XP-DITE Deliverable Summary
Work Package 2 – Technologies

The aim of the XP-DITE project is to develop, demonstrate and validate a comprehensive, passenger-centred approach to the design and evaluation of integrated security airport checkpoints (ACPs).

In work package 2, five different innovative ACP component technologies are being developed:

- Biometric e-gate for passenger tracking
- QCL-based vapour detector
- Stand-off mm-wave imager
- Automatic X-ray luggage scanner
- Raman-based particle detector

These technologies have been selected in XP-DITE since they are not used in current ACPs and do not necessarily comply with current regulations, but might play a role in a future ACP which complies with regulations defined at the overall system level. Components developed using these detection and enabling technologies will have their performance evaluated and stored in the XP-DITE component repository. They will become candidates for implementation in the two proof-of-principle checkpoints which will be built to evaluate and demonstrate the XP-DITE approach.

Deliverable D2.1: biometric e-gate

Biometric tracking and identification technology can be used in an ACP to associate the output of all the different screening steps on a passenger and their belongings with that passenger. The passenger can be temporarily enrolled into the biometric system at the entrance to the ACP and biometric devices at each screening component identify the passengers and bags equipped with RFID tags as they pass through the checkpoint. This solution respects privacy because the acquired biometric data is not linked to the identity of the person and biometric data is deleted at the exit of the ACP.
In this way, information from all steps in the ACP process from screening of the traveler and screening of his belongings are linked, and finally, all screening information can be considered as a whole before making a decision to allow the traveler access to the security restricted area or to detain the traveler for further investigation. This opens up ways to strengthen the link between the traveler and his belongings.

Although not explicitly studied in XP-DITE, in risk-based screening implementation, a risk mark can be assigned to the passenger from flight data (destination, special events…) or identity of the passenger computation that can be done by API/PNR systems. This risk is assigned at entrance and let the system vary the screening process.

The selection of the best biometric technique for use in an airport environment has been explored by **Morpho** during the project and a study has been carried out to compare the advantages and disadvantages of each technology, especially in terms of accuracy and ergonomics. This study showed that even if the use of fingerprints can be somewhat constraining for the traveler, this option is one of the best ones compared with the results obtained with other biometrics thanks to both ease

of use of contactless fingerprint acquisition and high accuracy. Iris scanning was considered as alternative option for XP-DITE ACPs. Depending on the concept of operations and expectations of the airport and/or checkpoint authorities, iris or face recognition solutions can now be technically implemented.

A contactless 'on the fly' fingerprint acquisition prototype already existed when the XP-DITE project began. However, this device had some scope for improvement on ergonomics. A redesign and size reduction were carried through in XP-DITE to optimize the finger acquisition volume and so improve the user experience, as well as to improve the accuracy of the device to make it suitable for use in an ACP.

Deliverable D2.2: QCL-based vapour detector

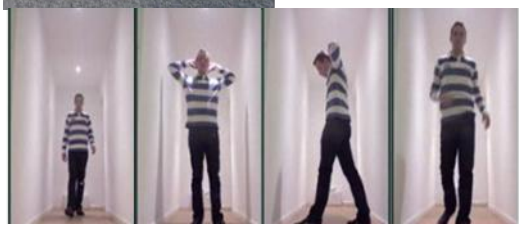
With the emergence of new mid infrared (MIR) semiconductor laser sources, numerous novel detection systems are being developed. Sensitive and selective detectors based on Quantum Cascade Lasers (QCL) have been developed for applications in various industry sectors including process control, emission monitoring, medical and, in recent years, years, security.

The deliverable summarises the development by **Cascade Technologies** of QCL-based vapour detection for screening cabin bags and divested items for trace level vapour emanating from selected explosives and explosives precursors.

The development has focused on integration of an existing QCL detection engine into a standard cabin baggage screening device (CBS) cabinet without the X-ray section. The detection engine is capable of detecting vapours of at least four precursors of liquid so-called homemade explosives (HMEs), where the sampling of vapours surrounding bags has been optimized. The capabilities can be combined with another development in XP-DITE which focuses on detection of particulate trace contamination on passenger bags (see deliverable D2.5).

A prototype system has been developed and is ready for implementation in a proof-of-concept aviation security checkpoint within XP-DITE.

Deliverable D2.3: passive stand-off mm-wave full-body scanner



A passive stand-off mm-wave full-body scanner has been developed by **Alfa Imaging**. This deliverable presents the progress of the development work, the achieved results and the outlook for this task. Alfa Imaging had an existing passive mm-wave imager (ALFA2) that has been redesigned for XP-DITE use, increasing the aperture and improving the Automatic Threat Detection (ATD) software.

The passive stand-off millimetre-wave full body scanner will provide a high throughput of passengers (>400 people/hour) and the resolution and sensitivity have been increased to improve the detection rate and reduce the number of false alarms.

Two stand-off millimetre wave imagers have been developed to be used together or as standalone systems. The final configuration will be defined in the ACP design process.

A data collection test was undertaken from the 25th to the 29th November 2013 at TNO's test laboratory. More than 1800 runs were carried out and recorded. These recordings have been used to optimize the balance between false negatives and false positives, the result of which will be assessed during performance tests at the end of 2014.

Deliverable D2.4: X-ray luggage scanner

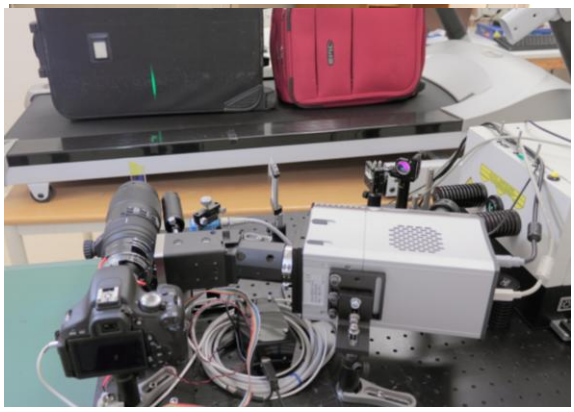
A novel X-ray luggage scanner is being developed by **Smiths Detection**. The focus of the development is on algorithms for detection of liquid and solid explosives in complex bags such as those containing laptops and other electronic devices. The development is based on a modern four view X-ray scanner: the aTiX machine, rather than full computed tomography (CT) scanning which is slower and requires more costly equipment. Due to the complexity of this task a new approach has been chosen: the development of scenario dependent algorithms. The image areas are split into different classes and different algorithms are selected for the detection of each image class and explosives type.

The three main image classes are:
1. Standard image area
2. Image area containing electronics
3. Image area containing a liquid container

Besides automatic detection of explosives the scanner also has to support operator-based detection of guns and knives. A 3-D reconstruction of the whole bag image using an algebraic reconstruction (ART) technique has been developed to provide information to the operator about the arrangement of the larger electronics items in the bag.

The performance of the X-ray scanner with the new developed detection software will be assessed and validated within XP-DITE.

Deliverable D2.5: Raman based luggage scanner



In task 2.5, a Raman-based luggage scanner has been developed by **FOI**. This is designed to detect explosives trace particle contamination on the surface of bags using a Raman spectroscopic imaging technique which has been previously developed at FOI.

The Raman detector has been developed with an autofocus concept which can perform measurements on a variety of items with different size. Particles in the microgram range have been detected in laboratory environments and verified for several explosives and precursors.

Deliverable D2.6: QCL-based vapour detector (update)

This deliverable continues the work started in D2.2 on the development of QCL-based vapour detection for screening cabin bags and divested items for trace level vapour emanating from selected explosives and explosives precursors by Cascade Technologies.

The current report builds on the previous results obtained after D2.2. The main objectives for D2.6 were to decide on the best sampling head configuration and provide a finalised version of the software which implements the automated detection and alarm resolution steps.

Several aspects of the configuration of the system have been tested such as the dependence on the position of the threat compound on the tray, the separation between each passing tray, and the stability and level of detection reached for some materials of interest. Finally, we describe the work that has been done with Fraunhofer-ICT in the final integration and testing of the combined trace and vapour detection system.

Deliverable D2.7: Passive stand-off mm-wave full-body scanner (update)

This deliverable details progress towards developing a Passive stand-off MMW full-body scanner by **Alfa Imaging**. This report presents the progress of the work on the full-body security scanner since the previous deliverable, D2.3. The automatic threat detection software has been improved following the analysis of the data collection runs, optimising the balance between the false negatives rates and false positives rates. This improvement is shown both graphically and quantitatively in this deliverable.

Deliverable D2.8: X-ray luggage scanner (update)

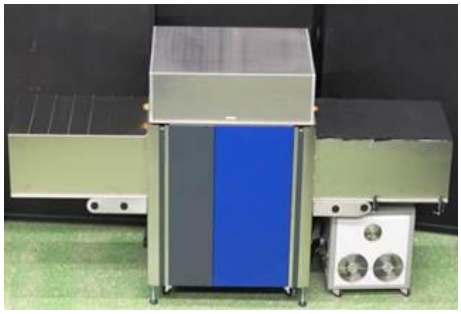
This deliverable details the development of a novel X-ray luggage scanner by **Smiths Detection**. The focus of the development is on algorithms for detection of liquids in bags and solid explosives in complex bags such as those containing laptops and other electronic devices. First results have been already presented in D2.4. Work has been continued since that time and this document summarizes progress on algorithm development, and results obtained in this period.

The focus was on progress with 3D reconstruction using the four-view projection scanner, and further elaboration of the liquid detection software in such a way that it can cover more scenarios.

Images to the right demonstrate Dual Energy reconstruction of a liquid – shown as a cross section through the container. It is clearly visible that the liquid container itself is much better reconstructed with the new version (bottom image) than with the old one (top image). This leads to improved density determination of the liquid content itself

Deliverable D2.9: Raman based luggage scanner (update)

This deliverable outlines the continued development of a Raman-based luggage scanner by **FOI**. This in-situ particle trace detector has the capability to screen all bags and divested items in real-time which cannot be done today by traditional sampling techniques. This report presents the progress of the development work since the previous



deliverable D2.5. Since then, the following major system updates have been accomplished:

- Enhanced signal processing in terms of performance and speed
- Installation of the Raman setup with the Cascade Technologies QCL-based vapour detector in an empty x-ray machine frame
- Replacement of some optical components for improved performance
- Fully automated hardware control and improved external communication interface
- Additional laboratory performance testing