Dear reader,

Technological change is not gradual. It comes in leaps of disruptive transformation followed by longer periods of consolidation and adaptation. We are now facing another period of technology transformation similar to the Nineties and the advent of the Internet. This time cloud computing and virtualisation, mobility and social networks are the cause of disruption.

Aircrafts have become more intelligent as well. Information and data links between aircraft systems, satellites and ground stations have gone beyond navigation, tracking and simple voice communication.

At the same time we have the passengers in the cabin. They expect access to a plethora of information at the tip of their fingers on a smart device which is connected by a broadband link to a cloud of services across the globe.

Independent to whether we embrace this change today or whether we decide to «sit it out,» a wave of technological change will impact air traffic management in the coming years. We need to ask ourselves whether we want to surf that wave and adapt and learn and have fun or whether we want to dive under and be swept ashore eventually.

Our strategic initiative to introduce virtual centres is a clear statement that we intend to actively drive change towards future air traffic management based on standardization and virtualization. We are confident that our model is both feasible and sustainable, as long as we don’t forget that innovation is driven by people and that technology is only the tool. Without people working together and embracing the outcome, innovation cannot take off. The focus now is on implementation.

In air traffic management, of course, there are intrinsic constraints to any transformational change. Nevertheless, we are in a better position to move forward than others. We have the backing of the local decision makers and we can rely on exceptional know-how in air traffic management. And Switzerland’s unique situation, being multi-cultural, small and nimble, open-minded and highly skilled is an asset, which we should exploit without hesitation.

This is an exciting time to be at the intersection of technology and air navigation services. The challenges we face are real and so are the implications of our choices regarding new technologies.

Thanks for taking the time to review our progress. I appreciate your continuous support in this endeavor.

Sincerely,

Klaus Meier
Implementing a harmonized Swiss-wide infrastructure
Andreas Paul, Programme Manager VCCH-T, skyguide

When SWISS flight LX 2021 from Madrid calls up Swiss ATC, the controller could be in Zurich or Geneva. It’s 2020, and skyguide has just implemented its Virtual Centre, enabling controllers in different locations to work as a single team with harmonized equipment, processes and procedures.

The efforts to harmonize skyguide’s Air Traffic Management (ATM) infrastructure are all based on the Virtual Centre Model (VCM) concept, which promises new ways of providing air navigation services by enabling flexibility, bringing controlled competition into the ANS domain and ultimately driving down costs. Applied to our country, we talk about VCCH: The Virtual Centre Switzerland which will also support the introduction of future contingency concepts.

It’s to this end that skyguide is running its VCCH operational and technical harmonization programme. And the elements it produces will provide a solid-but-flexible and sustainable foundation on which to achieve the Virtual Centre goal of operating a single virtual unit from two physical locations.

The associated Virtual Centre Architecture Project has already conducted an analysis of skyguide’s existing ATM system landscape and underlying infrastructure. This has confirmed the present high quality levels; but it has also revealed areas for improvement, such as better aligning and standardizing functions, reducing systems complexity and enhancing IT security.

The project has also devised an optimized system and infrastructure set-up: the Skyguide Target Architecture. Based on IT’s Service-Oriented-Architecture (SOA) principle, this should help reduce systems complexity, and uses a common integration platform to provide connectivity and communication to all users of a specific ATM service such as conflict detection or correlation management.

The Target Architecture here has been proposed to the top management, and will now be further aligned with corporate strategy and other parts of the Virtual Centre Programme. To implement it skyguide would also need to change its way of «doing IT»: think less in closed applications and instead use services where and when they are needed by the controller or the flight management tool.

If our Air Traffic Controllers (ATCOs) are to manage Switzerland’s airspace from either Zurich or Geneva, we also need to make our network and communications infrastructure flexible and accessible from all sites. Voice-over-IP (VoIP) technology should help to achieve this goal. And our colleagues from Network and CNS will be playing a major part here.

Once this target has been achieved, we will not only align skyguide with the System Wide Information Management (SWIM) and Single European Sky ATM Research (SESAR) principles (which will also be applied by our international partners); we will also have the IT agility required, and will be able to drive down costs and operational expenses, to the benefit of all our customers – including LX 2021!
The existing systems landscape is characterized by disparate silo applications whose point-to-point integrations are the result of organic growth over time. So harmonization and greater interoperability are the VC Target Architecture’s main objectives.

Two of the key tasks here are to eliminate duplicate functionalities and establish a systems infrastructure that supports key information-sharing throughout Switzerland: a flight data management solution, for instance, must permit the Swiss-wide coverage of critical data elements such as full flight trajectory.

To achieve these aims, the functional capabilities of existing IT systems must be refactored, reused and streamlined into a set of services deployed at redundant data centres to ensure service continuity. Such services must be location-independent and able to run anywhere on the VC data centres, as long as the underlying network infrastructure respects the relevant communication constraints.

The key elements of the Target Architecture include:

- A Service-Oriented Architecture (SOA) with clearly-defined architecture layers using IT and ATM industry standards based on the SWIM and SESAR initiatives. SOA enables application functionality to be provided as a set of technical services. These services are autonomous, i.e. each service is independently maintained and deployed.

- A Common Integration Platform: The services are integrated horizontally and accessed via a Common Integration Platform which makes their location transparent to their consumers such as the Controller Working Position (CWP).

- A Common Data Centre: These technical services are deployed at a logical data centre covering both Zurich and Geneva. The existing network architecture and infrastructure need to evolve to address new aspects of the Target Architecture such as Voice over IP (VoIP).

- Full separation of Human Machine Interface (HMI) from back-end applications: HMI-related capabilities are separated from the back-end business logic to avoid tight coupling. This delivers deployment flexibility, which is also needed for the virtualization of the underlying hardware.

The VC Target Architecture could deliver significant benefits by harmonizing the infrastructure (i.e. streamlining it and removing duplicate capabilities) and providing operations with a logical Swiss-wide data centre. It would also improve interoperability by using standard data exchange formats which facilitate systems integration.

A successful realization of the Target Architecture would also entail a change of mindset, from functional silo thinking to a service-oriented approach. Many non-technical issues – such as operational process harmonization – will also need to be addressed before we can derive full benefit from the Target Architecture’s potential. The transition to the Target Architecture is a long-term journey that requires the total support and commitment of all skyguide staff.
Service-Oriented Architecture or SOA is a style of systems architecture that is based on distinct software components and provides functionality for applications. The main goals of SOA are to permit an easier IT alignment for the business, and to provide more flexible systems. A «service» in this sense is a self-contained unit of functionality, such as calculating an aircraft trajectory. The SESAR European ATM Architecture is SOA-inspired, too.

**Description**

With their evolution over time, many companies can end up with multiple similar applications supporting their business processes. And some of these will not have been designed for interoperability. This «spaghetti architecture» is both expensive and difficult to maintain.

Service-Oriented Architecture or SOA – a concept that is used in other industries, too – represents a change in the relationship between business and IT, enabling the partners to work together to develop new ways of using the technology.

SOA enhances the way computers cooperate on a network, and can eliminate the need for point-to-point integrations between applications. A service, made of a discrete piece of code, can be either used by an application or combined with other services to provide advanced functionalities.

In SOA a service should be reusable, autonomous and as stateless as possible. And it must be loosely coupled with its surrounding environment. Interoperable services must be designed to cover the business needs, in both scope and granularity.

A service consumer should be able to invoke a service regardless of its actual location (i.e. in a private or a cloud data centre). This is a major enabler characteristic for meeting business continuity requirements.

The SESAR European ATM Architecture specifies how systems should evolve. Its SOA components will communicate using industry standards for technology-independent data exchanges, such as the Aeronautical Information eXchange Model, the Flight Information eXchange Model and the Weather Information eXchange Model. The combination of these three models is expected to cover the majority of data that need to be exchanged within ATM.

**Impact**

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**Applications**

As it is currently being studied, a SOA framework could help define and shape the look of skyguide’s ATM and AIM systems in the decades ahead. SOA could also help to orchestrate a series of business process-aware services around the flight object: one for trajectory calculations, one for route extractions, one for coordination and so on.

Eurocontrol’s SOA-based System Wide Information Management (SWIM) will, amongst other things, permit net-centric ATM operations and the use of web services.

SOA and its infrastructure require governance involving technical specialists from every business area, along with project managers and technicians.

Application developers will also have to undergo a cultural change under SOA: with this style of systems architecture, they will obtain their data from a service that they no longer master themselves.
PENS: the Pan-European Network Service
Nicolas Devincenti, Head Internal Services Networks, skyguide

The Pan-European Network Service or PENS should form the backbone of Single European Sky’s System Wide Information Management (SWIM) initiative – even if alternative communications carriers may also be used. PENS is intended to promote the interconnection of a wider range of ATM stakeholders. And any definition of future communications needs will rely strongly on adherence to PENS, whatever the political constructions may be.

Description
The current generation of the Pan-European Network Service (PENS) is an international ground-to-ground communications infrastructure co-implemented by Eurocontrol and Europe’s air navigation service providers (ANSPs) to meet some of their existing air traffic communications needs.

PENS was born of the idea of sharing content and information through smart sourcing. All PENS users at the same site can share the same infrastructure securely, offering substantial economies of scale. Needless to say, PENS must provide a secure and robust infrastructure for this, along with fully redundant connectivity and appropriate availability.

PENS permits a seamless and integrated exchange of common aeronautical information, and provides a cost-effective shared infrastructure for emerging ATM applications. It will also significantly reduce the costly fragmented network services implemented under outdated protocols such as X.25, which is still widely used.

The next generation of PENS will need to provide a common IP-based network service Europewide covering critical voice and data communications and delivering efficient support to existing services. It will also need to accommodate the new ATM requirements (such as information exchanges between ANSPs and ATM stakeholders) foreseen under Single European Sky’s System Wide Information Management (SWIM) initiative.

The ANSPs and Eurocontrol are currently working on new PENS initiatives that should a) make it a key element in their future technical infrastructure and b) permit substantial cost optimizations for Europe’s ATM community.

Establishing a single PENS network should:
• enhance cost-effectiveness compared to fragmented network services;
• meet current and future communications needs while reducing complexity;
• achieve flexibility and speed of deployment by providing a managed international IP service environment;
• provide a greater capability for integrated developments involving the entire ATM community by enabling a rapid and secure exchange of information in a meshed environment;
• align with Single European Sky implementing rules and industry standard services by supporting IP-based networking.

Applications
PENS is already used operationally for Eurocontrol’s Network Manager Operations Center and the Aeronautical Message Handling System. Skyguide has been actively pressing for a PENS 2, though, as the current PENS does not offer sufficient maturity and service levels for safety-critical applications.

Skyguide also intends to participate in the Eurocontrol Centralized Service 8 feasibility study, in close collaboration with other ANSPs.

Impact

CNS
ATM
AIM

| none | low | medium | high |

2010 15 20 25 30 2035
Virtualizing ATM voice communications
Luc Chevalley, CNS Expert, skyguide

«Scandinavian 793, descend to Flight Level 290, cross VEVAR at level.» One of the countless ATC clearances delivered from skyguide’s Geneva Area Control Centre (ACC) to all types of flights, this one descending to Nice and crossing Sector L2. How about providing the same clearance to the same aircraft from Zurich ACC? ATCO Werner in Karlsruhe UAC wants to call Sector M5 at Zurich ACC to coordinate a flight leaving his sector. How about having M5 hand led by Geneva ACC and the phone ringing there?

Description
At first glance, air-to-ground and ground-to-ground voice communications seem easy to «virtualize». Providing access to radio transmitters and receivers from multiple ACCs or offering automatic call forwarding from one centre to another doesn’t sound like rocket science. In ATM voice communication terms, though, this kind of functionality just hasn’t been available to date. Why? Because no ANSP has ever needed it. So even skyguide’s current main and emergency radio and telephone voice communication systems or VCSs (which are from three different suppliers) cannot meet such apparently basic needs.

As a result, when it comes to virtualizing our radio and telephone communications between Geneva and Zurich, few options are available. We could work on our main and emergency VCSs, improving their interoperability and simulating a single VCS. For radio, this would allow access from each ACC to the resources of the other; and for the telephone, automatic call forwarding could be developed. This approach would limit the changes needed to only a few components in the voice communication chain. But skyguide-specific software would need to be developed with each supplier. Not only is that expensive; it is also unlikely that the specific systems developed could be re-used in a wider context, such as FABEC.

A second option here would be more ambitious, but would have the advantage of being part of a global trend. In line with SESAR, NextGen and Eurocontrol strategies, this approach relies on the implementation of the new ATM-VoIP protocol.

ATM-VoIP has been standardized by EUROCAE (ED136), and will also be implemented in the USA.

Fortunately, the new opportunities offered by ATM-VoIP can indeed be used to fully meet skyguide’s voice communication «virtualization» needs. And, to benefit from the potential synergies involved, the FABEC Voice Coordination Body has also chosen this technology as the basis for defining FABEC’s future radio and telephone interoperability requirements. This approach will also enable skyguide to comply with national and international regulation.

Applications
The adoption of ATM-VoIP has already been approved by skyguide’s top management. The new ATM-VoIP technology will now be introduced step-by-step for the company’s radio transmitters and receivers, between Geneva and Zurich and for its VCSs, through gateways or through a partial replacement of the relevant VISTA systems.

Impact

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2010 15 20 25 30 2035
Dear reader,

As you can see from the preceding pages, skyguide’s technical services are indeed negotiating a new, interesting and exciting period in their already long history. And as our latest Blueprint confirms, a number of choices need to be made in the next few months that will substantially shape our long-term technical infrastructure. This also explains why so many discussions are currently being conducted around our future architecture concepts, and why our top management recently launched a number of initiatives to ensure that all these endeavours are supported with the commitment required.

As they respond to the challenges posed by the new business model with its Virtual Centre concept and by the continuing development of SESAR and FABEC at the European level, our technical services are at the forefront of making optimum use of the precious resources available, and thereby securing skyguide’s future in tomorrow’s ATC landscape.

Needless to say, these challenges also include the constant influence of the external market, along with the evolution of the ICT sector into a genuine «commodity» market. In all the areas that we have touched upon in our latest Blueprint, our future choices will be strongly influenced by this last trend, as we look more and more to benefit from what is available on the global market rather than developing solutions that are specific to the ANSP world. This is also a matter of economic efficiency, and is a move that our customers clearly expect from us, too.

Skyguide will continue to focus its financial and human resources on its core mandate and mission. At the same time, we will continue to look to other market offerings to provide us with the further products and services we require. Our global quest for optimum efficiency here will be helped not only by the markets, but also by our own ability to respond quickly and appropriately to an ever-faster-moving world – a world in which the qualities and competencies of our employees will be crucial to our continuing to deliver the best added value from our activities.

In all these aspirations, though, our prime priority remains unchanged: to provide safe, reliable and efficient technical services that enable skyguide to fulfil its mandate of ensuring the safety of its skies. And this is a task – and an achievement – of which we can all be justly proud.

Sincerely,

Philippe Chauffoureaux

*To the top through narrow ways*
Our services

From technology to operation, our extensive civil and military air navigation services expertise allows us to create value for our customers with Swiss-made comprehensive integrated solutions or tailor-made products and services.

- **TECHNOLOGY**
  - Communication navigation surveillance engineering & maintenance
  - Data processing & Network

- **DATA**
  - Planning & operational aeronautical data delivery & management

- **OPERATION**
  - Managed air traffic services

- **SUPPORT TO OPERATION**
  - ATM operational concept
  - ATM integration & safety
  - Project management
  - Airspace & procedure design

- **TRAINING**
  - Air traffic controller & safety related tasks personnel
    - Ab-initio & recurrent training