FREQUENTIS

research BULLETIN

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Corporate Research – Getting our Grip on Innovation

Frequentis Corporate Research supports the Business Units with research activities and innovative concepts to pursue the goal set out in the vision statement "In our core competencies, we set the standards the rest of the world follows". Studies, demonstrators, and technical prototypes are a means for evaluating new ideas with both external and internal stakeholders, as well as partner companies. We constantly stimulate creativity and innovation, but we also regularly scan the markets for relevant new ideas and technological breakthroughs. Results of those activities inspire our product development and often make the difference to distinguish Frequentis products from others.

But how to practically link research outcomes with the daily business? – Well, that is a difficult question to answer. At Frequentis Corporate Research we follow different strategies: Regular exchanges with our business units assist in setting up business development activities early on. Expert consultancy is offered to key customers and interested parties in-house. Know-how transfer is achieved via technical trainings and temporary assignments to product development teams.

This issue of the Research Bulletin presents a selection of ongoing research and development projects: Data models are a means to standardise data representation and to foster system interoperability. Our work on Crisis and Disaster Management has received a new boost by a number of new activities on national and international level. On the subject of usability, we investigate the impact of gender aspects on the design of working positions with a number of academic partners. Other technical reports present the results of our activities on optimising data link usage by multi-link concepts and how to achieve secure separation of processes on a single hardware device.

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The steady investment into R&D allows Frequentis to build technologically high advanced products and consequently provide our customers with long-term investment security and high value for money. We hope you enjoy following our spotlight into the future by reading the articles. Please feel free to contact us if you come across anything of particular interest to you: our team of experts will be more than happy to discuss any of the topics covered in the bulletin.

HANNES BARDACH GEORG TRAUSMUTH

semNOTAM – A Semantic Approach for Prioritising DNOTAMs

AUTHOR: Eduard Gringinger
http://semnotam.frequentis.com

semNOTAM
Intelligent NOTAM Prioritization

Intelligent filtering and querying of Digital NOtices To AirMen (NOTAM) has been identified as important but is still an unsolved issue in terms of fully exploiting the potential in future Air Traffic Management. The research project "semNOTAM" uses a knowledge-based approach exploiting semantic technologies for tackling the problem of efficient, flexible and context-aware filtering and querying of NOTAMs. Notices to airmen provide timely knowledge which is essential to personnel concerned with flight operations.

Nowadays NOTAM-systems are still based on teletype technology leading to insufficiently structured text messages which are difficult to filter. Pilots, as a consequence, complain about excessively long pre-flight bulletins, information overload, lack of support on what NOTAMs actually mean, lack of priorisation by space and time, lack of situation-awareness and temporal relevance, and lack of control over how, when and what information is presented. The introduction of Digital NOTAM will provide information in a much more structured way, but will still require rules and filtering functions to provide the information in an efficient way to the end user.

The semNOTAM approach extends semantic technologies for fine-grained event-type, location-, time-, and aircraft-aware filtering and querying of Digital NOTAMs. Semantic systems are characterised to differentiate between a declarative (usually logic-based) knowledge representation of data and business rules of a domain and processing engines that control the knowledge or query extensional data of the knowledge base. They are thus in line with the move to the data-centric nature of Aeronautical Information Management (AIM) from the product-centric nature of Aeronautical Information Services (AIS) and in addition they provide a semantic description of data and business rules. By offering declarative specifications independent of use, semantic systems simplify interoperability and applications (as these can rely on and [re-]use concept definitions of the knowledge base.)

This work was supported by the Austrian Research Promotion Agency (FFG) [grant number 839006].

Dynamic Workflow Support for Aerodrome ATC Controllers in the iCWP

AUTHORS: Nicolas Klein, Hubert Künig

Air Traffic Control (ATC) at an aerodrome means the controlling of landings and take-offs as well as the movements of aircraft and ground vehicles on the surface. To manage this traffic in a safe and efficient manner, procedures have been established in the past decades, involving many singular 'workflow steps' to be applied to each individual participant. For a departing flight, for example, the air traffic controller has to provide a sequence of instructions (known as 'clearances') to the pilot, such as to start up the engines, to push back from the parking position, to follow a certain taxi route, to go to the de-icing area, to enter a runway, to take off. The actual number and sequence of these steps is not fixed, but depends on the context, such as weather conditions, traffic situation, etc.

The Integrated Controller Working Position (iCWP, being prototyped in a DFS/Frequentis cooperation in the scope of the SESAR 12.05.04) supports the controller in following these workflow steps in an optimal way. The iCWP provides:

- Single Workflow Button for each flight, located on the electronic flight strip:
  - Always indicates the most probable next step and allows to perform this step by a single click
  - Depends on the current flight state and aircraft position and is dynamically updated
  - Execution of alternative steps is still possible

- Alert Prediction on the workflow button:
  - Indicates to the controller the case, where the execution of the next workflow step would lead to a safety alert (e.g., due to a conflicting clearance given to a second aircraft)
  - The alert automatically disappears when the conditions are safe again
  - Execution of the step is still possible

- Datalink integration in the workflow:
  - For aircraft (and ground vehicles) being capable to communicate via datalink, the workflow button is used to send messages (e.g., D-Taxi messages), the next best suited datalink message is automatically shown on the button
  - Interaction via voice is still possible (via alternative buttons).

From the controller's perspective, executing the workflow for a certain flight becomes very simple. The iCWP always suggests the most appropriate next step to be performed, depending on the actual circumstances, while still providing full freedom to the controller to execute alternative steps, whenever necessary.

Technically, this solution relies on close interaction of the iCWP with services such as Flight Data Processing, Surface Routing, Safety Nets, Datalink Communications, etc.

Multipath TCP (MPTCP) as Multilink Concept

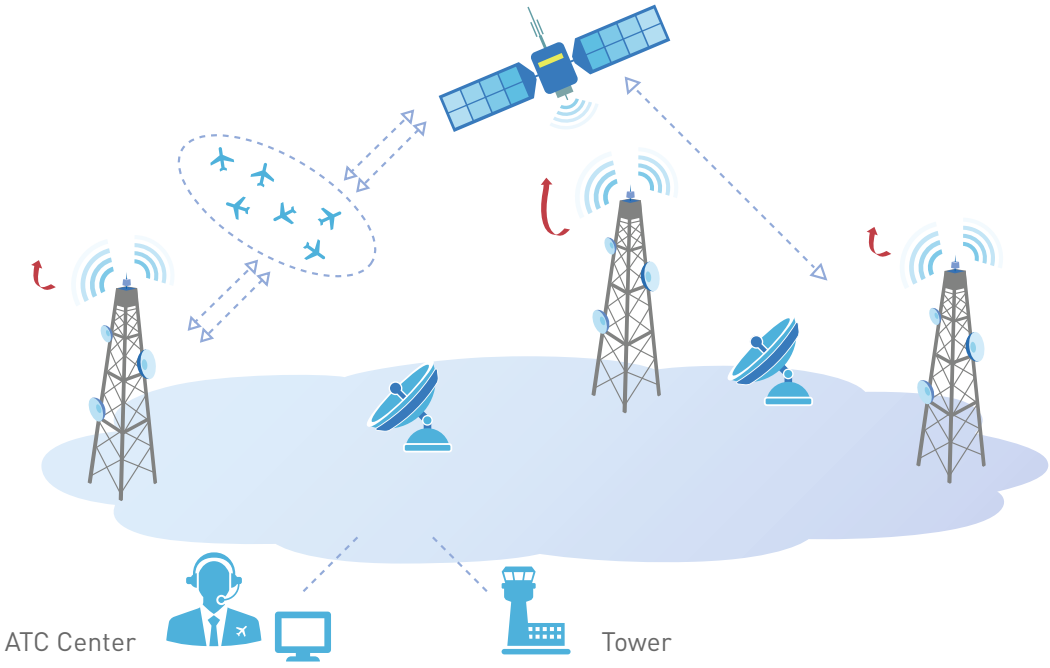
AUTHORS: Saadan Ansari, Miodrag Sajatovic

Multipath TCP [RFC6824] is a set of extensions to the standard TCP [RFC793]. The fundamental idea behind MPTCP is decoupling the TCP from IP. While regular TCP establishes its end-to-end transport connection using a single path, MPTCP can simultaneously use multiple paths. If the mobile host is an MPTCP-aware node, MPTCP provides opportunistic mobility management without requiring any new network entity. For legacy mobile hosts MPTCP proxy must be used, which translates regular TCP into MPTCP by rewriting the packet header.

Multiple MPTCP paths can belong to heterogeneous networks, e.g. one sub-flow may be a terrestrial network and another sub-flow may be a satellite network. Simultaneous use of multiple paths provides higher throughput and higher resilience against link failures.

MPTCP inherently implements a make-before-break principle when switching between involved paths and is fully backward-compatible with regular TCP in the sense that it is able to automatically (without user interaction) fall-back to regular TCP if the peer mobile host is not MPTCP-capable and no MPTCP proxy is available.

Following an agreement with the ESA, Frequentis intends to test Linux-based MPTCP implementation within the appropriate SW test environment. Interoperability and performance of the MPTCP proxy and MIPv6 must be compared and analysed, particularly considering satellite channels with long propagation delays. Furthermore, simultaneous utilisation and compatibility of MPTCP and MIPv6 in a single mobile host with respect to Multilink Concept should be analysed and verified.



D-MILS – Console Subsystem

AUTHOR: Wolfgang Kampichler
http://www.d-mils.org/

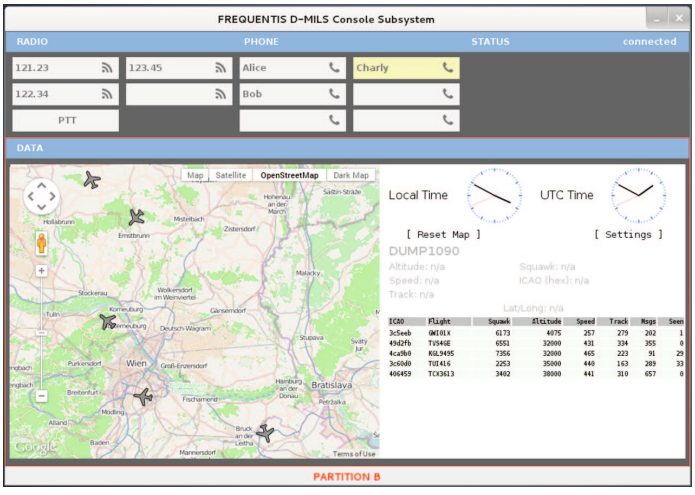
As industrial partner in the D-MILS project (STREP/FP7), Frequentis evaluates a new architecture that allows, for the first time, for application architectures to seamlessly span multiple computer systems, with scalable deterministic operation over a set of nodes, thus opening many new practical application areas.

One important piece of the D-MILS architecture is the MILS Console Subsystem (MCS) designed to complement a dependable information and communication infrastructure applied to ATM voice and data services. Frequentis Corporate Research designs the concept and implements the console subsystem that manages the interactions between a human user and one or more separation kernel (SK) partitions.

The MCS itself runs on a separation kernel. Its clients are partitions on the same SK node in an enclave that are capable of reliable communication with the MCS. In the introduced architecture, the MCS communicates with its clients (client application back-end) via SK information channels (e.g. IP communication configured on a single node). The human interface provided by the MCS consists of input/output devices exemplified by a display screen, keyboard, mouse, microphone and speaker that can be shared among partitions for voice and data applications at the same time.

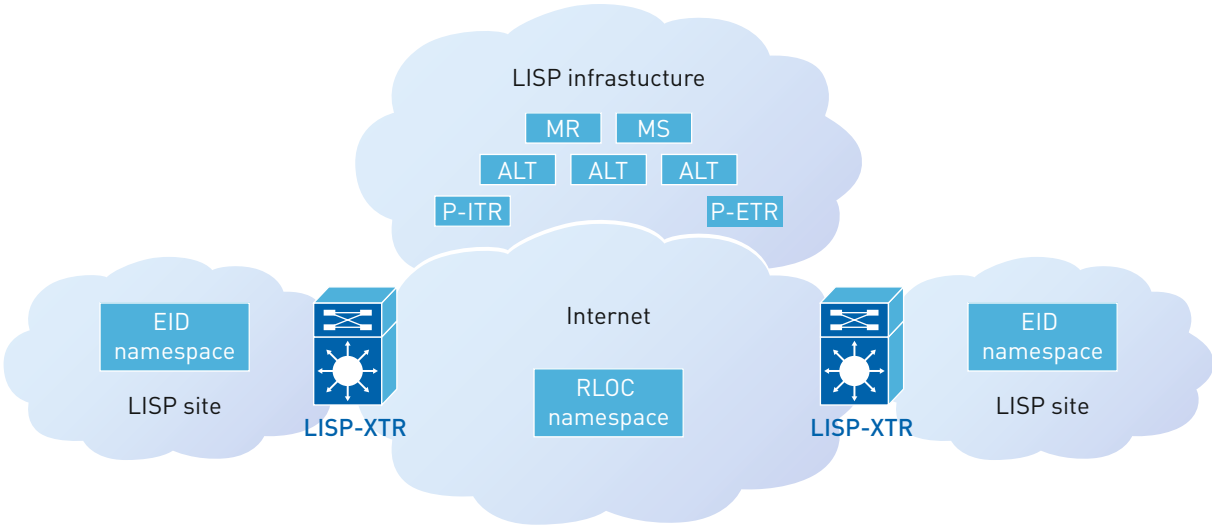
Distributed MILS methodologies are used to achieve the required system safety and availability. For instance D-MILS allows selected information elements to reside in all instantiated structures while completely prohibiting the propagation of faults from one side to the other and as such providing a valid business continuity design.

This work was supported by the EU's Seventh Framework Programme for Research (FP7) [grant number 318772].



ICAO Considers LISP as New Technology

AUTHORS: Manfred Lindner, Bernhard Haindl



LISP (Locator/Identifier Separation Protocol) was introduced by Frequentis at the WG-I – 17th Meeting in Montreal as a novel approach for the enhancement of the ATN/IPS-based network layer for operating multi-link communication between aircraft and ground infrastructure. Especially the LISP multihoming and mobile LISP site elements contribute to high availability, secure dynamic location updates and make-before-break handover.

In traditional IP networks the IP address is used for both: The identity of an IP system and the location of this particular IP system. By separating location ('Where are you') from identity ('Who are you'), LISP does not only solve multihoming issues but also inherently enables mobility, virtualisation and seamless communication ('Make before break') without using separate protocol techniques like BGP routing, Mobile-IP, MPLS-VPN.

LISP introduces a clear border between user networks (where the application resides) and transportation networks (which is the domain of network service providers). Further, LISP is IP-address agnostic where IPv6 user networks can communicate over any IPv4 service provider networks without any constraints or special negotiations with the service providers. LISP networks can easily be enhanced by the use of GETVPN (Group Encrypted Transport VPN) to achieve security (integrity/authenticity and optional encryption) for messages in transit. GETVPN, a stateless IPsec technology, dramatically reduces complexity for designing, configuring, operating and maintaining such networks compared to traditional technology.

Future Air Traffic Management/Control will rely on reliable IP communication networks both on ground and in air. These networks require high availability for their mission critical business which can be achieved using LISP multihoming and LISP fast convergence mechanisms. LISP has been thoroughly evaluated and tested in the Frequentis NISLAB in order to get this confidence.

EUROCAE WG-67 10th Anniversary

AUTHOR: Wolfgang Kampichler

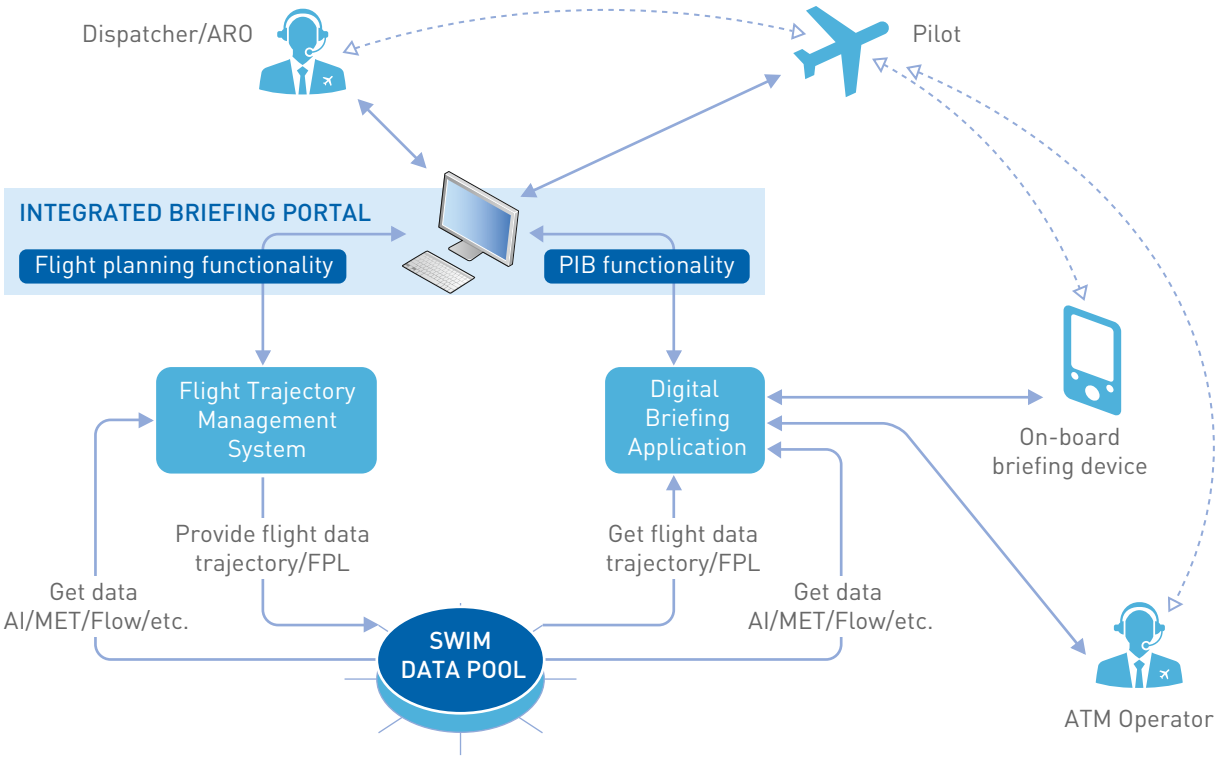
In 2004, EUROCAE (European Organisation for Civil Aviation Equipment) Working Group 67 (WG-67) was formed to define requirements for VoIP-based communication for Air Traffic Management (ATM). Founding members of WG-67 include European Air Navigation Service Providers (ANSPs), suppliers of VCS equipment and ground-based radio systems, the US Federal Aviation Administration (FAA) and EUROCONTROL. The aim of WG-67's activities is to harmonise interoperability of IP-based voice communication systems in ATM across the globe. The need to develop and agree on international standards for voice and data communications networks is critical for the transition to globally integrated air traffic management.

Released EUROCAE Documents (EDs) address the main requirements of both European countries and the Federal Aviation Administration (FAA), thus ensuring their global applicability. Since the formal adoption by the International Civil Aviation Organization (ICAO), countries from other continents (South America, Asia and Australia) have addressed their interests and introduced new requirements specific to their region. Therefore, WG-67 is preparing new releases particularly with regard to new requirements from such countries and further discusses a new document structure in order to provide a solid basis for the global implementation of VoIP in air traffic management.

A decade has passed since WG-67 approved the reference architecture (Vienna Agreement) and began developing standards for VoIP in ATM, with official releases and updates of relevant specifications (ED-136 to ED-138) as well as successfully completing interoperability testing on two continents. Through its research and development activities, Frequentis has contributed significantly to the development of standards and congratulates WG-67 to its 10th Anniversary.

FREQUENTIS Participates in EUROCAE WG-76 Aeronautical Information and Meteorological Data Link Services

AUTHOR: Eduard Gringinger



Between 2007 and 2010, EUROCAE Working Group (WG) 76 and RTCA Special Committee (SC) 206 worked together to deliver a document (ED-151/DO-308) and a Safety and Performance Requirements (SPR) document (ED-175/DO-324), as an initial step in the definition of standards for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services. At the end of 2010, WG-76 successfully achieved their goal and it was decided to suspend the working group. Since then a tremendous amount of new requirements have arisen and WG-76 needed to be reactivated.

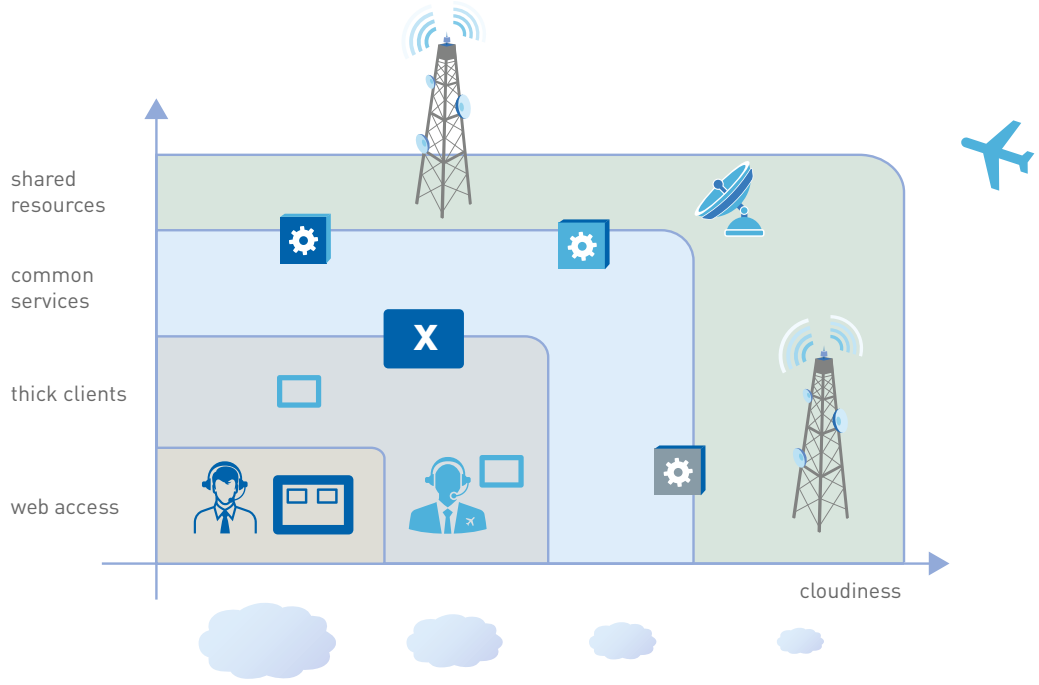
The new goals of WG-76 are to consider the use of Single European Sky ATM Research (SESAR) developments, and service concepts defined within the Information Service Reference Model (ISRM) for standardisation. WG-76 will define AIS and MET Data Link Services that will be fully compatible with SESAR SWIM and use the SESAR service development methods for the development of AIS and MET Data Link Services.

Frequentis is part of WG-76 and focuses on standardising the Digital Briefing Data Link. The term 'Digital Briefing Data Link' designates an on-board briefing device like an Electronic Flight Bag (EFB) which uses a briefing service component based on AIS/MET/ATFM data. The intended functions of the Digital Briefing Data Link are pre-flight data load, in-flight data update and post-flight data report.

Future Control Rooms

AUTHOR: Wolfgang Kampichler

Achieving operator effectiveness and situational awareness in control rooms to ensure safe operations and maximise productivity is a key performance indicator of future control rooms. This requires new thinking not only on the necessary operational changes but also on the technological paradigms that determine our current service architectures. Driven by the availability of more and more bandwidth within wide area ground networks, new technologies, such as Cloud Computing, are emerging. Beyond that, operational concepts are heading towards distributed decision making with a strong need for content management and collaboration tools in virtualised control rooms. This includes, for instance, dynamically moving the responsibility for airspace blocks from one facility to another and ensuring continuity of operation by providing contingency operations. Frequentis has already proven such capabilities with installed base- and state of the art technology. In order to further improve the efficiency and strengthen the resilience of control room services and their ability to interoperate with each other, Frequentis is now designing and implementing the next generation control room solutions following new technological paradigms. These include not only virtualised communication resources or cloud hosted information services, but also the latest advances in technology, for instance giving browsers native, real-time communication capabilities. Provided that these features prove to be applicable in specific domains it is very likely that any kind of outsourced cloud service may be accessed via a common browser environment. All things considered, it is to be expected that cloud computing in future control rooms will become an open framework for replaceable components and services across different domains, leading to flexible and cost-efficient service provisioning concepts envisioned today. However, this assumes willingness of actors, a changed way of thinking with significant institutional, political and technical challenges Frequentis' is ready to take.



Public Safety is Becoming an Electronically Networked Effort

AUTHOR: Christian Flachberger

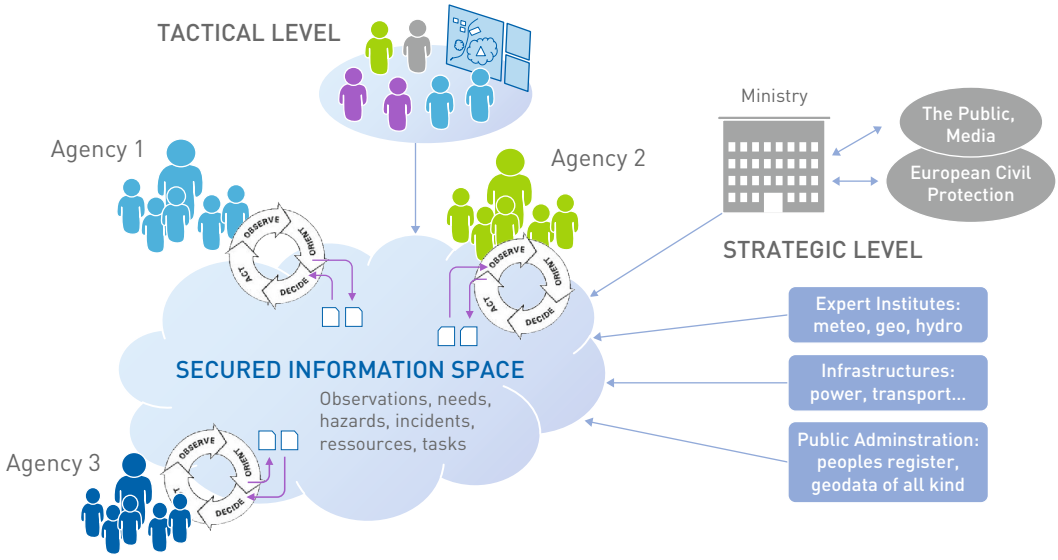
Collaboration has always been key in emergency management: During many situations, the police, fire and ambulance services work together. Collaboration counts even more in case of large emergencies, crises or disasters. A number of additional parties enter the picture in such situations:

- Civil protection authorities
- Specific units of the armed forces (e.g. CNBR)
- Operators of vital infrastructures (power, telecommunications, transport, food logistics)
- Specialised institutes that provide forecasts on weather, hydrology or the spreading of dangerous substances, for example
- Various departments of the public administration, providing data such as people registers, company registers, geo-data on land properties and similar

While basic collaboration procedures for crisis situations are already in place today or are today at least under implementation in many countries, electronic means for information exchange are still largely missing. We believe that modern control centre solutions must provide open interfaces for information exchange with all the above-mentioned organisations to support the collaboration procedures. Frequentis is therefore involved in several research projects focusing on the development and implementation of information exchange standards for control centres.

The most recent activity was started together with the European research project EPISECC, which was kicked off in June 2014. The acronym stands for 'Establish a Pan-European Information Space to Enhance SeCurity of Citizens'. Within this project, Frequentis is developing the reference-architecture for a secured information space for information exchange and collaboration during large-scale emergencies and disasters.

EPISECC is funded by the European Community's Seventh Framework Programme FP7/SEC. This work is supported by the EU's Seventh Framework Programme for Research (FP7), grant number 607078.



Secured information space for emergency management

ENGINE112 – Next Generation 112 Testing Project

AUTHOR: Wolfgang Kampichler

The manner in which emergency calls are made today is changing and the change of pace has legal ramifications for our citizens. Society is using internet-based tools for everyday activities (e.g. VoIP) but making emergency calls is not possible using some IP based products. Smartphone penetration is growing rapidly and while society benefits from this digital world, the future of how we make emergency calls is not so clear.

NG112 enables citizens to contact emergency services in different ways, using the same types of technology as those they use to communicate every day. It also makes it possible for emergency services to receive more and better information about emergencies of all magnitudes and improves interoperability between emergency services. Consequently, response time and operation cost will be reduced, while effective response will increase significantly.

Frequentis is a partner in a consortium with European technology providers, emergency services organisations, research and development laboratories, and telecommunication network providers that has submitted a proposal for funding for a unique opportunity in Europe to build a testing regime for NG112 products. The project identifies the main requirements of the emergency services in the medium-term, relying on extensive research already conducted as well as carrying out further research. Frequentis Corporate Research has overall technical responsibility.

The Unexploited Potential of Spontaneous Volunteers

AUTHOR: Christian Flachberger

Foto: ©Fraunhofer

Volunteers are a fundamental part of emergency response organisations in almost every country: ambulance services and many fire brigades rely heavily on volunteers. These volunteers are well-trained and an integrated part of the organisation. In addition, during large-scale emergencies, spontaneous volunteers arrive at the scene as a matter of course and want to contribute to the relief effort, e.g. during a flood event. Social media allows them to organise themselves rapidly and on a large scale. For professional response organisations, the unguided activities of spontaneous volunteers may become an obstacle or even an additional risk for the co-ordinated and controlled relief effort as a whole. Spontaneous volunteers may be seen as an additional hazard or as unexploited potential of capabilities and capacities. But how to guide and control this potential?

We believe that new concepts for volunteer management based on modern techniques and media can exploit this potential and can allow emergency management organisations to achieve more with the same effort. Together with the Austrian Red Cross and the Austrian Institute of Technology, a new concept for the management of pre-registered spontaneous volunteers called 'crowd tasking' has been developed. Up to now, this concept was presented on international conferences in Austria and the Czech Republic. Within two research projects (RE-ACTA on national level and DRIVER on European level), a framework of appropriate operational procedures for crowd-tasking and prototypes of electronic tools including a mobile app for the volunteers will be developed. The new concept of crowd tasking will be tested and shown together with the Austrian Red Cross during national and international exercises.

RE-ACTA is funded by the Austrian Security Research Programme KIRAS. DRIVER is funded by the European Community's Seventh Framework Programme FP7/SEC. RE-ACTA is supported by the Austrian Ministry for Transport, Innovation and Technology and its Security Research Programme (KIRAS), grant number 840869. DRIVER is supported by the EU's Seventh Framework Programme for Research (FP7), grant number 607798.

GenSiSys: Gender-Specific Design for Working Positions in Safety-Critical Environments

AUTHOR: Ronald Berger

In the field of safety-critical systems the design of working environments has been dominated by gender agnostic requirements, which did not take into consideration any specific characteristics of the genders. In the past the field was dominated by male employees and the lack of gender sensitivity has led to the current situation. There is still a lack of research studies and very little knowledge about methods in this area. Current surveys, both in military standards as well as in occupational medicine, show gender-specific job requirements. For the industry the lack of knowledge makes it difficult to develop gender-sensitive work environments. This may be one reason for the continuing male dominance, especially in safety-critical systems with high technical requirements for the users.

FREQUENTIS along with project partners such as FH St. Pölten, TU Wien, Usecon and ZIMD is developing a set of methods used for the evaluation of gender and diversity dimensions of the ergonomics and usability of jobs in safety-critical systems within this research project. By applying these methods in the contexts of railroad control centres, an emergency call centre and a highway authority, qualitative findings regarding gender requirements in such jobs as well as detailed guidelines are created.

In a first step the status quo of the gender composition of the workforce in the respective environments will be examined. Then a contextual analysis is to be carried out in the control centre which will also elaborate on the similarities and differences. For this, the systems, the tasks of the users, the education of the users, etc. will be analysed. The possible test methods will be identified (e.g. interviews, observations, questionnaires, usability tests, etc.) and finally checked within the control centre environments in terms of usability and significance.

Based on the outcome of these tests it will be possible to consider specific diversity requirements for future design processes, using context-sensitive studies of workplace ergonomics and software usability in the field of safety-critical systems.

This work was supported by the Austrian Research Promotion Agency (FFG) [grant number 3497234].

DRIVER – the Largest ever Crisis & Disaster Management Research Project

AUTHOR: Christian Flachberger

In May 2014, Frequentis kicked off its research activities within DRIVER, the largest ever Crisis & Disaster Management research project within the European Union. DRIVER stands for 'Driving Innovation in Crisis Management for European Resilience' and gathers 37 organisations from different member states and beyond together in a joint effort to improve the capabilities to prevent, prepare for and respond to natural disasters and technical accidents. Within this project, Frequentis takes the lead for the improvement of 'situation assessment tools'.

We believe that situation awareness is the most basic prerequisite for being able to take leadership in critical situations. Crises and disasters often start with a 'chaotic' phase, where managers are simultaneously confronted with information overflow, lack of reliable information and resulting difficulties to draw a comprehensive and relevant picture of the situation. Electronic situation assessment tools are supposed to support the crisis manager in analysing the situation and providing meaningful situation status reports by answering the following basic questions:

- What is the impact on population, ecology, infrastructure and economy?
- What is the probable further development of the situation?
- Which specific hazards have to be considered?
- Which response capacities are available and how are they to be used most efficiently?

Within DRIVER, Frequentis is organising a series of end-user experiments, where situation assessment tools from Frequentis and other vendors are tested during field exercises and then improved together with end-user organisations throughout the project.

DRIVER is funded from the European Community's Seventh Framework Programme FP7/SEC. DRIVER is supported by the EU's Seventh Framework Programme for Research (FP7), grant number 607798.

FREQUENTIS Experts and Authors of this Edition:

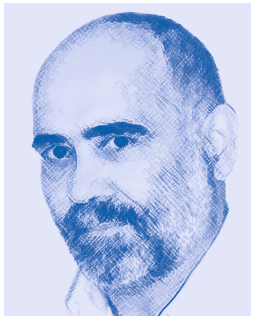
www.frequentis.com

Eduard Gringinger
Main fields of research:
ATM Data and Services Models

Nicolas Klein
Main fields of research:
ATM Systems and User Interfaces

Hubert Künig
Main fields of research:
Software architecure mainly for ATM

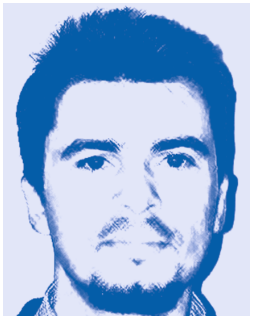
Saadan Ansari
Main fields of research:
IPv6 Network Mobility in ATM



Miodrag Sajatovic
Main fields of research:
Mobile aeronautical communication, including new technologies

Manfred Lindner
Main fields of research:
Locator/Identifier Separation Protocol (LISP), Software Defined Networking (SDN), IP Network Programmability

Wolfgang Kampichler
Main fields of research:
Architectures and Standardisation for VoIP based Control Centre Solutions



Bernhard Haindl
Main fields of research:
Expert in radio and IP communications, in particular for aeronautical applications

www.frequentis.com/researchbulletin

FREQUENTIS AG HEADQUARTERS

Innovationsstraße 1, 1100 Vienna, Austria
Tel: +43/1/811 50-0, Fax: +43/1/811 50-5009

www.frequentis.com

Christian Flachberger
Main fields of research:
Control Centre Solutions, Public Safety and Security

Ronald Berger
Main fields of research:
Aeronautical Information Management