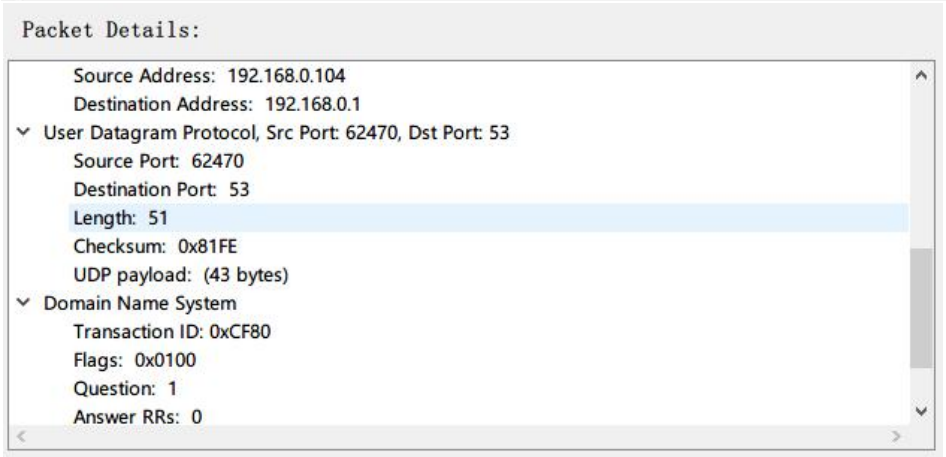


3.2 PacketList



3.3 PacketDetails





3.4 BinaryData in Hex

调用 printDataBinaryInHex

```
void MainWindow::printDataBinaryInHex(const u_char *packet, unsigned int packetLength){
    //以十六进制打印数据包的二进制流
    QByteArray plainText;
    plainText.append(reinterpret_cast<const char*>(packet), packetLength);
    QString formattedData = formatPacketData(plainText);
    ui->plainTextEdit->setPlainText(formattedData);
}
```