SIP session helper / ALG

Starting @ 1:30pm

Who am I ?

- David Attias
- Installing VoIP systems for over 11 years
- Owner of Penny Tone LLC
- Mikrotik user for 6 years
- Mikrotik Trainer
  MTCNA, MTCRE & MTCWE

Purpose of this lecture

To inform Mikrotik users on the purpose and functions of SIP ALG.

Agenda

1- What is ALG & what does it do.
2- The problem with VoIP and NAT
3- When is SIP ALG necessary and un-necessary?
4- How SIP ALG corrects problems.
5- Testing with wireshark
6- SIP ALG Timeout
7- SIP ALG direct-media

WHAT IS ALG?

WHAT IS ALG?

- Application Layer Gateway
- A Gateway (firewall) that re-writes specific Application Layer data fields.
- ALG is a firewall feature that rewrites Layer 7 data for specific applications.

Keep in mind

- Only applies to NAT translation rules.
- NAT’ed devices are unaware that ALG is changing anything.
- Also known as:
  -NAT helper (Linux)
  -NAT session helper
  -SIP Transformations
  -Service ports

The Problem with VoIP and NAT

The Problem with VoIP and NAT

- SIP servers need to know the IP of all registered phones.
- Phones register their locally configured IP with the SIP server.
- If the phone and server are in the same network, no problems.
- If the phone is behind NAT and reports its IP to a remote server, the server responses will NOT be able to reach the phone.

The Result

- Phone can not receive calls
- One way audio

What ALG Does.

What ALG Does.

- **ALG does exactly the same thing NAT translation does, but at layer 7**
- ALG intercepts the application messages before they leave the router
- Then inspects and replaces the “private client ip:port” with the “public ip:port” of the router (nat rule)

What ALG Does

Dear SIP Server,
I’ve been thinking about you and I want to INVITE you to SIP and RTP with me.
Contact 192.168.20.100

What ALG Does

Dear SIP Server,
I’ve been thinking about you and I want to INVITE you to SIP and RTP with me.
Contact 1~~92.168.20.100~~

75.142.151.49

ALG WAS HERE

Basic terms

SIP and SDP

- SIP and SDP are VoIP Layer 7 protocols

- SIP – Session Initiated Protocol are commands exchanged between sip devices (register, invite, trying, hold, xfer, bye)

- SDP – Session Description Protocol is information about the audio (RTP) stream of a call.

RouterOS SIP ALG settings

RouterOS SIP ALG options

/ip firewall service-port

Ports: - Remote Sip Server listening port. default values are 5060,5061
- Applies to TCP and UDP
- Single port, no ranges
- Up to 8 entries

Sip-direct-media - Allows a redirect of the RTP media stream to go directly from sip device to sip device
- Default value is yes.

Timeout: - Sets the sip UDP timeout in connection tracker.
- Default is 1 hour

Mikrotik CLI

```
/ip firewall service-port
set sip ports=5060,5061 sip-direct-media=yes sip-timeout=01:00:00 disabled=no
```

How does ALG correct SIP problems?

How does ALG correct SIP problems?

- By replacing specific private IP:port with router’s wan side IP:port

  ALG changes:
  SIP headers: Via, Contact
  SDP Body: m= o= c=

- ALG makes changes to Layer 7 data transparently as it passes through the NAT rule.

Layer 7 data before and after (with ALG enabled)

Layer 7 Data with before ALG

SIP REGISTER message BEFORE ALG modification:

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-8fb0e171
From: "David Attias" <sip:201525@207.252.1.148>;tag=191914b06bec0
To: "David Attias" <sip:201525@207.252.1.148>
Call-ID: 6894e30c-h1c8d357@192.168.20.100
CSeq: 1373 REGISTER
Max-Forwards: 70
Contact: "David Attias" <sip:201525@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER,
UPDATE
Supported: replaces
```

The fields ALG will change

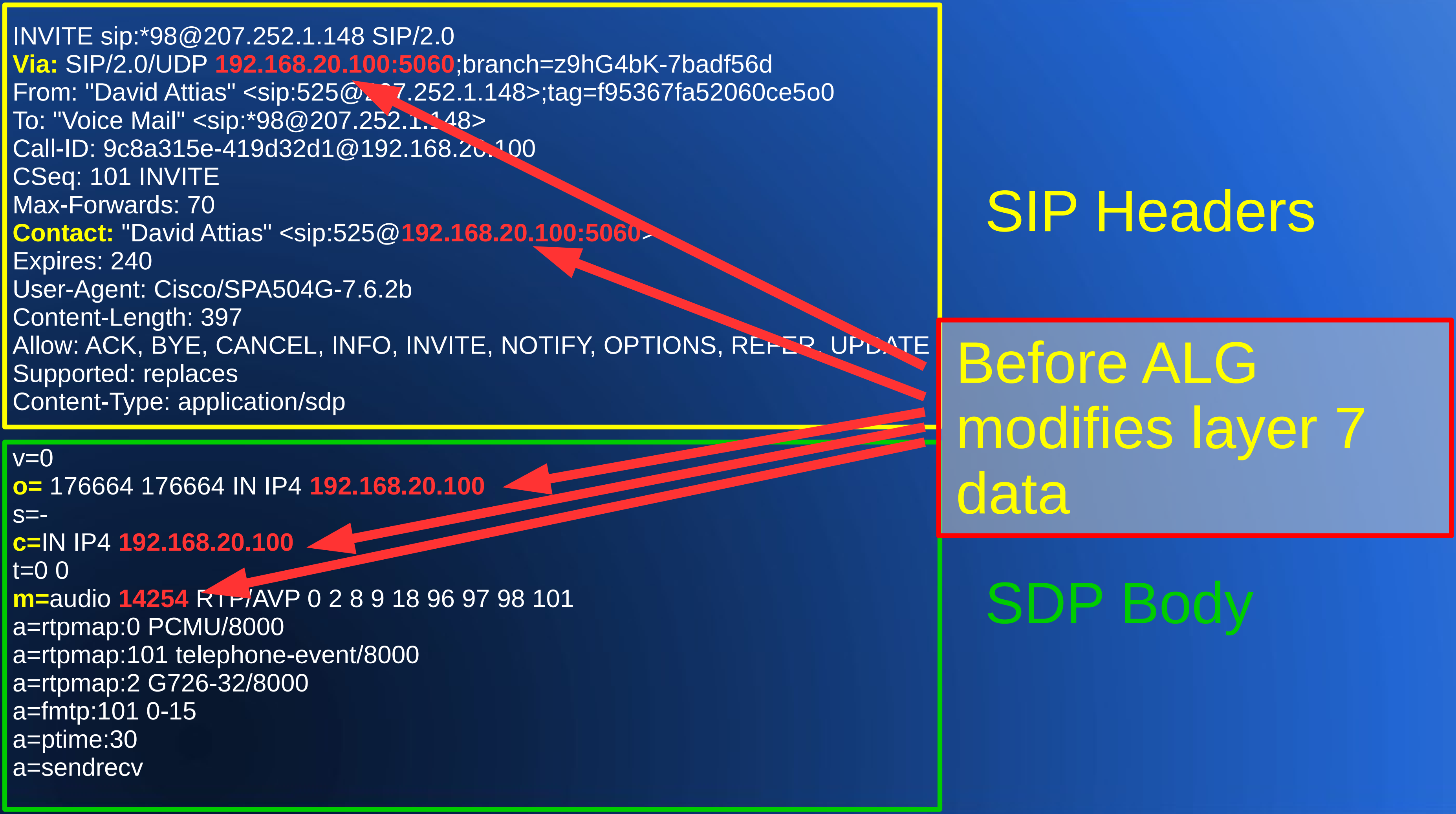
Layer 7 Data with after ALG

SIP REGISTER message AFTER ALG modification:

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 75.142.151.49:1024;branch=z9hG4bK-8fb0e171
From: "David Attias" <sip:525@207.252.1.148>;tag=191914b06beo0
To: "David Attias" <sip:525@207.252.1.148>
Call-ID: 6894e30c-h1c8d357@192.168.20.100
CSeq: 1373 REGISTER
Max-Forwards: 70
Contact: "David Attias" <sip:525@75.142.151.49:1024>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER,
UPDATE
Supported: replaces
```

After ALG
The “respond to”
IP and port

Layer 7 Data with before ALG



```
INVITE sip:*98@207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-7badf56d
From: "David Attias" <sip:525@207.252.1.148>;tag=f95367fa52060ce5o0
To: "Voice Mail" <sip:*98@207.252.1.148>
Call-ID: 9c8a315e-419d32d1@192.168.20.100
CSeq: 101 INVITE
Max-Forwards: 70
Contact: "David Attias" <sip:525@192.168.20.100:5060>
Expires: 240
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 397
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
Content-Type: application/sdp
```

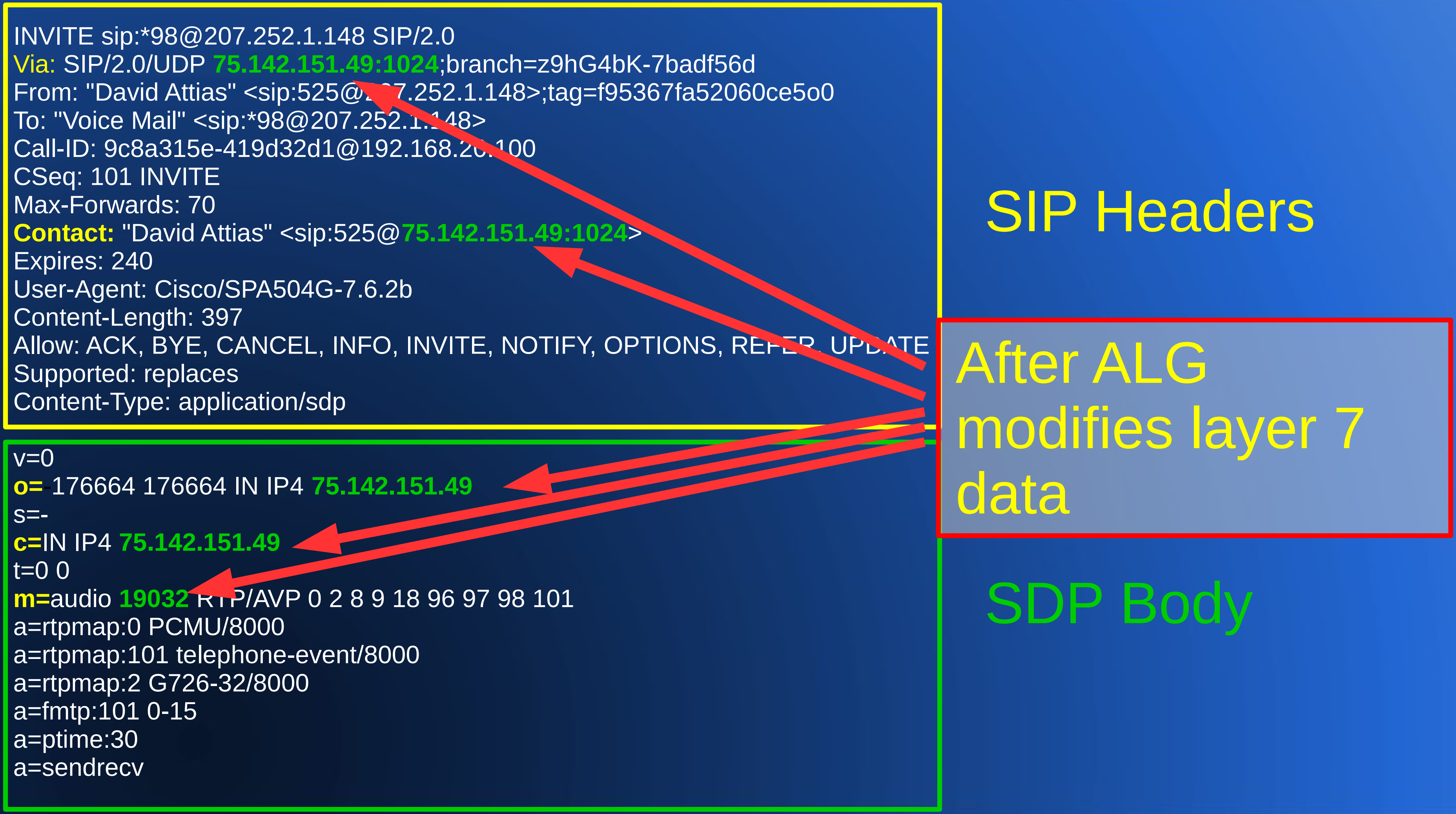
```
v=0
o= 176664 176664 IN IP4 192.168.20.100
s=-
c=IN IP4 192.168.20.100
t=0 0
m=audio 14254 RTP/AVP 0 2 8 9 18 96 97 98 101
a=rtpmap:0 PCMU/8000
a=rtpmap:101 telephone-event/8000
a=rtpmap:2 G726-32/8000
a=fmtp:101 0-15
a=ptime:30
a=sendrecv
```

SIP Headers

Before ALG modifies layer 7 data

SDP Body

Layer 7 Data with after ALG



```
INVITE sip:*98@207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 75.142.151.49:1024;branch=z9hG4bK-7badf56d
From: "David Attias" <sip:525@207.252.1.148>;tag=f95367fa52060ce5o0
To: "Voice Mail" <sip:*98@207.252.1.148>
Call-ID: 9c8a315e-419d32d1@192.168.20.100
CSeq: 101 INVITE
Max-Forwards: 70
Contact: "David Attias" <sip:525@75.142.151.49:1024>
Expires: 240
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 397
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
Content-Type: application/sdp
```

```
v=0
o= 176664 176664 IN IP4 75.142.151.49
s=-
c=IN IP4 75.142.151.49
t=0 0
m=audio 19032 RTP/AVP 0 2 8 9 18 96 97 98 101
a=rtpmap:0 PCMU/8000
a=rtpmap:101 telephone-event/8000
a=rtpmap:2 G726-32/8000
a=fmtp:101 0-15
a=ptime:30
a=sendrecv
```

SIP Headers

After ALG modifies layer 7 data

SDP Body

When is SIP ALG necessary?

When is SIP ALG necessary?

When the SIP device behind NAT is NOT NAT aware

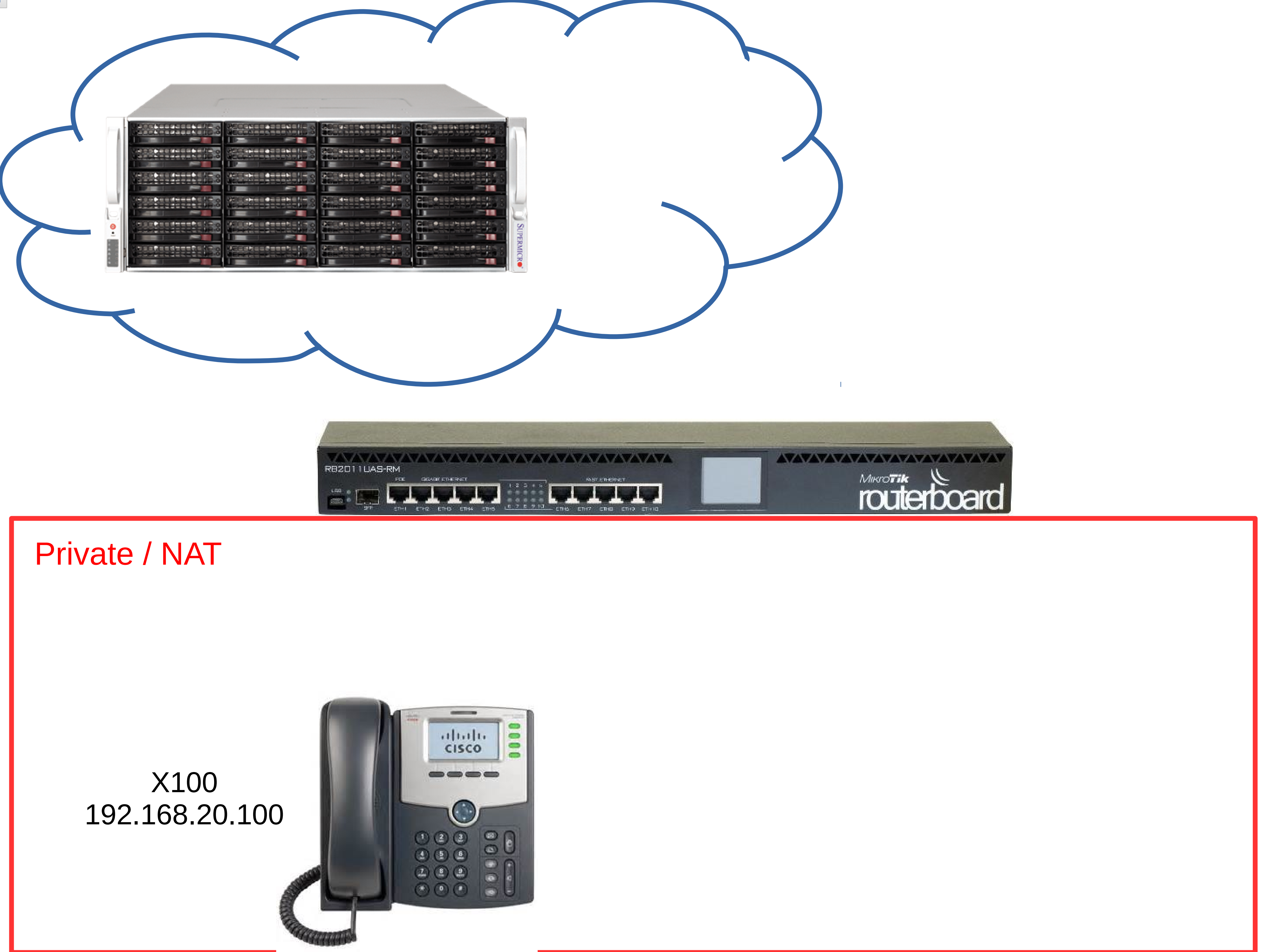
SIP devices that are not “NAT Aware”

- Some SIP devices are not NAT aware and write their (private) device IP in layer 7 messages to the server.
- The remote SIP server receives the layer 7 message which specifies a private reply address.
- The server sends replies to the private address, which can never be reached.

SIP servers that are not “NAT Aware”

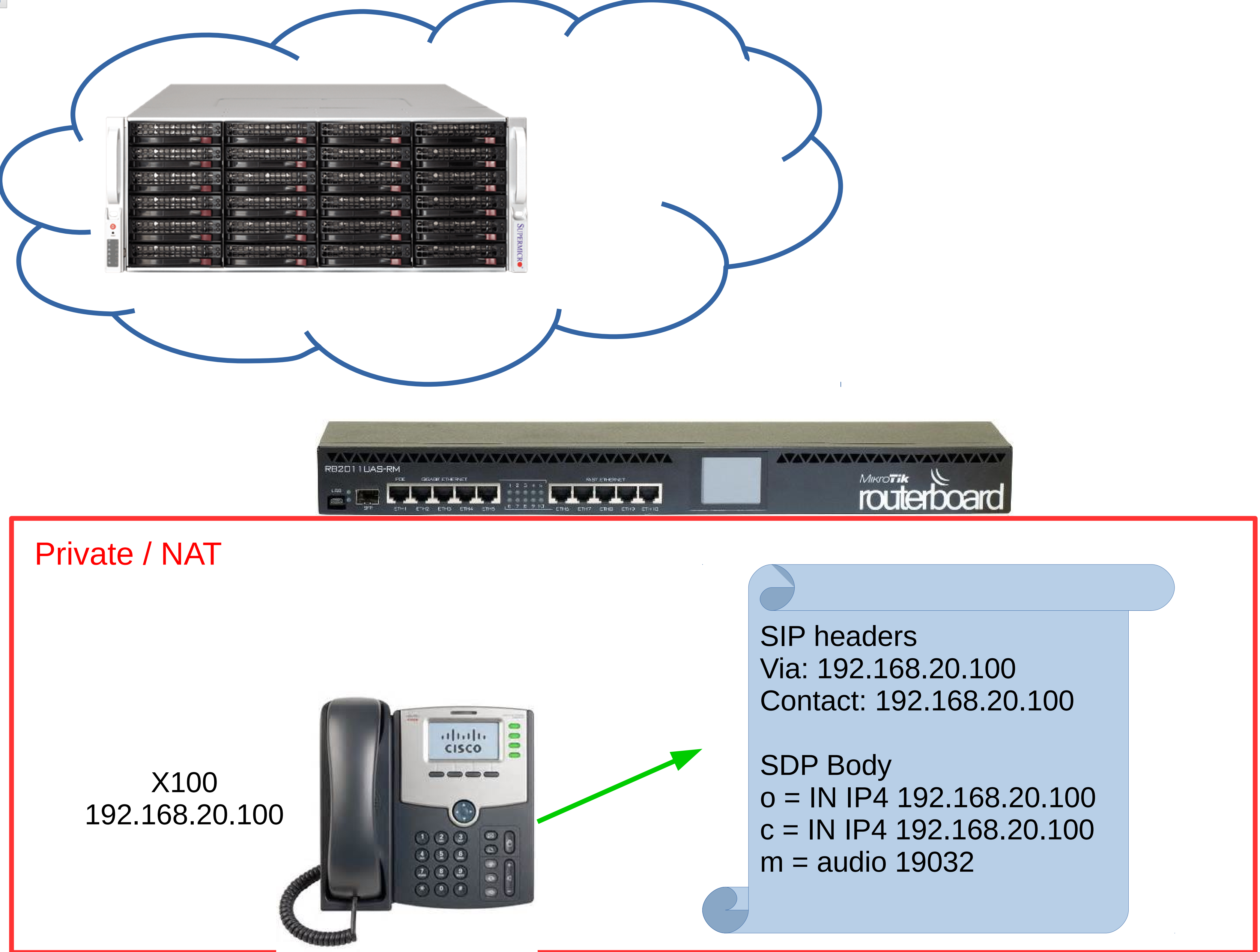
The public server can receive data, but reply packets are dropped.

Example of a SIP device that is not NAT aware



Private / NAT

X100
192.168.20.100

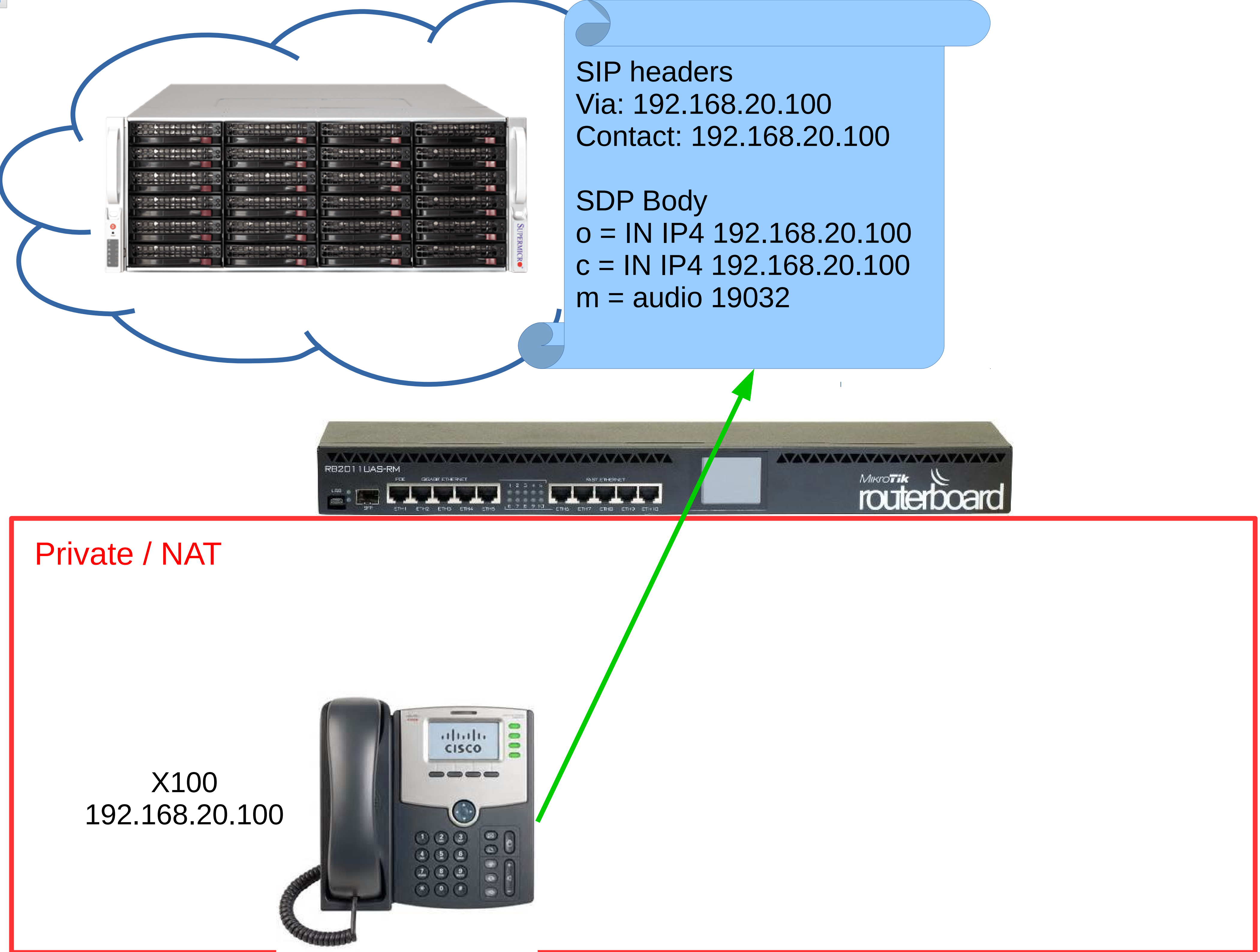


Private / NAT

X100
192.168.20.100

SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032

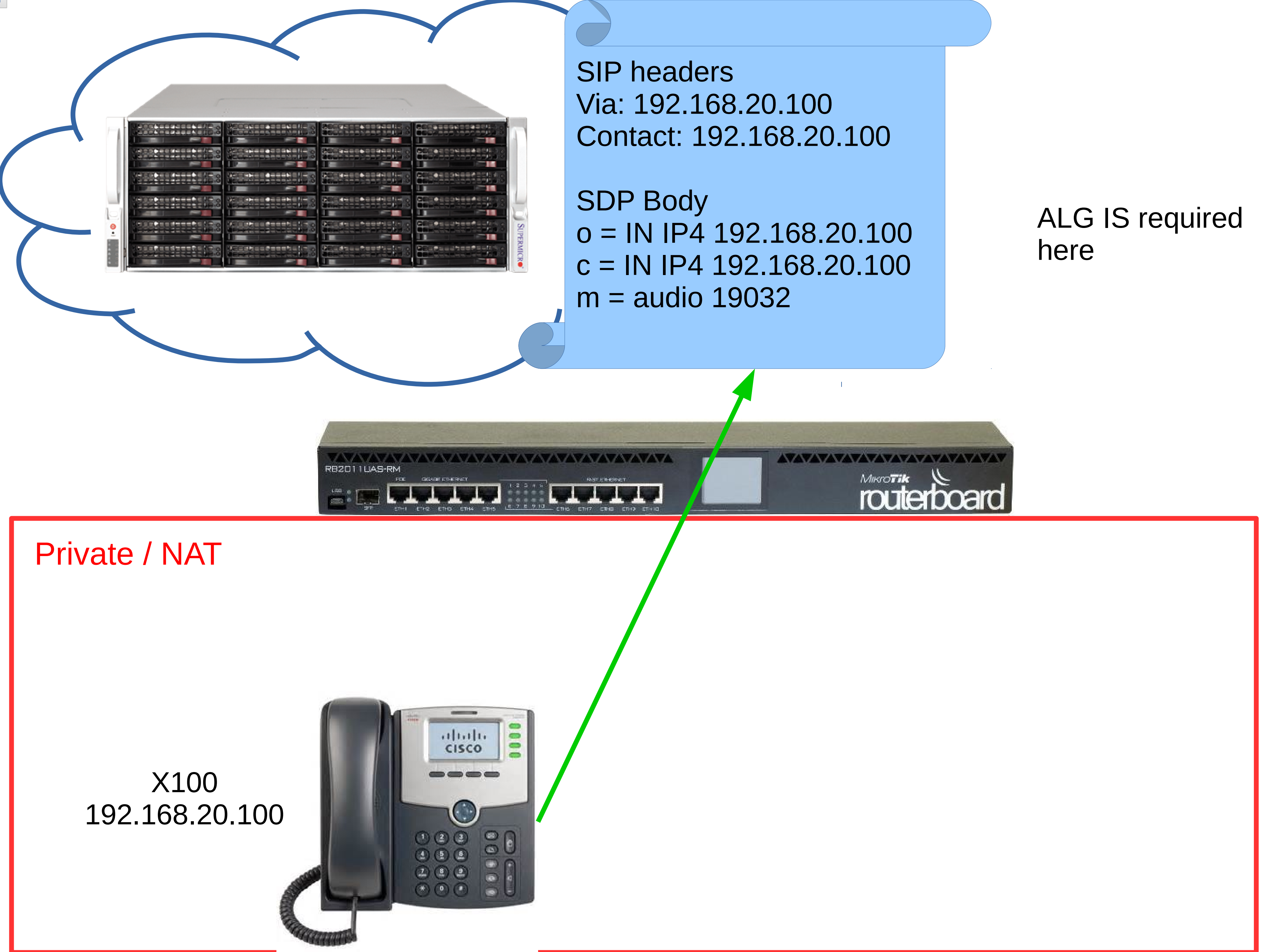


SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032

Private / NAT

X100
192.168.20.100



SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

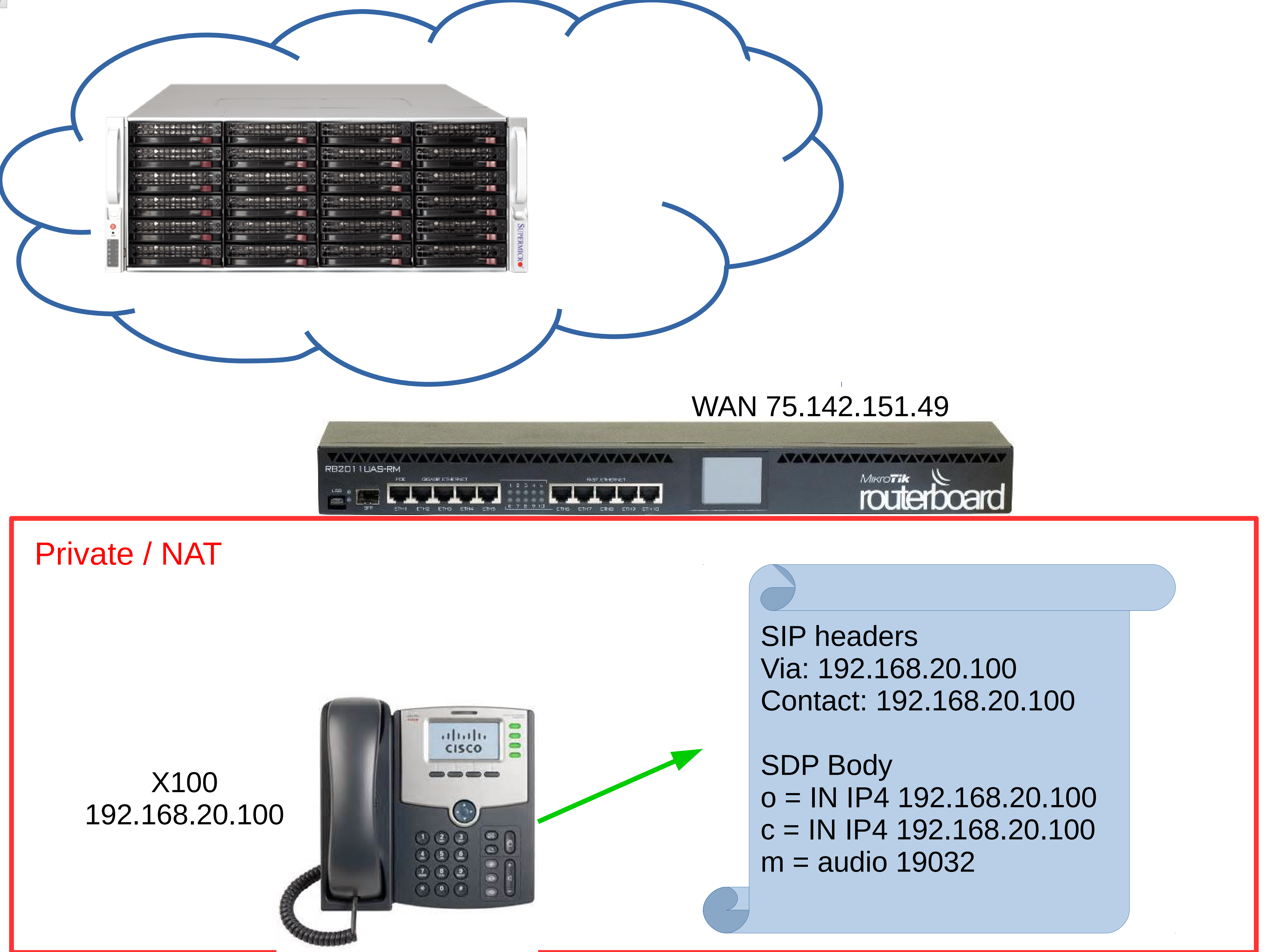
SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032

ALG IS required here

Private / NAT

X100
192.168.20.100

With RouterOS SIP ALG enabled



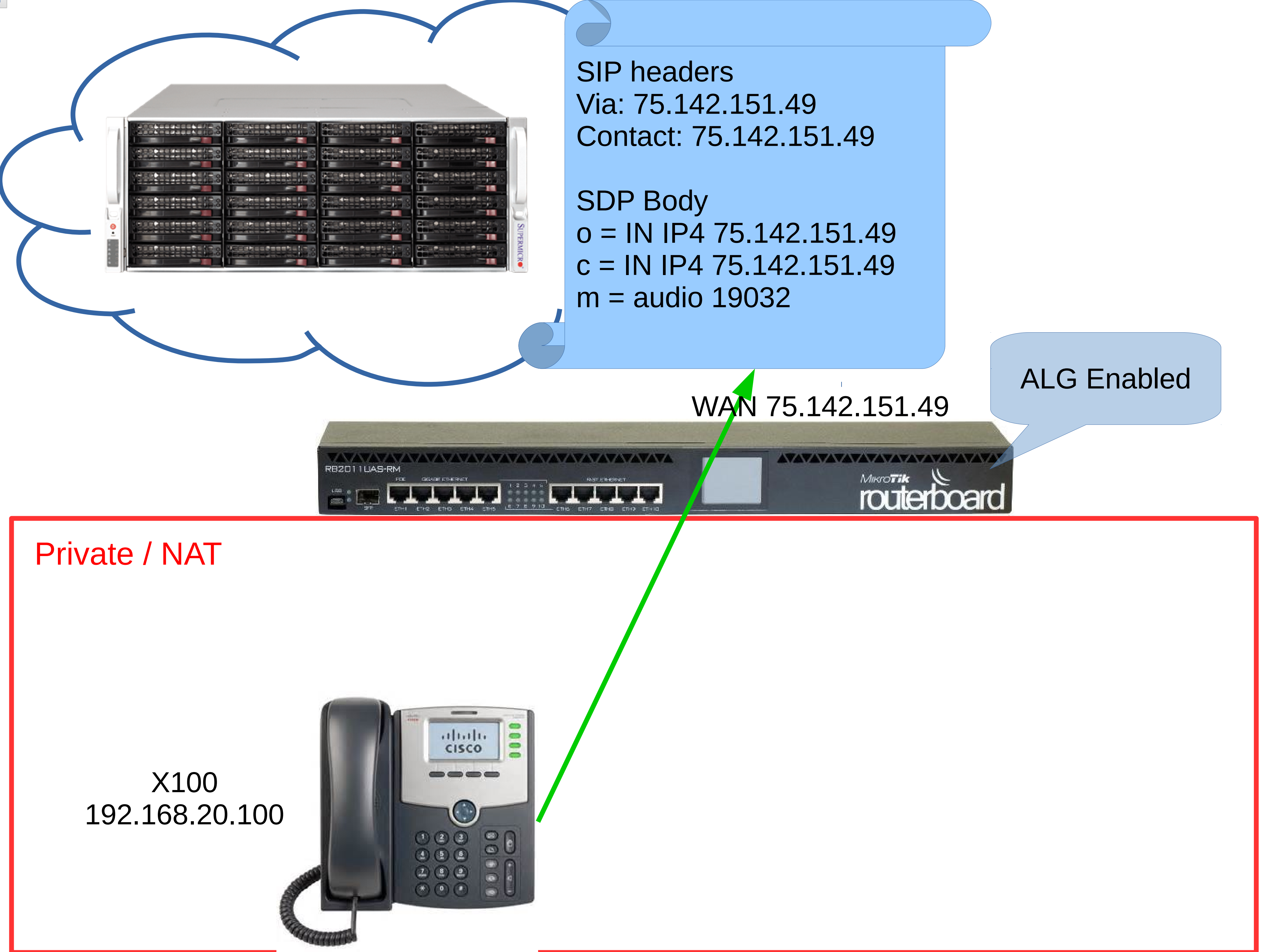
WAN 75.142.151.49

Private / NAT

X100
192.168.20.100

SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032



SIP headers
Via: 75.142.151.49
Contact: 75.142.151.49

SDP Body
o = IN IP4 75.142.151.49
c = IN IP4 75.142.151.49
m = audio 19032

ALG Enabled

WAN 75.142.151.49

Private / NAT

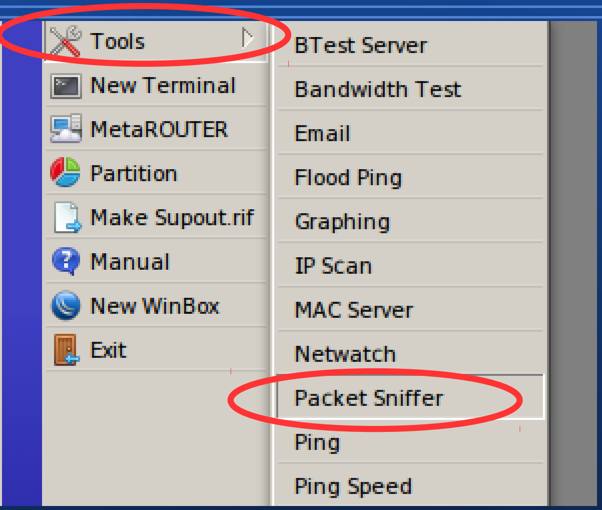
X100
192.168.20.100

Is your SIP device NAT Aware?

- Packet capture in routerOS
  - Capture packets before and after they get modified by ALG
- Decode the capture files in Wireshark

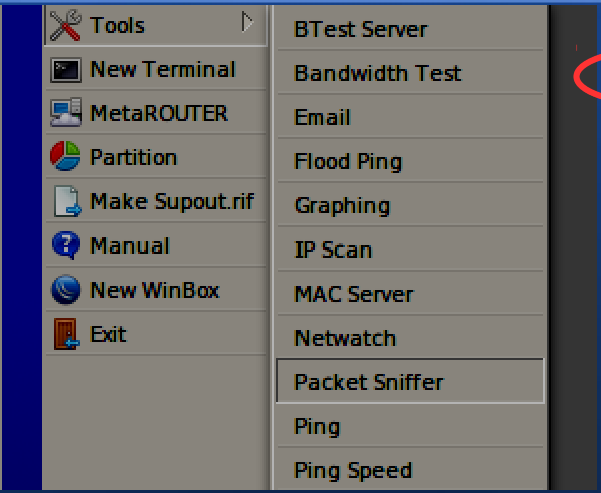
Setting up the packet capture

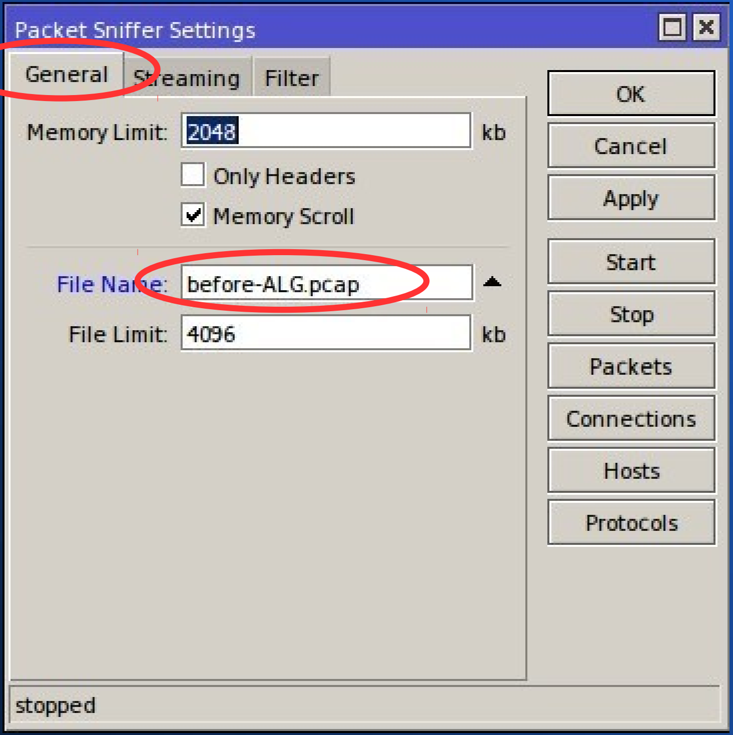
Before ALG modifications pcap



/tool sniffer

Before ALG modifications pcap





Memory Limit: 2048 kb

☐ Only Headers

☑ Memory Scroll

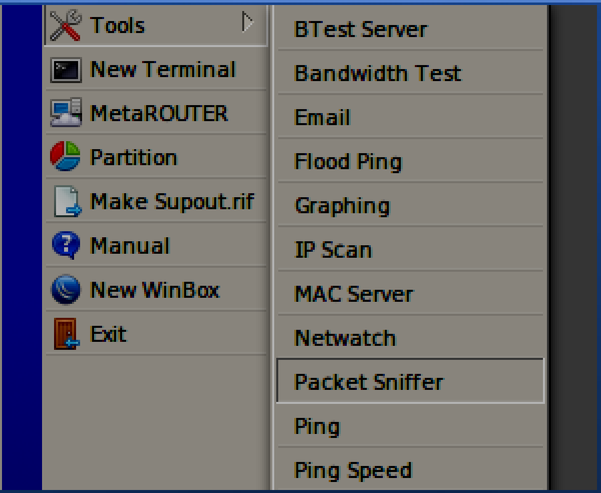
File Name: before-ALG.pcap

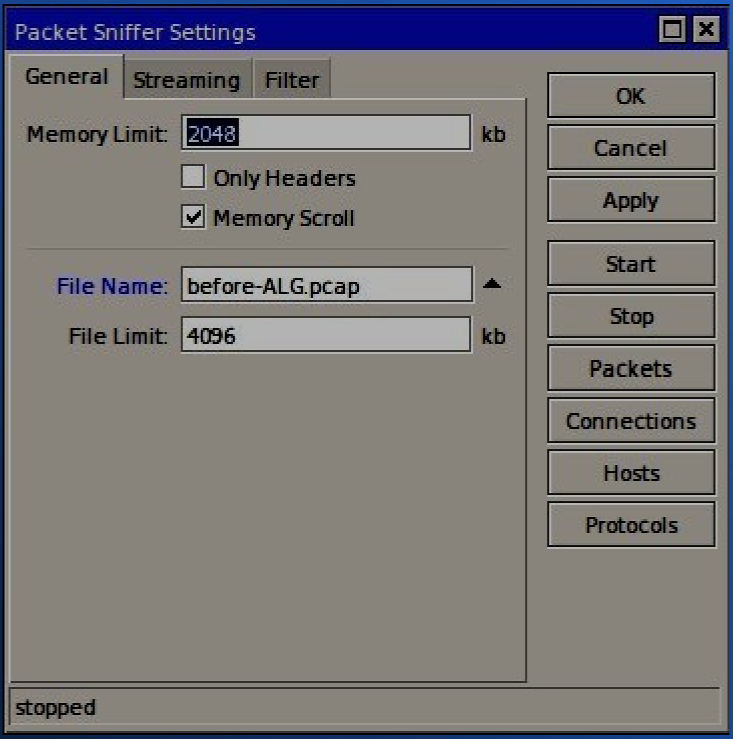
File Limit: 4096 kb

stopped

```
/tool sniffer
set only-headers=no file-name=before-ALG.pcap file-limit=4096
```

Before ALG modifications pcap





Memory Limit: 2048 kb

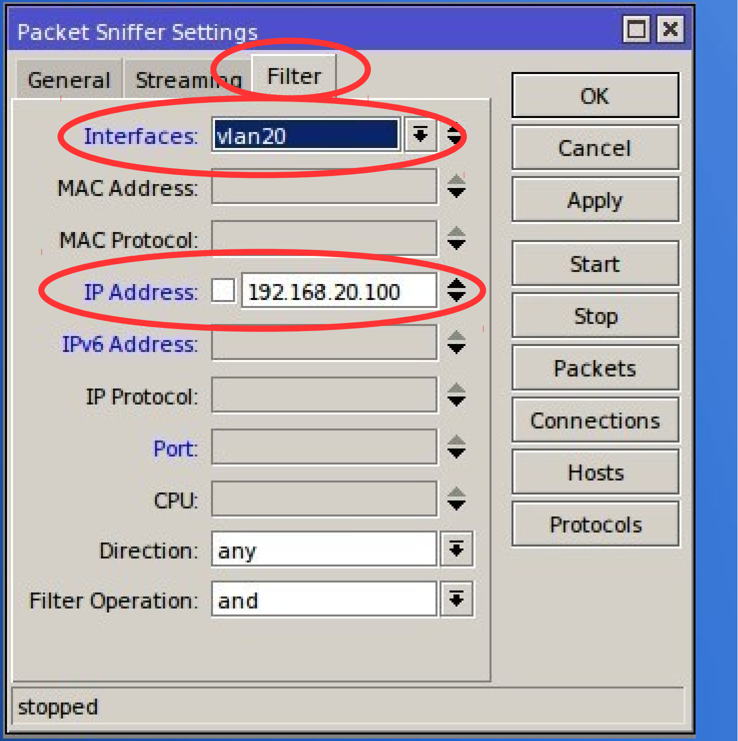
□ Only Headers

☑ Memory Scroll

File Name: before-ALG.pcap

File Limit: 4096 kb

stopped



Interfaces: vlan20

MAC Address:

MAC Protocol:

IP Address: □ 192.168.20.100

IPv6 Address:

IP Protocol:

Port:

CPU:

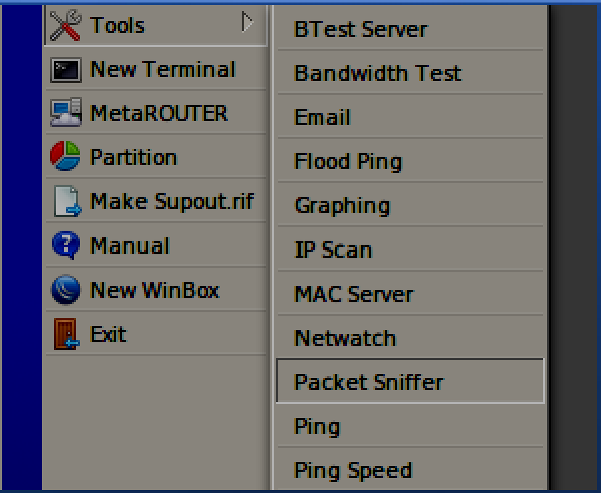
Direction: any

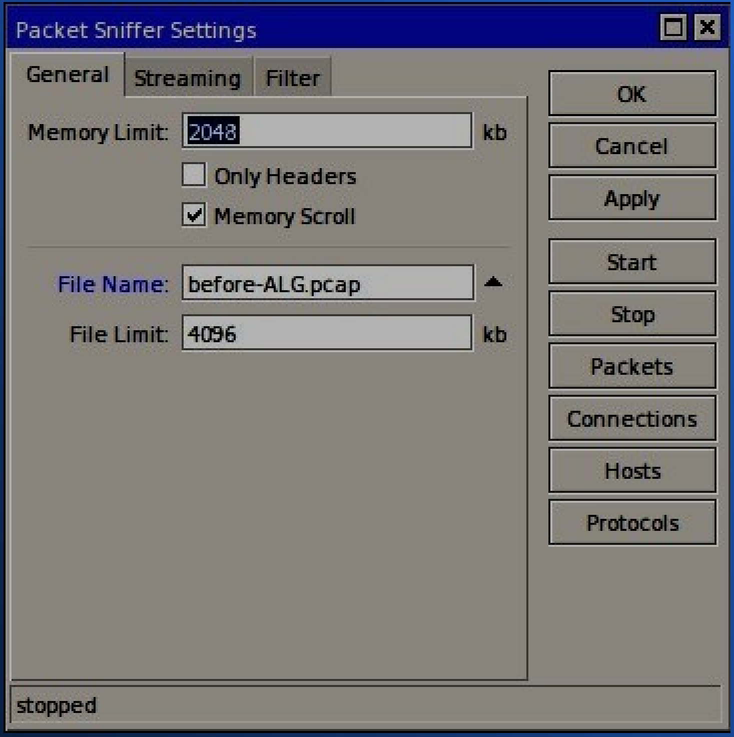
Filter Operation: and

stopped

/tool sniffer
set only-headers=no file-name=before-ALG.pcap file-limit=4096 filter-interface=vlan20 filter-ip-address=192.168.20.100/32 filter-direction=any

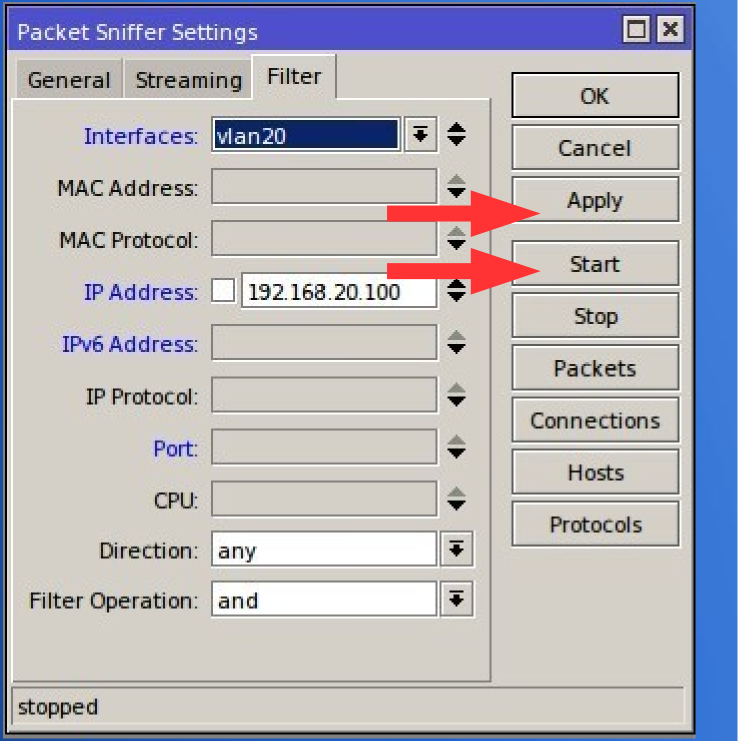
Before ALG modifications pcap




Packet Sniffer Settings

Memory Limit: 2048 kb
□ Only Headers
☑ Memory Scroll
File Name: before-ALG.pcap
File Limit: 4096 kb

stopped


Packet Sniffer Settings

Interfaces: vlan20
MAC Address:
MAC Protocol:
IP Address: □ 192.168.20.100
IPv6 Address:
IP Protocol:
Port:
CPU:
Direction: any
Filter Operation: and

stopped

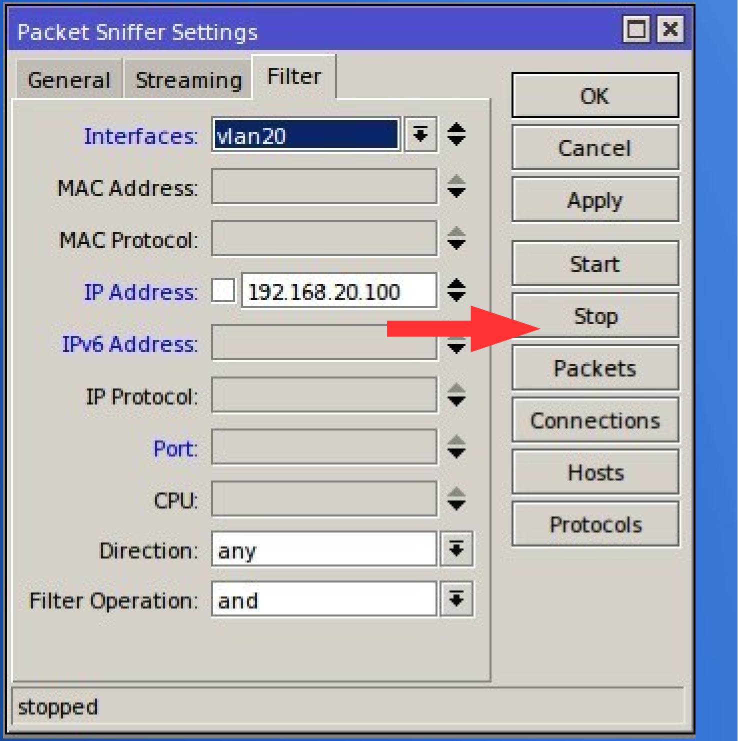
```
/tool sniffer
set only-headers=no file-name=before-ALG.pcap file-limit=4096  filter-interface=vlan20 filter-ip-address=192.168.20.100/32 filter-direction=any

start
```

Generate some traffic while the sniffer is capturing packets.

Before ALG modifications pcap

Make sure to stop the sniffer



Packet Sniffer Settings

General | Streaming | Filter

Interfaces: vlan20

MAC Address:

MAC Protocol:

IP Address: □ 192.168.20.100

IPv6 Address:

IP Protocol:

Port:

CPU:

Direction: any

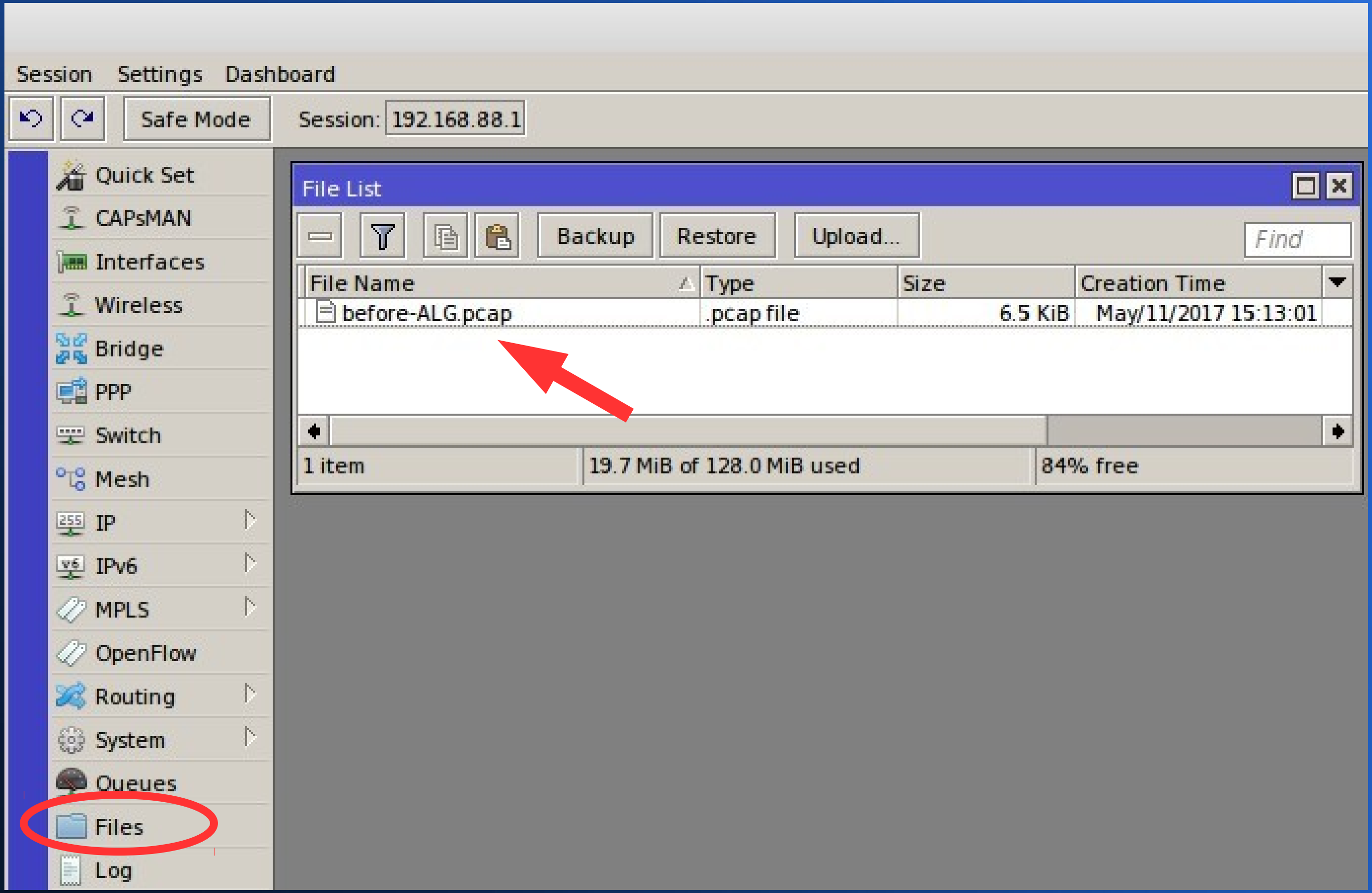
Filter Operation: and

stopped

```
/tool sniffer

stop
```

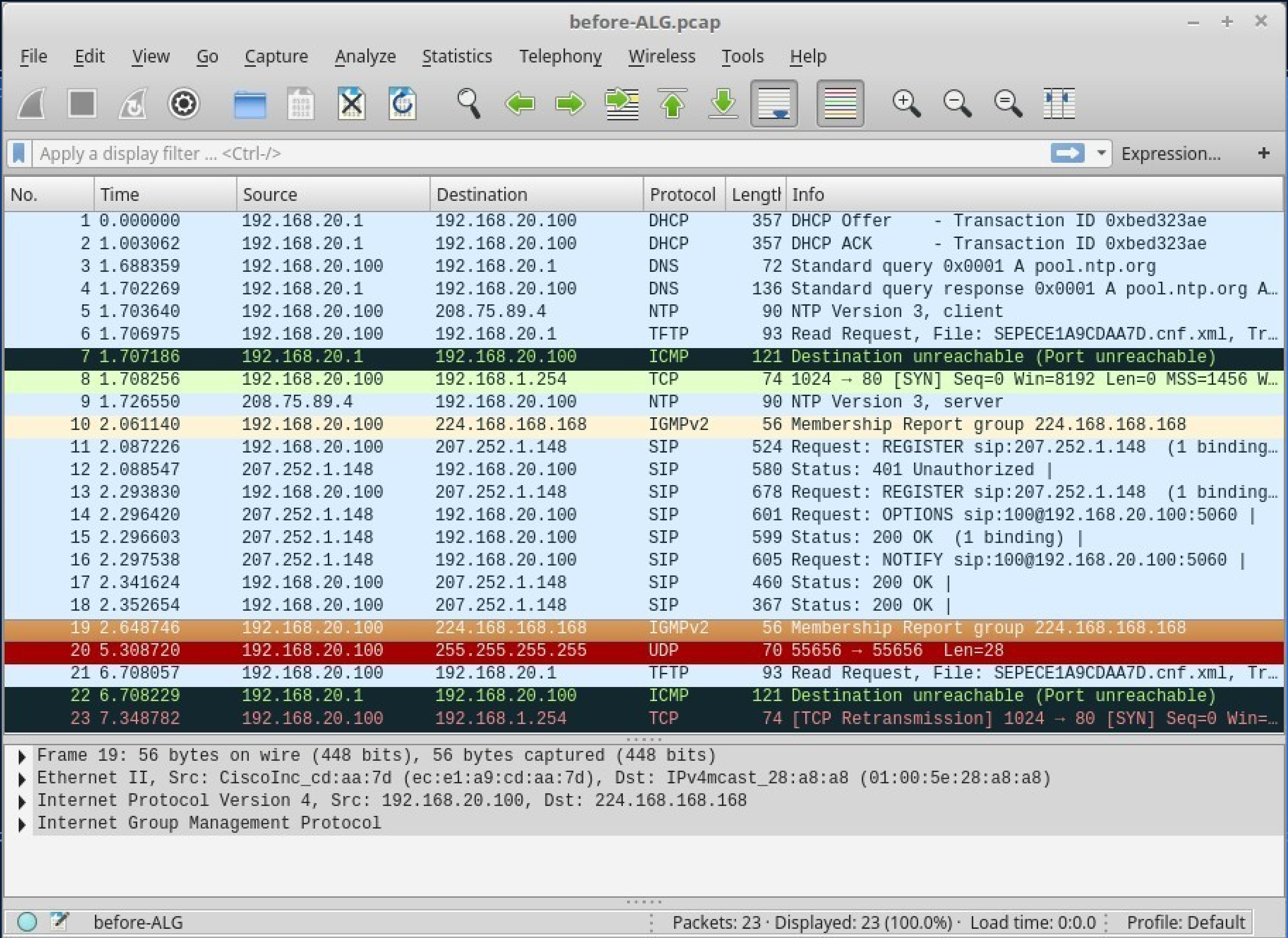
Download pcap files



File Name	Type	Size	Creation Time
before-ALG.pcap	.pcap file	6.5 KiB	May/11/2017 15:13:01

1 item | 19.7 MiB of 128.0 MiB used | 84% free

Decode in wireshark

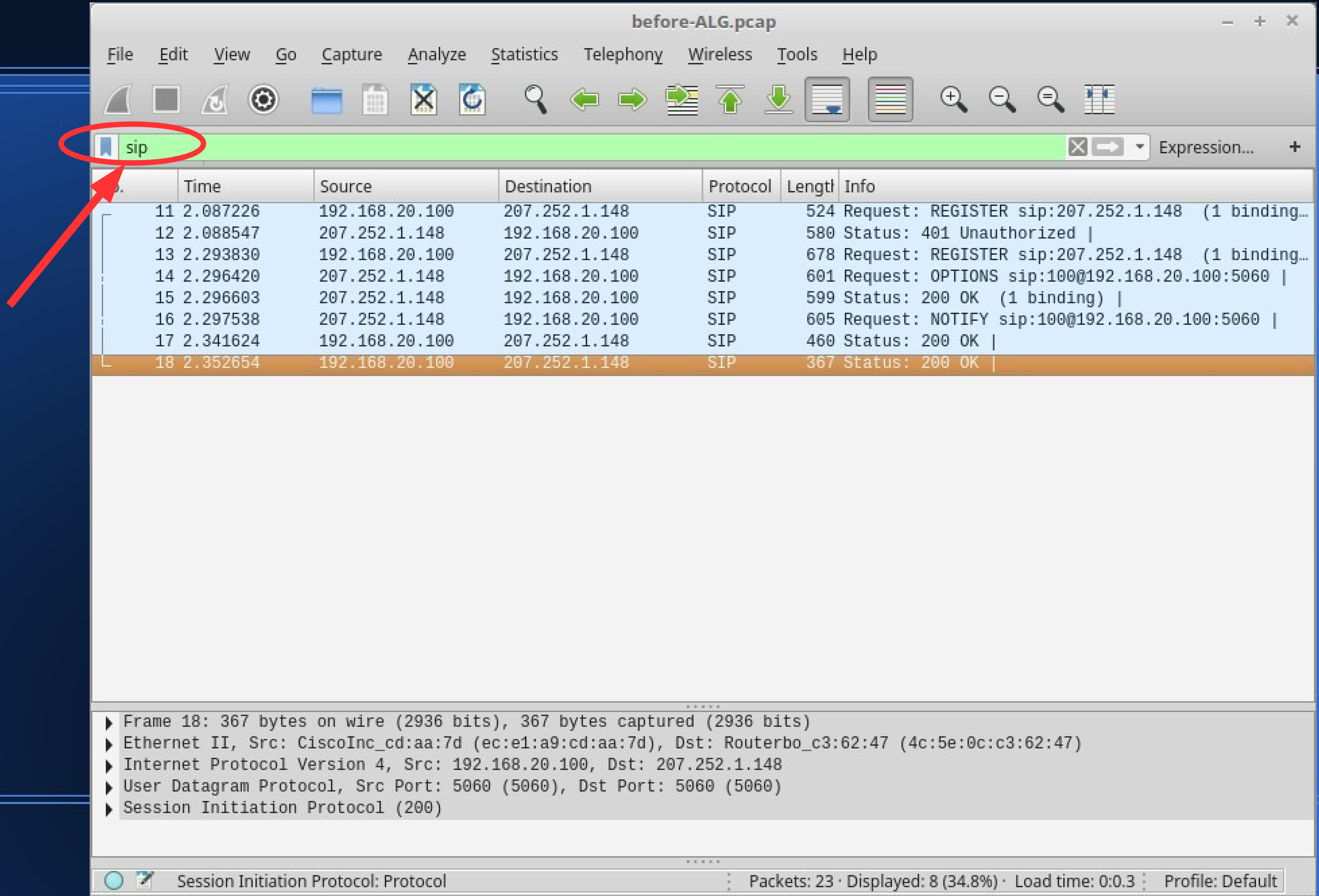


```
No.  Time      Source           Destination      Protocol Lengtl Info
   1 0.000000  192.168.20.1     192.168.20.100   DHCP     357 DHCP Offer    - Transaction ID 0xbed323ae
   2 1.003062  192.168.20.1     192.168.20.100   DHCP     357 DHCP ACK      - Transaction ID 0xbed323ae
   3 1.688359  192.168.20.100   192.168.20.1     DNS       72 Standard query 0x0001 A pool.ntp.org
   4 1.702269  192.168.20.1     192.168.20.100   DNS      136 Standard query response 0x0001 A pool.ntp.org A…
   5 1.703640  192.168.20.100   208.75.89.4      NTP       90 NTP Version 3, client
   6 1.706975  192.168.20.100   192.168.20.1     TFTP      93 Read Request, File: SEPECE1A9CDAA7D.cnf.xml, Tr…
   7 1.707186  192.168.20.1     192.168.20.100   ICMP     121 Destination unreachable (Port unreachable)
   8 1.708256  192.168.20.100   192.168.1.254    TCP       74 1024 → 80 [SYN] Seq=0 Win=8192 Len=0 MSS=1456 W…
   9 1.726550  208.75.89.4      192.168.20.100   NTP       90 NTP Version 3, server
  10 2.061140  192.168.20.100   224.168.168.168  IGMPv2    56 Membership Report group 224.168.168.168
  11 2.087226  192.168.20.100   207.252.1.148    SIP      524 Request: REGISTER sip:207.252.1.148  (1 binding…
  12 2.088547  207.252.1.148    192.168.20.100   SIP      580 Status: 401 Unauthorized |
  13 2.293830  192.168.20.100   207.252.1.148    SIP      678 Request: REGISTER sip:207.252.1.148  (1 binding…
  14 2.296420  207.252.1.148    192.168.20.100   SIP      601 Request: OPTIONS sip:100@192.168.20.100:5060 |
  15 2.296603  207.252.1.148    192.168.20.100   SIP      599 Status: 200 OK  (1 binding) |
  16 2.297538  207.252.1.148    192.168.20.100   SIP      605 Request: NOTIFY sip:100@192.168.20.100:5060 |
  17 2.341624  192.168.20.100   207.252.1.148    SIP      460 Status: 200 OK |
  18 2.352654  192.168.20.100   207.252.1.148    SIP      367 Status: 200 OK |
  19 2.648746  192.168.20.100   224.168.168.168  IGMPv2    56 Membership Report group 224.168.168.168
  20 5.308720  192.168.20.100   255.255.255.255  UDP       70 55656 → 55656  Len=28
  21 6.708057  192.168.20.100   192.168.20.1     TFTP      93 Read Request, File: SEPECE1A9CDAA7D.cnf.xml, Tr…
  22 6.708229  192.168.20.1     192.168.20.100   ICMP     121 Destination unreachable (Port unreachable)
  23 7.348782  192.168.20.100   192.168.1.254    TCP       74 [TCP Retransmission] 1024 → 80 [SYN] Seq=0 Win=…
```

```
▸ Frame 19: 56 bytes on wire (448 bits), 56 bytes captured (448 bits)
▸ Ethernet II, Src: CiscoInc_cd:aa:7d (ec:e1:a9:cd:aa:7d), Dst: IPv4mcast_28:a8:a8 (01:00:5e:28:a8:a8)
▸ Internet Protocol Version 4, Src: 192.168.20.100, Dst: 224.168.168.168
▸ Internet Group Management Protocol
```

before-ALG   Packets: 23 · Displayed: 23 (100.0%) · Load time: 0:0.0   Profile: Default

Decode in wireshark

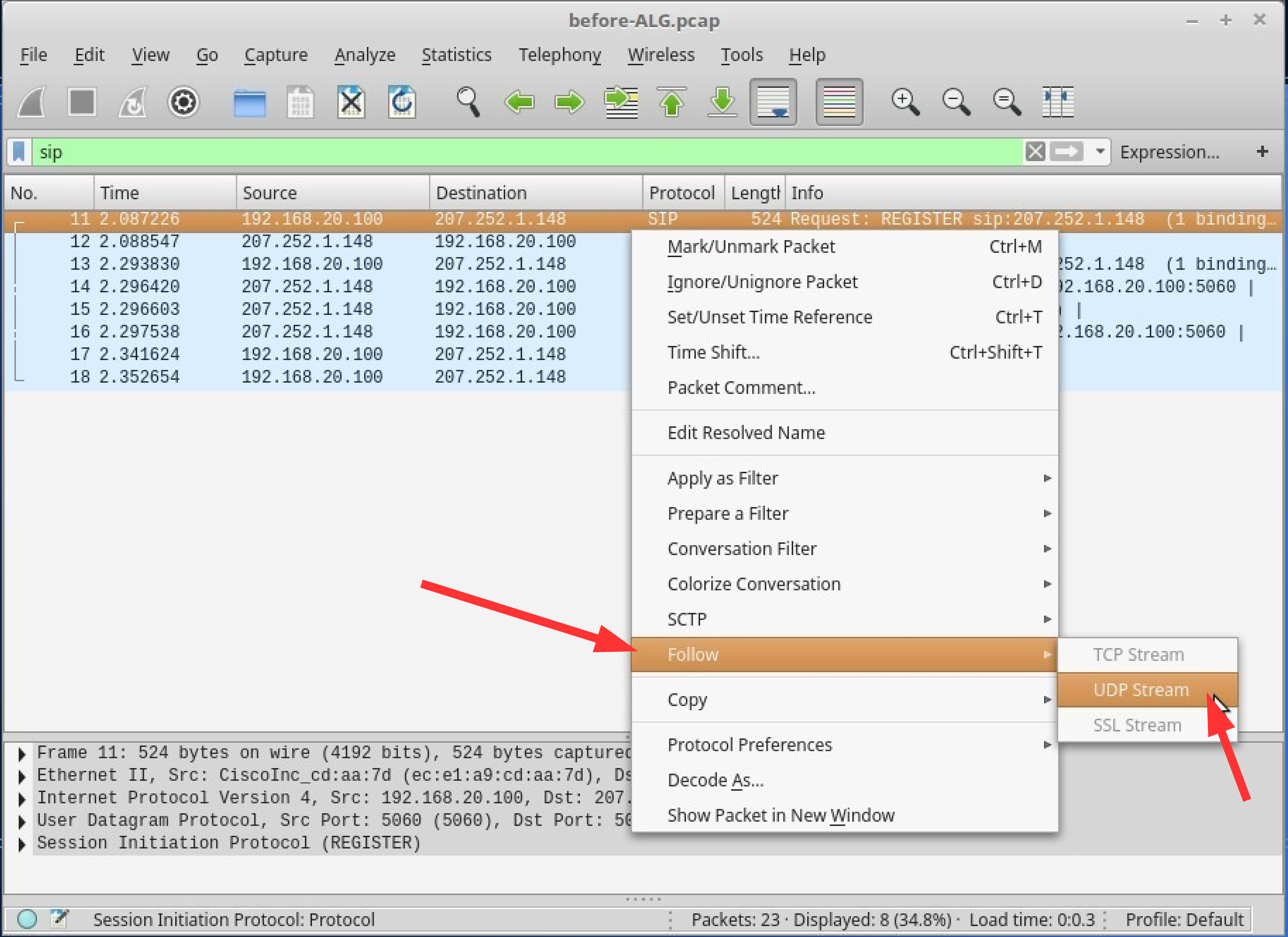


```
 o.      Time         Source            Destination       Protocol  Lengtl Info
      11 2.087226     192.168.20.100    207.252.1.148     SIP        524 Request: REGISTER sip:207.252.1.148  (1 binding…
      12 2.088547     207.252.1.148     192.168.20.100    SIP        580 Status: 401 Unauthorized |
      13 2.293830     192.168.20.100    207.252.1.148     SIP        678 Request: REGISTER sip:207.252.1.148  (1 binding…
      14 2.296420     207.252.1.148     192.168.20.100    SIP        601 Request: OPTIONS sip:100@192.168.20.100:5060 |
      15 2.296603     207.252.1.148     192.168.20.100    SIP        599 Status: 200 OK  (1 binding) |
      16 2.297538     207.252.1.148     192.168.20.100    SIP        605 Request: NOTIFY sip:100@192.168.20.100:5060 |
      17 2.341624     192.168.20.100    207.252.1.148     SIP        460 Status: 200 OK |
      18 2.352654     192.168.20.100    207.252.1.148     SIP        367 Status: 200 OK |
```

```
▶ Frame 18: 367 bytes on wire (2936 bits), 367 bytes captured (2936 bits)
▶ Ethernet II, Src: CiscoInc_cd:aa:7d (ec:e1:a9:cd:aa:7d), Dst: Routerbo_c3:62:47 (4c:5e:0c:c3:62:47)
▶ Internet Protocol Version 4, Src: 192.168.20.100, Dst: 207.252.1.148
▶ User Datagram Protocol, Src Port: 5060 (5060), Dst Port: 5060 (5060)
▶ Session Initiation Protocol (200)
```

Session Initiation Protocol: Protocol | Packets: 23 · Displayed: 8 (34.8%) · Load time: 0:0.3 | Profile: Default

Decode in wireshark



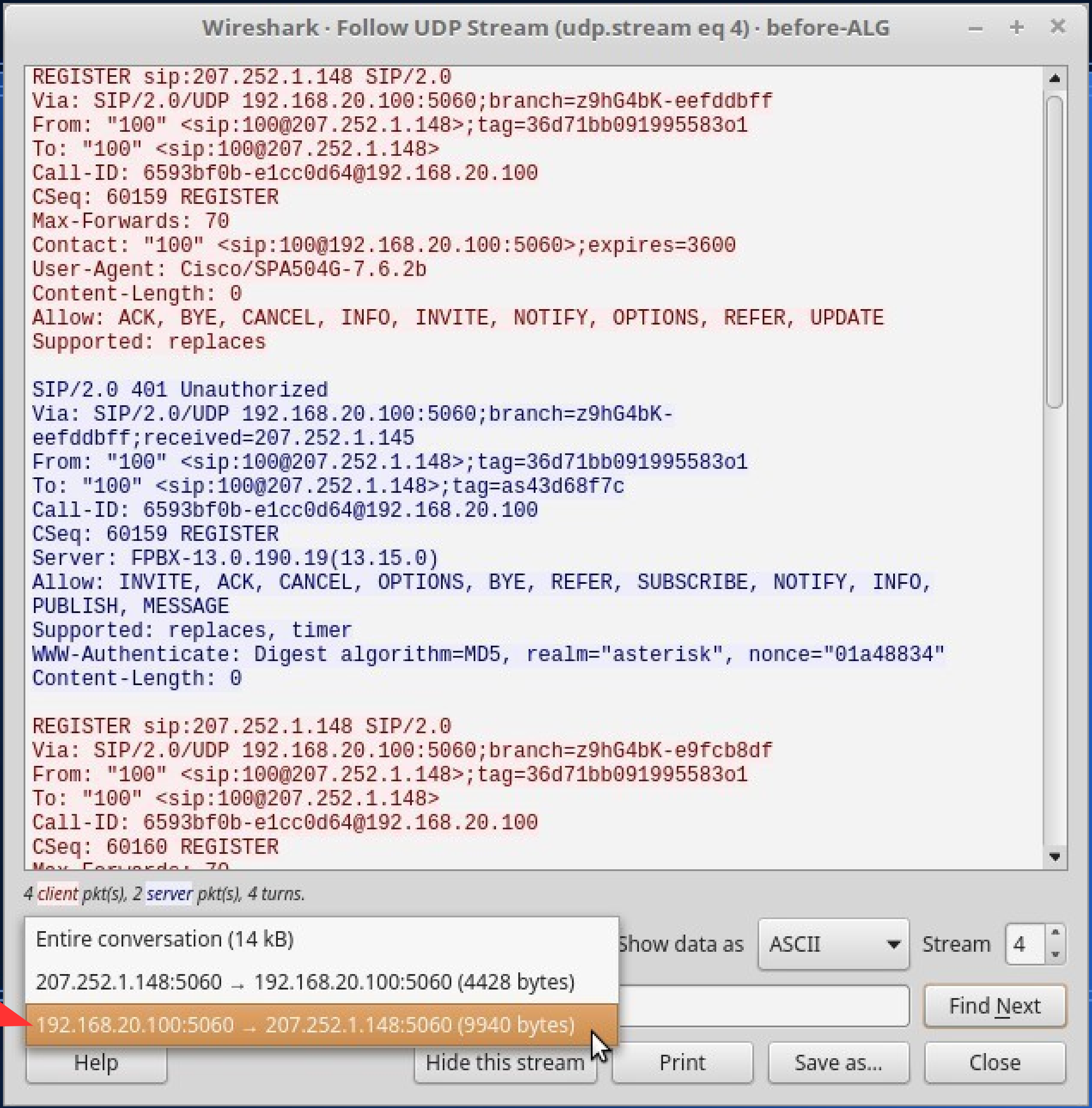
Filter: sip

No.	Time	Source	Destination	Protocol	Lengtl	Info
11	2.087226	192.168.20.100	207.252.1.148	SIP	524	Request: REGISTER sip:207.252.1.148 (1 binding…
12	2.088547	207.252.1.148	192.168.20.100			
13	2.293830	192.168.20.100	207.252.1.148			252.1.148 (1 binding…
14	2.296420	207.252.1.148	192.168.20.100			92.168.20.100:5060 |
15	2.296603	207.252.1.148	192.168.20.100			) |
16	2.297538	207.252.1.148	192.168.20.100			.168.20.100:5060 |
17	2.341624	192.168.20.100	207.252.1.148			
18	2.352654	192.168.20.100	207.252.1.148			

```
▸ Frame 11: 524 bytes on wire (4192 bits), 524 bytes capturec
▸ Ethernet II, Src: CiscoInc_cd:aa:7d (ec:e1:a9:cd:aa:7d), Ds
▸ Internet Protocol Version 4, Src: 192.168.20.100, Dst: 207.
▸ User Datagram Protocol, Src Port: 5060 (5060), Dst Port: 50
▸ Session Initiation Protocol (REGISTER)
```

Session Initiation Protocol: Protocol | Packets: 23 · Displayed: 8 (34.8%) · Load time: 0:0.3 | Profile: Default

Decode in wireshark



Wireshark · Follow UDP Stream (udp.stream eq 4) · before-ALG

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-eefddbff
From: "100" <sip:100@207.252.1.148>;tag=36d71bb091995583o1
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60159 REGISTER
Max-Forwards: 70
Contact: "100" <sip:100@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces

SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-
eefddbff;received=207.252.1.145
From: "100" <sip:100@207.252.1.148>;tag=36d71bb091995583o1
To: "100" <sip:100@207.252.1.148>;tag=as43d68f7c
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60159 REGISTER
Server: FPBX-13.0.190.19(13.15.0)
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, SUBSCRIBE, NOTIFY, INFO,
PUBLISH, MESSAGE
Supported: replaces, timer
WWW-Authenticate: Digest algorithm=MD5, realm="asterisk", nonce="01a48834"
Content-Length: 0

REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-e9fcb8df
From: "100" <sip:100@207.252.1.148>;tag=36d71bb091995583o1
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60160 REGISTER
Max-Forwards: 70
```

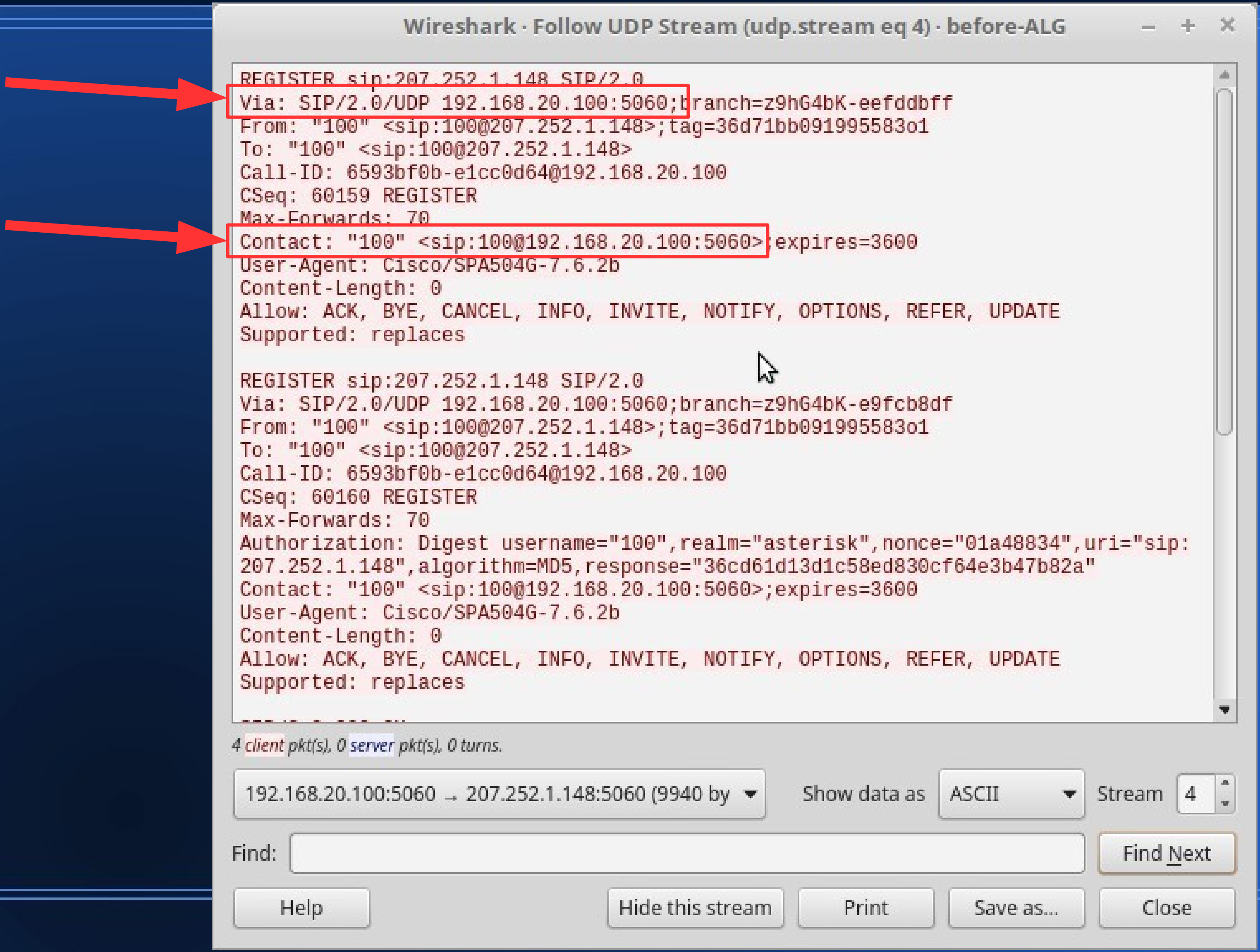
4 client pkt(s), 2 server pkt(s), 4 turns.

Entire conversation (14 kB)
207.252.1.148:5060 → 192.168.20.100:5060 (4428 bytes)
192.168.20.100:5060 → 207.252.1.148:5060 (9940 bytes)

Show data as ASCII

Stream 4

Decode in wireshark



Wireshark · Follow UDP Stream (udp.stream eq 4) · before-ALG

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-eefddbff
From: "100" <sip:100@207.252.1.148>;tag=36d71bb0919955830l
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60159 REGISTER
Max-Forwards: 70
Contact: "100" <sip:100@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces

REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-e9fcb8df
From: "100" <sip:100@207.252.1.148>;tag=36d71bb0919955830l
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60160 REGISTER
Max-Forwards: 70
Authorization: Digest username="100",realm="asterisk",nonce="01a48834",uri="sip:
207.252.1.148",algorithm=MD5,response="36cd61d13d1c58ed830cf64e3b47b82a"
Contact: "100" <sip:100@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

4 client pkt(s), 0 server pkt(s), 0 turns.

192.168.20.100:5060 → 207.252.1.148:5060 (9940 by

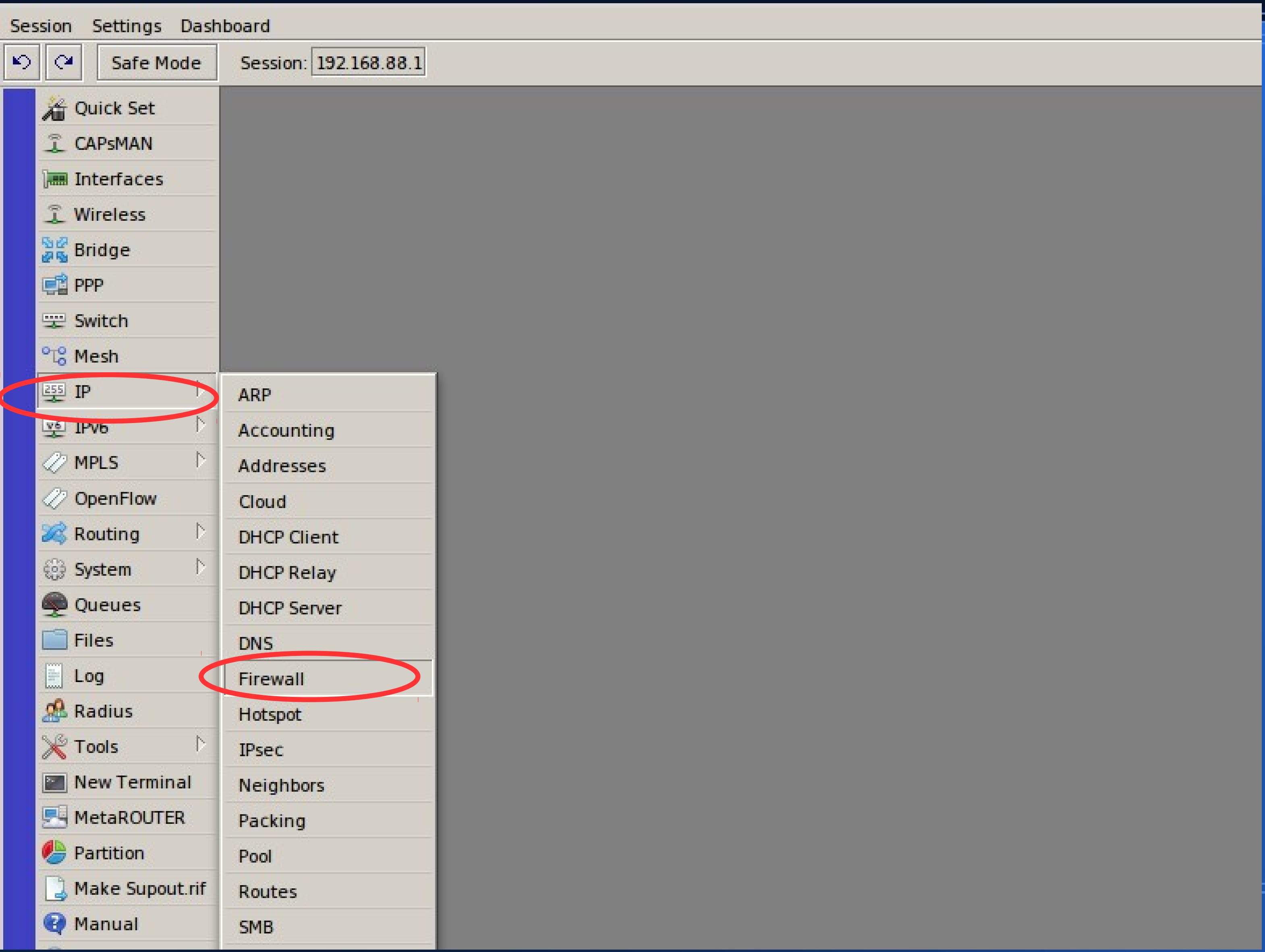
Show data as: ASCII

Stream: 4

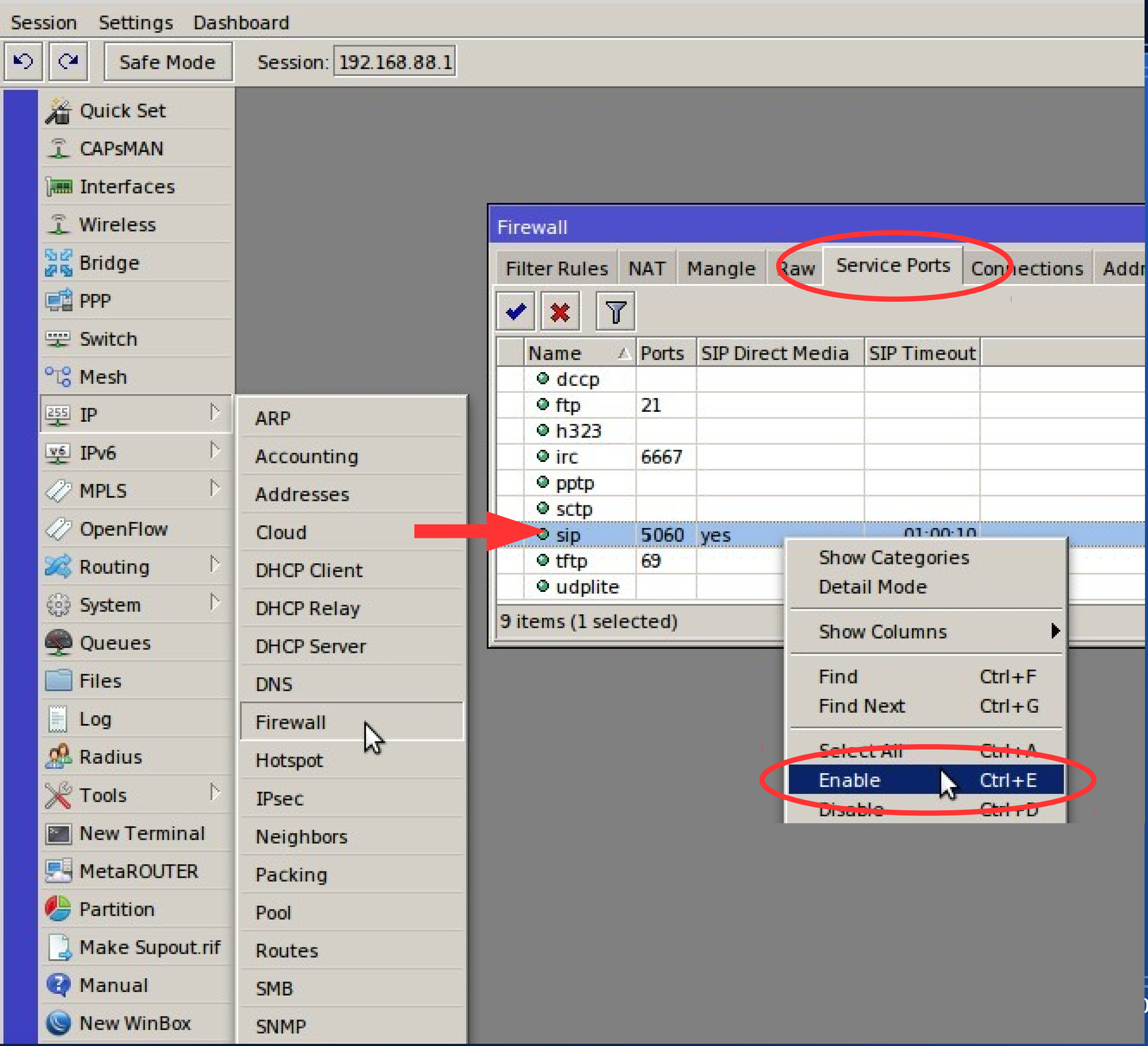
Find:

If your SIP device is not NAT Aware
Enable SIP ALG !

Enable SIP ALG



Enable SIP ALG



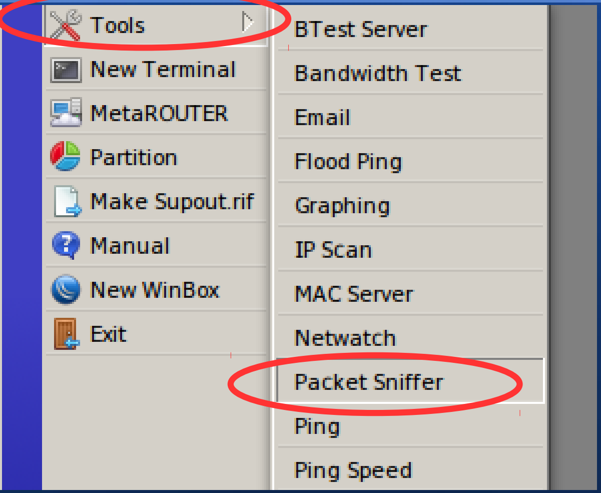
Name	Ports	SIP Direct Media	SIP Timeout
dccp			
ftp	21		
h323			
irc	6667		
pptp			
sctp			
sip	5060	yes	01:00:10
tftp	69		
udplite			

9 items (1 selected)

/ip firewall service-port enable sip

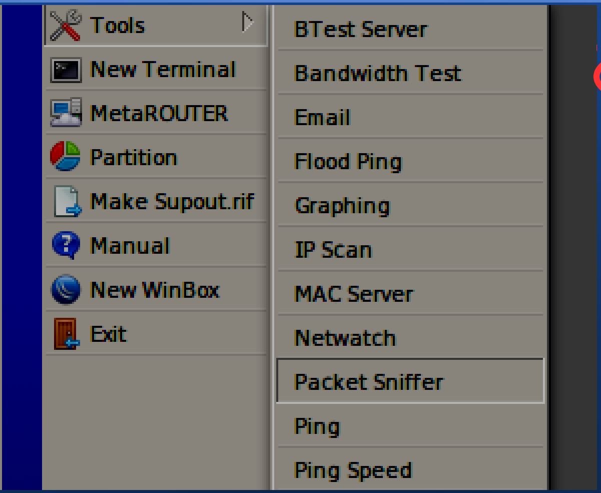
capture packets after ALG modification

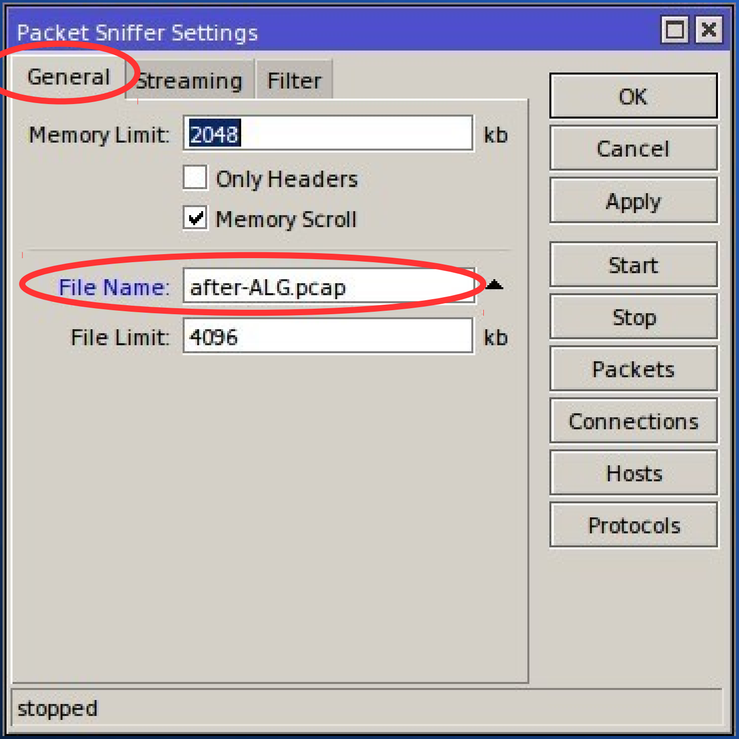
After ALG modifications pcap



/tool sniffer

After ALG modifications pcap




Packet Sniffer Settings

General | Streaming | Filter

Memory Limit: 2048 kb

□ Only Headers

☑ Memory Scroll

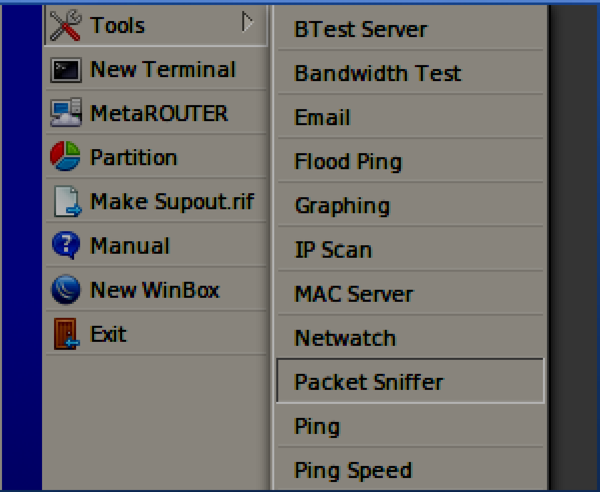
File Name: after-ALG.pcap

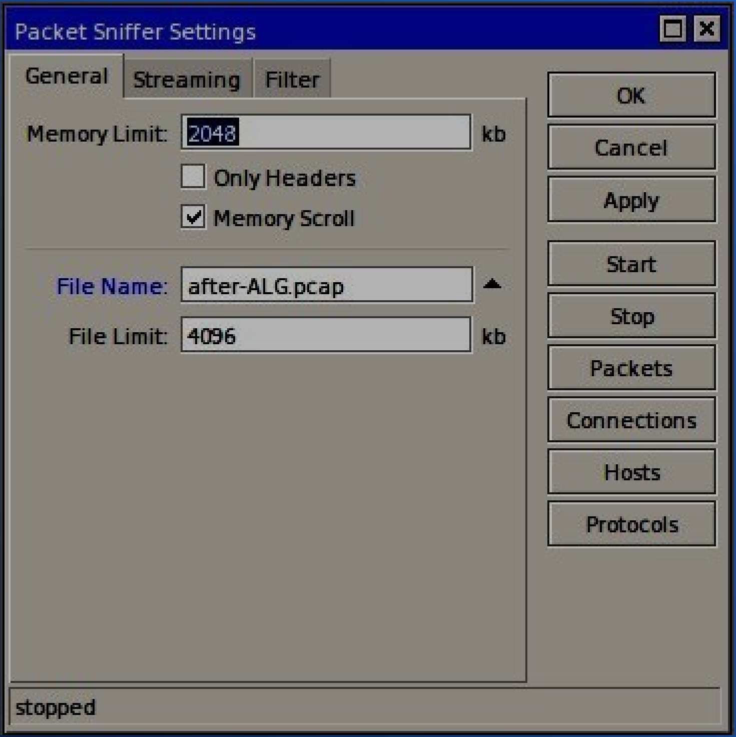
File Limit: 4096 kb

stopped

```
/tool sniffer
set only-headers=no file-name=after-ALG.pcap file-limit=4096
```

After ALG modifications pcap




Packet Sniffer Settings

Memory Limit: 2048 kb

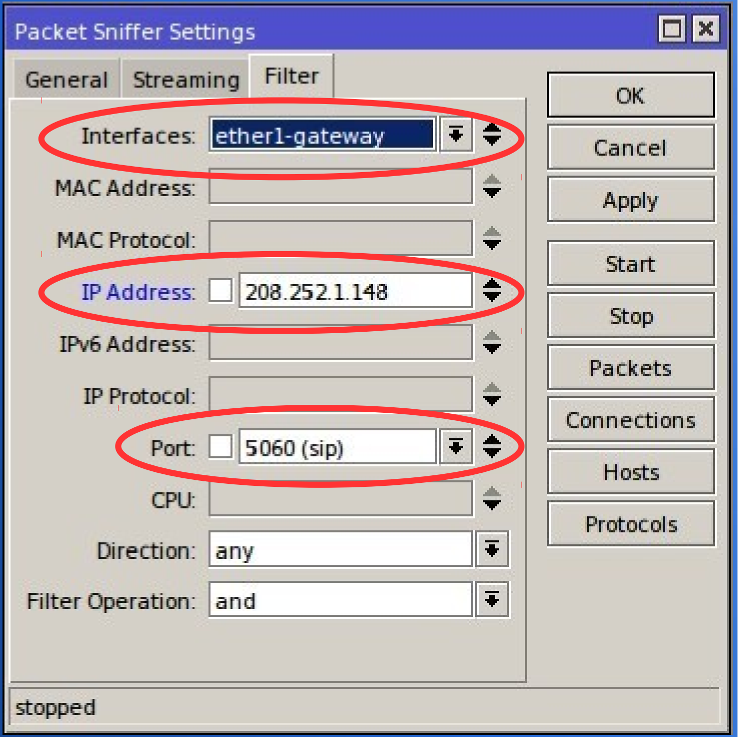
□ Only Headers

☑ Memory Scroll

File Name: after-ALG.pcap

File Limit: 4096 kb

stopped


Packet Sniffer Settings

Interfaces: ether1-gateway

MAC Address:

MAC Protocol:

IP Address: □ 208.252.1.148

IPv6 Address:

IP Protocol:

Port: □ 5060 (sip)

CPU:

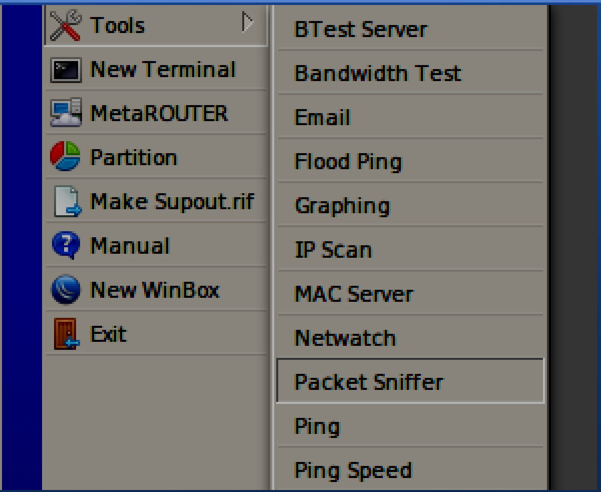
Direction: any

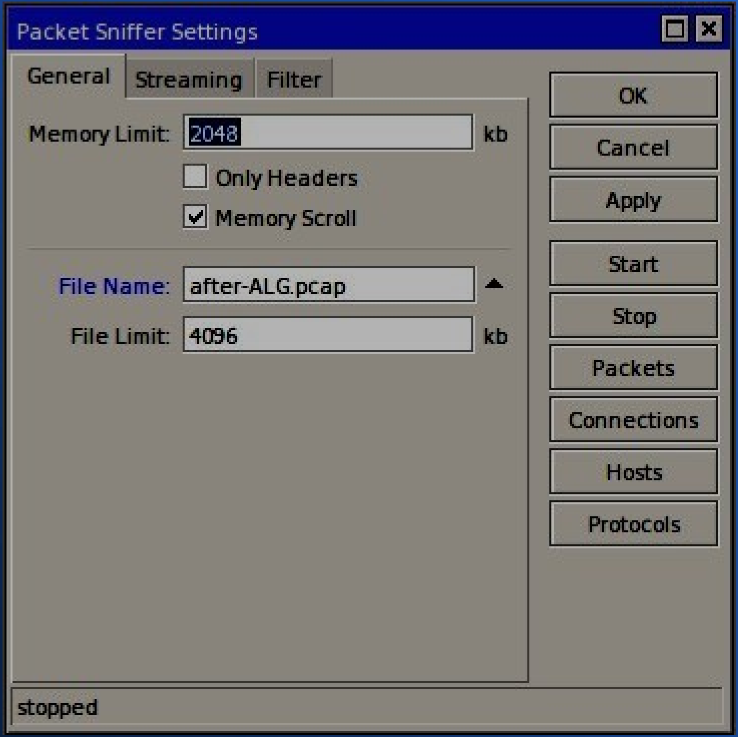
Filter Operation: and

stopped

```
/tool sniffer
set only-headers=no file-name=after-ALG.pcap file-limit=4096 filter-interface=ether1-gateway
filter-ip-address=207.252.1.148/32 filter-port=5060 filter-direction=any
```

After ALG modifications pcap





Memory Limit: 2048 kb

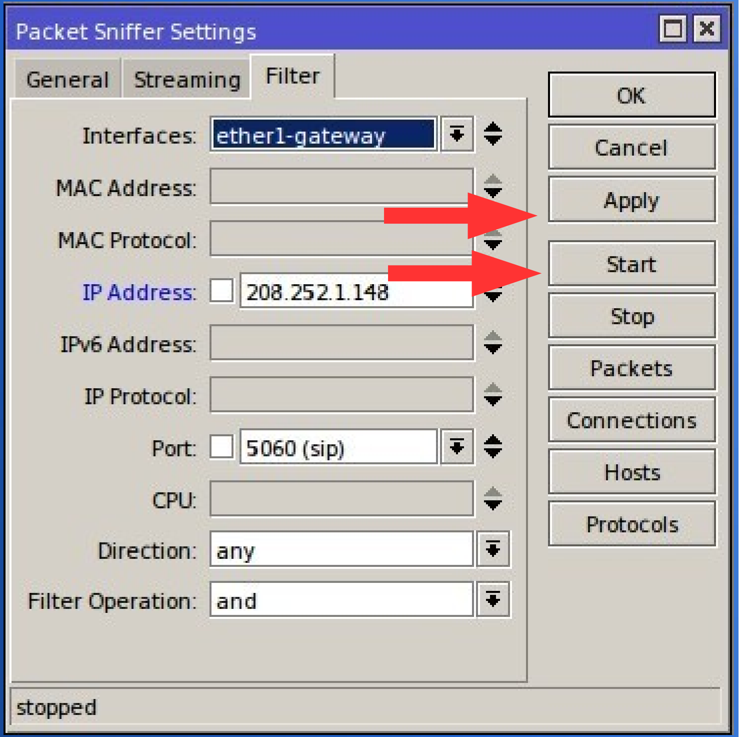
□ Only Headers

☑ Memory Scroll

File Name: after-ALG.pcap

File Limit: 4096 kb

stopped



Interfaces: ether1-gateway

MAC Address:

MAC Protocol:

IP Address: □ 208.252.1.148

IPv6 Address:

IP Protocol:

Port: □ 5060 (sip)

CPU:

Direction: any

Filter Operation: and

stopped

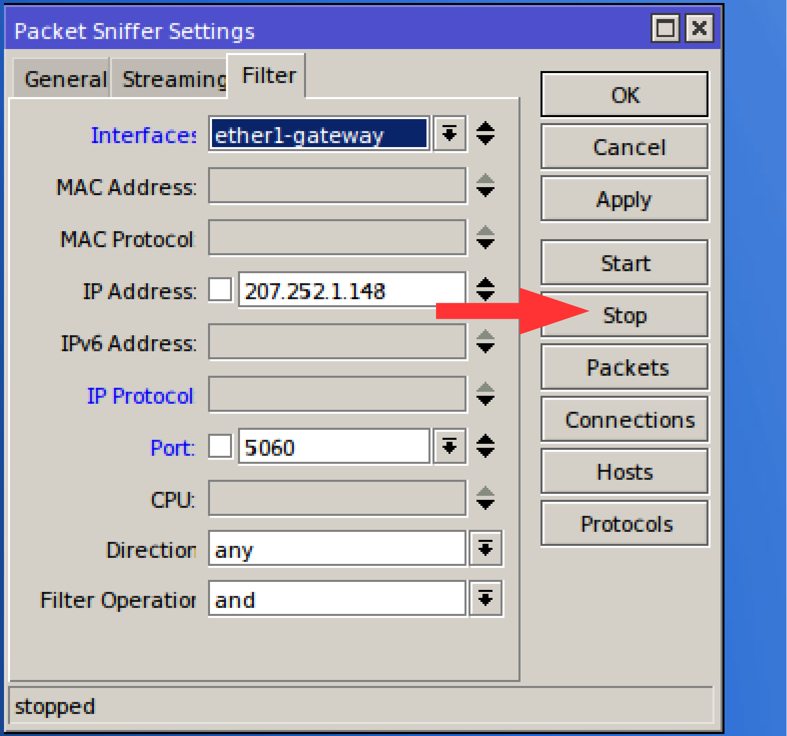
```
/tool sniffer
set only-headers=no file-name=after-ALG.pcap file-limit=4096 filter-interface=ether1-gateway
filter-ip-address=207.252.1.148/32 filter-port=5060 filter-direction=any

start
```

Generate some traffic while the sniffer is capturing packets.

After ALG modifications pcap

Make sure to stop the sniffer


Packet Sniffer Settings

General | Streaming | Filter

Interfaces: ether1-gateway

MAC Address:

MAC Protocol:

IP Address: □ 207.252.1.148

IPv6 Address:

IP Protocol:

Port: □ 5060

CPU:

Direction: any

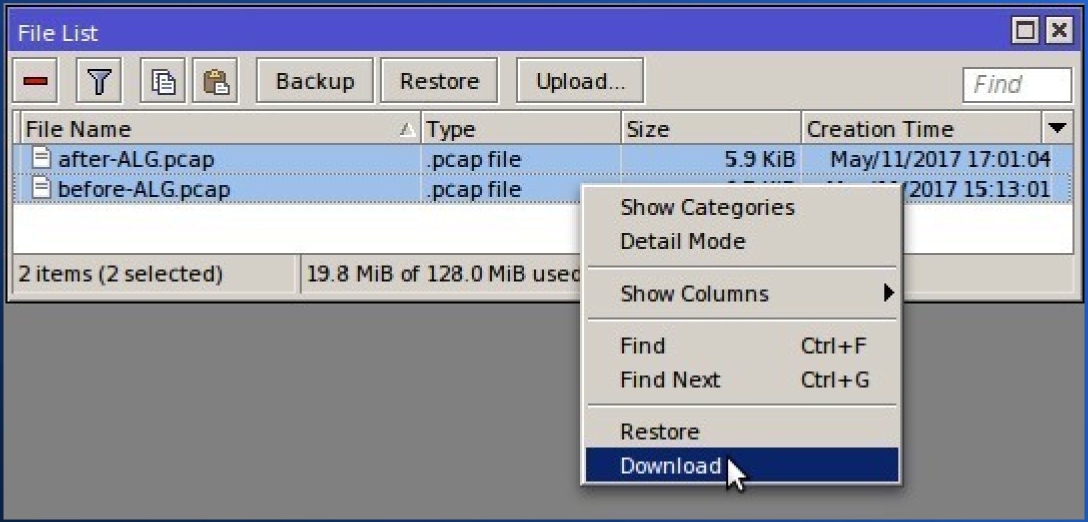
Filter Operation: and

stopped

/tool sniffer

stop

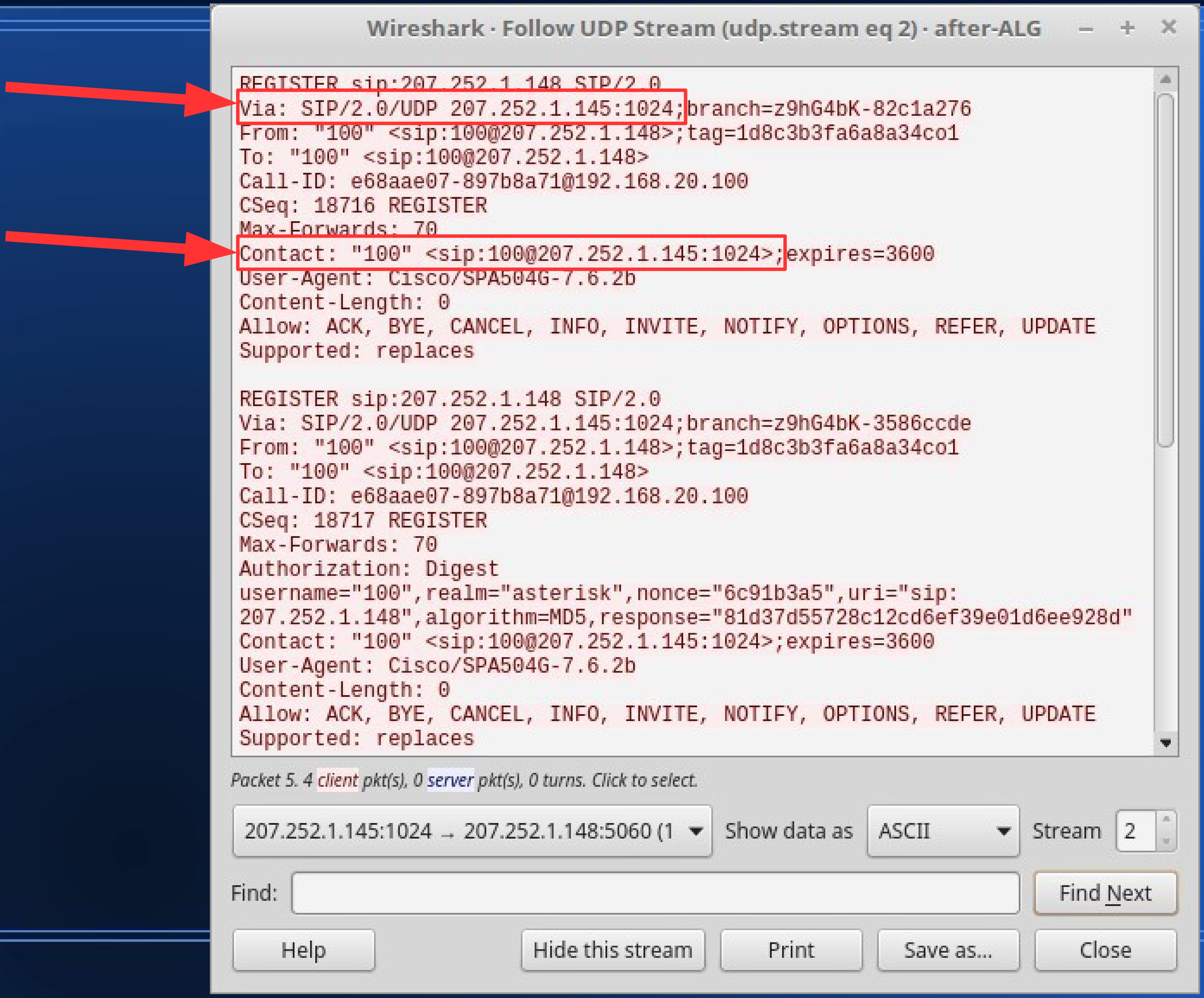
Download pcap files



File Name	Type	Size	Creation Time
after-ALG.pcap	.pcap file	5.9 KiB	May/11/2017 17:01:04
before-ALG.pcap	.pcap file	[illegible]	[illegible]2017 15:13:01

2 items (2 selected) 19.8 MiB of 128.0 MiB used

Decode in wireshark



Wireshark · Follow UDP Stream (udp.stream eq 2) · after-ALG

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 207.252.1.145:1024;branch=z9hG4bK-82c1a276
From: "100" <sip:100@207.252.1.148>;tag=1d8c3b3fa6a8a34co1
To: "100" <sip:100@207.252.1.148>
Call-ID: e68aae07-897b8a71@192.168.20.100
CSeq: 18716 REGISTER
Max-Forwards: 70
Contact: "100" <sip:100@207.252.1.145:1024>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces

REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 207.252.1.145:1024;branch=z9hG4bK-3586ccde
From: "100" <sip:100@207.252.1.148>;tag=1d8c3b3fa6a8a34co1
To: "100" <sip:100@207.252.1.148>
Call-ID: e68aae07-897b8a71@192.168.20.100
CSeq: 18717 REGISTER
Max-Forwards: 70
Authorization: Digest
username="100",realm="asterisk",nonce="6c91b3a5",uri="sip:
207.252.1.148",algorithm=MD5,response="81d37d55728c12cd6ef39e01d6ee928d"
Contact: "100" <sip:100@207.252.1.145:1024>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

Packet 5. 4 client pkt(s), 0 server pkt(s), 0 turns. Click to select.

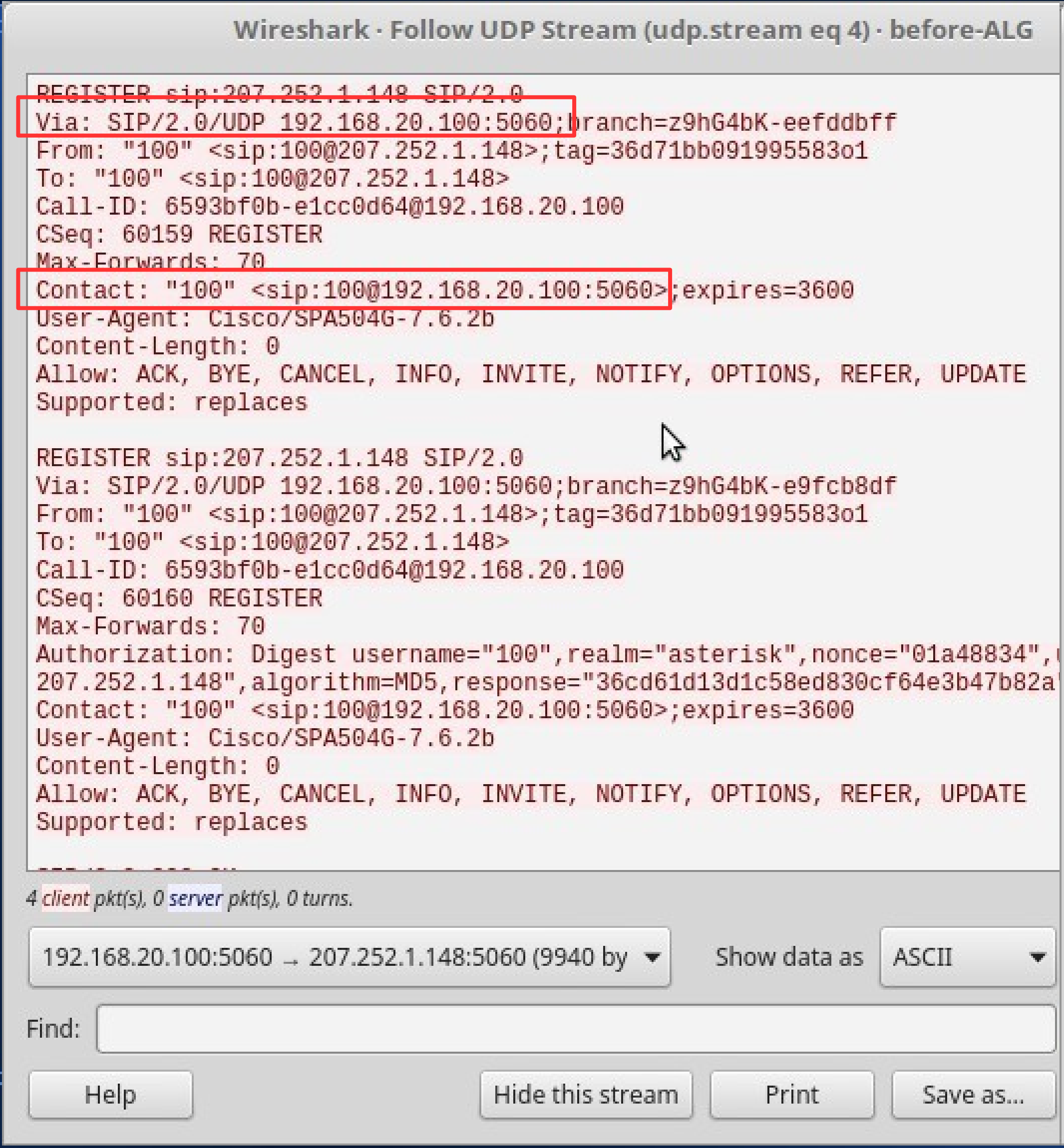
207.252.1.145:1024 → 207.252.1.148:5060 (1

Show data as: ASCII

Stream: 2

Find:

ALG Enabled
Before modification & after modification



Wireshark · Follow UDP Stream (udp.stream eq 4) · before-ALG

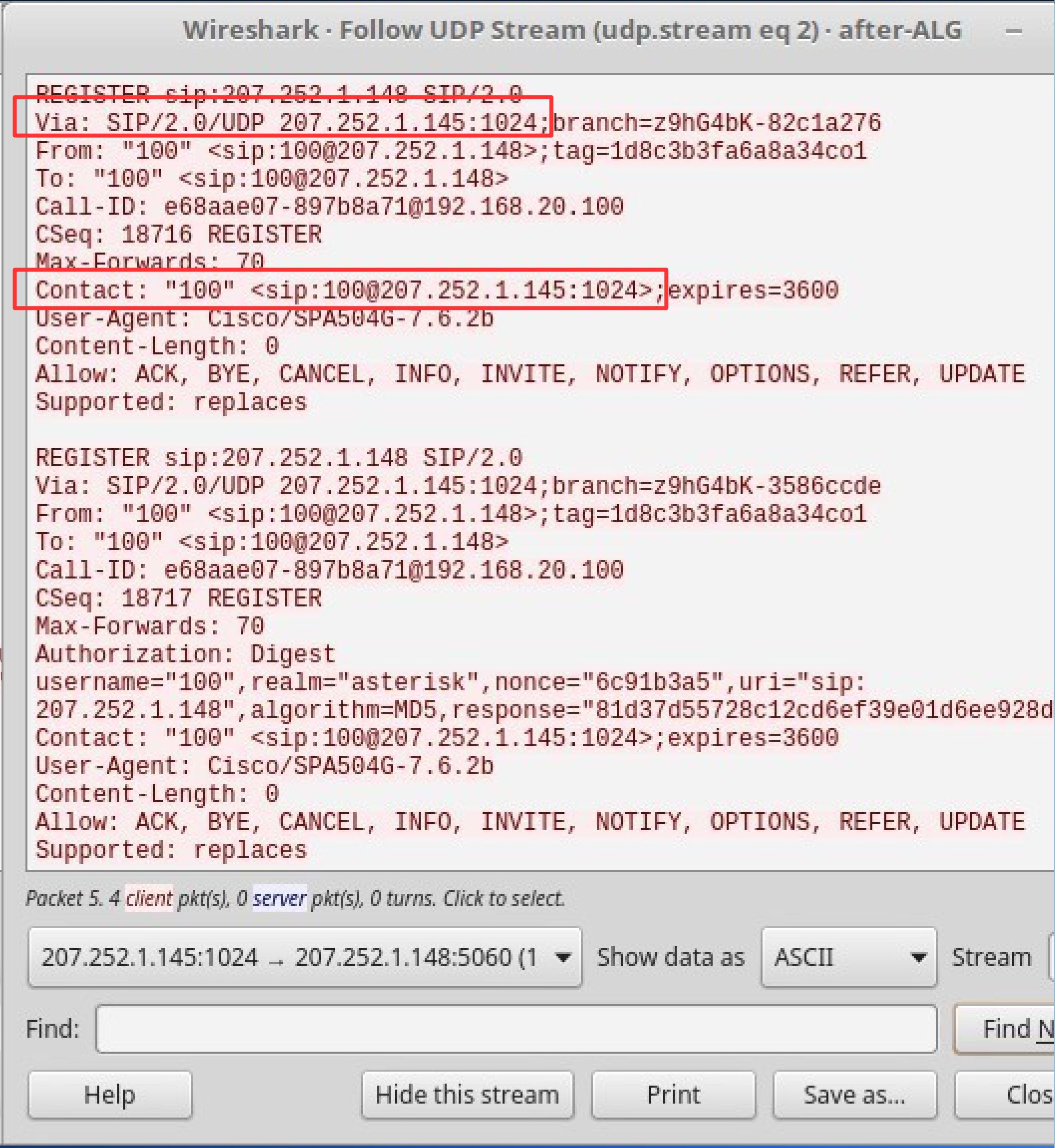
```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-eefddbff
From: "100" <sip:100@207.252.1.148>;tag=36d71bb091995583o1
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60159 REGISTER
Max-Forwards: 70
Contact: "100" <sip:100@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces

REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-e9fcb8df
From: "100" <sip:100@207.252.1.148>;tag=36d71bb091995583o1
To: "100" <sip:100@207.252.1.148>
Call-ID: 6593bf0b-e1cc0d64@192.168.20.100
CSeq: 60160 REGISTER
Max-Forwards: 70
Authorization: Digest username="100",realm="asterisk",nonce="01a48834",
207.252.1.148",algorithm=MD5,response="36cd61d13d1c58ed830cf64e3b47b82a
Contact: "100" <sip:100@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

4 client pkt(s), 0 server pkt(s), 0 turns.

192.168.20.100:5060 → 207.252.1.148:5060 (9940 by

Show data as: ASCII



Wireshark · Follow UDP Stream (udp.stream eq 2) · after-ALG

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 207.252.1.145:1024;branch=z9hG4bK-82c1a276
From: "100" <sip:100@207.252.1.148>;tag=1d8c3b3fa6a8a34co1
To: "100" <sip:100@207.252.1.148>
Call-ID: e68aae07-897b8a71@192.168.20.100
CSeq: 18716 REGISTER
Max-Forwards: 70
Contact: "100" <sip:100@207.252.1.145:1024>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces

REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 207.252.1.145:1024;branch=z9hG4bK-3586ccde
From: "100" <sip:100@207.252.1.148>;tag=1d8c3b3fa6a8a34co1
To: "100" <sip:100@207.252.1.148>
Call-ID: e68aae07-897b8a71@192.168.20.100
CSeq: 18717 REGISTER
Max-Forwards: 70
Authorization: Digest
username="100",realm="asterisk",nonce="6c91b3a5",uri="sip:
207.252.1.148",algorithm=MD5,response="81d37d55728c12cd6ef39e01d6ee928d
Contact: "100" <sip:100@207.252.1.145:1024>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

Packet 5. 4 client pkt(s), 0 server pkt(s), 0 turns. Click to select.

207.252.1.145:1024 → 207.252.1.148:5060 (1

Show data as: ASCII

When is SIP ALG unnecessary?

When is SIP ALG unnecessary?

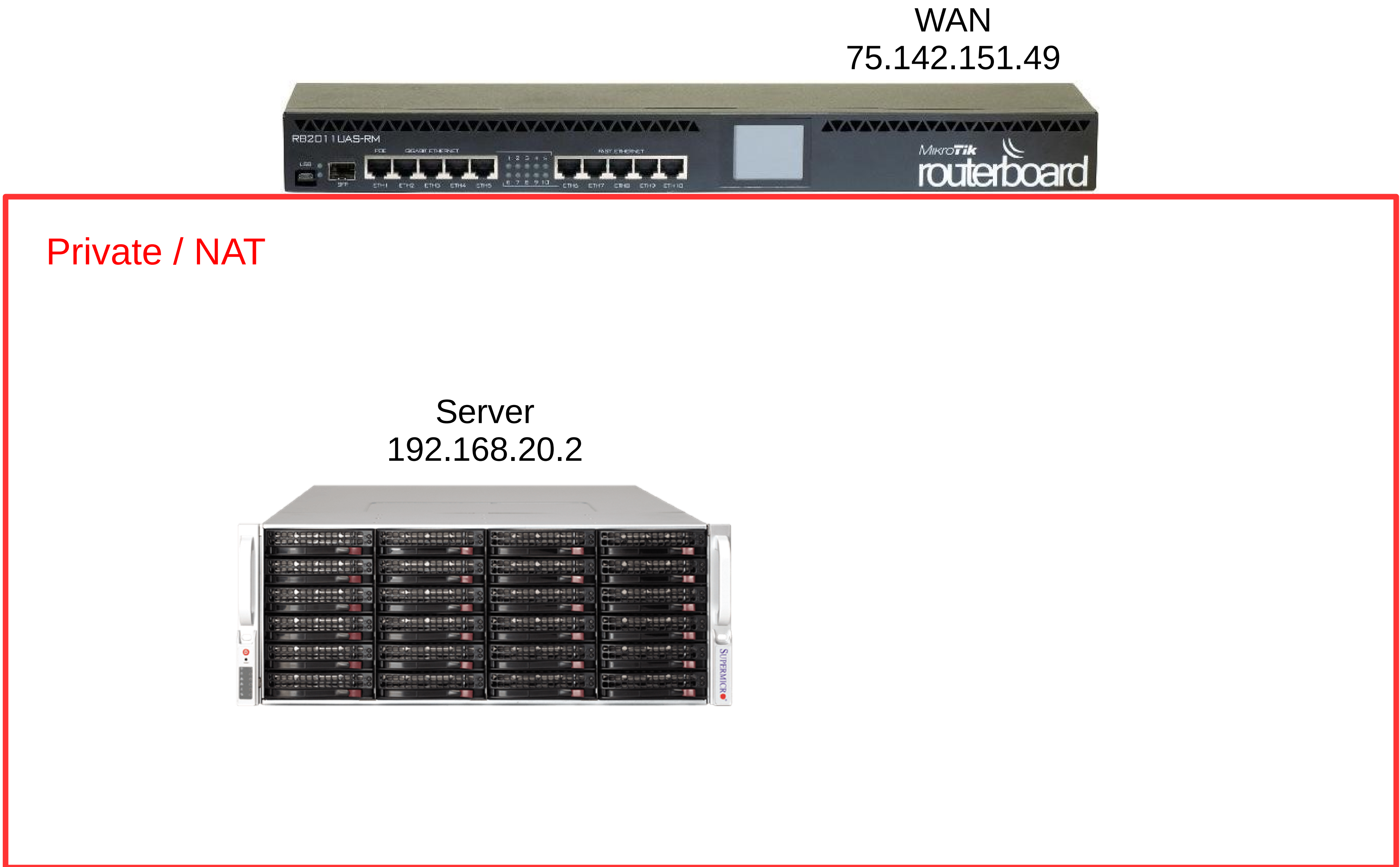
When the SIP device is NAT aware.

1. Server is behind NAT
2. Server is outside NAT (public server)

When is SIP ALG unnecessary?

SIP servers behind NAT

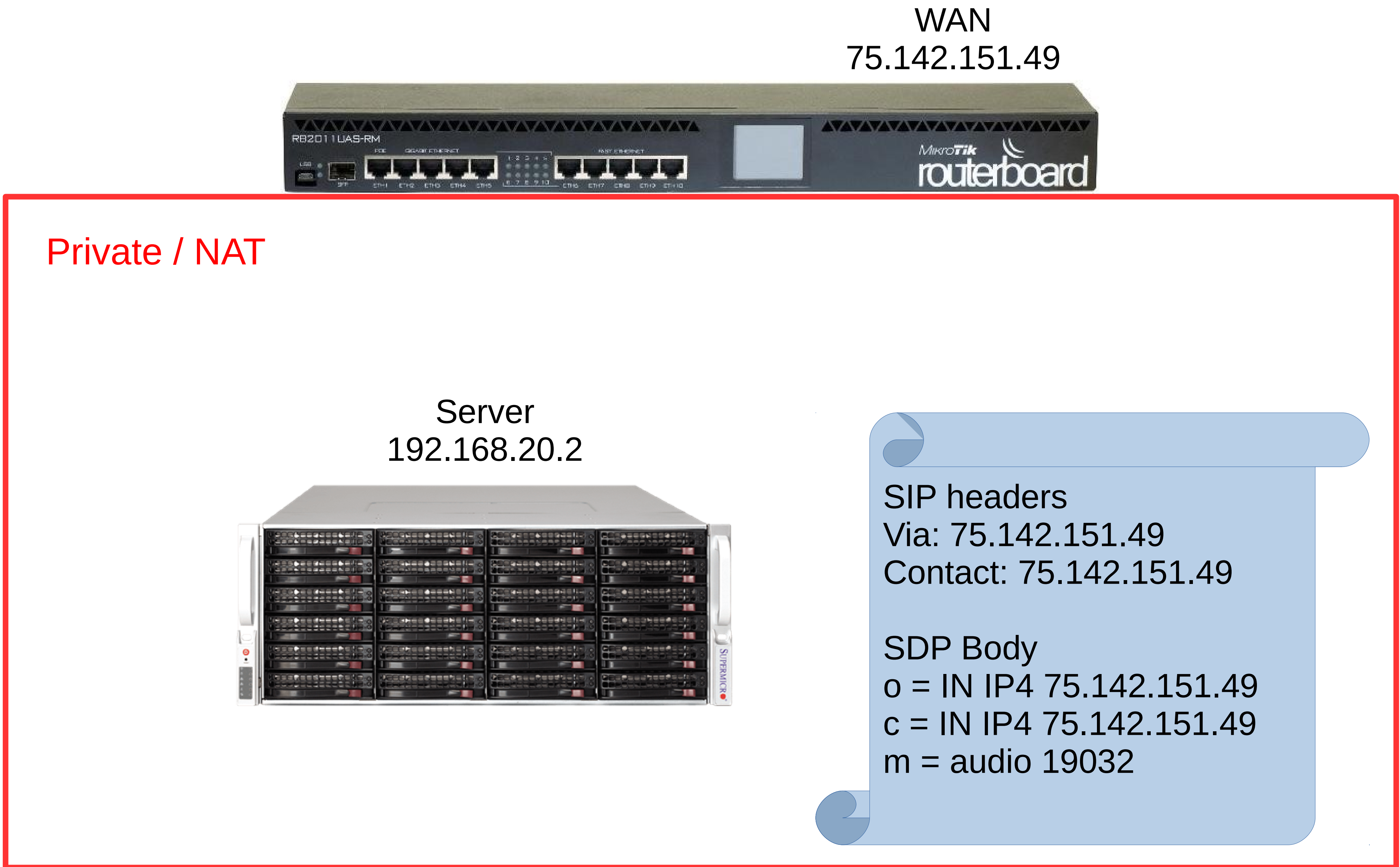
- Nat aware SIP servers have the option to detect their WAN ip and write it in the SIP/SDP messages where necessary, before sending it.
- FreePBX detects the WAN ip and inserts it in SIP messages where necessary.



WAN
75.142.151.49

Private / NAT

Server
192.168.20.2



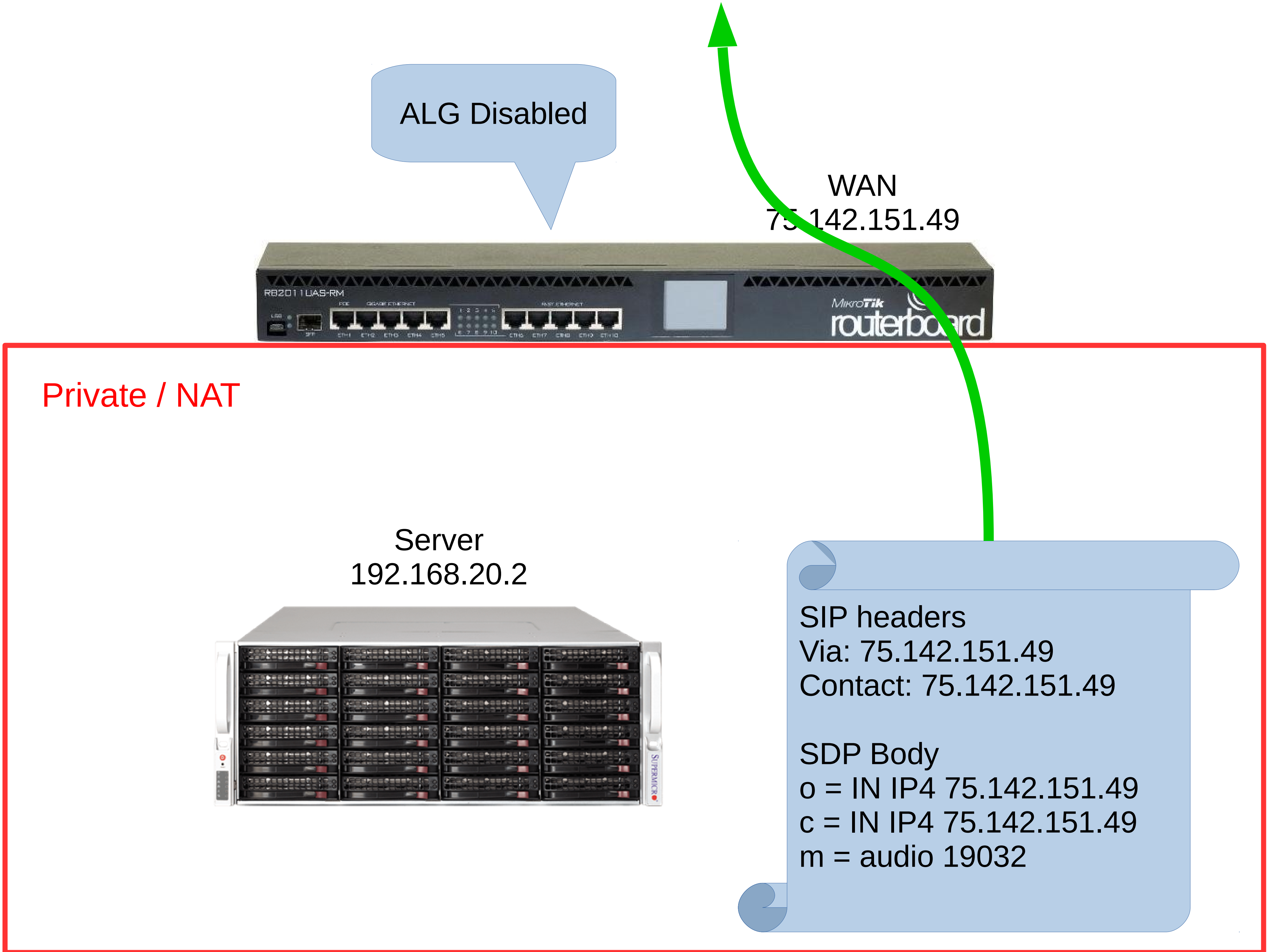
WAN
75.142.151.49

Private / NAT

Server
192.168.20.2

SIP headers
Via: 75.142.151.49
Contact: 75.142.151.49

SDP Body
o = IN IP4 75.142.151.49
c = IN IP4 75.142.151.49
m = audio 19032



ALG Disabled

WAN
75.142.151.49

Private / NAT

Server
192.168.20.2

SIP headers
Via: 75.142.151.49
Contact: 75.142.151.49

SDP Body
o = IN IP4 75.142.151.49
c = IN IP4 75.142.151.49
m = audio 19032

Servers outside NAT (public server)

Servers outside NAT (public server)

- SIP servers have NAT options for each extension

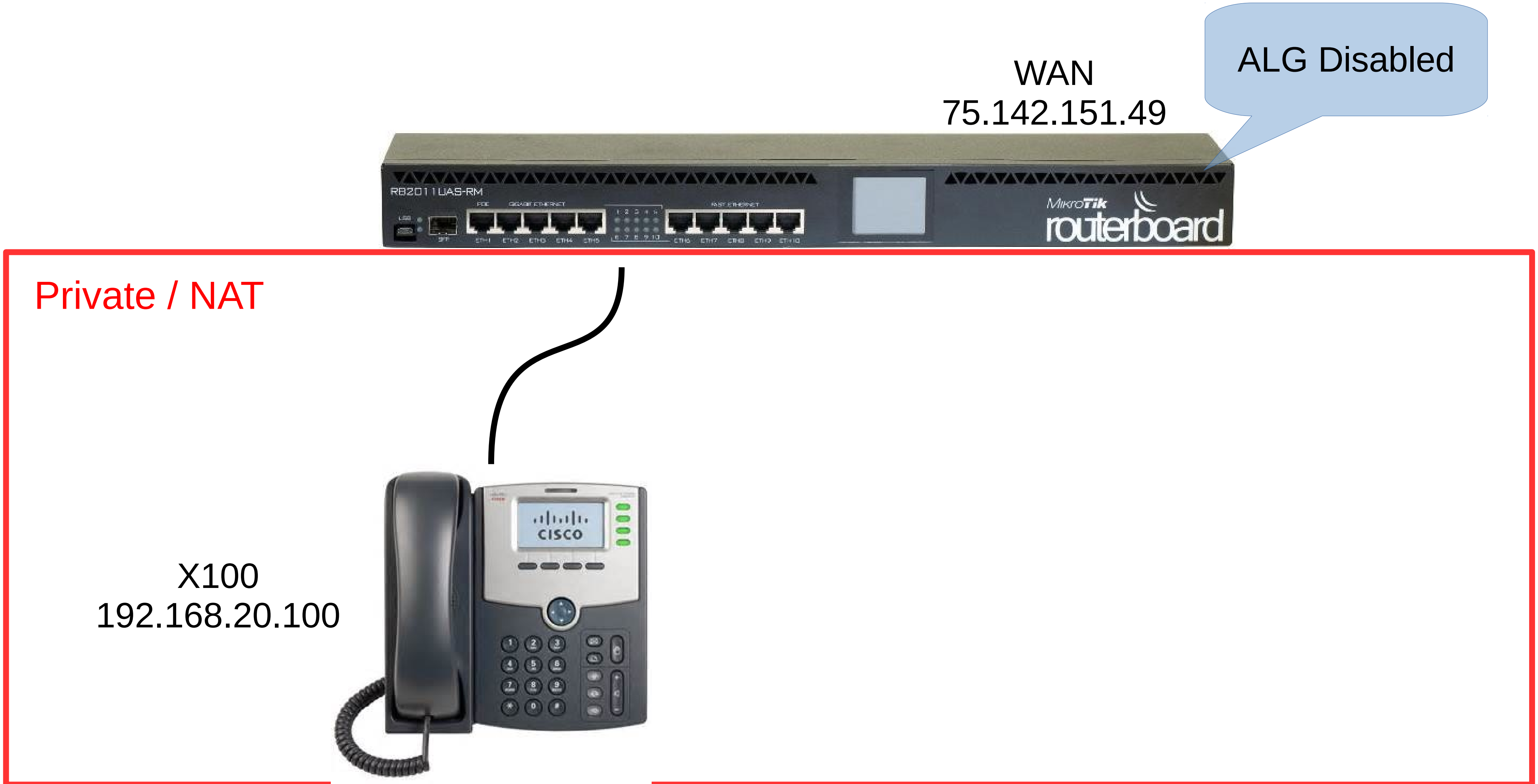
Servers outside NAT (public server)

- SIP servers have NAT options for each extension
- If server side extension states NAT=Yes then send all responses to the client originating IP and Port.

WAN
75.142.151.49

ALG Disabled

Private / NAT

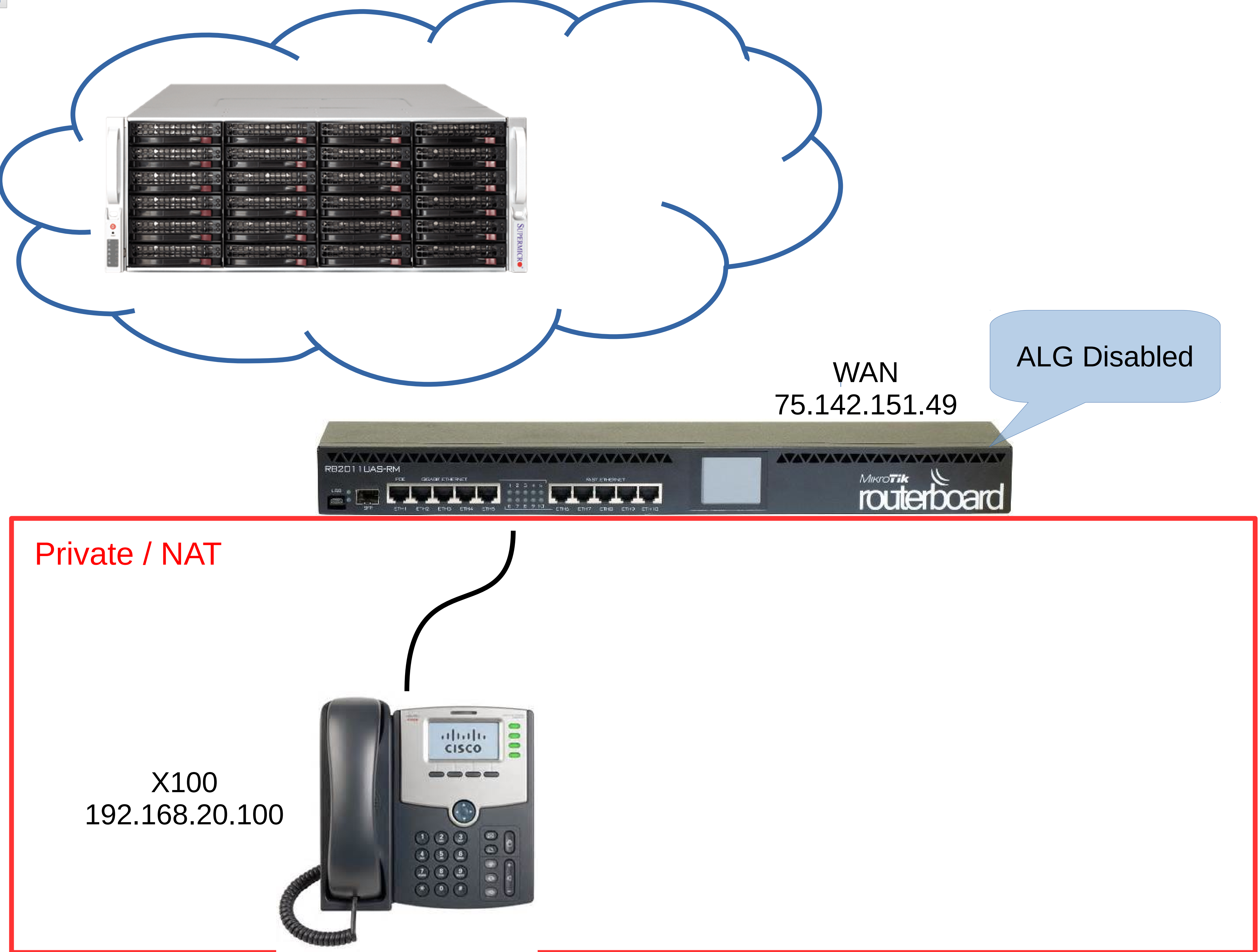


WAN
75.142.151.49

ALG Disabled

Private / NAT

X100
192.168.20.100

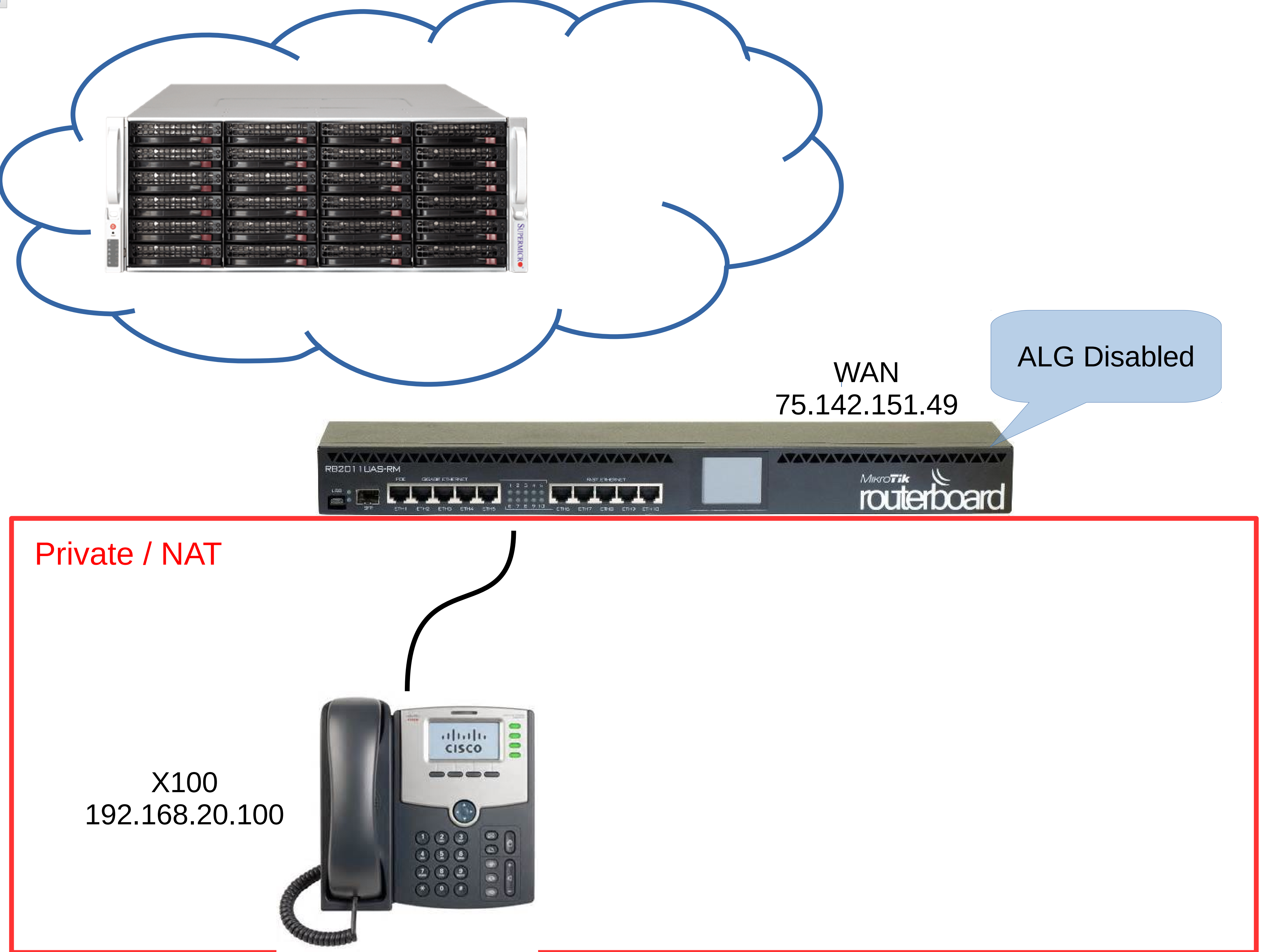


WAN
75.142.151.49

ALG Disabled

Private / NAT

X100
192.168.20.100

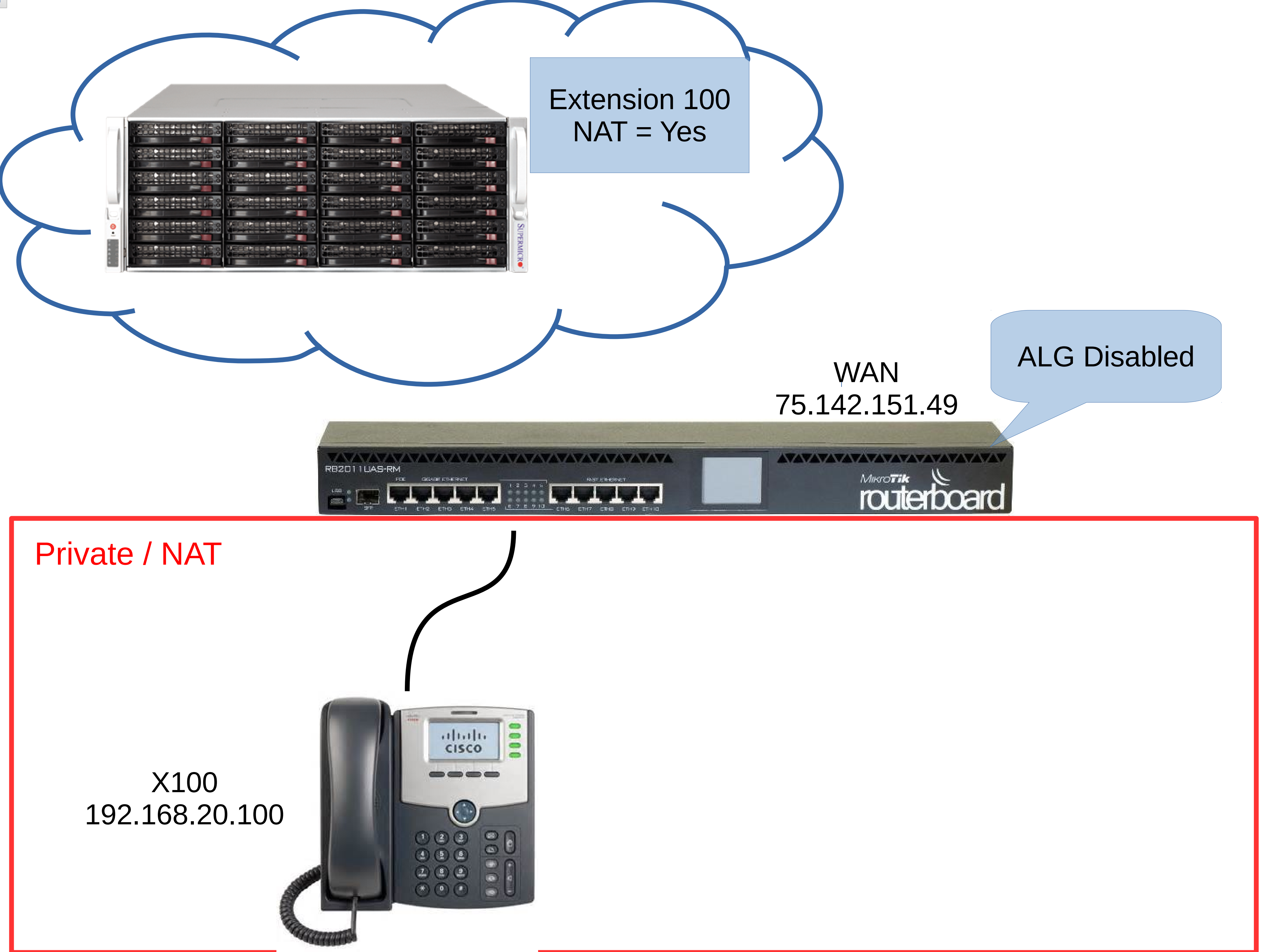


ALG Disabled

WAN
75.142.151.49

Private / NAT

X100
192.168.20.100



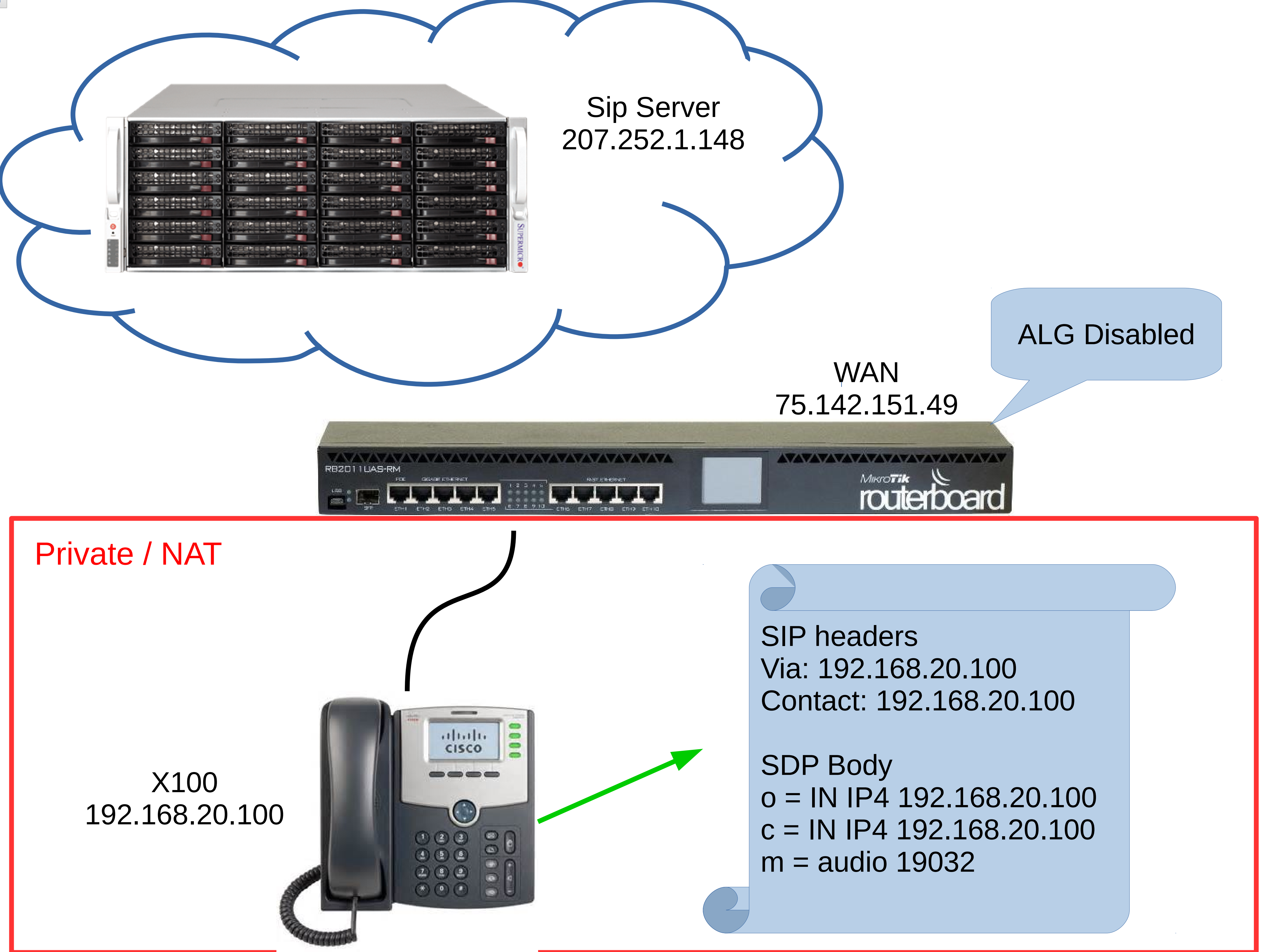
Extension 100
NAT = Yes

WAN
75.142.151.49

ALG Disabled

Private / NAT

X100
192.168.20.100



Sip Server
207.252.1.148

WAN
75.142.151.49

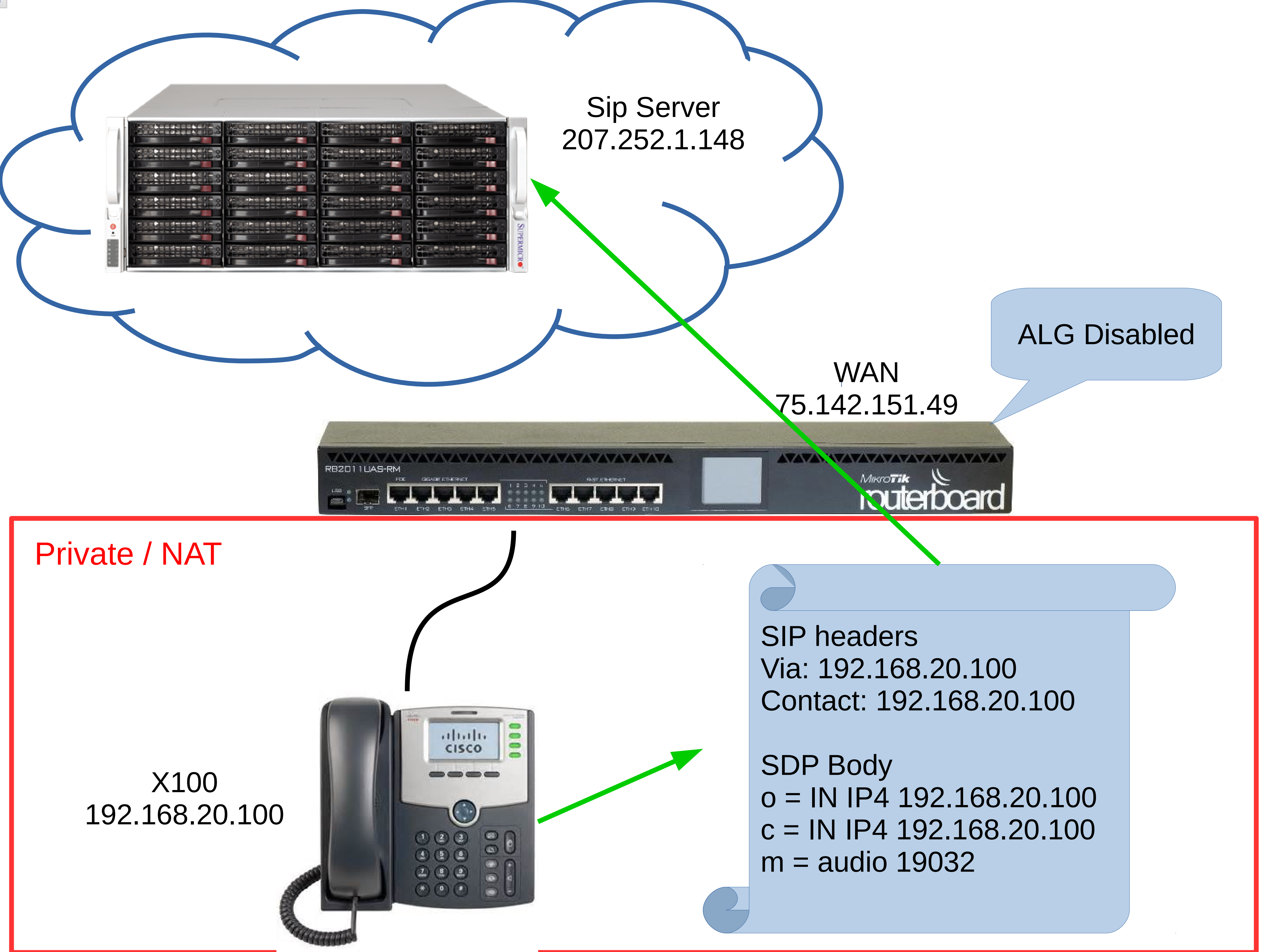
ALG Disabled

Private / NAT

X100
192.168.20.100

SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032



Sip Server
207.252.1.148

ALG Disabled

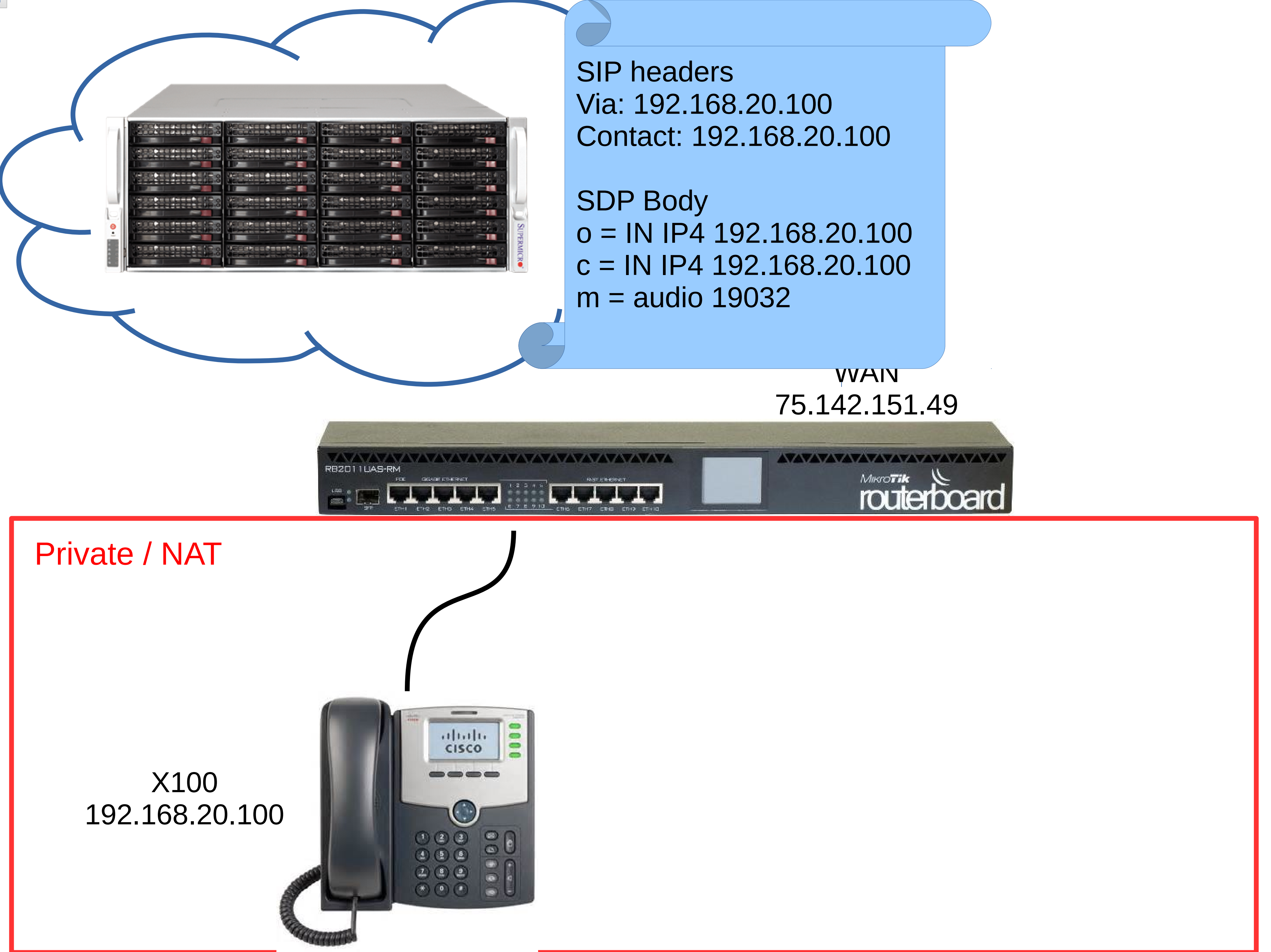
WAN
75.142.151.49

Private / NAT

X100
192.168.20.100

SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032



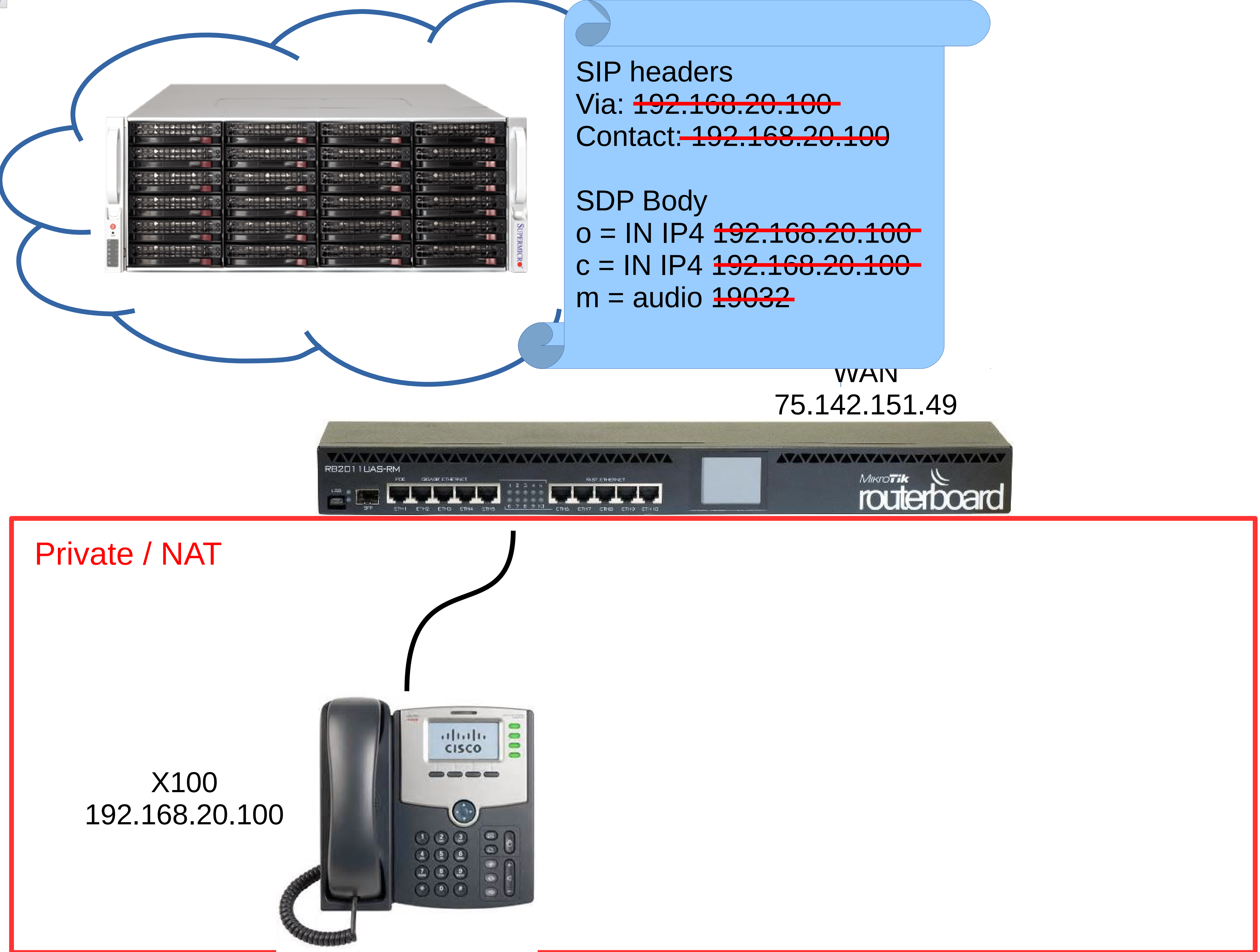
SIP headers
Via: 192.168.20.100
Contact: 192.168.20.100

SDP Body
o = IN IP4 192.168.20.100
c = IN IP4 192.168.20.100
m = audio 19032

WAN
75.142.151.49

Private / NAT

X100
192.168.20.100



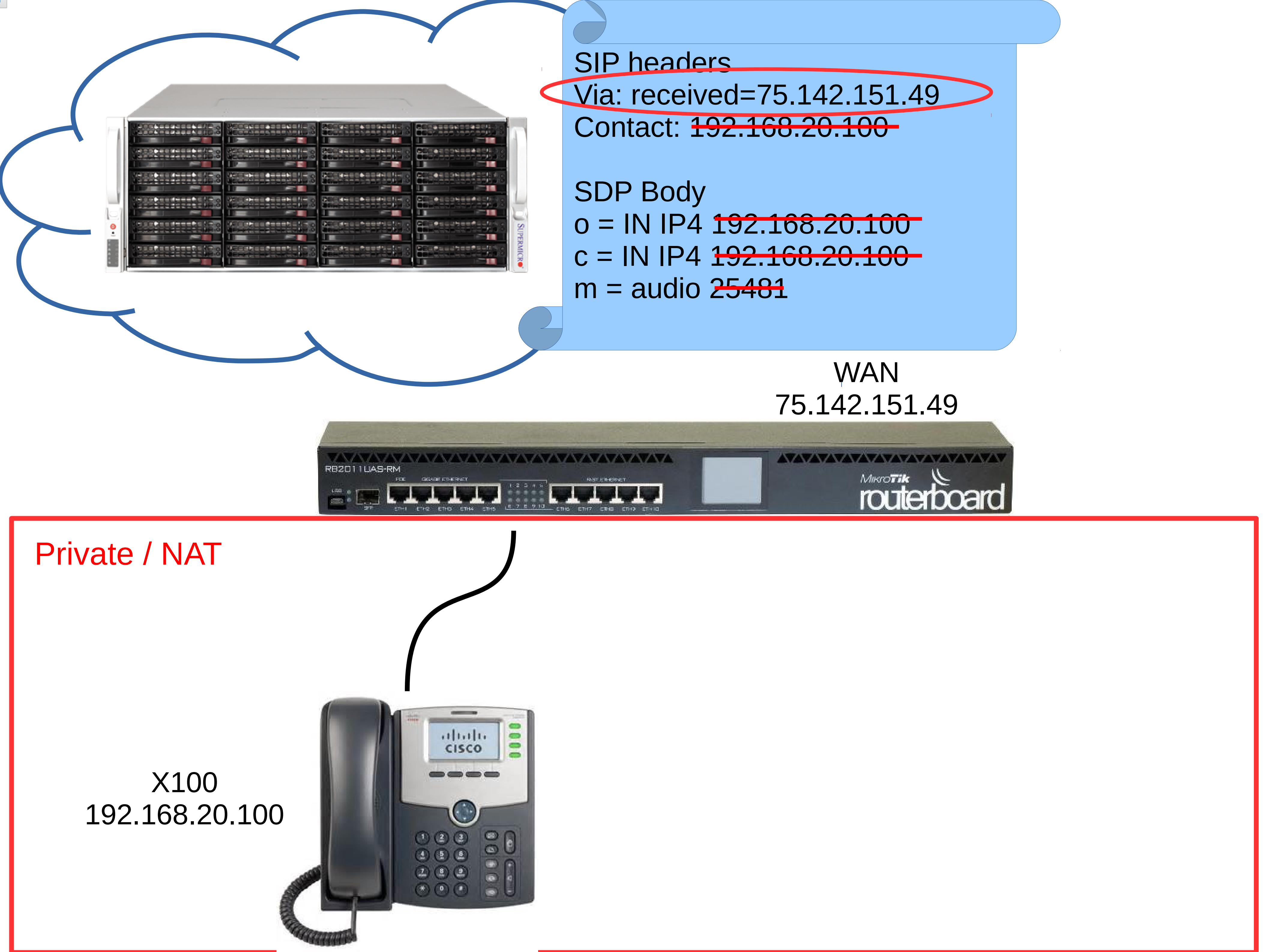
SIP headers
Via: ~~192.168.20.100~~
Contact: ~~192.168.20.100~~

SDP Body
o = IN IP4 ~~192.168.20.100~~
c = IN IP4 ~~192.168.20.100~~
m = audio ~~19032~~

WAN
75.142.151.49

Private / NAT

X100
192.168.20.100



SIP headers

Via: received=75.142.151.49

Contact: ~~192.168.20.100~~

SDP Body

o = IN IP4 ~~192.168.20.100~~

c = IN IP4 ~~192.168.20.100~~

m = audio ~~25481~~

WAN

75.142.151.49

Private / NAT

X100

192.168.20.100

When does ALG break VoIP?

When does ALG break VoIP?

- DOES NOT HAPPEN WITH Mikrotik RouterOS !
- Poor quality ALG’s replace ALL private IP’s in SIP headers, including Call-ID

When does ALG break VoIP?

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-8fb0e171
From: "David Attias" <sip:201525@207.252.1.148>;tag=191914b06beo0
To: "David Attias" <sip:201525@207.252.1.148>
Call-ID: 6894e30c-h1c8d357@192.168.20.100
CSeq: 1373 REGISTER
Max-Forwards: 70
Contact: "David Attias" <sip:201525@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

When does ALG break VoIP?

```
REGISTER sip:207.252.1.148 SIP/2.0
Via: SIP/2.0/UDP 192.168.20.100:5060;branch=z9hG4bK-8fb0e171
From: "David Attias" <sip:201525@207.252.1.148>;tag=191914b06beo0
To: "David Attias" <sip:201525@207.252.1.148>
Call-ID: 6894e30c-h1c8d357@192.168.20.100
CSeq: 1373 REGISTER
Max-Forwards: 70
Contact: "David Attias" <sip:201525@192.168.20.100:5060>;expires=3600
User-Agent: Cisco/SPA504G-7.6.2b
Content-Length: 0
Allow: ACK, BYE, CANCEL, INFO, INVITE, NOTIFY, OPTIONS, REFER, UPDATE
Supported: replaces
```

NEVER change anything in this field !!!

When does ALG break VoIP?

- DOES NOT HAPPEN WITH RouterOS !
- Poor quality ALG’s replace ALL private IP’s in SIP headers, including Call-ID
- Poor quality ALG’s unnecessarily adds a ; which breaks the syntax of sip requests.

SIP ALG Timeout

The problem:

- The phone sets layer 7 session timeout on the server.
- The router sets the UDP timeout for the session.

SIP ALG Timeout

The problem:

- The phone sets layer 7 session timeout on the server.
- The router sets the UDP timeout for the session.
- If the router session timeout expires before the server session timeout, the server would send data to an expired session (closed return port)

SIP ALG Timeout

The Solution:

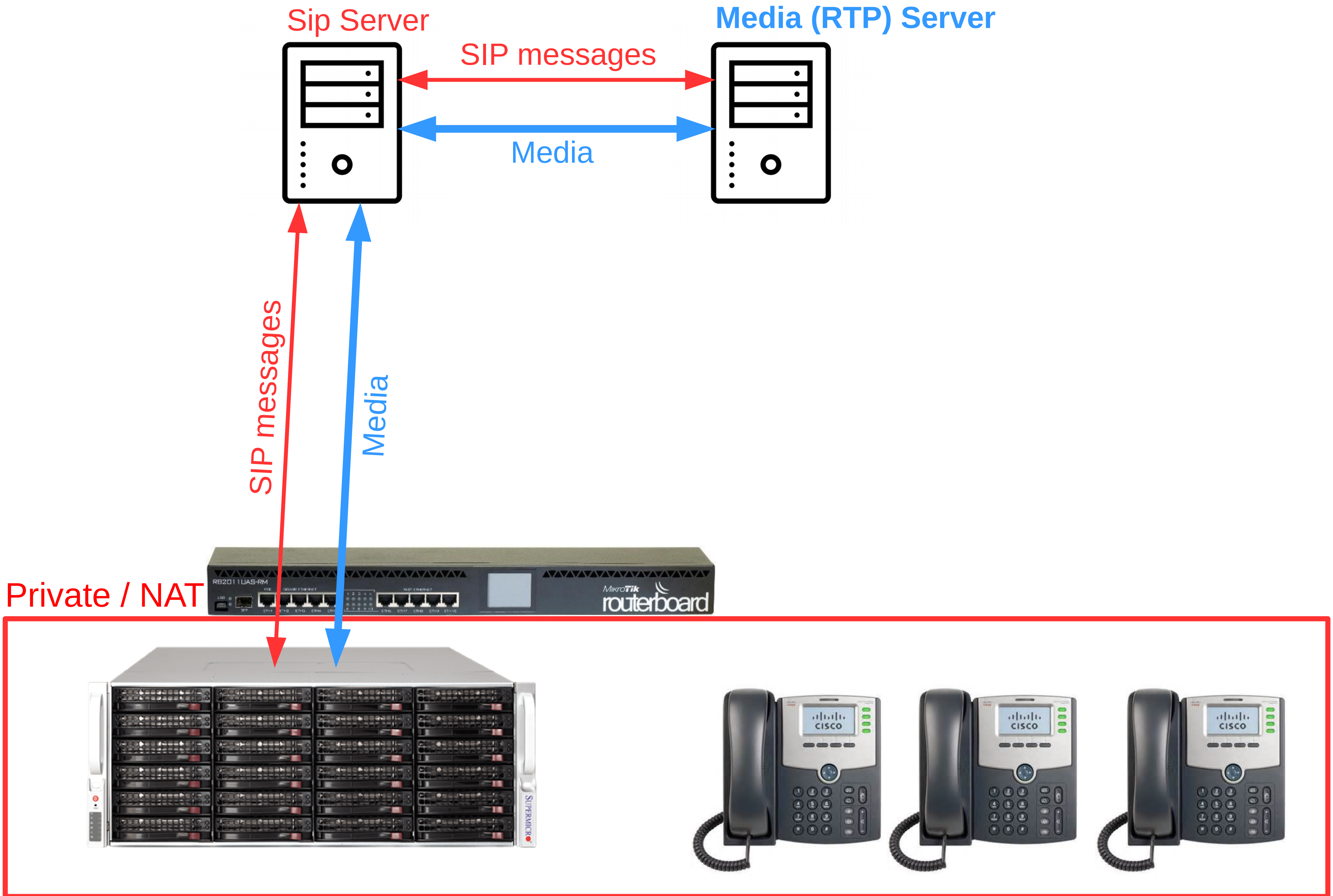
- Manually set SIP ALG timeout
- Set it higher than your lowest sip keepalive message interval (register, invite, options)

SIP Direct Media

SIP Direct Media

- Allows a redirect of the RTP media stream to go directly from SIP device to SIP device, “cutting out the middle man”
- The SIP servers are responsible for setting up the direct media stream.
- After the initial call is established the NAT’ed SIP server will re-invite the public media server to establish a direct media connection, bypassing the middle server

Standard Flow



Sip Server

Media (RTP) Server

SIP messages

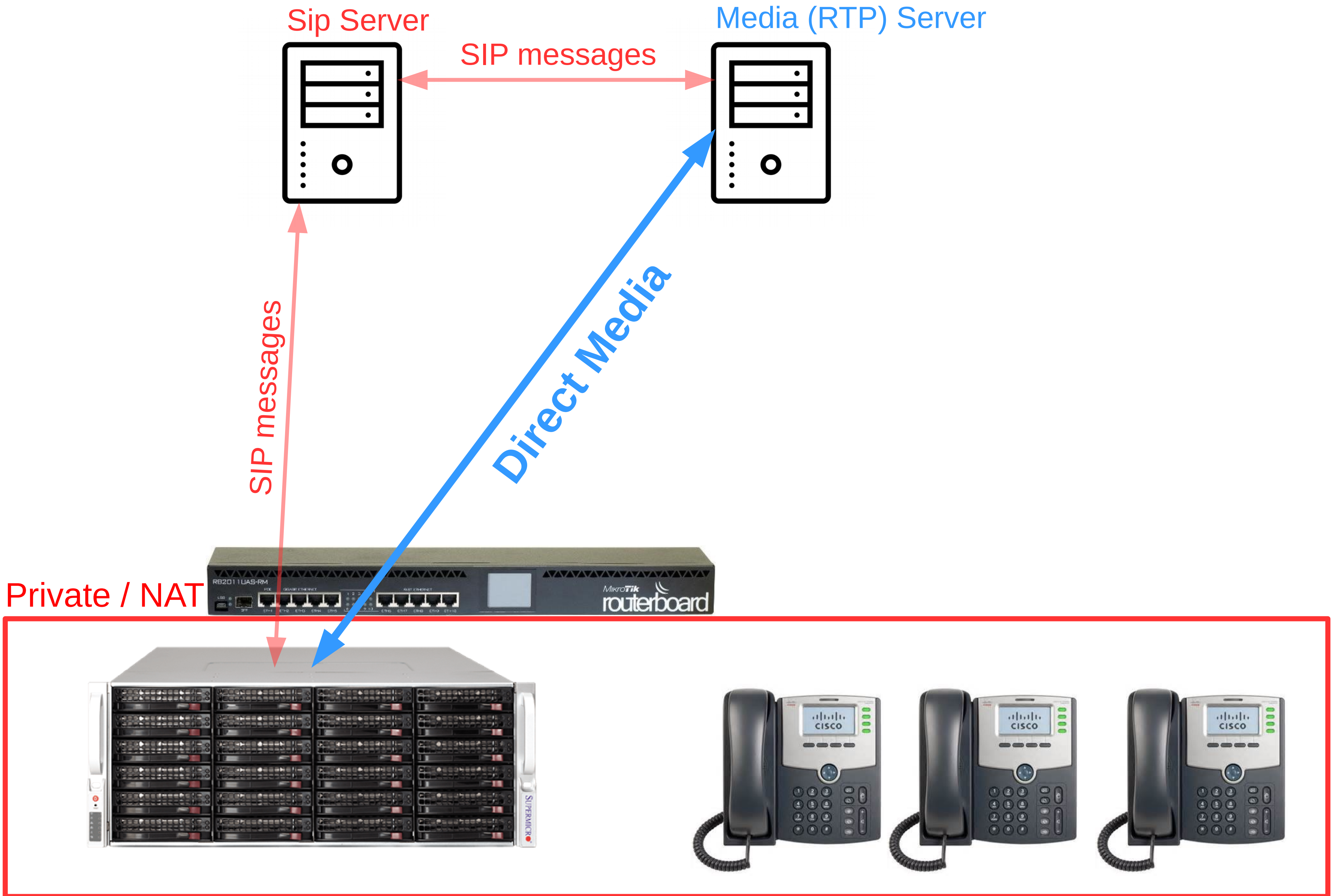
Media

SIP messages

Media

Private / NAT

Direct-Media



SIP Direct Media

- The sip-direct-media option has the ability to block or allow the NAT’ed server from re-inviting the media server for a direct media session.

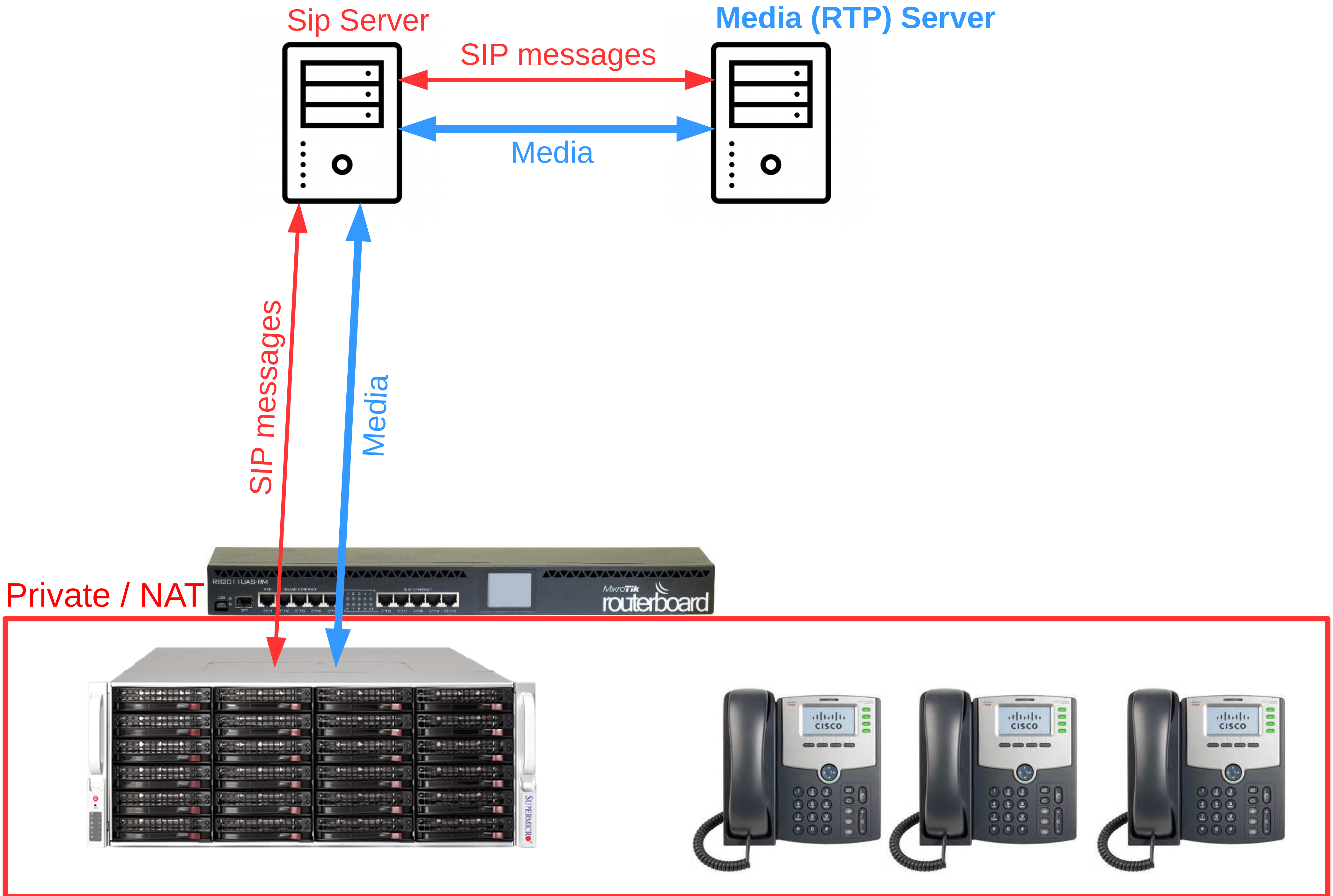
- sip-direct-media yes

  Allows direct media re-invites

- sip-direct-media no

  Blocks direct media re-invites

Standard Flow



Re-cap

1- Use SIP ALG when your NAT’ed sip device is NOT NAT aware!

2- Make sure you set your SIP-Server ports correctly

3- Set your UDP timeout higher than your sip keep alive

4- Don’t fear SIP ALG, it’s designed to make your job easier !

Agenda

1- What is ALG & what does it do.
2- The problem with VoIP and NAT
3- When is SIP ALG necessary and un-necessary?
4- How SIP ALG corrects problems.
5- Testing with wireshark
6- SIP ALG Timeout
7- SIP ALG direct-media