CERT participation in incident handling related to the Article 13a obligations

Handbook, Document for teachers

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Contributors to this report

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Agreements or Acknowledgements

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1 Introduction

Goal

This exercise provides students with information about rules, procedures and best practice in handling incident related to obligation for internet service providers described in the Article 13a of the European Telecom Package.[1]

Target audience

Incident handlers and CERT managers responsible for incident handling procedures within an organisation

Course Duration

3 hours

Frequency

Once for each new CERT member

Structure of this document

	Task	Duration
	Introduction to the exercise	10 min
	Task 1: Building technical environment for analysing network monitoring data	30 min
	Task 2: Analysing of network monitoring data	90 min
	Task 3: Preparing report according to the Article 13a template report	30 min

2 General Description

The purpose of this exercise is to prepare participants to be ready to analyse a set of data related to a DDoS attack. The proposed type of attack is similar to those that should be reported to the Regulatory Authority according to the rules and obligations for internet service providers (ISPs) described in Article 13a of the European Telecom Package. In this particular example, the attack is against an important online service provided by ISP and used by ISP customers for e-services. The service for customers is not available due to on-going DDoS attack. Additionally due to the DDoS attack, the network service is temporarily unavailable.

[1] *Directive 2009/140/ec of the European Parliament and of the Council (dealing with electronic communications) - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF*

During the exercise participants will learn:

- how to analyse network traffic data related to the attack;
- what kind of information can be obtained from network traffic data;
- how to prepare the report that should be used for reporting security incidents according to Article 13a.

3 EXERCISE COURSE

The course of this exercise is as follows. All assumptions and discussions should be moderated by the trainer.

3.1 Introduction to the exercise

At the beginning of the exercise you should introduce participants to the attack that occurred in the network of the ISP. Participants play the role of representatives of the ISP CERT team, which is responsible, along with other duties, for analysing network monitoring data and preparing an incident security report for the national regulatory authority.

There are three different levels of incident notifications and obligations related to them:[2]

- a service provider reporting to the national regulatory authority;
- a national regulatory authority reporting to other national regulatory authorities;
- a national regulatory authority reporting to ENISA.

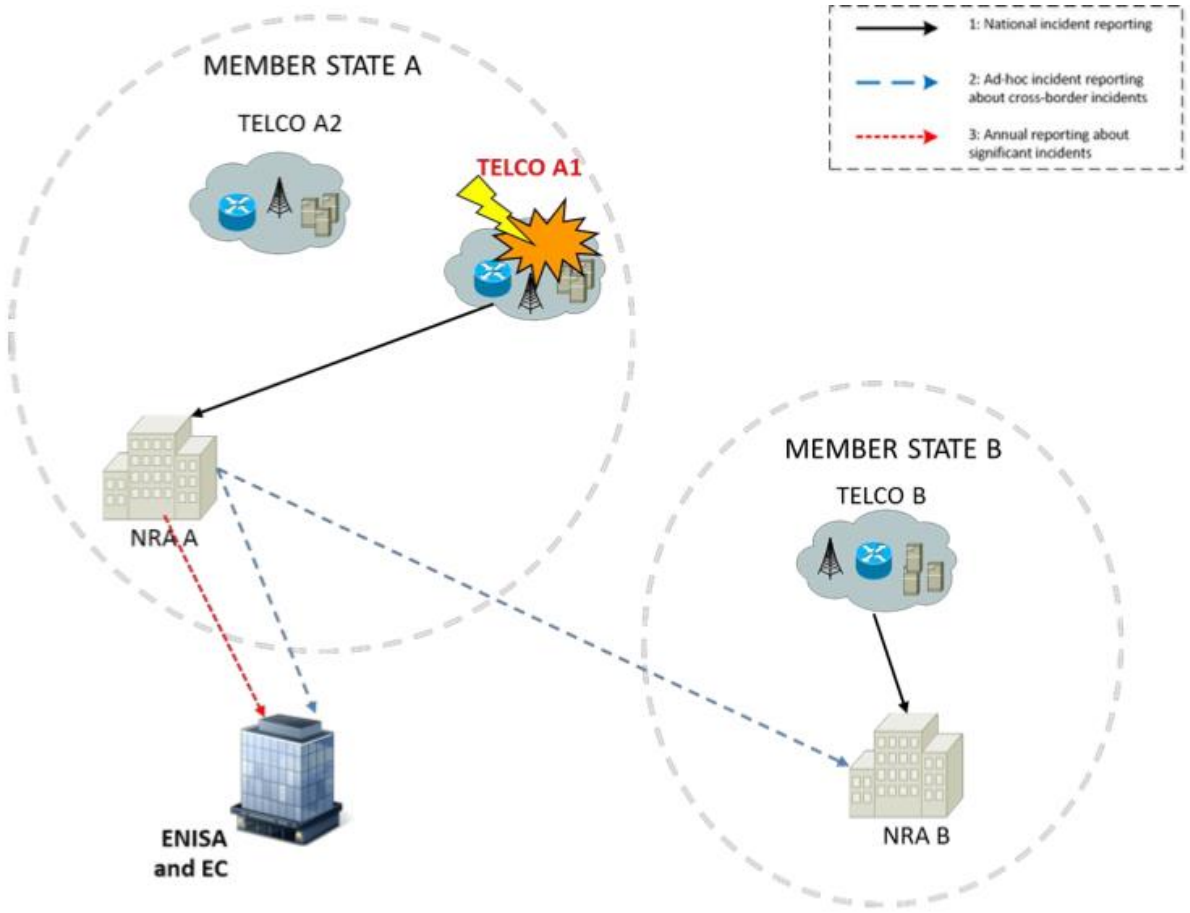

Figure1: Reporting schemes of Article 13a[2]

These obligations are described in paragraph 3 of Article 13a[3]:

Member States shall ensure that undertakings providing public communications networks or publicly available electronic communications services notify the competent national regulatory authority of a breach of security or loss of integrity that has had a significant impact on the operation of networks or services.

In practice it means that the provider (mainly this will relate to ISPs) should continuously monitor the level of the security of their telecommunication resources. Detection and especially reaction and handling to observed incidents should be based on the best practices related to incident handling activities,[4] which means that incident handling capability should exists in all providers.

A citation from Article 13a of the European Telecom Package: "Where appropriate, the national regulatory authority concerned shall inform the national regulatory authorities in other Member States and the European Network and Information Security Agency (ENISA). The national regulatory

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[2] *'Technical Guideline on Reporting Incidents – Article 13a Implementation'* - http://www.enisa.europa.eu/activities/Resilience-and-CIIP/Incidents%20reporting/Technical%20Guidelines%20on%20Incident%20Reporting/incidents-reporting-to-enisa/technical-guideline-on-incident-reporting

[3] http://ec.europa.eu/information_society/policy/ecomm/doc/library/regframeforec_dec2009.pdf

[4] *ENISA Good Practice Guide for Incident Management:* http://www.enisa.europa.eu/activities/cert/support/incident-management

authority concerned may inform the public or require the undertakings to do so, where it determines that disclosure of the breach is in the public interest."

In particular cases, where the security incident could have a significant influence on the level of security in countries other than the country of the incident's origin, cooperation and effective communication between national regulatory authorities is very important. Thanks to this cooperation an appropriate warning and alerting in other countries is possible. It is worth adding that this internal country warning and alerting activities are very often based on CERT involvement in these processes.

A citation from Article 13a of the European Telecom Package: "Once a year, the national regulatory authority concerned shall submit a summary report to the Commission and ENISA on the notifications received and the action taken in accordance with this paragraph."

The purpose of such reporting is to gather relevant information about Internet network breaches. The assumption is that it will help authorities to better understand new trends and mechanisms in Internet threats as well as being an important element in raising the public's level of awareness regarding Internet security.

In this exercise a security incident related to the ISP network is discovered: the online service for customers is not available due to on-going DDoS attack. Additionally due to the DDos the network service is temporarily unavailable. There is no clear information on how long it could last, what requests might come from customers in case they have no access to their data or network.

3.2 Task 1: Building a technical environment for analysing network monitoring data

Participants will have to build a technical environment for analysing network monitoring data. They will need to install Wireshark software[5] for extracting data from Pcap files (packet capture).

Additionally as a recommended tool they would need the tcpdump application. Alternatively the technical environment can be prepared by trainer.

The Wireshark application installation guide can be found in *Wireshark User's Guide* in Chapter 2: 'Building and Installing Wireshark'.[6]

[5] http://www.wireshark.org

[6] *http://www.wireshark.org/download/docs/user-guide-a4.pdf*

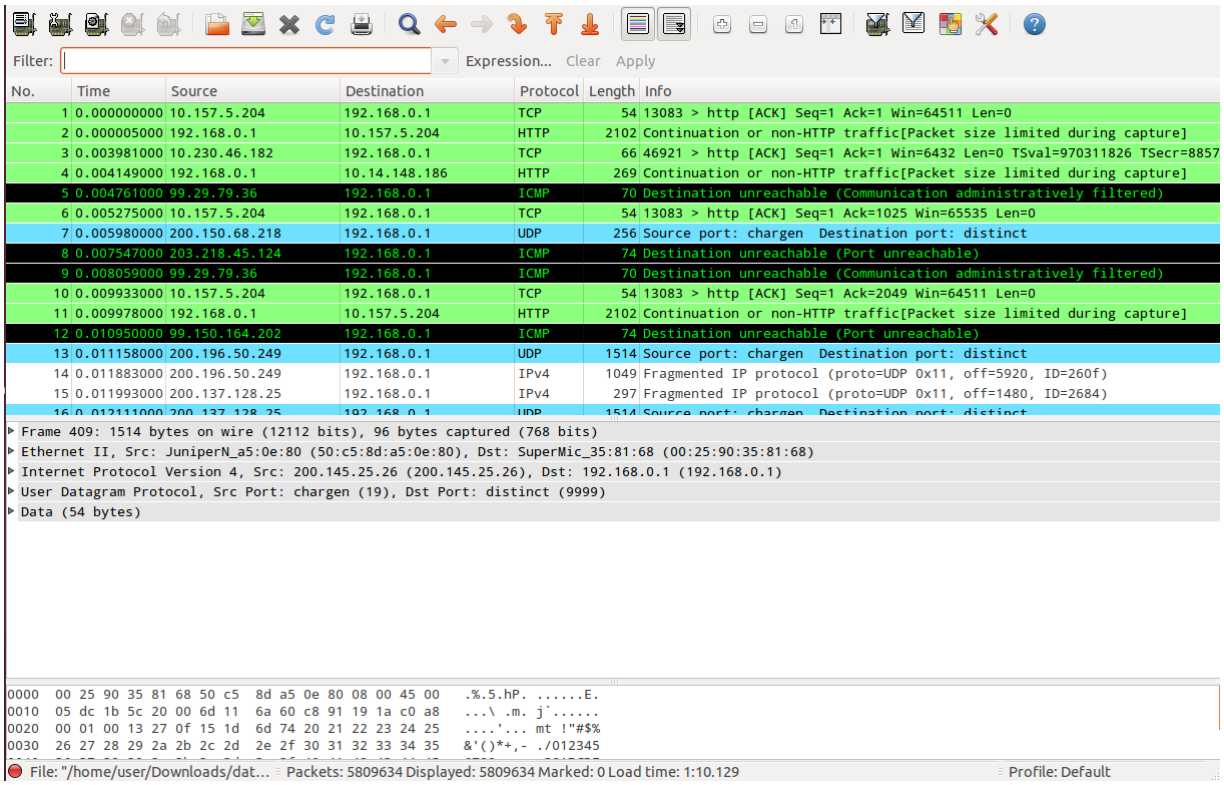


Figure 2: Using Wireshark

The figure presents the Wireshark interface with pcap loaded into the application; information about packets can be seen in the picture.

3.3 Task 2: Analysing of network monitoring data

Network monitoring data, provided to participants in this exercise, includes different types of network TCP/IP protocol data, like ICMP flows and UDP flows. Participants should make the following types of analysis.

Subtask 1 – determination of time and volume of the attack

Firstly, participants should create a short summary including basic information of each pcap file they have. They should check:

- the start and end time of capture;
- the size of captured packets;
- the total number of packets as well as average packet/byte rates;

This information should give a general overview of the size of data that are going to be analysed and allow the placement of PCAP files on the timeline (note that capture times of separate PCAPs can overlap).

All of this information can be easily checked using the capinfos tool that comes with Wireshark:[7]

[7] http://www.wireshark.org/docs/man-pages/capinfos.html

```
$ capinfos /path/to/pcap/file.pcap
```

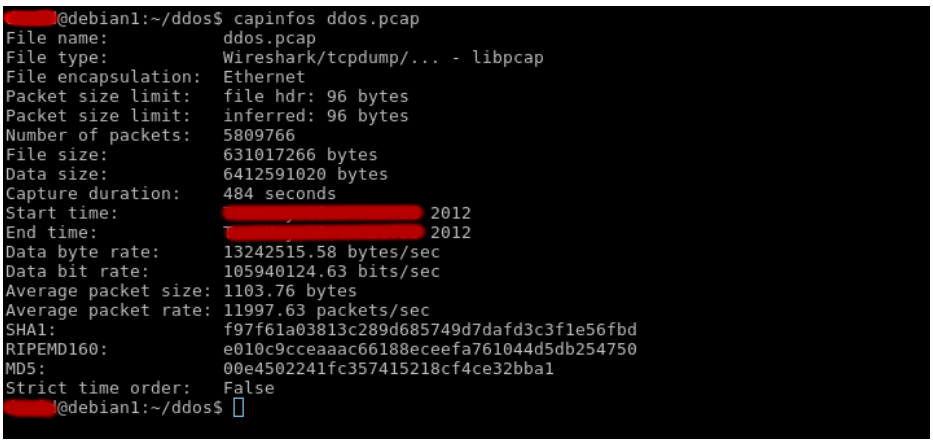


Figure 3: Using capinfos

Figure 3 shows the output of the capinfos application, allowing the user to obtain general information about the pcap file. Information consists of file size, number of captured packets, checksums, capture times and also a few average values.

In the next step, participants should examine the captured traffic and try to determine what kind of DDoS attack was performed. Usually, during a DDoS attack, more than one DDoS technique is used; or there are separate and distinct attack sources. At this point, they should try to create a Wireshark filter [8] or a tcpdump Berkeley Packet Filter (BPF) filter,[9] which would allow filtering out each type of DDoS attack stream.

In fact there were two kinds of attacks and this should be found out by participants (see below).

- ICMP flood
- UDP flood

In the ICMP flood, all ICMP packets were type 3 (Destination Unreachable) with codes 3 (Destination Port Unreachable) and a few cases of code 1 (Destination host unreachable) and 13 (Communication administratively prohibited).

[8] *More on Wireshark filters: https://www.wireshark.org/docs/dfref/*

[9] *More on tcpdump filters: http://www.cs.ucr.edu/~marios/ethereal-tcpdump.pdf*

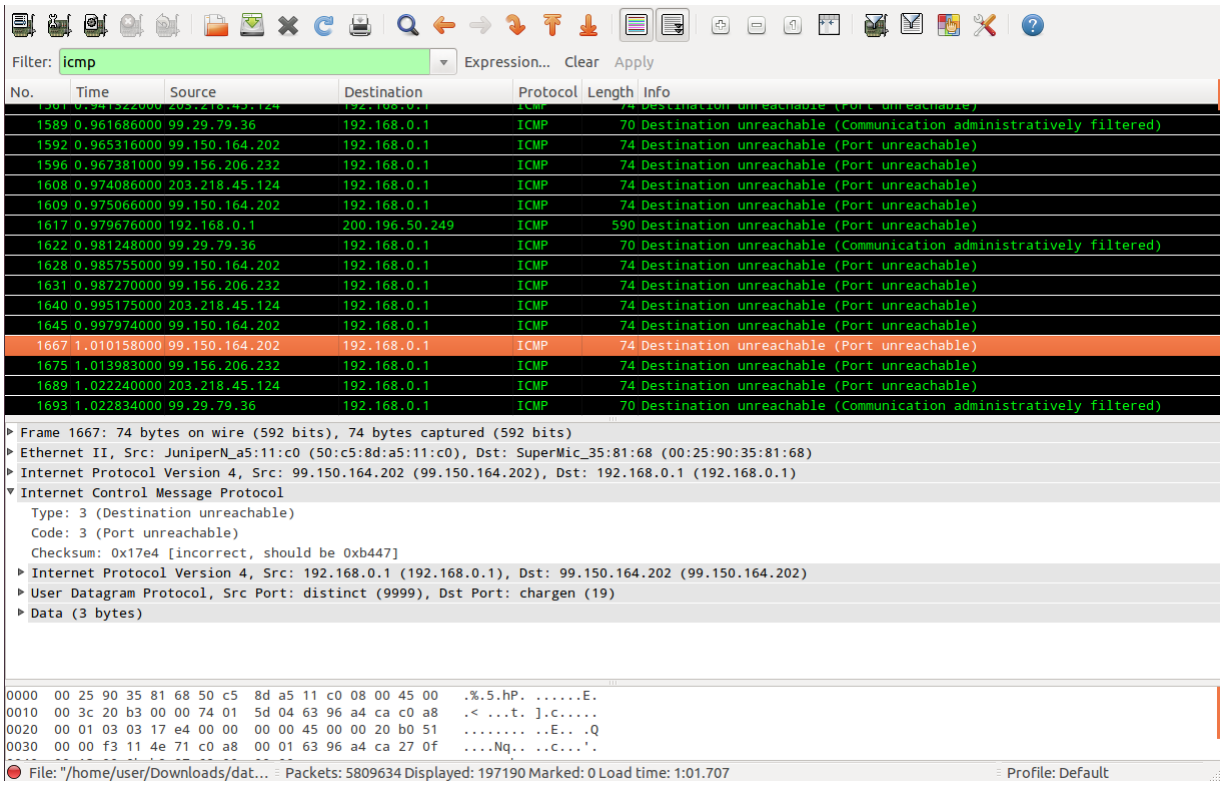


Figure4: ICMP packet of type 3 (Destination Unreachable) with code 3 (Destination Port Unreachable)

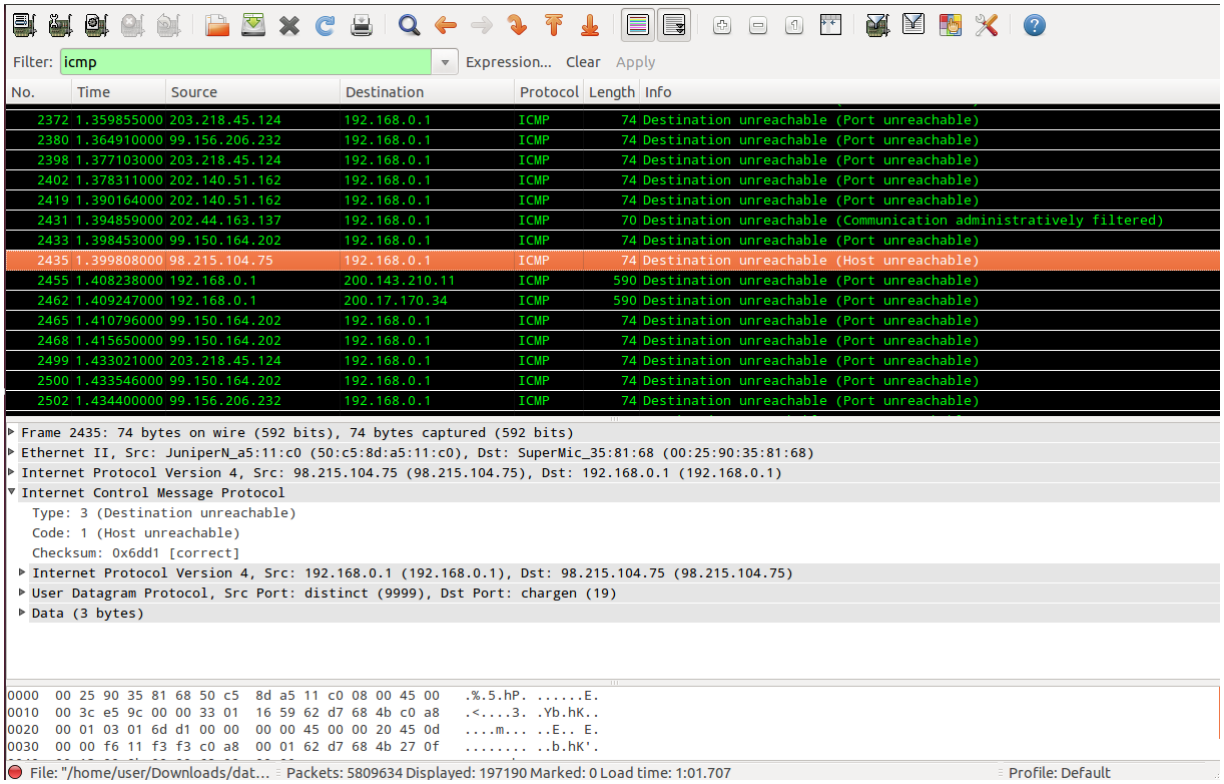


Figure 5: ICMP packet of type 3 (Destination Unreachable) with code 1 (Destination host unreachable)

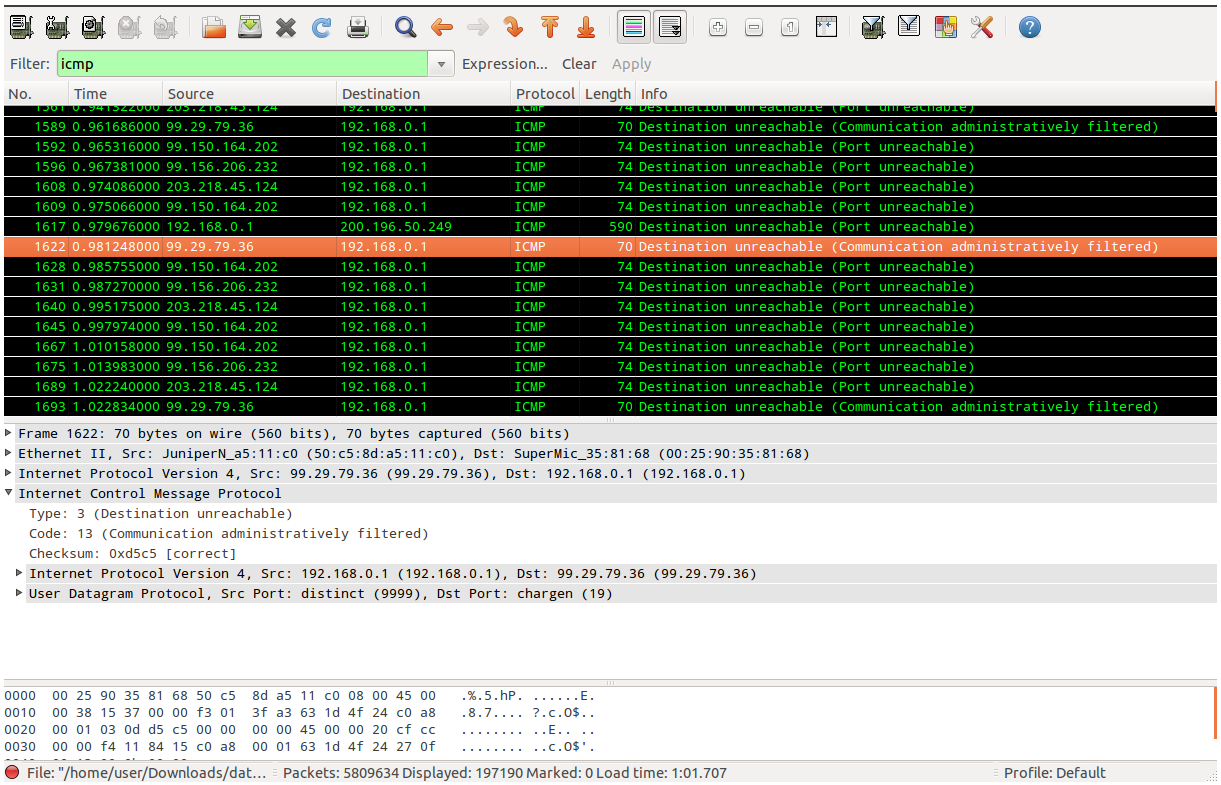


Figure 6: ICMP packet of type 3 (Destination Unreachable) with code 13 (Communication administratively filtered)

The UDP flood consisted of many fragmented IP packets. For all of them, the protocol field was set to UDP and for most of them either the MF flag was set or the fragment offset was greater than zero.

Help participants by explaining the filters presented below. If participants have problems with finding the solution, provide the proper Wireshark.

Filters which could be used for this analysis are the Wireshark display filter, and the tcpdump filter.

Wireshark display filter: `(udp && not udp.port == 53) || ip.flags.mf == 1 || ip.frag_offset > 0`

This is a sample Wireshark display filter allowing us to separate DDoS UDP flood. To do this we select all packets matching a) or b) or c) rule:

a) (udp && not.udp == 53) - all udp packets with port other than 53 (we're not interested in DNS traffic which isn't part of DDoS attack)
b) ip.flags.mf == 1 - packets having IP flag MF (More Frag.) set
c) ip.frag_offset > 0 - packets with fragment offset greater than 0.

Tcpdump filter: `ip[6:2]&8191>0 or ip[6]&32!=0 or (udp and not port 53)`[10]

The second filter is the same filter, but written in BPF tcpdump filter syntax. This time we can't refer to separate fields of IP or UDP headers. To filter packets by IP header fields values we must refer to IP

[10] *ip[6:2]&8191>0 is for checking IP fragment offset field (2 bytes length starting from 6th byte of IP hdr, counting from 0)*

ip[6]&32!=0 is for checking whether MF (More fragments) flag was set

header as byte array with ip[0] being a first byte of IP header. Syntax is as follows: ip[a:n] - 'n' bytes starting from 'a' position/element/byte. & operator denotes bitwise AND operation. a) ip[6:2]&8191>0 - fragment offset greater than 0 b) ip[6]&32!=0 - flag MF is set c) udp and not port 53 - all udp packets with port other than 53

Packets to port 53 are excluded as packets sent to this port were proper DNS requests and weren't part of DDoS attack (at least in this case).

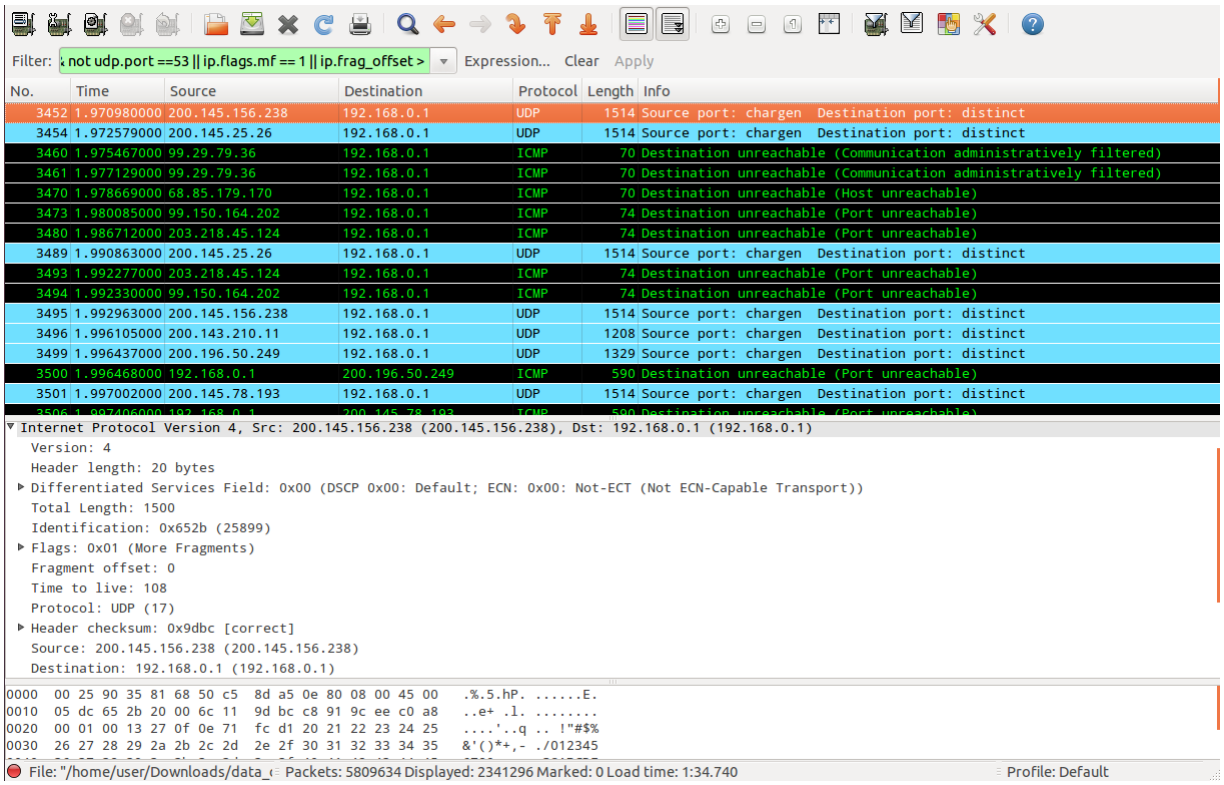


Figure 7: Excluded packets to port 53 that are legitimate packets

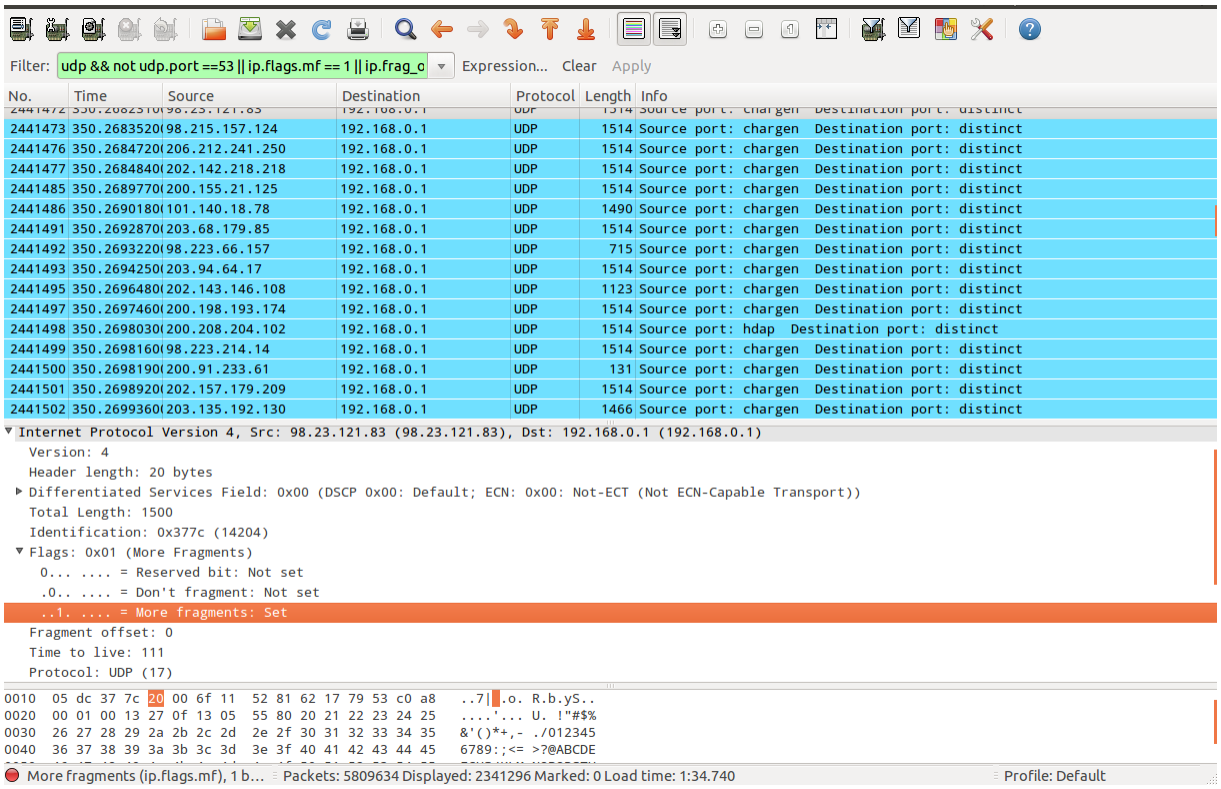


Figure 8: UDP packet with More Fragments (MF) bit set

Next, participants should recognise what distinct streams the DDoS attack consisted of (either different attack methods/techniques or clear source distinction). They can analyse input/output statistics for those streams in comparison with normal server traffic. To complete this task they should:

1. open the PCAP file in Wireshark;
2. choose Statistics → IO Graph;
3. use the display filters created in the previous point to create separate graphs;
4. adjust other options if needed (X and Y axis scale, line style, etc.)

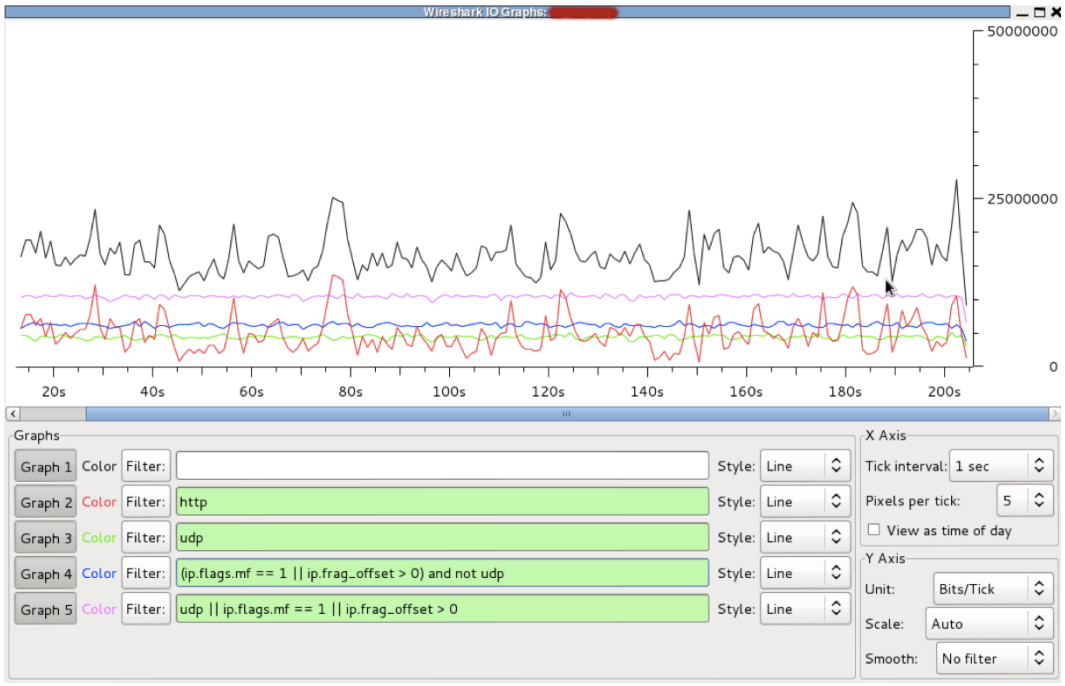


Figure 9: statistics of the initial DDoS phase.

Figure 9 presents the initial phase of the DDoS attack. Legitimate HTTP traffic is marked with a red line. We can see strong fluctuations over time of this type of traffic (which is quite normal). DDoS traffic (UDP flood) is marked with a pink line. In this case, fluctuations are much smaller and its throughput is almost constant (~10 Mbps). Also we can see that DDoS traffic doubles the average throughput of HTTP traffic.

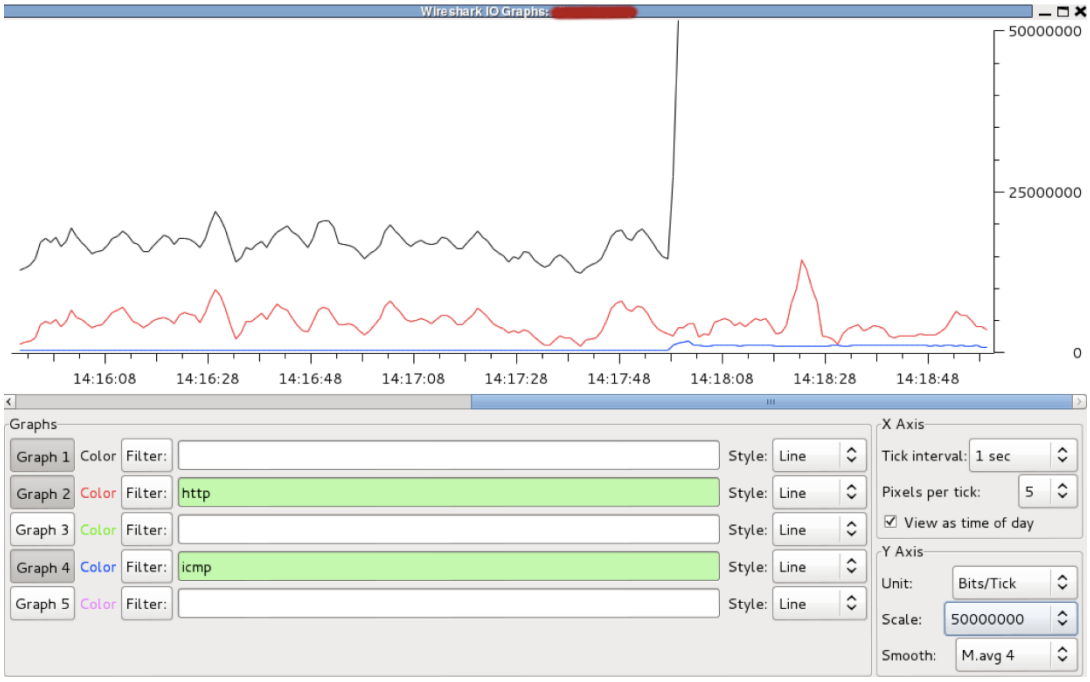


Figure 10: Slight increase of ICMP traffic (blue line) with the start of the second DDoS phase

Figure 10 presents a slight increase of value for ICMP traffic around 14:18:00. This increase is a representation of the second phase of the DDoS attack.

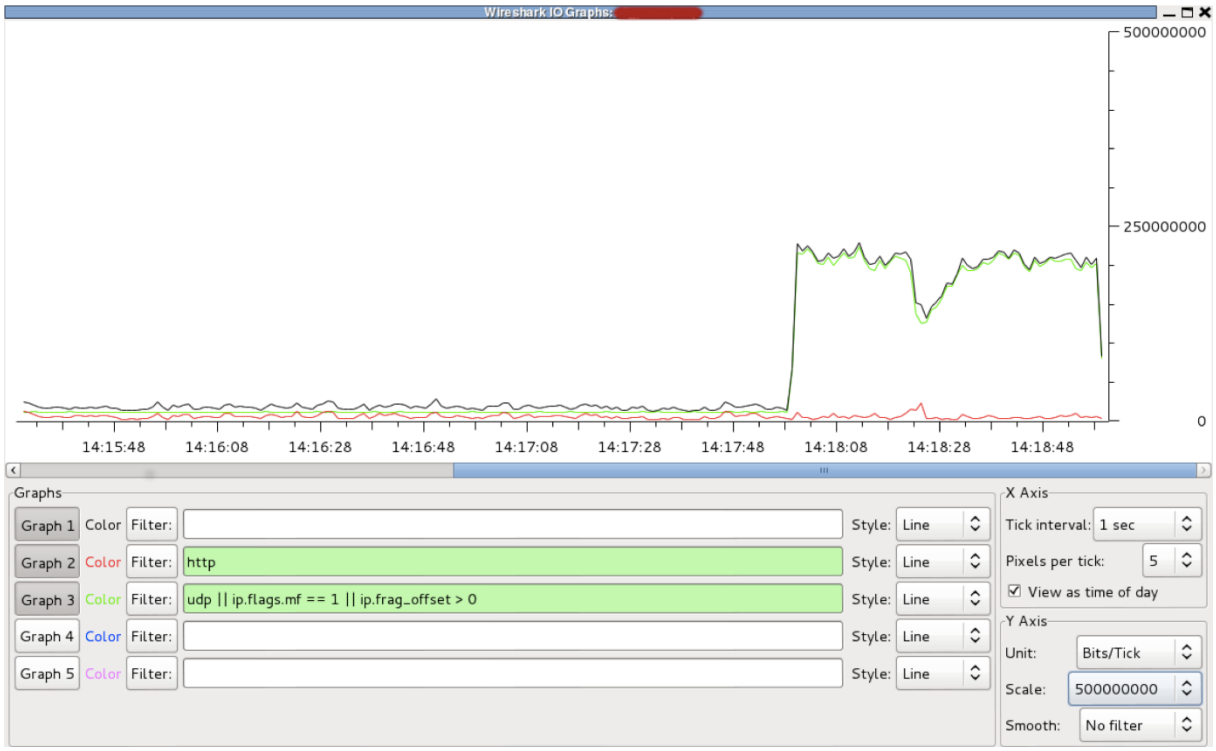


Figure 11: Second DDoS phase

Around 14:17:58, the second DDoS phase started. We can see that with the start of the second DDoS phase, the total traffic significantly increased. Total traffic throughput increased from ~22.5 Mbps to ~200 Mbps, which means that traffic increased nearly nine times in comparison with the first phase, and forty times in comparison with legitimate HTTP traffic (~5Mbps). We should also note that traffic increase was almost entirely due to UDP flood (green line).

Figure 12: Second DDoS phase in detail

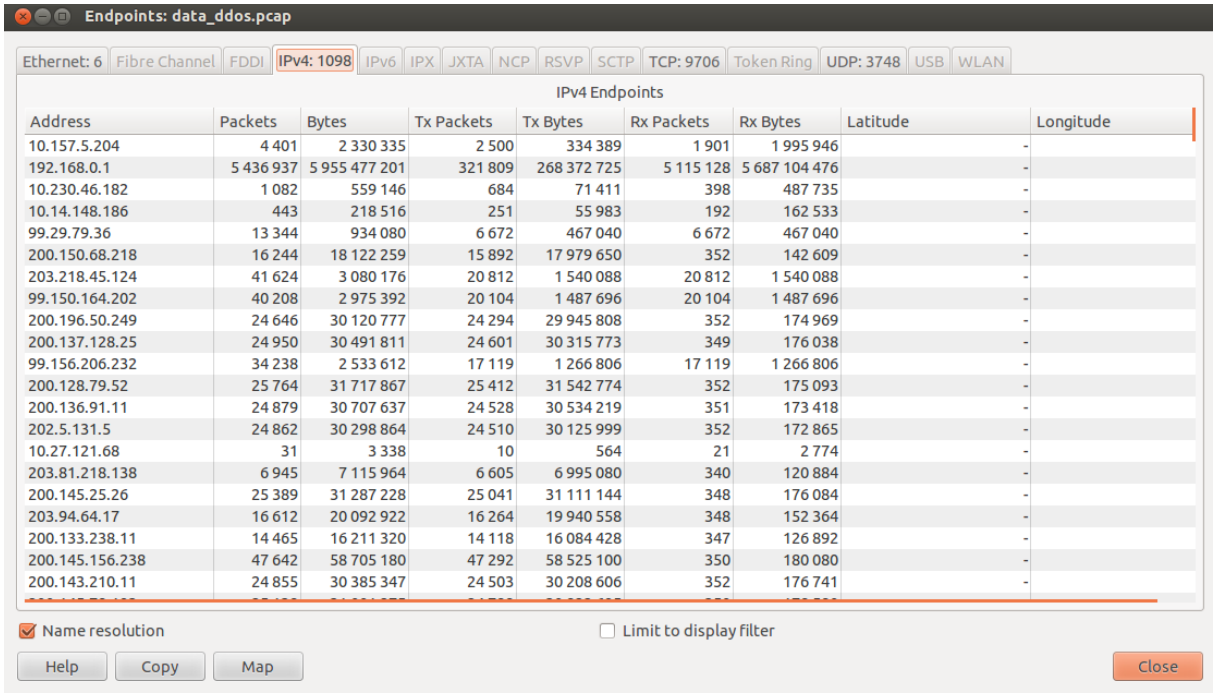
Figure 12 more clearly shows us increase of UDP flood (green line) traffic with the beginning of the second DDoS phase.

The next subtask for participants is to determine the endpoints' addresses of analysed hosts. There are various ways to export such addresses – they can do this using either Wireshark or tcpdump.

Method 1 with Wireshark:

If participants use Wireshark application they should follow the following steps.

1. Open pcap with DDoS traffic in Wireshark (alternatively just apply the proper display filter to the file with all captured traffic).
2. Choose Statistics → Endpoints and switch to IPv4 tab.



Address	Packets	Bytes	Tx Packets	Tx Bytes	Rx Packets	Rx Bytes	Latitude	Longitude
10.157.5.204	4 401	2 330 335	2 500	334 389	1 901	1 995 946	-	
192.168.0.1	5 436 937	5 955 477 201	321 809	268 372 725	5 115 128	5 687 104 476	-	
10.230.46.182	1 082	559 146	684	71 411	398	487 735	-	
10.14.148.186	443	218 516	251	55 983	192	162 533	-	
99.29.79.36	13 344	934 080	6 672	467 040	6 672	467 040	-	
200.150.68.218	16 244	18 122 259	15 892	17 979 650	352	142 609	-	
203.218.45.124	41 624	3 080 176	20 812	1 540 088	20 812	1 540 088	-	
99.150.164.202	40 208	2 975 392	20 104	1 487 696	20 104	1 487 696	-	
200.196.50.249	24 646	30 120 777	24 294	29 945 808	352	174 969	-	
200.137.128.25	24 950	30 491 811	24 601	30 315 773	349	176 038	-	
99.156.206.232	34 238	2 533 612	17 119	1 266 806	17 119	1 266 806	-	
200.128.79.52	25 764	31 717 867	25 412	31 542 774	352	175 093	-	
200.136.91.11	24 879	30 707 637	24 528	30 534 219	351	173 418	-	
202.5.131.5	24 862	30 298 864	24 510	30 125 999	352	172 865	-	
10.27.121.68	31	3 338	10	564	21	2 774	-	
203.81.218.138	6 945	7 115 964	6 605	6 995 080	340	120 884	-	
200.145.25.26	25 389	31 287 228	25 041	31 111 144	348	176 084	-	
203.94.64.17	16 612	20 092 922	16 264	19 940 558	348	152 364	-	
200.133.238.11	14 465	16 211 320	14 118	16 084 428	347	126 892	-	
200.145.156.238	47 642	58 705 180	47 292	58 525 100	350	180 080	-	
200.143.210.11	24 855	30 385 347	24 503	30 208 606	352	176 741	-	

Figure 13 Sources of the DDoS attack and packets statistics

3. If necessary make sure the '`Limit to display filter`' option is selected.
4. Click 'Copy' and paste the data to some file. The data is in CSV format.
5. Save file as `ddos.csv`
6. Get the ip addresses only from .csv file using the following command:
   - `cat ddos.csv | cut -d '"' -f 2 > ddos_ip.uniq`

Method 2 with tcpdump

If participants want to use tcpdump they should follow the following steps.

1. Use the tcpdump command:
   - `tcpdump -n -r data_ddos.pcap '<filter>'`

As the result they should receive:

14:13:28.944879 IP 99.29.x.x > 92.158.x.x: ICMP host 99.29.79.36 unreachable - admin prohibited filter, length 36

14:13:28.947665 IP 203.218.x.x > 92.158.x.x: ICMP 203.218.45.124 udp port 19 unreachable, length 40

14:13:28.948177 IP 99.29.x.x > 92.158.x.x: ICMP host 99.29.79.36 unreachable - admin prohibited filter, length 36

14:13:28.951068 IP 99.150.x.x > 92.158.x.x: ICMP 99.150.164.202 udp port 19 unreachable, length 40

2. Use the tcpdump command:

   - `tcpdump -n -r ddos.pcap | perl -ne 'if (m/IP (\d+\.\d+\.\d+\.\d+)/){print "$1\n";}' | sort -u > ddos_ip.uniq`

This should produce the list of unique IP addresses (ddos_ip.uniq). Such list can be used for finding more information, e.g. autonomous systems. To get list of autonomous systems associated with these addresses, participants can use the free service available at The Shadowserver Foundation: http://www.shadowserver.org/wiki/pmwiki.php/Services/IP-BGP

All information gathered during the subtasks should be used to prepare the full report (see Task 3).

3.4 Task 3: Evaluating countermeasures values

After collecting all information from network monitoring data, participants should prepare a security incident report for the national regulatory authority (NRA). To better prepare this report, they should first learn more about the reporting schema template. You should present them the template and explain its fields using the following guide from the ENISA document *Technical Guide on Reporting Incidents*.[11] Each participant should use one of the ISP providers that they are most familiar with. The name of the ISP can be fictitious. Keeping in mind and referring to the real examples from their countries gives participants an additional chance to exchange information about practical aspects of cooperation between CERTs and ISPs in different countries. There is no need to use real names for this purpose.

Field	Description	Tip for fulfilling
Country	The country that sends the report to NRA	
Date and time	Details of the date and time when the incident took place (in national time). It can be interpreted as the time the incident was discovered.	According to analysed logs

[11] *(http://www.enisa.europa.eu/activities/Resilience-and-CIIP/Incidents%20reporting/Technical%20Guidelines%20on%20Incident%20Reporting/incidents-reporting-to-enisa/technical-guideline-on-incident-reporting) (page 20).*

	Time should be expressed in both CET and local time.	
Impacted services	The affected service: the service rendered unavailable to the end-user. This field includes a description of the service whose continuity and availability are affected by the impact level. It should be noted that assessing the Level of Service (LoS) Quality of Service (QoS) introduces complexity into the analysis criteria and can become subjective. The possible choice is: fixed telephony, mobile telephony, (short) message services, Internet, email.	According to participants' knowledge of online service functionality and services
Number of users affected	The total number of users affected when an incident occurs (percentage of all affected users of that service in a given country). The national report to the NRA may include the absolute number the NRA would have to translate into percentages for inclusion in the annual report to ENISA and the European Commission.	According to participants' knowledge of online service functionality and services
Duration	The duration of the incidents	According to analysed logs
Geographic spread/region	If available, the region impacted by the incident	According to the participants' choice of ISP geographical location. Add information about geographical location of attacking parties.
Impact on Emergency calls	If available emergency service impacted by the incident	For the purpose of the exercise, the real data of CERTs represented by participants
Description	Fill in any further information you can share on the impact of the incident.	According to the findings from logs analysis

Root cause	What kind of disaster or reason caused the security problem. The potential choices are: natural disaster or phenomena, human error, malicious attack, hardware or software failure, failure at third party or external party.	According to participants' knowledge of the source of incident. The description and findings can be changed during the analysis.
Other incident information	A general description of the incident. Also the description of all the incident handling actions and activities undertaken by a handler and post-incident actions. In this part of the report, there is information about other possible parties affected by an incident. Other descriptive information about an incident includes lessons learnt from an incident and further remarks. There is one more particular piece of information requested – NRA's contacted (in case of a cross –border incident). This one is especially dedicated for the NRA. From the perspective of the ISP and its CERT it is included in information about cooperation and contact with other parties.	

Some of the information is not very important in preparing the report in terms of the exercise purposes, but it is important to give participants the whole picture and mention and discuss all information.[12]

4 Summary of the exercise

In the summary ask participants to present their findings about the incident by presenting the requested fields of the security incident report. Be sure that all participants present their work results. In particular, discuss findings if they differ among participants. Find a proper solution.

At the end of the summary, present again the main rules for incident reporting schema between ISPs, NRAs and ENISA and explain the purposes of these regulations, as well as benefits for CERTs. These benefits may include:

- closer cooperation between CERTs on the operational level;

[12] *More descriptions of the report fields are available in the ENISA document 'Technical Guideline on Reporting Incidents – Article 13a Implementation' (page 21).* https://resilience.enisa.europa.eu/article-13/guideline-for-incident-reporting/technical-guideline-for-incident-reporting-v1.0

- common schema for collecting information about incidents;
- closer cooperation inside each Member States between parties involved in improving security level;
- systematic collection of security incident related data and its usage for building awareness about security threats in the Internet;

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