Leonardo Nve Egea
lnve@s21sec.com

Playing in a Satellite environment 1.2

Why 1.2?

1. because I'm sure that some people will publish more attacks.

.2 cause previously presentations about satellite.

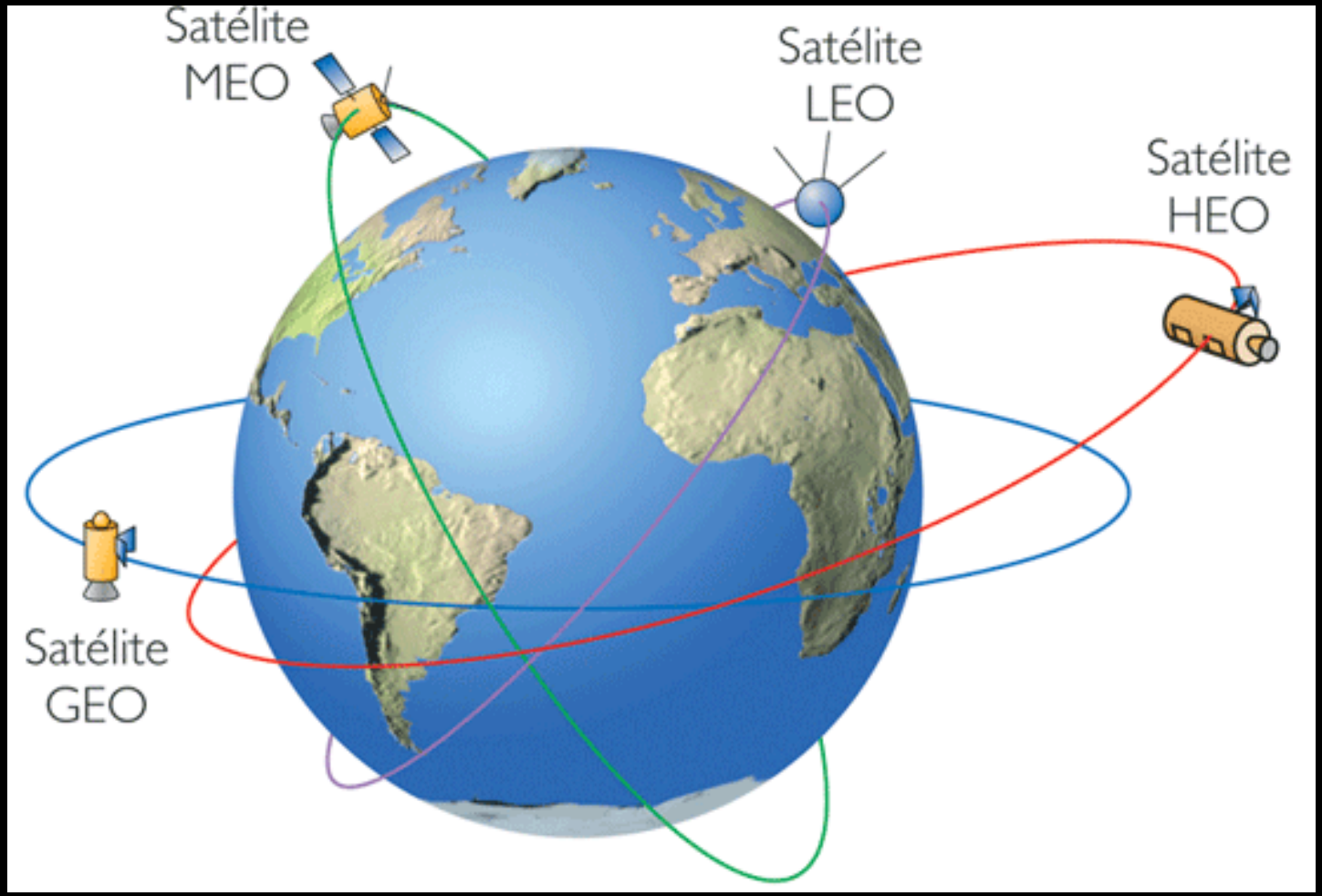
Who comented this before?

- Warezzman – (in 2004 at Undercon VIII first Spanish hacker CON)
- Jim Geovedi & Raditya Iryandi (HITBSecConf2006)
- Adam Laurie (Blackhat 2009 at DC)
- Myself at S21Sec Blog (February 2009)

Intro to SAT

- Orbit based satellites
  - Low Earth orbiting (LEO)
  - Geostationary orbit (GEO)
  - Other: Molniya, Alta (HEO), etc.
- Function based satellites
  - Communications
  - Earth observation
  - Other: Scientifics, ISS, etc.

Intro to SAT



Intro to SAT

- Satellite LEO
  - Meteorological
  - HAM (Amateur Radio Operator)
- Satellite GEO
  - UFO (UHF Follow ON) Military
  - Inmarsat
  - Meteorological (Meteosat)
  - SCPC / Telephony link FDMA

The signal from the sky you ever waiting

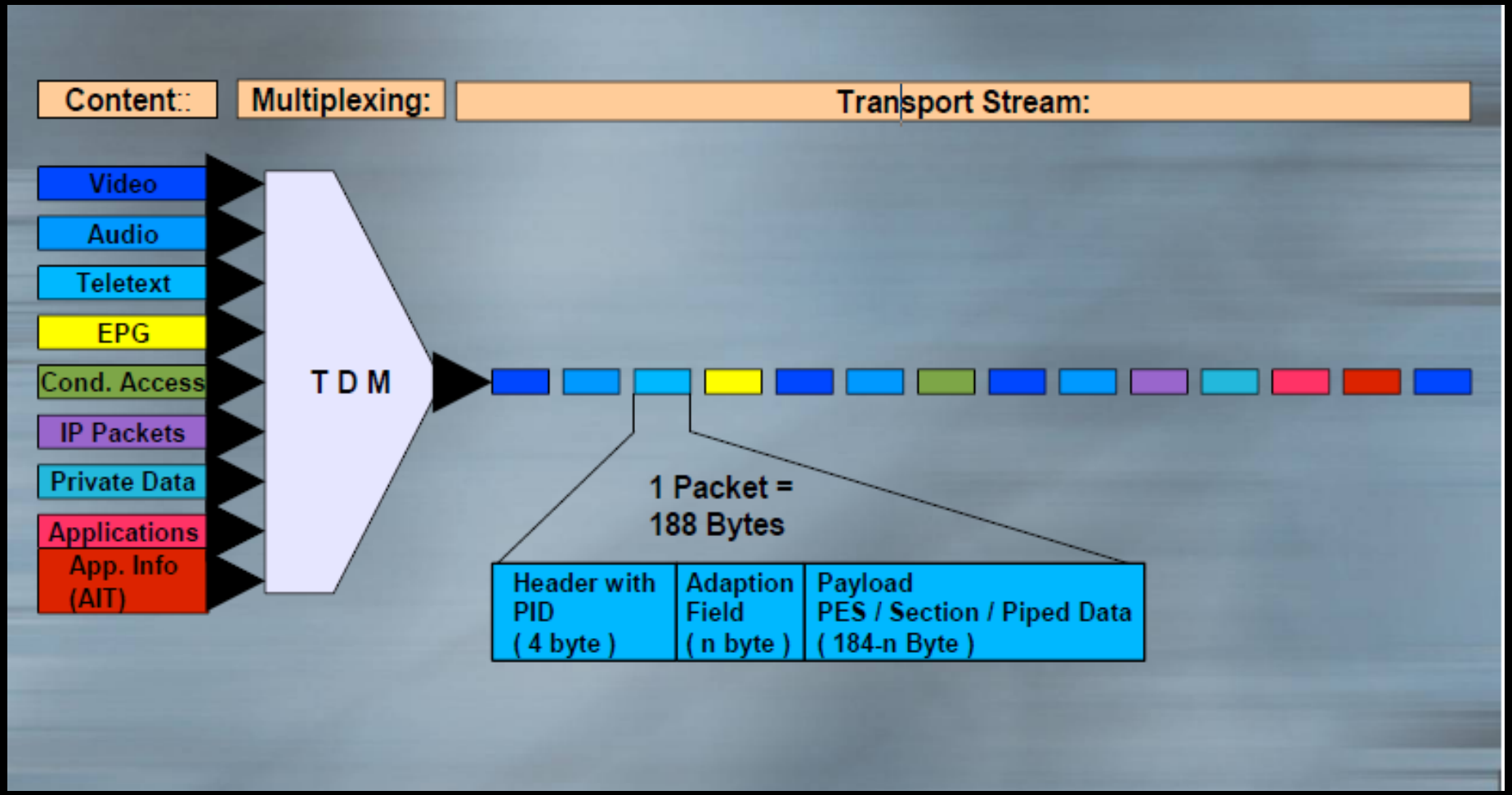
DVB

- Standard of European Telecommunications Standards Institute (ETSI).
- Defines audio and video transmission, and data connections.
- DVB-S & DVB-S2 is the specification for Satellite communications.

DVB-S

- Transponder: Like channels (in Satellite comms)
  - Frecuency (C band or Ku). Ex: 12.092Ghz
  - Polarization. (horizontal/vertical)
  - Symbol Rate. Ex: 27500Kbps
  - FEC.
- Every satellite has many transponders onboard which are operating on different frequencies

DVB-S


Content::
Multiplexing:
Transport Stream:
Video
Audio
Teletext
EPG
Cond. Access
IP Packets
Private Data
Applications
App. Info (AIT)
T D M
1 Packet = 188 Bytes
Header with PID (4 byte)
Adaption Field (n byte)
Payload PES / Section / Piped Data (184-n Byte)

DVB-S

Program ID (PID): It permits different programs at same transponder with different components [Example BBC1 PIDs: 600 (video), 601 (English audio), 603 (subtitles), 4167 (teletext)]

Special PIDs: NIT (Network Information Table), SDT (Service Description Table), PMT (Program Map Tables), PAT (Program Association Table).

DVB Feeds

- Temporal video links.
- Live emissions, sports, news.
- Temporal.
- FTA – In open video.

DVB Feeds

Hispasat Pre news feed (live news)

DVB Feeds

ATLAS Agency to TV feeds

DVB Feeds


BBC NEWS | Programmes | ...
http://news.bbc.co.uk/1/hi/programmes/newsnight/2041754.stm
BBC CATEGORIES TV RADIO COMMUNICATE WHERE I LIVE INDEX SEARCH Go
BBC NEWS
You are in: Programmes: Newsnight
News Front Page
World
UK
England
N Ireland
Scotland
Wales
Politics
Business
Entertainment
Science/Nature
Technology
Health
Education
Talking Point
Country Profiles
In Depth
Programmes
BBC SPORT
BBC WEATHER
CBBC news
SERVICES
Daily E-mail
News Ticker
Mobile/PDAs
Text Only
Feedback
Help
EDITIONS
Change to World
Newsnight
Thursday, 13 June, 2002, 00:28 GMT 01:28 UK
Enthusiast watches Nato spy pictures
By Mark Urban
Newsnight's Diplomatic Editor
Nato surveillance flights in the Balkans are beaming their pictures over an insecure satellite link - and anyone can tune in and watch their operations live.
The discovery was made last November by John Locker, a satellite enthusiast in north west England.
He told Newsnight that he spent
WATCH/LISTEN REAL MEDIA
ON THIS STORY
The BBC's Mark Urban
"A serious threat to Nato continues"
Newsnight
Home
Newsnight Review
Latest programme
Recent highlights
About Newsnight
Contact us
newsnight
FORUM
NATO security risk?
See also:
09 Mar 00 | Europe
Nato spy 'leaked bombing secrets'
09 Mar 00 | Politics
Nato spy revelations 'staggering'
23 Oct 01 | Americas
Hacktivists take sides in war
Internet links:

DVB Feeds

Captured NATO feeds

DVB Feeds

- Find feeds:
  - Lists of channels in www
  - Blind Scan
  - Visual representations of the signal

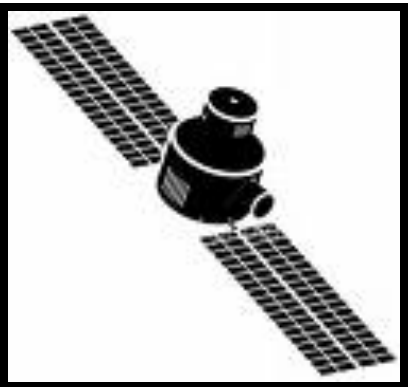
DVB Feeds - Too know more

- Dr HANS
  - http://drhans.jinak.cz/news/index.php
- Zackyfiles
  - http://www.zackyfiles.com (in spanish)
- Satplaza
  - http://www.satplaza.com

DVB Data

- Two scenarios
  - Satmodem
  - Satellite Interactive Terminal (SIT) or Astromodem

DVB Data - Satmodem



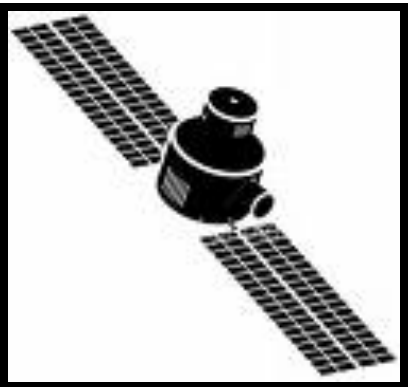
CLIENT

INTERNET

ISP

DVB Data - Satmodem

DOWNLINK

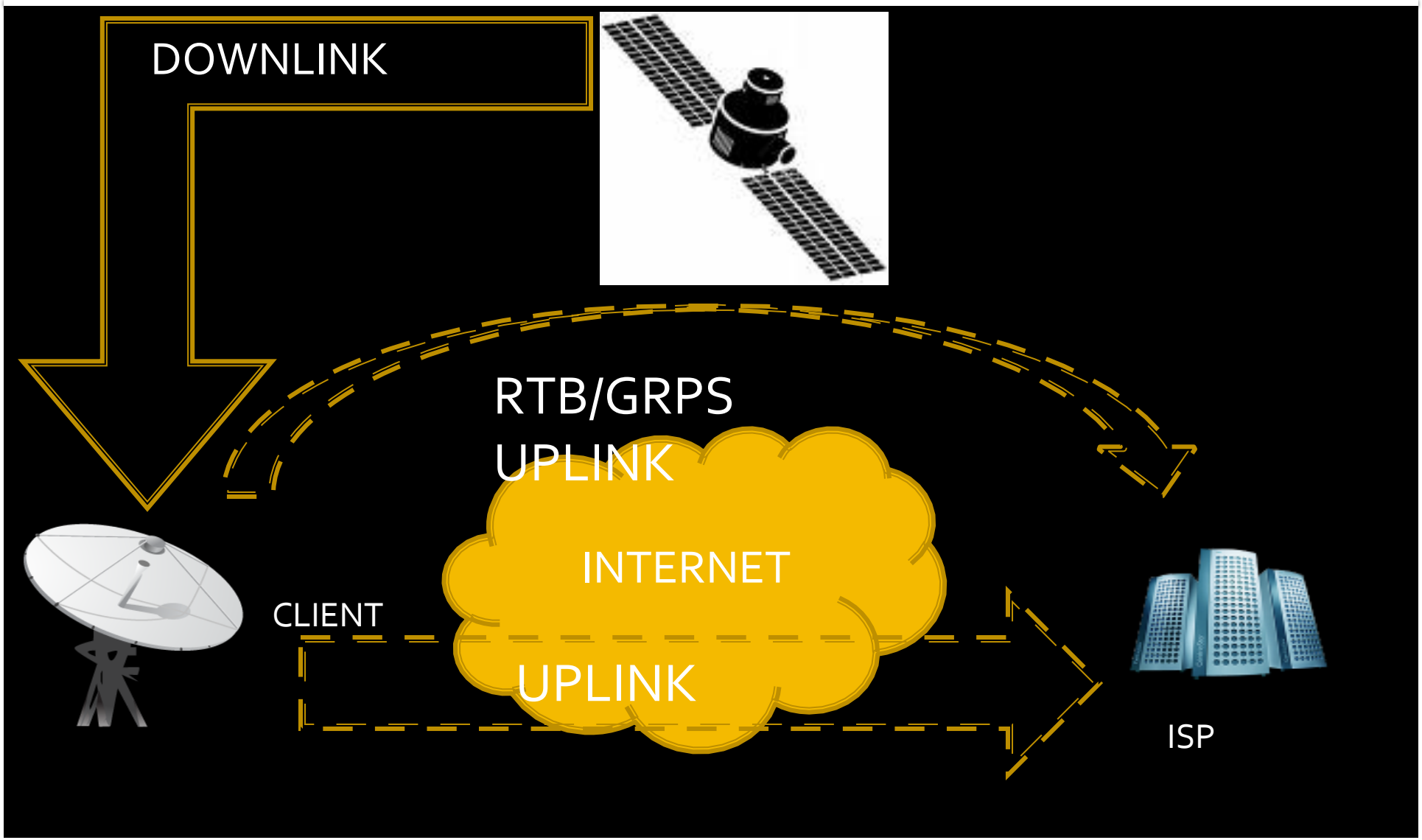


CLIENT

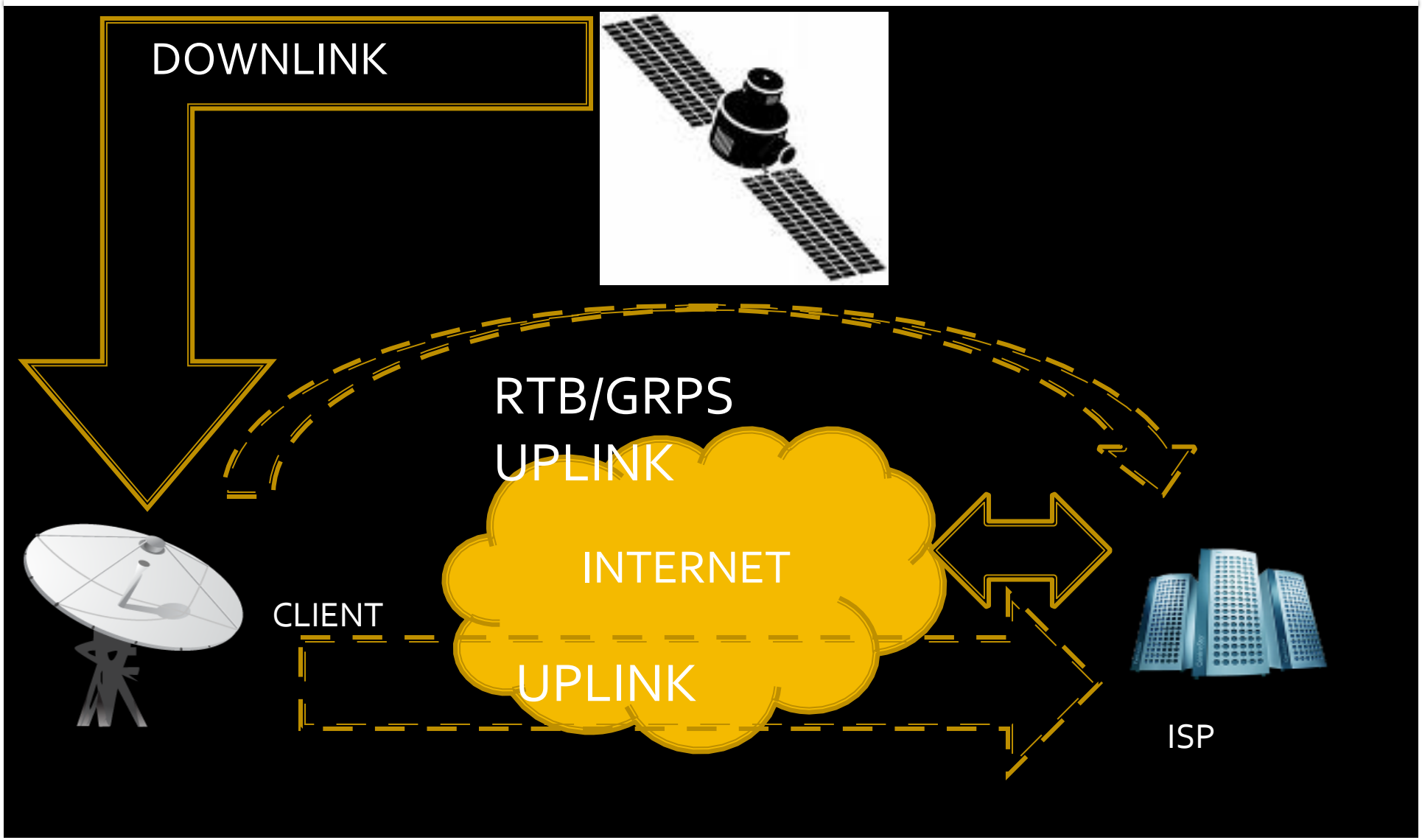
INTERNET

ISP

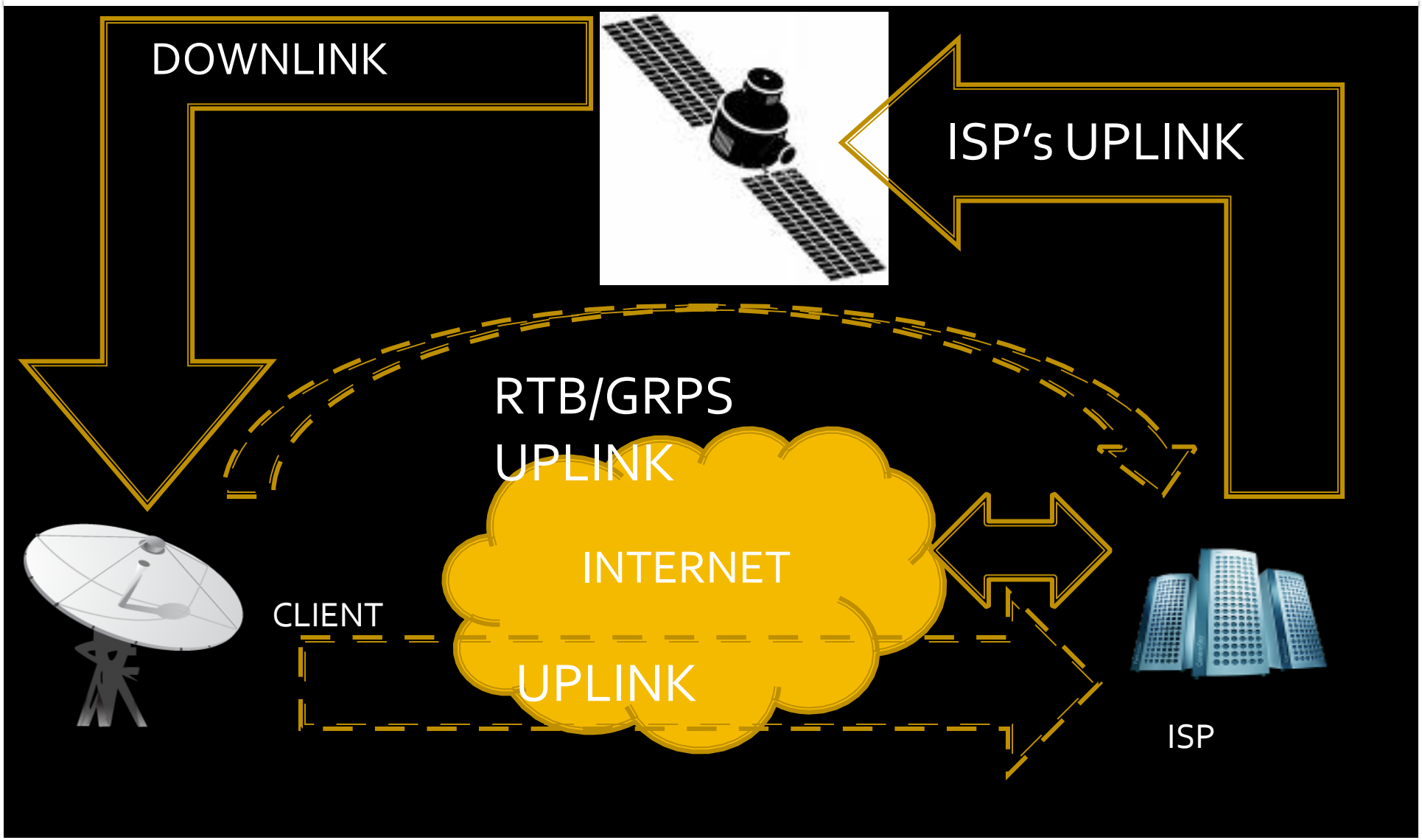
DVB Data - Satmodem



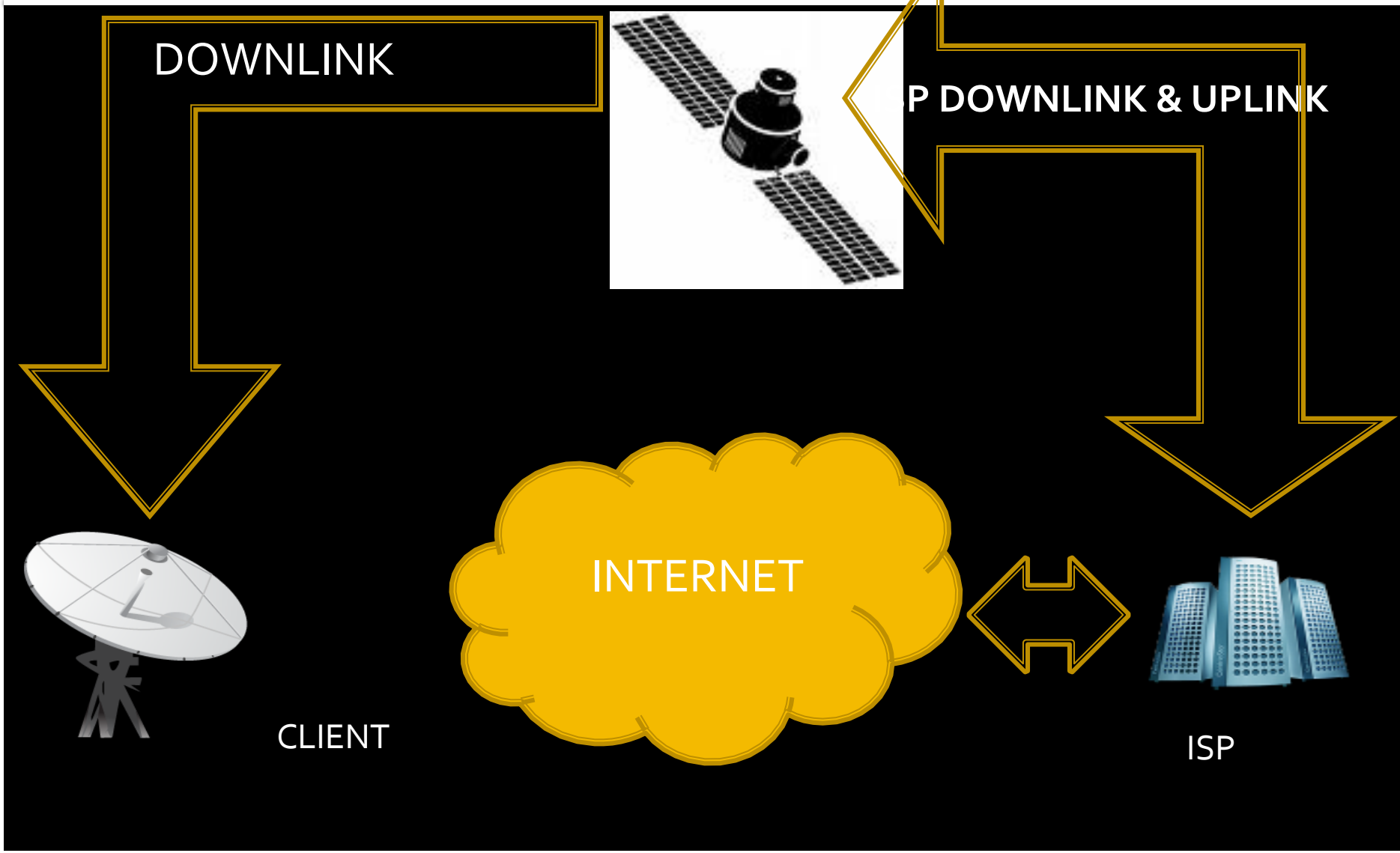
DVB Data - Satmodem



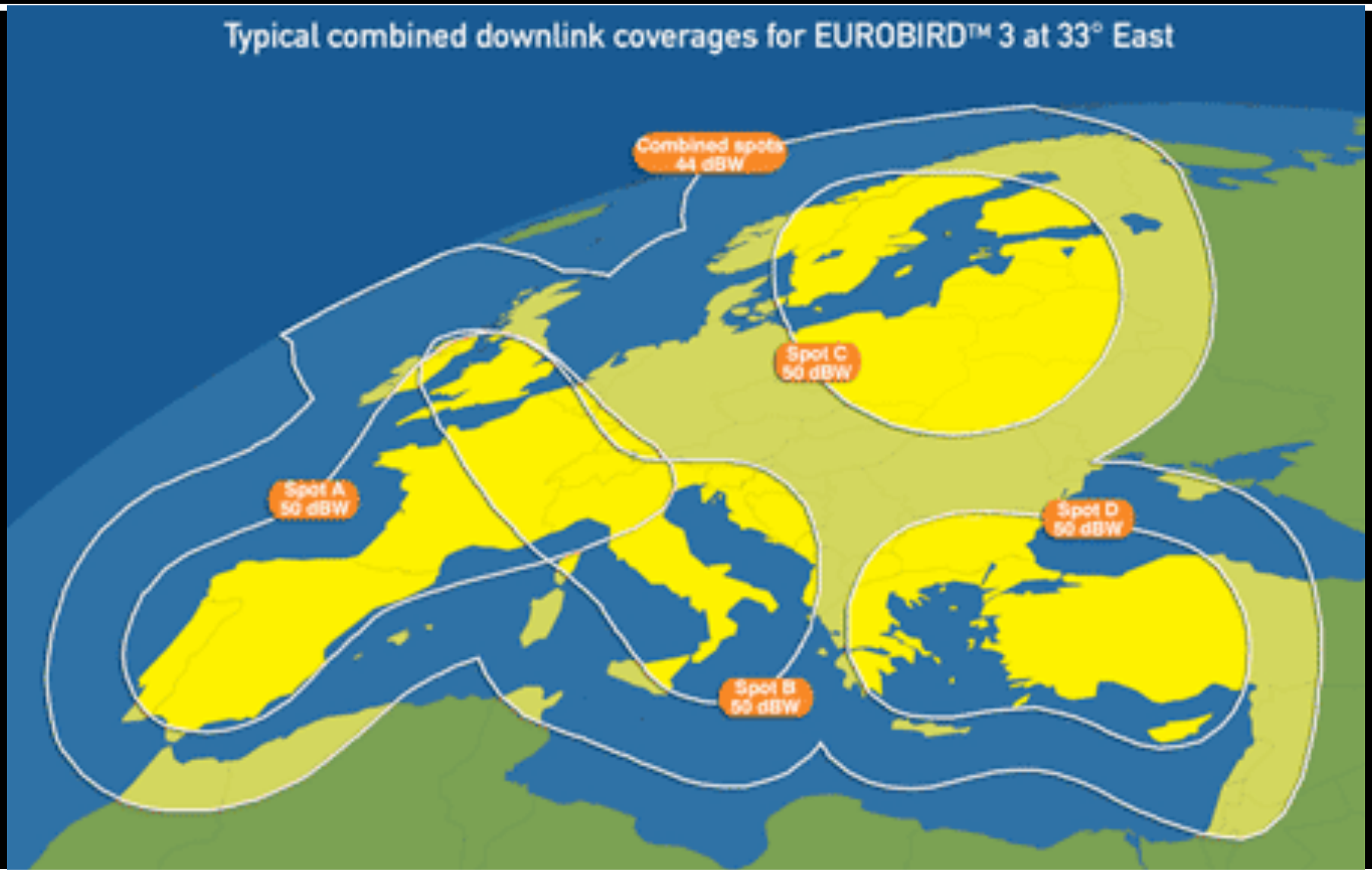
DVB Data - Satmodem



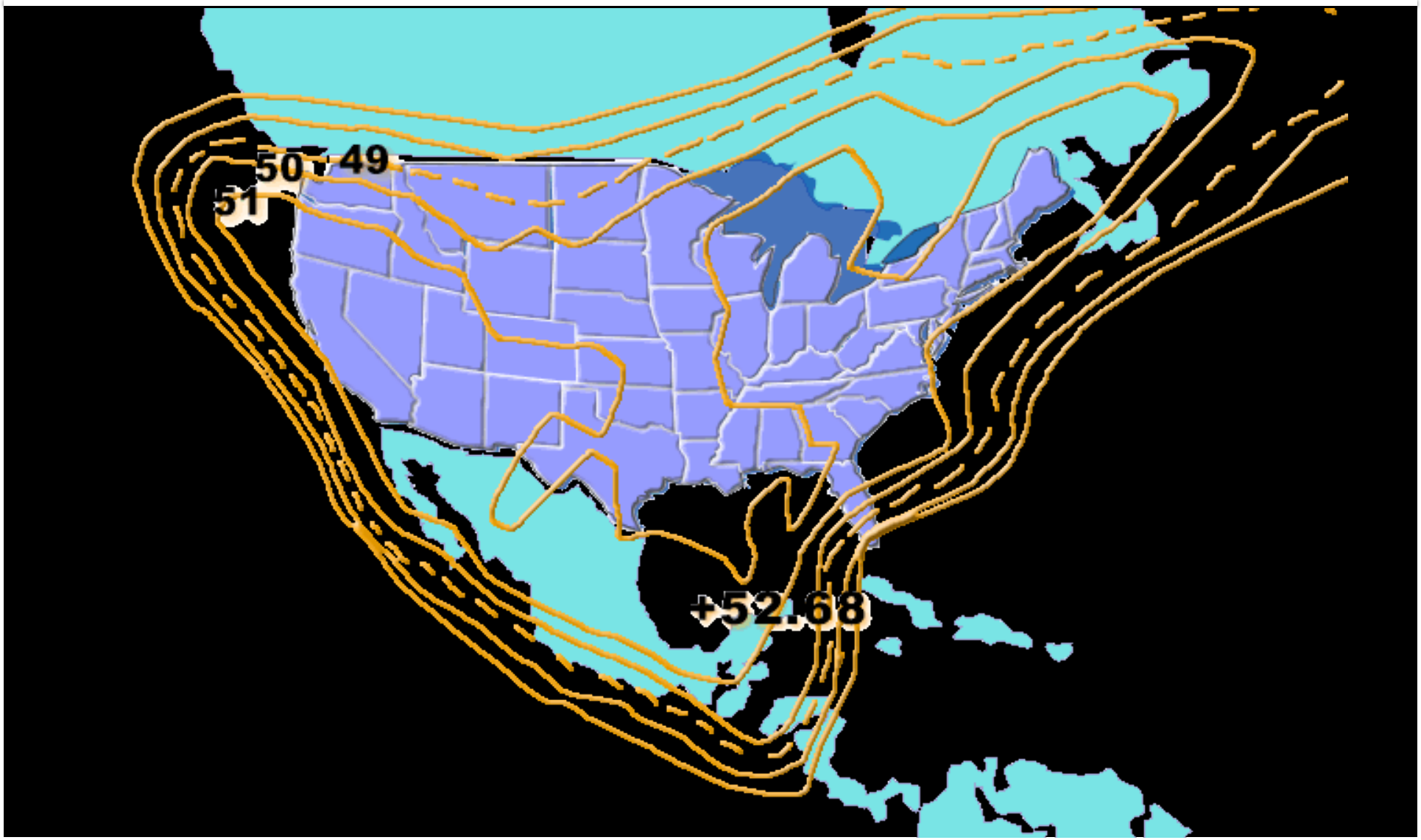
DVB Data - Satmodem



Satellite Coverage



Satellite Coverage



DVB Data

Anyone with coverage can SNIFF the DVB Data, and normally it is unencrypted.

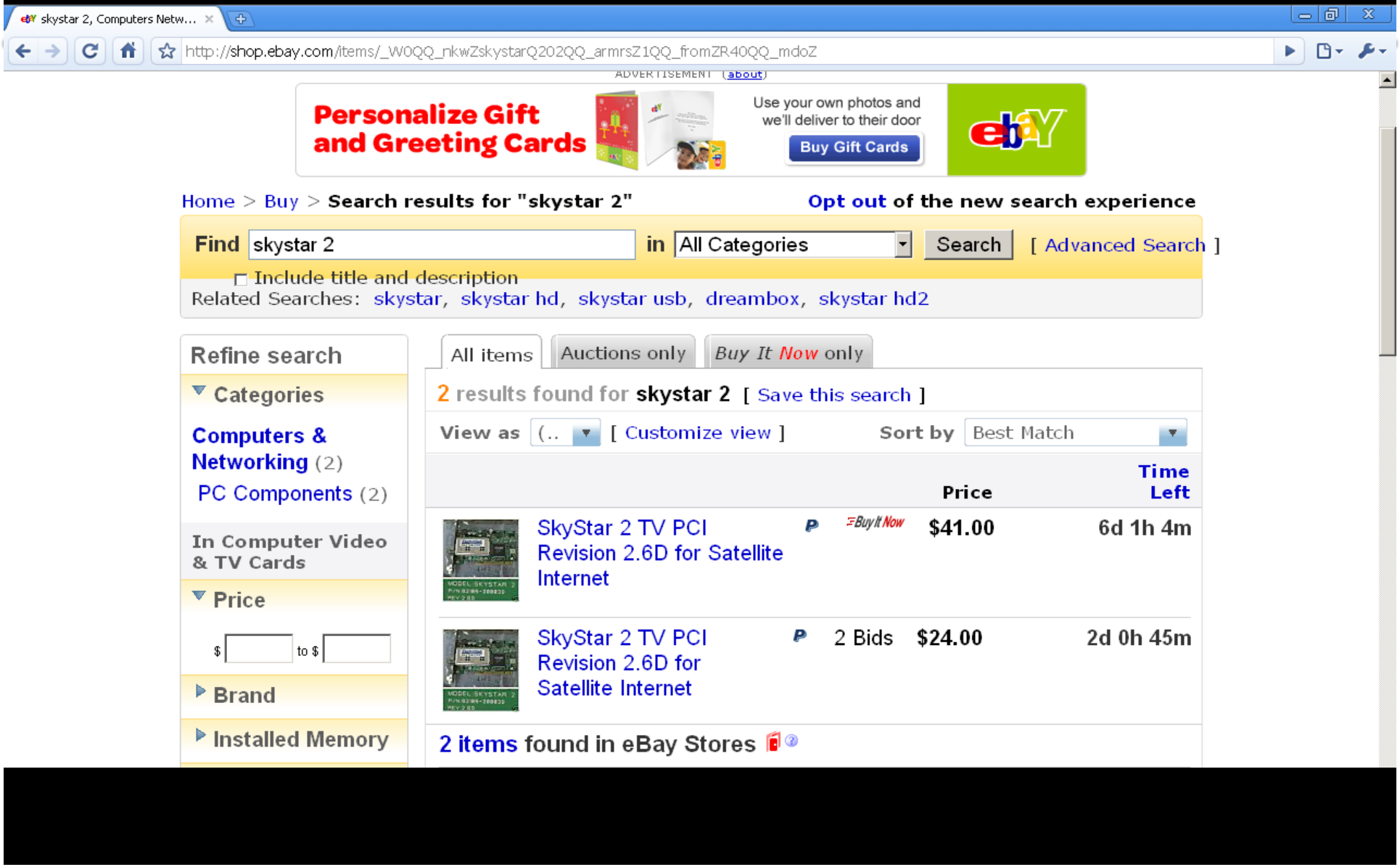
DVB Data

- What do you need:
  - Skystar 2 DVB Card
  - linuxtv-dvb-apps
  - Wireshark
  - The antenna
  - Data to orientate it (Internet)

DVB Data

I bought it for 50€!!! from an PayTV ex-"hacker" :P
(Including a set-top box that I will not use)

DVB Data


skystar 2, Computers Netw...
http://shop.ebay.com/items/_W0QQ_nkwZskystarQ202QQ_armrsZ1QQ_fromZR40QQ_mdoZ
ADVERTISEMENT (about)
Personalize Gift and Greeting Cards
Use your own photos and we'll deliver to their door
Buy Gift Cards
Home > Buy > Search results for "skystar 2"
Opt out of the new search experience
Find skystar 2 in All Categories Search [Advanced Search]
Include title and description
Related Searches: skystar, skystar hd, skystar usb, dreambox, skystar hd2
Refine search
Categories
Computers & Networking (2)
PC Components (2)
In Computer Video & TV Cards
Price
$ to $
Brand
Installed Memory
All items
Auctions only
Buy It Now only
2 results found for skystar 2 [Save this search]
View as [Customize view]
Sort by Best Match
Price
Time Left
SkyStar 2 TV PCI Revision 2.6D for Satellite Internet
Buy It Now
$41.00
6d 1h 4m
SkyStar 2 TV PCI Revision 2.6D for Satellite Internet
2 Bids
$24.00
2d 0h 45m
2 items found in eBay Stores

DVB Data

satellite antenna, Electroni...

http://shop.ebay.com/items/_W0QQ_dmptZPCCQ5fVideoQ5fTVQ5fCards?_nkw=satellite+antenna&_sacat=0&_fromfsb=&_trk

Enlarge

DirectTV round 18" satellite dish antenna directv DTV — 2 Bids — $10.50

XM RADIO TRUCK / SEMI SATELLITE ANTENNA HI-GAIN NEW — Buy It Now — $39.99 — Free shippin

FREE SHIPPING ! 2ND DAY SHIPPING ONLY $9

XM Home Antenna Satellite Radio SKYFi SKYFi3 XMP3 NEW — 0 Bids — Buy It Now $12.95 — $9.95 — Free shipp

Works with all newer XM Receivers! Free Shipping!

NEW DirectTV round 18" satellite dish antenna directv — 4 Bids — $11.52

XM-9000 XM Satellite Radio Semi Truck RV Antenna, NIB — Buy It Now — $39.95 — Free shippin

DVB Data

Linux has the modules for this card by default, we only need the tools to manage it:

linuxtv-dvb-apps

My version is 1.1.1 and I use Fedora(Not too cool to use Debian :P).

Sniffing Data

Once the antenna and the card is installed and linuxtv-dvb-apps compiled and installed, the process is:

1- Tune the DVB Card

2- Find a PID with data

3- Create an Ethernet interface associated to that PID

We can repeat 2 to 3 any times we want.

Sniffing Data

Tune DVB Card
The tool we must use is *szap* and we need the transponder's parameters in a configuration file.

For example, for "Sirius-4 Nordic Beam":
echo "sirius4N:12322:v:0:27500:0:0:0" >> channels.conf

We run szap with the channel configuration file and the transponder we want use (the configuration file can have more than one).
szap –c channels.conf sirius4N

Sniffing Data

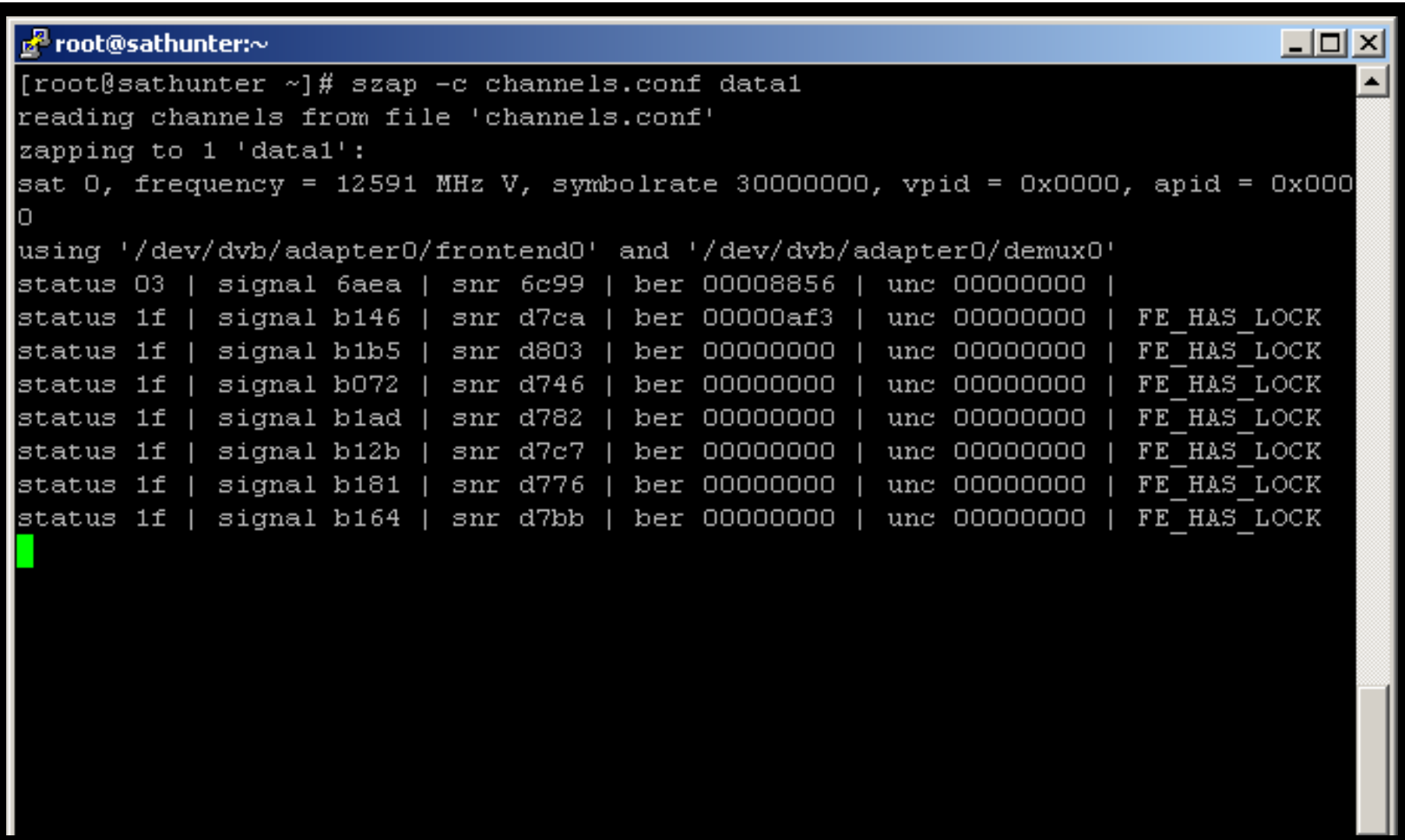
Tune DVB Card

We run szap with the channel configuration file and the transponder we want use (the configuration file can have more than one).

```
# szap –c channels.conf sirius4N
```

We must maintain it running.

Sniffing Data



Sniffing Data

The transponder parameters can be found around Internet.

http://www.fastsatfinder.com/transponders.html

Sniffing Data

- Find a PID

#dvbsnoop -s pidscan

Search for *data section* on results.

Sniffing Data

root@sathunter:~

```
[root@sathunter ~]# dvbsnoop -s pidscan
dvbsnoop V1.4.50 -- http://dvbsnoop.sourceforge.net/

-----------------------------------------------------
Transponder PID-Scan...
-----------------------------------------------------
PID found:    0 (0x0000)  [SECTION: Program Association Table (PAT)]
PID found:   16 (0x0010)  [SECTION: Network Information Table (NIT) - actual network]
PID found:   17 (0x0011)  [SECTION: Service Description Table (SDT) - actual transport stream]
PID found:   20 (0x0014)  [SECTION: Time Date Table (TDT)]
PID found: 1000 (0x03e8)  [SECTION: Program Map Table (PMT)]
PID found: 1001 (0x03e9)  [SECTION: Program Map Table (PMT)]
PID found: 1010 (0x03f2)  [SECTION: User private]
PID found: 1011 (0x03f3)  [SECTION: User private]
PID found: 1012 (0x03f4)  [SECTION: User private]
PID found: 1013 (0x03f5)  [SECTION: User private]
PID found: 1014 (0x03f6)  [SECTION: Network Information Table (NIT) - other network]
PID found: 1020 (0x03fc)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1021 (0x03fd)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1022 (0x03fe)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1023 (0x03ff)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1025 (0x0401)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1026 (0x0402)  [SECTION: DSM-CC - private data section  // DVB datagram]
```

Sniffing Data

- Create an interface associated to a PID

#dvbnet -a <adapter number> -p <PID>

- Activate it

#ifconfig dvbo_<iface number> up

Sniffing Data

root@sathunter:~

```
[root@sathunter ~]# dvbnet -a 0 -p 1022

DVB Network Interface Manager
Version 1.1.0-TVF (Build vie mar 06 12:54:43 2009)
Copyright (C) 2003, TV Files S.p.A

Device: /dev/dvb/adapter0/net0
Status: device dvb0_0 for pid 1022 created successfully.
[root@sathunter ~]# ifconfig dvb0_0 up
[root@sathunter ~]# ifconfig dvb0_0
dvb0_0    Link encap:Ethernet  HWaddr 00:D0:D7:0C:67:8D
          inet6 addr: fe80::2d0:d7ff:fe0c:678d/64 Scope:Link
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:4096  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
          Base address:0x3fe

[root@sathunter ~]#
```

Sniffing Data

Back to de pidscan results

root@sathunter:~

```
[root@sathunter ~]# dvbsnoop -s pidscan
dvbsnoop V1.4.50 -- http://dvbsnoop.sourceforge.net/

-----------------------------------------------------------
Transponder PID-Scan...
-----------------------------------------------------------
PID found:    0 (0x0000)  [SECTION: Program Association Table (PAT)]
PID found:   16 (0x0010)  [SECTION: Network Information Table (NIT) - actual network]
PID found:   17 (0x0011)  [SECTION: Service Description Table (SDT) - actual transport stream]
PID found:   20 (0x0014)  [SECTION: Time Date Table (TDT)]
PID found: 1000 (0x03e8)  [SECTION: Program Map Table (PMT)]
PID found: 1001 (0x03e9)  [SECTION: Program Map Table (PMT)]
PID found: 1010 (0x03f2)  [SECTION: User private]
PID found: 1011 (0x03f3)  [SECTION: User private]
PID found: 1012 (0x03f4)  [SECTION: User private]
PID found: 1013 (0x03f5)  [SECTION: User private]
PID found: 1014 (0x03f6)  [SECTION: Network Information Table (NIT) - other network]
PID found: 1020 (0x03fc)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1021 (0x03fd)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1022 (0x03fe)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1023 (0x03ff)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1025 (0x0401)  [SECTION: DSM-CC - private data section  // DVB datagram]
PID found: 1026 (0x0402)  [SECTION: DSM-CC - private data section  // DVB datagram]
```

Sniffing Data

Create another interface

root@sathunter:~

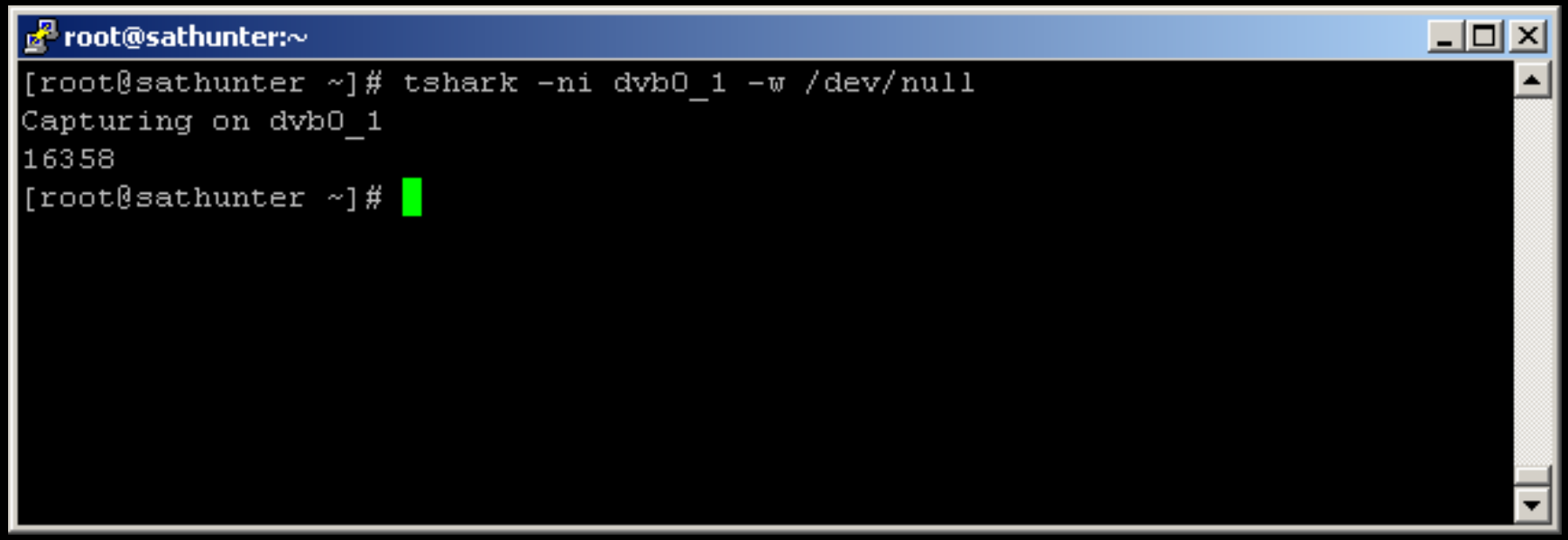
```
[root@sathunter ~]# dvbnet -a 0 -p 1021

DVB Network Interface Manager
Version 1.1.0-TVF (Build vie mar 06 12:54:43 2009)
Copyright (C) 2003, TV Files S.p.A

Device: /dev/dvb/adapter0/net0
Status: device dvb0_1 for pid 1021 created successfully.
[root@sathunter ~]# ifconfig dvb0_1 up
[root@sathunter ~]# ifconfig dvb0_1
dvb0_1    Link encap:Ethernet  HWaddr 00:D0:D7:0C:67:8D
          inet6 addr: fe80::2d0:d7ff:fe0c:678d/64 Scope:Link
          UP BROADCAST RUNNING NOARP MULTICAST  MTU:4096  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
          Base address:0x3fd
```

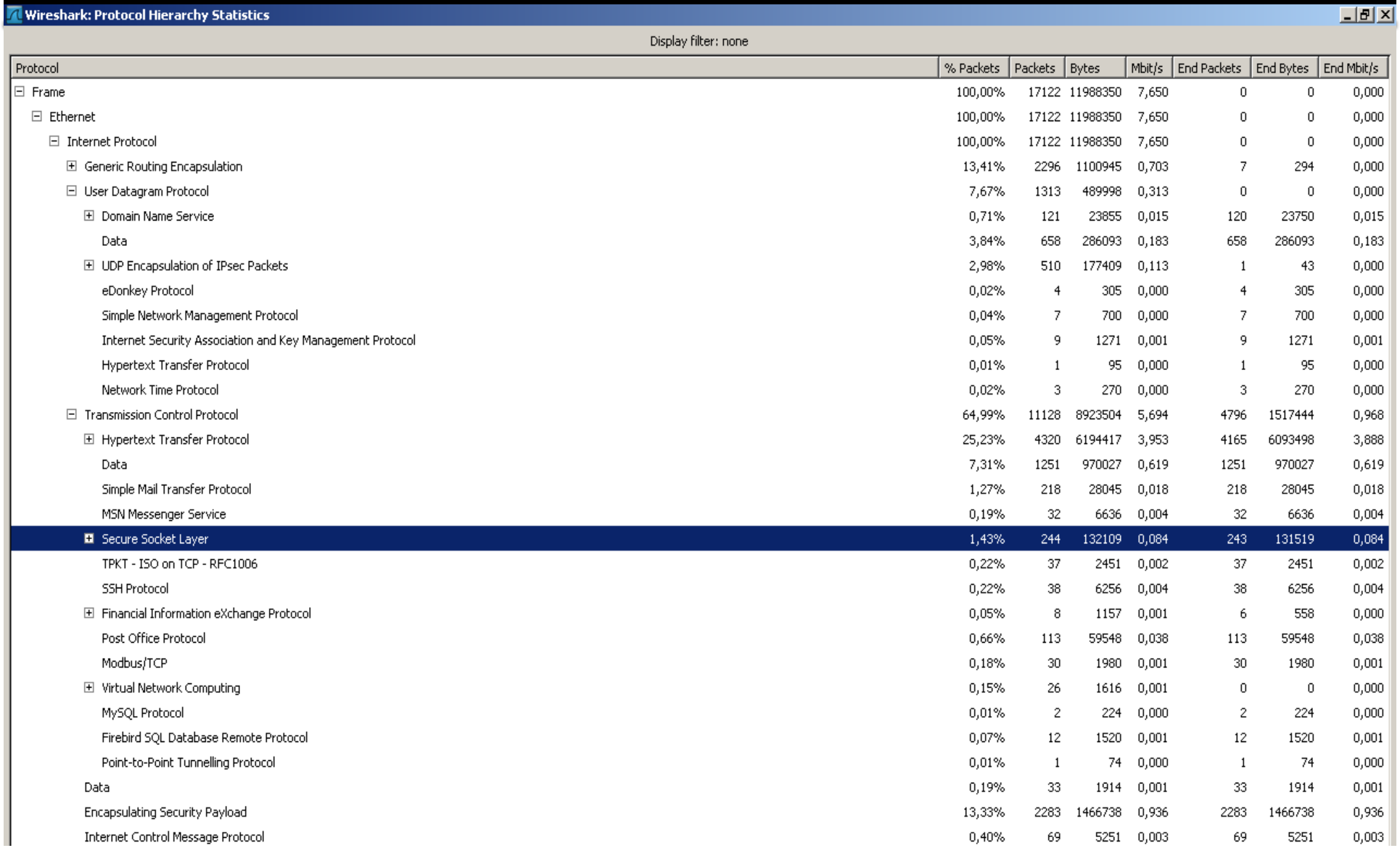
Sniffing Data

Wireshark is our friend



16358 packets in 10 seconds

Sniffing data



Wireshark: Protocol Hierarchy Statistics

Display filter: none

Protocol	% Packets	Packets	Bytes	Mbit/s	End Packets	End Bytes	End Mbit/s
Frame	100,00%	17122	11988350	7,650	0	0	0,000
Ethernet	100,00%	17122	11988350	7,650	0	0	0,000
Internet Protocol	100,00%	17122	11988350	7,650	0	0	0,000
Generic Routing Encapsulation	13,41%	2296	1100945	0,703	7	294	0,000
User Datagram Protocol	7,67%	1313	489998	0,313	0	0	0,000
Domain Name Service	0,71%	121	23855	0,015	120	23750	0,015
Data	3,84%	658	286093	0,183	658	286093	0,183
UDP Encapsulation of IPsec Packets	2,98%	510	177409	0,113	1	43	0,000
eDonkey Protocol	0,02%	4	305	0,000	4	305	0,000
Simple Network Management Protocol	0,04%	7	700	0,000	7	700	0,000
Internet Security Association and Key Management Protocol	0,05%	9	1271	0,001	9	1271	0,001
Hypertext Transfer Protocol	0,01%	1	95	0,000	1	95	0,000
Network Time Protocol	0,02%	3	270	0,000	3	270	0,000
Transmission Control Protocol	64,99%	11128	8923504	5,694	4796	1517444	0,968
Hypertext Transfer Protocol	25,23%	4320	6194417	3,953	4165	6093498	3,888
Data	7,31%	1251	970027	0,619	1251	970027	0,619
Simple Mail Transfer Protocol	1,27%	218	28045	0,018	218	28045	0,018
MSN Messenger Service	0,19%	32	6636	0,004	32	6636	0,004
Secure Socket Layer	1,43%	244	132109	0,084	243	131519	0,084
TPKT - ISO on TCP - RFC1006	0,22%	37	2451	0,002	37	2451	0,002
SSH Protocol	0,22%	38	6256	0,004	38	6256	0,004
Financial Information eXchange Protocol	0,05%	8	1157	0,001	6	558	0,000
Post Office Protocol	0,66%	113	59548	0,038	113	59548	0,038
Modbus/TCP	0,18%	30	1980	0,001	30	1980	0,001
Virtual Network Computing	0,15%	26	1616	0,001	0	0	0,000
MySQL Protocol	0,01%	2	224	0,000	2	224	0,000
Firebird SQL Database Remote Protocol	0,07%	12	1520	0,001	12	1520	0,001
Point-to-Point Tunnelling Protocol	0,01%	1	74	0,000	1	74	0,000
Data	0,19%	33	1914	0,001	33	1914	0,001
Encapsulating Security Payload	13,33%	2283	1466738	0,936	2283	1466738	0,936
Internet Control Message Protocol	0,40%	69	5251	0,003	69	5251	0,003

Sniffing Data

- We can have more than one PID assigned to an interface, this will be very useful.
- Malicious users can:
  - catch passwords.
  - Catch cookies and get into authenticated HTTP sessions.
  - Read emails
  - Catch sensible files
  - Do traffic analysis
  - etc ….

Sniffing Data

Remainder:

In satellite communications we have two scenarios:

A- Satmodem, Only Downlink via Satellite

B- Astromodem, Both uplink and downlink via Satellite.

Sniffing Data

In Satmodem scenario we can only sniff the downloaded data. We can only sniff one direction in a connection.

Sniffing data

In Astromodem scenario, if we find the PID used to send the uploaded packets to the main ISP to be routed to Internet, we can sniff all the traffic, uploaded and downloaded data.

Active Attacks

For this chapter, we will suppose all the time that we are in a Satmodem scenario so we can´t sniff uploaded data of the client with the Sat link.

Some "old" Stuff in Sat hacking

- DNS Spoofing
- TCP hijacking
- Attacking GRE

DNS Spoofing

- Data we need to realize this attack
  - DNS Request ID
  - Source Port
  - Source IP
  - Destination IP
  - Name/IP asking for

DNS Spoofing

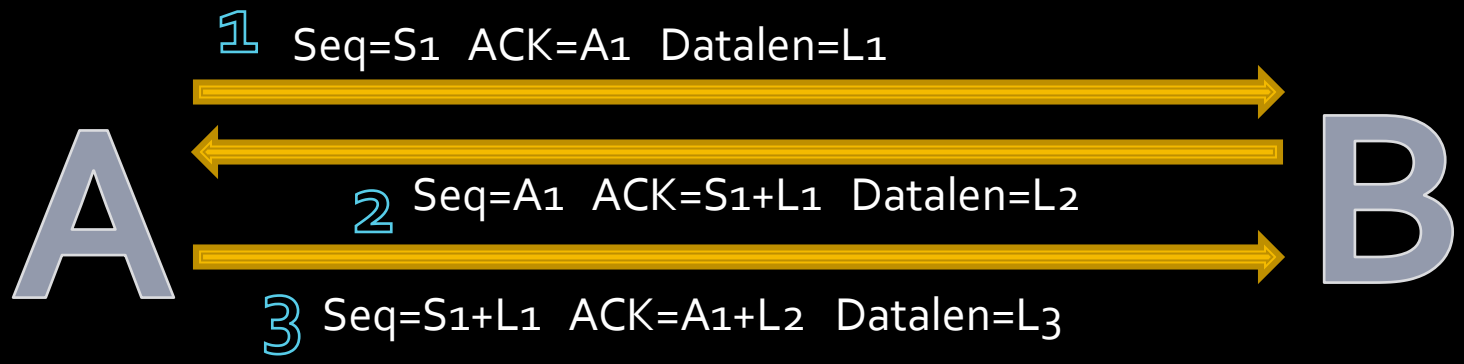
- It´s trivial see that if we sniff a DNS request we have all that information and we can spoof the answer.
(and Dan Kaminsky can rule the world)

- Many many tools around that do this job, the only thing also we need is to be faster than the real dns server.

DNS Spoofing

- Why is this attack important?
  - Think in phising
  - We this attack, uplink sniff can be possible
    - Rogue WPAD service
    - sslstrip can be use to avoid ssl connections.

TCP hijacking



If we sniff 1 we can predict Seq and Ack of 2 and we can send the payload we want 3 will we not accepted by B.

TCP Hijacking

A

1 Seq=S1 ACK=A1 Datalen=L1

3 Seq=S1+L1 ACK=A1+L2 Datalen=L3

B

TCP Hijacking

- Initially we can only have a false connection with A.
- In certain circumstances, we can make this attack to B, when L2 is predictable (whitepaper soon).
- Some tools to doing this:
  - Hunt
  - Shijack
  - Scapy

Attacking GRE

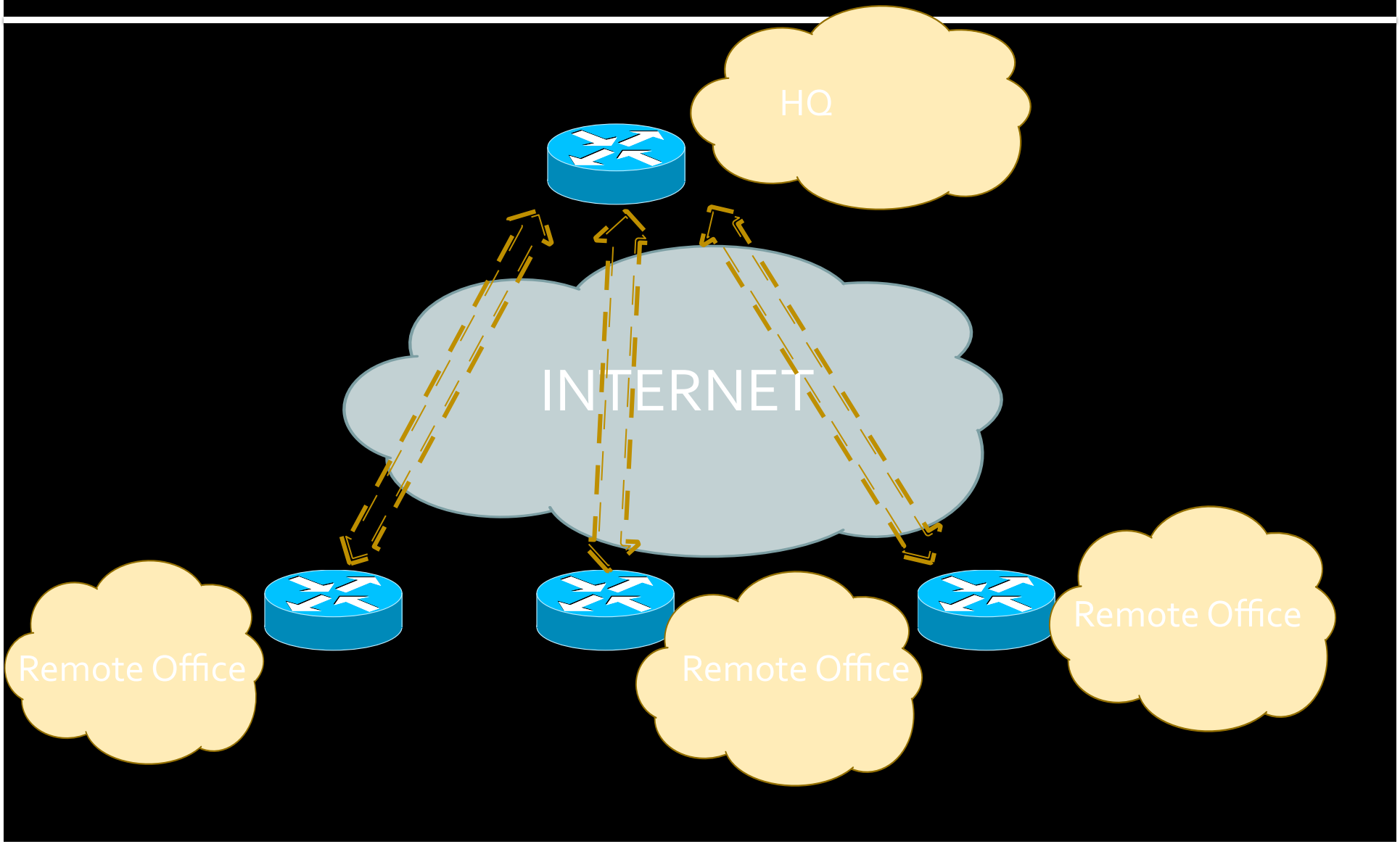
- Generic Routing Encapsulation
- Point to point tunneling protocol
- 13% of Satellite's data traffic in our transponder is GRE

Attacking GRE

This chapter is based in Phenoelit's discussion paper written by FX applied to satellite scenario.

Original paper:
http://www.phenoelit-us.org/irpas/gre.html

Attacking GRE



Attacking GRE

Find a target:

#tshark –ni dvbo_0 –R gre –w capture.cap

Attacking GRE

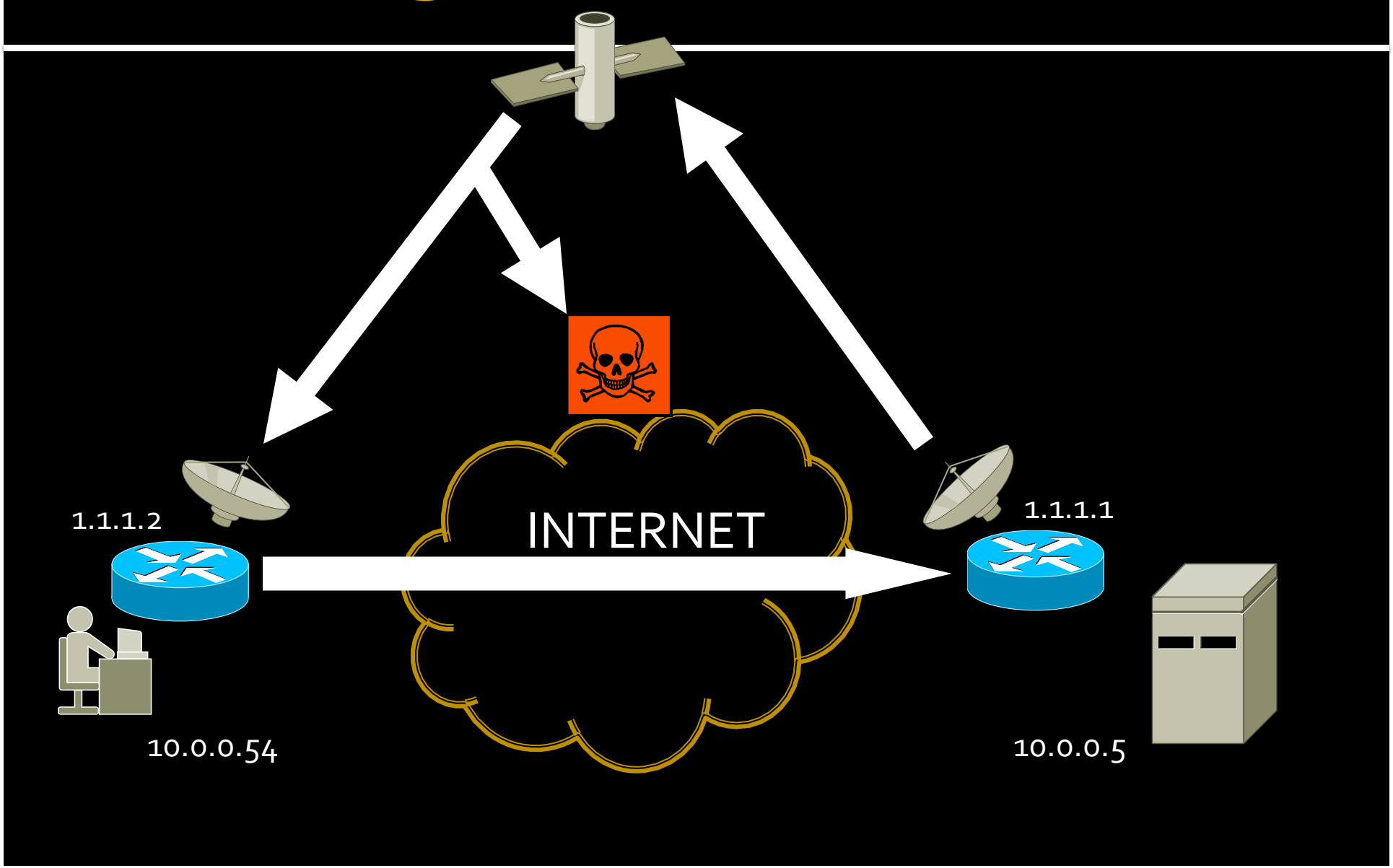
GRE Packet

IP dest 1	IP source 1

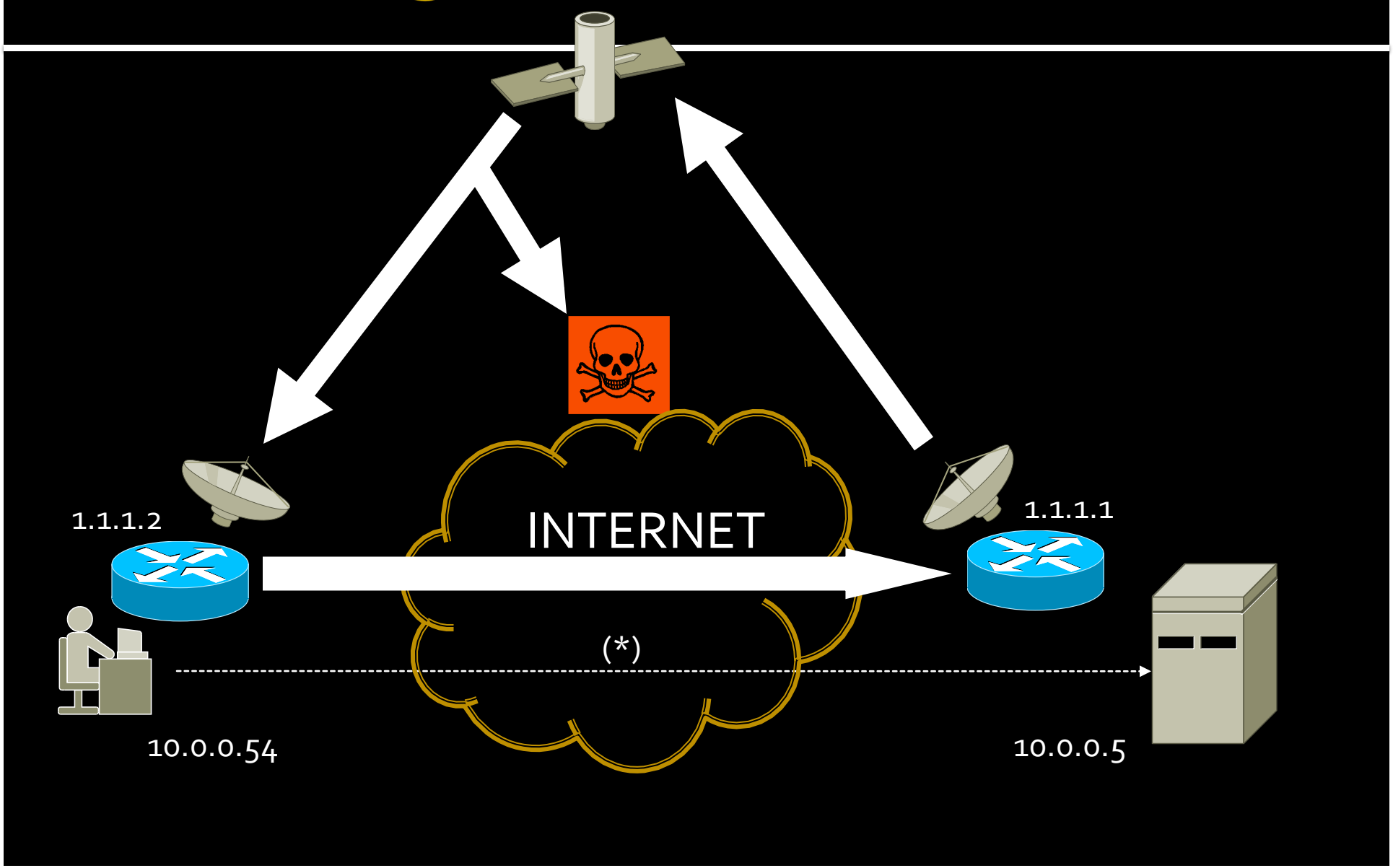
Attacking GRE

- IP destination and source 1 must be Internet reachable IPs
- The payload's IPs used to be internal.

Attacking GRE

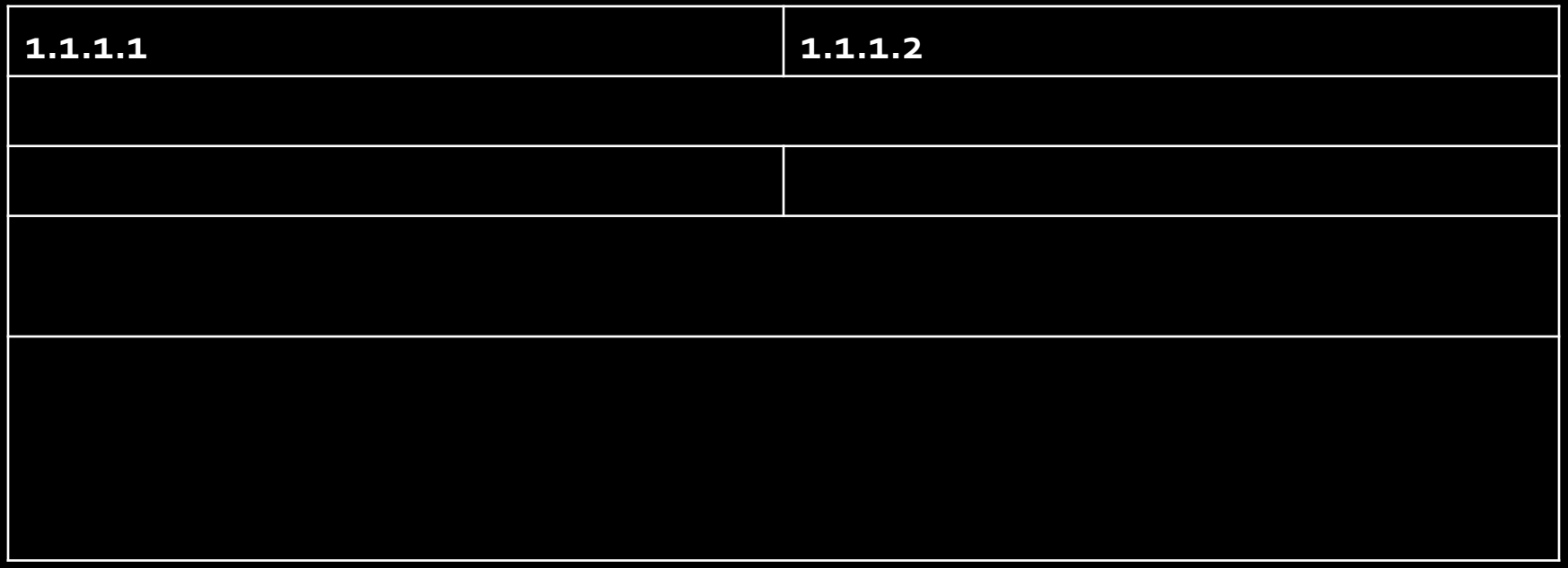


Attacking GRE

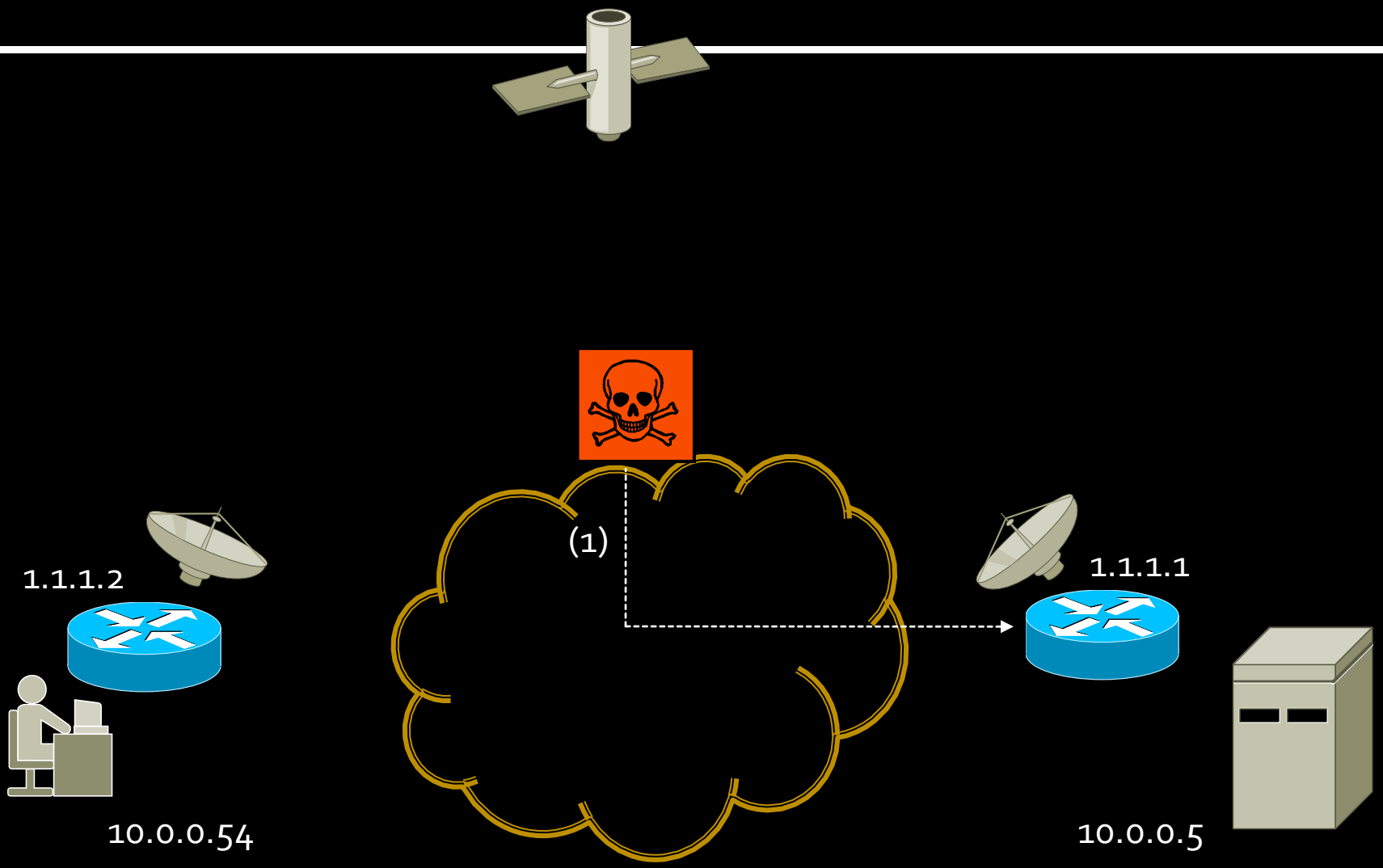


Attacking GRE

(*) GRE Packet

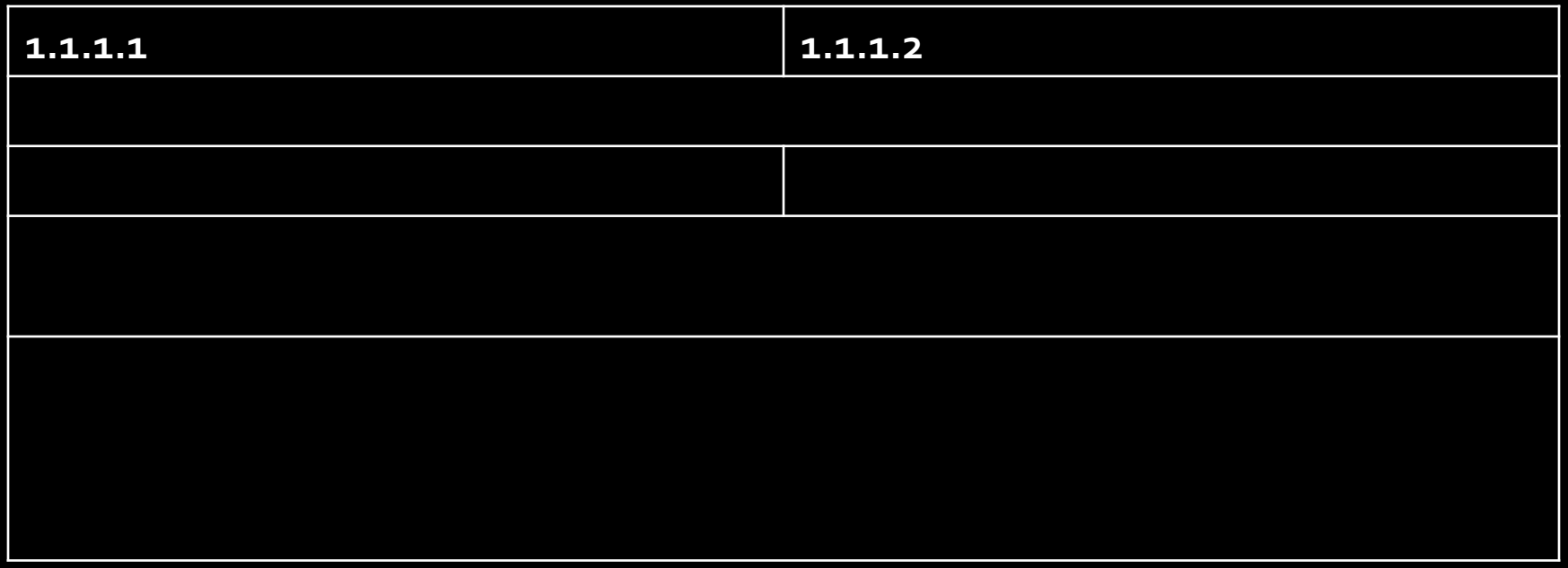


Attacking GRE

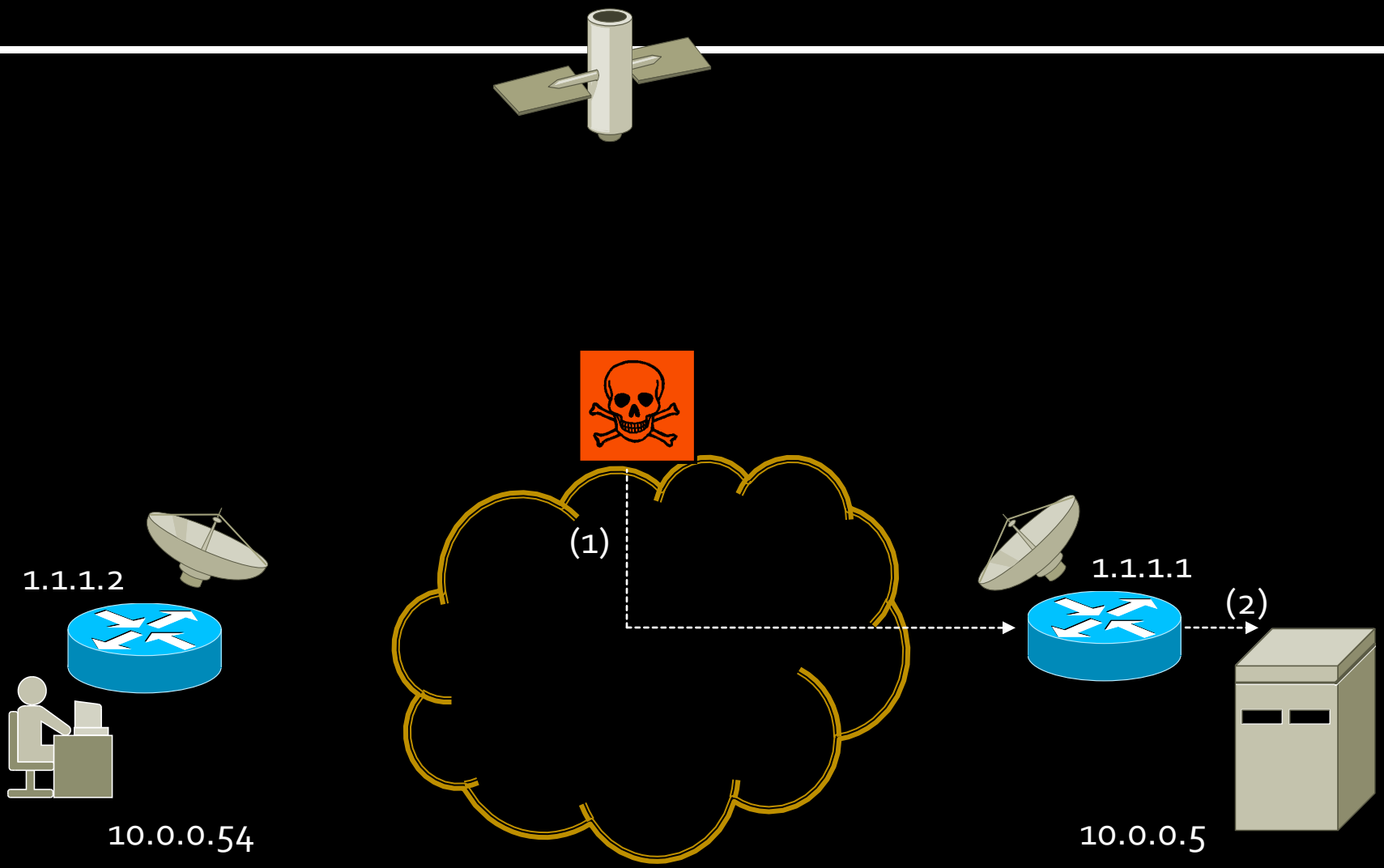


Attacking GRE

(1) GRE Packet



Attacking GRE

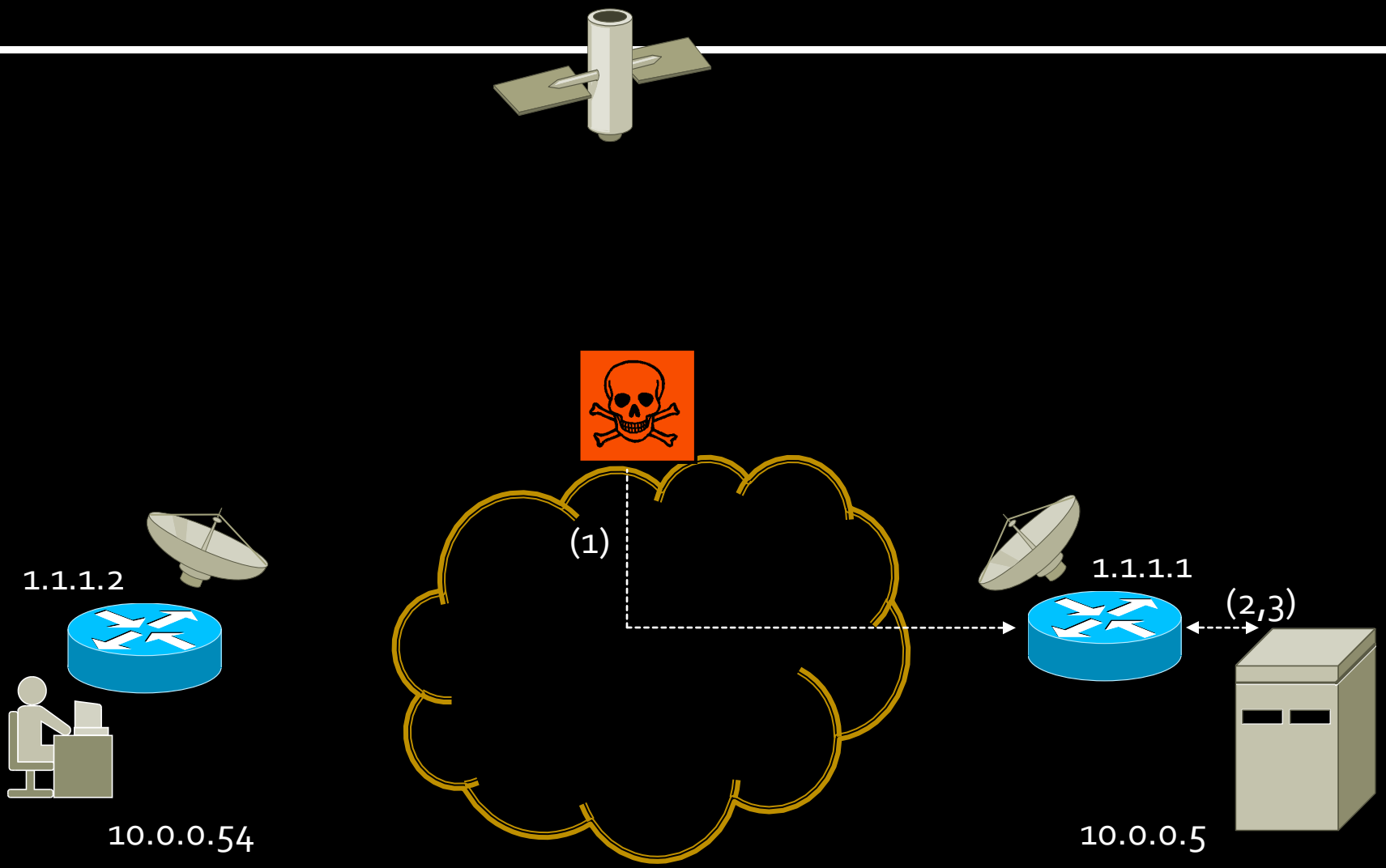


Attacking GRE

(2) IP Packet

10.0.0.5	10.0.0.54

Attacking GRE

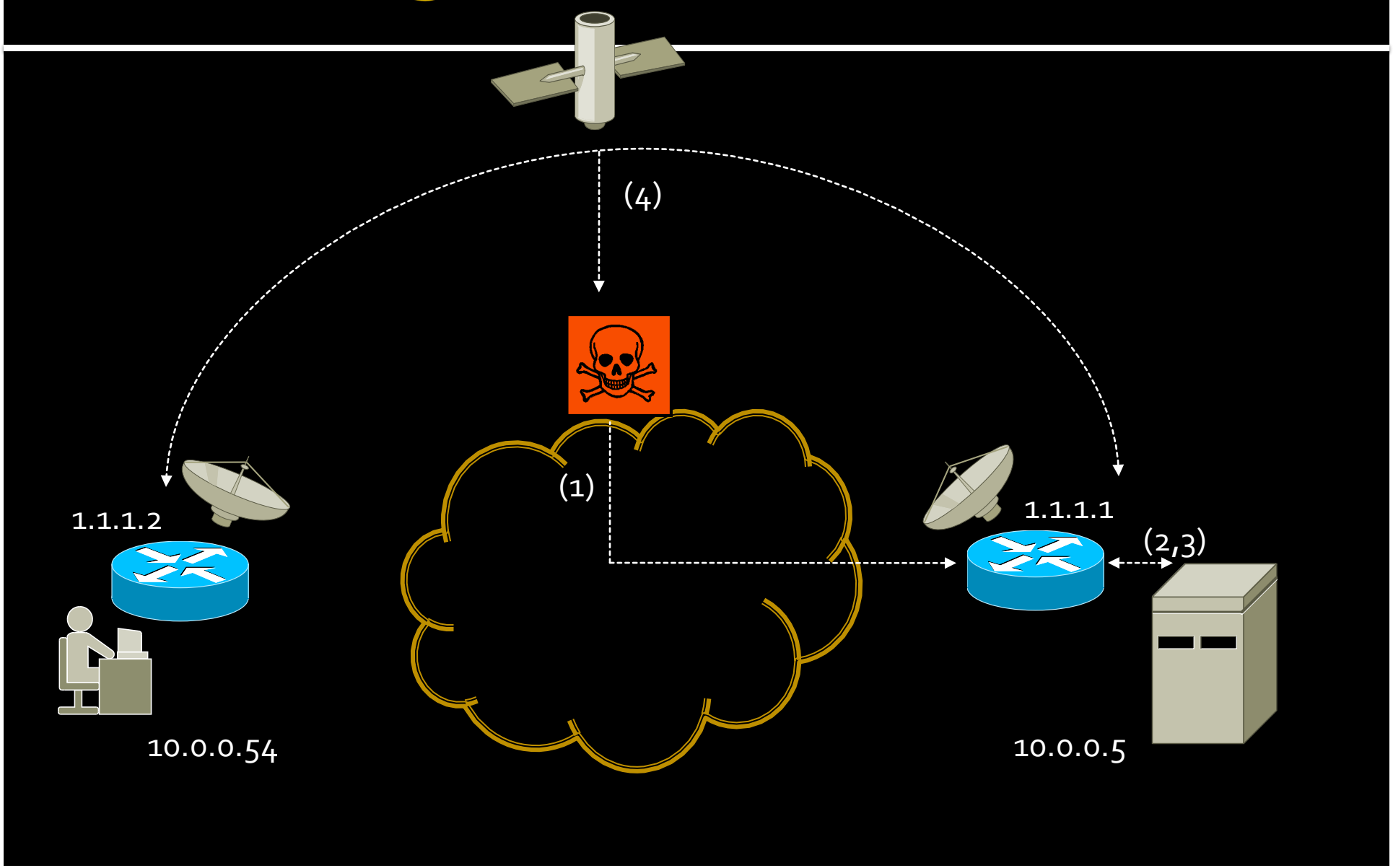


Attacking GRE

(3) IP Packet

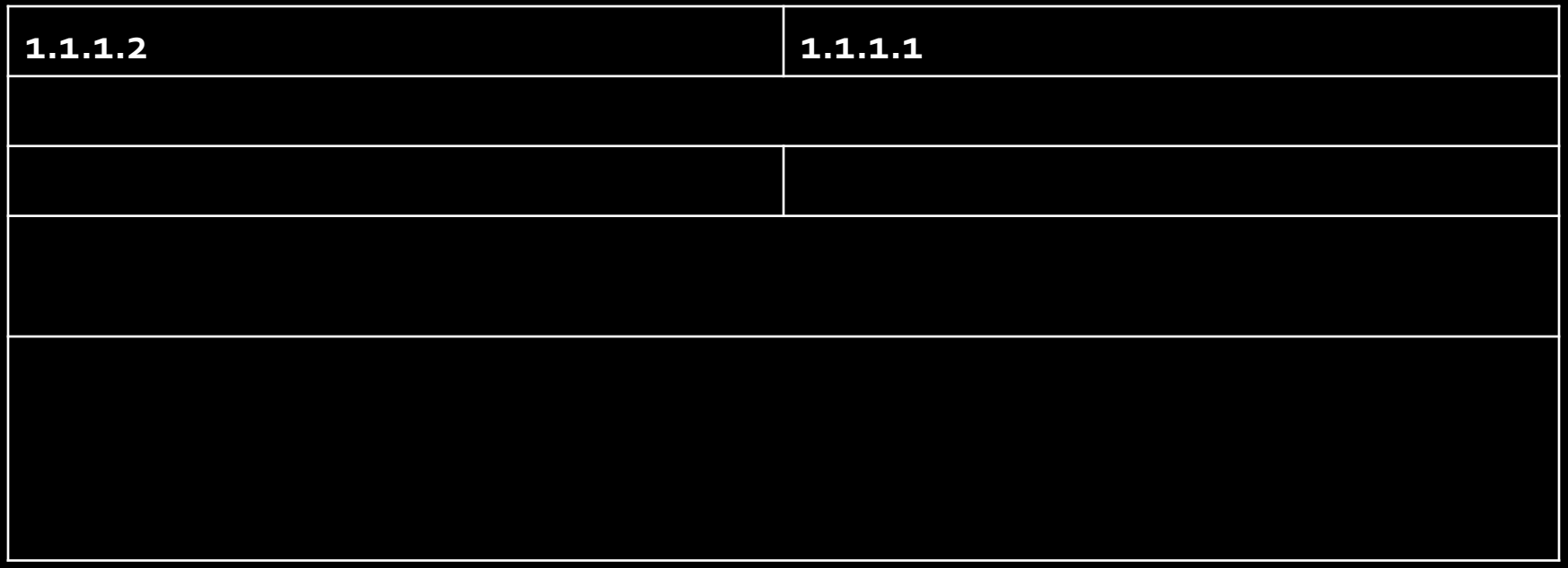
10.0.0.54	10.0.0.5

Attacking GRE



Attacking GRE

(4) GRE Packet



Attacking GRE

At Phenoelit´s attack payload's IP source is our public IP. This attack lacks if that IP isn´t reachable from the internal LAN and you can be logged.

I use internal IP because we can sniff the responses.

To better improve the attack, find a internal IP not used.

HTSNACBT Attack

How
To
Scan
NSA
And
Cannot
Be
Traced

HTSNACBT Attack

We can spoof (putting a satellite's routable source IP) a *SYN packet* with any destination IP and *TCP* port, and we can sniff the responses.

We can analyze the responses.

HTSNACBT Attack

OR… We can configure our linux like a satellite connected host.

VERY EASY!!!

HTSNACBT Attack

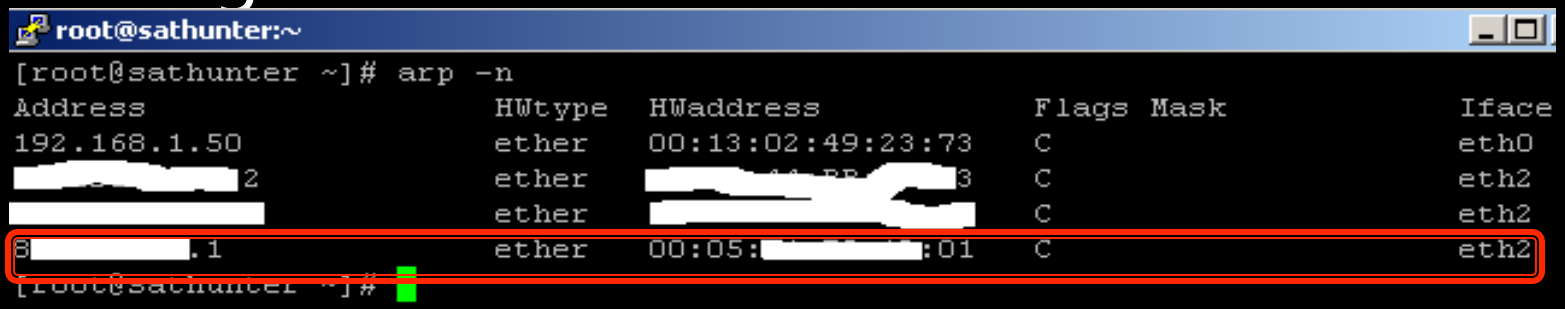
- What we need:
  - An internet connection (Let's use it as uplink) with any technology which let you spoofing.
  - A receiver, a card….

HTSNACBT Attack

- Let's rock!
  - Find a satellite IP not used, I ping IPs next to another sniffable satellite IP to find a non responding IP. We must sniff our ping with the DVB Card (you must save the packets).
  - This will be our IP!

HTSNACBT Attack

- Configure Linux to use it.



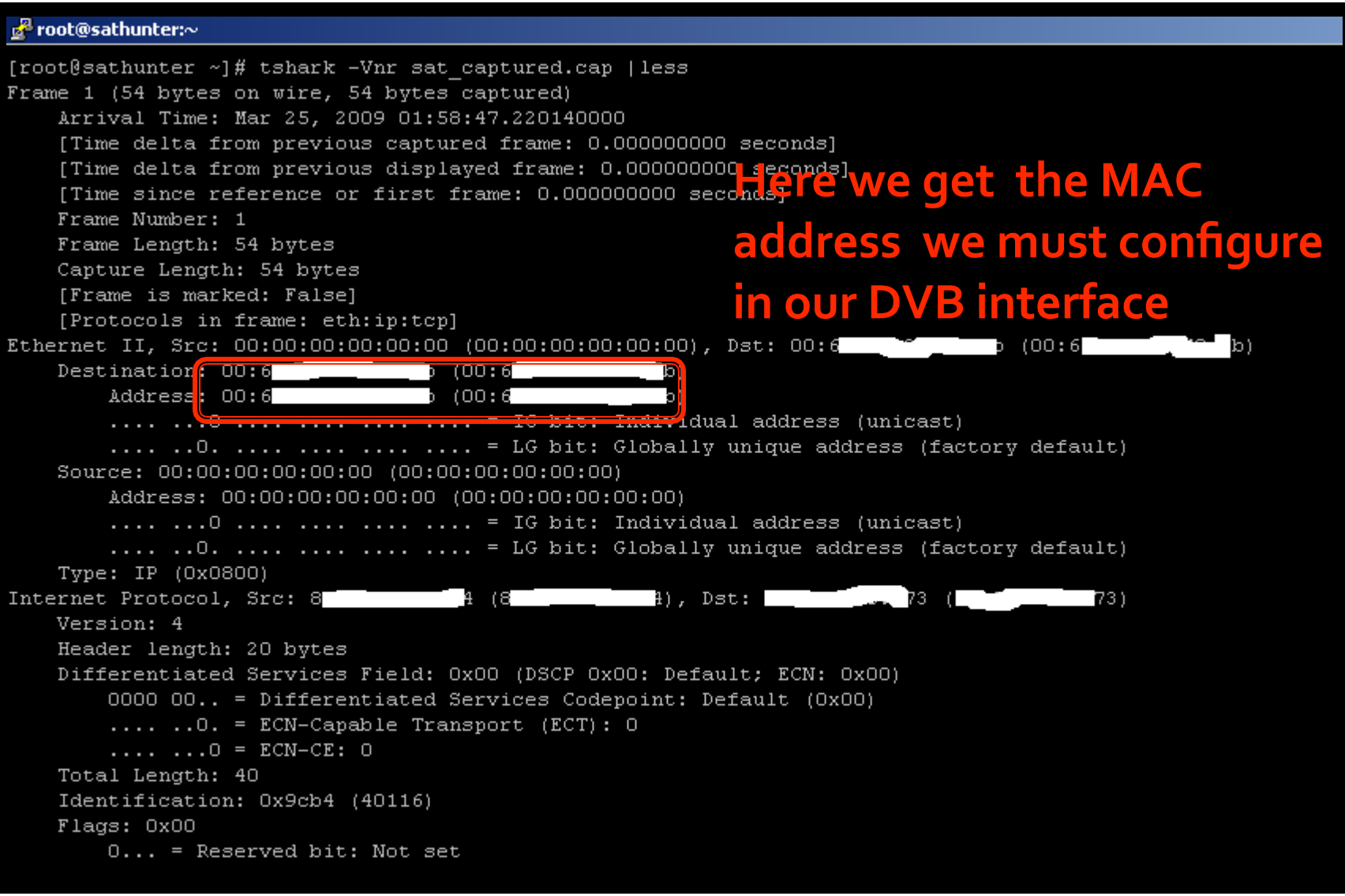
We need our router 's MAC

HTSNACBT Attack

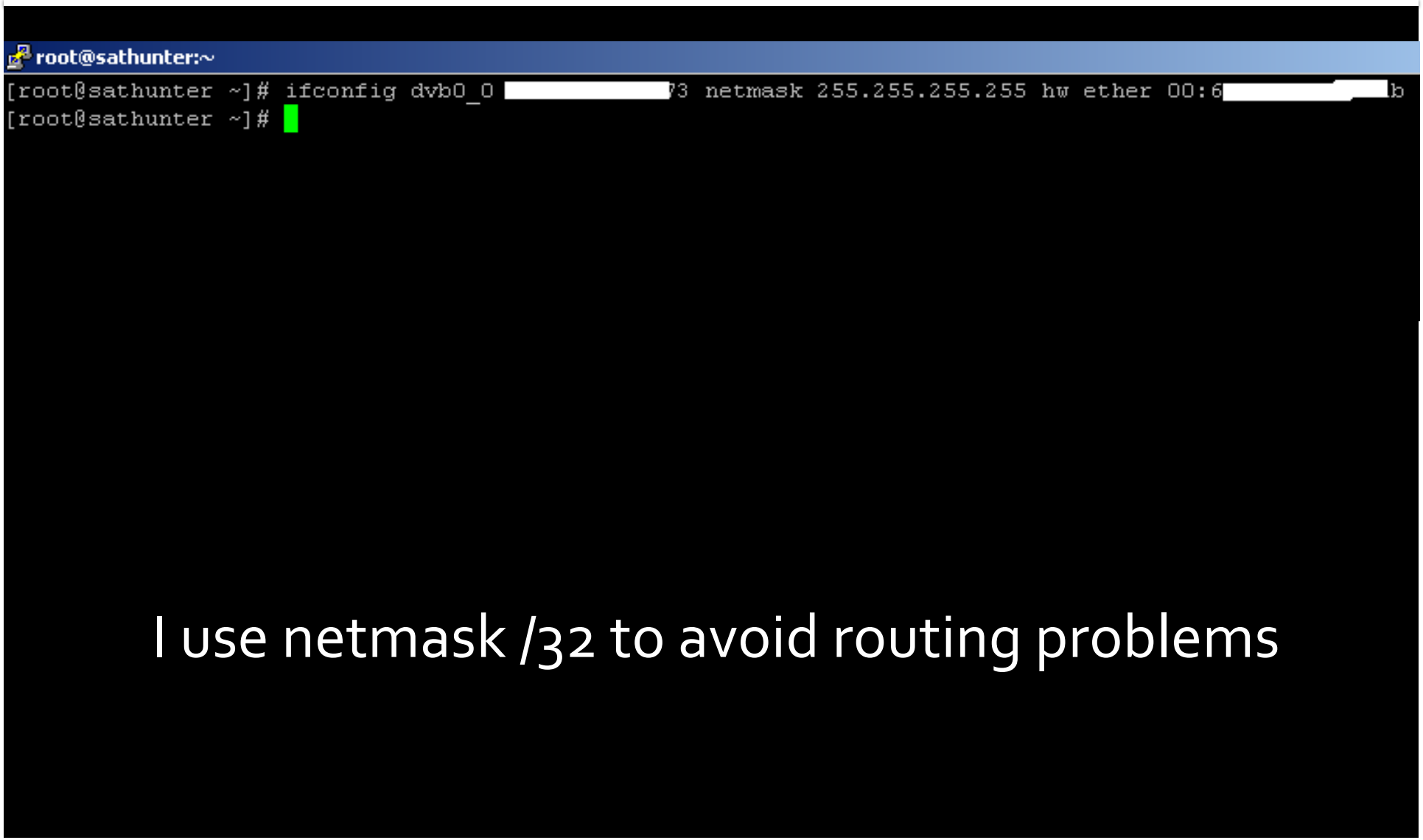
Configure our dvb interface to receive this IP (I suppose that you have configure the PID…)

The IP is the one we have selected and in the ICMP scan, we must get the destination MAC sniffed.

HTSNACBT Attack



HTSNACBT Attack

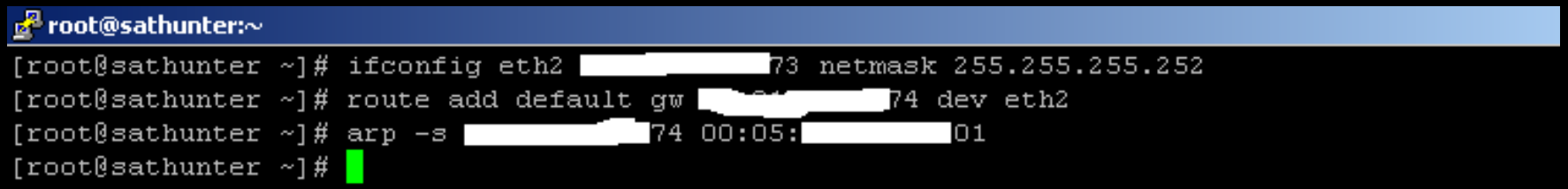


I use netmask /32 to avoid routing problems

HTSNACBT Attack

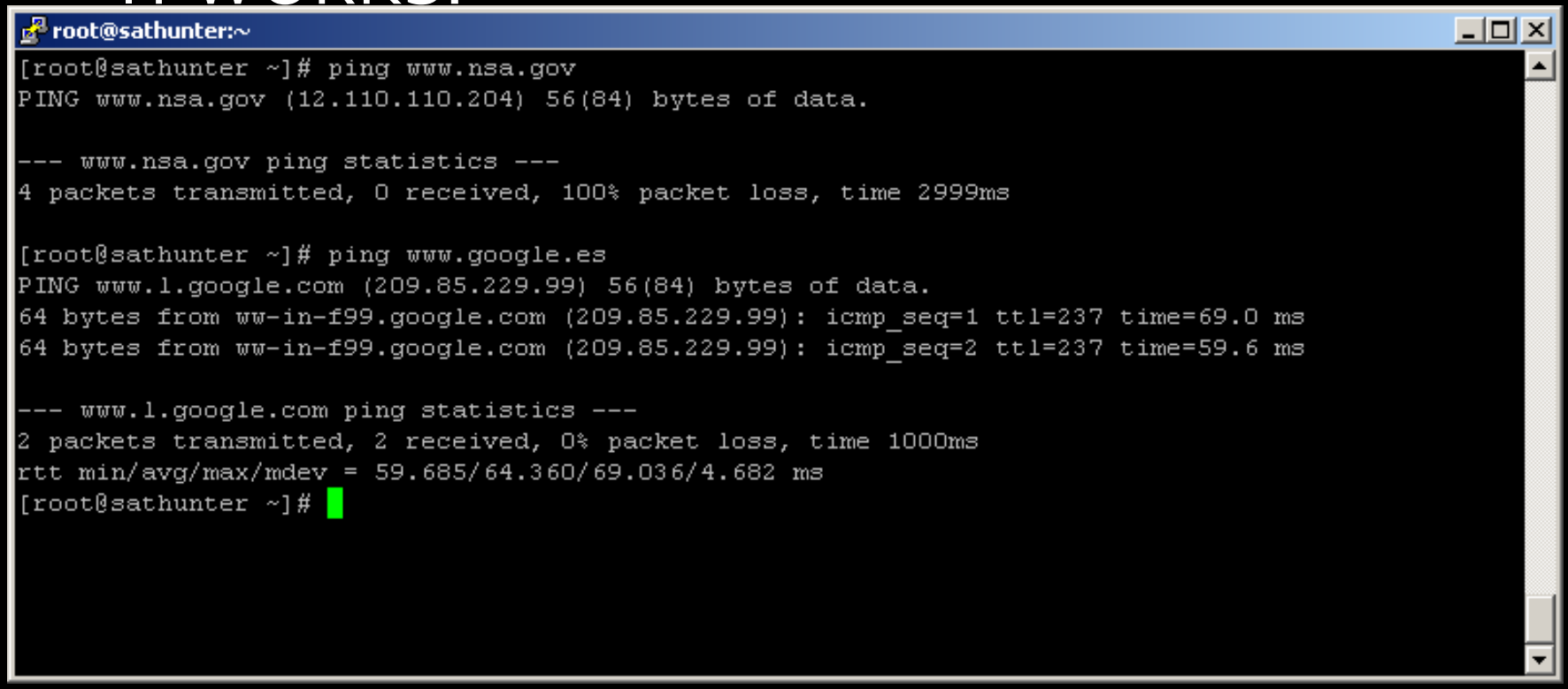
Now we can configure our Internet interface with the same IP and configure a default route with a false router setting this one with a static MAC (our real router's MAC).

HTSNACBT Attack



HTSNACBT Attack

IT WORKS!



HTSNACBT Attack

This is all !!!

Some things you must remember:

The DNS server must allow request from any IP or you must use the satellite ISP DNS server.

If you have any firewall (iptables) disable it.

HTSNACBT Attack

Some things you must remember:

The DNS server must allow request from any IP or you must use the satellite ISP DNS server.

If you have any firewall (iptables) disable it.

All the things you make can be sniffed by others users.

HTSNACBT Attack

Now attacking GRE is very easy, you only need to configure your Linux with IP of one of the routers (the one with the satellite connection) and configure the tunneling.

http://www.google.es/search?rlz=1C1GPEA_en___ES312&sourceid=chrome&ie=UTF-8&q=configuring+GRE+linux

The other scenario

What happened with the scenario where the client use an astromodem?

We can capture the downlink and the uplink so all these attacks are easier to do.

We can capture all queries for the DNS Spoofing attack.

We can capture all traffic in a TCP connection, we can hijack easily in any direction.

What TODO now?

- I'm studying the different methods to trace illegal users. (I only have a few ideas).
- In the future I would like to study the possibilities of sending DVB data to Satelite via Astromodem.

Conclusions

- Satellite communications are insecure.
- It can be sniffed.
- A lot of attacks can be made, I just talked about only few level 4 and level 3 attacks.

Conclusions

- With these technology in our sky, an anonymous connection is possible.
- Many kinds of Denial of Service are possible.

THANK YOU!!!