



**NATO**  
**Science for Peace and Security (SPS)**  
**Programme**

# DEXTER

**Detection of EXplosives  
and firearms to counter TERRORism**



## Context

Subway stations, airports, and other mass transit and gathering venues across the world have been targeted by terrorist attacks, leading to significant loss of life and damage to infrastructure. The on-site prevention of these events depends primarily on random searches on passengers or checkpoints, but technological advancements are providing more thorough, accurate and reliable solutions, which can also reduce the impact of the current security measures on the public.

DEXTER (Detection of Explosives and firearms to counter TERrorism) is a flagship initiative of the NATO Science for Peace and Security (SPS) Programme that will seek a solution to this challenge, by developing an integrated system that can identify the carriers of explosives and firearms in crowds without disrupting the flow of pedestrians.

## Goals

- DEXTER will allow the identification of carriers of firearms and explosives among moving pedestrians, remotely and in real time.
- It will detect these threats discretely, without requiring random checks on moving passengers or checkpoints in crowded venues and mass transit scenarios.
- It will integrate multiple technologies into an infrastructure capable of incorporating new and upgraded detection systems in the future, thus it has the potential of keeping up with evolving threats.

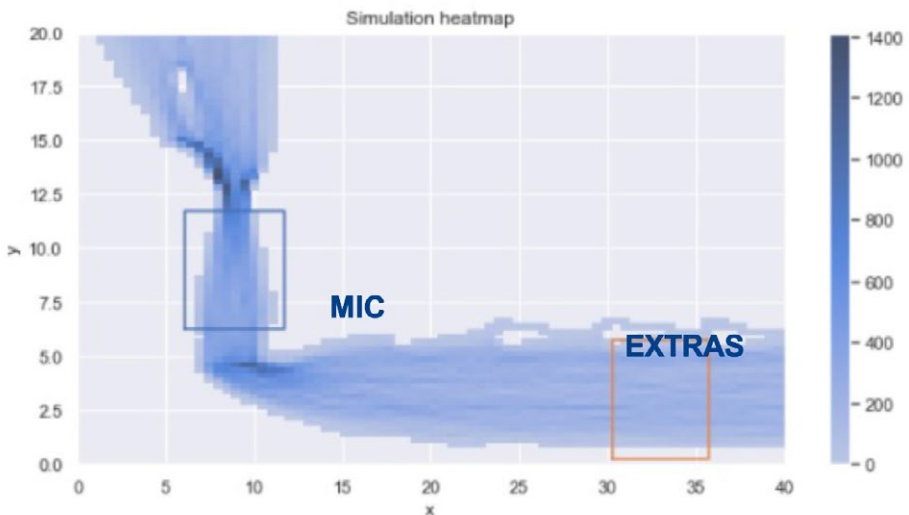
## Impact

DEXTER will deliver a prototype that discretely identifies explosives and firearms remotely and in real time. This integrated system will be applicable to mass transit scenarios, such as subway stations, train stations and airports, and to critical infrastructures and mass gathering venues.

DEXTER will help increasing the safety of mass transit and gathering venues by delivering a solution at the crossroads between counter-terrorism and advanced technologies. In doing this, it will contribute to NATO's Action Plan on enhancing NATO's role in the international community's fight against terrorism by helping to prevent, protect and respond to terrorist threats.

Additionally, by making use of the most recent advancements on sensors, detection and artificial intelligence, DEXTER represents

a perfect example of NATO's agenda in the field of Emerging and Disruptive Technologies.



## The Research Setup

DEXTER includes 3 research and development projects:

- 1 MIC (Microwave Imaging Curtain)** aims at designing and developing an efficient Multiple Input Multiple Output (MIMO) Synthetic Aperture Radar (SAR) system capable of generating high-resolution 2D and 3D images in real time. MIC will make use of machine learning algorithms to elaborate the images and automatically identify and characterize potential threats. By doing this, it will enable the detection of explosives and firearms without the need for checkpoints.
- 2 EXTRAS (Explosives TRAce detection Sensor)** aims at developing a sensor for the proximal trace detection of explosives and their precursors on surfaces. It will make use of spectroscopy techniques that will allow the real-time investigation of a wide range of surfaces of a potential bomber that might be contaminated with energetic materials.
- 3 INSTEAD (INtegrated Systems for ThrEAts early Detection)** aims to deliver a system for the centralized management of a plurality of sensors deployed on a specific location. INSTEAD will interface sensors developed in MIC and EXTRAS, as well as a video system using both conventional 2D cameras and innovative 3D cameras. These will work according to advanced video tracking algorithms. Video-based person re-identification will be used to couple the output of multiple sensors at different locations. A Command and Control suite will enable centralized data fusion and smart processing. The outputs of INSTEAD will be used to optimize the efforts of a number of entities (e.g. officers in control rooms, agents on the field) and resources (sensors, imaging systems with tracking capabilities, communication tools), and will enhance the ability to raise alarms on suspects and to trigger emergency and intervention protocols.





### The Big City Trial

The technologies developed by DEXTER's three research and development projects will be demonstrated with an integrated trial in a real-life environment.

The DEXTER Big City Trial will take place in a subway station in Rome in May 2022 and is expected to attract interest from mass transportation operators and security authorities, while simultaneously feeding further industrial developments.



## The DEXTER Consortium

The DEXTER Consortium Agreement was signed on 8 July 2019 at NATO Headquarters, and marked the start of this multinational collaborative effort.

The establishment of a Consortium provided a coordination framework among the three projects, while ensuring close engagement among stakeholders. Through its Executive Board, the Consortium enables joint research and development, delivers better situational awareness and provides direction and guidance to the research and technological developments.

The Consortium includes all countries involved in the implementation of the three DEXTER projects. In addition, five NATO nations (France, Italy, Turkey, United Kingdom and United States) are contributing financially to DEXTER and are among the members of its Executive Board. During the implementation of DEXTER, its Executive Board met 6 times to discuss the progress of the three projects and their integration, as well as preparations for the Big City Trial.



# Participating Nations and Institutions

DEXTER is a multi-national research and development effort involving 11 institutions in 4 NATO countries and 4 partner nations.



11 Institutions



4 NATO Countries



4 NATO Partner Nations



## ENEA, Italy

ENEA is the National Agency for New Technologies, Energy and Sustainable Economic Development, an Italian public body aimed at research, technological innovation and the provision of advanced services to enterprises, public administration and citizens in the sectors of energy, the environment and sustainable economic development. Since its foundation in the 1960s, its strengths have been applied research, technology transfer and technical-scientific support to companies, associations, territories, central and local administrations. Its focus sectors are energy technologies (renewable sources, energy storage, smart grids), nuclear fusion and nuclear safety, energy efficiency, technologies for cultural heritage, seismic protection, food safety, pollution, life sciences, strategic raw materials, and climate change.



## Italian Forensic Science Police Service, Italy

The Italian Forensic Science Police Service supports investigations through its expertise in biology, chemistry, physics, fingerprinting, forensic medicine and more. Since its inception, in 1902, the Italian Forensic Science Police has progressively improved its capabilities, providing essential

support to all investigations carried out by the Italian National Police. It operates all over Italy through its Interregional, Regional and Provincial offices, and it responds to the Central Anticrime Directorate, established in 2005 to fight major crime and organized crime.



### **Atac, Italy**

Atac S.p.A. - Rome's municipal utility for public transport services - is Italy's leading urban mobility operator and one of the largest local public transport companies in Europe. Atac manages all kinds of collective mobility within the metropolitan area of Rome: surface vehicles, metro lines and railways, up to the administration of park & ride areas and on-street metered parking spaces. Atac's resources consist of 11,024 employees (1,341 women, 9,683 men). Every day more than half of them, though with different professional roles, interact with customers aiming at a public transport service whose main drivers are quality and safety.



### **ONERA, France**

ONERA (Office National d'Études et de Recherches Aérospatiales) is the French national aerospace research center. It is a public research establishment with eight major facilities in France and about 2,000

employees, including 1,500 scientists, engineers and technicians. ONERA conducts Application-Oriented Research designed to support the competitiveness and creativity of the aerospace and defense industries. ONERA covers all the disciplines and techniques needed to drive progress in aerospace: aerodynamics, flight dynamics, propulsion, structural strength, materials, optics and laser, acoustics, radar and electromagnetism, electronics, systems, robotics, information processing. The research carried out at ONERA results in computation codes, methods, tools, technologies, materials and other products and services.



### **TNO, the Netherlands**

TNO, the Netherlands Organisation for applied scientific research, was founded in 1932 by law as an independent research organization. It focuses on transitions or changes in several social themes, including defense and security, industry, energy and healthy living. TNO supports allies of military and security professionals with technological and behavioural innovations including intelligent imaging, radar, acoustics and optics.



### **Fraunhofer ICT, Germany**

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (FhG) works in applied research and development. It was founded in 1949 as a non-profit registered



association and has a staff of  $\pm 28000$  predominantly scientists and engineers and an annual budget of  $\pm 2.8$  billion euros. Fraunhofer is an autonomous organization with a decentralized organizational structure, which maintains 74 research institutes throughout Germany. The employees carry out research and development projects on a contract basis on behalf of industry, the service sector and government. The Fraunhofer Institute for Chemical Technology (ICT) is one of the main research institutes on explosives and an accredited and approved testing facility. In conjunction with the German Federal Police, Fraunhofer ICT is the German national test center for testing and evaluation of explosives detection equipment. ICT has a broad experience in developing explosives-related analytical methods and detection techniques and is the German national competence center on explosives detection, synthesis and processing of energetic materials including relevant homemade explosives.



### **VTT, Finland**

VTT Technical Research Centre of Finland Ltd. is a visionary research, development and innovation partner. VTT is part of Finland's innovation system and operates under the mandate of the Ministry of Employment and the Economy. With over 75 years of experience in top-level research and science-based results, VTT's main tasks are research and development, and the transfer and testing of technologies. VTT steers and develops its activities in cooperation with industry, research institutes, universities, and the authorities in charge

of technology policies and research funding. In its operations, VTT follows and develops national policies on technology, industry and energy.



### **SNU, Republic of Korea**

Seoul National University (SNU) is a national research university located in Seoul, Republic of Korea. Founded in 1946, Seoul National University is considered the most prestigious university in South Korea. The university comprises sixteen colleges, one graduate school and nine professional schools. The student body consists of nearly 17,000 undergraduate and 11,000 graduate students.



### **Vinča Institute, Serbia**

Founded in 1948, the Vinča Institute of Nuclear Sciences has been the most prominent multidisciplinary research institute in Serbia. Today the Vinča Institute is a leading institution for high-quality science in Serbia. Multidisciplinary approaches to research are enabled by its internal organization and established practices. More than 500 researchers and Ph.D. students work on multidisciplinary projects in fundamental and applied research (from innovation to commercialization) through technology development projects.

Research at the Institute covers the following areas: physics, chemistry, biology, power engineering and technology, radiation and environmental protection, production of radiopharmaceuticals, accelerator science, and nanoscience.



### **IRE-NASU, Ukraine**

The Usikov Institute for Radiophysics and Electronics of the National Academy of Sciences of Ukraine was established in 1955 with the objective of conducting research and development focused on the wide frequency range of the electromagnetic wave spectrum, with a special emphasis on millimeter and sub-millimeter waves. Since its establishment, the Institute has become a widely known scientific center whose achievements determine the level of national science in radio physics, vacuum electronics, quasi-optics, microwave studies in solid-state physics and biophysics, millimeter wave technique and noise radar, radio wave propagation, as well as remote sensing of Earth from airborne and space-borne platforms.



### **NTUU-KPI, Ukraine**

Founded in 1898, the National Technical University of Ukraine - Igor Sikorsky Kyiv Polytechnic Institute is the largest research-oriented technical university in Ukraine. It is home to 22,000 students - 25% of all technical university students in Ukraine. The university has 16 faculties, 11 educational and scientific institutes, several scientific and research institutes and educational centers. It trains Bachelors, Specialists and Masters, PhDs and Doctors of Science.

# The NATO Science for Peace and Security (SPS) Programme

The NATO Science for Peace and Security (SPS) Programme develops and implements practical cooperation and enhances dialogue between NATO nations and partner countries through security-related civil science technology and innovation.

The SPS Programme has been contributing to the core goals of the Alliance for more than six decades. Today, the SPS Programme continues to be one of the largest and most important partnership programmes addressing 21st century security challenges, particularly cyber defence, counter-terrorism, CBRN defence, energy security and advanced technologies.

The NATO Science for Peace and Security (SPS) Programme connects scientists, experts and officials from NATO and partner countries to work together to address these challenges. It provides funding and expert advice for security-relevant activities in the form of Multi-Year Projects (MYP), Advanced Research Workshops (ARW), Advanced Training Courses (ATC), and Advanced Study Institutes (ASI). SPS activities are always demand-driven, modular, and designed to meet the requirements of nation(s) and end user(s).

Through calls for proposals advertised on its website, the SPS Programme invites scientists and experts to submit proposals for cooperative activities aligned with a set

of thematic key priorities approved by NATO Allies. The relevance of SPS activities to NATO Strategic Objectives and political priorities is reinforced also via special calls for proposals, which are issued on an ad hoc basis to draw the attention of the scientific community towards current topics of interest for Allies.

The SPS Programme also has a high public diplomacy value for NATO, providing the Alliance with separate, non-military communication channels by bringing together experts from NATO and partner countries, often in situations or regions where other forms of dialogue more directly focused on defence and security are difficult to establish. Accordingly, the Programme enables NATO to become actively involved in such regions, often serving as the first concrete link between NATO and a new partner.

Every year, approximately 2000 experts participate in SPS activities and help to build capacity in partner nations and support NATO's goals.

More than 20 Nobel Laureates have been involved in the SPS Programme, a testament to the scientific excellence supported by the SPS Programme.

Young scientists are also actively supported through SPS activities, which contribute to broaden their professional network and scientific expertise.

## **Science for Peace and Security (SPS) Programme**

### **Emerging Security Challenges Division (ESCD)**



[www.nato.int/science](http://www.nato.int/science)



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