Security is an issue of growing social importance. Threats posed by terrorism operating internationally, organized economic crime, major accidents or extreme weather events represent a continuing challenge. In the Fraunhofer Group for Defense and Security VVS, ten Fraunhofer Institutes have joined forces in order to face these challenges. As centers of excellence, they create intelligent and comprehensive solutions both for civil security as well as for defense in order to improve the protection of society against manmade and natural threats. By pooling expertise and research activities, the Fraunhofer Group develops cutting edge technology and the accompanying concepts concerning methods, processes and tactics which are essential for facing the whole spectrum of potential and emerging security threats appropriately.

As a result, the Fraunhofer Group is conducting research in the following business segments:

- Protection of critical infrastructures
- Management of crises and disasters
- Cyber security and defense
- Protection and effects
- Reconnaissance and surveillance
- Explosives technology and security technology
- Communication and information
- Command, control and operation
- Decision making support for government and economy

Being committed to the German Federal Ministry of Education and Research (BMBF) and the German Federal Ministry of Defence (BMVg), the Fraunhofer VVS has come to assert itself as the driving force in the entire defense and security sector. Even on a European level, the Fraunhofer VVS represents one of the key players and facilitates intensive networking with promising collaborative research activities. Through excellent performance, the Fraunhofer-Gesellschaft significantly contributes to the future strategic orientation of the European security- and defense-research program.

Since 2006, the Fraunhofer Group for Defense and Security VVS annually organizes the conference “Future Security”. This conference serves as international platform for scientists, decision-makers and others who are responsible for our safety – from both the business segment and public institutions. Each year, a different member institute from the Group plans and carries out the conference. Thereby new areas of focus in the field of security research are set annually. Whereas in the past the topics of “organized crime” and “international terrorism” received particular attention, the emphasis of this year’s conference is placed on the topic of “resilience”.

The national scientific forum for the Security Research Community with international participation
www.future-security.eu
Fraunhofer Institute for Applied Solid State Physics IAF
Optical and Electronic Security Systems

Fraunhofer Institute for Chemical Technology ICT
ExplosiveS, safety and security technology and energy supply systems

Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR
Radar – a key technology

Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
Command, Control and Reconnaissance

Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI
Protection, Security and Effects

Fraunhofer Institute for Technological Trend Analysis INT
Planning Support for State and Industry

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB
From Networked Sensor Data to Decision

Fraunhofer Institute for Integrated Circuits IIS
Communication, Positioning Technologies and X-Ray for Safety and Security Applications

Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, HHI
Information and Secure Communication

Fraunhofer Institute for System and Innovation Research ISI
Visions for Decisions
© 2013 Bundeswehr/Bienert: In order to prevent igniting explosive devices through wireless remote initiation via mobile phones or other radio technology devices, Fraunhofer IAF develops powerful broadband jammers which cover the entire spectrum of frequencies used for communication worldwide.

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<th>1957</th>
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<tr>
<td>Annual budget</td>
<td>31.6 million €</td>
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The Fraunhofer Institute for Applied Solid State Physics IAF is one of the few research facilities world-wide which have mastered the entire value chain in the field of III-V compound semiconductors and synthetic diamond on the highest international level. Year-long experience, highly qualified staff and state-of-the-art instrumentation are the basis on which we develop optical and electronic devices and systems. Among others, we manufacture infrared lasers and detectors, ultraviolet light cameras, high frequency and power electronics, as well as sensors for gases and liquids. These semiconductor based components are of great benefit for safety and security applications. The institute features a clean room with cutting edge semiconductor process technology as well as outstanding metrology equipment.

In general, the R&D results are transferred to industrial companies for mass production. If small production numbers make it difficult to find an industrial partner, the institute is also able to provide its customers with high quality small series. Therefore, IAF significantly contributes to ensuring the availability of strategic, innovative semiconductor-based components for national and European industry.

Some examples illustrating the successful transfer of our research results into products:

- Broadband jammers to suppress radio signals activating explosive devices.
- Imaging millimeter-wave systems which detect concealed weapons.
- Radar sensors which support helicopter pilots during difficult landing operation under brownout or whiteout conditions.
- Fast-switching protective filters which guard infrared sensors against blinding sunlight and directed optical countermeasures.
- Imaging dual-color infrared sensors which warn aircrafts against approaching missiles.
- Optical systems for stand-off detection of smallest traces of explosives on surfaces.
- Novel miniaturized sensors which detect hazardous substances in water and in air.

R&D work at Fraunhofer IAF is certified according to ISO 9001:2008.
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[www.ict.fraunhofer.de](http://www.ict.fraunhofer.de)
The Fraunhofer ICT offers its long-standing research experience and know-how in the field of explosives to the German Federal Ministry of Defence, the public sector and industrial customers. Laboratories and experimental workshops are available for R&D purposes, allowing projects to be carried out from a laboratory scale up to a small series production.

The Fraunhofer ICT draws on the competence of its employees in the development of improved chemical energy sources, energy supplies and systems for the German army, and the development of new technologies and materials for defense against terrorist attacks.

In particular the Fraunhofer ICT offers R&D services in the following technology fields:

**Explosives:**
Development, manufacture and characterization of:
- Rocket propellants for defense engineering and space craft
- Gas generators
- Gun propellants, explosives, new ignition systems
- Chemical fuels and systems
- Safety and protective systems

Modeling tools:
- Interior ballistics
- Reaction kinetics, combustion processes, thermodynamics

Detection technology:
- Detection of explosives in the area of civil security, for example for portal systems in the framework of national and European projects (including EXPEDITE, EMPHASIS)
- Operation of the national “Test Center for the Detection of Liquid Explosives”
- Electrochemical sensor technology

Safety and security technology:
- Technologies for defense against terrorist attacks (EU project SUBCOP)
- Non-lethal weapons

**Technical safety and security:**
- Risk analyses in the handling of combustible and explosive materials
- Investigation and analysis of safety risks and accident scenarios in the design/operation of industrial testing units
- Safety and security assessments of energy storage devices

**Energy supply systems:**
Electrochemical energy storage devices:
- Redox-flow batteries
- Lithium-ion modules

Fuel cell systems
Energy management systems
Radar and related high-frequency systems form a key technology for defense and security, particularly in the field of reconnaissance and surveillance. Due to its unique capabilities – independence from weather and daylight, long-range, high sensitivity to range rate changes and the generation of high resolution images – radar is now an indispensable tool for military and civilian applications.

The Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR develops concepts, methods and systems for electromagnetic sensors, particularly in the field of radar, together with innovative signal processing methods and state-of-the-art technology in the microwave to the lower terahertz frequency range. It has supported the German Ministry of Defense in this field since the foundation of the institute in 1957. With a budget of approx. € 24.5 million and approx. 279 employees, Fraunhofer FHR is one of the largest radar research institutes in Europe.

Examples of successful research projects accomplished by the institute:

- Air-borne radar imaging with ultra high resolution
- Moving target detection and tracking of ground-, air and maritime targets
- Space observation with the experimental Tracking and Imaging Radar system TIRA
- Sensor-based landing aid for helicopters in poor visibility (Whiteout/Brownout)
- Passive systems for airspace reconnaissance by using radio- and TV-broadcasting signals
- Security: Active and passive scanner systems for people, luggage and mail
- Monitoring of instable buildings with MIMO-Radar
Founded: 1963
Staff: 400
Annual budget: 27 million €

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www.fkie.fraunhofer.de
The Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE develops innovative technologies for the detection, awareness and prevention of threats. The systems are used by the Bundeswehr (German federal armed forces), civilian security services and industry.

When it comes to the recognition of threats a reliable understanding of the operational scenario is indispensable. We acquire, transmit, process and protect data and make it available in a comprehensible form to support decision-making. We develop methods and procedures for all types of military reconnaissance whether it be on the ground, in the air, at sea or under water.

**Seamless security assistance systems**

Defense against terrorist threats largely depends on intelligent situational awareness systems. Fraunhofer FKIE explores advanced tracking and fusion methodologies to exploit data from networks of multiple heterogeneous sensors. Our unmanned systems group develops (multi-)robot systems which provide data in missions too dangerous for human forces.

**Robust and secure communication systems**

Modern security missions rely on trusted communication networks. We develop robust networks and solutions for radio propagation effects, and localize and classify communication emitters. The security of critical network infrastructures is central to our Cyber Security & Defense Lab.

**Smart decision support systems**

Smart decision support systems provide the necessary methods to access relevant information more rapidly. We develop tools for the fusion of information acquired from the field-data and ensure consistent distribution within information systems. Furthermore, we design and create human-machine interfaces that enable the human user to work with the system intuitively and effectively.
FRAUNHOFER INSTITUTE FOR HIGH-SPEED DYNAMICS, ERNST-MACH-INSTITUT EMI

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Founded 1959
Staff 310
Annual budget 23 million €
The Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI, develops and researches new approaches and solutions for applications in the business segments defense, security, space and transport. The institute's competences are the investigation of impact, shock and penetration phenomena by experimental, simulation-based and analytical methods in order to improve the security, safety and reliability of components, structures and systems under dynamic loads.

**Protection & bridging technologies**

Fraunhofer EMI analyzes and develops protection concepts and new materials for high dynamic loadings, sensor systems for the application in ballistics as well as practice oriented engineering software. Solutions range from vehicle and personal protection systems against ballistic and explosive threats, the protection of service infrastructures and the development of materials to the reduction of vulnerabilities of aerostructures and vehicles.

**Protection of critical infrastructures**

The main research focus lies on technologies to physically protect critical infrastructures. Our solutions include efficient building reinforcement and structural concepts, the development of dedicated, customized materials such as ultra high performance concretes and integrated sensor systems for real-time monitoring of static loading capacities. Thus, we can offer balanced security concepts of the protection of building infrastructures.

**Hazard and risk analysis**

Hazard and risk analysis research services provided by EMI support the risk management especially in case of terrorist events such as explosions, but also in case of industrial accidents, natural disasters and even of cross-linked, multimodal risks caused by such events.
FRAUNHOFER INSTITUTE FOR TECHNOLOGICAL TREND ANALYSIS INT

Founded 1974
Staff 110
Annual budget 8 million €

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The Fraunhofer Institute for Technological Trend Analysis INT creates and continuously updates a comprehensive overview of the general research and technology landscape and of the entire spectrum of national and international technological developments. In addition to this general overview, we generate our own specialized analyses and forecasts in selected technological areas.

For more than 30 years, the Institute has been advising the German Federal Ministry of Defense on questions of technology and on how to plan and realize new research and technology projects. In recent years, research has increasingly been carried out also for other public institutions involved in security precautions and long-term changes in society. In addition to this, INT performs its own experimental and theoretical research on the effects of ionizing and electromagnetic radiation on electronic components and systems.

The Institute is equipped with state-of-the-art measurement technology. The major laboratory and large-scale devices are radiation sources and electromagnetic simulation facilities which cannot be found in this combination in any other civilian institution in Germany. Our main clients include authorities and organizations concerned with security affairs and precautions. Additionally, the Fraunhofer INT advises a client base ranging from medium-sized companies to DAX30 corporations.
Fraunhofer IOSB

Founded in 2010 as merger of Fraunhofer IITB (founded 1956) and FGAN FOM (founded 1957)

Staff 445
Annual budget 41 million €

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Fraunhofer IOSB is a well established partner of choice in networked sensors and image exploitation for security and defense. Its security-related work is concentrated in two business units:

With its approach “Consulting and Technology for Defense”, the business unit Defense focuses on and develops feasibility studies and methods based on basic investigations for military research. It evaluates trends and technologies, tests and develops demonstrator and supports industry to produce innovative equipment. National and international cooperation secures competency, expertise and broad background knowledge of the military and security research landscape.

The business unit Security focuses on the security needs of people, companies and authorities wishing to protect against natural and intentionally planned hazards, and comprises a broad range of interlinked competencies that deal with sensor sphere optronic aspects as well as multimodal surveillance robotics (land, sea, air), big data analytics, the support of interoperable standards for real-time exchange of information for risk detection and management as well as assistance in situational analysis and human machine interaction in situation control rooms. IOSB’s Cyber Security research team assists customers in various application domains, and the work on Security for Industry 4.0 builds on IOSB’s long-standing expertise in both Security and Automation.

At Fraunhofer IOSB, special attention is given to bridging technologies in order to optimize economic efficiency and help protect societies against a wide variety of threats. Sample project work includes the ABUL system helping German forces in Afghanistan process and analyze UAV video data, and the SENEKA project bringing together a number of Fraunhofer institutes under IOSB leadership in order to define entirely new ways to manage disasters using sensor networks based on mobile robots.
Fraunhofer IIS ranks first among the Fraunhofer-Gesellschaft’s institutes in terms of both headcount and revenue generated. We provide our expertise based on technical analyses, in-depth feasibility studies, research and development contracts and partnerships, services like independent tests and measurements, as well as various basic technologies and systems for safety and security applications. This security-related work centers on communications and locating as well as on imaging and X-ray technologies.

Communications
- New interfaces for tactical software defined radio
- High-quality wireless voice and data communication for first responders and military personnel
- Long-lasting wireless multi-hop sensor networks for data collection in hard-to-reach places
- Long-range terrestrial communications
- RFID for security applications and logistics processes
- Measurement equipment for design support and verification

Positioning Technologies
- Autonomous positioning without data communication for example in critical communication infrastructures
- Protection against plagiarism
- Robust GNSS receiver against jamming/spoofing
- Inertial sensors and sensor fusion

X-Ray Inspection
- 3D high-energy X-ray technology for inspection of maritime containers and truck freight
- 2D X-ray transmission and scatter methods and systems for application-specific inspection
- Material-selective computed tomography for 3D visualization of objects in closed containers
- Fully automatic 2D and 3D image processing for screening packaged goods for illicit material
- Dedicated detector systems: fast, robust, radiation-resistant, spatially high-resolving, energy-discriminating, with flexible geometry and size

Imaging Systems
- People and face detection
Information and communication technologies are the most important enabling technologies for the modern society. Safety and Security is based on knowledge and information. Providing appropriate data is the key mission of Fraunhofer HHI. Images, video, language, gestures, sound and sensor-signals are used to transform data into knowledge.

**Interception protection based on 60 GHz Communications**
Broadband millimeter-wave communication in the 60 GHz range is an appropriate method for transmission of high data rates in short range transmission. The main advantage of this frequency band is the large free bandwidth. In view of high transmission losses of walls, the radio cells are small. This leads to high safety from interception.

**Visible Light Communication**
LEDs are more and more used for general lighting applications. By modulating the light high data rates can be transmitted, positioning systems can be set up as well as indoor navigation based on standard components.

**Photoacoustic Sensors**
The detection of explosives and gas in distributed sensor networks is enabled by miniaturized photoacoustic sensors. They are designed as a fully integrated wafer level optical device. They are highly sensitive and used for the early identification of fires, methane detection in mines and for bio analytics based on photoacoustic spectroscopy, cavity ring-down spectroscopy and multi-pass absorption spectroscopy.

**Miniaturized THz Systems**
THz systems are widely used for security applications. Analogous to the change in consumer electronics from the valve to the transistor radio Fraunhofer HHI builds miniaturized systems shrunk by an order of magnitude. It applies its InP-technology matured with telecom applications to convert optical signals into THz radiation. The novel THz hardware can be used even for handheld active THz.
The Fraunhofer Institute for Systems and Innovation Research ISI analyzes the origins and impacts of innovations. We research the short- and long-term developments of innovation processes and the societal impacts of new technologies and services.

Fraunhofer ISI’s systemic approach guarantees a sound analysis and foresight of innovative security services. Individual technologies, organizational innovations, social and political framework conditions are not considered in isolation. A reliable assessment is only possible by viewing the various aspects as a whole. This is the basis for constructing roadmaps or scenarios of future markets and applications.

In security economics projects, Fraunhofer ISI analyzes the supply and demand for security services, and addresses user acceptance, regulation and competitive conditions. The innovativeness of security services is determined using bibliometric data or patent statistics; value chains and social developments are analyzed as the drivers of demand and future security requirements.

Assessing the vulnerability of water, energy, transport or information infrastructures and deriving suitable preventive measures for resilient structures and systemic risk management is part of Fraunhofer ISI’s core competence in security research. We also propose solutions and options in the field of data protection for information and communication technologies.