eHealth Interoperability Lab
The Intelligent Medical Technology for Tomorrow

» The key problem of eHealth is lack of interoperability. Systems must be able to speak to one another within hospitals, between hospitals and ultimately across borders. We need interoperability and information exchange in order to ensure continuity of care and safe emergency care delivery. I believe interoperability can come about without infringing on national competence in the area of health. «

John Dalli, European Commissioner for Health and Consumer Policy, October 2010

Powerful Networking

The interoperability of electronic systems and seamless data transfer guarantees better healthcare. eHealth applications and IT architectures that interact intelligently will help hospitals, pharmacists and health insurances to improve their performance and reduce expenses.

With the eHealth Interoperability Lab, Fraunhofer FOKUS provides a powerful environment for testing and optimization of electronic systems within the healthcare sector. Even before the first practical use and the launch onto the market, the quality, interoperability, networking, security and scalability of new IT infrastructures and software solutions can be tested and assured.

The seamless information flow and seamless data transfer play an important role in modern healthcare. Whether it is a medical record, a current case file or accounting records, providers and benefactors need to have equal access to diagnostic, therapeutic and process-related data. These include doctors, nurses and medical assistants as well as pharmacists, health insurance companies and hospitals. Seamless and preferably automated information flow between medical devices in the operating room, in the laboratory and in the hospital is crucial for reliable and safe healthcare.

In order to manage information and data in the healthcare sector, cross-organizational, IT-based systems are becoming more and more common for the support and automation of work processes. As a result, the number of networked medical systems in the healthcare sector and of different work processes that have to be supported electronically is increasing. This has lead to an expanding complexity of the systems. In addition, various IT architectures and software solutions by different manufacturers are often used for the operation of eHealth processes.

Efficient data management – life-saving seconds

In order to transfer data and information in the healthcare sector precisely, securely and without loss, the various systems must work together seamlessly and interoperably. Patients, doctors and especially the operators of healthcare facilities profit from this. Due to the fast electronic transfer of information, doctors, particularly in emergency medicine, can gain life-saving seconds. The use of networked eHealth applications and IT architectures that interact intelligently and without friction losses allows for enormous efficiency potential in the healthcare sector and thus improved healthcare and cost savings.

The eHealth Interoperability Lab of Fraunhofer FOKUS provides the operators and developers of eHealth systems as well as processes with the possibility to test the efficiency of new applications and communication infrastructures. Further, they are enabled to assure their interoperability with other systems even before they are offered as a product on the market or before their first use. In addition, the experts of Fraunhofer FOKUS provide the suppliers of ICT systems in the healthcare sector with the opportunity to analyze the conformance and interoperability of new or existing systems and to automate the testing of these systems.

The eHealth Interoperability Lab

Whether it is the electronic transfer of health records or the proactive care of emergency patients, the eHealth Interoperability Lab offers the state-of-the-art development and test environment for all relevant applications in the healthcare sector.

In the eHealth Interoperability Lab, relevant applications can be realistically reproduced – from the emergency care, the ambulance service and the outpatient treatment to pharmaceutical therapy and the integrated care. All test scenarios are taken from everyday life in the healthcare sector and the medical care. They build the basis for users and manufacturers to assure the data transfer and interaction of applications with other healthcare information systems.

Equipped with the most advanced IT test technologies, the eHealth Interoperability Lab is based on the latest research in the tool-based software development. The infrastructure of the laboratory covers many process chains in the healthcare sector and is thus precisely geared to the needs of the actors.

The laboratory facilities are constantly being updated through partnerships as well as development and research projects. Fraunhofer FOKUS thus assures that the test and development environment can be flexibly adjusted to current and future demands in the healthcare sector.

Standards as common denominator

The compliance with standards is an important basis to assure the interoperability of systems by different manufacturers in the healthcare sector. All test tools and methods that are used in the eHealth Interoperability Lab are based on current IT standards for eHealth applications and architectures.

In addition to specifications of the standardization bodies ISO, IEC, ETSI and ITU, the eHealth Interoperability Lab supports the following IT standards:

- The HL7 protocol in the versions 2 and 3; these define standard message formats and transfer protocols for the information exchange within all standardized Health Information Systems (HIS)
- The IHE profiles; they define, how the exchange of patient-related data between the actors in the healthcare sector has to be carried out, for example between cardiology and radiology
- The EHR standard; the standard defines the data exchange for the electronic health record

The support of further standards, for example DICOM (Digital Imaging and Communications in Medicine), is in development.

The systematic test approach used in the laboratory contributes significantly to the improvement of the product quality of eHealth systems. For the development of the test scenarios, the experts of Fraunhofer FOKUS employ the modelling language UML, the UML testing profile as well as the test specification and test implementation language TTCN-3. In this way, the different actors can be integrated transparently and efficiently in the test procedure in order to simulate the direct interaction of the actors within the process.

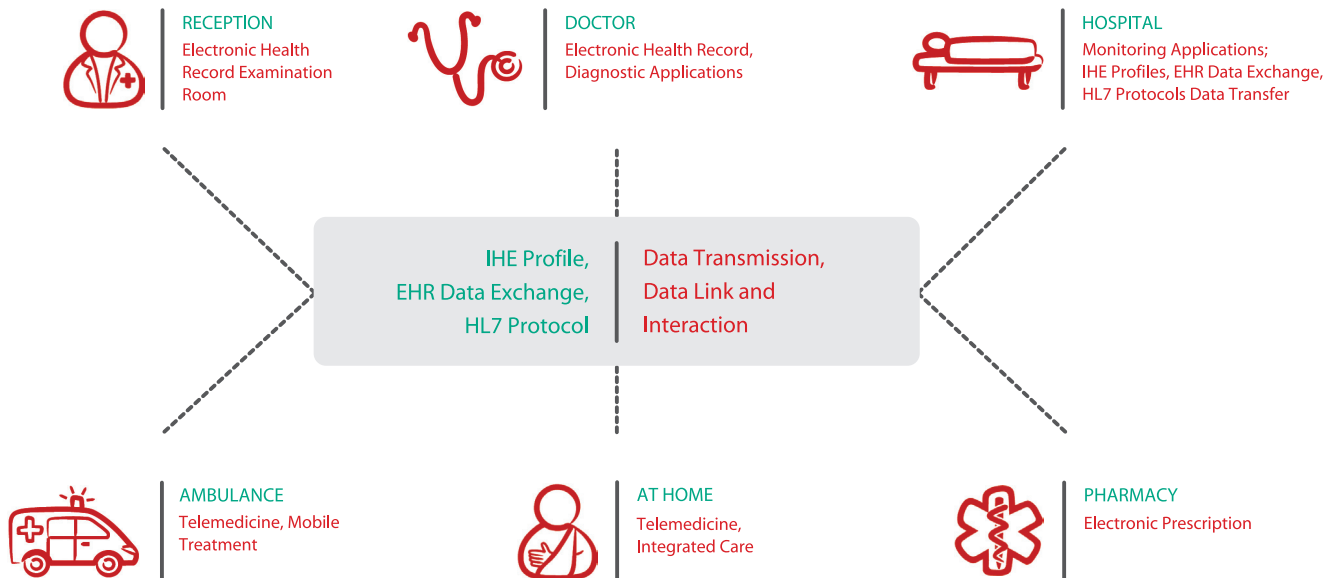### Up to date on the latest research

The eHealth Interoperability Lab is integrated into domestic and international research activities. The experts of Fraunhofer FOKUS contribute considerably to the research of new eHealth applications and systems and are established as competent partners in research and development projects.

Recent results from these research and development activities, like those of the Connectathon events, are immediately incorporated into the test and software environment of the eHealth Interoperability Lab. In this way, current developments on the healthcare market, activities of the German and European healthcare policy and the integration of existing demands from medical technology can be promptly represented. In addition, Fraunhofer FOKUS is represented in international standardization bodies and thus actively involved in the definition and specification of international standards.

RECEPTION
Electronic Health Record Examination Room

DOCTOR
Electronic Health Record, Diagnostic Applications

HOSPITAL
Monitoring Applications; IHE Profiles, EHR Data Exchange, HL7 Protocols Data Transfer

IHE Profile, EHR Data Exchange, HL7 Protocol

Data Transmission, Data Link and Interaction

AMBULANCE
Telemedicine, Mobile Treatment

AT HOME
Telemedicine, Integrated Care

PHARMACY
Electronic Prescription

Reception / workplace nurse

Evaluation and monitoring of current patient data, evaluation of laboratory test, management of the patient data in the electronic health record.

Doctor / examination room

Use of diagnostic devices like sphygmomanometers and heart rate monitors, recording of the diagnosis as well as the therapeutic measures, prescriptions and referrals to specialists in the electronic health record, management of doctor appointments, billing the health insurance company.

Ambulance

Accessing patient data in the electronic health record, examination and initial diagnosis, determination of the closest hospital, mobile transfer of the data for the preparation of medical emergency measures in the chosen hospital.

Hospital

Recording and adding to the patient data in the electronic health record. Monitoring of the vital signs of the patient, general and personal care.

At home

Self-medication, mobile transmission of the data of diagnostic devices.

Pharmacy

Handing-out of prescribed medication according to the electronic prescription, transfer of the data and billing of the health insurance company.

Test Scenario: Emergency Medicine

Accident, outpatient treatment, therapy - until recovery, a patient goes through a variety of stations. Especially in emergency medicine, doctors, paramedics and patients profit from fast data and information management.

In the eHealth Interoperability Lab, the experts of Fraunhofer FOKUS research and develop test systems and future-oriented eHealth applications. For a perfect interaction, interoperability, security and compatibility are indispensible. The networking and the communication between the devices play an important role in guaranteeing efficient and fast treatment. The practice-oriented test scenarios of the laboratory are suited to optimize processes in the healthcare sector.

In the eHealth Interoperability Lab, test scenarios for reading electronic health cards as well as for their application with different systems can be assessed and tested in different environments in a defined process.

Practical example traffic accident

The example of a traffic accident shows the application possibilities of eHealth technologies in the healthcare sector. Already today, networked and integrated eHealth systems are being used. Continuous processes enable the electronic health card and the electronic health record in particular, which are already being tested in selected German regions. A nationwide launch of these

systems is currently in preparation. The experts of Fraunhofer FOKUS offer support for the technical implementation as well as for the development and adjustment of suitable applications.

The injuries and vitals of the patient are initially diagnosed in the ambulance. With the help of eHealth monitoring systems, the collected data as well as the data of the electronic health record can be transferred in encrypted form in the future. On this basis the available hospital offering the optimal treatment for the particular injury can be located. There, the doctor on call can refine the diagnosis and prepare the operating room, if necessary, even before the ambulance arrives at the clinic.

In the hospital, the attending physicians can access the medical history as well as the current medication of the patient in the electronic health record and take that information into account for their therapy. That way, medication and therapy can be adjusted to the individual patient. The recorded vitals of the patient are transferred to other systems for the patient-related analysis.

The primary care provider continues the treatment of the patient after the hospital stay. The health record that is stored on the

It is the goal of the eHealth Interoperability Labs to support manufacturers of eHealth systems during the development, approval, and certification as well as during the integration and launch of secure, standard-conform and interoperable eHealth systems.

In the eHealth Interoperability Lab, eHealth systems and applications can be assessed in test scenarios: data exchange and interactions are illustrated, weak points are eliminated and the interoperability with systems by other manufacturers is assured.

electronic health card provides the primary care provider with all relevant information about the medical history and the specific traffic accident of the patient. The primary care provider can for example directly access operative reports, laboratory findings or x-rays. Based on this information, the primary care provider treats the patient until he or she is recovered. The primary care provider saves an electronic prescription on the card. In addition, vitals of the patient can be monitored in the home environment via telemedicine.

During the recovery phase, the patient wears a mobile device around his or her wrist which alerts the treating physician via Bluetooth and mobile communication in case specified threshold values are exceeded. Patient and physician can overcome spatial and time constraints by using telemedicine and telemonitoring. The hospital stay is thus shortened.

In the future, the patient will pick up his or her medication from the pharmacy by presenting an electronic prescription that is stored on their electronic health card. The pharmacist can access the medication history and is thus able to determine whether incompatibilities and interactions with the prescribed medications can be expected. The complete process, from writing the prescription and the distribution of the medication to the patient to the billing is seamless.

Successful testing of functionality and interoperability

In the eHealth Interoperability Lab, the functionality and interoperability of eHealth systems and applications can be comprehensively tested. Thus, the transfer and processing of information as well as the interaction with other systems by other manufacturers can be assured and improved.

TTCN-3 Test Design

TS : Test System
PTC : Parallel Test Component
SUT : System under Test
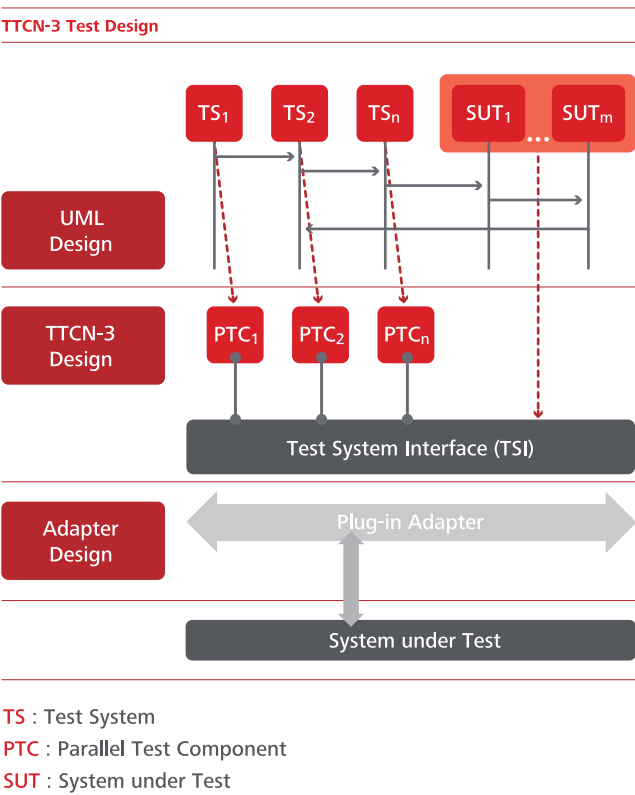
Test design based on the standard TTCN-3

The tests are designed in three phases: In the UML design, the interactions, for example the exchange of messages or operational requests, between the actors of the test system (TS_i) and the components of the system that is being tested (SUT_i), are illustrated. The modeling of the actors of the test system is carried out in the TTCN-3 design using parallel test components (PTC_i). In addition, the actors are connected with the ports of the test system interface (TSI). In the adapter design, the test adapters of the different protocols for the communication with the »system under test« are designed and provided as plug-ins.

Cost and Process Optimization with eHealth Technologies

What future does eHealth have in store? Actors from the healthcare sector evaluate current challenges and perspectives.

For five years, funding agencies, service providers as well as experts in the healthcare sector were questioned about how they would rate the current challenges and perspectives of the process optimization, eHealth and networking. The goal of the current study »eHealth & Healthcare Management 2010« is to evaluate measures and solution approaches for a future-oriented healthcare system from the perspective of health insurance companies, hospitals and experts. The spectrum spans from the status quo in the healthcare sector to the significance of eHealth technologies and networking.

The study was carried out under the leadership of the Wegweiser GmbH Berlin Research & Strategy in collaboration with part–ners from the healthcare sector: The Federation of German Industry (BDI), the German Federation of Information Industry, Telecommunication and New Media (BITKOM), the Association for Purchasing, Material Management and Logistics in the Hospital (femak), the Hartmannbund, the German Federation of Electrical Engineering and Electronic Industry (ZVEI) and the German Social Association VdK.

Around 2,000 German hospitals, approximately 6,000 resident and employed doctors, 160 private and statutory health insurance companies as well as 350 experts from the healthcare sector submitted their evaluations in regards to the innovation and optimization potential in organizations as well as to networking and IT in the healthcare sector.

Networking as basis for collaboration

Networking and a nationwide IT and telematic infrastructure are the basis for future-oriented healthcare. Therefore, cross-sector networking and an integrated care are the top priority for following questioned groups: Experts (92 %), health insurance companies (86 %) and hospitals (85 %) identified them as an important approach for a better collaboration. The respondents considered the necessity of a nationwide IT and telematic infrastructure and

technological network as basis for cross-sector networking to be very important. The experts rank the area of telemonitoring and the integrated care in the home environment with 86 % amongst the important to very important approaches for mastering the challenges in the healthcare sector. Health insurance companies and hospitals however attribute telemonitoring / home care with a significantly lower potential.
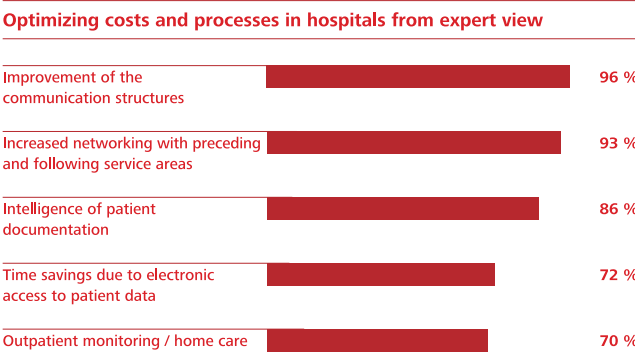
Optimization approaches for the healthcare sector

Cross-sector networking — 92 %
— 86 %
— 85 %

Technological networking — 83 %
— 80 %
— 82 %

Implementation of a nationwide IT and telematic infrastructure — 81 %
— 80 %
— 88 %

Telemonitoring / home care — 86 %
— 52 %
— 53 %

- Experts
- Health insurance companies
- Hospitals
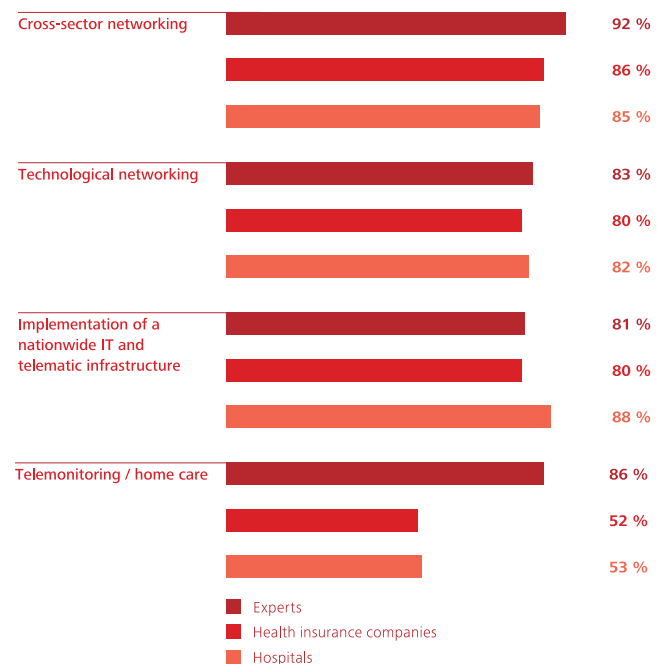
Mentions ›important‹ and ›very important‹ are cumulated
Source: Wegweiser GmbH, Berlin 2010

Optimizing costs and processes in hospitals

Especially hospitals can profit from better networking and eHealth applications. From the political point of view, the improvement of the communication structures (96 %) and increased networking with the preceding and following service areas (93 %) harbour great efficiency reserves in hospitals. The following additional approaches for the cost and process optimization in hospitals are identified: the intelligence of patient documentation (86 %), time savings due to electronic access to patient data (86 %) and outpatient monitoring / home care (70 %).

Optimizing costs and processes in hospitals from expert view

Improvement of the communication structures	96 %
Increased networking with preceding and following service areas	93 %
Intelligence of patient documentation	86 %
Time savings due to electronic access to patient data	72 %
Outpatient monitoring / home care	70 %