D8.5 Standardisation activities report

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Executive Summary

This deliverable contributes towards the standardization of FLYSEC platform and acts as an extension of existing standards for airport use. This is certainly the case for Front-End and Back-End GIS standards and Front-End technologies. Several standards from ISO, ETSI, CEN, IATA and ACI were assessed during WP8 activities and presented here among others. Front end components include:

- TravelDoc component
- Visual Sensors
- FLYSEC Indoor Localisation system

TravelDoc component provides information for the passenger's documentation compliance and travel-related information, Visual Sensors provide alerts based on specific behavioural indicators in the airport premises, the FLYSEC Indoor Localisation system provides location information for the passenger and the carrying luggage.

Standardisation activities report include among others: OpenLS, IndoorGML, PostGIS, OpenLayers API, etc. An important aspect of FLYSEC contribution to standardisation, is to define the standard implementation of the joint security programme by IATA and ACI – Smart Security.

The alignment between FLYSEC and Smart Security programmes raises the possibility of promoting FLYSEC as a complete certified Smart Security platform. FLYSEC is capable to incorporate recommended security principles that enhance security, improve passenger experience and optimize airport resources.

Keywords: Aviation Security, Checkpoint of the Future, FLYSEC, Airport Standards, Indoor Location, OpenLS, IndoorGML, GIS, PostGIS,

List of Acronyms and Abbreviations

ACRONYM	EXPLANATION
ACI	Airports Council International
CDB	Common DataBase
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
EC	European Commission
COP	Common Operating Picture
EPSGR	Epsilon International Greece
EFTA	European Free Trade Association
ETSI	European Telecommunications Standards Institute
ESO	European Standards Organization
ESRI	Environmental Systems Research Institute
EU	European Union
FLYSEC	Optimising time-to-FLY and enhancing airport SECurity
GIS	Geographic Information System
GML	Geography Markup Language
GUI	Graphical User Interface
IETF	Internet Engineering Task Force
IATA	International Air Transport Association
LOF	Location Organizer Folder
NCSRD	National Centre for Scientific Research “Demokritos”
OGC	Open Geospatial Consortium
REST	REpresentational State Transfer
RDBMS	Relational Database Management System
RFID	Radio-frequency identification
SQL	Structured Query Language
SLD	Styled Layer Descriptor
OWS	OGC Web Services
WMC	Web Map Context
WMS	Web Map Service

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1 INTRODUCTION

FLYSEC deals with many processes related to data processing and to their integration into heterogeneous systems, focusing on the interoperability of spatial data and related network services. Within this context the **Geographic Information standards** have a key-role, with their positive impact on the project and vice versa. In this task EPSGR identified standards / regulations related implementation gaps, including potential misalignments between standards from different sources or uneasy implementations of standards / regulations, in order to be properly tackled within the project. EPSGR examined and reported on the standards related with the Back End and Front End GIS standards of FLYSEC platform. The above are examined mostly via Open Geospatial Consortium (OGC) which is an international not for profit organization committed to making quality open standards for the global geospatial community. These standards are made through a consensus process and are freely available for anyone to use to improve sharing of the world's geospatial data. There are over 500-member organizations come from across government, commercial organizations, NGOs, academic, and research institutes supporting OGC. OGC standards are used in a wide variety of domains including:

- ✓ Geosciences & Environment
- ✓ Defense & Intelligence
- ✓ Smart Cities, including IoT & Sensor Webs
- ✓ Mobile tech
- ✓ 3D & Built Environment
- ✓ Emergency Response & Disaster Management
- ✓ Aviation
- ✓ Energy & Utilities and many more

Extension to other standards from European Telecommunications Standards Institute (ETSI) and European Committee for Standardization (CEN) were assessed during the project. ETSI provides members with an open and inclusive environment to support the timely development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services across all sectors of industry and society. ETSI is at the forefront of emerging technologies and they address technical issues which will drive the economy of the future and improve life for the next generation. ETSI is a not-for-profit body with more than 800-member organizations worldwide, drawn from 66 countries and five continents. Members comprise a diversified pool of large and small private companies, research entities, academia, government and public organizations. ETSI is one of only three bodies officially recognized by the EU as a European Standards Organization (ESO).

CEN, is an association that brings together the National Standardization Bodies of 34 European countries. CEN is one of three European Standardization Organizations (together with CENELEC and ETSI) that have been officially recognized by the European Union and by the European Free Trade Association (EFTA) as being responsible for developing and defining voluntary standards at European level. CEN provides a platform for the development of European Standards and other technical documents in relation to various kinds of products, materials, services and processes. CEN supports standardization activities in relation to a wide range of fields and sectors including: air and space, chemicals, construction, consumer products, defence and security, energy, the environment, food and feed, health and safety, healthcare, ICT, machinery, materials, pressure equipment, services, smart living, transport and packaging.

The alignment between FLYSEC and Smart Security programs examine the possibility of promoting **FlySec as a certified Smart Security Platform**. Organizations such as International Air Transport Association (IATA) and Airports Council International (ACI) release periodically safety standards for aviation and airports. IATA collaborates with airports worldwide to ensure infrastructure development and charges adhere to established principles. Airport planning and infrastructure development under IATA regulations must support safe, functional, capacity-optimized and user-friendly airports. ACI advances the interests and acts as the voice of the world's airports and promotes professional excellence in airport management and operations.

EPSGR work presented in this Deliverable is related to the FLYSEC database (FRONT END and BACK END GIS standards) and to FRONT END technologies. Front END technological features applied to FLYSEC were visual components, RFID, Bluetooth iBeacons, etc. Standards related to the project were examined regarding their incorporation into FLYSEC platform. The aim is to promote security principles within the FlySec project and to facilitate the adoption of recommended security principles that enhance security, improve passenger experience and optimize airport management and resources.

2 Back End GIS standards

Back End GIS follows Open Geospatial Consortium (OGC) standards implemented in PostGIS as Geometrics and geospatial functions. All data stored in PostGRESQL are exported into the shapefile OGC standard and then converted into mbTiles (OGC Tile format std) by TileMill. Finally, the tiles are distributed to the platform by an apache web server.

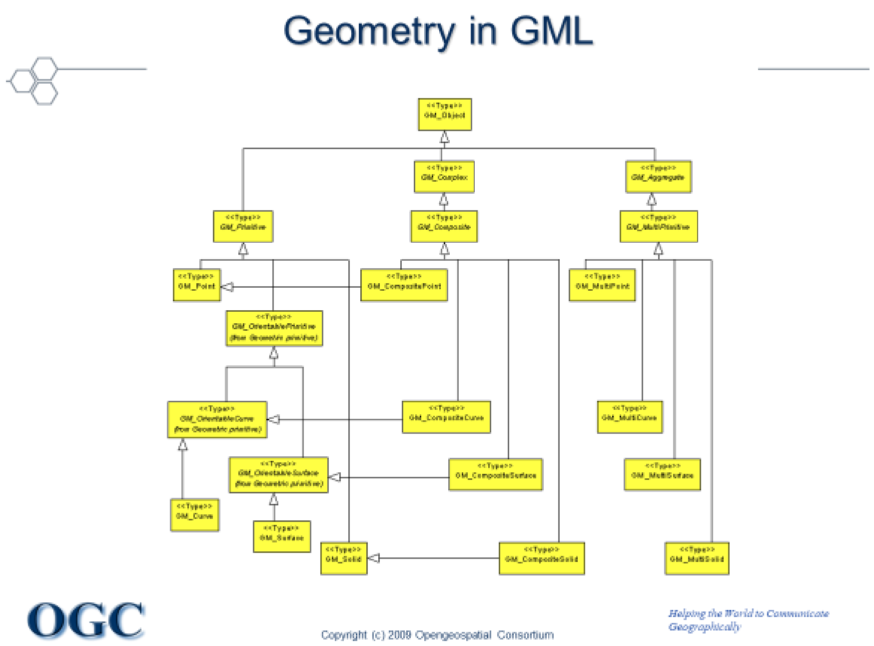

Figure 1 - OGC Geometry in GML[1]

2.1 PostGIS / Geometries and geospatial functions

PostGIS is a spatial database extender for PostgreSQL object-relational database. It adds support for geographic objects allowing location queries to be run in SQL. In addition to basic location awareness, PostGIS offers many features rarely found in other competing spatial databases such as Oracle Locator/Spatial and SQL Server. PostGIS adds extra types (geometry, geography, raster and others) to the PostgreSQL database. It also adds functions, operators, and index enhancements that apply to these spatial types. These additional functions, operators, index bindings and types augment the power of the core PostgreSQL DBMS, making it a fast, feature-plenty, and robust spatial database management system.

PostGIS 2+ series provides:

- Processing and analytic functions for both vector and raster data for splicing, dicing, morphing, reclassifying, and collecting / unioning with the power of SQL
- Raster map algebra for fine-grained raster processing

[1] OGC Standards for Emergency Services Presentation to SDO Emergency Services Coordination Workshop (ESW-7) 11-13 May 2010

- Spatial reprojection Structured Query Language (SQL) callable functions for both vector and raster data
- Support for importing / exporting ESRI shapefile vector data via both command line and GUI packaged tools and support for more formats via other 3rd-party Open Source tools
- Packaged command-line for importing raster data from many standard formats: GeoTiff, NetCDF, PNG, JPG to name a few
- Rendering and importing vector data support functions for standard textual formats such as KML, GML, GeoJSON, GeoHash and WKT using SQL
- Rendering raster data in various standard formats GeoTIFF, PNG, JPG, NetCDF, to name a few using SQL
- Seamless raster/vector SQL callable functions for extrusion of pixel values by geometric region, running stats by region, clipping rasters by a geometry, and vectorizing rasters
- 3D object support, spatial index, and functions
- Network Topology support
- Packaged Tiger Loader / Geocoder/ Reverse Geocoder / utilizing US Census Tiger data

PostGIS follows the Open Geospatial Consortium's"Simple Features for SQL Specification" and has been certified as compliant with the "Types and Functions" profile. PostGIS is open source software, released under the GNU General Public License.

In FLYSEC PostGIS is applied as database systems implementing OGC for geometry storage and geospatial functions. Geometry-related data is offered as PostGRES geom file type and perform geospatial functions. The OGC standards for Geospatial functions are:

GeoXACML Implementation Specification

Geospatial User Feedback (GUF)

GeoSPARQL - A Geographic Query Language for RDF Data

2.2 Tile Server

The solution decided to be followed to FLYSEC platform and mobile applications regarding serving maps methodology is described with the following steps:

1. Create shape files[2] (spatial data)
2. Use of TileMill[3] to load them
3. Export to MBTiles
4. Use mbutil to get mbtiles into file tiles (.png formatted)

[2] https://en.wikipedia.org/wiki/Shapefile

[3] https://tilemill-project.github.io/tilemill/

5. Hosting file tiles to Apache server[4]
6. Server communication with FLYSEC portal
7. Server communication with applications (Android & iOS)

Tile Map Service (TMS) is a protocol for serving maps as tiles i.e. splitting the map up into a pyramid of images at multiple zoom levels[5]. See examples of existing Tile servers.

According to OGC, there is OpenGIS Web Map Tile Service Implementation Standard[6] that includes:

OpenGIS Web Map Tile Service Implementation Standard

OGC Web Map Tile Service (WMTS) Simple Profile

OWS-6 DSS Engineering Report - SOAP/XML and REST in WMTS

Shape files according to OGC standard: CDB Best Practice use of Shapefiles for Vector Data Storage[7]

Esri had publish Shapefile technical description as an "ESRI white paper" in July 1998. Esri also provides OGC and ISO/TC211 Support for Geospatial Standards[8] published in May 2015.

Exporting process of maps made in TileMill can be shared quickly and easily in a number of formats. An interactive map can be exported to MBTiles format for uploading on the web. Exporting documentation and examples, according to TileMill-project, into MBTiles are available at the link.

The project Spatial Information System (SIS) is committed to the implementation of OGC standards in Apache projects[9]. SIS enables efficient representation of coordinates for searching, data clustering, archiving and other spatial functions. The library implements OGC GeoAPI Implementation Specification 3.0 interfaces for use in desktop or server applications. The Apache SIS project recently released version 0.6 of their Java library, with support for ISO-19115 metadata and ISO-19111 referencing by coordinates. This library is among the first implementations of ISO-19162, also published as the OGC Well-known text representation of coordinate reference systems. Apache SIS also provides support for reading and writing Coordinate Reference System (CRS) objects from GML documents and performing map projections with those CRSs. The Apache SIS metadata model has been updated to the ISO 19115-1 standard published in 2015 while maintaining compatibility (as deprecated methods) with the older version published in 2003. This update also integrates the ISO-19115-2 extension for imagery.

[4] http://www.apache.org/

[5] https://wiki.openstreetmap.org/wiki/TMS

[6] http://www.opengeospatial.org/standards/wmts

[7] https://portal.opengeospatial.org/files/?artifact_id=72715

[8] http://www.esri.com/library/whitepapers/pdfs/supported-ogc-iso-standards.pdf

[9] http://www.opengeospatial.org/blog/2346

A significant work presented by ESRI in 2003 as a White Paper is Spatial Data Standards and GIS Interoperability

2.3 Routing Standards

The routing engine includes GraphHopper[10] routing algorithm, loads IndoorGML graphs into memory for fast access.

GraphHopper Directions API consists of the following parts:

- ✓ Routing API,
- ✓ Route Optimization API,
- ✓ Isochrone API,
- ✓ Map Matching API,
- ✓ Matrix API
- ✓ Geocoding API

IndoorGML[11], as shown in Figure 2, is an OGC standard for an open data model and XML schema for indoor spatial information. It aims to provide a common framework of representation and exchange of indoor spatial information. IndoorGML standards by OGC[12] include:

IndoorGML - with Corrigendum

OGC Geographic Markup Language (GML) 3.2.1

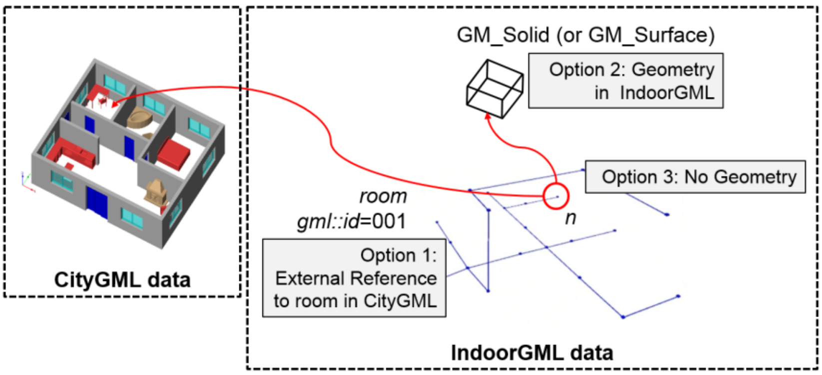

FIGURE 2 - GEOMETRY IN INDOORGML11[11]

ESRI announced on 9 July 2018 a New Indoor Mapping Product called ArcGIS Indoors. ArcGIS Indoors is a complete indoor mapping system for assembling, managing, and sharing building and campus information. ArcGIS Indoors system for location discovery and wayfinding, asset management, operational data analysis, and crowdsource reporting to keep the indoor

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[10] https://www.graphhopper.com

[11] http://www.indoorgml.net/

[12] http://www.opengeospatial.org/standards/indoorgml

environment functional and safe. An example of Paris Mall13 is shown Figure 3. ArcGIS Indoors uses data streams, real-time processing, and location intelligence tools to help businesses and other organizations understand how to better coordinate space and other resources with their facilities and campuses. Insights from sensor networks deliver real-time information to managers and executives through interactive dashboards, while visitors and employees can find useful information about the buildings they occupy. Floor-aware, 3D maps allow building operators and occupants to quickly access and explore critical business information, like the location and status of fire extinguishers and their last inspection dates, or conference rooms and their projector options.

FIGURE 3 – ESRI INDOORMAPS SHOWING PARISMALL13[13]

[13] http://coolmaps.esri.com/IndoorMaps/ParisMall/

3 FRONT END GIS STANDARDS

The back-end management and control system collects information from the FLYSEC front end components. Then it performs fusion and data analysis to result in meaningful risk-based security outcomes. Section three of this report describes the FLYSEC Indoor Localisation system with respect to the GIS standards. Such system provides location information for the passenger and the carrying luggage.

PostgreSQL is used as the RDBMS (Relational Database Management System), as it offers a great number of geospatial functions, AngularJS for the front-end web application and WildFly Application Server for all the back-end calculations and the REST API deployment, which is used for the data transfer between the back-end and the front-end components.

3.1 Open Layers API / WMS for map visualization

OpenLayers is an open source (provided under the 2-clause BSD License) JavaScript library for displaying map data in web browsers as slippy maps. It can be found at https://openlayers.org/ It provides an API for building rich web-based geographic applications similar to Google Maps and Bing Maps.

The OpenGIS Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not. More information and standards are available to the following:

http://www.opengeospatial.org/standards/wms

The format for reading WMS capabilities data according to OpenLayers is presented as an example[14] of showing the contents of the result object from parsing a WMS capabilities response.

```
<!DOCTYPE html>

<html>

  <head>

    <title>WMS Capabilities Parsing</title>
```

[14] https://openlayers.org/en/latest/examples/wms-capabilities.html

```
    <link rel="stylesheet"
href="https://openlayers.org/en/v5.1.3/css/ol.css" type="text/css">

    <!-- The line below is only needed for old environments like Internet
Explorer and Android 4.x -->

    <script
src="https://cdn.polyfill.io/v2/polyfill.min.js?features=requestAnimationFr
ame,Element.prototype.classList,URL"></script>

    <style>

      .log-container {

        height: 400px;

        overflow: scroll;

      }

    </style>

  </head>

  <body>

    <pre class="log-container"><code id="log"></code></pre>

    <script>

      import WMSCapabilities from 'ol/format/WMSCapabilities.js';

      var parser = new WMSCapabilities();

      fetch('data/ogcsample.xml').then(function(response) {

        return response.text();

      }).then(function(text) {

        var result = parser.read(text);

        document.getElementById('log').innerText = JSON.stringify(result,
null, 2);

      });

    </script>

  </body>
```

```
</html>
```

Regarding WMS, ISO19128 is available. ISO19128 developed by a base document supplied by the Open Geospatial Consortium, Inc. A Web Map Service (WMS) produces maps of spatially referenced data dynamically from geographic information. This International Standard defines a “map” to be a portrayal of geographic information as a digital image file suitable for display on a computer screen. A map is not the data itself.

WMS-produced maps are generally rendered in a pictorial format such as PNG, GIF or JPEG, or occasionally as vector-based graphical elements in Scalable Vector Graphics (SVG) or Web Computer Graphics Metafile (WebCGM) formats.

In the introduction of the specific ISO it is stated that the International Standard defines three operations: one returns service-level metadata; another returns a map whose geographic and dimensional parameters are well-defined; and an optional third operation returns information about particular features shown on a map. Web Map Service operations can be invoked using a standard web browser by submitting requests in the form of Uniform Resource Locators (URLs). The content of such URLs depends on which operation is requested. In particular, when requesting a map the URL indicates what information is to be shown on the map, what portion of the Earth is to be mapped, the desired coordinate reference system, and the output image width and height. When two or more maps are produced with the same geographic parameters and output size, the results can be accurately overlaid to produce a composite map. The use of image formats that support transparent backgrounds (e.g. GIF or PNG) allows underlying maps to be visible. Furthermore, individual maps can be requested from different servers. The Web Map Service thus enables the creation of a network of distributed map servers from which clients can build customized maps. Illustrative examples of map request URLs and their resulting maps are shown in Annex G.

This International Standard applies to a Web Map Service instance that publishes its ability to produce maps rather than its ability to access specific data holdings. A basic WMS classifies its geographic information holdings into “Layers” and offers a finite number of predefined “Styles” in which to display those layers. This International Standard supports only named Layers and Styles, and does not include a mechanism for user-defined symbolization of feature data.

The Open Geospatial Consortium (OGC) Styled Layer Descriptor (SLD)[15] specification defines a mechanism for user-defined symbolization of feature data instead of named Layers and Styles. SLD-enabled WMS retrieves feature data from a Web Feature Service and applies explicit styling information provided by the user in order to render a map.

3.2 Rest services for data exchange

REST (REpresentational State Transfer) is applied to develop FLYSEC platform. REST architectural style applied for developing web services. REST is a popular methodology due to

[15] http://www.opengeospatial.org/standards/sld

its simplicity and the fact that it builds upon existing systems and features of the internet's HTTP in order to achieve its objectives, as opposed to creating new standards, frameworks and technologies.

REST determines how the API looks like. It stands for "Representational State Transfer". It is a set of rules that developers follow when they create their API. One of these rules states that you should be able to get a piece of data (called a resource) when you link to a specific URL. Each URL is called a request while the data sent back to you is called a response. The anatomy of a request is made up of four things:

- The endpoint
- The method
- The headers
- The data (or body)

A primary benefit of using REST, both from a client and server's perspective, is REST-based interactions happen using constructs that are familiar to anyone who is accustomed to using the internet's Hypertext Transfer Protocol (HTTP). An example of this arrangement is REST-based interactions all communicate their status using standard HTTP status codes. So, a 404 means a requested resource wasn't found; a 401 code means the request wasn't authorized; a 200 code means everything is OK; and a 500 means there was an unrecoverable application error on the server.

Similarly, details such as encryption and data transport integrity are solved not by adding new frameworks or technologies, but instead by relying on well-known Secure Sockets Layer (SSL) encryption and Transport Layer Security (TLS). So, the entire REST architecture is built upon concepts with which most developers are already familiar. REST is also a language-independent architectural style. REST-based applications can be written using any language, be it Java, Kotlin, .NET, AngularJS or JavaScript. As long as a programming language can make web-based requests using HTTP, it is possible for that language to be used to invoke a RESTful API or web service. Similarly, RESTful web services can be written using any language, so developers tasked with implementing such services can choose technologies that work best for their situation.

The other benefit of using REST is its pervasiveness. On the server side, there are a variety of REST-based frameworks for helping developers create RESTful web services, including RESTlet and Apache CXF. From the client side, all of the new JavaScript frameworks, such as JQuery, Node.js, Angular and EmberJS, all have standard libraries built into their APIs that make invoking RESTful web services and consuming the XML- or JSON-based data they return a relatively straightforward endeavor.

Disadvantages and Alternatives

HTTP does not store state-based information between request-response cycles, which means REST-based applications must be stateless and any state management tasks must be performed by the client. Similarly, since HTTP doesn't have any mechanism to send push notifications from the server to the client, it is difficult to implement any type of services where the server updates the client without the use of client-side polling of the server or some other type of web hook. From an implementation standpoint, a common problem with REST is the fact that developers disagree with exactly what it means to be REST-based. Some software developers incorrectly consider anything that isn't SOAP-based to be RESTful. Driving this common misconception about REST is the fact that it is an architectural style, so there is no reference implementation or definitive standard that will confirm whether a given design is RESTful. As a result, there is discourse as to whether a given API conforms to REST-based principles.

Alternate technologies for creating SOA-based systems or creating APIs for invoking remote microservices include XML over HTTP (XML-RPC), CORBA, RMI over IIOP and the Simple Object Access Protocol (SOAP). Each technology has its own set of benefits and drawbacks, but the compelling feature of REST that sets it apart is the fact that, rather than asking a developer to work with a set of custom protocols or to create a special data format for exchanging messages between a client and a server, REST insists the best way to implement a network-based web service is to simply use the basic construct of the network protocol itself, which in the case of the internet is HTTP. This is an important point, as REST is not intended to apply just to the internet; rather, its principles are intended to apply to all protocols, including WEBDAV, FTP and so on.

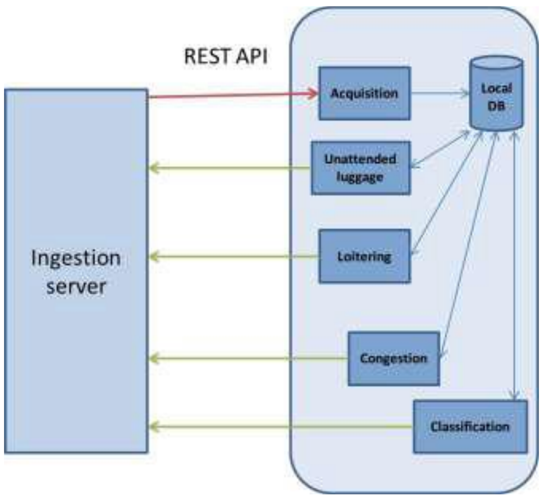

FIGURE 4 – REST API ROLE IN COMPONENT ARCHITECTURE

Apache HTTP Server

FLYSEC project uses Apache servers to hosting tile files and make them available to the web platform and the mobile applications (Apple and Android).

The Apache HTTP Server, colloquially called Apache, is a free and open-source cross-platform web server, released under the terms of Apache License 2.0. Apache is developed and maintained by an open community of developers under the auspices of the Apache Software Foundation and to the Apache Software Foundation.

The Apache HTTP Server is cross-platform; as of 1 June 2017 92% of Apache HTTPS Server copies run on Linux distributions. Version 2.0 improved support for non-Unix operating systems such as Windows and OS/2. Old versions of Apache were ported to run on OpenVMS and NetWare. Originally based on the NCSA HTTPd server, development of Apache began in early 1995 after work on the NCSA code stalled. Apache played a key role in the initial growth of the World Wide Web, quickly overtaking NCSA HTTPd as the dominant HTTP server, and has remained most popular since April 1996. In 2009, it became the first web server software to serve more than 100 million websites. As of March 2018, it was estimated to serve 43% of all active websites and 37% of the top million websites.

HTTP server has the following features:

- Loadable Dynamic Modules
- Multiple Request Processing modes (MPMs) including Event-based/Async, Threaded and Prefork.
- Highly scalable (easily handles more than 10,000 simultaneous connections)
- Handling of static files, index files, auto-indexing and content negotiation
- .htaccess support
- Reverse proxy with caching
  - Load balancing with in-band health checks
  - Multiple load balancing mechanisms
  - Fault tolerance and Failover with automatic recovery
  - WebSocket, FastCGI, SCGI, AJP and uWSGI support with caching
  - Dynamic configuration
- TLS/SSL with SNI and OCSP stapling support, via OpenSSL.
- Name- and IP address-based virtual servers
- IPv6-compatible
- HTTP/2 protocol support
- Fine-grained authentication and authorization access control
- gzip compression and decompression
- URL rewriting
- Headers and content rewriting
- Custom logging with rotation
- Concurrent connection limiting
- Request processing rate limiting
- Bandwidth throttling
- Server Side Includes
- IP address-based geolocation
- User and Session tracking
- WebDAV
- Embedded Perl, PHP and Lua scripting
- CGI support
- public_html per-user web-pages
- Generic expression parser
- Real-time status views
- XML support

- FTP support (by a separate module)

All the documents and relevant standards that the Apache HTTP Server follows, along with brief descriptions can be found to:

https://httpd.apache.org/docs/2.4/misc/relevant_standards.html

3.3 GeoJSON data format / Data exchange

GeoJSON is a format for encoding a variety of geographic data structures. GeoJSON supports the following geometry types: Point, LineString, Polygon, MultiPoint, MultiLineString, and MultiPolygon. Geometric objects with additional properties are Feature objects. Sets of features are contained by FeatureCollection objects.

Point, LineString and Polygon shapes are also known as single type Geometry objects. While MultiPoint, MultiLineString, and MultiPolygon are also called homogeneously typed multipart Geometry objects.

A Position is a fundamental geometric construct. Simply put, it is an array of 2 or three numbers. The first two numbers represent longitude and latitude (in that order). And the third (optional) number represents altitude or elevation. So, a position is basically the array [longitude, latitude, elevation/altitude].

In 2015, the Internet Engineering Task Force (IETF), in conjunction with the original specification authors, formed a GeoJSON WG to standardize GeoJSON. RFC 7946 was published in August 2016 and is the new standard specification of the GeoJSON format, replacing the 2008 GeoJSON specification.

OGC OWS Context GeoJSON Encoding Standard

This standard describes the GeoJSON encoding of the OGC Web Services (OWS) Context conceptual model. This standard defines how to encode an OWS context document that

1) can be extended to allow a context referencing a fully configured service set, and

2) can be defined and consistently interpreted by clients.

The OWS Context Document standard (OWS Context) was created to allow a set of configured information resources to be passed between applications primarily as a collection of services (but also potentially in-line content). The objective is to support use cases such as the distribution of search results, the exchange of a set of resources in a Common Operating Picture (COP), or delivery of a set of configured processing services to allow the processing to be reproduced on different processing nodes. The goal for OWS Context is to replace previous OGC standards and best practices that provide similar capability. Web Map Context (WMC) has been reasonably successful but is limited to working with only Web Map Service (WMS) instances. Other work on the Location Organizer Folder (LOF) was also taken into consideration. The concept of OWS Context and the first prototype document was produced as part of OWS Testbed 7 and documented in [OGC10-035r1], Information Sharing Engineering Report. A principal goal of the OWS Context SWG was to develop encodings that would appeal for use in mass market applications yet also provide facilities for more advanced uses. OWS-7 originally considered the application of existing encoding standards for OWS Context. The OGC Standards Working Group (SWG) has concluded that this standard can have multiple encoding formats and that each encoding format will be described in a separate OGC Extension to the Core model.

Supported Software and Compatibility

GeoJSON is supported by numerous mapping and GIS software packages, including OpenLayers, Leaflet, MapServer, Geoforge software, GeoServer, GeoDjango, GDAL, Safe Software FME, and CartoDB. It is also possible to use GeoJSON with PostGIS and Mapnik, both of which handle the format via the GDAL OGR conversion library. Bing Maps, Yahoo!, HERE, and Google also support GeoJSON in their API services.

The Google Maps JavaScript API v3 directly supports the integration of GeoJSON data layers as of March 19, 2014. For the Julia language a GeoJSON.jl package is available. GitHub also supports GeoJSON rendering and Potrace GeoJSON export. Geojson.io supports GeoJSON rendering and editing in the web browser.

An example of GeoJson format is the following[16]:

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "type": "Feature",
      "geometry": {
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      },
      "properties": {
        "prop0": "value0"
      }
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        ]
      },
      "properties": {
```

[16] https://en.wikipedia.org/wiki/GeoJSON

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          "prop1": 0.0
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      },
      {
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        "geometry": {
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              [100.0, 1.0], [100.0, 0.0]
            ]
          ]
        },
        "properties": {
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          "prop1": { "this": "that" }
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      }
    ]
  }
```

The above mentioned Geometries are presented in detail below[16]:

Geometry primitives		
Type	**Examples**	

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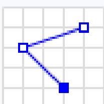
LineString		{
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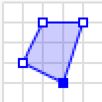
<tr><td rowspan="2">Polygon</td><td></td><td><pre>
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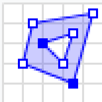
<tr><td></td><td><pre>
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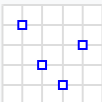
[35, 10]],
        [[20, 30], [35, 35], [30, 20], [20, 30]]
    ]
}
</pre></td></tr>
</table>

<table>
<tr><th colspan="3">Multipart geometries</th></tr>
<tr><th>Type</th><th colspan="2">Examples</th></tr>
<tr><td>MultiPoint</td><td></td><td><pre>
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}
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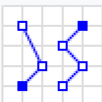
<tr><td>MultiLineString</td><td></td><td><pre>
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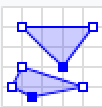
        [[40, 40], [30, 30], [40, 20], [30,
10]]
    ]
}
</pre></td></tr>
<tr><td>MultiPolygon</td><td></td><td><pre>
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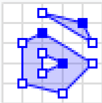
[30, 20]]
        ],
        [
            [[15, 5], [40, 10], [10, 20], [5,
10], [15, 5]]
        ]
</pre></td></tr>
</table>

		] }

		{
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		[[30, 20], [20, 15], [20, 25], [30, 20]]
		]
		]
		}

4 FRONT END TECHNOLOGIES

FLYSEC Front-End technologies includes hardware installation such as RFID Sensors, Bluetooth Beacons and surveillance cameras. Existing standards regarding the above-mentioned hardware are described in this section of the deliverable.

4.1 RFID Sensors

RFID tracking sensors were applied on luggage system. They are responsible for:

- the scanning of carry-on luggage pieces in designated security control points;

- the matching of the luggage pieces with corresponding passengers; and

- the issuance of alerts in case of inconsistencies.

According to https://www.idtechex.com which present the first in-depth research for the "rapid increase in use of RFID in the air industry", Radio Frequency Identification (RFID) is an extremely powerful enabling technology in airports and aircraft, serving to improve security against criminal attack, safety against general hazards, efficiency, error prevention and data capture and to remove tedious tasks.

It can even create new earning streams where it makes tolling feasible without causing congestion and where new airport "touch and go" cards offer new paid services without delays. RFID creates competitive advantage in many ways and in many locations. Managers in the air industry and their suppliers are in danger of being left behind if they are ignorant of the successes and new possibilities of using RFID to improve the air industry.

In the report presented by idtechex, the main subjects are the broad sweep of work in this area, and to give market sizes, paybacks and forecasts aiming to the following applications:

- Airline baggage tagging
- Reduced wastage in food trolleys
- Cargo tracking: improving operations
- Parts
- Freight: enabling the IAT e-freight initiative

The potential amount that RFID baggage tagging can save amounts to $760 million a year and is therefore worthwhile tackling. In some cases, the saving has been very high - in Hong Kong airport, for example, the average cost of handling bags has gone from $7 per bag to $4 - a huge saving. By early 2008, more than 30 airports are using/trialling RFID for baggage handling. The major roll-out at Hong Kong is beginning to be done elsewhere - including now at Milan airport.

According to IATA[17] aviation RFID solutions can be applied to "Flyable parts" and to "Non-Flyable Parts" as shown in Figure 5.

[17] Radio Frequency Identification (RFID) into airline maintenance operations, Material No.: 8671-01, ISBN 978-92-9252-193-6, International Air Transport, Montreal – Geneva, 2013

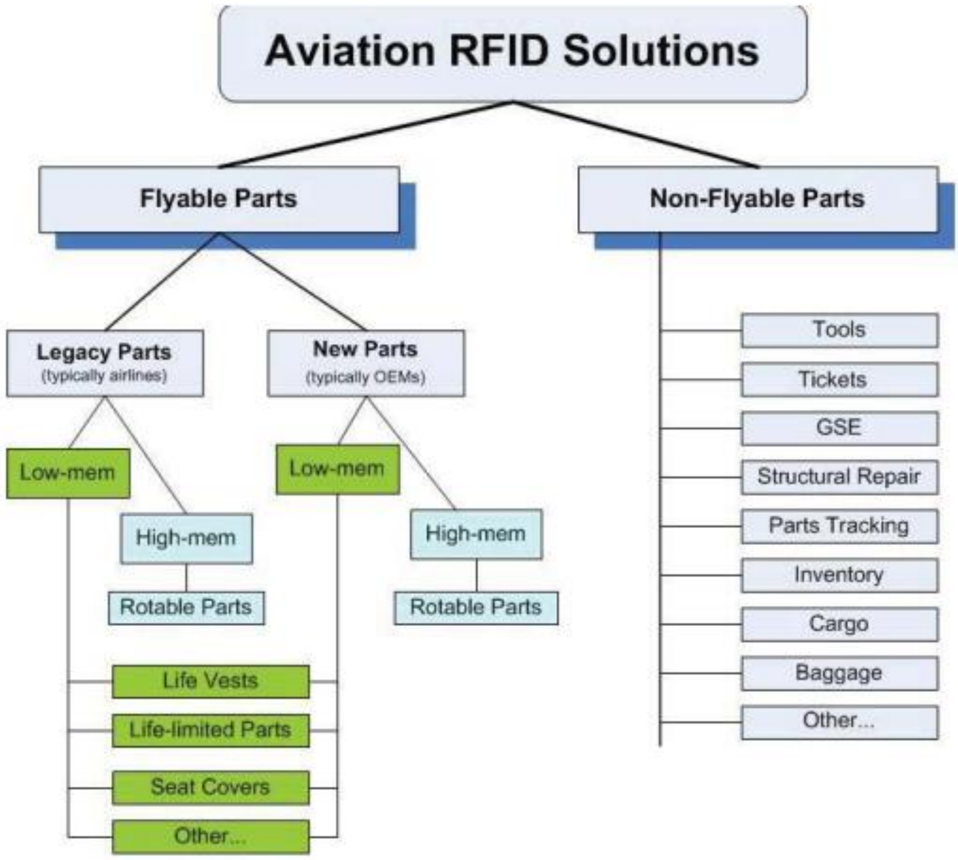

FIGURE 5 – RFID IN AVIATION ACCORDING TO IATA

SAE AS5678 is a requirements specification created by SAE International for the production and test of passive only Radio Frequency Identification (RFID) tags for the Aerospace industry. The scope of SAE AS5678 is to:

1. Provide a requirements document for RFID Tag Manufacturers to produce passive-only UHF RFID tags for the Aerospace industry.
2. Identify the minimum performance requirements specfic to the Passive UHF RFID Tag to be used on aircraft parts, to be accessed only during ground operations.
3. Specify the test requirements specific to Passive UHF RFID tags for airborne use, in addition to RTCA DO-160E compliance requirements separately called out in this document.
4. Identify existing standards applicable to Passive UHF RFID Tag.
5. Provide a certification standard for RFID tags which will use permanently-affixed installation on aircraft and aircraft parts.

SAE specification is also related to the Air Transportation Association SPEC2000 specification as shown in Figure 6.

FIGURE 6 – SPEC2000 AT A GLANCE

4.2 Beacons and iBeacons

The term iBeacon and Beacon are often used interchangeably. iBeacon is the name for Apple's technology standard, which allows Mobile Apps (running on both iOS and Android devices) to listen for signals from beacons in the physical world and react accordingly. In essence, iBeacon technology allows Mobile Apps to understand their position on a micro-local scale, and deliver hyper-contextual content to users based on location. The underlying communication technology is Bluetooth Low Energy.

"A Guide to Bluetooth Beacons" A white paper by the GSMA was published in September 2014 presenting a full technological background, possible applications and examples and many more information[18].

FLYSEC uses Beacons as an indoor location sensing module integraded into the Android and Apple application.

On the 14th of March 2018, wayfindr, developed the world's first internationally-approved Open standard for accessible audio navigation. Chapter 1 refers to Bluetooth Low Energy beacons. Information about **Installation** and **Configuration** of Bluetooth Low Energy (BLE) beacons in a built environment, as long as Maintenance and Operational considerations that should be taken into account in order to manage a fleet of installed BLE beacons are presented.

[18] https://www.gsma.com/digitalcommerce/wp-content/uploads/2013/10/A-guide-to-BLE-beacons-FINAL-18-Sept-14.pdf

Airport Beacons Recommended Practice was published by ACI in September 2016. In response to the growing use of beacons in the airport community, the ACI World Airport IT Standing Committee (WAITSC) has created a Beacons task whose mandate is to make recommendations on how to adequately deploy and control beacons at an airport, all available in a Recommended Practice. ACI has worked intensely with IATA and other organizations (Airport, airlines, and suppliers) to publish this report.

More information about IT related information and standards can be found in "Common Use IT Handbook" published in 2007 by ACI. Airports increasingly rely on common use IT services within the terminal and airfield operations to reduce capacity congestion and increase efficiency. This new handbook provides a compilation of best industry practices taken from airports around the world and identifies some of the key areas that must be considered in the development of common use IT services. It provides airport operators with a high-level overview as well as the detailed technical descriptions contained in the annexes.

5 TOWARDS CERTIFICATION AND SECURITY IMPLEMENTATION STANDARDS FOR FLYSEC

FLYSEC platform aims to be certified for airport use. This means that all software and hardware components should follow international standards.

As presented in this deliverable, FLYSEC platform was developed according to international standards. The procedures followed and the hardware applied for FLYSEC testing were in compliance with international standards for Airports ETSI and CEN, and also IATA and ACI.

To proceed for FLYSEC certification for airport use, an in-detail analysis of all the procedures followed within the platform need to be presented and the respective standard followed during development. The same applies for hardware compliance.

Companies such as Airsight are providing consulting services for Airport standardization and civil aviation standards that can be useful for FLYSEC certification.

For the time being and with the projects reaching its end, FLYSEC takes pride for being the first implementation of IATA/ACI Smart Security framework in the context of EU Research. In Annex I we present an executive report with regards to the FLYSEC implementation of the ACI/IATA Smart Security which paves the way towards a certified and operational solution.

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LIST OF FIGURES

ANNEX I THE FLYSEC SMART SECURITY IMPLEMENTATION

FLYSEC project provided the first implementation of the ACI/IATA Smart Security Joint Programme and recommendations in the context of H2020 and European Security Research. We provide here the Smart Security context followed by the key achievements of FLYSEC towards a certified Smart Security implementation and contribution to identified challenges of the Smart Security programme: proof of concept and practice in an operational airport (Luxembourg AIport), Passenger Differentiation implementation based on risk classification, enabling deployed technologies for behaviour detection as well as the Data Fusion framework.

The Smart Security Context

Airports Council International (ACI) and the International Air Transport Association (IATA) signed a Memorandum of Understanding (MoU) in December 2013 to jointly develop Smart Security (Smart Security). With the MoU, ACI and IATA have aligned their resources and expertise to improve the journey from curb to boarding. Passengers will be able to proceed through security checkpoints with minimal inconvenience, security resources will be allocated based on risk and airport facilities can be optimized.

In 2012, IATA and ACI, together with a range of government and industry partners defined a roadmap for the future of passenger screening with proposals that were operationally achievable, technically feasible and believed to be publically acceptable. This roadmap was adopted by the International Civil Aviation Organization (ICAO) High Level Conference on Aviation Security in September 2012.

The roadmap prepared in 2012 is now a reference document, with many of the innovative technologies and practices being implemented at airports around the world. This updated Smart Security Blueprint details the further development of that roadmap. Elements of the original blueprint that were related to technologies or processes considered operationally ready were moved across to relevant Smart Security Guidance documents which are available upon request.

The need to modernize and improve passenger security screening has long been a topic of conversation across the aviation industry. Screening works, but at great cost to the aviation industry, to authorities, and to passengers. Given the predicted growth in air travel, continuously evolving threats, and passengers becoming increasingly dissatisfied with queues and intrusive measures, today’s model is no longer sustainable.

Through Smart Security, government and industry have come together to collaborate and to define a future where passengers proceed through security with minimal inconvenience, where airport facilities are optimized and where security resources are allocated based on risk, thus contributing towards an improved journey from curb to airside.

As with any serious undertaking, specifics outcomes must be established to ensure that a successful conclusion can be defined. To that end, the stakeholders have agreed that the goals of the Smart Security are:

Strengthened security

- Increase unpredictability
- Better use of existing technologies
- Introduce new technologies with advanced capabilities
- Focus resources based on risk and advanced information

- Increased operational efficiency
- Increase throughput
- Maximize equipment and space utilization
- Optimize staffing resources
- Optimize cost per passenger
- Improved passenger experience
- Reduce queues and waiting times
- Use technology for a less intrusive and disruptive search o Reduce divestment requirements

Smart Security sets the context and identifies considerations that the aviation community needs to address in order to move away from the rigid and predictable “one-size-fits-all” approach that characterizes today’s passenger security screening environment to a risk based approach based on security outcomes, process improvement, and technology. The evolution to Smart Security can be accomplished using options tailored to meet the specific needs of government and industry within a State, the airport environment in which the checkpoint operates, and the availability of emerging technologies.

The purpose of the Smart Security Blueprint is to provide an overview of the program, including today’s trends, envisaged capabilities for the future as well as key research, testing, lobbying activities and regulatory action that may be needed to see these capabilities realized. It is hoped that by setting out the short, medium and long term goals of the project, this document will act as a roadmap to aid planning and coordination of solution development.

[Source: ACI/IATA Smart Security Blueprint, Version 4, available online at: https://aci.aero/about-aci/priorities/security/smart-security/smart-security-guidance-documents/]

The FLYSEC Smart Security Deployment in Luxembourg International Airport

The FLYSEC final field test was the first deployment of the innovative airport risk based screening and security concept in an actual operational airport environment with Lux-Airport security personnel, practitioners and security managers operating the FLYSEC system and components.

The integrated FLYSEC System successfully deployed and demonstrated:

- A mobile application for passengers, including features such as routing and navigation, positive boarding and assisted security walkthrough, assisted shopping and time management.
- A mobile application for security personnel with location-based alerts, incident handling capabilities and notifi cations, queue monitoring and assisted passenger and behavior screening
- Intelligent Visual Sensors for behaviour analytics and risk detection
- The TravelDoc mobile kiosk and terminal for travel document scanning, enhanced validity verifi cation and integration of PNR data in the FLYSEC risk classifi cation service
- A SmartQ component for smart security queue management integrated with transparent risk classifi cation assessment algorithms
- The RFID carry-on luggage tracking system for unattended luggage detection and fast retrieval service
- A Beacon-based localization system for enabling location based passenger services, also offering location correlation capabilities to the security fusion algorithms

- A web based command and control portal, providing holistic airport real time monitoring and security checkpoint management as well as communication capabilities which include integrated passenger simulation module for training and decision support
- Risk Classification and Enhanced situational awareness fusion and machine learning services, correlating input from heterogeneous sources, behaviour and risk indicators and generating relevant alerts
- The FLYSEC simulation platform for airport operational flow and passenger/personnel crowd simulation including realistic 3D visualization of Luxembourg Airport Terminal

The successful Lux Airport field test marked the first implementation of SMART SECURITY within the EU research programme.

FIGURE 7 – LUXEMBOURG FIELD TEST IMPRESSIONS

Passenger Differentiation: Risk Classification of passengers

The risk classification is responsible for the automatic categorization of the passengers into three categories according to their security risk. This categorization results in the assignment of a specific security checkpoint(s) for each passenger. The objective of the screening differentiation is to (i) facilitate the fast passage of trusted and registered travellers without generating additional risks, (ii) enhance security through a proactive risk-based approach based on behavioural analysis and risk assessment. The component classifies passengers into three categories: (1) Trusted/Pre-Registered, (2) Casual and (3) Enhanced screening passengers. The alert generation is responsible for the automated detection of suspicious incidents that could be related to malicious behaviour. During 21 – 22 February pilot at the Luxembourg airport, it was demonstrated two suspicious incidents detections: (a) suspicious loitering in high risk areas incident detection based on cameras or beacons data, and (b) unattended luggage incidents detection.

Passenger's categorization and alerts generation processes are based on information collected from the FLYSEC front-end components. The TravelDoc component provides information for the passenger's documentation compliance and travel-related information, the Visual Sensors provide alerts based on specific behavioural indicators in the airport premises, the FLYSEC Indoor Localization system provides location information for the passenger and the carrying luggage.

The scope of the classification services is to classify passengers in three categories: (1) Trusted/Pre-Registered, (2) Casual and (3) Enhanced screening passengers. The task is accomplished using specific behaviour indicators which are extracted automatically (from visual sensors) or manually (from security personnel).

A practical example of risk classification process in FLYSEC:

Initially, the classification procedure checks the payment method of the boarding pass and the travel destination. If the payment method is "CASH" of the destination belongs to a pre-defined list of suspicious destinations, the passenger is classified as "ENHANCED". Otherwise it is calculated the sum of the weights of the abovementioned indicators and compared versus two predefined thresholds. The weights are defined as indicated by the WP3. Consequently there arise three possibilities:

- The sum is smaller than the first threshold which results that the algorithm classifies the passengers to the "TRUSTED" category if he/she is not classified to a higher class already. In such case the algorithm retains the previous class.
- The sum lies between the first and the second thresholds which results that the algorithm classifies the passengers to the "CASUAL" category if he/she is not already classified to a higher class already. In such case the algorithm retains the previous class.
- The sum is larger than the second threshold which results that the algorithm classifies the passengers to the "ENHANCED" category.

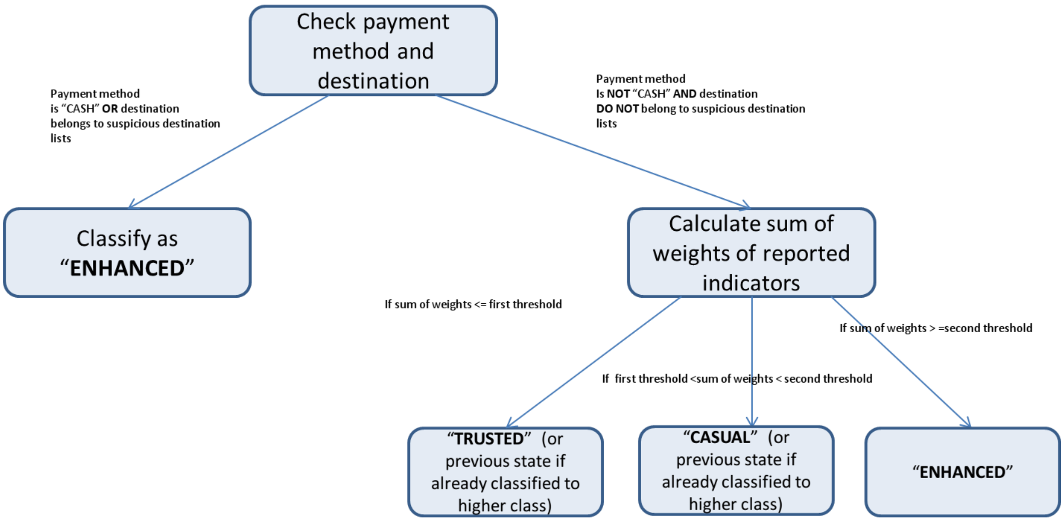

FIGURE 8 – RISK CLASSIFICATION FLOW CHART

Innovative Technological Components for Enhanced Data Fusion and Behaviour Analytics

FLYSEC Web Based C2I System

The FLYSEC Command, Control and Information (C2I) Portal is intended for use by the security personnel of the airport. The purpose is for security personnel and system administrators to be able to manage and monitor all airport-related data. Portal users, administrators and security personnel with different access levels, receive information from mobile app users (passengers and other people present at the airport), cabin luggage data, front-end interfaces data (cameras, beacons, RFIDs, labels), flights data and airport areas. The portal also offers the possibility of sending push notifications (e.g. security alerts) to all the other FLYSEC system users. The C2I is empowered by the intelligence offered by the Fusion and Risk Based Alerts component.

FLYSEC Fusion & Risk Based Alerts

The Fusion Center collects and uses the passenger-related information from:

- the TravelDoc system,
- the Visual Sensors
- localisation sensors (RFID, Beacons)
- the mobile devices (apps)
- and the manual entries from the security personnel based on risk-based indicators

It applies the FLYSEC fusion algorithms in order to classify the passengers into different security levels: Casual, Trusted/Registered and Enhanced risk. The FLYSEC Fusion Center uses collected information from sensors and security personnel to provide enhanced situational awareness, issue alerts and notification to the Control & Command Portal.

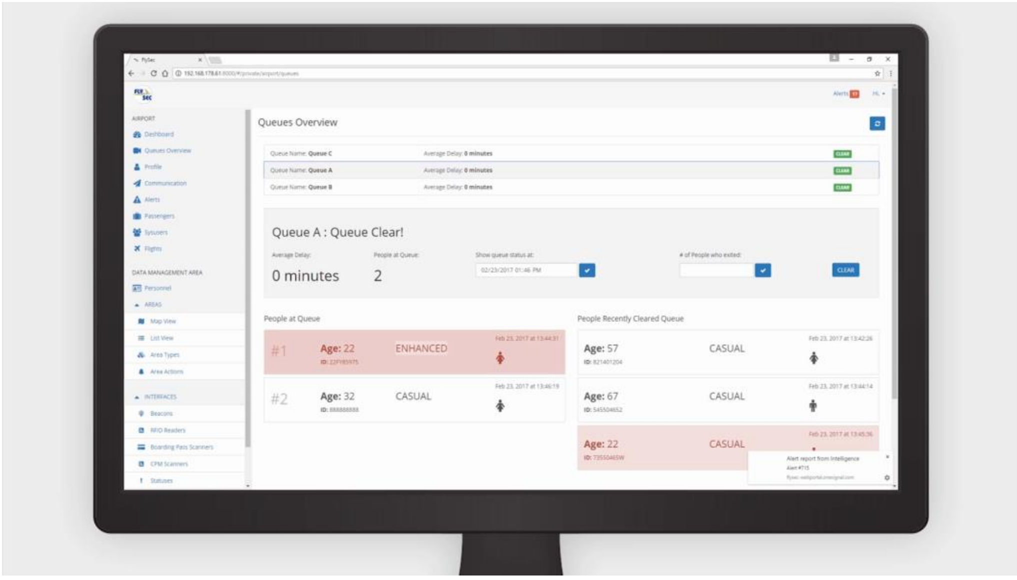

FIGURE 9 WEB C2I PORTAL WITH QUEUE OVERVIEW AND ALERT NOTIFICATION

Visual Sensors

Visual Sensors monitor specific airport areas and sends to the management centre real-time information about the number of people in the area, unattended luggage, congested areas and relevant behavioural indicators, e.g. running, loitering. Information is then sent to the Management System and an alert is raised in the Control & Command Portal when necessary.

Within FLYSEC, EMZA deployed a large number of algorithm-backed sensors that monitor movements of persons and objects within the terminal and the outside area.

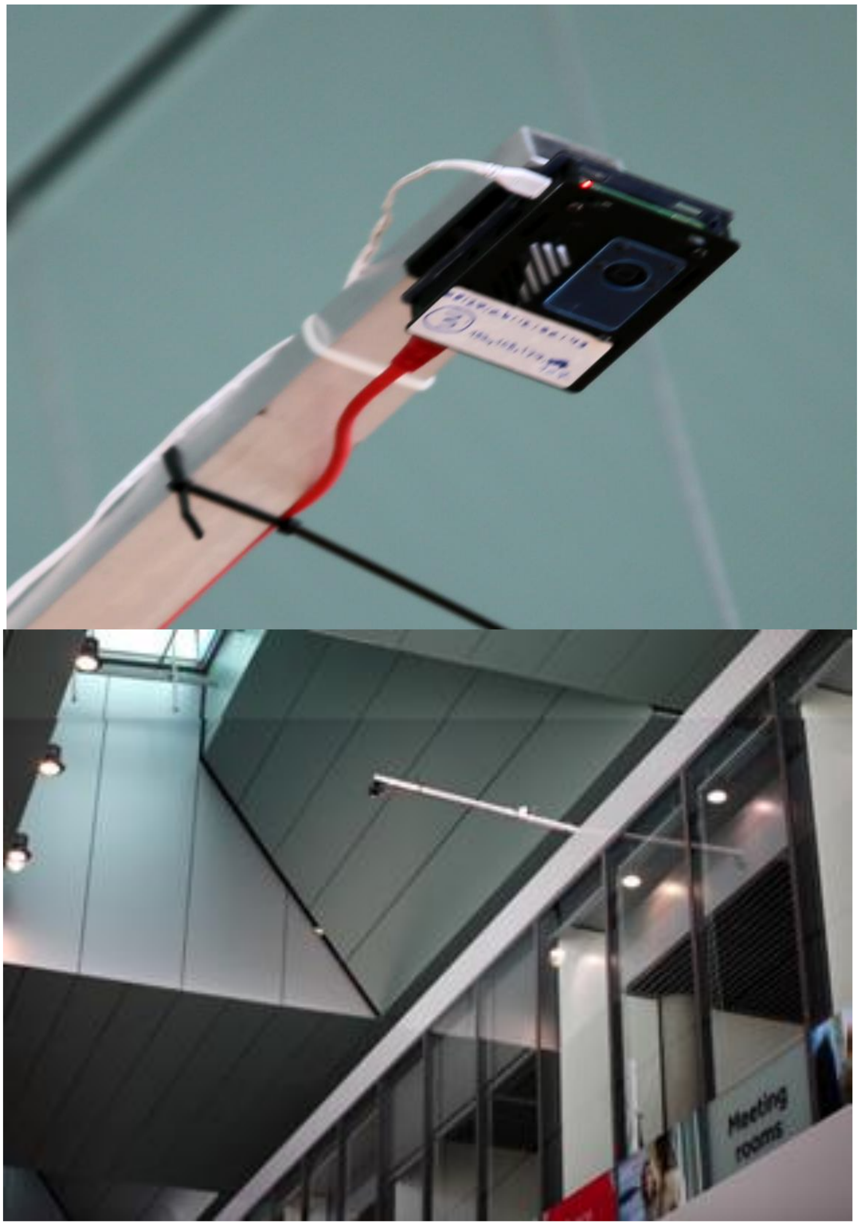

Figure 10 Visual Sensors Installation At Luxembourg Airport

TravelDoc

TravelDoc is a bespoke software system that verifies passengers' international travel documentation, including visa requirements.

Developed in-house by FLYSEC partner ICTS, TravelDoc quickly and efficiently checks documentation against a variety of travel restrictions imposed by the authorities in the transit or destination country. An online Travel Document Rule Library (APP or Web) that displays each country's immigration, health and safety, and customs rules is also available.

TravelDoc is a leading automated document check (ADC) solution from ICTS Europe Systems. TravelDoc allows users to quickly and easily check passenger visa requirements for all destinations worldwide. Using a sophisticated and advanced database, TravelDoc returns clear and easy to understand responses to even the most complex of queries.

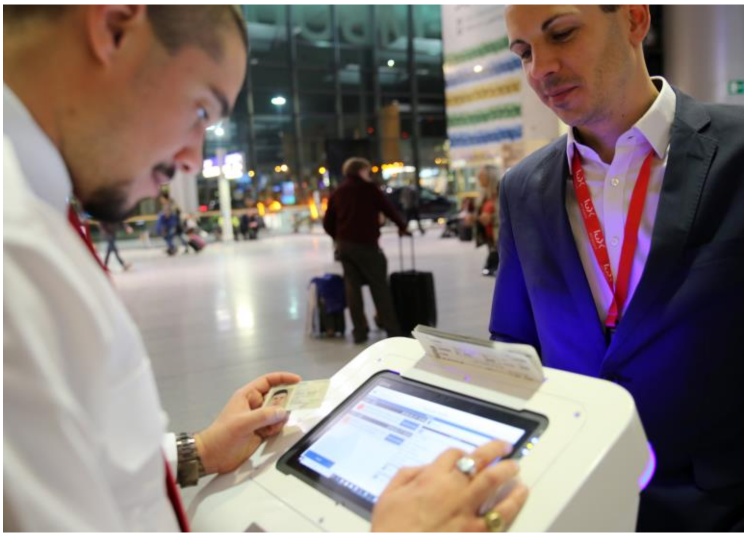

FIGURE 11 TRAVELDOC AT LUXEMBOURG AIRPORT FIELD TEST

The TravelDoc RedApp allows Sabre users to quickly check passengers' itinerary by automatically loading a PNR and submitting it to the TravelDoc service In addition, TravelDoc RedApp users also have access to the TravelDoc Library, an online reference tool that allows users to search, filter and browse the immigration, customs and health requirements for all countries worldwide.

Key functionalities include:

- A clear Go/No Go indication along with clear instructions as to the documents needed
- Real-time online updates of travel rules information

Fines for incorrectly documented passengers can be crippling for an airline. With the total cost of a single violation reaching tens of thousands of dollars, airlines can hardly afford to transport passengers who do not hold the correct documentation for their intended destination.

TravelDoc is a comprehensive travel-documentation verification system that allows airlines to efficiently check whether a passenger possesses the correct documentation for the journey, thus helping airlines eliminate fines and save money. At the same time, the system can provide security-related indications on risk-based indicators such as suspicious ticket- buying practice, PNR or internal mismatch.

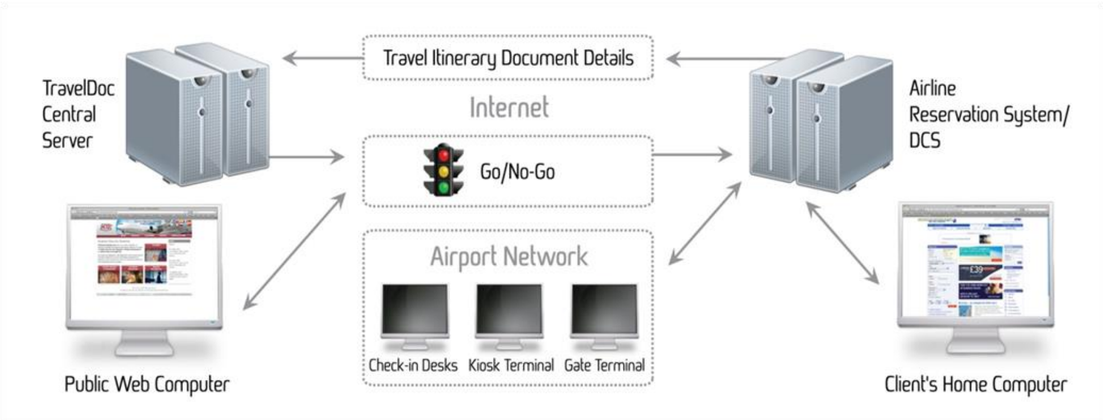

FIGURE 12 TRAVELDOC SYSTEM SET UP

TravelDoc has already been chosen by many leading airlines around the world and is currently being integrated into Amadeus Altea and other DCS platforms. ICTS Europe Systems has recently launched the use of TravelDoc, embedded self-service kiosks within the airports. Such a system was used during t the LuxAirport test.

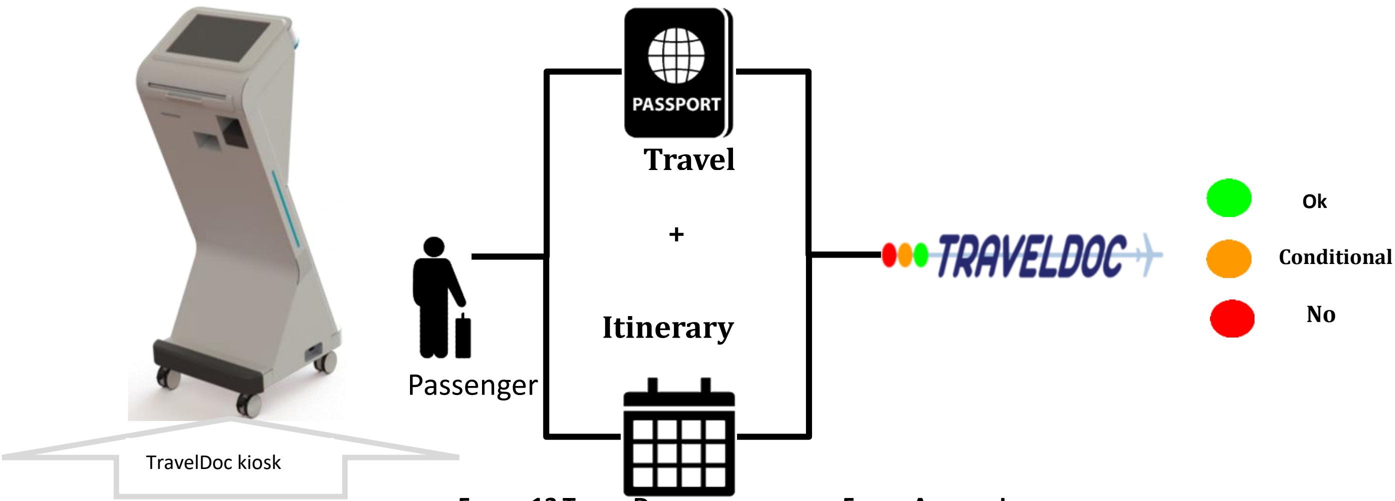

FIGURE 13 TRAVELDOC INSTALLATION AT FINDEL AIRPORT LUXEMBOURG

SmartQ

SmartQ is the system that, based on the TravelDoc kiosk, manages the flow of the check-in process. It enables airport management to acquire detailed real-time information regarding queues and dwelling time landside to airside.

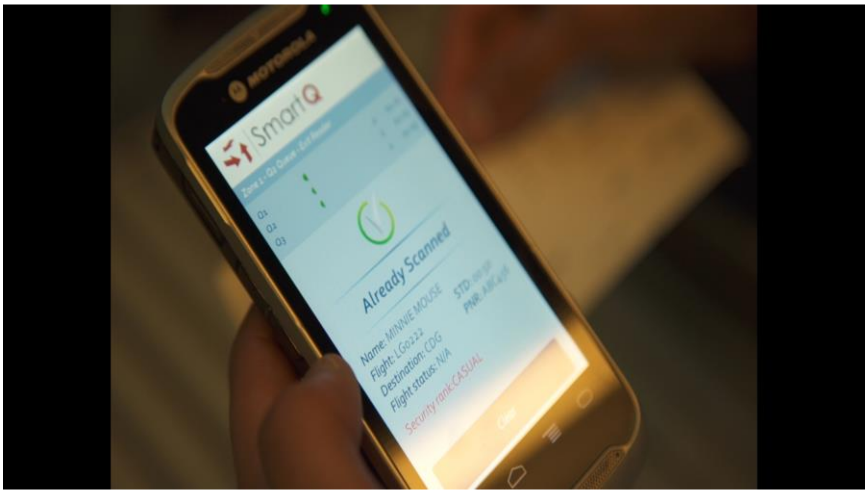

FIGURE 14 SMARTQ AT LUXEMBOURG AIRPORT FIELD TEST

As passengers scan their boarding passes, SmartQ logs the time of their arrival, validates their boarding pass and routes them to a certain queue. The database matches the time and location of each passenger in order to estimate and display accurate queuing times throughout the terminal. Queue times syndicate as to provide a complete picture of terminal operations, delivering detailed, real-time statistics on every journey and queue in the airport.

At its core, SmartQ allows users to read or scan IATA standard boarding passes, including home-printed and mobile phones and provides an auditable record of when a passenger's boarding pass is scanned.

Mobile APP for Passengers

A mobile application installed on passengers' mobile phones. It includes features such as routing and navigation within the terminal, boarding and assisted security walkthrough as well as assisted shopping and time management.

FIGURE 15 PASSENGER MOBILE APP LOGIN

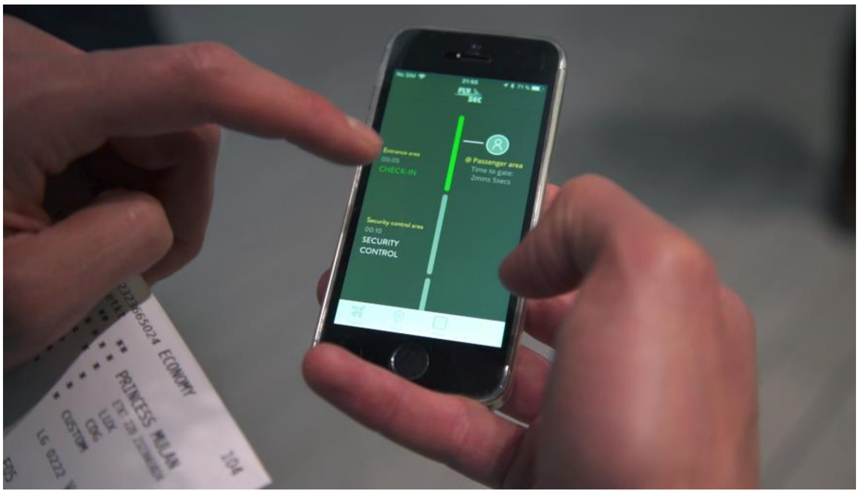

FIGURE 16 PASSENGER MOBILE APP DETAILS

Mobile app for security personnel

A mobile application installed on mobile devices of security personnel has location-based alerts, incident handling capabilities and notifications as well as information on queue monitoring, passenger check-in and behavior screening.

FIGURE 17 SECURITY PERSONNEL APP AT LUXEMBOURG FIELD TEST

RFID carry-on luggage tracking system

The RFID carry-on luggage tracking system serves to monitor the movement of carry-on luggage within the terminal. In the security context, its main significance is in alerting unattended luggage as well as a fast retrieval service in case of loss or unauthorized displacement.

FIGURE 18 RFID SCANNER WITH RFID TAG

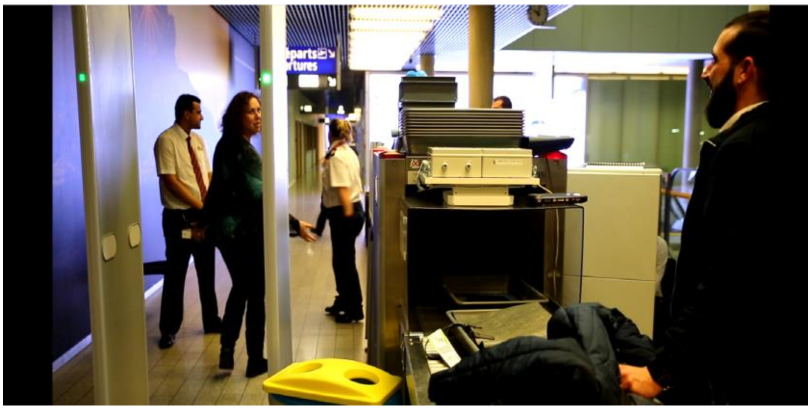

FIGURE 19 RFID READER PLACED WITH SECURITY BELT

FIGURE 20 RFID READER AT DUTY FREE EXIT AT LUXEMBOURG FIELD TEST

A Beacon-based localization system

By communicating with hand-held devices the beacon-based localization system enables location-based passenger services. It also offers location related capabilities to the security fusion algorithms. FLYSEC partner, NCSR "Demokritos", developed this system.

FIGURE 21 IBEACON AT LUXEMBOURG FIELD TEST

Simulation Platform

The FLYSEC simulation platform for airport operational flow and passenger/personnel crowd simulation including realistic 3D visualization of Luxembourg Airport Terminal.

The simulation platform was fully integrated with the C2/Web Portal at Lux-Airport and supported also crowd evacuation scenarios and relevant decision support.

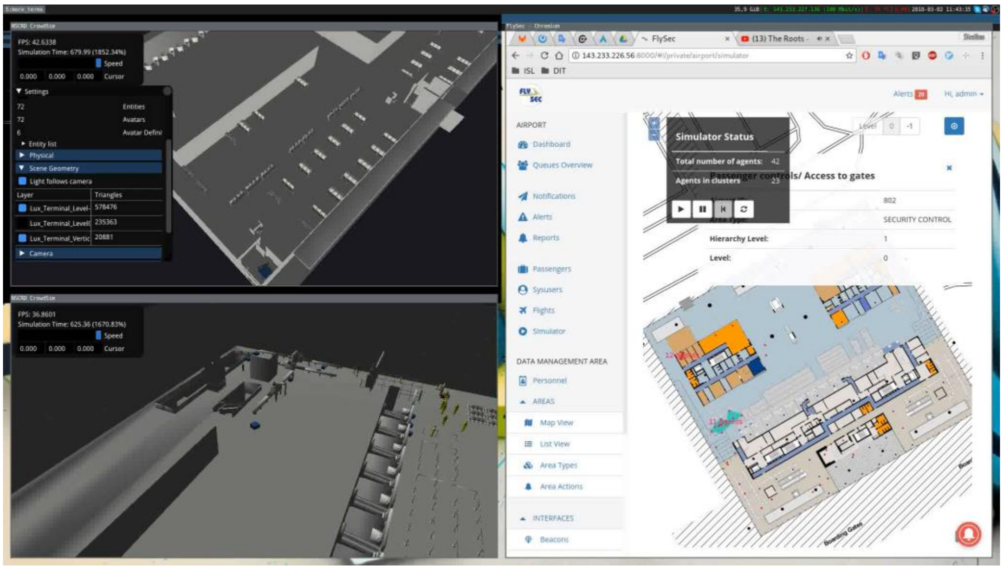

FIGURE 22 PARTIAL SIMULATION WITH WEB C2I PORTAL INTEGRATION

Data Fusion

The FLYSEC Data Fusion and Risk Based security reasoning unit is responsible for the information fusion and the intelligence extraction, the generation of notifications and alerts to the admin control centre, the classification of the passengers into three security classes, and for handling an up-to-date database used for admin control security status monitoring and passengers' routing purposes. All the available information (see Table 1) coming from the TravelDoc Server, the Visual Sensors API, the RFID API, the i-beacons, the mobile app location and the SmartQ Management API consists potential input of the unit. The collected information is integrated and fused for future use or storage and is exploited so as to produce the necessary intelligence.

TABLE 1 SOURCES OF AVAILABLE INFORMATION PROVIDED TO THE DATA FUSION AND RISK BASED UNIT

Sensor/System	Information provided (Abstraction due to classification reasons)
Visual Sensors	Detection of behavioural indicators
Security mobile app	Manual entries from the security personnel updating the behavioral indicators.
i-beacons, RFIDs	Passenger's localization data
SmartQ service	Information related to the passenger security check points, the security exit time as well as the Queue status and the "queue jumper" indicator.
TravelDoc service	Passengers' related data consisting of name, passport number, Documents approval indicator, boarding pass, destination, departure gate PNR indicators
Routing engine	Security check points information

The FLYSEC Data Fusion is a practical integrated implementation deployed in an operational airport. A graphical representation of the seamless fusion throughout all areas of the airport can be found in Figure 23. Although the outside areas are not in scope of FLYSEC, the analytics models and fusion system are easily extensible and sensing technologies highly mobile to support the moving of security perimeter to an outer position.

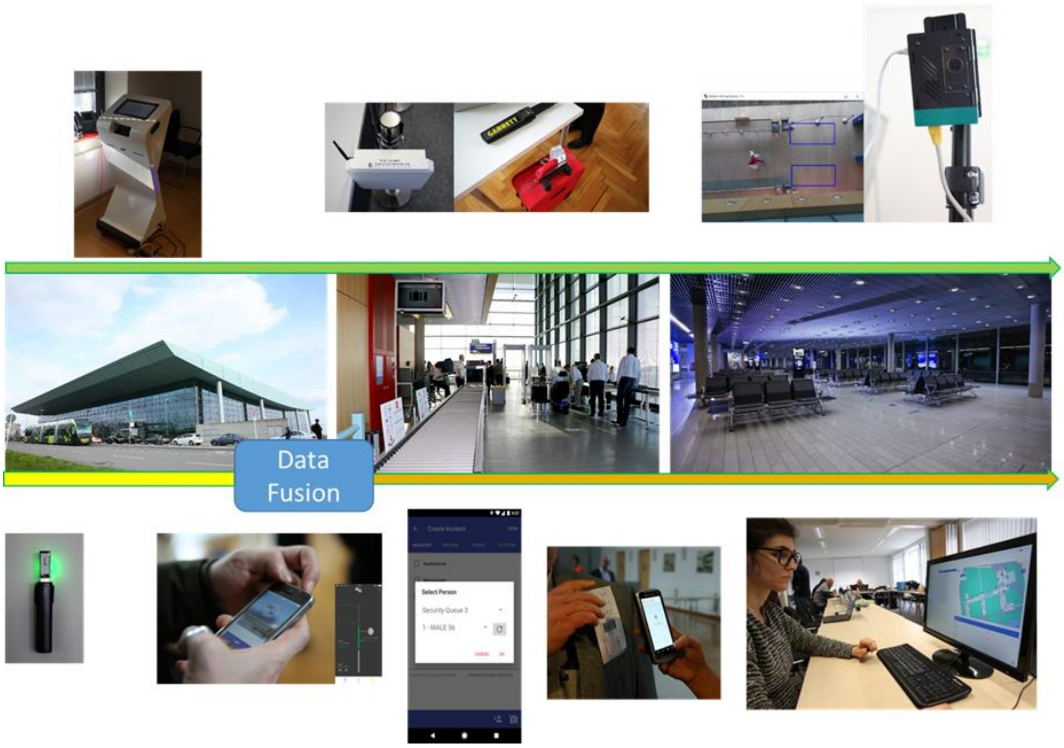

FIGURE 23 – FLYSEC: FROM LANDSIDE TO GATE AIRPORT DATA FUSION

Data Fusion and the seamless intelligent analytics in all areas and phases of the security process in the airport constitutes an important element of the smart security paradigm shift, as presented by the ACI Smart Security recommended model below.

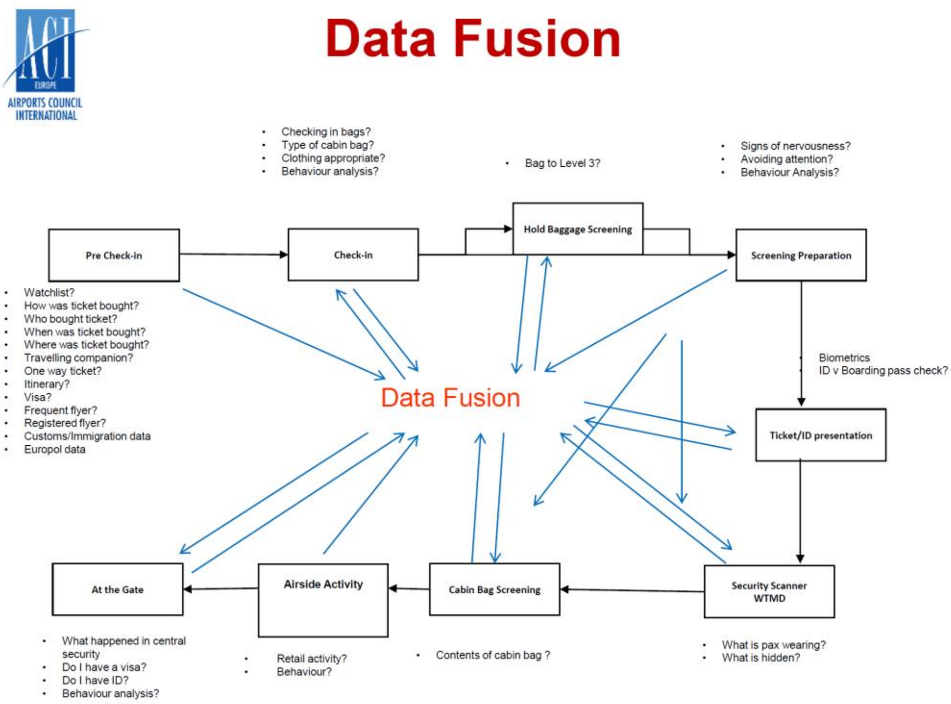

FIGURE 24 – SMART SECURITY DATA FUSION PARADIGM (ACI)

FLYSEC Impact

Evaluation of the FLYSEC system included a large range of engaged stakeholders, including airport higher management and security practitioners, law enforcement agencies, airport commercial/sales, passengers' departments and others.

The FLYSEC project may have closed at the end of July 2018, however its impact and next actions are to follow in the short, mid and long term.

FLYSEC validated an innovative concept and identified opportunities in process optimization and regulatory framework.

FLYSEC provides promising and enabling technical solutions which will also be further developed for a closer to market technology readiness level, including computer vision analytics, AI and machine learning algorithms as well as on the fly identification and screening techniques.

Finally, the alignment between FLYSEC and the IATA/ACI Smart Security programme paved the path for the promotion of FLYSEC into a certified Smart Security implementation.

As the risk-based screening paradigm shift is further adopted and developed in other border modalities and security applications, the FLYSEC project provides the reference validated implementation within the framework of the EU Horizon 2020 and beyond.