BLUEPRINT

THE 2012 SKYGUIDE TECHNOLOGY OUTLOOK
Dear reader,

«Virtual Centre», «Common Controller Cockpit», «Logical Consolidation»: when it comes to the future of the air traffic management (ATM) industry, a number of new terms are currently doing the rounds. Why? Because the approaches adopted over the past few years to achieve further substantial enhancements to ATM in safety, capacity, performance and sustainability terms, primarily by exerting financial and regulatory pressures, have failed to deliver the desired success. And that has faced ATM today with the challenge of finding new means to do so.

One possible way of achieving these industry objectives is to make greater use of the technologies that already exist today. As even a casual survey will reveal, the technological opportunities which are currently available are only partly being exploited. And the remaining potential here offers the ATM industry attractive new avenues to pursue and explore.

The present capacities in computer performance, data transmission and data storage, for instance, provide sizeable scope for developing innovative solutions. And this scope now needs to be combined with new business. It is, after all, hard to imagine having cockpit data links with a capacity of just a few hundred bits per second while the 300 passengers in the cabin behind are enjoying broadband access aloft…

The road to tomorrow’s ATM won’t always be straight and smooth: replacing the tried-and-trusted is fraught with difficulties, and many questions will need to be addressed and answered in safety, social and political terms. The discussion has started, though; and we should soon be able to see if the new concepts proposed can truly take our industry into a better future.

I hope that you enjoy this 2012 edition of skyguide’s own ATM technology outlook; and I hope that, in providing it, we can make our own further contribution to this vital and valuable debate.

Sincerely,

Robert Stadler
How much more GPS do we need?

Maurizio Scaramuzza, Head of CNS Expert Group, skyguide

The question is incorrectly phrased, of course. We should really be asking: how much more GNSS (Global Navigation Satellite Systems) do we need? Because «GNSS» covers not just GPS facilities but all satellite navigation systems. These include, alongside the familiar GPS developed by the USA, Russia’s GLONASS, Europe’s GALILEO, China’s COMPASS and QZSS from Japan. To these must be added further satellite-based augmentation systems such as WAAS in the USA, EGNOS in Europe, MSAS in Japan and several other projects in China, India, Russia and elsewhere. And to complete the picture, we also have a large number of supplementary ground-based systems that provide local enhancements to the above. But to return to our original question: as far as we can see, for all its evident excellence, people are not content with GPS. Several further satellite navigation systems are also being developed; and the keenness to do so shows no sign of abating any time soon.

Is all this development really needed? Isn’t it enough for us to determine our position down to within a few metres whatever the location, time of day and current weather conditions? To understand the trends of today, we need to turn the clock back more than 300 years and travel to the Scilly Isles, just off South-west England. It was here that Admiral Sir Cloudesley Shovell lost four of his ships on the rugged local coastline as he was returning from the Siege of Toulon in summer 1707. Over 1,400 seamen drowned. The likely cause of the disaster: Shovell had miscalculated his fleet’s position.

Shocked at the catastrophe, the British parliament promptly offered an enormous reward to anyone who could provide a practicable solution to the age-old problem of calculating a vessel’s longitude while it was at sea. More precisely, the prize would be awarded for any device that could determine longitude at sea to within one degree – a distance of some 80 kilometers at our latitudes. The most promising solution would be by providing an accurate means of determining local time and using a sextant to establish the vessel’s position with reference to the stars or sun.

This in turn prompted a dramatic acceleration in the development of precision clocks. Prominent among the pioneers here was John Harrison. The son of a carpenter, Harrison would only earn true recognition of his achievements towards the end of his life. Yet no less a luminary that the explorer James Cook took a Harrison clock with him on his third and final expedition to the South Seas.

The means of determining longitude steadily improved as better clocks and better sextants were developed. But right up until the beginning of the 20th Century, the basic method of doing so still remained largely unchanged. Then, new research into the field of electromagnetic wave propagation offered new technologies that could also be used for positioning purposes.

A further key development occurred in the mid-20th Century with the arrival of LORAN-A, a system that was eagerly adopted by navigators and provided a positioning accuracy down to a few kilometers. (Systems such as VOR and ILS are not, incidentally, included in the present survey, as their prime function is to guide vessels and not to determine their position.) LORAN-A was subsequently refined – a development that culminated in the 1960s’ LORAN-C, which represented a tenfold improvement in accuracy terms.

It was during this time, too, that the first satellites began orbiting the Earth and emitting their own signals. These, it was realized, could also be used to determine a vessel’s position; and it was from this realization that the first US satellite navigation system, named Transit, was born. The new system allowed positions to be determined down to a few dozen meters. The new technology was further and further developed, gradually evolving into what we now know as GPS, a system designed essentially for military purposes which, even back in the 1990s, was already delivering an accuracy down to around 10 meters. And thanks to the evolution of further sophisticated calibration methods, smart algorithms, high-performance processors and suitable additional systems, we can now calculate a vessel’s position down to a few centimeters.

The diagram shows the increasing positioning accuracy that has been achieved over the past few decades. What is noticeable...
here is that the accuracy in doing so seemed to increase around tenfold every 15 years. Around the turn of the century, the progress in doing so sped up dramatically, with the same tenfold increase achieved in seven years. The trend is likely to stop soon, though, as any further increases in the accuracy provided will be of only limited practical use.

This, of course, raises the question: why do billions of dollars (or euros) continue to be spent on upgrading existing satellite navigation systems and even developing new ones entirely? The reasons for this are manifold, ranging from technical to political and even military considerations. For the final consumer, though, it's a better «satnav» service that is likely to be centrepiece. And here, as we have seen, it is positioning accuracy which has tended in the past to be the prime criterion and concern.

At the same time, however, we have also seen an expansion in the range of uses to which satellite navigation systems are put in the last few years. And, with it, further performance criteria have also grown in importance. For a satnav user who suddenly finds themselves in danger or distress, the prime concern will be to ensure that their position can be determined as quickly as possible, even if the GNSS receiver is switched off until just before it is used. Accuracy is only a secondary issue here: their position need only be calculated down to a few metres.

When it comes to navigating vehicles through a city, the main aim will be to provide some kind of adequate position calculation even when signal strengths are substantially reduced by the tall buildings all around. For the highly precise synchronization that is required among computers located all over the world, users will inevitably turn to GNSS timing. And in indoor applications of all kinds the key concern will be whether the signals can still be used after they have been weakened by their passage through walls and further obstructions.

And the aviation sector? With the prime uses of satellite navigation here being in the safety-critical field, it is system integrity that is likely to be most important of all: the system must be capable of alerting the user any time it cannot be used for a particular operation. This could be because the system can no longer provide the positioning accuracy required, for instance, or if a problem suddenly occurs with one of the system's satellites. As a further requirement, a strict limit will need to be placed on the maximum time permitted between...
the problem occurring and the system issuing the appropriate alert. Developments in the satellite navigation field today are often focused on improving all the above quality parameters and many more besides. These efforts are welcome and of course, any improvement to the system as a whole will benefit aviation too. The provision of more satellites, for example, can help enhance system integrity; having multiple signals on different frequencies will strengthen the system against interference; and any improvements to signal reception in a narrow city street may have applications for aircraft on the ground in the vicinity of terminal buildings.

Ultimately, though, the question will always be: who is going to finance all these developments? At present, most such funding comes from the public sector. It’s an investment in an infrastructure that is opening up new markets and is creating new jobs, too. More than 400 million GNSS receivers were produced worldwide in 2010, and current projections expect this volume to rise at over 10% a year. In the same year – 2010 – the volume of the market directly accessible via GNSS was estimated at more than EUR 40 billion, and was expected to continue to grow at around 13% a year.

On the basis of such figures alone, it makes sound and perfect sense to continue to invest in this satellite navigation technology. Aviation actually accounts for only a small proportion of the users involved – just 0.01% of all GNSS users, generating 0.5% of total market volume. Yet aviation does benefit from all these developments.

As for «how much more GPS we need» nobody can really say. One thing is clear, though: for aviation’s sake, too, development must continue in the GNSS field.
Non-ICAO-compliant approach procedures must be evaluated in detail to verify that their operation is acceptably safe. A risk-based approach will analyze all the individual components of a flying platform in terms of its failure probability. The hazardous scenarios here often include the simultaneous unexpected loss of GNSS navigation capability and the failure of one aircraft engine.

In mountainous areas, GNSS performance is usually limited by the topography. The GeoSTARS software package, which has been developed by skyguide in-house, can estimate overall GNSS approach availability for any given period of time. In critical cases, a GNSS signal generator can then be used to analyze specific avionics GNSS receivers and give a more detailed picture of their individual approach availabilities.

The probability of losing the services of a GPS satellite can be calculated reasonably accurately, on the basis of their failure rates and maintenance outage periods over the last few years. For a dedicated approach procedure, though, such availability can be determined on the basis of the relevant dedicated GPS satellite constellation and the possible failure of one of these satellites. The approach availability can be determined for each one of these scenarios (e.g. 30 scenarios in the case of a 30-satellite constellation), along with the probability of an unpredicted availability outage.

This probability is then taken, together with the failure probabilities of the GNSS receiver, antenna, cables, FMS, autopilot, flight display (where some equipment may be redundant) and aircraft engine, and is integrated into a risk failure model. The hazard will only be critical in adverse weather, i.e. if visual continuation of the flight is not possible. So weather variables are included in the failure model, too.

The result produced by the failure model is the probability of a hazardous situation. This must then be compared with the target level of safety defined by the operator. And provided the probability determined by the failure model does not exceed that specified in the target safety level, the approach procedure concerned can be confirmed as an acceptably safe operation.

Applications

GNSS simulations are a major contributor to permitting the adoption of new flight procedures in mountainous terrain, where standard ICAO criteria may not apply. As a first application here, this method has been used to analyze the safety of helicopter approaches in fog to Meiringen Air Force Base in Central Switzerland.

One way of determining the safety of non-ICAO-compliant instrument flight procedure designs is by conducting risk-based assessments of the proposed new approach procedures. If satellites are to be used for the navigation guidance concerned, the quality of the corresponding GNSS performance will be a major factor here. Coverage studies using a GNSS analysis tool combined with simulations using a GNSS signal generator will allow the performance quality of an aviation GNSS receiver to be evaluated for a designated approach procedure.
Future flight inspection: data are the key!
Markus Schwendener, Technical Director, FCS Flight Calibration Services GmbH

Flight inspection in Switzerland started in the late 1940s, when the first ground-based radio navigation systems were installed. Flight inspection back then was focused on verifying the positioning accuracy of terrestrial navigation aids, and was mainly performed on flight profiles referred to these points. With the emergence of first area navigation and now satellite-based navigation systems, a steady shift towards interference and data flight inspection has been required.

**Description**
Area navigation enables aircraft to navigate on a flight path that is detached from the location of ground-based navigation aids. This method allows Airways and approaches to be defined by waypoints without any direct navigation from or to a ground-based station. The method requires coverage by ground-based navigation systems (such as DME) or space-based navigation systems (such as GNSS) for position determination and the data defining the path and, if required, the positioning information for ground-based systems. Its implementation started with RNAV, which was followed by non-precision approaches (GNSS NPA) and approach procedures with vertical guidance (APV). A next step here will be the implementation of GBAS precision approaches.

An error in a database may have the same effect on safety as a misleading ILS signal, and their verification should be weighted the same.

Future flight inspection will require extensive preparation, perfect scheduling and comprehensive reporting. Very close collaboration between procedure designers, project engineering, air traffic control and flight inspectors is essential, too.

**Applications**
Some new flight inspection procedures have already been adopted for special cases in the last few years, especially in connection with the CHIPS project. With each new procedure, experience is gained, and new flight inspection procedures have to be established or existing ones improved.

Verifying positioning accuracy is no longer the main task of flight inspection. Any positioning uncertainty in area navigation will be due mainly to the geometry and the availability of the range information from DMEs or GNSS space vehicles during the inspection. Flight inspection’s focus has changed instead to availability, interference research and data verification.

The data for the routes and approaches are provided by the ANSP, and are either distributed via a database (such as B-RNAV) or transmitted by a ground station (like GBAS). These data are verified by flight inspection (e.g. GBAS) and by flight validation (e.g. GNSS NPA). An ILS approach will always lead to the location of the ILS, generally to a runway, even if the published location is wrong. The ILS approach may be influenced by multi-path effects, equipment drift or misalignment.

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To see or not to see!

Axel Maubach, Head of Airspace & Routes, skyguide

Would you board an aircraft without a human pilot sitting in the front? Probably not. Maybe you are reading this article while on a manned flight, wondering why you should even be concerned about unmanned aircraft systems. But would you feel comfortable flying alongside an aircraft that, if you ever got in its way, would fly right through you? Probably not, either... but there may be one next to you right now. To find out why there is no reason to worry, read on.

Description

Ever since the dawn of manned flight, «see-and-avoid» has been the fundamental principle for every pilot aloft. Aviation today has systems and rules which keep aircraft sufficiently far apart, frequently eliminating the need to be on the lookout for other traffic. However, no matter where and under which rules you fly, see-and-avoid is always the last line of defence. Or, in the words of the ICAO Rules of the Air: “Nothing shall relieve the pilot-in-command of an aircraft from the responsibility of taking such action as will best avert collision”. But how does see-and-avoid work for vehicles without any eyes on board?

Some such unmanned aircraft systems (UAS) are operated within line of sight, similar to a model aircraft. But with the «big birds» here, the pilot is usually located far away in a ground control station. The past few years have seen the successful integration of the Swiss Air Force’s RANGER UAS into military and mixed civil/military CTRs and TMAs. But now that we are striving for their introduction into Class C and D airspace controlled by civil ATC units, we are faced with the challenge of mitigating the lack of see-and-avoid capability owing to the absence of a human pilot.

Possible solutions here include having the UAS accompanied by a chase plane. This is effective, but is obviously not very efficient. A further option is to install an air situation display at the UAS’s ground control station. This has proved very helpful; but most UAS operators do not have this option, either for financial reasons or because they lack access to the radar data required.

On-board solutions are a further possibility. The UAS can, for instance, be equipped with a camera for airspace observation. The ANSP involved can then assist by enabling operations within a known traffic environment, where traffic information can be issued by the ATCO and acquired via the camera system. The UAS can then be made to take any avoiding action needed: not so much «see-and-avoid» as «sense-and-avoid» instead.

The measures above, together with specific separation requirements, have formed the basis of successful UAS operations in Switzerland for many years now. And that’s why you have no reason to worry!

Applications

The current further R&D efforts on this front are being aimed at developing autonomous sense-and-avoid systems, e.g. based on TCAS or ADS-B for cooperative traffic (i.e. traffic transmitting information and usually under control by an ATC unit) or based on radar, laser-ranging or infrared signatures for non-cooperative aircraft.

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**MSPSR: a new radar approach**

Luca Quiriconi, Head of SIGINT Applications, command support A6, Swiss Air Force

New primary radar technologies using multi-static techniques are currently a key topic in the surveillance community. ANSPs are looking for cheaper and less susceptible radars where the loss of a single transmitter (Tx) or receiver (Rx) will only result in degraded performance. And while traditional mono-static radar has Tx and Rx collocated and bi-static radar has Tx and Rx physically separated, multi-static primary surveillance radar (MSPSR) is a collection of bi-static radars which ensures that the signal reflected by the target is detected by multiple Rxs.

**Description**

With MSPSR, the means of determining the target’s position is based on the elementary bi-static radars made up by each Rx/Tx pair. For a given Rx/Tx, the target will give an echo with a time delay. The points in space with the same delay are located on an ellipsoid, whose foci are the Tx and the Rx sites. If multiple Rx/Tx pairs are used, the target lies at the intersection of all the corresponding ellipsoids. When the number of such Tx/Rx pairs is at least three (i.e. either three Txs and one Rx or one Tx and three Rxs), the target’s 3D location can be unambiguously established.

Notional MSPSR deployment builds multi-static cells where each Rx may pick up echo returns from the same target originating from different Txs. Adjacent Txs will operate on separate frequencies to aid the resolution of the source Tx; and, as with GPS, additional discrimination can be achieved by modulating the radar signal with different pseudo-random noise sequences.

MSPSR offers a number of advantages over mono-static radar: 3D information, a fast renewal rate (of under one second), no rotating parts, estimated lower costs (about 60%), less impact on the environment (through less transmitting power) and reduced antenna size. It does have some drawbacks, too, though: its digital signal processing is very complex, there are certain cost credibility issues, it is suited for only limited coverage, and the target needs to be in “line of sight” for Rx and Tx. The time and frequency synchronization in separated Tx and Rx is a further challenging issue, owing to ageing, temperature variations and other environmental influences.

Eurocontrol has devoted two separate studies to demonstrating the feasibility of multi-static radar, and MSPSR has also been identified by the SESAR programme as a key future supporting technology. MSPSR promises many attractive features; but it may have difficulty achieving the same performance as a modern pulse Doppler mono-static radar.

One high-potential MSPSR application, however, could be in the field of airport surface detection equipment (ASDE), where traditional mono-static radar is susceptible to multi-pathing. Here MSPSR would diminish the detection of false targets by combining information from a number of Rxs positioned at different locations.

**Applications**

The applications for MSPSR in ATC terms are still in the development phase. Under current thinking, MSPSR might be initially used in terminal areas, and then extended to provide en-route coverage. It also already has some military applications, in the form of passive multi-static radar where Tx is a signal of opportunity (FM radio, GSM, DAB, TV, etc).

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New technologies speed up military procedure design
Lt. Colonel Sergio Rämi, Pilot and Chief of Instrument Flight, Swiss Air Force

The latest ANS technologies such as satellite navigation and digital terrain modelling (and the information they provide) are making innovative military procedures all the quicker to devise. These procedures can then be flown by the Swiss Air Force's helicopters, not only in Switzerland but in any region of an extended Europe.

Description
For a subsidiary mission with transport units (generally helicopters) in Switzerland or abroad, the Swiss Air Force must be able to acquire the information needed to calculate and design the appropriate military procedure in about four to five days, permitting a quick start to the mission even in a period of adverse weather conditions.

Once the decision has been taken that transport units are to be deployed for search-and-rescue (SAR), helicopter emergency medical services (HEMS) or any other mission, there are usually one to two days available to collect the data required.

If the deployment is in Switzerland, the area data needed will be readily available. Things will be more complex, however, if the deployment is elsewhere. Non-Swiss data must be collected and adapted with different partners, and this will take at least one to two days more.

Let's take a concrete (and eminently feasible) scenario: an earthquake in Eastern Anatolia.

Once the decision to deploy has been made, two Super Puma TH06s will fly to a headquarters near the devastated area. There will, of course, be a need to fly in and out of here even in adverse weather conditions. The mission leader starts out with two Super Puma TH06s at T+24, and arrives at the headquarters area 24 hours later.

A further 24 hours after his arrival (i.e. at T+72) the mission leader obtains the first information on how to get to the earthquake area, with the relevant charts sent by SATCOM / internet. So within three days of the decision to deploy, the mission leader will be flying the approach with the new procedure on a mobile digital device.

For the purposes of this example it is assumed that:
- there is segregated airspace, with no airspace issues to be resolved
- the operation will be under Swiss Air Force military control
- the operational air traffic will consist solely of helicopters
- the approach angle will be 6-8°
- a straight-out missed-approach procedure will apply.

Applications
This overall approach can be used to establish a process that meets the time-critical requirement for HEMS missions Euro-wide. It can also be adopted to produce an approach procedure which can be flown by the Swiss Air Force under adverse weather conditions.

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Service-Oriented Architecture (SOA) is a basic architecture that represents the technically functional interfaces of software building blocks as reusable, distributed, loosely coupled, and standardised accessible services. This article endeavours to explain Service-Oriented Architecture in laymen’s terms and impress upon the reader the measures required to successfully utilise the paradigm.

Description
Processes and systems are becoming more and more complex and yet business success is reliant upon adapting to a rapidly changing environment. The decisive point is the flexibility of an enterprise, being agile, reacting to change and even embracing the change. The key enabler is the flexibility of the business process to enact the rapid change.

SOA is a software architecture principle based on several architectural best practices and the paradigm of realising and maintaining business processes in an IT system. The architecture contains several components: Services, Front End Applications so that users can access the Services and Infrastructure upon which the Services are deployed, often referred to as Service-Oriented Infrastructure (SOI)

The principle is based on the concept of a service: a software component of distinctive functional meaning, that typically encapsulates a business process. The granularity of the service is selected to give the optimum reuse of functionality, reduction of redundancy and minimise maintenance. As in a real world ‘Service’ the contract is a statement by the Service Provider of what the Service Consumer shall receive when both parties uphold their respective obligations.

SOA has been chosen by EUROCONTROL as the foundation of the future ATM system in the SESAR programme. SOA though is not a silver bullet solution, it is a IT landscape strategy for the ease of maintenance and evolution of business processes in an IT system.

This IT strategy can only be executed with an incremental and iterative approach. A definition of the ‘target’ architecture can be determined using a combination of bottoms-up analysis of the existing system architecture coupled with a tops-down analysis of business processes; a ‘meet in the middle’ approach. A transition plan provides a path to achieve the defined ‘target’ architecture over a period. The architecture landscape requires continual monitoring, control and alignment with strategic objectives of the enterprise.

It is essential for the company to realise that this strategy can not just evolve in isolated areas of the company but requires a planned, concerted and focussed effort at realising the paradigm. Otherwise the results would equal the current issues that we are facing today; demanded functionality is rising starkly, raising complexity and cost benefit is reducing. A Service-Oriented Architecture is an opportunity to reverse this trend but only when realised in a conscious manner.

Applications
The use of Service-Orientation can be applied to the AIM and ATM systems. The application of this strategy is compliant with Eurocontrol’s SESAR programme. It would enable Skyguide to use Services supplied internally or to source them externally from companies.

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2000 05 10 15 20 2025
XMAN: FABEC extends the arrival management process

Urs Tobler, Head of ATM Engineering Group, Data Services, skyguide

Most of the current arrival management systems focus only on lower airspace. This means that the effects of speed adjustments and vectoring are felt at these lower altitudes, where they have a sizeable adverse impact on noise and CO2 emissions. Extending the time horizon of such arrival management techniques to adjacent and/or upper airspace would reduce both environmental impact and the controllers’ workload in such lower airspace areas.

Description

An arrival management system or AMAN is an ATM tool that determines the optimal inbound sequence times at an airport and at the coordination points to approach (APP). All the FABEC member ANSPs (except Maastricht Upper Airspace Control) have either adopted or intend to adopt AMANs as part of their technical systems and operational procedures. Skyguide has been using an AMAN for Zurich Airport since 2001.

The goal of AMANs to date has been to maintain an optimal runway throughput and minimize arrival queuing. Within FABEC, however, it has now been decided to introduce a so-called «extended arrival manager» or «XMAN», to permit smoother traffic adjustments more in advance and ensure better compliance with arrival sequence conditions.

To perform such tasks, XMAN will need to expand its arrival management operations up to 200 NM around the airports concerned. The corresponding planning tools will thus extend their planning horizon into the en-route areas of adjacent area control centres (ACCs) and Upper Airspace Control (UAC) to cover the top of descent and an appropriate portion of the previous flight route. Most FABEC control centres will therefore be affected by XMAN operations. It has also been decided that five major airports – Paris, Frankfurt, Amsterdam, London and Munich – should receive XMAN first.

Expanding the present arrival management also means providing access to the radar tracks and flight plans for the extended horizon. If a direct national radar data link cannot be provided here, the radar data concerned could be obtained from EUROCONTROL’s CFMU, which can deliver all such data for the FABEC partners. The AMAN will then compute a target time for each flight – not only for the runway threshold and the ACC/APP handover point, but also for the upstream coordination points.

To extend the data involved from the AMANs to the ACC/UAC sectors, the OLDI standard used for electronic flight plan data exchanges between ANSP centres has been enhanced through the provision of a new «arrival manager message» or AMA. These AMAs will be exchanged between the local and the upstream flight plan systems (FDPS) of the various centres, and will be displayed at the controller’s working position (CWP).

Applications

The new XMAN concept is fully in line with the development of SESAR and its long-term vision of extending such arrival management systems to the en-route sectors. The first implementations of XMAN within FABEC are envisaged for 2013-14: by DFS for Munich and Frankfurt, by LVNL for Amsterdam and by Belgocontrol for Brussels. The adoption of XMAN for Munich and Frankfurt will entail skyguide’s involvement, too.

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Cloud networking moves the complexity of data centres to the networks. The experts are convinced that cloud networks will be just as influential as the e-business.

Description
The «cloud» is a set of services and technologies that enable the delivery of computing services over a network in real time, allowing end-users instant access to data and applications from any device.

The cloud can be categorized as providing three distinct services, which can be used individually or in combination with existing internal infrastructure:

1. Software-as-a-Service (SaaS) is a model of applications that are delivered over the network, usually via a web browser.
2. Infrastructure-as-a-Service (IaaS) is the delivery of computer architecture over the network.
3. Platform-as-a-Service (PaaS) is a model in which application middleware and build tools are made available to developers via a remote service provider.

What does the cloud provide?
The cloud enables access to applications and data any time, anywhere and from any connected device. The cloud also allows complexity and costs to be reduced at the IT level, by concentrating infrastructure in data centres and virtualizing the applications.

In the ATC and Single European Sky contexts, the cloud will play a key role, enabling the sharing of raw and processed data. In order to enable the new business model for air navigation services like «Virtual Center» and taking into account FABEC performance goals, the global network architecture has to be revised.

What does the cloud really mean for the network?
Network services will have to be adapted to meet these new demands. The prime challenges here will be in terms of the availability, integrity, accuracy and latency of the networks concerned.

The cloud should simplify the customer experience, while the architectural complexity will increase. To ensure safe operations, then, it is vital that the various network layers are fully controlled. As access flexibility increases, security levels will be of paramount importance, too.

The SWIM concept within SESAR proposes a new means of data sharing that should deliver the right data to the right users at the right time. As such, the concept is vital to developing our own cloud to meet the data needs of our planned Virtual Centre.

Applications
The coming SESAR/SWIM concept should put various types of shared computed data (radar, weather/environmental, flight, voice data and more) at the disposal of cloud users.
BYOD: the IT way ahead?

Xavier Coppin, Network Security, skyguide

The «Bring Your Own Device» or BYOD trend started a few years ago, when a number of firms decided to save money by allowing their employees to use their private mobile phones for work purposes, too. The concept sounds good, but it does pose challenges. Some 53% of US corporations now allow BYOD, but almost half of these have faced security breaches. The use of BYOD is sure to further increase; but its adoption should be restricted to companies with high security maturity.

Description
BYOD is a growing trend within the corporate world. But it’s one that poses several questions, too. Where’s the borderline between professional and private life? And what risks are also entailed by the BYOD approach?

With BYOD, file-sharing protocols are permitted at home. But information leakage is a serious risk if the P2P software isn’t correctly configured and allows the sharing of sensitive corporate information stored on the same device. Virus infection is another high risk: Juniper found that mobile malware increased dramatically (by 155%) in 2011.

Adopting the BYOD approach raises ownership issues as well. What if the device is needed for a forensics investigation? And who owns the licence? After all, some software is free for personal use but needs a licence if used for business purposes.

In security terms, BYOD requires us to find the right balance between the security levels demanded and the usability of the mobile device. A brute-force attack will crack the four-digit PIN on an iPhone in about seven minutes. One countermeasure here is to increase password complexity. But users are notoriously reluctant to accept changes of this kind.

So what questions should a company ask (and answer) before adopting BYOD? Should all the various operating systems be allowed? Are minimum versions to be required? What level of support will the helpdesk be able to offer for each device? Is minimum security software (anti-virus, encryption etc.) a requirement for connectivity to the company, or will only recommendations be made here? And will any such requirements be remotely checked before remote access is granted?

The overall connectivity of a BYOD device to the corporate IT environment should be separated from any access to other internal networks. In many cases, though, a wireless network will be used inside the company to allow the connectivity of BYOD devices with limited access to email, with a virtual desktop infrastructure provided to permit access to business applications.

The «state-of-the-art» approach here is to segregate data on the mobile device itself. This involves creating a «secure» container on it, access to which is restricted and remotely managed by the company. The company can then enforce strict authentication, or even remotely wipe the corporate data from the device in the event of its loss.

Applications
With the flexibility it provides, the use of the BYOD approach is sure to increase. Before adopting it, though, any company should ensure that it has high security levels and proper device management and endpoint protection in place. And a comprehensive IT security programme must be part of the overall corporate culture.

Impact
Europe’s ANSPs are facing an interesting new era compared to the 1990s. SES programmes, market consolidation and the private sector popping up with new business models are all factors that make the ATC mission today more challenging, while still leaving it heavily dependent on its legacy environment. Obviously, such an evolution can also have a substantial impact on ATC services in technical terms in the form of ventures like the Swiss «Virtual Centre». So what does it all mean for a technical entity like skyguide’s Network Services?

Description
Skyguide’s Network Services unit is convinced of the vital importance of pursuing and maintaining a consistent business development strategy – even one that is required to evolve in a purely technical field. After all, business development means anticipating the future of the core business, and efficiently managing the opportunities that arise from the market.

That market it still driving the ATC business today, even if we are in a quasi-monopolistic situation. ATC has also long been considered a niche market, and one that has some sizeable entry barriers in terms of its complexity and specifics.

What, then, is the challenge for Network Services unit?

The mission of Network Services unit is to guarantee the availability, accuracy and integrity of ground-to-ground communications for skyguide’s operations. Parallel to this, the unit must also secure the future of the services it provides, by ensuring their alignment with further skyguide programmes such as BMS, SMT2, the Virtual Centre and the coming FABEC milestones.

In such a complex system, a clear need has been identified to define and implement a business development activity called SM2 (Sales & Marketing Machine) within the Network Services unit. In order to pursue the business development activities expected here within an acceptable timeframe, an impressive results-oriented approach called Rapid Results Initiative© is being adopted.

The main goals of Network Services’ business development strategy are to gain market maturity, anticipate customer pains and secure skyguide’s niche positioning on a mid-to-long-term basis. Being closer to our internal and external customers also helps us leverage mutual trust and emphasize our key differentiators.

Applications
Business development contributes to:
- maintaining a customer-oriented culture
- anticipating market trends
- leveraging trust with stakeholders
- looking first for customer pains… the «why»
- securing core business for the longer term
- improving opportunity qualification and resource use efficiency
- drawing a consistent and market-oriented technological roadmap.

Impact

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<th>CNS</th>
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CHIPS stands for CH-wide Implementation Program for SESAR-related objectives and activities. The program has its roots in the Northerly Approach to Zurich (NAPP) project, which was rejected in 2008, and has been around in its present form since 2010. CHIPS has taken the philosophy and logic of stage-by-stage project development and the working procedures of the former Zurich Area Adaptation Program (ZAP), and has enlarged its scope from a local airport to the national aviation system.

Content
The CHIPS program is designed to permit the implementation of procedures that have become possible through advances in technology. CHIPS thus provides solutions to stakeholders’ needs by promoting flight procedures that are integrated into and supported by our ATM/CNS environment.

Satellite and Performance Based Navigation is the first new technology which the CHIPS program is promoting. The program here consists of over 30 projects, six of which have already been implemented. A second new technology for CHIPS is the concept of the «Remote Tower»: this is just evolving and about to start.

Purpose
The adoption of any new technology - Satellite and Performance Based Navigation is a good example - requires the close coordination of all its stakeholders, even if skyguide is the most substantially involved. And the main purpose of CHIPS is to set up the framework needed to allow such individual projects to be implemented.

Any new element needs to be introduced into the existing framework on the technological, the systemic and the institutional level. CHIPS provides the coordination required, by ensuring close collaboration and networking among the project partners. Meanwhile, the relevant governance principles ensure that all the organizations involved fully support the program and its projects.

Organizational structure
CHIPS is owned by the FOCA, who chair the Board of CHIPS. The management of the program has been delegated to skyguide, who chair the CHIPS Steering Committee. Jürg Hänni (OE) and Heinz Wipf (OEE) are responsible for managing CHIPS at the Swiss level, with the administrative support of Monica Ezquerra. Within skyguide, Jürg and Heinz are supported by Maurizio Scaramuzza (TNS) and Laurent Delétraz (OOTX) in managing program development and progress. The program’s management reports to Chief Operating Officer Alex Bristol and the Executive Board Committee Operations (EBCO).

Individual CHIPS projects are normally owned by the airports. Under Swiss aviation law, the airports must apply to FOCA to have any proposed new procedures approved. At the existing airport system level, the projects are steered by bodies such as the Koordinationsgremium Flugverfahren Flughafen Zürich (KFFZ) or the Genève Aéroport Coordination Group (GACG), to ensure that they fit into each airport’s own development strategy.
This means that all CHIPS projects, and indeed the program itself, have an explicitly multi-corporate character. Needless to say, though, all such projects are also expected to respect and follow our internal skyguide processes – a demand that is by no means self-evident, and requires a lot of attention and support.

Skyguide’s internal ownership of such projects is normally allocated to the operational unit manager. This approach is key to the successful implementation of a new procedure within the skyguide ATM concept. But it is also quite a challenge, especially in terms of keeping the complexity under control: Satellite Navigation and Performance Based Navigation procedures cannot simply replace existing ones, and such replacements will only be feasible once the vast majority of airspace users have been equipped and trained to fly the new procedure safely. The long-term aim, incidentally, is to replace the existing instrument landing system technology with Satellite Navigation and Performance Based Navigation procedures at the end of the former’s life-cycle.

The challenges for skyguide
The main challenge for skyguide in all the above is not only to acquire the necessary expertise in procedure design and upgrading the technical equipment involved, but also to understand the behaviour of electromagnetic signals in space, where noise and interference will affect their practical use. Pilots’ expertise is also required here to properly assess the risks. This «total system approach» to safety further underlines the multi-corporate nature of the CHIPS program.

And that’s not all. Impact on airspace design, the use of points-in-space (PinS) and flights to hospitals must also be considered and adequate solutions developed. And the effects on our air traffic management concept and CNS strategy must be carefully analyzed, too, given the tendency to shift from pure «separation and control» to a more dynamic «management of space and time» in lower airspace.

At the airports, meanwhile, the approach and departure procedures will gradually shift from conventional navigation with terrestrial equipment such as ILS, DME and VOR to space-based satellite systems such as GPS and GLONASS. Satellite navigation is a giant leap forward for aviation; but it is still a long way from becoming a worldwide standard for all possible applications such as curved approaches. The complexity of the international and national contexts requires a strong network and close coordination of all the activities, strategies and goals of the Swiss aviation community.

Roles and responsibilities
A clear understanding of the roles and responsibilities of each stakeholder is one of the key elements of CHIPS. This is true not only between the organizations involved but also within them, among their departments and divisions. The role of FOCA shifts from the supervisory authority to a framework enabler as institutional questions require a proper legal foundation.

An international benchmark
From what the program team have learned on their fact-finding missions to Australia, the USA and Sweden, we are right on target with CHIPS and our way of implementing PBN in Switzerland. The development of the procedure design at ICAO is also progressing well, thanks to our contributions to the various working groups and task forces.

Conclusion
The CHIPS program is as complex as its context. But thanks to the support and contributions of everyone involved, it is effective and successful, and is progressing constantly towards its ambitious but invaluable objectives.