WAVECAMM:
A fully integrated People Screening Check-Point

«Every day millions of people all over the world pass through security checkpoints:
It is time for new security culture that exploits technology »
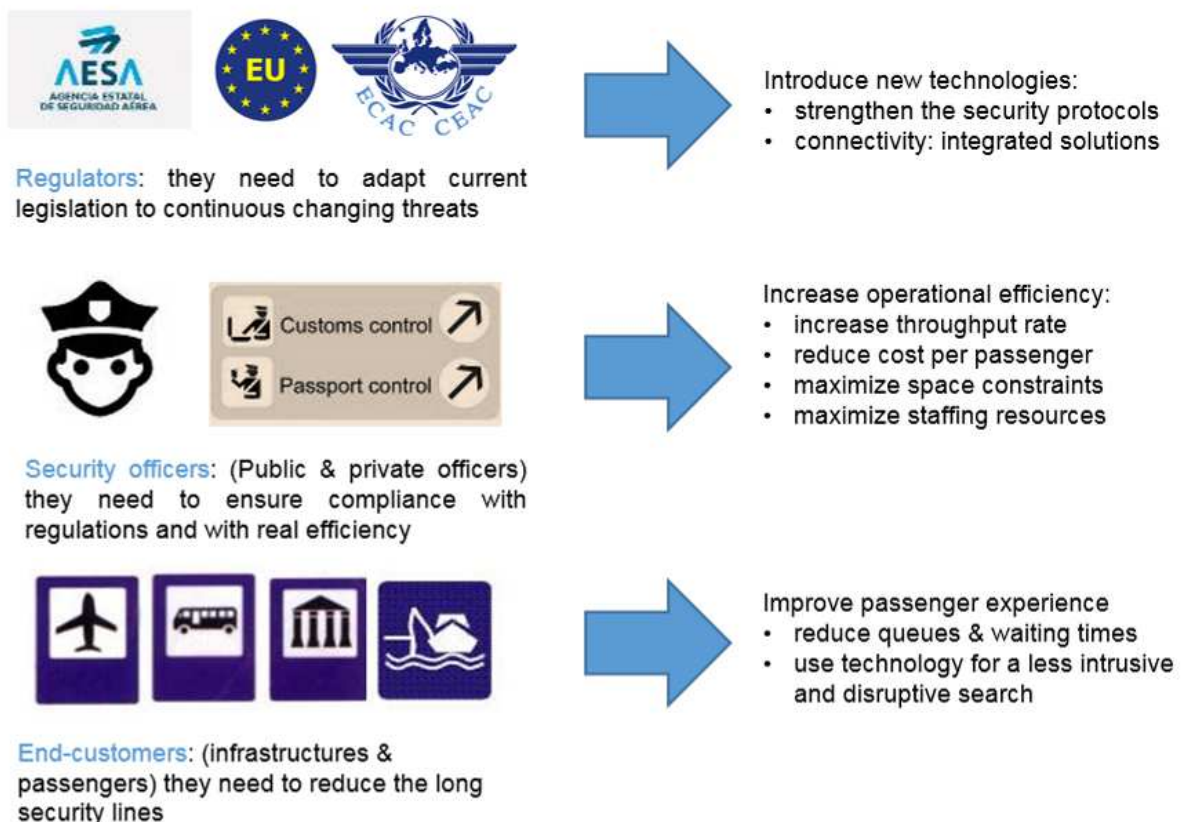
1. Excellence

1.1 Objectives

In today's EU scenario there are many security layers to protect not only infrastructures and citizens against the challenging threats, but also to defend the European society values. Intelligence services, security officers surveillance, regular patrols, canine units, and technical equipment are only some of the most widely known solutions. In the technical equipment there is a wide catalogue of different solutions for different threats and enviroments such as X-ray scanners for post/baggage screening, explosive trace detector (ETDS), Walk Trough Metal Detector (WTMD) or Security Scanners "SS" (X-ray backskater, Active or Passive type).

> **WAVECAMM focus the efforts in the "People Screening Solutions"**
> **to detect concealed objects by people.**

The nature of the threats is nowdays evolving and hybrid. There are: (1) conventional and unconventional threats, military and non-military, covert and overt actions. (2) wide range of materials: metals, liquids, powders, plastics, suicidal vests, and potentially anything may be an offensive weapon or object of illegal traficking, and (3) broad type of scenarios with different requeriments in flow-rates and risk-level (airport and other infrastructures, civil events like sport or cultural events, Custom and border check-points…)

WAVECAMM aims to **increase the security level in all EU infrastructures by integrating disruptives technologies** in one single **People Screening check-point**. WAVECAMM allows security officers to make a **quick and effective** people screening process with appropiated balance between risk-levels and flow-rates (person/hour)

Due to the nature of the security sector (confidental and restricted information) the applicant SME, has been already working very close with all stakeholders involved in this topic during last years to know and understand their exact needs and requirements, in particular, the following:

Regulators: they need to adapt current legislation to continuous changing threats

Introduce new technologies:
- strengthen the security protocols
- connectivity: integrated solutions

Security officers: (Public & private officers) they need to ensure compliance with regulations and with real efficiency

Increase operational efficiency:
- increase throughput rate
- reduce cost per passenger
- maximize space constraints
- maximize staffing resources

End-customers: (infrastructures & passengers) they need to reduce the long security lines

Improve passenger experience:
- reduce queues & waiting times
- use technology for a less intrusive and disruptive search

WAVECAMM aims to be a fully integrated People Screening Check-Point to detect any type of threat: a disruptive and hybrid system which integrates different technologies to detect all threats and equipped with Risk Level Configuration to balance security level (High-medium-low risk) and flow rates.

The applicant SME has been working with different Research Centers and Universities as external supplier for different components (<2010). During 2010-2014 period, as partner in different research & development tasks in National and EU R+D projects. Since 2010, with the initial development of the WAVECAMM project, the SME has signed agreements to guarantee the "freedom-to-operate" in order to develop the different elements needed for WAVECAMM operation.
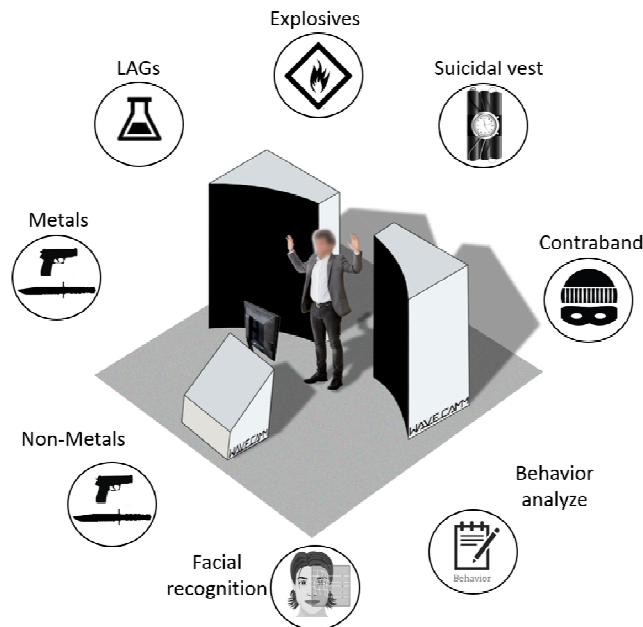

Figure 1: WAVECAMM millimeter Wave Camera "intrinsecally safe"

The actual alternatives for People Screening are
- the slow and invasive manual pathdowns conducted by the Security Officers
- the Walk-Trough-Metal-Detectors (WTMD) that detect only metalls (aprox. 1K-10K €)
- the Active security scanners (Active-SS) recently deployed in EU (2014) which are very expensive to be deployed in all EU infrastructures (aprox. 200K €) and have a very high False Alarm Rate (reported >60% Germany, 2014)
- the actual Passive security scanners (Passive-SS) are unable to detect in arms or legs and and still have a very high price (aprox. 150K €). Moreover, their screening process is not easy and straighfoward and some of them cannot screen the complete body of the passenger
- There is no alternative to automatically analyze the behaviour (BA Behaviour Analyze) of the people when arriving to an infrastructure nor to the automatic Facial Recognition (FC) with integration with oficial data-base of persons: not only Europol lists, but also, for instance, workers of the Nuclear plants, executives of the air-companies, diplomatic staff or VIPs.

WAVECAMM integrates all technologies detailed before in a single checkpoint: all sensors cooperate to offer efficient operation, high reliability and attractive price. With no alternative in the market to WAVECAMM and with a target price of 100K € a great business opportunity arise. Moreover **WAVECAMM provides following benefits**

- for Regulators: no privacy nor health issues / trazability of person of interest / effective threat detection: Our TRL-5 offers 85% detection 5% FAR as per external Test at Granada University (July 2015: 5000 screenings / 40 different people / 15 threats / 12 body locations). Similarly, our TRL-7 offers 95% detection and 4% FAR (February 2016).
- for Security Officers: easy to use / efective & efficient system / easy configurable to balance between risk-level and required flow-rate (300 pax/h in our TRL-7, expected 700 pax/h with the SMEInst-2) /

low FAR / information about exact threat location faciliting alarm clearance / risk-level configurable for different gates /risk-level evaluation of the passenger in real-time / a fully integrated tool.

- for Infrastructures: warranty security while keeping smooth flood of the passengers at the check-point / synchronization with personal-data (personal ID-card, boarding pass…) detecting metals (guns & knives), explosives (powder, plastics), LAGs (liquids and gels), prevent terrorist attack (including Front-House attack), smuggling, contraband and any type of illegal traficking / synchronization with "intelligent buildings" to open/close gates to reduce consequences of the eventual explosion / flexible solution: possibility of covert ("invisible"-behind the wall) or overt (collaborative-similar to existing Active-SS) inspection
- for Citizens: non-invasive technology / 100% respect health / 100% respect privacy / possibility to reduce screening time by giving personal information in advance (boarding pass) / easy and straighforward process
- for EC Authorities: keeping the EU society standars while increasing the global security / detect metallic and non-metallic threats / avoid smuggling and contraband / attractive price / safe technology to be widely accepted and deployed / do not create a new bottle neck (to prevent Front-House attack for instance)

1.3   Concept and methodology

Europe continuously needs to increase the security standards. The changing threats (new explosives, smuggling and illegal trafficking) and the challenging new terrorist organizations are a very real threat to the EU society (as seen in tragic events in Paris and Brussels). At the same time, we need to guarantee not only the privacy of the persons and their data while being screened, but also that all legal issues relating the health are full fitted. Finally, we need to create new security equipment that allows infrastructures to remain open and welcoming for all EU citizens and its visitors.

Taking all that in consideration and as per the applicant SME "Business Plan 2010-2015", the following activities and milestones has been achieved:

- **"SME-Promotion 2010-2015"**: The applicant SME has been working closely with all stakeholders during 2010-2015 period: Regulators, end-user, security officers, prescriptors, Research centres…
- **"Product development"**: Our TRL-5 prototype was succesfully tested in a Proof-of-Concept in July 2015 at external entity with 5.000 screenings.Our TRL-7 was tested in March-2016
- **"SME- Promotion 2016"**: The CEO of the company, Mr. Francis Bazus, was invited last Feb-2016 to the Technical Task Force of the ECAC to explain the advantages of WAVECAMM.
- **"Product development" & "Marketing activities":** Our TRL-7 unit was presented to spanish stake-holders during the 3 days conferences "New technological challenges for the Infrastructure Security" (http://www.itainnova.es/actualidad/eventos/nuevos-retos-tecnologicos-para-la-seguridad-de-las-infraestructuras) in March-2016 **co-organized by the applicant SME** and with the active participation, among others, of the following key stakeholders:

AESA http://www.seguridadaerea.gob.es/	REGULATOR: Spanish National Authority for Air Security. Member of the ECAC organization
AENA http://www.aena.es/	INFRASTRUCTURE: In english, "Spanish Airports and Air Navegation": the biggest airport operator in the world (nr. of airports)
INTA http://www.inta.es/	REGULATOR: Technologic Centre in charge of certification of security equipment under ECAC rules (official ECAC Test centre).
GOBIERNO ARAGON http://www.aragon.es	INFRASTRUCTURE: Government of the Aragon Autonomy (Spain)
PROSEGUR http://www.prosegur.es/esp/	PRIVATE SECURITY OFFICERS: One of the biggest private security companies in Spain, with security officers in airports, government buildings, sport stadiums…
SPANISH ARMY http://www.ejercito.mde.es/	PUBLIC SECURITY OFFICERS: Spanish army
GRANADA UNIVERSITY http://decsai.ugr.es/~rms	STRATEGIC PARTNER: Informatic & Telecommunications dept.: Experts in image processing and algorithm development for [mm] images

Our Actual Status of development **needs now to demonstrate the technology** in a real environment to reach the **full commercialization phase**. This requires further technological development and demo phases

involving end users and potential clients to be carried out during the SMEInst-2 project. WAVECAMM needs two years to be ready for full commercialization phase, following the end of SMEInst2 by 2018. The methodology consists in:

- Hardware optimization: The actual main limitation of WAVECAMM is its foot-print: Optic and gear-box optimization (WP#1) will be needed to reduce considerably the size and the foot-print. Actual scanning time is 2,7 seconds: after optimization 1sec only will be needed
- Software optimization: Actual software needs 200 milliseconds to analyse de passenger image, but further development is needed to optimize the detection rates with the disruptive hybrid sensors (passive and active) (WP#2)
- Pilot-Test in real end-users infrastructures: in order to demonstrate the WAVECAMM capabilities, the SME has agreements with two key-customers for the installation of WAVECAMM in demo modus (Airport & government building, WP#3)
- ECAC Certification: Although all ECAC members were very interested in the WAVECAMM presentation of last Feb-2016, is difficult to get their real confidence without the ECAC certification. With the SMEInst-2 the applicant SME will get the funds to obtain the ECAC certification during the SMEInst-2 project. The cost of the ECAC Certification is round 100K € (WP#4)
- Intense marketing activities in conjunction with "SME-Promotion" actions, with the final goal of creating a WAVECAMM worldwide distribution channel and commercialization net. (WP#5)

	Advantages	Disadvantages	WAVECAMM
MANUAL PATHDOWN Manual search in complete body by security officer	Effective / Detect all type of threads / 0% False Alarm rate	Inefficient / slow / **Invasive** / Not easy accepted by all passengers (privacy/invasive)	**Stand-off = non-invasive** / **Use of safe mm-waves = generally accepted** / **All type of sensors= all type of threats in all locations**
WTMD Walk Trough Metal Detector	Efficient / Fast / Easy & straightforward process / Small foot-print	Detect **only metals**	**Use of mirror = easy process (1 single position 1 sec) and fast**
SS X-ray Security Scanners with X-radiation	Effective	Slow / **Forbidden** due to not respect health / **Forbidden** cannot operate with automatic detection software***nude images***	**Effective** / **Detect all type of threads** / **Non-invasive** / **Efficient & Fast** / **Easy & straightforward process** / **Capacity to screen 100% body** / **FAR <10%**
SS-active Security Scanners with [mm]-radiation	Detect Metallic and non-metallic threads / Easy & straightforward process / Foot-print / size / Capacity to screen 100% body	Automatic Thread detection software is mandatory / **False alarm rate 60%** / Acceptance by all passengers (pregnated women, children) due to active emission	**Foot-print / Size** / **Full fit all EC regulations (ECAC)**
SS-passive Security Scanners with no radiation	Detect Metallic and non-metallic threads / False alarm < 5% / No nude images	Low detection in arms& legs / Low detection small threads / Not easy-process (4 positions)	**H2020 SMEInst-2**

Figure 2: Alternative solutions for People Screening: Advantages and disadvantages

1.4 Ambition

The market references as eventual alternative solutions are the manual pathdown conducted by security officers, the WTMD and the existing Security Scanners (SS). WAVECAMM will integrate all sensors in one single check-point. WAVECAMM has the following main components:
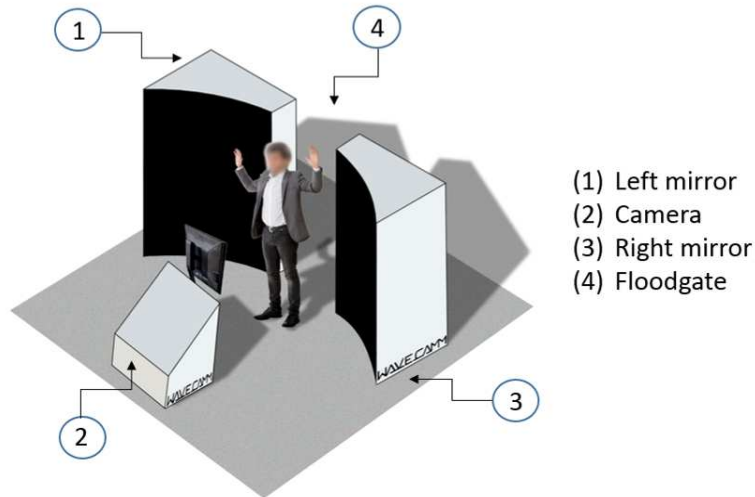
Figure 3: WAVECAMM main elements

(1) Left mirror
(2) Camera
(3) Right mirror
(4) Floodgate

Disruptive opto-scanner

PATENTED

Patent nr.: P201530828
"Optical scanning system for frequencies between 10 GHz and 1000 GHz". Invention submitted to the Spanish Patent Office in 2015

THE CAMERA: Stand-off screening: "**Millimetric Wave Camera**"

By using our very own **optomechanical scanner (patented)** we can screen **full body of the passenger** and detect any type of threat. It is knowed as "Stand-off" screening. It can operate in "Real-time" or in "1 second 1 photo" mode. The use of the optomechanical scanner reduce the number of passive & active sensors, and final price is lower compared with other existing solutions with no opto-scanner

Inside the camera, there is a complex gearbox that move reflectors in order to capture radiation at submillimeter wave frequencies and generate the images.
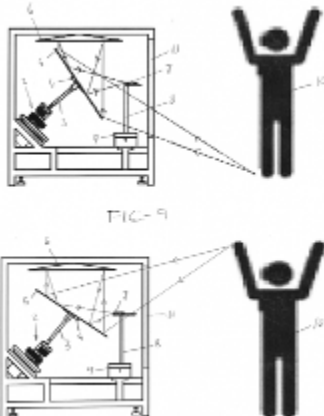
It is the only system with hybrid technology: Passive sensors to screen quickly trought the clothes & Active sensors to look for small objects in legs & arms locations. The screening time will be 1 second with the arms-up (to avoid threats in armpit) at a distance of 1m from the Camera. Non-invasive nor closed-cabinet operation. These disruptive hybrid technology includes:

1) Passive millimeter wave SENSORs, to detect metals, explosives, drugs, liquids, powders, gels, etc.. only using the natural radiated emission by the passenger body: It doesn't emit any type of radiation to the passenger (emission free) and do not create any interference to any other system / not beeing afected by interference caused by other systems located nearby (X-ray). Passive sensor can screen trought the clothes

2) Active millimeter wave SENSORS. Further development is needed to make the integration with the Passive sensors by means of the SMEInst-2 funds. Active sensor uses safe mm-waves to detect plastic threats in arms&legs position (not mm-ratiation in full body, but only arms&legs)

The first TRL-5 prototype size was 2x2x2 m. The actual TRL-7 system is 1.2x0.7x1.3 m. It has been tested during last 16 months in different enviroments to evaluate the real lifetime of all elements.

With SMEInst-2 considerable size reduction is expected (0.5x0.5x0.5 m) by using mechanical and optic optimization software. Actual equipment offers 1 frame per 2sec. With the SMEInst-2 funds further development is needed to screen at least at 2 frame/sec rate

Passive

Non-invasive photos
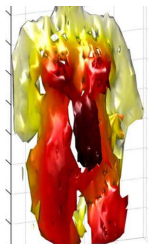
Active

THE ALGORITHMs: AUTOMATIC THREAT DETECTION Software

As per EC regulations all SS needs to operate with Automatic Threat Detection Software (ATDS) to guarranty the privacy of the passengers: there is no need of an operator to interpretate the image. WAVECAMM ATDS was sucessfully tested in July-2015 (TRL-5) and March-2016 (TRL-7). Altough there is debate in the sector about the Human Factor of the security officers and the importance of interacting with the passenger with more than "yes-no" communication.

All collected data from all sensors are analyzed by our **own algorithms** and as a result we get useful information to be sent to the security officer by means of an interface in which the exact threat location is represented in a generic silhouette.
(More info: http://www.eurasip.org/Proceedings/Eusipco/Eusipco2015/papers/1570103163.pdf)

With the SMEInst-2 further development is expected to improve even more the detection capabilities, and integration & optimization with other hardware platforms, like smart-phones or security-platform of end-user (actual solution has been integrated in a tablet for Show/Demo reassons).

Disruptive MIRROR

PATENTED: Patent nr. 201531628: « Method to increase the speed of inspection, incorporation of autonomous operation and behavior anomaly detection, in the imaging devices based in millimeter wave and method to put it in practice". Invention submitted to the Spanish Patent Office in 2015

CONVEX MIRROR: FULL BODY SCREENING

WAVECAMM includes a **reflection convex MIRROR** that allows the Camera to screen the back part of the passenger body (**patented**). The mirror system has been evaluated recentlty (TRL-7, March-2016) and the system can now offer same detection capabilities in the front or in the back part of the passenger body (average detection 90%+ **no hidden parts** *except body cavities*)

The camera receives **3 photos**: one frontal with 1cm resolution + one left-side 1cm resolution + one right-side 1 cm resolution

Flexible & non-invasive for passenger (not closed-cabinet operation)

FLOOD-GATE

Automatic floodgate to open/close the door after each passenger evaluation. The installation can be customized to final-customer exact needs. Even if it is not a very technological component, it is important to offer the exact risk-level required in conjunction with the conditions of operation (CONOPS) like the need to divest or not (coins, keys, coats, boots…), or the need of a valid identification (biometrical, ID card…) Actual solution includes automatic barrier synchronized with the result of previous screening (to send the passenger to "further evaluation desk" (Hand baggage, ETDS, passport control…)

The Flood-Gate hiddes inside a standard electromagnetic detector to be offline in case of low-risk situations (no need to divest) or connected in case of high-risk enviorements (need to divest every single small item)

The Flood-gate can be equiped with keblar to reduce eventual damages in case of a bomb-attack: The structure could be designed to stop the

explosive-wave and encapsule it as far as possible.

RISK LEVEL

All electric&electronic elements are closed in a electronic-board hidden inside the camera. RISK LEVEL is own software that easily modify sensivility of all sensors in order **to balance between max threat size and flood-rates**

The user can set the desired risk level: need to divest small objects or not (min. threat size required), need to divest coats and shoes, max. body temperature (quarantine advise), open/close floodgate, random inspections, etc..The WAVECAMM stand off screenning is therefore **configurable to be more or less exhaustive.**

Actual configuration needs further development for the fully integration of FR and BA with the result of the stand-off screening:

FACIAL RECOGNITION (FR), the integrated high-resolution video camera recognizes the face of the passengers and compares it with oficial data-base, to lock/unlock the Flood-gate to green/suspicious passengers. It can also be used to detect "person of interest", "frequent flyer", employees or diplomatic staff.

BEHAVIOUR ANALYZE (BA), by screening the passenger movements and analyzing them, WAVECAMM can detect unusual/strange actions, micro-expression like fear, nervous, stress, strange movements, high-body-temperature,… that may indicate illness/**fieber, willing-to-attack attidute, illegal trafficking**…

A subtask will be focus on cyber security to guarantee that WAVECAMM is inmune to a cyber attack.
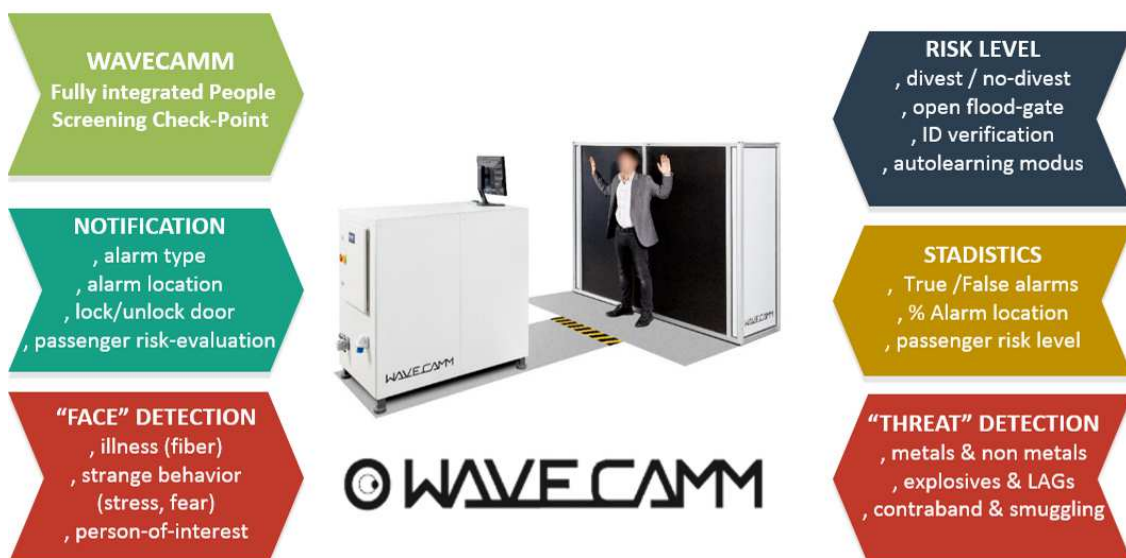

Figure 4: WAVECAMM main features

"Asking a Security Device to stop a terrorist attack is like asking an Olympic team to win a gold medal: it is a goal that they will all agree with, but achieving it requires many things that they have no control over"

WAVECAMM will provide (1) exact threat location (2) stakeholders interaction and notifications, and (3) an increased security at the check-point. The competitive advantages are

- It is the only fully integrated solution to detect all types of threats with hybrid active and passive technology, behaviour analyse and facial recognition software integration.
- No health nor privacy issues (ATD Software + safe mm-waves)
- Designed BY and FOR all stakeholders: regulators, private and official security officers, infrastructures responsibles and EC Authorities
- Designed to be very robust and easy deployable and with a special care in the esthetic design.
- Stand-off screening, cover or overt operation
- Value for money: there is no alternative for such a complete and automatic people screening solution (100K € target price)

Since the very beginning of the development of WAVECAMM, the applicant SME has been working closely with all stakeholders in order to solve all legal and technical issues. Our actual TRL-7 system has demonstrated capabilities and some stakeholders **are willing to pay with the actual results**.

In order to be in the commercialization step by the end of the project (2018) we need further fundings to re-design actual system and to go further in the development and integration of all sensors.

Moreover, the commercialization strategy needs to be developed during the SMEInst-2 period. We need to make pilot test (TRL-9) in different potential end-customer installations with customized final solutions. Finally, we need to get the official ECAC Certification to be able to install WAVECAMM at the EU airports. **It is important to notice that an eventual attack to EU may accelerate the sales in other private or civil installations (Nuclear plants, Bus & Train stations, corporate buildings…) where no ECAC certification is needed**.

WAVECAMM cost structure

The applicant SME has experience as manufacturer of many different types of equipment since 1960. Since 2010 the applicant SME has been manufacturing opto-scanning devices and Terahertz and millimetric equipment and components (receptors, arrays, antennas, anechoic chambers…).

Two different configurations are available, depending on the infrastructure requirements: The "HIGH RISK" configuration, with the most restrictive operation conditions, and the "LOW RISK" configuration, valid for many infrastructures.

SENSOR	Screening Time	Divesture	Complete body detection	Technology	Guns & Knives (metalls)	Explosives	Liquids	Plastics	Others	HIGH Risk	LOW Risk
Metal detector	real time	Yes	Yes	Electromagnetic field	key, coins…	No	No	No	No	✓	✓
Behavior An.	real time	No	Yes	Image video	No	No	No	No	Yes	✓	✓
Facial Recog.	real time	No	Yes	Image video	No	No	No	No	Yes	✓	✓
PASSIVE	real time	No	except legs & arms	PMMW 94 GHz receptor	50 cm	suicidal vest	suicidal vest	No	Yes	✓	✓
PASSIVE	1 sec stop	No	Except below knee	PMMW 94 GHz receptor	12 cm	200 gr	150 ml	20 cm	Yes	✓	✓
ACTIVE	1 sec stop	Yes	Yes	300GHz transceiver	8cm	200 gr	150 ml	10 cm	Yes	✓	

Figure 5: Configuration tabelle for High / Low risk enviroments

Based on the previous prototype phase the following cost structure can apply. All previous costs has been paid 100% with the applicant SME own resources.

Component	R+D & paid costs 2012-2015	Actual element costs (TRL-7) 2016	Target costs (TRL-9)2018	Target costs 2020	Target costs 2025
Camera	86.400 €	16.000 €	15.000 €	12.000 €	10.000 €
Passive receptors	22.800 €	15.000 €	12.000 €	10.000 €	8.000 €
Active transceivers	-	50.000 €	40.000 €	35.000 €	25.000 €
Algorithm	48.500 €	2.000 €	2.000 €	2.000 €	2.000 €
Flood Gate & Mirror	16.500 €	4.000 €	5.000 €	4.000 €	3.000 €
Risk Level App	12.800 €	4.000 €	2.000 €	2.000 €	1.000 €
Warranty & installation	-	-	1.200 €	1.000 €	1.000 €
COST "High Risk" config.		91.000 €	77.200 €	**66.000 €**	**50.000 €**
COST "Low Risk" config.		41.000 €	37.200 €	**31.000 €**	**25.000 €**

Price strategy: the final cost of WAVECAMM will decrease with manufacturing optimization and therefore a scalable Price List can be offered. Updates of continuous improved algorithms and warranty services can also be included as extra incomes.

Nr. Units	WAVECAMM High Risk	WAVECAMM Low Risk	Algorithm update	Warranty & service
1	100.000 €	50.000 €	3.000 €/year	3.000 €/year
10	90.000 €	45.000 €	2.500 €/year	2.000 €/year
1000	85.000 €	42.500 €	1.500 €/year	1.000 €/year

The Sales Pitch

It is difficult to evaluate costs when we are talking about security. The measures to avoid terrorist attacks or illegal trafficking cannot be evaluated with economical ratios only. It is not (only) a question of money. Of course, any new technology costs, but... what is the cost of a threat detection failure? Just some numbers: 24 billion € in illicit drugs / 1.82 illegal border crossing in EU / 5 Billion € Bruxelles attack (Zaventem airport and Metro). In any case, the sales pitch of WAVECAMM has been developed under stakeholders premises and it is the only fully integrated people screening solution.

At the same time, it is difficult to calculate in € the profitability of any security equipment. Nevertheless if we think that one WTMD can cost from 1K € (low cost units) to 10K€ (standard deployed WTMD at EU airports) and one Active-SS is round 200K €, our system, with a target price of 100K €, seems to be in a privileged position. With our very own WAVECAMM multi-layer security system the EC Authorities and the Security Officers involved in the people screening process may increase their profitability by:

- by <u>decreasing their operation costs</u>: WAVECAMM offers autonomous and semi-autonomous operation modes to reduce the man-power needed at the check-point, effective alarm clearence to reduce the manual pathdowns time consumption and eventual reduction in insurance costs. Moreover WAVECAMM target costs (100K €) is aprox. 50% of recently deployed Active-SS
- by avoiding attacks (inclugind Front-Haus), contraband & smuggling (drugs, medic pills, money..)
- by <u>optimizing passengers access</u>: risk level configuration (open doors to "green-passengers"), no need to divest in low-risk ambience (the passive sensor is able to screen trough the clothes)
- optimize information: notify direclty to authorities (police if contraband/ hospital in case of an high-risk fieber detected), real-time monitoring
- <u>valuable and trusted information</u>: low FAR and real-time data of the passenger
- prevent losses and damages: synchronization with CCTV to follow eventual person of interest, open/close gates to prevent eventual damages/losses
- easy deployable solution with easy risk-level configuration: operation overt-collaborative (similar to exisiting WTMD, real-time screening); overt-collaborative (similar to existing Active-SS, 1sec screening); covert-invisible (hidden behind the wall- real-time screening)

WAVECAMM innovative solution:

Able to screen complete body, thanks to our **patented opto-mechanical** scan system
Stand-off **Passive & Active hybrid screening**
Effective to detect **metallic and non-metallic threads**
Effective to detect strange behaviour and to recognize risk-level passengers
Validated own advanced algorithms (Automatic Threat Detection Software ATDS)
False Alarm rate 5% and detection 90%
Efficient & Fast
Easy & straightforward process (one single position) thanks to our **patented "Mirror system"**
Covert or overt operation configuration. Invisible or collaborative inspection
Small footprint (target size with SMEInst-2 funds: "similar to existing Active-SS")
Respect health & Respect privacy (ATD Software) + Autonomous operation (ATD Software)
Very robust & easy deployable
Very competitive price
Operational capacity demonstrated (February and March 2016)
Complies EU regulations (except ECAC certification)

Existing solutions Vs WAVECAMM innovative solution evaluation:

Mark Technology Price	Health	Privacy	time <1sec	FAR <20%	ATD	easy process	Threat size	main technology limitation
Manual Pathdown	✓	☒	☒	✓	☒	☒	all	invasive
WTMD	✓	✓	✓	✓	☒	✓	5 mm	only metals
WAVECAMM mm-hybrid 90K €	✓	✓	✓	✓	✓	✓	**5 mm**	**new product**
Wavescann Passive 85K €	✓	✓	✓	☒	☒	☒	100 mm	not full body
T800 Passive 150K €	✓	✓	✓	☒	✓	☒	30 mm	only big threats
Millivision 350 Passive 200K €	✓	✓	✓	☒	☒	☒	40 mm	not easy process
Rapiscan X-active 130K €	☒	☒	☒	☒	☒	☒	Forbidden	X-ray
Provision mm-active 180K €	✓	✓	✓	☒	✓	✓	2 mm	FAR >50%
QPS (R&S) mm-active 180K €	✓	✓	☒	☒	✓	✓	Unknown	FAR

Figure 6: Existing solutions evaluation.

2.   Impact

2.1   Expected Impacts

a) Users/Market

WAVECAMM targets to critical EU infrastructures. No other fully integrated solution offers similar capabilities to screen all type of threats in an easy, fast, and straightforward people checkpoint. There is a wide type of scenarios where WAVECAMM can be a useful solution: airports (airside and landside), train and bus stations, transport hubs, ports, Malls, VIP residences and VIP entrances, football stadiums or other high populated sport scenarios, fashion galas, cinema, theatres and other cultural events, international and

politic summits, government and corporate buildings, Custom and border check points, employees screening to avoid loss prevention, diplomatic staff, etc…

In a first step, the efforts of the applicant SME will focus in Europe, for economic reasons and due to the "Reasonable-growth" strategy of the SME. However, US, as second step, and Russia, Africa and Asia later, are huge future potential markets to be unlocked beyond 2020 period. **The global overview below represents the "worst case scenario"**. The strategy of the SME to develop any new market can be summarized as "*Expect the worst numbers, but be prepared for the best ones*". "Best case scenario" can increase the accessible markets (see Figure 7) considerably.
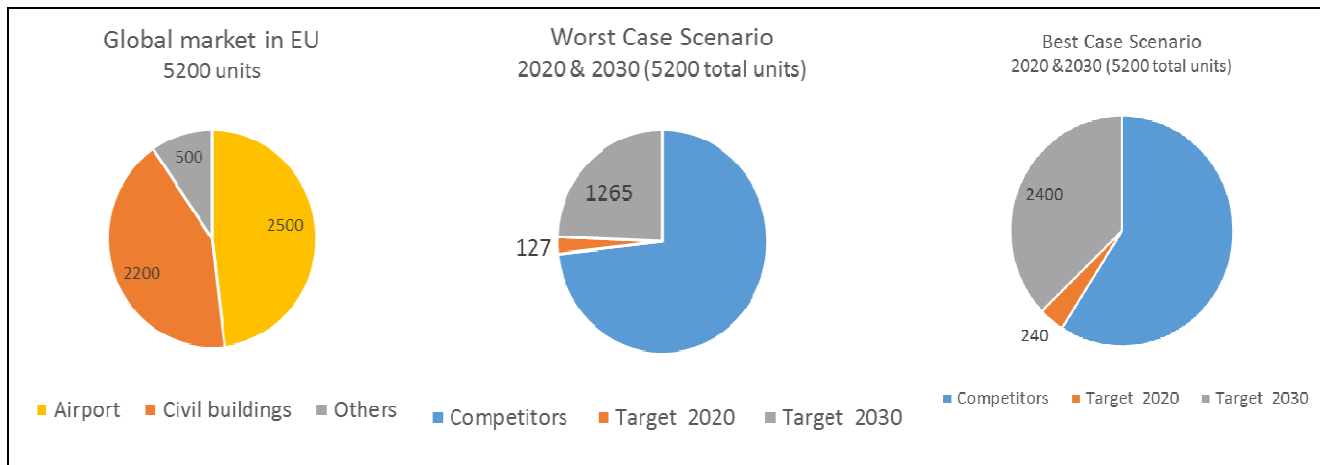

Figure 7: Global overview (data only in EU): Global market & Pessimistic & Optimistic scenarios

The market segmentation has been divided into three key-customers types:

1) **Airports: [High-Risk environments] "Core market"**: The WAVECAMM "High-Risk" configuration has been designed for infrastructures with high volume of people, high flow-rate demand and maximal risk-level. Typically is the airport use.

2) **Civil buildings: with Low/Medium risk-level: "Market to unlock"**: WAVECAMM "Medium/Low Risk" configuration, to use in civil installations with lower requirements in flow-rates

3) **Others**: Configuration of WAVECAMM under special end-user requirements

The analysis of the competitive rivalry within the industry shows three identified major competitors: all of them are established, strong, and big-sized companies. Due to the weak-points detected in their equipment, WAVECAMM will offer to the market a unique product with high quality (high detection capacity + low FAR rate) at a lower price. Moreover, the WAVECAMM staff add together more than 30 years developing millimetric equipment and 6 years manufacturing millimetric screening systems.

The threat of new entry is medium-low. The high R&D resources to be committed in the development of any security equipment, the time consumption needed to achieve the TRL-9 status, and the certification costs are a high entry barrier. WAVECAMM will need to create a branch image in the security sector as new game-changer. That will need intense promotion and marketing activities, before the big-sized companies have time enough to "copy" the developed technology. Moreover, the configuration capability of WAVECAMM allow the SME to offer a personalized solution to the end-customers, increasing the acceptance of the product.

In contrast, for actual competitors WAVECAMM will mean a real threat of substitution of their equipment: unique technology & low cost. Even if normally the contracts for security equipment are long-terms agreements with the existing manufactures, the end-customers are always open to new technologies if they address all regulations and they offer new & increased quality standards.

The bargaining power of the suppliers is very low: they are all small sized local suppliers with strong and long relationships with the SME. The key-components are manufactured by the SME internally and the

suppliers of all other low-cost elements can be easily changed if needed. Moreover, the applicant SME strategy also includes strategical alliances with suppliers of specific RF components, ensuring the supply of this components

The bargaining power of the customers is medium-low, as they are devoted to the Regulators and EC authorities. Almost all of them are big sized public companies. The offer of security equipment is not huge and the security equipment market and the manufacturing costs fix the final equipment price level. WAVECAMM will increase their visibility by offering increased services and warranties thanks to the growth of existing service-net of the applicant SME. WAVECAMM offers a unique security equipment with no other competitor in same terms of detection Vs. Price. The applicant SME will create own "Promoting dept", in order to promote the WAVECAMM benefits within the Regulators and will participate in the Manufacturer Groups of the regulators and different manufacturers private associations.
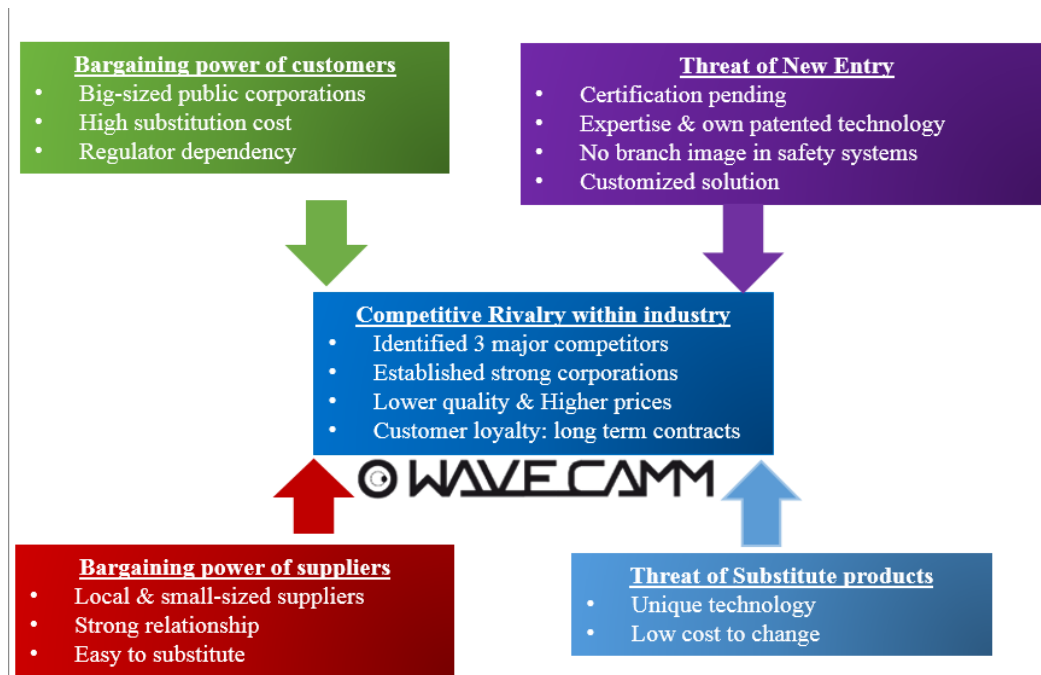

Bargaining power of customers
- Big-sized public corporations
- High substitution cost
- Regulator dependency

Threat of New Entry
- Certification pending
- Expertise & own patented technology
- No branch image in safety systems
- Customized solution

Competitive Rivalry within industry
- Identified 3 major competitors
- Established strong corporations
- Lower quality & Higher prices
- Customer loyalty: long term contracts

Bargaining power of suppliers
- Local & small-sized suppliers
- Strong relationship
- Easy to substitute

Threat of Substitute products
- Unique technology
- Low cost to change

Figure 8: Competitive forces between industry players

The Regulators are a key-force in the Security market: they fix the risk-level on each infrastructure based in the official reports of the Intellicenge Agencies and the political situation: they stablish the definition (types and sizes) of the threats (what is allow/what is not allow). With this regulations in mind, the infrastructure owner (normally public in case of transport hubs, but also private in case of civil buildings) asks to an Architec/Engineering Office to design the infrastructure, and later to a constructor Company to build up the building. Also updates of the building might be needed (due to an increased security level). There are many private companies providing all type of services to the infrastructure owner, including security services. In some cases, these type of companies provide not only the security staff, but also the security equipment. For the infrastrucutre owner is much easier as they don't need to worry about maintenance, product warranty, etc… In other cases, the infrastructure owner decides and buys the security equipment directly. The manufacturers, where WAVECAMM is located in Figure-9, may cooperate together in order to apply to a public or private service call.

In order to reach full commercialization phase by the end of the SMEInst-2 period, the applicant SME will work further with all stakeholders. In particular, the SME will make efforts in all key-actors detailed in Figure-9:
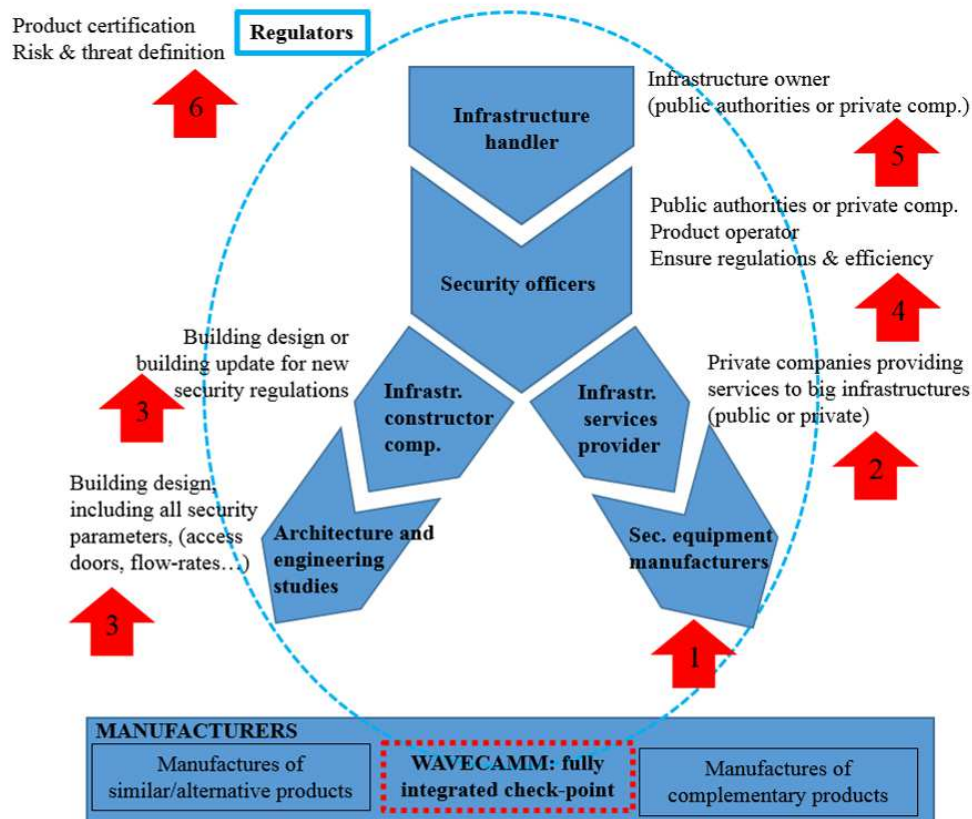
Figure 9: Customer access channels

1. Marketing activities: to promote the advantages of WAVECAMM between the Security Equipment manufactures. Alliances search with complementary-products manufactures (WTMD, X-baggage…)
   - Participation in the most important sectorial show in Europe is scheduled for 2017 (http://www.uksecurityexpo.com)
   - Website continuous improvement with updated information on WAVECAMM capabilities

2. Promotion among private companies providing services to the infrastructures, in order to increase their technology equipment and reduce the man-power needed at the check-point. There is a key benefit for them if the same ratios (quality, detection, flow rates) are achieved. An agreement was signed to include one demo unit of WAVECAMM at their installations (show room www.prosegur.es), so all potential end-customers that visit their installations might also check WAVECAM features.

3. Dissemination activities in order to inform big Architecture and Enginneering offices about the WAVECAMM foot-print, flow rates, etc… not only for new buildings (new football stadium) but also for remodellation of existing ones (update of Terminal building..). If they consider the use of WAVECAMM from the beginning of the infrastrucutre design, flow-rates and customer experience can be improved considerably.

4. Organization of own promotion events (as the one co-organized by the applicant SME in March 2016(http://www.itainnova.es/actualidad/eventos/nuevos-retos-tecnologicos-para-la-seguridad-de-las-infraestructuras) to explain to Security Officers (public and private) the key-benefits in people screening process with the use of WAVECAMM. Public Relations & "SME-lobby" with responsibles of National Police & local authorities.

5. Pilot Test in key-infrastrucutres to really convince them of the advantages of WAVECAMM. Product customization after Pilot-Test so they can claim their providers the use of WAVECAMM technology in new contracts or public calls. Moreover, active participation in the infrastructures associations meetings in order to promote the results of the Pilot-Test

6. Last but not least: as far as possible, participate in the decision-makers meetings and Regulators work-groups to include WAVECAMM features in the risk evaluation reports and to prepare new

regulations as per WAVECAMM advises in threat definition and detection capabilities: Participation in ECAC meetings and in ECAC Manufacturers Work Groups.

Another facts:

- WAVECAMM was presented to **Technical Task Force of the ECAC Organization** in Paris, during their last meeting in Feb-2016
- AENA has invited the applicant SME to participate in the annual meeting of the International Airports Association ACI (http://www.aci.aero/) as they find the solution very useful and **willing to pay for WAVECAMM** (Nov-2016)
- WAVECAMM is already included in the ECAC mailing list: Manufacturer Work Group meeting…

Video promo:
- **"HOW IT WORKS" video presentation (1,12 min) = https://youtu.be/9mAiwvW5_7A**
- **"WAVECAMM PASSENGER PROCEDURE" video loop for demos (34 sec) https://youtu.be/OzTfp-UJKBo**

AESA AGENCIA ESTATAL
DE SEGURIDAD AÉREA

Ángel Soret Lafraya

DIRECTOR DE SEGURIDAD DE AVIACIÓN CIVIL
Y PROTECCION AL USUARIO

To Whom It May Concern:

Madrid, 17 May 2016

Subject: Letter of Support to WAVECAMM Body Scanner.

AESA, the Spanish Aviation Safety and Security Agency, is committed to promote research and development of new security equipment, processes and procedures that take into consideration human factors principles. We believe that, by doing so, in cooperation with other ECAC and ICAO Member States, we will better achieve civil aviation security objectives.

As a result, AESA plays an active role within the ECAC Common Evaluation Process (CEP) of Security Equipment, by joining the Management Group and by nominating a test center, INTA, to perform laboratory tests within this program.

We had the opportunity to welcome Mr. Bazus, CEO of WAVECAMM at our headquarters, in order to review and discuss the documentation provided. We were also informed that a WAVECAMM initiative is going to be submitted to the call "H2020 SME Instrument Phase-II", and AESA supports this participation.

AESA fully support the WAVECAMM initiative of providing body scanning technology, based on innocuous passive millimeter waves, offering high throughput rates, with a low false alarm rate (FAR) and at lower prices while maintaining the privacy of the person subject to screening. As a result, it is our opinion that such technology should be developed and, thereafter, tested under ECAC CEP.

Yours sincerely,

DIRECTOR FOR CIVIL AVIATION SECURITY AND USER PROTECTION

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GOBIERNO DE ARAGON
Departamento de Innovación,
Investigación y Universidad

Asunto: Carta de Apoyo al proyecto a WAVECAMM Body Scanner

Fecha: 10.06.2016

A quien corresponda:

Dª. Mª. Teresa Gálvez Jaqués Directora General de Investigación e Innovación del Gobierno de Aragón, apoya mediante este escrito el proyecto **WAVECAMM** de cara a la solicitud de subvención que va a presentar en el marco del programa H2020.

Se trata de un proyecto de alta tecnología para el desarrollo final de un sistema de escaneo corporal basado en ondas milimétricas pasivas e inocuas. Pretende ofrecer una alta tasa de detección y una baja tasa de falsa-alarma, todo ello a un precio muy competitivo y manteniendo siempre la privacidad de la persona objeto de control. El resultado del proyecto WAVECAMM es, en nuestra opinión, muy interesante tanto a nivel tecnológico, como para aumentar los ratios de seguridad en las infraestructuras públicas.

LA DIRECTORA GENERAL DE INVESTIGACIÓN E INNOVACIÓN

Fdo. Mª Teresa Gálvez Jaqués.