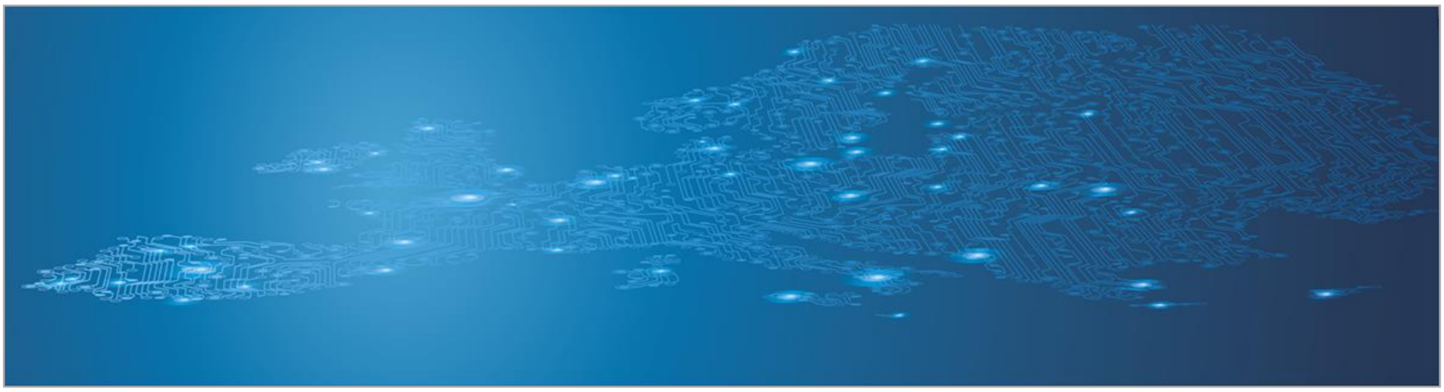

Guideline on Threats and Assets

Technical guidance on threats and assets in Article 13a

DRAFT, V.0.98, July 2014

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Authors

Dr. Marnix Dekker, Christoffer Karsberg, Rossella Mattioli, Cedric Levy-Bencheton

Contact

For contacting the authors please use resilience@enisa.europa.eu

For media enquires about this paper, please use press@enisa.europa.eu.

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Preface

The 2009 reform of the EU legislative framework for electronic communications (EU Directive 2009/140/EC) introduces Article 13a into the Framework directive (Directive 2002/21/EC as amended by Directive 2009/140/EC). The reform, was transposed by most EU Member States halfway 2011.

Article 13a concerns security and integrity of electronic communication networks and services. The first part of Article 13a requires that providers of networks and services manage security risks and take appropriate security measures to guarantee the security (paragraph 1) and integrity (paragraph 2) of these networks and services. The second part of Article 13a (paragraph 3) requires providers to report about significant security breaches and losses of integrity to competent national authorities, who should report about these security incidents to ENISA and the European Commission (EC) annually.

In 2010, ENISA, the European Commission (EC), Ministries and Telecommunication National Regulatory Authorities (NRAs), initiated a series of meetings (workshops, conference calls) to achieve an efficient and harmonised implementation of Article 13a across the EU. The Article 13a working group now comprises experts from NRAs of most EU countries, and several EFTA and EU candidate countries. Meetings (telephonic or physical) are organized and chaired by technical experts from ENISA. The European Commission acts as an observer in these meetings.

The Article 13a Working Group reached consensus on two non-binding technical guidelines for NRAs: the "Technical Guideline on Incident Reporting" and the "Technical Guideline on Security Measures". This document complements the other two guides by providing a list of assets and a list of threats. This document provides a full list of threat types, the relation between threats and rootcause categories (used in incident reporting), a full list of asset types, and it introduces asset groups and component layers.

The primary goal of this document is to improve pan-EU annual summary reporting. NRAs could also use this document for cross-checking risk assessments by providers, for supervising the security measures taken by providers, and for their national incident reporting frameworks.

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1 Introduction

In this document, we provide guidance to National Regulatory Authorities (NRAs) about the risk assessment mentioned in paragraphs 1 and 2 of Article 13a of the Framework directive (Directive 2002/21/EC as amended by Directive 2009/140/EC).

This document is drafted by a working group comprising experts from NRAs and representatives of the EC, supported by technical experts from ENISA (see Preface): the Article 13a Working Group.

Target audience

This document is addressed to national ministries and NRAs in European Member States, the authorities tasked with the implementation of Article 13a.

This document may be useful also for experts working in the EU's electronic communications sector and for experts working in the information security field.

Goal

This document is published by ENISA to provide NRA's with a vocabulary/glossary of terms to speak about threats and assets. This can directly be used in incident reporting (which is mandated by paragraph 3 of Article 13a) or used by NRAs to discuss with providers about their (internal) risk assessment (which is mandated by paragraph 1 and 2 of Article 13a).

Updates

ENISA updates this guideline periodically, when necessary and in agreement with the NRAs.

Structure of this document

In Section 2 we introduce the relevant parts of Article 13a and some terminology used in this document. In Section 3 position this document vis-à-vis the supervision tasks of regulators. In Section 4 we provide a list of detailed threat types, and we explain the five (broader) root causes categories. In Section 5 we provide a list of asset types, which are commonly used in fixed and mobile telecommunications networks and we introduce a model off asset groups and component layers. In Annex A we provide a glossary of terms and acronyms commonly used to describe specific assets.

2 Risk assessment in Article 13a

In this section we introduce Article 13a and the terminology used in this document.

2.1 Paragraph 1 and 2 of Article 13a

For the sake of reference, we reproduce the text of paragraphs 1 and 2 of Article 13a here.

"1. Member States shall ensure that undertakings providing public communications networks or publicly available electronic communications services take appropriate technical and organisational measures to appropriately manage the risks posed to security of networks and services. Having regard to the state of the art, these measures shall ensure a level of security appropriate to the risk presented. In particular, measures shall be taken to prevent and minimise the impact of security incidents on users and interconnected networks.

2. Member States shall ensure that undertakings providing public communications networks take all appropriate steps to guarantee the integrity of their networks, and thus ensure the continuity of supply of services provided over those networks. […]"

In the interest of brevity, we use the following abbreviations:

- The term "provider" is used to refer to an *"undertaking providing public communications networks or publicly available electronic communications services"*.
- The term NRA is used to refer to competent *"national regulatory authority"* as mentioned in Article 13a, which could be a ministry, or a government agency, depending on the national situation.
- The term "networks and communication services" is used to refer to *"public communications networks or publicly available electronic communications services*" as mentioned in Article 13a. This includes telecom operators, mobile network operators, internet service providers, et cetera.

2.2 Appropriate security measures

Paragraphs 1 and 2 of Article 13a contain two different requirements:

- Paragraph 1 requires providers to *"take appropriate technical and organisational measures to appropriately manage the risks posed to security of networks and services*", and to take measures "*to prevent and minimise the impact of security incidents on users and interconnected networks".*
- Paragraph 2 requires providers to *"take all appropriate steps to guarantee integrity of their networks, and thus ensure the continuity of supply of services"*.

The use of the term integrity (of networks) in the article text may be confusing to some readers. We refer the reader to the definition in technical literature about networks and network inter-connections[1], which defines integrity *"as the ability of the system to retain its specified attributes in terms of performance and functionality"*. Integrity of networks would be called availability or continuity in most information security literature.

We use the term 'appropriate security measures' to indicate the 'appropriate technical and organisational measures' and the 'appropriate steps' mentioned in the two paragraphs.

[1] Ward, K, 1995, 'The Impact of Network Interconnection on Network Integrity'. British Telecommunications Engineering, 13:296–303.

The technical guideline on security measures provides an overview of different security measures that NRAs should take into account when assessing compliance of providers to these two paragraphs.

Both requirements use the term appropriate, and this means that providers should do a risk assessment. In this document we focus on the risk assessment.

2.3 Security incidents

Article 13a mentions 'security incidents', 'security breaches' and 'integrity losses':

- Paragraph 1 requires "*that measures shall be taken to prevent and minimise the impact of security incidents on users and interconnected networks"*
- Paragraph 2 requires providers to *"take all appropriate steps to guarantee integrity of their networks, and thus ensure the continuity of supply of services"*.
- *Paragraph 3 requires "to 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"*

We use one term for these incidents:

Security incident: A breach of security or a loss of integrity that could have an impact on the operation of electronic communication networks and services.

This definition is in line with the definition used in the document 'Technical Guidelines for Incident Reporting'[2], which focusses on the process of incident reporting.

[2] Note that only a subset of these incidents have to be reported to ENISA and the EC, that is, those incidents that have had a significant impact on the continuity of services.

3 Risk assessment

Article 13a describes three main processes:

1) Provider assess the risks (for its users and connected networks),
2) Provider takes 'appropriate' security measures and
3) Provider reports about incidents to the NRA, should something go wrong.

The three processes are depicted in the diagram below.

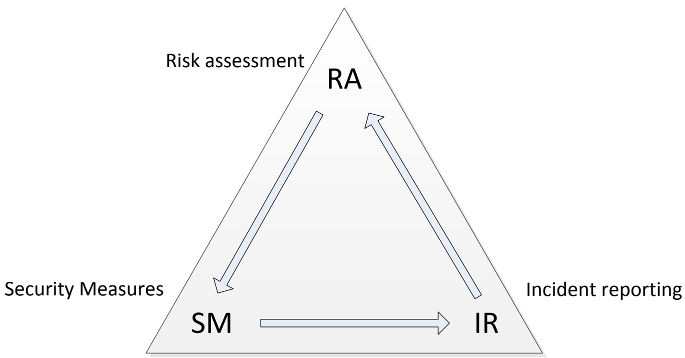


Figure 1 - The three security processes mandated by Article 13a.

Article 13a basically asks NRAs to supervise that these three processes are implemented adequately by the provider. Incidents could trigger an update of the risk assessment, and in this way lead to a change of security measures. So the processes feed into eachother: Following a risk assessment a provider might want to take certain security measures. Vice versa, security measures which are in place, decrease certain risks. Incident reports provide feedback about the effectiveness of security measures, and they might lead to changes in the risk assessment.

There is an Article 13a guideline for NRAs about how to supervise that providers take appropriate security measures, and there is a guideline for NRAs about how to implement incident reporting. In this guideline we address the top of the triangle by providing a glossary of common threat types and asset types. The primary goal of this dictionary of threats and assets is to improve incident reporting. Secondly, because threats and assets are the two key components of a risk assessment, this dictionary provides a terminology to speak about risks and risk assessments.

Remark about risk assessments and asset owners: *This guideline does not explain how providers can perform a risk assessment. There are many different methods for performing risk assessments inside an organisation. Providers should adopt appropriate methodology for performing risk assessments internally, depending on the assets, the complexity of their systems et cetera. Risk assessment is a continuous improvement process and assessments need to be updated, because risks scenarios continuously change over time.*

Remark about cross-sector threats: *Incident reporting could be used by NRAs to feed information about common threats and vulnerability of assets back to the sector itself. For instance, NRAs could aggregate the received incident reports periodically and inform providers about common threats. In this way providers can improve their risk assessments, even before they themselves experience a certain type of incident.*

4 Threats and causes

We define a threat (or a cause) as follows[3].

Threat: A threat is an event or a circumstance which could cause a security incident.

This definition is based on the definition of a security incident as defined in the incident reporting guideline (see also Section 2). Threats are also referred to as causes. Usually the term cause is used to speak about a threat which already caused an incident (in the past).

Note that in this guideline we take a so-called "all-hazards" approach, i.e. all threats which could have an impact on the security of networks and services are in scope.

4.1 Threat types

In this section we provide a list of threat types. To explain what we mean with threat type we give an example: The Gudrun storm (also called Erwin) of 2005, which hit Denmark, Sweden and Estonia, was a threat. The threat type would be "storm".

Note that this list of threat types is non-exhaustive.

4.1.1 Heavy snowfall

Heavy snowfall can impact (or obstruct access to) physical infrastructure, such as overland cables, roads, base stations, et cetera.

4.1.2 Storm

Storms (combination of wind, rain etc), heavy winds can impact physical infrastructure, such as overland network cables, overland power supply lines, transmission base station, et cetera.

4.1.3 Flood

Floods can impact (or obstruct access to) physical infrastructure, such as street cabinets, sites, et cetera.

4.1.4 Earthquake

Earthquakes can impact physical infrastructure, such as power supply lines, underground and overland cables, sites, et cetera.

4.1.5 Wildfire

Wildfire can impact (or obstruct access to) physical infrastructure, such as cables, servers, et cetera.

4.1.6 Electromagnetic storm

Electromagnetic storm can disable (or permanently damage) electronic devices used in electronic communications networks.

4.1.7 Fire and explosion

Fires and explosions can damage or destroy physical infrastructure, such as sites, cables, servers, routers, et cetera.

[3] This definition is similar to the definition in ISO27K5, which defines a threat as the cause of an incident.

Note that fire can also have an indirect impact, for example, when firefighters spray water or foam, or when they give orders to turn off power generators.

4.1.8 Cable cut or cable break

Cable cuts or cable breaks, for example by an excavation machine or by ship anchorage, can have an impact on networks or services.

4.1.9 Cable theft

Cable theft (when parts of a cable are dug up or cut by thieves, for example copper thieves) can have an impact on networks or services.

4.1.10 Hardware theft

Hardware (IT equipment, etc) can be stolen from sites. Particularly multi-purpose IT equipment can be attractive for thieves.

4.1.11 Power cut

Power cuts of the (public) powergrid, can have an impact on infrastructure which relies on power, for example basestations, sites, et cetera.

4.1.12 Power surge

Power surges, in the power supply of the main (public) powergrid, could have an impact on electronic devices connected to it.

4.1.13 Fuel exhaustion

Power generators can run out of fuel, which could have an impact on electronic devices.

4.1.14 Cooling outage

An outage of cooling systems can cause damage or malfunctioning of infrastructure.

4.1.15 Overload

Overload of traffic and usage could impact the networks and services.

4.1.16 Human factor

Personnel can make mistakes, for example forgetting to close a door or making a typo when entering text on a commandline.

4.1.17 Design error

Design errors, for example, a mistake in capacity planning, or a bad choice of systems, could have an impact on networks or services.

4.1.18 Physical attack

Physical attacks, such as vandalism or firestarting, could cause damage or obstructed access to physical infrastructure, such as cables, servers, sites, street cabinets, et cetera.

4.1.19 Cyber attack on networks

Cyber attacks aimed at disturbing or altering the network connections between systems could have an impact on the security of networks and services. An example is a Denial of Service (DoS) attack which aims to overload systems with traffic. DoS attacks can have an impact on the continuity of networks or services. Other examples include attacks on the DNS and BGP systems, to interrupt or hijack traffic and internet routes, et cetera.

4.1.20 Cyber attack on applications

Cyber attacks aimed aimed at disturbing or altering the (software) applications, such as databses, servers, et cetera. An example is the use of malware (aka a computer virus or trojan) to infect a system and alter the way it works.

4.1.21 Advanced Persistent Threats

Advanced Persistent Threats are cyber attacks, which are to some degree targeted and covert, often orchestrated. APTs could impact ICT systems, such as routers, servers, databases, et cetera, and in this way impact networks or services. APTs could have an impact on the security of networks and services.

4.1.22 Hardware failure

Hardware failures could affect physical infrastructure such as servers, routers, base stations, et cetera, and in this way have an impact on networks and services.

4.1.23 Software bug

Software bugs could have an impact on ICT systems, such as routers, servers, databases, et cetera, and in this way impact networks or services. This type of threat also includes complex failures like network failures when several systems fail to connect or otherwise work together.

4.1.24 Configuration error

ICT systems are often divided in hardware, software, and the ‘configuration’, which are software and/or hardware settings under control of the customer. Configuration errors of ICT systems, such as routers or servers, which can have an impact on networks or services.

4.1.25 Bad change

Changes, for example the installation of new devices in the network, the introduction of new functions, or updates of software, if carried out in the wrong way, could have a negative impact on the networks or services.

4.1.26 Bad maintenance

Maintenance, for example patching software or changing consumed parts, if carried out in the wrong way, could have a negative impact on networks or services.

4.1.27 Policy or procedure flaw

A flaw in a policy or procedure, or the absence of a policy or a procedure, could have a negative impact on the networks or services.

4.2 Root cause categories

In this section we define 5 categories of root causes[4]. Unlike the detailed causes (defined in the previous section) the root cause categories are broad categories to describe the underlying problem. Similar incidents might be categorized differently depending on the details. For example, suppose a storm causes a power cut of several hours, which causes an outage because the fuel ran out in one of power generators of a data center. Depending on the detailed description of the incident, in some cases it might be categorized as a natural disaster, in other cases it might be categorized as a human error (because someone forgot to refill the fuel), or a system failure (because the fuel refill procedure was flawed).

4.2.1 Human errors

The category "human errors" includes the incidents caused by human errors during the operation of equipment or facilities, the use of tools, the execution of procedures, et cetera.

> *For example, suppose an employee of a provider made an error in following prescribed equipment maintenance procedures, which causes an outage. In this case the incident would be in the root cause category 'Human errors'.*

4.2.2 System failures

The category "system failures" includes the incidents caused by failures of a system, for example hardware failures, software failures or flaws in manuals, procedures or policies.

> *For example, suppose the provider operates a full maintenance program for its equipment, that diesel generators are not included on this program, and that a generator fails because of lack of maintenance. In this case the root cause of the incident would be in the root cause category 'System failures'.*

4.2.3 Natural phenomena

The category "natural phenomena" includes the incidents caused by severe weather, earthquakes, floods, pandemic diseases, wildfires, wildlife, and so on.

> *For example, suppose squirrels caused a cable cut, causing an outage, then the incident would be in the root cause category 'natural phenomena'.*

4.2.4 Malicious actions

The category "malicious actions" includes the incidents caused by a deliberate act by someone or some organisation.

> *For example, incidents which have a root cause like a fire started by employees as an act of sabotage, the poisoning of the provider's DNS systems by criminals, the hacking of the provider's computer systems, vandalism directed at street cabinets, and so on.*

4.2.5 Third party failures

The final category "third party failure" is used as a flag (in combination with another root cause category) to indicate that the cause was not under direct control of the provider.

> *For example, an outage caused by a cable cut caused by a mistake by the operator of an excavation machine used for a building a new road, would be categorized in the root cause category 'human error'* and *'third-party failure'.*

[4] The categories were derived from secondary legislation issued by FICORA and CESG UK.

5 Assets and asset components

An asset is basically anything of value. Assets can be abstract assets (like processes or reputation), virtual assets (data for instance), physical assets (cables, a piece of equipment), human resources, money, et cetera.

In this guideline we focus on the following assets:

> Scope: The assets in scope are those assets which, if breached and/or failing, could have a negative impact on the security or continuity of electronic communication networks and services.

This means that abstract assets like 'the reputation of the provider' are out of scope. Similarly, suppose a provider has an online store for selling smartphones and subscriptions. The shopping cart system is an asset, but it would be out of scope here if it does not directly support the provisioning of network and communication services.

Remark on primary and secondary assets: *We would like to make a remark for the sake of clarity: Often in literature there is a distinction between primary assets and secondary assets. For a provider, the services and the subscriber data would be primary assets. Servers or HR processes would be secondary assets. The secondary assets are supporting the primary assets. In this guideline we do not use the term primary assets and instead we refer more specifically to services or subscriber data. Secondary assets are simply referred to as assets.*

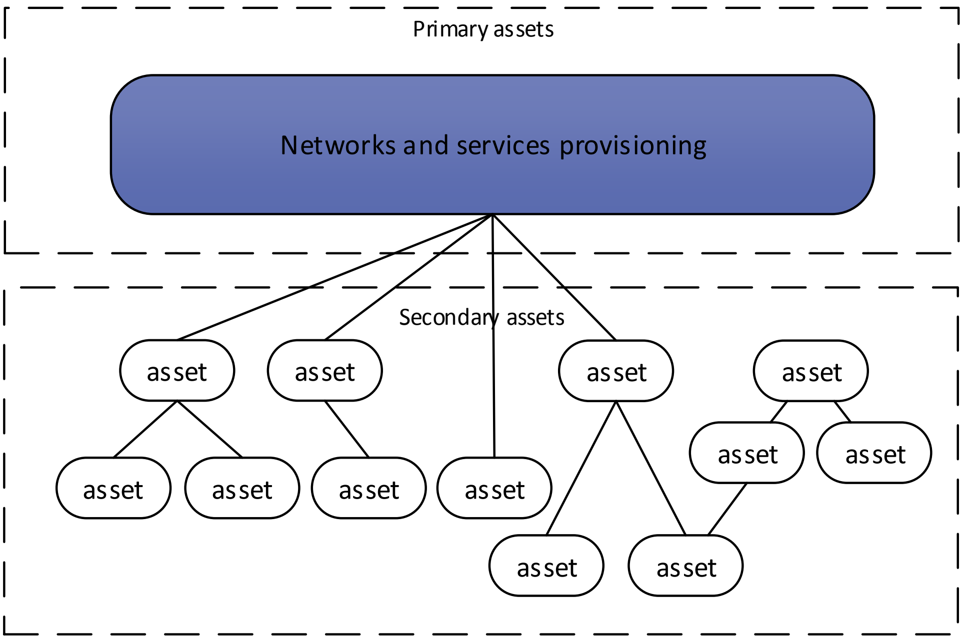


Figure 2: Primary and secondary assets

Assets are different for different providers. This guideline introduces a vocabulary[5] for speaking about the assets of providers. This vocabulary could be used when sharing incident reports with other NRAs, when discussing the results of risk assessments, and or common issues with these assets, with other NRAs, ENISA and the EC.

[5] It would perhaps be tempting to call this a taxonomy or a classification, but we would like to avoid these more formal words here. A taxonomy or a classification of assets would require a precise model of the provider's assets, and it would be hard to create a model that fits all settings.

5.1 Asset types

In this section we provide a list of asset types. To explain what we mean with “asset type” we give an example: KPN’s basestation in the north-east of Wassenaar (NL) is an asset. The asset type would be “mobile base stations and controllers”.

The list of assets is non-exhaustive. We include a glossary of common terms and acronyms in an annex.

5.1.1 Subscriber equipment

[Mobile, Fixed]

Subscriber equipment, also known as user equipment (UE) or customer premise equipment (CPE), are systems at the subscriber’s premises and fully or partially under control by the subscriber. In some settings the provider retains some control (and responsibility) over this equipment, for example, in the case of a managed PBX.

See also Section A.1.

5.1.2 IP switches and routers

[Mobile, Fixed]

IP switches and IP routers are systems for switching and routing IP traffic.

Examples: IP switches, routers, DSLAM, Hosted IP PBX, core (Tera-Giga) routers, Edge routers, SBC. See also Section A.2.

5.1.3 Mobile user and location registers

[Mobile]

Systems which keep records of subscribers and their locations in mobile networks.

Examples: HLR, AuC, HSS. See also Section A.3.

5.1.4 Mobile base stations and controllers

[Mobile]

Systems which provide users access to mobile networks.

Examples: BTS, BSC, NodeB and eNodeB, RNC, MME ANDSF, PCRF. See also Section A.4.

5.1.5 Fixed switching

[Fixed]

Systems which perform switching in legacy fixed voice networks (PSTN).

Examples: LE, TAX, Tandem Exchange. See also Section A.5.

5.1.6 Mobile switching

[Mobile]

Systems which perform switching in mobile networks.

Examples: MSC, VLR, SGSN, GGSN, PGW, SGW, ePGW. For more details see Section A.6.

5.1.7 Transport nodes

[Mobile, Fixed]

Systems which perform data transport over optical networks.

Examples: SDH, WDM, DWDM. For more details see Section A.7.

5.1.8 Legacy systems

[Mobile, Fixed]

Legacy assets are components of old (PSTN) telecommunication networks.

Examples: X.25 architectures. For more details see Section A.8.

5.1.9 Addressing servers

[Mobile, Fixed]

System which perform look-up and addressing, like IP address allocation, domain name services.

Examples: DHCP, DNS. For more details see Section A.9.

5.1.10 Interconnection points

[Mobile, Fixed]

Assets through which a provider exchanges traffic between its network and other provider's networks.

Examples: IXPs, POP. For more details see Section A.10.

5.1.11 Submarine cables and landing points

[Mobile, Fixed]

Submarine cables are cables and optical fibres rolled out on the seabed between two points on land, to carry telecommunication signals across stretches of ocean. A landing point is the location where a submarine or other underwater cable makes landfall.

5.1.12 Underground and over-the-air cables

[Mobile, Fixed]

Underground and over the air cables or fibres used to perform physical interconnection between IP switches/routers, transport nodes, fix switching assets, et cetera.

Examples: twisted copper pair, optical fibre, optical cable aggregation, cable aggregation. See also Section A.11.

5.1.13 Mobile messaging centre

[Mobile]

Systems providing messaging services in mobile networks.

Examples: SMS-C, MMS-C. See also Section A.14.

5.1.14 Billing and mediation systems

[Mobile, Fixed]

Systems performing billing in fixed and mobile networks. Mediation is the term used for converting usage and consumption data (length of calls) into billing and payment information.

5.1.15 Backup power supplies

[Mobile, Fixed]

Assets that ensure power backup functionality in case of power cut.

Examples: diesel generator, batteries. See also Section A.13.

5.1.1 Power supply

[Mobile, Fixed]

Systems providing power to other assets.

Examples: Transformers, power lines, power connectors, solar cells.

5.1.2 Cooling systems

[Mobile, Fixed] Systems providing cooling or ventilation.

5.1.3 Street cabinets

[Fixed]

Street cabinets aggregate fixed connections. Street cabinets can house passive and active equipment and can be used for pure fibre or a combination of copper-fibre and spliced, cross-connect and splitter applications to serve specific needs of the subscriber.

5.1.4 Buildings and physical security

[Mobile, Fixed]

Buildings and physical security includes the assets used by providers to protect other assets from physical and environmental threats.

Examples: Sites, data centers, fences, walls, doors, et cetera.

5.1.5 Operational support systems

[Mobile, Fixed] IT systems that support the operation of telecommunication networks. The term typically refers to systems managing the network and supporting processes such as maintaining a network inventory, configuring network components, managing faults, etc.

5.1.6 Intelligent network devices

[Fixed]

Devices that provide intelligent network services allowing telecom operators to provide value-added services in addition to the standard communication services (e.g. number portability, green numbers, et cetera).

Examples: STP, SCP. See also Section A.14.

5.1.7 Data retention systems

[Mobile, Fixed]

Data retention systems is a group of systems which includes systems for data retention (also known as call records retention). Such systems retain subscriber data for a specified time for reasons of legal compliance or for business reasons.

5.1.8 Lawful interception systems

[Mobile, Fixed]

Lawful interception (LI) systems are ICT systems designed to provide access to national authorities who request certain subscriber information mandated by law. Lawful interception data generally consist of signalling information or network management information or the content of the communications, such as voice/data communication content, e-mail access logs and contents, Call detail records, positioning information, user log files, et cetera.

5.1.9 Logical security systems

[Mobile, Fixed]

Systems providing logical protection of provider's network perimeter, including authentication, and authorization, encryption, and supporting services (e.g. directory information -LDAP).

Examples: firewalls, VPN servers, AAA systems, and LDAP. See also Section A.15.

5.1.10 Personnel terminals

[Mobile, Fixed]

Personnel terminals include the systems and devices used by the provider’s personnel, as end-users.

Examples: PCs, USB sticks, smartphones, tablets, etc.

5.2 Asset groups

Assets play a different role depending on their role and location in the provider’s network. For example, a cable connecting two providers plays a very different role than a cable between a base station and a base station controller.

For the sake of clarity we group assets in 4 groups, depending on where the asset is located in the provider’s network:

- Peering points – Assets in the group “Peering points” support the communications between the subscribers of one provider and the subscribers of another provider. For example, an IXP or a submarine cable, connecting several providers would be in this group.
- Core network – Assets in the group “Core network” support the bulk of the communications of the subscribers. For example, a backbone connecting two major cities in a country, or a central site would be in this group.
- Area network - Assets in the group “Area network” support a large part of the communications of the subscribers. For example, the cables between different parts of a large city or a regional site would be in this group.
- Access network – Assets in the group “Access network” support access of individual subscribers to the networks and communication services of the provider. For example, basestations or fiber-to-the-home infrastructure would be in this group.

The different asset groups are depicted below.

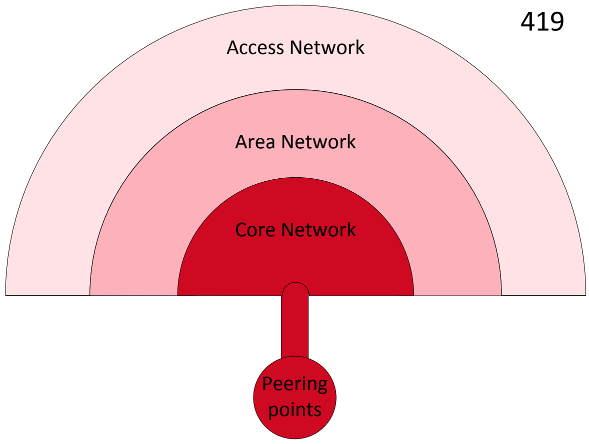


Figure 3: Assets are grouped in 4 main groups

Note that not all providers have assets in all groups. For example, some providers may just offer access network infrastructure, for others operators to use when offering services.

5.3 Asset components

For some assets, especially complex ICT assets, it can be useful to split them in several components. For example, the components of a mobile basestations are the basestation's OS and applications, and its antenna's, battery and connection to the power grid.

For the sake of clarity we group these components in three different layers .

- Supplies layer – The Supplies layer consists of components such as power supply from the grid, or fuel supply from energy firms. Most ICT assets ahve
- Physical layer –The Physical layer consists of hardware components.
- Logical layer – The logical layer consists of software components.

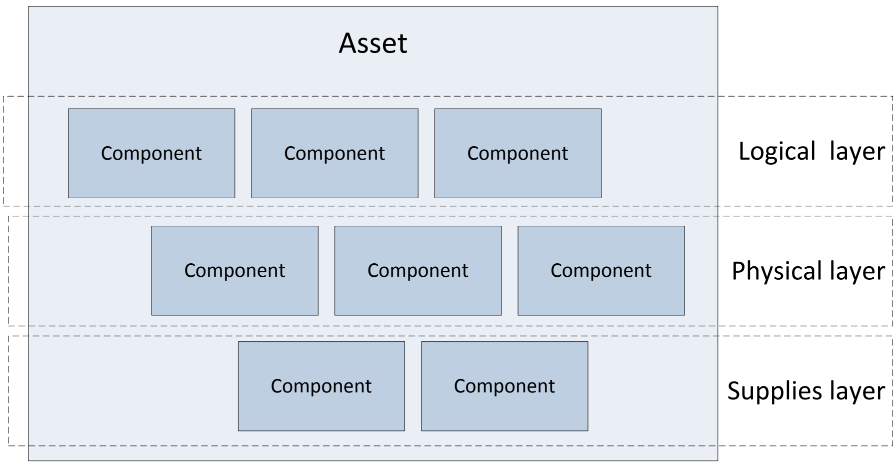


Figure 4: Assets consist of components at three different layers.

Note that not all assets have components inn all layers. For example, a basic diesel generator, which has to be started manually, does not have components at the logical layer. A solar-cell powered base station does not have components at the supplies layer.

References

As references, we provide reference and a non-exhaustive list of common standards on risk assessment.

Related ENISA papers

- Annual reports of incidents are available at: https://www.enisa.europa.eu/activities/Resilience-and-CIIP/Incidents-reporting/annual-reports
- Article 13a guidelines are available at: https://resilience.enisa.europa.eu/article-13
- ENISA's whitepaper on cyber incident reporting in the EU shows Article 13a and how it compares to some other security articles mandating incident reporting and security measures:

  http://www.enisa.europa.eu/activities/Resilience-and-CIIP/Incidents-reporting/cyber-incident-reporting-in-the-eu
- For the interested reader, ENISA's 2009 paper on incident reporting shows an overview of the situation in the EU 3 years ago: http://www.enisa.europa.eu/activities/Resilience-and-CIIP/Incidents-reporting/good-practice-guide-on-incident-reporting/good-practice-guide-on-incident-reporting-1

EU Legislation

- Article 13a of the Framework directive of the EU legislative framework on electronic communications: http://ec.europa.eu/information_society/policy/ecomm/doc/140framework.pdf
- The electronic communications regulatory framework (incorporating the telecom reform): http://ec.europa.eu/information_society/policy/ecomm/doc/library/regframeforec_dec2009.pdf
- An overview of the main elements of the 2009 reform: http://ec.europa.eu/information_society/policy/ecomm/tomorrow/reform/index_en.htm
- The EU's cyber security strategy was adopted in 2013. The strategy contains a proposal for a directive on Network and Information Security. Article 14 of the proposed directive is basically an extension of Article 13a to other critical sectors.

Relevant telecom architecture documents

- Telecommunications Network and Service Architecture. Principles, Concepts and Architectures. http://www.efort.com/media_pdf/ARCHITECTURES_EFORT_ENG.pdf
- Telecommunication Services Engineering: Definitions, Architectures and Tools. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.19.1091&rep=rep1&type=pdf
- Collaborative Procedures for Mobile Network Infrastructure Architectures. A Concept to Share Sensitive Information Between Competitors to Improve Situational Awareness and Protection. ASMONIA http://www.asmonia.de/deliverables/D1.2_CollaborativeProceduresForMobileNetworkInfrastructureArchitectures.pdf
- Threat and Risk Analysis for Mobile Communication Networks and Mobile Terminals. ASMONIA

http://www.asmonia.de/deliverables/D5.1_II_ThreatAndRiskAnalysisMobileCommunicationNetworksAndTerminals.pdf

- The Internet and the Public Switched Telephone Network. Disparities, Differences, and Distinctions.
  http://www.internetsociety.org/sites/default/files/The%20Internet%20and%20the%20Public%20Switched%20Telephone%20Network.pdf
- X.25 Architecture
  X.25 - Wikipedia, the free encyclopedia
- X.25 Network Communications Overview
  http://publib.boulder.ibm.com/infocenter/aix/v6r1/index.jsp?topic=%2Fcom.ibm.aix.aixlink25%2Fdoc%2Fx25usrgd%2Foverv.htm

Annex A: Glossary of terms for assets

In this annex we provide a glossary for terms providers may be using to refer to some of their assets.

A.1 User equipment

User equipment (UE), also known as Customer Premise Equipment (CPE), such as mobile phones, VOIP gateways, et cetera. Depending on the setting and the type of equipment, providers may have some control over these systems, for example in the case of a PBX or a VOIP gateway.

A.1.1 PBX

A private branch exchange (PBX) phone system is a system for handling call routing or switching, at the subscriber's location. Providers often offer PBX's as hosted services, and in these settings they manage the PBX equipment and software. Hosted IP PBX services can be delivered over the Internet (hosted IP PBX via Internet telephony, or VoIP). Traditional PBXs work via the PSTN public switched telephone network.

A.1.2 RG

Residential gateways (RG) are systems connecting local networks (LAN) to the network offered by the provider. The term residential gateway is often used to indicate gateways with less functionality compared to corporate gateways.

A.1.3 VOIP gateways

VOIP (Voice Over IP) gateways are systems connecting normal (PSTN) telephones to SIP (Session Initiation Protocol) servers. Recently PBXs are often implemented using VOIP, for cost efficiency.

A.2 IP switches and routers

A.2.1 Metro routers

Metro routers are systems for routing traffic in metropolitan area networks.

A.2.2 Feeder

A feeder is a multilayer switch installed in the same principal centrals of metropolitan and regional area, and it has the function of collecting and aggregating traffic from client devices and the access network. A Remote feeder is a multilayer switch with redundant connections to two different feeder multilayer switches.

A.2.3 IP Routers

IP Routers perform routing of Internet protocol (IP) traffic. Tera routers and Giga routers are terms for IP routers handling Terabits or Gigabits of IP traffic per second.

A.2.4 Edge routers

Edge routers, also called provider edge routers, are routers at the edge of the povider's IP network.

A.2.5 DSLAM

A digital subscriber line access multiplexer (DSLAM) is a network device used in the access network, that connects multiple digital subscriber line (DSL) interfaces to a high-speed digital communications channel using multiplexing techniques.

A.2.6 SBC

A session border controller (SBC) is a device in Voice over Internet Protocol (VoIP) networks for controlling signalling and media streams for telephone calls and interactive media communications.

A.3 Mobile user and location registers

A.3.1 HLR

The home location register (HLR) is central database of mobile networks that contains details of each mobile phone subscriber that is authorized to use the GSM core network.

A.3.2 AUC

The authentication centre (AuC) is a component of mobile networks GSM home locator register (HLR). The AuC validates any security information management (SIM) card attempting network connection when a phone has a live network signal.

A.3.3 HSS

The Home Subscriber Server (HSS) is a master user database in mobile networks and it contains the subscription-related information (subscriber profiles), performs authentication and authorization of the user, and can provide information about the subscriber's location and IP information.

A.4 Mobile base stations and controllers

A.4.1 BTS

A base transceiver station (BTS) is a piece of equipment of mobile networks in access layer that ensure wireless communication between user equipment (UE) and a network.

A.4.2 BSC

The base station controller (BSC) provides in the access layer of mobile networks the intelligence behind the BTSs. Typically a BSC has tens or even hundreds of BTSs under its control.

A.4.3 NodeB and eNodeB

Node B is a term used in UMTS mobile networks equivalent to the BTS description used in GSM; the Evolved NodeB (eNodeB) is an element for fourth generation technology LTE.

A.4.4 RNC

The Radio Network Controller (or RNC) is a governing element in the UMTS mobile access network (UTRAN) and is responsible for controlling the nodes BS that are connected to it. The RNC carries out radio resource management, some of the mobility management functions and is the point where encryption is done before user data is sent to and from the mobile.

A.4.5 MME

The MME is the key control-node for the LTE mobile access network. It is responsible for idle mode UE tracking and paging procedure including retransmissions.

A.4.6 ANDSF

An Access Network Discovery and Selection Function (ANDSF) is an entity within a mobile evolved packet core network (EPC/LTE), which helps an UE to discover non-3GPP access networks, such as Wi-

Fi or WIMAX – that can be used for data communications in addition to 3GPP access networks (such as HSPA or LTE) and to provide the UE with rules policing the connection to these networks.

A.4.7 PCRF

A Policy and Charging Rules Function (PCRF) is a software node to determine policy rules in a multimedia network. PCRF plays a central role in next-generation (IP) networks.

A.5 Fixed switching

A.5.1 LE

A Local exchange (LE) is a central system of switches and other equipment which establishes connections between individual telephones.

A.5.2 TAX

A TAX (Trunk Automatic Exchange) switches (non-IP) long-distance calls in public switched telephone networks (PSTN).

A.5.3 Tandem exchange

A tandem exchange switches calls between LEs in a metro networks and handles spill over traffic from direct routes.

A.6 Mobile switching

A.6.1 MSC

A Mobile Switching Centre (MSC) is the primary service delivery node for GSM/CDMA mobile network, responsible for routing voice calls and SMS messages as well as other services (such as conference calls, FAX and circuit switched data).

A.6.2 VLR

A Visitor Location Register (VLR) is a database of mobile network subscribers in the area the MSC (Mobile Switching Centre) serves. Each base station in the network is served by one VLR.

A.6.3 SGSN

A Serving GPRS Support Node (SGSN) in a mobile network is responsible for the delivery of data packets from and to the mobile stations within its geographical service area.

A.6.4 GGSN

A Gateway GPRS support Node (GGSN) is a key component in a GPRS mobile network. The GGSN is responsible for the connections between the GPRS network and the external packet switched networks, like the Internet and X.25 networks.

A.6.5 PGW

A PDN Public data network Gateway (PGW) connects user equipment (UE) to external IP networks.

A.6.6 SGW

The SGW routes and forwards data packets, while acting as an anchor for the user plane during inter-eNodeB handovers and as the anchor for mobility between LTE and other 3GPP technologies.

A.6.7 ePDG

An ePDG secures data transmission between user equipment connected to the EPC over untrusted non-3GPP access.

A.7 Transport nodes

A.7.1 SDH, ADM, ROADM, ODXC

Synchronous Digital Hierarchy (SDH) are standardized protocols which transfer multiple digital bit streams over optical fibres. For example ADM is a multiplexing function used in SONET optical technologies.

A.7.2 WDM and DWDM

Wavelength-division multiplexing (WDM) and Dense wavelength division multiplexing (DWDM) is a technology which multiplexes a number of optical carrier signals into a single optical fibre by using different wavelengths (i.e. colours) of laser light. This technique enables bidirectional communications over one strand of fibre, as well as multiplication of capacity.

A.8 Legacy systems

A.8.1 X.25

X.25 is an ITU-T protocol suite for packet switched wide area network (WAN) communications. X.25 WAN consists of packet-switching exchange (PSE) nodes as the networking hardware, and leased lines, plain old telephone service connections or ISDN connections as physical links. X.25 is a family of protocols that was popular during the 1980s with telecommunications companies and in financial transaction systems such as automated teller machines.

A.9 Addressing servers

A.9.1 DHCP

The Dynamic Host Configuration Protocol (DHCP) is a protocol and service which allocates an IP address to systems in the network.

A.9.2 DNS

The Domain Name System (DNS) is a hierarchical distributed naming system for computers, services, or any resource connected to the Internet or a private network. It associates various information with domain names assigned to each of the participating entities. The DNS service commonly is supplied through IT components (e.g. servers).

A.10 Interconnection points

A.10.1 IXPs

An Internet exchange point (IX or IXP) is a physical infrastructure through which Internet service providers (ISPs) exchange IP traffic between their networks.

A.10.2 POP (IP transit)

A point of presence (PoP) is an access point to the telecommunication provider network.

A.11 Underground and over-the-air cables

A.11.1 Twisted (copper) pair

Twisted pair is the ordinary copper wire that connects the subscriber to the provider's network. Wires are twisted to prevent interference from the outside.

A.11.2 Wire cables

Wire cables are strands or braids of copper wires.

A.11.3 Optical fibres

Optical fibres are used for transmitting information by modulating a light beam (through the fibre). Optical fibres are more suitable for long distances and they have a higher bandwidth than wire cables.

A.12 Mobile messaging centres

A.12.1 SMS-C

A short message service centre (SMS-C) is a network element in the mobile telephone network and its purpose is to store, forward, convert and deliver SMS (Short Message Service) messages.

A.12.1.1 MMS-C

A MMS centre (MMS-C) is a network element in the mobile telephone network and its purpose is to store, forward, convert and deliver MMS(Multimedia Messaging Services) messages.

A.13 Backup power

A.13.1 Diesel generator

A diesel generator provides emergency power supply, by using diesel fuel.

A.13.2 UPS

An uninterruptible power supply, also uninterruptible power source, UPS or battery/flywheel backup, is an electrical apparatus that provides emergency power when main power supply fails.

A.14 Intelligent network devices

A.14.1 STP

A Signal Transfer Point (STP) is a component of Intelligent Network (IN, fixed and mobile telephony) and it's a device that relays SS7 messages between signalling end-points (SEPs) and other signalling transfer points (STPs).

A.14.2 SCP

A service control point (SCP) is a standard component of the IN Intelligent Network (fixed and mobile telephony) telephone system which is used to control the service. Standard SCPs in the telecom industry today are deployed using SS7, Sigtran or SIP technologies.

A.15 Logical security systems

A.15.1 Firewall

Firewall is a software or hardware-based network security system that controls the incoming and outgoing network traffic by analysing the data packets and determining whether they should be allowed through or not, based on applied rule set.

A.15.2 VPN

A virtual private Network (VPN) extends a private network across a public network, such as the Internet. VPN function could be provided by firewalls, servers and end-points (PCs tablets, smartphones et cetera).

A.15.3 AAA

AAA commonly stands for authentication, authorization and accounting or auditability. It refers to a security architecture for distributed systems in which the identity of users is first authenticated, then users are granted access, and finally a log is kept of their access (for the sake of accounting or auditing).

A.15.4 LDAP

The Lightweight Directory Access Protocol (LDAP) is a protocol for accessing and managing a directory of information about users and their access rights. LDAP is typically used for finding information about users quickly in directories with large numbers of users.

Annex B: Using model of threats and assets in reporting

//TO BE REMOVED IN FINAL VERSION – Below we show how this model could be used in reporting.

B.1 User interface for reporting

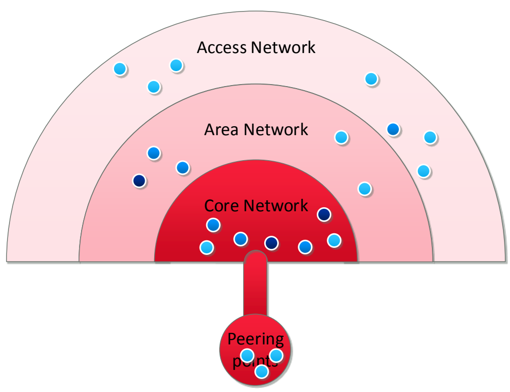
The user interface for reporting could be as follows:

- User explains the impact
  - User selects which services were impacted
  - User quantifies the impact (number of users, duration)
  - User selects other impact (emergency services, interconnections)
- User explains the primary cause
  - User chooses one primary cause
  - User selects one or more assets affected by this cause.
  - System derives the component layer where the threat had impact (supplies, physical or logical) based on the threat type and asset type.
  - User selects which group these assets are in (peering points, or core, area, or access network).
- Optionally, the user selects a secondary cause
  - User chooses one secondary cause
  - User selects one or more assets affected by this cause.
  - System derives the component layer where the threat had impact (supplies, physical or logical) based on the threat type and asset type.
  - User selects which group these assets are in (peering points, or core, area, or access network).
- User selects a rootcause category
- User provides a general description of the incident
- User provides further information about the incident
- User saves the incident report

B.2 Incident reporting analysis

Using this model of threats and assets an aggregate analysis could show, per service (or overall):

- Which threats often lead to incidents.
- Which are common combinations of threats?
- Which threats affect which assets?
- Which assets fail in incidents.
- Where in the network threats have an impact on assets (see diagram to the ritght).
- At which layer (supplies, physical, logical) threats often have an impact.



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ENISA
European Union Agency for Network and Information Security
Science and Technology Park of Crete (ITE)
Vassilika Vouton, 700 13, Heraklion, Greece

Athens Office
1 Vass. Sofias & Meg. Alexandrou
Marousi 151 24, Athens, Greece

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PO Box 1309, 710 01 Heraklion, Greece
Tel: +30 28 14 40 9710
info@enisa.europa.eu
www.enisa.europa.eu