The 2017 Skyguide Technology Outlook

Blueprint
TABLE OF CONTENTS

EDITORIAL
Klaus Meier

ONE-SKY-BY-ONE-SYSTEM
SWITZERLAND – A PATHFINDER FOR EUROPE’S SINGLE SKY
Klaus Meier

DEFINING & REFINING
A COMMON OPERATIONAL CONCEPT DETERMINES THE SCOPE OF VCT2
Richard Landreville

ONE-SKY-BY-ONE-SYSTEM
HOW A “SOFTWARE FACTORY” HELPS TO IMPLEMENT SKYGUIDE’S VIRTUAL CENTRE STRATEGY
Marco Sieber

FROM EXPLORATION TO EXECUTION
AN AGILE APPROACH FOR VALIDATING THE NEW SINGLE SKY TECHNOLOGIES
Frank Barner

CASE STUDY #1 FROM PILOT TO PRODUCTION
Frank Barner

CASE STUDY #2 PUTTING THE “VIRTUAL” INTO VIRTUAL CENTRE
Jean-Philippe Shepherd

STANDARDIZATION AND CONSOLIDATION
STRONGER TOGETHER WITH SOI
Xavier Ruvilly and Michele Bruno

ENSURING PROVISION OF ESSENTIAL AIR NAVIGATION SERVICES IN THE EVENT OF A DISASTER
THE SKYGUIDE STRATEGY FOR SERVICE CONTINUITY
Philippe Chauffoureaux

FROM IDEA TO IMPLEMENTATION
LEARNING TO INNOVATE, EVERYDAY
Joël Jordan
ONE SKY

ONE SYSTEM
Dear reader,

Welcome to the new Blueprint 2017, skyguide’s technology outlook, with a focus on our Virtual Centre Initiative.

We have made significant progress since the last edition of Blueprint. We went “strip-less”, which was the core objective of Tranche 1. With the Stripless Project, we launched for the first time an identical application for both centres – a major step towards harmonization of operation. With Tranche 1, we have been successfully “setting the scene” to move on to the next phase, Tranche 2.

In Tranche 2, we are “building the foundation.” We will replace the two different legacy systems in Geneva and Zurich with one new system based on a modern service-oriented architecture. At the same time we will be able to flexibly manage the upper sectors of our airspace as one Swiss airspace. Tranche 2 will deliver our “one sky by one system.”

For Tranche 2, we adapted and strengthened leadership, organization, delivery methodology, risk management and decided on a strategic partner. This Blueprint 2017 highlights those various aspects of Tranche 2.

Thank you for taking the time to follow our progress. I appreciate your continuous support in this endeavour.

Sincerely,

Klaus Meier
The last few years have seen skyguide advance with Switzerland’s national Single Sky initiative. As we successfully complete Tranche 1 of our Virtual Centre Programme and move to Tranche 2, other European ANSPs are curious about our progress. A virtual centre is the technical foundation for seamless, location-independent air traffic management. As skyguide CIO Klaus Meier explains, Switzerland’s smaller size proves advantageous when faced with such a complex and far-reaching programme. As he states: “Thanks to our natural openness to change, entrepreneurial spirit, and an ability to be swift and responsive, Switzerland is intrinsically agile.” This agility and nimbleness is why Switzerland is turning Single Sky objectives into operational reality. Here, Klaus discusses how and why Switzerland welcomed the chance to step forward and create a scalable, sustainable Single Sky model that others could potentially adopt and adapt.
Switzerland cannot achieve its Virtual Centre ambitions alone. What kind of partnerships has skyguide established to help achieve its vision?

The first partnership we have established is with a best-in-class software house from outside the ATM world to introduce a new way of developing and implementing software in skyguide. We bring the ATM expertise and this new global partner brings skills in software engineering and service orientation. We also will work very closely with our current suppliers to engage and identify critical technologies that help us break away from the usual limitations in the ATM world. Today's ATM systems are tightly coupled, locked and insufficiently connected with their neighbours. Furthermore, we need a close partnership with regulators. Safety and compliance must be at the core of our transition. We must transition towards the new generation system together with the regulator.

Our success outside of Switzerland depends on teaming up with willing industry partners, suppliers and with other ANSPs on the Single Sky journey. A collaboration with other like-minded air navigation service providers, as well as industry partners and service suppliers will be critical. Thanks to our daughter company, SkySoft, we can build services ourselves and source non-strategic solutions from industry suppliers or other ANSPs.

Switzerland is one of the first countries in Europe to begin building a Single Sky system. What are Switzerland's hopes to become a model for others?

Skyguide’s Virtual Centre will not just be a Swiss solution; if we can demonstrate that it can work, our Virtual Centre has the potential to be a model for Europe. We know that other countries are interested to see if we can deliver on our promises. Although we are not diminishing the challenge, we consider the inter-centre handover that happens between our Geneva and Zurich control centres a microcosm of what takes place above European skies, every minute. This is why, if skyguide can achieve harmonized, location-independent air traffic management and successfully deploy a Virtual Centre that is replicable, relevant and reliable, we can inspire other to target the same. Our ambition is to be a best-in-class role model – not just for Switzerland’s success but to support European ambitions towards a new era of seamless, sophisticated air traffic management.

“SMALL, SWIFT AND AGILE, SWITZERLAND CAN BE AT THE FOREFRONT OF CHANGE, AND IS EMBRACING THIS CHANCE.”

“We consider the inter-centre handover that happens between our Geneva and Zurich control centres a microcosm of what takes place above European skies, every minute.”
Switzerland’s Virtual Centre Programme (VCP) is inspired by the ambitions of the European Commission to create a Single European Sky (SES). A Single Sky will bring greater efficiencies to the European airspace, one of the busiest and most complex in the world. Key European Member States – Belgium, France, Germany, Luxembourg, Switzerland and the Netherlands – are united in this ambition and form part of a Single European Sky initiative known as FABEC: the Functional Airspace Block for Europe Central. Each country is responsible for implementing its part of the Single European Sky, and the VCP represents Switzerland’s move towards this. However, as no EU country has yet fully implemented a harmonized air traffic management system for a Single Sky, there is no set blueprint to follow on how to do it. Switzerland’s contribution to FABEC is an air traffic management (ATM) platform based on a hybrid architecture, and which includes the services and features that will best serve skyguide customers. Richard Landreville was a key member of a team that designed the blueprint for Switzerland’s ATM system, and for creating the Common Operational Concept (COC). Here he discusses the steps taken by the team and by skyguide management to decide the top features of the pioneering Virtual Centre.

**Skyguide**

FABEC guidelines already exist as to how to build a Single Sky and achieve greater air traffic management efficiencies. Why did Switzerland need a special operational concept to achieve its Virtual Centre Programme?

Richard Landreville

It is true that under the FABEC agreement, a set of guidelines, known as SESAR – Single European Sky ATM Research – outlines ways to achieve the more intelligent, seamless and cost-effective air navigation system that is the target of a Single Sky. However, European initiatives are not “one size fits all” and do not necessarily provide value for each and every air navigation service provider (ANSP). This is why it was absolutely necessary to develop a specific common operational concept for Switzerland.

How did you set about designing the common operational concept and what are some of its key features?

We analyzed the SESAR and FABEC road map plans together with skyguide’s own concept of operations (Conops) and identified which pieces within those plans would provide added value to skyguide and our customers. We also liaised with other European members, notably NATS in the UK, which, like Switzerland, is merging two air traffic control facilities under one system. We did this so as not to “reinvent the wheel”, to make informed architecture decisions and to identify synergies. The result of all these findings was our common operational concept. It was completed in 2016 and contributed significantly to the Dynamic Road Map, which is the development charter for the entire Virtual Centre Programme.

The common operational concept will help skyguide deliver on key goals that are required within the framework of a more efficient European air traffic management system. In particular, we incorporate features that will help us manage the new demands in air traffic management capacity, that will enhance coordination with neighbouring ACCs, improve conflict detection and/or automated conflict resolution and achieve a enhanced dynamic/multi-sector planner or extended-sector planner. Finally, the COC will also be used to contribute to Reference Period n°3 (RP3) efficiency targets.

“AS WE ARE MODERNIZING OUR SYSTEMS AND MOVING AWAY FROM COMPLEX STANDALONE SYSTEMS, THE NOTION OF FLIGHT DATA PROCESSING NO LONGER MAKES SENSE.”
The CoC includes a “New Operational Concept” that ushers in a more service-orientated approach to flight data management – what does this entail?

As we are modernizing our systems and moving away from complex standalone systems, the notion of flight data processing (FDP) no longer makes sense. A traditional FDP has many functionalities imbedded within it, such as route calculation, flight level allocation and sector-sequence calculation. Our mission is to break down these functionalities into discrete services contained within a more modern flight data management (FDM) concept, and to move away from two distinct air traffic management philosophies in Geneva and Zurich to a shared FDM philosophy that satisfies the needs of both these control centres. Doing this will make our overall system architecture service-oriented. It will be more modern, less complex and will result in lower costs. However, revamping the FDM concept is not an insignificant task, and many operational and technical changes are needed. This is why implementation is progressive, taking advantage of the Agile approach and the Exploration Packages, with a first step forecast for early 2018. The teams are now finalizing the concept and thereafter making a transition plan that is both realistic for the technical department and feasible for the operations.

The overarching aim of the Virtual Centres in Europe is to make efficiencies in how air traffic is managed. Do these efficiencies involve people or technology?

Both: like any industry today, we are being asked to “do more with less”. To prepare our business for the future, we are developing and introducing new technologies that will make the job of an air traffic controller significantly easier. These improved technologies will bring better systems, which may mean people do their jobs differently. This will require us to adjust and rebalance roles. This doesn’t necessarily mean fewer jobs – it means gaining new understandings as to how to maximise our employees’ capacity and use the new bandwidth they will have thanks to these improvements. Elsewhere, under EU regulations we are required to make cost savings by reducing our unit rate, which is the price of flying through Swiss skies. We are doing this to ensure we remain an attractive ANSP and to meet our customers’ budgetary objectives too.
Marco Sieber leads a team of 120 people and is responsible for implementing and operating the software components of the Skyguide Virtual Centre Tranche 2 (VCT2) Programme. His challenge is to gradually transform the existing Air Traffic Control systems into a new service-oriented architecture while assuring availability of the systems, 24/7 – without significantly increasing Skyguide’s IT workforce. Marco firmly believes that the Programme can only be successful by introducing best-in-class IT practices into the company and by improving IT development in the form of a “Software Factory”. As Marco explains here, this framework promotes a new, more fluid way of developing, implementing and integrating IT solutions and a quicker way of delivering value to his internal customers.

**What is an IT “Software Factory” and how does it work?**

Over the last 10–15 years, the software industry has become more mature and industrialized by adapting and integrating key concepts from the manufacturing world. Two of the main concepts that have emerged are Agile Development and DevOps. A Software Factory is not a physical factory, but rather a software engineering framework rooted in best-in-class approaches. It defines the principles, methods and tools for how we build, integrate, test and deploy software. It also helps us manage innovative projects we are working on, such as the Virtual Centre, and classic IT projects. The Agile principles help us to focus on gradually delivering value to our clients, and increase the project success rate by keeping costs and planning stable, by improving transparency and adaptability, and by reducing the risks. In “Scrum”, which is the most common Agile practice, projects are broken down into pieces of functionality, prioritized by business value, and delivered in short two-to-three week cycles called “sprints”; software is built incrementally from the start of the project, rather than being delivered all at once near the end. Cross-functional teams take full responsibility to deliver the agreed scope of each sprint. The Agile approach, which is time-boxed, more naturally allows for change. It also allows for more predictability in terms of cost and time, which is essential on a programme as broad and ambitious as Switzerland’s Virtual Centre.

While Agile helps us to develop the “right” system in an efficient way, the DevOps principles allow us to bring the software components into production more smoothly.
efficiently and safely. DevOps bridges the gap between the development and the technical operations units by improving collaboration and communication, through integrated processes, tool-chains and more automation.

You are working with a new strategic partner to develop the Virtual Centre. Does this add extra complexity?
To fulfill all the tasks we need to complete, and to migrate to a new platform, the capacity and the capabilities of SkySoft and skyguide simply weren’t enough: we couldn’t build and implement everything ourselves. We decided to team up with Tata Consultancy Services (TCS), a branch of the large Indian-based conglomerate, Tata Group. TCS is a really strong partner that has had huge success in similar wide-ranging IT transformations. They are true partners on this project, and are based alongside us, in-house. We are now building cross-functional teams composed of skyguide, SkySoft and TCS employees. This close partnership will help us to internalize the know-how from TCS, which we require in order to maintain the new solutions in the future.

“A SOFTWARE FACTORY IS A FRAMEWORK THAT BRINGS BEST-IN-CLASS SOFTWARE ENGINEERING PRACTICES TO SKYGUIDE, WHICH IS NECESSARY TO SUCCESSFULLY IMPLEMENT OUR BOLD VISION.”

What changes or challenges have you experienced in VCT2 so far?
We have used Agile principles on a variety of projects for a few years now, and we have seen improved collaboration with our clients and better quality software with a predictable cost and time plan. And this is great! Using these principles on a larger scale – e.g. the scale needed to implement the Virtual Centre – does not come automatically, though. Implementing the “Agile and DevOps way” is not just about implementing new processes, methods and tools – it demands a cultural change. And it requires a learning organization and continuous improvement. We have only just started the journey. Showing successes along the way will increase acceptance of the new principles across all levels of the organization and will support this cultural, internal shift. Despite the learning curve, we are delivering value faster and increasing the quality of what we are producing too. Management enjoys greater predictability about when we deliver value at which cost. But they do not get a large, detailed document at the beginning of the project describing what we will deliver! This does create some uncertainty. The yearly review and approval cycle is the answer to this concern. We now need to prove that, through close collaboration between clients and the engineers, we are able to choose the right scope and deliver maximum value to the company.

I am convinced that, through continuously living and breathing this “new way” to deliver projects, we will create more success stories, have more people on board, and become even more confident that we are on the right path. This will create more and more momentum for positive change.
Frank Barner is part of the Virtual Centre Initiative and responsible for the crucial Exploration phase that must take place before any new technology or software is integrated into the Skyguide platform. The capabilities of Frank and his team now fully come into play as VC Initiative moves into Tranche 2, which lays the foundations for the operational and technical capabilities that will support Switzerland’s location-independent platform. This requires testing, building and deploying technologies that will serve essential business services such as flight data management, flight trajectories, human – machine interaction or route extraction. Tranche 2 also sees the phasing-in of a single visual display broadcast from one data-stream to two control centres in Geneva and Zurich. Here, Frank outlines the importance of the exploration process and discusses the implementation targets for 2018.

**Frank Barner**

*Project Manager, Exploration Packages*

---

**Skyguide** We hear a lot about the so-called Exploration Packages; how do these work? (Frank Barner)

The Virtual Centre will introduce a new architecture for Skyguide and, to reduce risks and remove uncertainties, the new technology and services must carefully be developed and implemented. During these Exploration Packages, we validate how hard or easy it will be to integrate and run any one of the new technologies. With so many components to be checked for the Virtual Centre, we are currently bundling these activities into two Exploration Packages. These will contain individual “Proof of Concepts, Prototypes or Pilots” (known as PPPs).

**What benefits does the Exploration phase bring?**

The objective of this work is to reduce the risk and uncertainties about how teams will collaborate. However, the VC Initiative involves multiple partners and companies that have not worked together before. In addition to validating all the technical aspects of this Programme, we also needed to confirm our assumptions around how Skyguide will collaborate with its new partners. Working in this test environment helps us trial working conditions too.

**PPPs are run on Agile principles; how well does Agile translate to a highly regulated environment such as air traffic control?**

Although Agile provides an effective way of working to meet development deliverables, the air traffic industry is highly regulated. Any changes made to air traffic control services have to be safe and developed in accordance with standards set by the Federal Office of Civil Aviation (FOCA). In the framework of the Exploration Packages, we purposely did not focus on these topics so as to avoid overloading the teams. However, as our activities move further away from “exploration status” and closer to “realization status”, we will, of course, respect these requirements and regulations. Our next step is the Change Transformation project, which we have just begun, and which addresses how change is managed at Skyguide, in the future.

**What kind of components are being worked on from now until 2017?**

The Exploration Packages and Realization Streams we launched are managed within the Explore, Build & Integrate project, otherwise known as the Software Factory. Whereas in 2016 we concentrated on organizing the building and initial demonstration of new services, 2017 will see the first operational impact of our work. The Flow Management Position (FMP) stream for example will deliver CRYSTAL (sector allocation capacity tool) on our new service-oriented infrastructure. Another crucial topic and focus will be the Flight Data Management (FDM) stream in which we continue to build services such as Route Extraction and Flight Object Repository. Finally we will have a dedicated work-stream which will deliver the FDM transformation concept as a key input to the Common Operational Concept (COC).
Operational Delivery Reparation

From Pilot to Production

Spotlight on PPP1 – Route Expansion & Extraction Service (RES) Workstream

The PPP1, as part of Exploration Package 1, relates to skyguide’s route expansion and extraction services. The aim is to maintain a pilot- or operator-filed route without applying any business rules, to extract the route for the Swiss Area of Interest (AoI). We will also utilize the Network Manager (NM) Business to Business (B2B) System Wide Information Management (SWIM) service. It delivers route expansion information within AoI for en route, including arrival/departure routes for domestic flights as well as displaying the route on SkyViewer. Within this technical context, the team needed to prove that the NM route expansion feature based on European AIS Database (EAD) meets skyguide’s requirements.

A PPP with 10 Sprints
This PPP kicked-off on 21 April, with sprint durations of three weeks; by end of December 2016, the team will have delivered Sprint 10. In 2017, PPP1 will become part of a workstream tasked with handling all Flight Data Management (FDM) services. This workstream, as others, will be managed within the Software Factory.
PUTTING THE “VIRTUAL” INTO VIRTUAL CENTRE


As Jean-Philippe Shepherd’s team is in charge of delivering this critical component of the VC, they will ensure through the exercises conducted in this PPP that the Geneva flight data picture is properly displayed in Zurich, and vice versa, and eventually broadcast to towers in Kloten and Geneva.

Jean-Philippe and his team addressed this in a stepwise manner, with various iterations: Iteration 1 confirmed the use of multicast as a means of transmitting information over the network; Iteration 2 explored and overcame the challenges of streaming and Iteration 3 offered the chance to address the barometric pressure difference across Switzerland and the mismatch between the position of Geographic North on the ATCO displays and the Magnetic North that pilots navigate by.

PPP2 – ITERATION 1:
USE OF MULTICAST (VS. BROADCAST) AS A MEANS OF TRANSMITTING INFORMATION OVER THE NETWORK

Today, SkyServer and SkyViewer must be co-located on the same subnet and use broadcast on that subnet to communicate. Multicast is considered a better practice as the bandwidth is only used once; the publish/subscribe pattern is also cleaner, in order to maintain the list of clients. Historically, multicast routing has not worked well in skyguide, and Iteration 1 of PPP2 therefore focused on using multicast between MV-NT, SkyServer and SkyViewer.

Minor constraints were successfully overcome at an application level for multicast, with multicast re-routing tested on a network level. Testing did reveal that firewalls do not currently support multicast and this could impact the external stakeholders who access data to create position reports for capacity and load calculation. This is currently an open issue to be further worked on.
While exploring the somewhat scarce off-the-shelf solutions for streaming, SkyViewer and those provided by SkySoft, the latter proved excellent in many ways. Those who participated in the demos were not able to differentiate between the original local position and the streamed ones, even when they were fed via a 300 km network loop.

This technology offers very promising opportunities out of this PPP, but will require further analysis before being used for the Geneva and Zurich centres; this configuration completely changes many redundancy concepts and would need enhancements on a virtualization platform planned to only host servers.

"Those who participated in the demos were not able to differentiate between the original local position and the streamed ones... via a 300 km network loop."

Local barometric pressure (QNH) is used by pilots to ensure that their altitude matches the ground level for landing and take-off. Providing one Swiss picture means that the variations across the country must be dealt with. In this PPP, equipment was set up to display track altitudes based on their local QNH up to the transition level of the controller. Small QNH areas ensure that adjacent QNH are always very similar (less than 5 millibar difference).

Magnetic declination—the difference between the position of Magnetic North and the Geographic North—causes real issues for those in the navigation industry. ATCOs in Switzerland currently manage a magnetic declination of 2 degrees, and do not really suffer from the Magnetic North not pointing vertically to the top of their screen. By providing one global set of coordinates for Geneva and Zurich, the distortion of projections increases this issue. Jean-Philippe and his team are addressing this by slightly tilting the new SkyViewer cross-site displays to ensure that they point north at all times. Each picture would have a vertical line at the centre of the screen pointing to the Magnetic North, regardless of which area the screen displays, based on projection distortion and magnetic declination at this point.
By: Xavier Ruvilly and Michele Bruno

Head of System Administration | Project Manager, SOI Platform Lead

Below the Virtual Centre Programme lies skyguide's network, newly created hosting platform and the system and application integration enabler, known as the Common Integration Platform or CIP. This is a transversal layer which enables the integration of skyguide's core business applications and which champions the concept of service-oriented architecture (SOA) or infrastructure (SOI). Xavier Ruvilly explains that it will bring greater efficiencies in terms of improved agility and increased synergies with other teams. As he states: “The standardized solution offers better interoperability between applications and will enable skyguide to easily transfer regular and standardized IT operations over to our third party partner, scheduled for June 2017.” The SOI is based on a TIBCO stack, a well-known vendor, renowned for handling massive workloads and unwavering, reliable performance.

Skyguide is experiencing a paradigm shift as it moves from a monolithic to a layered architecture thanks to SOI. Where have the greatest challenges been: people, processes or tools?

Our main challenge has been overcoming the novelty of innovation for skyguide and the organizational challenges that come with standardizing and consolidating our IT processes, tools and systems. Application managers can now focus on the business logic. Although logic would suggest that this makes our architecture more vulnerable, it actually makes it far more reliable and resilient. The wide-reaching standardization and consolidation effect powered by the introduction of SOI is new to skyguide and to our industry, but is already present in other industries, such as the banking world. Proof that it works is helping us promote this new approach. Now we just have to deliver it in skyguide.

“WE DELIVERED MORE THAN 100 VIRTUAL MACHINES TO THE TEST PLATFORM IN GENEVA AND ZURICH.”
As a provider of air navigation services, skyguide is highly safety oriented. How does the SOI setup contribute to meeting these safety standards? How do you ensure that the project is operated well?

It is acknowledged by air traffic management safety experts that the Virtual Centre has two layers of safety: the application layer, and the infrastructure layer, which is what our team is responsible for. Our contribution is provided by ensuring quality: everything we develop and deliver must be built to high quality standards. That is why, right from the outset, we ensure that the service-oriented architecture we develop is based on solid design and checks off all requirements. From then on, we provide systems that are reliable, resilient and easily maintainable – these are the keystones of any first-class infrastructure.

It is this unwavering focus on quality that led us to introduce more consolidation and standardization into our core components, tools and processes. As mentioned, harmonization and standardization moves us away from a “piecemeal”, siloed approach and moves us towards a simplified, more robust platform.

“HARMONIZATION AND STANDARDIZATION MOVES US AWAY FROM A ‘PIECEMEAL’, SILOED APPROACH.”
Service continuity is the extent to which a business can provide an acceptable level of service and recover essential data in the face of a major catastrophe. To prepare for such events, businesses that operate critical services such as ours have back-up centres in the form of “Hot”, “Warm” or “Cold” data recovery sites. These come into action in the event of a disaster. Typically, these are physical sites located away from usual business operations. A “Hot” site is usually a full replica of the original system and its data: it has the necessary equipment and links to be quickly up and running within hours in the event of a fail-out. A “Warm” centre is ready to operate to a slightly lesser extent, which may mean the business takes a couple of days to provide essential services: it has the necessary equipment ready to operate yet must acquire fresh new data. A “Cold” centre takes weeks rather than days to recover data and re-establish systems operations, although it offers a backup if the two other sites are critically impaired: it has the basic infrastructure but requires extensive deployment efforts to be in a position to deliver some services. Skyguide currently targets a Hot – Warm model, meaning that if Swiss air control centres experienced a disaster, such as destruction, a terrorist act, flooding or a major virus, skyguide would currently aim to take 24 hours to recover and be up and running again, drawing on the capabilities of a Hot and a Warm site. This type of “down time”, in the context of such an extreme scenario, is acceptable, and aligned with the concept provided by Eurocontrol contingency guidelines.
Does the Hot-Warm recovery model that has been decided for the VC Programme represent a change in skyguide’s service continuity solutions?
Yes and no. It will provide the future objective to skyguide to maintain the expected level of service and will enhance the capability of our system and be able to recover from situations that we currently cannot address. However, these new capabilities will not be available immediately. The first steps of VCT2 will deliver solutions that match the current limited recovery capabilities. After deliberation, the aim of targeting brand new service continuity capabilities right at the beginning of the Programme was deemed unnecessary in this early stage. This decision required a judicious risk-versus-cost calculation. Our calculation is highly pragmatic, and led us to retain, in the first stage, our current Hot–Warm target model as our future service continuity capability, with an initial “One Data Centre” configuration – and this is still extremely comprehensive.

One change we are implementing and enhancing though, is that we are strengthening our cyber security features in the new architecture.

How will this service continuity decision impact on the build of skyguide’s VCT2 system architecture?
Our decision impacts on what we do and don’t build at this stage of the project. We established that, for reasons of time, cost and security, and taking into account our system failure rates, there are more efficient ways to use our funds than the technologically complex Hot-Hot model that we had in mind at the start of the VC Programme. It has evolved even further by accepting a One Data Centre model for the realization of Tranche 2. Practically speaking, we will create the Hot centre first and the Warm site during Tranche 3 and 4. This step-by-step build chimes with the stepwise approach that is being employed in other workstreams for the VC Programme. This involves a certain degree of risk acceptance, but a Hot data centre is already very comprehensive and provides numerous local redundancy capabilities. We are not taking any greater risks by building the Warm centre in the second stage. Our target for the VCP is total contingency, but we also cannot embark on objectives that are not required at this time.

What comes after the VC Tranche 2 in terms of new service continuity capabilities?
We aim to deploy the Warm data centre after VCT2, when we move into Tranches 3 and 4. This is likely to be after 2020 and up until 2024. The final Hot–Warm solution will provide the required contingency expected by the VC Programme.
Joël Jordan is innovation lead for skyguide’s One-Sky-by-One-System, and responsible for translating the ambitious concept of the Virtual Centre into “bite-sized daily deliverables”. The challenge, Joël states, is to deliver on Single Sky ambitions whilst upholding the stability of skyguide’s normal air navigation services. With his colleagues having now completed Tranche 1 of the Virtual Centre, Joël and his team are fully into the development and delivery phase of VC Tranche 2 (VCT2), armed with an overall road map to keep them on course until 2020. Here, Joël describes the challenge of transforming innovation theory into daily business practice.

Switzerland’s ambitions of a Single Sky are openly audacious; what has been the experience of working with innovation internally?

The elegant hybrid solution that skyguide is building to create Switzerland’s Single Sky will pioneer a new, location-independent servicing model that has not yet been seen within our industry although it does exist in other business sectors. The type of solution we will deliver is truly service-orientated, designed to meet the efficiency gains needed by our customers, namely the airlines. Our model is new and the technologies we will use require us to significantly evolve our practices. This is not something we could have achieved alone, which is why we decided to bring external partners into the programme. Skyguide is evolving into a more innovative company. The whole One-Sky-by-One-System vision is prompting organizational change and influencing how we think, act and react. We have discovered that to embrace innovation is to embrace change.
At its heart, skyguide is responsible for “keeping planes in the sky”. How are new air navigation services being phased-in whilst maintaining a safe, stable operating environment?
The scope of VCT2 does not touch upon the “first-line” voice, radio or emergency controls: our focus is on data processing and evolving skyguide’s core technical systems. For safety reasons, delivery of the technology and software for VCT2 is supported by careful phase-ins – we cannot suddenly “swap in” new elements within the skyguide platform. To ensure that the slightest change does not destabilise the whole system, we continuously perform safety checks along the way. An alternate option, like the “big bang” model sometimes favoured in IT services, would not be suited to this environment; the key to successful, safe, deployment is to be iterative. The Agile approach is a key to this success.

What major considerations did you have to address when working in such a challenging, changing environment?
We have had to think hard about three core issues: people, costs and risks. We must be mindful not to over-stress our organization during any of the VC tranches – which could happen with this degree of organizational change and our hard and fast learning curve. Secondly, we must recognize the value of our legacy systems: we have invested significant sums in the existing systems and they cannot simply be thrown away. But we recognize that the platform does not offer the capabilities skyguide now requires, which is why we are adapting, creating and building onto and around it. Our third challenge is that of managing risk, in terms of safety, scope and budget. With our yearly review and approval cycles, time and money are “boxed” and the main risk is in the scope. The annual progressive and iterative approach brings in value stepwise, enabling management to measure and check on progress and avoid costly scope creep. The bywords for the Virtual Centre are reliability and evolutionary... these will create the stability that allows for skyguide’s bold and innovative vision.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATCO</td>
<td>Air Traffic Controller</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
</tr>
<tr>
<td>CANSO</td>
<td>Civil Air Navigation Services Organization</td>
</tr>
<tr>
<td>CIP</td>
<td>Common Integration Platform</td>
</tr>
<tr>
<td>CNS</td>
<td>Communication Navigation Surveillance</td>
</tr>
<tr>
<td>COC</td>
<td>Common Operational Concept</td>
</tr>
<tr>
<td>COPLEX1</td>
<td>Common Operations Flexibel 1</td>
</tr>
<tr>
<td>CWP</td>
<td>Controller Working Position</td>
</tr>
<tr>
<td>FABEC</td>
<td>Functional Airspace Block for Europe Central</td>
</tr>
<tr>
<td>FDM</td>
<td>Flight Data Management</td>
</tr>
<tr>
<td>FDP</td>
<td>Flight Data Processing</td>
</tr>
<tr>
<td>FDPZ</td>
<td>Flight Data Processing Zurich</td>
</tr>
<tr>
<td>FMP</td>
<td>Flow Management Position</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
</tr>
<tr>
<td>IFPS</td>
<td>Integrated Flight Plan System</td>
</tr>
<tr>
<td>INIS</td>
<td>Interface between IFPS – SYCO-NT / FDPZ</td>
</tr>
<tr>
<td>ISUP</td>
<td>Integrated Supervision</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>ITIL</td>
<td>IT Infrastructure Library</td>
</tr>
<tr>
<td>MV-NT</td>
<td>Machine Virtuelle New Technology</td>
</tr>
<tr>
<td>NM</td>
<td>Network Manager</td>
</tr>
<tr>
<td>ODD</td>
<td>Operational Deployment Date</td>
</tr>
<tr>
<td>PPP</td>
<td>Proof of Concepts, Prototypes or Pilots</td>
</tr>
<tr>
<td>QNH</td>
<td>Q code indicating the atmospheric pressure adjusted to mean sea level</td>
</tr>
<tr>
<td>RES</td>
<td>Route Extraction Service</td>
</tr>
<tr>
<td>RP3</td>
<td>Reference Period n°3 – Single European Sky Performance Scheme for RP3</td>
</tr>
<tr>
<td>SES</td>
<td>Single European Sky</td>
</tr>
<tr>
<td>SESAR</td>
<td>Single European Sky ATM Research</td>
</tr>
<tr>
<td>SkyServer</td>
<td>Commercial name of the SkySoft-ATM server managing CWP</td>
</tr>
<tr>
<td>SkyViewer</td>
<td>Commercial name of the SkySoft-ATM client CWP</td>
</tr>
<tr>
<td>SMC</td>
<td>System Monitoring and Control</td>
</tr>
<tr>
<td>SOA</td>
<td>Service-Oriented Architecture</td>
</tr>
<tr>
<td>SOABase</td>
<td>Project implementing base service-oriented architecture by skyguide</td>
</tr>
<tr>
<td>SOI</td>
<td>Service-Oriented Infrastructure</td>
</tr>
<tr>
<td>SWIM</td>
<td>System Wide Information Management</td>
</tr>
<tr>
<td>SYCO-NT</td>
<td>System Communication New Technology</td>
</tr>
<tr>
<td>VC</td>
<td>Virtual Centre</td>
</tr>
<tr>
<td>VCT1/2</td>
<td>Virtual Centre Tranche 1 or 2</td>
</tr>
<tr>
<td>VIS@S</td>
<td>Virtualization Infrastructure Setup @skyguide</td>
</tr>
<tr>
<td>VM</td>
<td>Virtual Machine</td>
</tr>
</tbody>
</table>
“Currently, when pilots fly over Switzerland, they are subject to a handover midway through the air. This system is the same all over Europe. Skyguide is building a new system that is far more efficient, user-orientated and fit for the 21st century.”