



## DIGITAL SAFETY & SECURITY RESEARCH

International cutting-edge technological  
developments "Made in Austria"



# INTRODUCTION

Since 2009 the AIT Austrian Institute of Technology's Center for Digital Safety & Security has been working on a unique technology portfolio for the security sector, and in doing so has consistently combined three of AIT's key strengths:

- successfully developing solutions and technologies for industry whose high degree of maturity and quality supports rapid go-to-market initiatives;
- working on fresh approaches including the use of new technologies in close cooperation with both customers in the security sector and national and international authorities;
- producing internationally recognised leading scientific work.

All these developments take place in close cooperation with users and public authority representatives from all over the world. The projects benefit from the generous co-financing of research and development activities through European innovation funding initiatives, which also provides a high degree of visibility at international level.

The successes summarised in this brochure are essentially co-financed through the Federal Ministry for Transport, Innovation and Technology (BMVIT) as part of the Austrian security research funding programme KIRAS (not all KIRAS projects are explicitly cited).

AIT, and through it Austria as a technology location, has succeeded in securing a leading international role in the fields of security research described in the following pages.

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# CYBER SECURITY

Our experts develop cutting-edge technologies and solutions for future cyber security ecosystems in order to combat the threats arising from new, extensive and increasingly networked ICT infrastructures, which represent growing potential targets for attack.

## POST-QUANTUM ENCRYPTION TECHNOLOGIES

AIT is world-leading in the development of 'quantum computer safe' technologies. These are encryption procedures which cannot be broken even once quantum computers are available. A quantum computer can very quickly break the conventional asymmetrical encryption used today. AIT plays a key role in what are currently the most important European flagship projects in quantum communication.

### Reference projects (excerpt)

- UNIQORN – Affordable Quantum Communication for Everyone: Revolutionizing the Quantum Ecosystem from Fabrication to Application; <https://quantum-uniqorn.eu/> (EU H2020 / FET Flagship)
- CiViQ – Continuous Variable Quantum Technology; <http://civiqquantum.eu/> (EU H2020 / FET Flagship)
- QUARTZ – Quantum Cryptography Telecommunication System (ESA project)



## ATTRIBUTE-BASED ENCRYPTION

Comprehensive digital transformation and global networking, plus trends including virtualisation (cloud systems) and the IoT, require flexible and powerful forms of encryption. It must be possible to dynamically manage pre-defined role-specific access rights within individual, specific data areas. AIT has established special research focuses in this field within the framework of major European innovation projects.

### Reference projects (excerpt)

- CREDENTIAL – Secure Cloud Identity Wallet; <https://credential.eu/> (EU H2020)
- PRISMACLOUD – PRIVacy and Security MAintaining services in the CLOUD; <https://prismacloud.eu/> (EU H2020)
- SECCRIT – SEcure Cloud computing for CRITICAL infrastructure IT; <http://www.seccrit.eu/> (EU FP7)

## AI TO DETECT ATTACKS ON IT SYSTEMS

AIT has specialised in developing AI-based detection technologies which use behaviour analysis in order to identify particularly sophisticated cyberattacks. This is achieved by evaluating data streams and by logfile analysis. Patented solutions are available. <https://www.ait.ac.at/aecid>

## AI-BASED ANALYSIS OF DATA STREAMS

The structure of the Internet and associated data streams are becoming increasingly complex. Extremely large volumes of network traffic data need to be precisely analysed in order to ensure the stability and security of our telecommunications networks. AIT is developing cutting-edge algorithms for this purpose, based on the latest data mining approaches and machine-based learning. <https://bigdama.ait.ac.at/>



## TRAINING AND CAPACITY BUILDING – AIT CYBER RANGE IT PLATFORM

For several years AIT has been active in the field of capacity building on behalf of the IAEA (International Atomic Energy Agency), conducting dedicated cybersecurity training programmes for operators of nuclear power stations. Based on this experience, AIT has also developed a special ‘cyber range’ which allows specific cyber-threat scenarios to be simulated in realistic IT environments, in order to practise defence and countermeasures. The AIT Cyber Range IT platform was also used to conduct Austria’s national cyber exercise (<https://www.ait.ac.at/csplanspiel17/>) in 2017, enabling all Austrian operators of critical infrastructures to jointly evaluate the relevant processes in cooperation with the government authorities (Ministry of Defence - BMLV, Ministry of the Interior – BMI, Federal Chancellery – BKA, Ministry for Europe, Integration and Foreign Affairs - BMelA).  
<https://www.ait.ac.at/cyberrange/>

## SAFETY & SECURITY BY DESIGN USING MODEL-BASED SYSTEMS DEVELOPMENT

The security and safety of cyber-physical systems (CPS) are vitally important in protecting people and society from harm. That’s why AIT experts are developing state-of-the-art security procedures and technologies for these complex areas.

In CPS it is not enough just to ensure that an environment is protected against a system malfunction (safety). As open and networked systems, CPS are an obvious target for cyberattacks, which can also impair their operational security. Safety (reliable and safe operation) and security (protection of the system against hostile agents) should not be considered in isolation. The high level of CPS complexity, the exacting real-time standards, and the time-to-market pressures can very easily have a negative effect on the quality of the developed systems.

AIT is developing a whole portfolio of tools and solutions in this area:

- 1) Model-based design tools which help to develop systems that are both safe and secure from the outset.
- 2) AIT guarantees this by offering runtime verification (monitoring) tools and
- 3) test case generation technologies for efficient CPS verification. AIT also actively contributes its expertise to the development of future security standards.

### Reference projects (excerpt)

- Enable-S3; <https://www.enable-s3.eu/> (ECSEL JU)
- AutoDrive; <https://autodrive-project.eu/> (ECSEL JU)
- ARROWHEAD; <http://www.arrowhead.eu/> (ARTEMIS)
- EMC<sup>2</sup>; (<https://www.artemis-emc2.eu/>) (ARTEMIS)
- EMBEET; <http://embeet.com/> (EUROSTARS)
- CARONTE; <http://www.caronte-project.eu/> (EU FP7)



# BLOCKCHAIN TECHNOLOGIES

AIT experts are investigating the mechanisms behind blockchain technologies and analysing bitcoin transaction flows as a means of fighting organised crime.

## FORENSIC TOOLS FOR VIRTUAL CURRENCIES

In the battle against money laundering, crime and terrorist financing, AIT has developed a leading international forensic technology which allows it to trace financial transactions in blockchain-based virtual currencies. AIT, and hence Austria, is leading and fundamentally driving important major EU initiatives in this area.

### Reference projects (excerpt)

- TITANIUM – Tools for the Investigation of Transactions in Underground Markets; <https://www.titanium-project.eu/> (EU H2020)
- VIRTCRIME – Forensic Methods and Solutions for the Analysis of Criminal Transactions in Post-Bitcoin Cryptocurrencies; <https://kiras.at/gefoerderte-projekte/detail/d/virtcrime/> (funded under the Austrian KIRAS security research programme of the Federal Ministry of Transport, Innovation and Technology)



# PROTECTING CRITICAL INFRASTRUCTURES

Today people want to move and travel freely as well as safely. Fast and secure access control, seamless border crossing, queue-less passenger checks at the airport and quick identification of individuals are the key to better security and convenience. Our experts develop systems for person identification and access control using novel technologies such as mobile contactless biometrics and stereo detection.

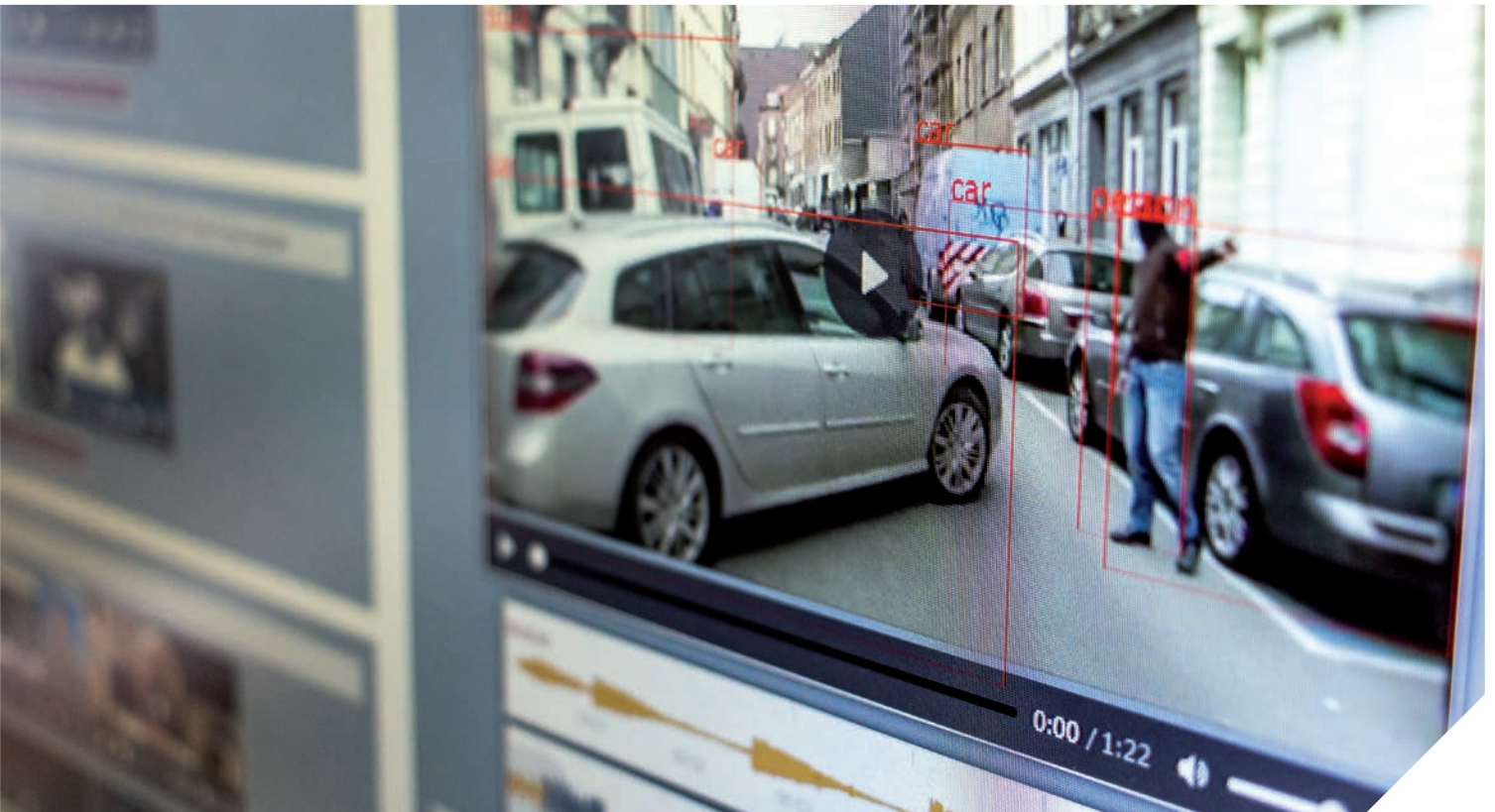
## DIGITAL IDENTITIES AND BORDER CONTROL

In recent years AIT has successfully adopted a leading European role in the field of modern IT-based border controls and property protection. In recent years, all major EU initiatives in this context have been led and driven by AIT. The developments include new biometric sensor technologies for person identification, plus sensor technologies and IT systems for protecting buildings and critical infrastructures.

### Reference projects (excerpt)

- FastPass – a harmonized, modular reference system for all European automated border crossing points; <https://www.fastpass-project.eu/> (EU FP7)
- MobilePass – a secure, modular and distributed mobile border control solution for European land border crossing points; <http://mobilepass-project.eu/> (EU FP7)
- FOLDOUT – Through Foliage Detection of Illegal Cross-Border Activities; <https://foldout.eu/> (EU H2020)
- FBC – Future Border Control; Modentity – Smartphone-based mobile document authentication and identity verification for future border control (funded under the Austrian KIRAS security research programme of the Federal Ministry of Transport, Innovation and Technology)





# PUBLIC SECURITY

Protecting citizens is one of today's biggest societal challenges. For this reason, airports, railway and subway stations and other public places are equipped with numerous cameras to enhance the security of people and infrastructure. In order to analyse the huge amount of video data generated, we develop advanced visual analysis systems which facilitate the automatic extraction of security-relevant information for infrastructure operators and law enforcement agencies.

## AI AND SENSOR FUSION FOR ANALYSING LARGE QUANTITIES OF DATA

By employing AI, big data science and modern sensor fusion technologies, AIT has succeeded in developing key technologies for use in the battle against terrorism and crime. They enable AI-based analysis of very large quantities of image data and material from video surveillance (offline and online) by combining audio and image information during analysis.

### Reference projects (excerpt)

- VICTORIA - Video analysis for Investigation of Criminal and TerrORist Activities; <https://www.victoria-project.eu/> (EU H2020)
- FLORIDA; <https://www.kiras.at/gefoerderte-projekte/detail/d/florida> (funded under the Austrian KIRAS security research programme of the Federal Ministry for Transport, Innovation and Technology)

## RELIABLE 5G WIRELESS TECHNOLOGY FACILITATES NEW APPLICATIONS

The comprehensive networking of devices (IoT) in many fields of application is the basis for a huge variety of innovations in all areas of our lives. The mobility and flexibility of the various applications rely on new and powerful wireless technology which is also thoroughly reliable and secure. In recent years AIT has successfully established an internationally renowned centre of expertise for 5G and smart antennas for use in tomorrow's factories, in robotic systems and for autonomous driving. Work is in progress on defence against UAV threats, and on substantially improving UAV defence measures in urban areas.

### Reference projects (excerpt)

- SCOTT; <https://scottproject.eu/> (ECSEL JU)
- AGENT; <https://www.eurostars-eureka.eu/project/id/10067> (EUROSTARS)
- MARCONI (Funding programme: ICT of the Future; Federal Ministry for Transport, Innovation and Technology and Austrian Research Promotion Agency, FFG)
- UNWIRE (Funding programme: Production of the Future; Federal Ministry for Transport, Innovation and Technology and Austrian Research Promotion Agency, FFG)



# CRISIS AND DISASTER MANAGEMENT (CDM)

A networked understanding of hazards and challenges is essential in order to protect the population in crisis and disaster situations. The actions taken must involve the population and take preventative measures into account. As growing quantities of data become available it becomes increasingly important to establish a comprehensive and reliable overview of a situation based on an extremely diverse range of data sources.





## STATE-OF-THE-ART IT SYSTEMS FOR CDM

In recent years AIT has successfully specialised in developing new generations of command and control (C&C) systems based on new sensor technologies which facilitate advanced forms of interoperability for civil and military purposes, in international and cross-organisational contexts. Based on NATO standards yet simultaneously designed for use by civil organisations, in future state-of-the-art communication systems can be used to effectively involve the population in crisis management. AIT plays a leading role in both major Austrian and international initiatives to develop these systems.

### Reference projects (excerpt)

- DRIVER+ - Driving Innovation in Crisis Management for European Resilience; <https://www.driver-project.eu/>; (EU FP7)
- INTERPRETER – Interoperability in Next-Generation Disaster Management; PASA - Public Warning and Alert System for Austria; (funded under the Austrian KIRAS security research programme of the Federal Ministry for Transport, Innovation and Technology)

## USE OF UAV AND SENSOR FUSION FOR SITUATIONAL AWARENESS

Guaranteeing the security of public spaces and critical infrastructures is the order of the day. A multiplicity of different sensors is needed in order to detect potentially dangerous situations quickly and efficiently. AIT is developing innovative technologies which guarantee reliable incident detection and situational awareness in real time in order to provide maximum support to emergency forces. Thanks to sensor fusion and the use of various data sources in a UAV, such as a 3D 360° panorama camera or sensor data on hazardous substances, up-to-the-minute analyses of the situation can be made available to the emergency operations centre in real time.

### Reference project (excerpt)

- SECURESCUE – Real-time mapping of local situation for first responders in crisis and disaster situations; DURCHBLICK – Detection of different improvised explosive devices by using smart analytic sensors (funded under the Austrian KIRAS security research programme of the Federal Ministry for Transport, Innovation and Technology)



# HIGH-TECH DEVELOPMENT AT AIT

Today, for the first time, we find ourselves in an era in which immense technological advances can help us solve the huge problems facing mankind. At the same time, global networking, complex infrastructures, enormous quantities of data and emerging artificial intelligence present us with challenges on an unprecedented scale.

Our ultimate aim is to create new technologies which gain wide acceptance and contribute to making life liveable. In order to achieve this we need to take the human factor fully into account when designing human-machine interfaces, integrate the user's established processes, and create future-proof and sustainable ecosystems with all their associated social, ethical and legal factors.

## INNOVATIVE ECOSYSTEMS AS FRAMEWORKS

The technological developments outlined in this brochure demonstrate that the AIT Center for Digital Safety & Security operates at the hot spots of our post-industrial, highly digital and networked knowledge society. It is embedded within a successful Austrian innovation culture – the result of cooperation between the public sector, commercial and industrial enterprises and science – and is involved in flagship projects designed to create the preconditions for future competitiveness and solid economic growth.

This requires test markets and experimental fields being available for new technologies at an early stage, to test not only their feasibility but also the social, ethical and legal standards. Open innovation, values-based design thinking for compliance with exemplary social norms of technological application, plus confident co-creation help us create the ecosystems needed to establish our country in the top rankings of international innovation.

## A FOCUS ON HUMANS

The huge convergence between information technology and the physical environment, facilitated by the integration of countless sensors in the global Internet, shifts the focus of technological proficiency increasingly to the relationship between human and machine, both in the workplace and the private sphere. For this reason, new technological breakthroughs will only achieve acceptance when they follow a human-focused approach, including addressing the associated questions of ethical responsibility and the legal framework conditions.

## USER PROCESSES ARE THE STARTING POINT

Never before have human efforts to continually develop its highly complex industrial and service sectors by creating and applying new and supportive technologies been accompanied by so many uncertainties and risks as they are today. The so-called “unknown unknowns” are the new normal. For that reason, here at AIT we regard innovation as positive selection, taking the primary needs of users and clients of advanced security technologies as the irrevocable starting point for every research activity. By allowing ourselves to be directed by the processes our clients apply in their tasks as we develop ideas, concepts, designs and prototypes, we reduce the “unknown” in the creative process of finding new solutions. That's why AIT considers innovation to be a customer-driven process, one which depends on close cooperation with our partners in national and international business and industry, as well as public administration, right from the start.

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