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summary

Privacy and Body Scanners at EU Airports

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Abstract: *At the beginning of 2010, with the aim of improving aviation security controls, some airports started to use full-body security scanners, also known as body scanners or security scanners. Body scanners make a full body screening of passengers, producing detailed images of the screened person's body in order to detect both metallic and non metallic objects that might be concealed under the clothes. Deployment of such scanners may entail an invasion of people's privacy since they produce a detailed display of the passenger's body with no clothing, revealing anatomical details and private parts, including medical prostheses. This article will analyse the currently existing screening technologies (millimetre wave systems -active or passive- and X-ray backscatter systems) as well as their level of deployment at EU airports, focusing on the impact they may have on passengers' privacy. In order to harmonize the various national regulations, the European Commission has passed a proposal on the use of body scanners at European airports, scanners which shall only be used under specific conditions.*

Keywords: *Access Control, Airports, Body Scanners, Privacy, Security, Security Scanners.*

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1. Introduction

On Christmas day 2009, Northwest Airlines flight 253 from Amsterdam to Detroit suffered an attempted terrorist attack when a passenger tried to detonate an explosive artefact during the flight. The author of the attempted terrorist attack had managed to board the plane with liquid explosives concealed in his underwear, which were not detected by the security controls at the airport. This incident made authorities in charge of security across the various European States give the green light to deploy body scanners at their airports.

Body scanners are able to detect both metallic and non-metallic objects, including plastics and liquid explosives, concealed under passengers' clothing. This article will analyse the different types of body scanners deployed to date, all having in common the capability to display a graphic image of the screened person's body.

Treatment of images produced by the scanners does have a great impact on privacy and human dignity, directly affecting certain fundamental rights laid down in the Universal Declaration of Human Rights and in the Charter of Fundamental Rights of the European Union.

Taking into account the definition of personal data laid down in article 2(a) of Directive 95/46/EC of the European Parliament and of the Council as *"any information relating to an identified or identifiable natural person"*, where the "physiological identity" is considered, among others, as an identifying item, there is no doubt that the body images produced by a body scanner are personal data and, therefore, their treatment must fully comply with all the guarantees of respect to the rights and obligations set out by the Directive.

In addition to protection of personal data, privacy and other fundamental rights (human dignity, freedom of movement, physical integrity or non-discrimination) are at stake. Are we willing to give up privacy in favour of greater security? In the aftermath of the attempted terrorist attack on Christmas day 2009, some European countries deployed security scanners, previously in trial. Then, after nearly two years, in which time each country set its own rules, the European Commission adopted in November 2011 a proposal for a legal framework on the use of security scanners. In this context, we will tackle the impact of this regulation on users' privacy.

1.1. Methodology

This article tackles three aspects in regard with body scanners: a) technical and operational equipment issues; b) European Union legal framework; and c) level of deployment of scanners at EU airports. Information to write this article has been directly obtained from the involved entities (manufacturers, institutions and aviation operators respectively).

Aside from the publications stated in the section "References", information provided by the manufacturers through their corporate websites has been taken into consideration in order to analyse the different technologies. The companies consulted have been (in alphabetical order): *Alfa Imaging*, *American Science and Engineering Inc* (AS&E), *Brijot Imaging System*, *EMIT Technologies*, *Farran Technologies*, *L3 Communications*, *Millivision Technologies*, *Rapiscan Systems*, *Smiths Detection*.

So as to have an insight into the current situation at EU airports, a brief questionnaire was sent to the aviation operators of the countries which had started to conduct body scanner trials, states which are listed on the "Communication from the Commission to the European Parliament and the Council on the Use of Security Scanners", comments on which will be made further on. The questionnaire was sent in February 2012 and all the consulted operators responded. The questionnaire posed four open-ended questions:
a) Have body scanners been installed at the airport of…?
b) If they have, are they operating on an experimental basis or are they operating as an additional security measure of access control?
c) If they have not, is installation of such devices being planned, even on an experimental basis?
d) If these scanners are being used or their use is being planned, will passengers be forced to go through the scanners, or will they be allowed to opt for alternative methods such as "pat down"?

The bodies consulted have been: Aéroports de Paris (ADP) (France), AENA (Spain), Department for Transport - Aviation Security (UK), Direction Générale de l'Aviation Civile (DGAC) (France), Ente Nazionale dell'Aviazione Civile (ENAC) (Italy), Finavia Corporation (Finland), Fraport AG (Germany), Københavns Lufthavne A/S (Den-

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mark), Schiphol Nederland B.V. (Netherlands). The information received has been complemented and contrasted with the information available in the analysed airport websites.

2. Body Scanner Technologies

Body scanners are person screening devices based on Advanced Imaging Technologies (AIT).

These technologies are able to reveal a display of a person's naked body, detecting objects that might be concealed underneath a person's clothing. Users must step inside an arch or portal (or stand in front of it, depending on the type of device) and stand still for several seconds while a scan of the full body takes place by means of electromagnetic waves. These waves pass through the clothing and reflect off the person's skin, allowing the AIT software to produce a body image of the individual.

Various types of body scanners are commercially available for security controls in the aviation sector. According to the electromagnetic wave frequency used, we can classify scanners in three groups: **X-ray**, **millimetre-wave** and **sub-millimetre-wave** (see **Table 1**).

We analyse below some of the technical and operating aspects of each of these scanners. Whereas in the USA, X-ray scanners (backscatter type) have been widely deployed, in Europe tests have been conducted with backscatter and millimetre-wave scanners. However, from November 2011 the European Commission has expressly prohibited the deployment of X-ray scanners, allowing the use of any other technologies.

2.1. X-ray

There are two ways to obtain an image by exposure to X-rays: *Transmitted X-ray* and *Backscatter X-ray* [1].

Transmitted X-ray emits X-rays like medical X-ray equipment, that penetrate the body and are capable of detecting concealed objects inserted into the body. Although this type of screening can be used under exceptional conditions, they are not used in security scanners since they produce ionising radiations which can cause adverse health effects.

Backscatter X-ray scanners emit low doses of electromagnetic X-ray waves which are able to pass through the clothing although they are reflected off the human skin and will not penetrate it.

A high resolution two-dimensional image is formed from capture of the reflected photons, the image revealing some surface detail of the body of the screened person, as if it were naked. If an object, metallic or non-metallic, were underneath the clothing, it would be revealed in the scanned image.

AS&E and *Rapiscan Systems* provide this type of scanners in the market. The UK Department for Transport (DfT), after trialling *Rapiscan Backscatter 1000* scanners, published a report [2] in February 2010 on the risks to health from exposure to this equipment. The experts concluded that the radiation dose from one scan was 0.02 micro Sierverts (ìSv), a small fraction of the maximum annual recommended radiation (2,700 ìSv). In comparison, the typical dose rate during a commercial flight from cosmic rays is approximately 5 ìSv/h.

2.2. Millimetre-Wave Scanner MMW

Millimetre-wave scanners use the Extremely High Frequency (EHF) radio frequency band, operating in the range 30 to 300 GHz. Within this range of frequencies, the waves pass easily through textile fabrics but cannot penetrate human skin. In addition, part of the thermal radiation emitted by the human body is within this range of frequencies, which therefore allows carrying out both passive and active scans.

Passive millimetre Wave *(Passive MMW)* **scanners** register the natural thermal radiation which is emitted by the body and produces images in contrast to the thermal radiation emitted by the environment. Good results are obtained with this technology in outdoor applications where thermal radiation contrast is significant. However, when it is operated inside buildings (such as in airports), it produces low resolution images and little reliability [3] due to a poor signal to noise ratio (SNR).

Brijot Imaging System, *Millivision Technologies*, and *Alfa Imaging* have developed equipment with passive MMW for airport control (see **Figure 1**[1]).

Active millimetre Wave (*Active MMW*) **scanners** generate EHF radiations which

Radio wave	Type of scanner	Name	Frequency	Wave-length
X-ray	Transmission	Transmission	30 - 3.000 PHz	10 - 0.01 nm
	Backscatter	Backscatter		
Millimetre-wave (MMW)	Passive	Passive MMW	30 - 300 GHz	10 - 1 mm
	Active	Active MMW		
Sub-millimetre wave (SMW or THz)	Passive	Passive SMW	0.3 - 3 THz	1 - 0.1 mm
	Active	Active SMW		

Table 1. Classification of Body Scanners According to Operating Frequencies.

> "… The communication, aiming at establishing a harmonised common framework on the use of scanners, deals with technical equipment issues, passengers´ health protection and users' fundamental data rights"

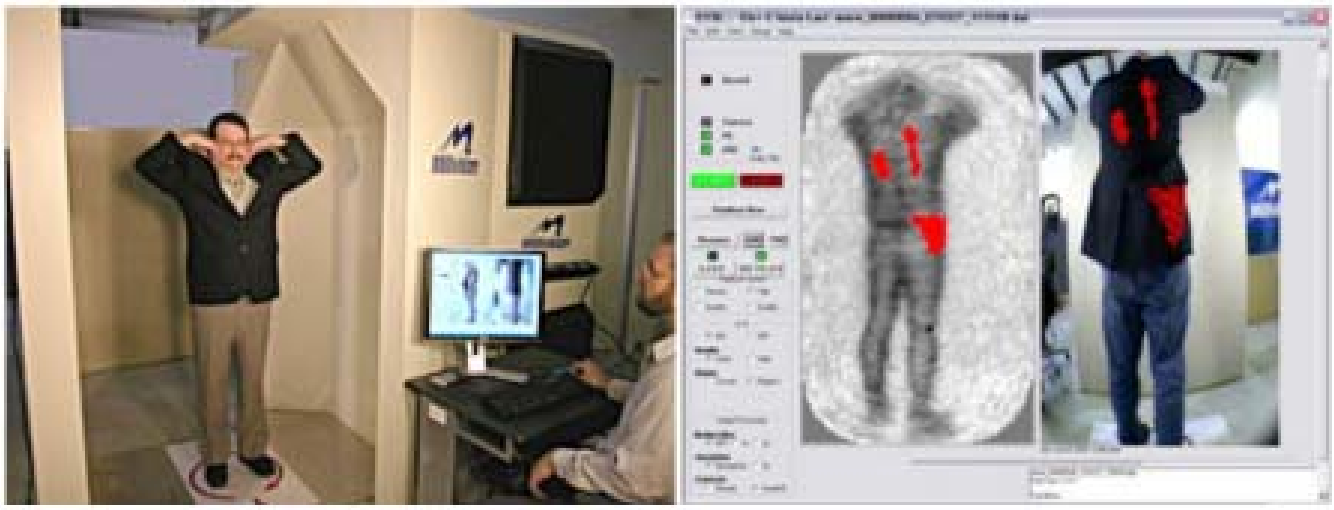

Figure 1. Millivision Portal Systems 350 scanner. On the Right, Screen Display Where ATD Software Enhances Threat. items.

pass through passengers' clothing and reflect off the human body. From the reflected waves a three-dimensional image is obtained of the human body and of any objects being worn. This results in a detailed anatomical and high resolution image.

L3 Communications provides various active MMW in the market, some of them using ATD (*Automated Target Detection*) technology with which no image of the individual is produced but, in case of detecting a threat item, it identifies the area of the body where it has been detected for further search of the passenger by an agent. (see **Figure 2**[2]).

2.3. Sub-Millimetre Wave Scanner SMW

SMW scanners (also named *Terahertz Scanners*) work within the range adjoining MMW between 0.3 and 3 THz, with a wavelength which goes from the infra-red limit (0.1 mm) to microwaves (1mm). A lower wavelength allows production of higher resolution images. However, the capability of penetration through textile fabric is reduced. As with MMW scanners, passive SMW and active SMW scanners have been developed.

To date, MMW technology has had a wider spread than SMW in security applications as, in order to operate in the terahertz frequency range, SMW technology needs more powerful sources of energy (for active scanners) or higher sensitive detectors (for passive scanners) [4]. *ThruVision Systems* provide various passive SMW devices.

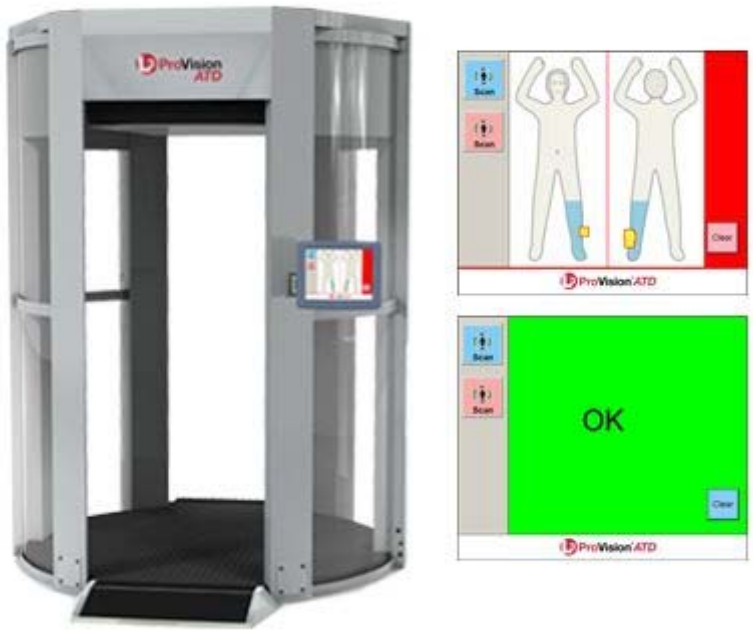

Figure 2. L3 ProVision ATD Scanner. The ATD Software Enhances, on a Human Silhouette, the Areas Where Threat Items Are Detected.

3. Legal Framework

European legislation on civil aviation security is established on Regulation (CE) nº 300/2008 of the European Parliament and the Council of 11 March 2008, *on common rules in the field of civil aviation security*. In this Regulation, the International standards of Annex 17 to the Chicago Convention on International Civil Aviation of 7 December 1944 (Chicago Convention) are adopted as common standards on security.

This rule was later supplemented by Regulation (CE) nº 272/2009 of the European Parliament and of the Council of 2 April 2009, *supplementing the basic common standards on civil aviation security laid down in the Annex to Regulation (EC) No 300/2008 and* by Regulation (EC) nº 185/2010 of the Commission of 4 March 2010, *laying down detailed measures for the implementation of the basic common standards on aviation security.*

Both complementary regulations were amended in November 2011, by other regulations having a special significance to the use of body scanners. Firstly, Commission Regulation (EC) nº 1141/2011, adds a new item to the list of allowed methods of screening: "*security scanners which do not use ionising radiation*". Secondly, Commission Regulation (EC) 1147/2011, which sets the minimum operational conditions on the use of security scanners. In section 5 of this paper we will analyse the aforesaid conditions.

Also of special significance is the Communication COM (2010)/311 [5] that the European Commission produced on 15 June 2010, at the request in 2008 of the European Parliament, in which it urged the Commission to define a specific legal framework on the use of body scanners at EU airports. For this purpose, the Commission raised a consultation to the European Data Protection Supervisor (EDPS), the Article 29 Working Party and to the European Union Agency for Fundamental Rights (FRA). The communication, aiming at establishing a harmonised common framework on the use of scanners, deals with technical equipment issues, passengers´ health protection and users' fundamental data rights.

All European legislation, aviation security included, must comply with the principles set in the Charter of Fundamental Rights of the European Union [6]. In this context, special attention must be brought to the following Fundamental Rights which cannot be interfered with nor limited by the Member States: human dignity, right to the integrity of the person, respect for private and family life, protection of personal data, freedom of thought, conscience and religion; non-discrimination, the rights of the child or freedom of movement. In section 5 of this paper we will cover in detail the impact of body scanners on these fundamental rights.

4. Situation of Body Scanners in Europe

As indicated above, the Communication from the Commission COM (2010)/311 of June 2010, aimed at ending the fragmented situation which existed wherein the various Member States and airports decided if and how to deploy Security Scanners, with the proposal that the use of Security Scanners "*must be based on common standards*", imposing the necessary safeguards to comply with fundamental rights and passengers' health provisions.

Various Member States (France, United Kingdom, Finland, Netherlands, Italy and Germany) have conducted trials of body scanners, with different results which we analyse below.

4.1. France

In February 2010 a Security scanner was tested for three months in terminal 2E at Paris Charles de Gaulle airport. It was a millimetre-wave scanner from the company *VISIOM (French subsidiary of L3 Communications)*. The image was analysed in a room located on another floor, by a reviewer of the same gender as the passenger. If a threat item was detected, the security checkpoint agent received an image with a human silhouette indicating in red those parts which had to be verified by a hand search. In no case was the image saved.

Over 8,000 passengers accepted being screened. The results of trials evidenced a good acceptance of scanners by passengers, who considered screening a less intrusive measure than hand searching. However, the French Directorate General of Civil Aviation (DGAC) considered that current technology was not sufficiently mature as to consider an immediate deployment of scanners; it would be necessary to reduce the ratio of false positive results and improve detection of certain items.

The *Comission Nationale de l'Informatique et des Libertés* (CNIL) conducted an on-site inspection of the experimental body scanner installed at Paris airport to verify if its recommendations had been regarded, verifying that: [7]:

- The scanner uses millimetre wave technology, which displayed a generic outline of the human body and not a real image.
- The scanner does not allow saving or copying any images.
- The reviewers are located in an isolated room and do not know the identity of the screened person, so that there is no chance of the passenger being directly or indirectly identified by the image.
- The passenger can choose between undergoing the scanner or a hand pat-down.

From this experience, they agreed to start a three-year trial period for which the CNIL has requested the State Council to pass a decree regulating the operation of these devices (technical conditions, exercise of rights by users, special information and consent rights, conditions for treatment of the images obtained). This new period started at regional airport Nice Côte d'Azur in September 2012, for International flights.

4.2. United Kingdom

At a first stage, body scanners were deployed at Manchester, Heathrow and Gatwick airports. Millimetre wave scanners from the companies *L3 Communications* (model *ProVision*) and *Smiths Detection* (model *Eqo*) are in operation at these three airports. *Backscatter* X-ray scanners were also in operation (*Rapiscan* models *Secure 1000* and *Secure 1000 Single Pose*) but only at Manchester airport.

The scanners were deployed within the common framework of measures to enhance security at British airports, which the Department for Transport introduced after the attempted terrorist attack of Northwest Flight 253 in 2009.

Unlike other countries, in the UK passengers selected for scanning are not permitted to refuse the scan, otherwise they will no be able to fly. British authorities defend this position by arguing that there are no other alternative methods capable of delivering the required levels of security [8]. According to the Department for Transport, the alternative would be a full private search in which the passenger could be asked to remove all or part of his clothing. It is estimated that 1.5 million passengers have been scanned since these measures were introduced, only 12 persons having refused the scan, who were not able to board the plane.

At the same time the scanners were being deployed, the "Code of practice for the Acceptable Use of Security Scanners in an Aviation Security Environment" was published. As concerns privacy, it states that the reviewers must not be able to see the person they are viewing, that the screen is only to be analysed by authorised officers and that procedures shall be established to prevent the capture of any images, including the prohibition of cameras or mobile phones, into the viewing room. It also states that, at the passenger's request, the reviewer shall be of the same gender as the screened person. As concerns data protection, the code states that no scanned image shall be stored, having to be deleted and destroyed after the scanning analysis is completed; it especially compels any facilities on the scanner which could be used to retain, copy or transmit data to be disabled.

Finally, even though the report from the Health Protection Agency - HPA of the British Government concluded that the radiation doses absorbed by the human body (0,02 ìSv) were so low as to be negligible, Manchester Airport respected the Decision from the European Commission and removed the X ray scanners in October 2012, replacing them by five next generation security scanners using radio frequency-based millimetre wave technology from L3 Communications.

At a second stage, body scanners were deployed at Stansted Airport and London City Airport at the end of 2012.

4.3. Finland

In November 2007, Helsinki-Vantaa airport started to test a backscatter scanner with the purpose of using it as an alternative method to hand search during peak hours. The screening, which was conducted on a voluntary basis, was undergone by passengers selected randomly, who were informed of the procedure and had to give their consent prior to the

> "According to the Council of Europe, authorities shall interfere in the right to privacy in an emergency case when it is a question of national security or public order. But, is routine security control at an airport a question of national emergency?"

screening. The person analysing the image was in a separate room with no possibility at all to see or identify the screened person.

One year and a half later, the Finish civil aviation authorities (*Finavia*) decided to withdraw the scanner, just before the Parliament and the European Council prohibited the use of X rays for human controls at airports.

4.4. Netherlands

Schiphol (Amsterdam) airport was the first in the world to deploy security scanners in a 2006, joint initiative of the Dutch customs authorities and the NCTb (National Coordinator for counter-terrorism).

During a first testing period, 17 devices were deployed, which passengers used voluntarily. After the testing period was completed, in May 2007, scanners became part of the airport security system. 60 millimetre-wave scanners from the *L3 Communications*, equipped with ATD (Automated Target Detection) technology, are currently deployed. In this technology a passenger's image is not displayed. Instead, a silhouette of the human body is displayed, ATD software enhancing those areas where the threat item has been detected. However, passengers can always refuse to be scanned and can opt for alternative controls.

4.5. Italy

In 2010 experimental scanners were deployed in Italy at Rome Fiumicino, Milan Malpensa, Venice and Palermo airports. The trials continued in 2011 only at Fiumicino and Malpensa airports. In a press communication of the Civil Aviation National Entity) (ENAC) on 9 February 2012 the experimental period was considered completed and the conclusion was that millimetre-wave scanner technology was the most effective. In particular, the scanners tested at Fiumicino and Malpensa were *L3 Provision ATD* with automatic target detection used by over 50,000 passengers.

After analysis of the testing period results [9], the Inter-ministerial Commission for Air Transport and airport security (CISA) has given the green light for the deployment of this model of scanners at the three Italian airports having regular connections with the United States and Israel: Roma Fiumicino, Milan Malpensa and Venice. When they are fully operational, all passengers must first walk through the metal detector arch, and then through the security scanner. Passengers refusing to undergo the security scanner will be able to opt for alternative methods such as pat-down.

4.6. Germany

Trials were performed at Hamburg Airport with two body scanners between September 2010 and July 2011, where about 809,000 passengers voluntarily underwent such scanning equipment. Both devices used were *L3 Provision ATD* millimetre-wave technology.

After analysis of the testing period results, the German Ministry of Home Affairs dismissed the use of such scanners because it considered that equipment detection reliability did not meet its expectations. The Ministry's report reveals a high ratio of false positive results which is translated into an increase of the amount of time at screening points. However, they do no refuse to take this equipment into consideration in the future when it meets the required security standards and can handle a great number of passengers.

Almost two years after trials at Hamburg Airport, a new trial period was started in November 2012 at Frankfurt Airport. For that purpose, a new generation of body scanners were used, which do not show actual body images but mark the places to be checked by airport staff on a pictogram of a body. Only passengers heading to North America can be required to walk through these scanners.

5. Body Scanners and Privacy

Various European and International entities and organizations have drawn attention to the impact of body scanners on fundamental rights, mainly on privacy, human dignity and data protection, although other rights might also be affected.

The use of scanners that emit ionizing radiations (e.g. X-rays) may violate the rights to physical integrity and health protection. The fact of passengers being compelled to undergo a scan, without being able to opt for alternative methods, entails a restriction of the right to freedom of movement for those refusing the scan. The capability of some devices to reveal a display of a "naked" body on a screen can affect the right of freedom of thought, conscience and religion or the selection of passengers based on criteria such as gender, race, ethnic or social origin, language, disability etc. directly affect the right of non-discrimination.

Any limitation to these rights must respond to principles of necessity and proportionality. According to the Council of Europe, authorities shall interfere in the right to privacy in an emergency case when it is a question of national security or public order. But, is routine security control at an airport a question of national emergency?

The security expert Bruce Schneier [10] argues that the security measures being applied will not stop terrorist threats and, instead, they are a nuisance and entail an invasion on users' privacy. First, metal detectors, then shoe inspection, later prohibition of liquids and finally body scanners. Each time a terrorist attack or an attempt of terrorist attack takes place on a plane, different techniques are used, precisely because terrorists try not to be detected by existing controls. Schneier argues that national security agencies must focus their efforts in detecting the threats before bombers get to the airport

In October 2011, European Data Protection Supervisor (EDPS) sent a letter [11] to the vice-president of the European Commission, responsible for Transport, saying that "use of body scanners is not duly justified when there are less intrusive procedures".

On 14 November 2011, the European Commission decided to adopt the proposal that permits the use of body scanners at EU airports under certain conditions that must safeguard fundamental rights and health protection:

- Prohibition of X-ray scanners.
- Scanners shall not store, retain, copy, print or retrieve images.
- The reviewer analysing the images shall be in a separate room so that the passenger cannot be identified.
- The passenger may request that reviewing of images is undertaken by a person of the same gender.
- The face of the passenger shall be darkened or blurred.
- Passengers shall be informed of the technology being used, of the conditions of use and the possibility of refusing the scan.

Concerning protection of data, the EDPS and

the Article 29 Working Party have stood by [12] the opinion that the use of scanners entails data protection treatment and falls into Directive 95/49EC on Data Protection and, therefore, must comply with the principles of necessity and proportionality.

In addition, the Article 29 Working party, has also given its point of view regarding consent. In Opinion 15/2011 of 13 June, on the definition of consent, expresses reservations towards consent given in terms of article 7 of Directive 95/46/EC. As passengers to undergo body scanners have the option to choose alternative methods (hand search, pat down etc.) it could happen that they give their consent to be scanned to avoid delays or other problems, since their objective is not to miss the flight. In consequence, the consent could be considered not to have been freely given.

6. Conclusions

Since some EU Member States started body scanner trials (mostly at the beginning of 2010) several legislative proposals have been progressively passed on civil aviation security, in general, and on use of body scanners, in particular. The different proposals intended, on one hand, to establish common rules on airport security and, on the other hand, to safeguard passengers' fundamental rights and health protection.

Opinions, recommendations, reports or consultations of the main bodies dealing with privacy and data protection (the European Data Protection Supervisor, Article 29 working party and the European Union Agency for Fundamental Rights) have decisively contributed to the definition of such rules.

The approval in November 2011 of Commission Regulations (EC) nº 1141/2011 and nº 1147/2011 set the starting point for the use of body scanners as a legal method for persons' control, and not only as a experimental method as it had been up to that point.

Current rules entail an improvement on safeguarding passengers' rights: X-ray scanners are prohibited; screening is optional and there will be alternative control methods; images shall not be able to be stored or transmitted in any way; passengers shall be informed of the technology used and the conditions of its use.

Despite the aforesaid, there are still questions to be answered. Considering that technologies allowing full automated target detection (ATD) are sufficiently developed, why not let the ATD software inform a human reviewer only when threats may be present? This would absolutely prevent the creation of body images in most cases (passengers concealing nothing) and, only in case of detecting a threat item, the device would show the area to be searched on a general body outline.

On the other hand, it should be noted that bodies such as Article 29 Working Party continue to criticize civil aviation authorities for not been capable of duly justifying the need of such scanners (e.g. with a privacy impact assessment (PIA) [13]). In addition,, the *Electronic Privacy Information Center* (EPIC) in the United States has filed a suit against the Transport Security Authority (TSA) of the *Department of Homeland Security* (DHS) of the American government to suspend the Body Scanner Program at airports [14].

We are facing an ongoing debate between privacy and security. Increasing security measures involves, in contrast, both a limitation on privacy and a nuisance and an inconvenience for the user. [15]. New tendencies in the civil aviation security field intend to avoid such limitations and inconveniences. Although security controls cannot be removed, they should be unified in such a way that passengers could walk through an checkpoint dedicated to security and not have to stop or even take off their coats, boots, belts, watches, mobile phones, luggage etc. Security would be reinforced by intelligence techniques and behaviour analysis. In this context, although not without some objections as far as privacy is concerned, the *International Air Transport Association* (IATA) presented the "*The Checkpoint of the Future*" [16] at the 67 World Air Transport Convention in Singapore (2011), under the motto "*Looks for 'bad people' and not just bad things*".

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Notes

[1] Figures 1 and 2 have been included and referenced from Section 2 (*Body Scanner Technologies*) only to show to the reader what the equipment (to capture three-dimensional images and human silhouettes, respectively) looks like. Therefore, they are not intended to reflect the actual procedures followed nowadays in the EU airports.

[2] See note 1.