Implementing

System Wide Information Management

(SWIM)

as the external enabler of ATM end-user applications

This document has been prepared on behalf of the airspace users. It is awaiting formal endorsement by the Airspace User Associations.

Record of Amendments

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Table of Contents

1 Introduction

In this document, we introduce SWIM as the externalised (from an ATM point of view) enabler entity that brings benefits by allowing end-user applications from the simple to the most complicated to make full use of the complete ATM data set and which can start on existing infrastructures. Institutional issues will need to be addressed, but for a simple start, no great changes are needed.

In many of the SWIM descriptions circulating at the time of writing, SWIM as the data management “entity”, ATM end-user applications and even institutional aspects are mixed up in a way that projects a flawed picture. The most important misconception is that SWIM should be under the purview of air traffic management, that it is a function integral to the air traffic management systems. One of the consequences is that the date for SWIM implementation is usually pushed to the right since SWIM is seen as belonging to a more advanced state of ATM and hence cannot be done earlier than the date those advanced functions become available.

In fact, SWIM is NOT an ATM category, it is simply the enabler of information sharing and indirectly the enabler of advanced end-user applications (which ARE ATM categories) which will be introduced in different phases of advanced ATM implementation projects.

Actually, the common ATM information model is the only aspect of SWIM which is really air traffic management specific.

Neither is SWIM part of the system architecture. SWIM drives architecture. Depending on the adopted SWIM concepts and performance requirements, the system architecture may need to look different.

THIS IS WHY IT IS VITAL THAT WE DEVELOP A COMMON UNDERSTANDING OF THE SWIM CONCEPT RIGHT UP FRONT. WITHOUT THIS, SYSTEM WIDE INFORMATION MANAGEMENT REMAINS AN UNATTAINABLE GOAL.

SWIM can bring benefits even in a legacy environment and hence it is wrong to make its implementation dependent on the availability of a more advanced ATM situation. Witness the limited information sharing being practiced by airport CDM to-day in Europe or the similar activities in the USA and it is clear that certain aspects of SWIM can be implemented now to enable immediate benefits. It can then grow as required to meet the demands of the more advanced ATM features.

Another misconception that can result in huge costs is the premise that SWIM needs dedicated highly secure networks under the stewardship of ATM organisations. Most of the information in ATM can be safely put on existing networks and even with the more sensitive information, costly and cumbersome security overkills must and can be avoided.

The SWIM figures provided are not meant to show a particular architecture or technical solution. They are designed to illustrate the elements that need to be enabled to achieve information sharing and common situational awareness in ATM and all areas of concern to ATM, via the SWIM concept.

It is important to remember that the benefits of SWIM arise from the end-user applications that make use of it and not SWIM itself. Such applications are possible to-day and hence SWIM must be there as soon as possible to release the full potential of even the semi-legacy environment of the short term with more extensive benefits possible in later phases of ATM development.

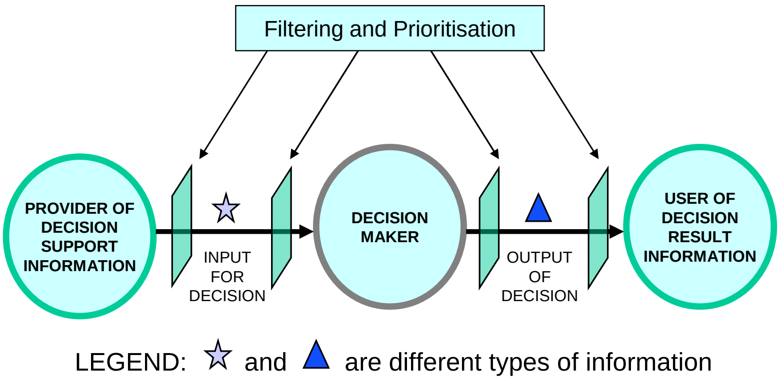
Finally it is essential to realise that there is no such thing as ground/ground and air/ground SWIM. SWIM is about information and how it is shared and managed. The complete network may be built in segments and air/ground may come later than ground/ground, but this is a connection issue and not a SWIM issue. An aircraft may not be able to use certain applications if the air/ground network segment is not yet available but conversely, this does not prevent other applications from using information that might come via the air/ground segment but which is also available from other sources (e.g. FOC). This however does not mean that SWIM has different characteristics in the ground/ground and the air/ground context and hence SWIM implementation must reflect this universal nature of information management.

System Wide Information Management can generate substantial benefits even in a legacy information environment. Its potential for benefits, through enabling advanced end-user applications and services, is enhanced even further in the European ATM Enterprise Architecture (EAEA) and the Service Oriented Approach (SOA) that will be used to populate it.

2 The relationship between SWIM and ATM Performance

From a generalised “command and control” perspective, the ATM system can be seen as a complex, distributed real-time information processing community populated by a large number of humans and automated systems in the role of sensors, information providers, information users and decision makers, all collaborating to ensure a safe, expeditious and efficient flow of air traffic.

The following figure illustrates the interaction between information providers, decision makers and information users.



As is illustrated in the figure, the performance of ATM depends on six factors:

1. Existence of airborne and ground-based suppliers (systems and service providers) for the various types of ATM decision support information;
2. Availability, quality and timeliness of the provided decision support information (quality includes integrity, accuracy, completeness, legibility, trustworthiness etc.);
3. Ability of airborne and ground-based ATM decision makers to receive, absorb and use available information;
4. Quality and timeliness of the airborne and ground-based decision making itself;
5. Effectiveness and timeliness of making the resulting ATM decision information available to (potential) airborne and ground-based consumers of that information (those who have to act on it);
6. Effective information filtering and prioritisation along the way.

In order to improve overall ATM performance, al six factors need to be improved.

Historically, the focus of attention has primarily been on item 4 — how to improve (algorithms, automated tools and procedures for) decision making in the various functional categories e.g. airspace management, flow and capacity management, separation assurance, sequencing and metering etc. — whereas the purpose of the *information management* perspective is complementary. It focuses (exclusively) on improving the other five factors which are equally determining how well ATM performs at the end of the day.

System Wide Information Management (SWIM) introduces a number of changes which are specifically designed to improve these other five factors. The final effect of the evolution towards SWIM is illustrated in the Table below, which contrasts the information management situation before and after deployment of SWIM.

ATM information management prior to SWIM	Target situation after SWIM deployment
Has roots in the traditional ATM environment where CNS limitations were the main determinant for what was possible	Applicable to a fully networked information-rich ATM environment
Focus on “micro-management” of information	Challenge: how to deal with large quantities of information
Interaction between decision makers is through communication (mainly point-to-point information flows)	Interaction between decision makers is through information sharing, i.e. via a distributed "virtual" information pool which uses concepts such as information replication, information caching, etc.
Real-time event propagation amongst ATM stakeholders occurs through message exchanges (send/receive) generated at decision making level, not at information management level	Real-time event propagation amongst ATM stakeholders is managed by a separate information management layer: triggered by information filters (publish/subscribe) and the dynamics of the information web, i.e. by synchronisation of information state & relationship changes in the various copies of the information)
Emphasis is on interface definition and standardisation in a static environment (development and acceptance of information architecture standards takes years)	Emphasis is on information standardisation in a rapidly evolving environment (advanced systems know how to adapt to new meta-information — this is the key to quick responses to changing information needs)
Most meta-information is embedded (hidden) in system designs and information architecture standards	Extensive amounts of explicit meta-information are circulating in the ATM system
Systems follow a classic design which enforces a rigid structure of information flows (functional architecture with "hardwired" data flow diagrams, i.e. static view of inputs and outputs of a function)	Systems are designed to support flexible information flows (not based on pre-defined data flow diagrams, but on predictive, dynamic information demand/supply balancing — capable of adaptation to the "information market")
Information management principles are applied at the local (system) level only (leads to islands of information)	ATM network characterised by the existence of common processes explicitly responsible for system-wide information management (leads to a coherent system-wide integrated web of distributed information: the ATM virtual information pool)
ATM is characterised by integration and interoperability problems	Integration and interoperability problems in ATM are solved by efficient information sharing capabilities

ATM information management prior to SWIM	Target situation after SWIM deployment
Information ownership, licensing, pricing and security are poorly addressed	Information has become a commodity: information ownership, licensing, pricing & security mechanisms have matured (for static as well as real-time information)

3 The context of SWIM

3.1 The net-centric ATM environment

Aeronautical information has been the mainstay of safe and efficient aircraft operations on a global scale from the early days of aviation and continues to be vital to-day. At the same time the air traffic management environment is undergoing several paradigm shifts both in Europe and the United States, that will have far reaching consequences for the information needs of the ATM partners as well as on how those needs are satisfied.

The most significant upcoming change is a total net-centric approach to managing air traffic coupled with a shift to focus on managing trajectories and changing some of the traditional roles of air traffic controllers and pilots.

This net-centric operation is supported by collaborative decision making processes which are based on the principle of common situational awareness predicated on shared information and the timely actions taken on the shared information.

Net-centric in the ATM context means that each information generator or consumer partner is a node on the global network, directly addressable by all the other partners, with everybody sharing a common virtual information space.

Another important feature is the generalised access to information. Limited only by legitimate security considerations expressed in powerfully protected and enforced access rights, all partners may contribute and/or access the shared information. Obviously, this raises the need to ensure the quality of information going into the system on the one hand and satisfying the expectations of the partners using the information for quality and timeliness, on the other.

3.2 Service oriented approach (SOA)

Note: SOA is commonly used to signify Service Oriented Architecture. In line with the conclusions of the European SOA TF, which uses SOA to mean more than just architecture, this document also interprets the letter A in SOA as "Approach" rather than "Architecture".

Service orientation is an approach to organizing distributed information resources into an integrated solution that breaks down information silos and maximizes business agility. Service orientation modularizes information technology resources, creating loosely coupled business processes that integrate information across business systems. Critical to a well-designed service-oriented architecture is producing business process solutions that are relatively free from the constraints of the underlying IT infrastructure, because this enables the greater agility that businesses are seeking.

The Service Oriented Approach (SOA) ultimately enables the delivery of a new generation of dynamic applications. These applications provide end users with more accurate and comprehensive information and insight into processes, as well as the flexibility to access it in the most suitable form and presentation factor, whether through the Web or through a rich client or mobile device. Dynamic applications are what enable businesses to improve and automate manual tasks, to realize a consistent view of customers and partner relations, and to orchestrate business processes that comply with internal mandates and external regulations. The net result is that these businesses (e.g. airlines, airports) are able to gain the agility necessary for superior marketplace performance.

3.3 The notion of the "virtual information pool"

The concept of SWIM is in fact much more than just switching from a point-to-point data communications model to network centric communications. SWIM is not the same as being able to send messages to any desired destination. SWIM is an information broker which resides between the originators of information and the users of information. It manages processes (which run outside of ATM applications) which manage standardization, data discovery, access rights, etc. and safeguard the overall quality and consistency of the total body of ATM decision support information. The net-centric communications method is of course an enabler of SWIM, but it is not SWIM.

SWIM is a "store and forward" layer between the applications. All aeronautical information provided by data sources can reside for an indeterminate length of time (from a millisecond to a year or more) somewhere in the "virtual information pool" before being picked up by those systems/applications needing it.

The "virtual information pool" notion symbolizes both the persistence (availability as long as needed) and accessibility (access as quickly as needed) of every bit of aeronautical information produced.

Some essential characteristics of SWIM that depend on the "virtual information pool" notion:

- primary focus changes from information exchange to distributed information storage (persistency aspect) and synchronized replication of information copies, making a distinction between "master copy" and "secondary copies" of information.
- searchable "virtual information pool" (through data discovery) represents the "unified market place" for ATM decision support information, appropriately protected by access and update rights (security management) with appropriate ownership, licensing, liability, charging, information archiving, disposal etc.
- fastest possible event propagation by information supplier: the "virtual information pool" is updated without delay after each (validated) change
- user-dependent speed of event propagation to information user: updates of the "virtual information pool" not necessarily propagated immediately to the information user, but based on individual timeliness needs

SWIM is the ultimate distributed information environment, the elements of which are tied together by the notion of the "virtual information pool.

3.4 The scope of SWIM

3.4.1 Background

Information has always played a vital role in aviation. "Knowing" and "being informed" has been synonymous with safety in the early days and having timely and accurate information is as important to-day as it was then.

It is both interesting and educating to cast a view backwards to bring into focus where we have come from before considering the present and even more importantly the future, from the specific view point of information.

The provision of aeronautical information was originally conceived to ensure that individual aircraft are given all the information necessary to conduct their flight safely. When the business aspects of aviation attained a more pronounced importance, becoming second only to safety, aeronautical information had to be enhanced to cater also for the requirements of efficient operations.

Although meteorological information is essential for safe and economic operations, for historical reasons the rules applicable to MET and its provision have evolved in a way that is parallel to, but not integrated with, the rest of aeronautical information.

With air traffic demand growing year after year and the world's busiest areas getting saturated both in the air and on the airports in those areas, the need to look at the air traffic management infrastructure as a network was increasingly recognised and with it the need for new types of information, including increased coverage both in the geographical and the temporal aspects. Since these new developments came at a time when electronic information processing and exchange was already well established, such methods were readily adopted also in the air traffic management context.

Very quickly the situation evolved to the point where the fragmentation (traditional AIS, MET, new types of information and services delivered in numerous different contexts) started to become a limitation to growth and in some cases even led to safety concerns (e.g. presence of multiple, slightly different flight plans, for the same flight).

A further complication was identified in the way information was/is being promulgated. Many point to point connections, a not always reliable addressing scheme, a push-type distribution which quite often missed the target users, difficulties in accessing important information, etc. all combined to help arrive at the realization that a new approach to managing information was needed.

3.4.2 New requirements to be met

The most important characteristics visible from plans for new ATM systems is the trajectory management approach to handling flights on the one hand and a shared information environment which is the main underpinning of all the air traffic management functions on the other. This shared information environment extends to include aircraft on the ground and in the air. In the ATM performance partnership flights that have agreed departure and arrival slots fly without delay. Even the traditional flight plan filing as we know it to-day will be replaced in Europe by the managed sharing of flight data and associated trajectories, demonstrating the depth to which the new way of handling information will reach. It is clear that this net-centric approach can only exist if the information generated and consumed by the various partners in the ATM system is managed in a safe, cost-efficient and quality assured manner without limitations on the type and quantity of information or the number of users. The system must also be agile, flexibly and cost efficiently adapting to new requirements, be it new information types or new users or providers.

The information shared environment also requires that fragmentation in terms if what is available and how, is eliminated and also that information must be provided in the form of data, which can then be processed into usable output on the client side.

Enhanced ground/ground data communications, including digitised voice, is also required to support new collaborative decision making applications like the User Driven Prioritisation Process (UDPP).

The importance of meteorological data will also increase substantially since the precise flying of trajectories and making precise predictions (essential to reduce uncertainty and hence increase capacity) all depend on improved meteorological information, especially wind aloft data. With the expectation that aircraft platforms will increasingly communicate such data, to be then shared via the new environment, it is clear that meteorological data will have to be part of the information sharing environment, just like all other information that is of concern to ATM.

3.4.3 From AIS to SWIM

As mentioned earlier, information has always been one of the cornerstones of aviation safety. Traditionally, the information was provided by the Aeronautical Information Service (AIS), one of the few, truly global services in aviation. Over the years the means used to deliver information have evolved and the scope of information has expanded. By necessity, international standardisation was one of the chief goals of all concerned, resulting in a product oriented output that served most needs but was rarely perfect for any specific need.

With the quantum leap in information use and the requirements for more information described above as well as the introduction by airspace users and other partners of a digital, data oriented paradigm in their operations, the gap between the requirements and the ability of the product oriented AIS system to deliver what was needed was becoming more and more apparent. The product oriented system is not really flexible and it is difficult and expensive to add new features and/or information and hence closing the requirements gap has proven impossible.

The difficulty was duly recognised by the AIS community as was the fundamental truth that the aeronautical information service is an essential service to aviation that must rise to the challenge through developing into the service that fully supports the future information sharing environment.

This evolution is taking place via the transformation of traditional, product based AIS into data oriented System Wide Information Management that has been discussed and agreed in numerous fora world wide.

3.4.4 The new scope of aeronautical information

The main drivers determining the scope of aeronautical information, and hence SWIM, are:

- Air traffic management is evolving into a net-centric, trajectory managed environment which is based in all its aspects on shared information and collaborative processes using the shared information
- A shared information environment implemented in a net-centric manner requires that there should not be fragmentation of the available information set. In other words, the shared space encompasses all types of information, be that meteorological, environment, traffic, flight or any other category
- An agile system means that it is easy to add new information and providers/users of information, in effect meaning that there is no predetermined limit on the scope

Only standardised information may be included.

3.4.5 The future meaning of aeronautical information

While in the past aeronautical information had been defined in a rather narrow manner, the shared information environment of the future, and in particular the collaborative processes envisaged, require that aeronautical information not be limited to a set of data that is pre-determined based on expectations. The new definition should also be net-centric and focus on the overall needs of air traffic management, recognising the propensity of these needs to change over time.

Based on the above, the best definition appears to be: Aeronautical information is any information of concern to air traffic management, without pre-defined limitation.

A system built to cater for this premise has no problem in accommodating an expansion of the information set or of the users/providers and hence can fully support the evolution of the net centric environment as it embraces new processes, both in the air and on the ground.

3.4.6 An upwards open scope

It is clear from the above that SWIM must have a scope that is open and which enables additions without difficulties or high cost. Obviously, this open scope is a characteristic that will be taken into increasing use as time passes, filling in the “space” with information in line with the evolving requirements and the pace of standardisation.

This latter is a critical issue. Only information the characteristics of which have been agreed can be shared in the ATM network and hence only such information can be considered for inclusion in the actual SWIM scope. This is a limitation that will have to be handled carefully.

Standardisation can be a very slow affair. If an ATM requirement appears asking for an as yet un-standardised information element, if the process is too long, if too much time elapses before the given element is included in SWIM, the users of that information may default to an alternative path, creating a degree of fragmentation that can lead to unnecessary complications. It is essential that data level standardisation be put in a regime that works with the required speed to keep pace with ATM developments.

4 SWIM and regulation

4.1 The main drivers of the need for regulation

International air navigation is by definition a highly regulated environment and regulations provide some of the most important pillars of both safety and interoperability. The net-centric and eventually service oriented future ATM environment possesses a number of aspects which by themselves provide powerful drivers for proper regulation. These aspects can be summarised as follows:

- Wide scope of information contributors – The information needs of the future ATM network, including the scope of that information, will result in a multitude of new information sources/contributors and/or new types of information being sourced from various information sources.
- Air and ground integration – In the traditional ATM set-up, the coupling between ground and airborne systems are normally very loose or non-existent. Once the net-centric ATM network is realised and aircraft become nodes on the network, a completely new regulatory-target regime is created in the form of the integrated air/ground ATM elements.
- Information sharing – The value of using shared information is one of the main reasons why SWIM for the future ATM environment is being defined as a shared information environment. There are however legitimate requirements for protecting some information in one or more of several ways, including de-identification of the source, limiting access, etc.
- Integration of diverse airspace use activities – Airspace is used for various purposes and civil aviation is just one of those. Specific military usage (not all of which involves aircraft operations) as well as various civilian projects and missions imply information that is even more sensitive than normal, business or security sensitive, information categories. Their proper protection is essential if the military and other operators generating such sensitive information are to be integrated into the overall ATM process (as called for by the capacity plans of e.g. SESAR). This aspect poses a specific challenge since not only is the information possibly in a military/State security domain but the regulatory domains may also be nested in different organisations that need to be brought together for and under the SWIM umbrella.
- Disappearance of the difference between voice and data – In the mid- to longer time frames, the expected traffic levels will make the move to almost exclusive use of data link communications inevitable. This does not mean the disappearance of voice communications on the end-user level. However, a reliable communications system that can serve the voice and data needs of the future ATM environment is by definition digital and hence even voice messages will be transferred via digital means. Hence a convergence of the regulatory regimes for voice and data communications will be inevitable.
- Global interoperability – Aeronautical information has always been global in nature but the strongly limited access and product oriented philosophy has contained the issues of global interoperability. The net-centric approach of the new ATM environment will create large islands of shared information which must however be able to interoperate between each other as well as with legacy environments, constituting a new, global need for proper regulatory regimes.

- Common information pipes for passenger and operational communications – In the traditional analogue environment, aviation has enjoyed dedicated communications means and this tradition was carried over to a certain extent also into the new digital communications technologies. The dedicated “pipe” in air/ground communications is certainly still a reality today but the same cannot be said of the ground-ground communications links. The early point to point connections have been replaced in most applications by leased lines which, for substantial segments, are in fact shared with other, often not aviation, users. The driver behind this change is obviously cost effectiveness considerations. Although early attempts to provide in-flight passenger connectivity have not proved the commercial success many had forecast, it is not unthinkable that in the not too distant future, personal communications needs will evolve to the point where people will demand uninterrupted connectivity even on relatively short flights. Since such demands will always fetch a premium price, it stands to reason that combining the operational and passenger connectivity needs onto a single air/ground pipe could be commercially attractive. While the technology to do this safely will certainly be available, the regulatory aspects will have to be explored in time to ensure that the actual solutions used meet all the safety and other requirements.
- The value of information – Information is a valuable commodity and in the competitive environment of aviation this commodity is of course sought after by many partners, including others than only aircraft operators or airports. The essential safety contribution of information in air traffic management creates an especially complicated web of relationships, some commercial some not, some State obligations some voluntary, and so on that need to be properly regulated with a view to ensuring cost recovery while not discouraging information use.
- Cost effectiveness – Although not always thought of as a driver for regulation, a proper regulatory environment will favour cost-effective, user oriented solutions.
- Training and personnel licensing – The information sharing environment of SWIM will require experts who are conversant not only with the requirements of air traffic management and aircraft operations but also the information technology aspects of the new approach to managing information. This has implications in the construction and approval of training syllabuses, examination fulfilment criteria as well as the qualification requirements. The need for refresher/recurrent training also grows and needs to be part of the overall regulatory regime.

4.2 Aspects of regulation to be considered

4.2.1 Safety

Most information in air traffic management can have a direct impact on safety. In the future, enlarged scope this will be no less true and the information categories with and without safety implication will only grow. The integration of the airborne elements will of course act to increase the safety critical part of the information set. To quote two pregnant examples: navigation data bases and terrain data will always be safety critical; information on the length of the queue at the security check points or the condition of the airport access road, while essential information from a collaborative decision making point of view (and with an impact on schedule keeping) will unlikely to become a safety consideration.

Safety regulation must therefore address all those aspects of SWIM which may have a direct or indirect impact on the ability of ATM to achieve the required level of safety. This must be done with due regard to the specific characteristics of the future net-centric and service oriented environment, its global aspects and the impact of legacy environments.

Safety regulation must also properly address the differences of information to be provided on a mandatory basis and all other information that may be provided, whether or not on a commercial basis. This is essential to ensure that at least the agreed minimum set of information is always provided, with the kind of guarantees we have in to-day's system.

4.2.2 Security

Security related regulations, applicable to all partners (suppliers, providers, users) in SWIM will need to aim at creating an environment with proper responsibility and traceability arrangements that assure the full participation of organisations with even the most sensitive and/or mission critical data. The security regulations will also need to apply, in the form of mandatory performance requirements and appropriate punitive measures in case of non-compliance, to operators of physical networks, equipment suppliers and even used equipment disposal operations. These regulations should also cover the system of access rights management. The security regulations will need to be developed keeping in mind that the global, shared information environment acts as a "threat multiplier" that needs to be managed within a proper security regulation framework. However, the level of security to be applied must be calibrated to the actual sensitivity of the information and systems concerned, avoiding security overkills that are costly and also reduce information accessibility.

4.2.3 Interoperability

The degree of interoperability of all elements of the SWIM environment determines its usability for the various partners. Appropriate regulation must ensure interoperability on two levels: information interoperability and service interoperability.

Achieving proper interoperability is in fact predicated on proper standardization, the enforcing of the use of the appropriate standards and ensuring that no proprietary solutions are applied.

4.2.3.1 Information interoperability

Rules and regulations concerning information interoperability must aim at ensuring that the data and data exchange models are properly standardized and only the standardized models are used. The importance of this level of interoperability cannot be over emphasized and it must be a top priority for the SWIM environment. Without proper rules and agreements on this type of standardization, the global sharing of information and generalised access to it cannot be ensured.

4.2.3.2 Service level interoperability

The types of services required in different regions may be different. For example, Europe and the USA may show such differences as it would not be cost efficient to align services so that all details are mirrored everywhere. However, by agreeing a basic set of common services (e.g. for data discovery, registry, etc.) it is possible to create a global environment which is able to operate seamlessly and totally transparently for the users even while embracing local differences. Regulations and agreements are needed to establish the common services.

4.2.3.3 Physical interoperability

The providers of the various services will have to ensure that they have access to the physical layers with the appropriate qualities that ensure their ability to meet the service level agreements in force.

4.2.4 Economic

As mentioned before, information has tremendous value and this value manifests itself in several ways, safety being the most important. Beyond that, however, the commercial value of information makes it very attractive for the information owner to try and sell the information and for the information consumer to acquire it at the lowest price possible. Although information is essential for a safe and cost-effective operation, too high a price may push information users to ignore some of the available information or to turn to alternative sources, the quality of which may not always be on the required level. Economic regulation must ensure the creation of an environment where the provision of information is attractive for the information source while the prices to be paid by the information consumers are such that they do not discourage information use. In particular, the need to be licensed (see below) in order to participate in SWIM should not put an undue burden on the applicants. Economic regulation must also foster a competitive environment.

4.2.4.1 General principles

- The cost of information management should be spread on the totality of the community to avoid discouraging information use
- Cost recovery must be ensured
- All information needed to conduct flights should be provided without a separate charge
- For value added use a separate charge may be levied or an information exchange deal may be negotiated
- The economic framework must be set up in a way that avoids any further issues of intellectual property rights.

4.3 Who should be regulated

The new SWIM environment brings with it several new “players” fulfilling essential roles, some traditional, some new, all of which needs to be subject to some kind of regulation. The most important players are summarized below, together with a brief description of their place in the likely future environment. It must be remembered that in the future SWIM environment, an airspace user, a MET provider or eventually a provider of ground transportation services may also be a data source or a user of data.

4.3.1 State as data provider

The obligation of States, arising from the Chicago convention, to provide aeronautical information will remain also in the future. States will be “regulated” by the applicable international conventions to which they are party and the provisions those conventions prescribe. States will typically ensure the provision of traditional AIS products for the benefit of users who have not made the transition to SWIM. They will also provide data for the new shared environment, most probably as a way of ensuring the obligatory minimum data set. More information on these entities is provided in Chapter 6.

4.3.2 Licensed providers of Services, including Common Services

The SWIM environment with its shared information will employ a number of providers of services including common services which are essential to realise the virtual information pool and its global interoperability. It is very likely that these providers will be offering competing services, but that it will be in a market which allows only licensed providers to be present.

4.3.3 Licensed Data Sources

One of the important characteristics of the SWIM environment is that the range of contributors increases together with the range of the information considered to be in the SWIM scope. Obviously, contributing information cannot be an unregulated activity. In order to ensure that all the quality requirements are met, the data sources from which quality data is expected, must be licensed. At the same time it is important to recognise that there may be very useful data to be contributed, even while its quality is lower or cannot be ascertained at all times. Examples of this could be lists of abbreviations, definitions, information exchange forums, etc. It would be everybody's loss if this kind of information were to be excluded. The regulations could specify the creation of licensed areas and free areas as well as tagging information to indicate whether it is from a licensed source or not.

4.3.4 Licensed providers of user applications

One of the most important paradigm changes in SWIM is the move from a product oriented approach to a data oriented one. In practice this means that data sources provide elementary data which is accessed by user applications and processed into whatever the given mission requires. For instance, a Flight Planning Application would, using the services available in SWIM, not only construct a viable trajectory for the flight, generating all the associated other flight data also, but would automatically collect all other relevant information also, like weather, facility availability, expected traffic and congestion along the route and at the destination airport, etc. It would also ensure the proper insertion of the flight intentions into the ATM system. In order to ensure that such user applications work properly with SWIM's shared information environment, the developers of the applications will need to be licensed.

Note: A user application may be interfacing with humans or other system elements, or both.

4.3.5 User Credentials and Trusted Users

Users should not as such be licensed in order to make use of SWIM. They will however have to have proper user credentials that will enable SWIM to establish their access rights. The concept of "Trusted Users" may also be considered. This type of user would be accessing information within SWIM via secure connections and enhanced security credentials enabling access to sensitive information reserved for users who have been extensively checked by the appropriate authorities.

4.4 Who should be the regulator

While having a single, international body to oversee and regulate the complete SWIM operation might be the most cost effective solution, in practice this is not likely to happen and in any case, the substantial existing resources and expertise on the State level should not be easily discarded. A longer term, progressive rationalisation in line with the evolving needs of the new SWIM environment is probably a more workable solution. This is not to say that the existing oversight and regulatory environment does not need some adjustment to be better aligned with the needs of SWIM. A possible regulatory framework is described below.

4.4.1 International rules and global oversight

This level of the regulatory environment would continue to reside with ICAO and executed via the individual Member States or equivalent (e.g. EU)

4.4.2 Licensing rules and global oversight

The global licensing rules would be developed and agreed by ICAO. The actual granting of licenses would be by States or specific organisations (e.g. EUROCONTROL) acting on the basis of delegated authority.

4.4.3 Regulation and licensing for operating (common) services

Since the proper operation of global SWIM is predicated to a very large extent on the providers of (common) services it may be necessary to develop specific licensing arrangements and oversight for those providers. Since the security and access rights management aspects are also housed in this regime, ICAO, with the involvement of military authorities and others from the security area, may be the best candidate as regulator. Since the common service regime entails also aspects like registry and discovery, a new entity acting under delegated authority may be needed. With proper arrangements, they could be entrusted also with all the security related tasks, with ICAO providing supervision.

4.5 Regulatory activity types

4.5.1 Compliance verification and certification

The oversight activity is aimed at ensuring compliance with the applicable regulations and certification would take the form of granting a license to operate. In terms of how deep certification should be enforced, a good balance needs to be found between the need to ensure a standardised and quality operation and the equally important need to avoid stifling innovation.

4.5.2 Quality maintenance

The maintenance of a consistently high quality in all aspects of SWIM is absolutely essential. Regulations must extend to an effective system of quality checking, auditing and service improvement. User feedback from all levels needs to be utilised alongside the more formal procedures.

4.5.3 Enforcement and penalties

With the global nature of SWIM and the shared environment in which many partners interact even while they are subject to different legal systems and backgrounds, identifying the auditors and enforcers of quality is no trivial matter. The same is true to a certain extent for the penalties for non-compliance. However, in this latter respect, the competitive business environment will act towards a certain level of self-regulation and peer-pressure reducing the need for penalties. Nevertheless, the proper international bodies for these tasks will have to be identified and agreed.

5 SWIM and standardisation

Standardisation in the SWIM context covers two main areas:

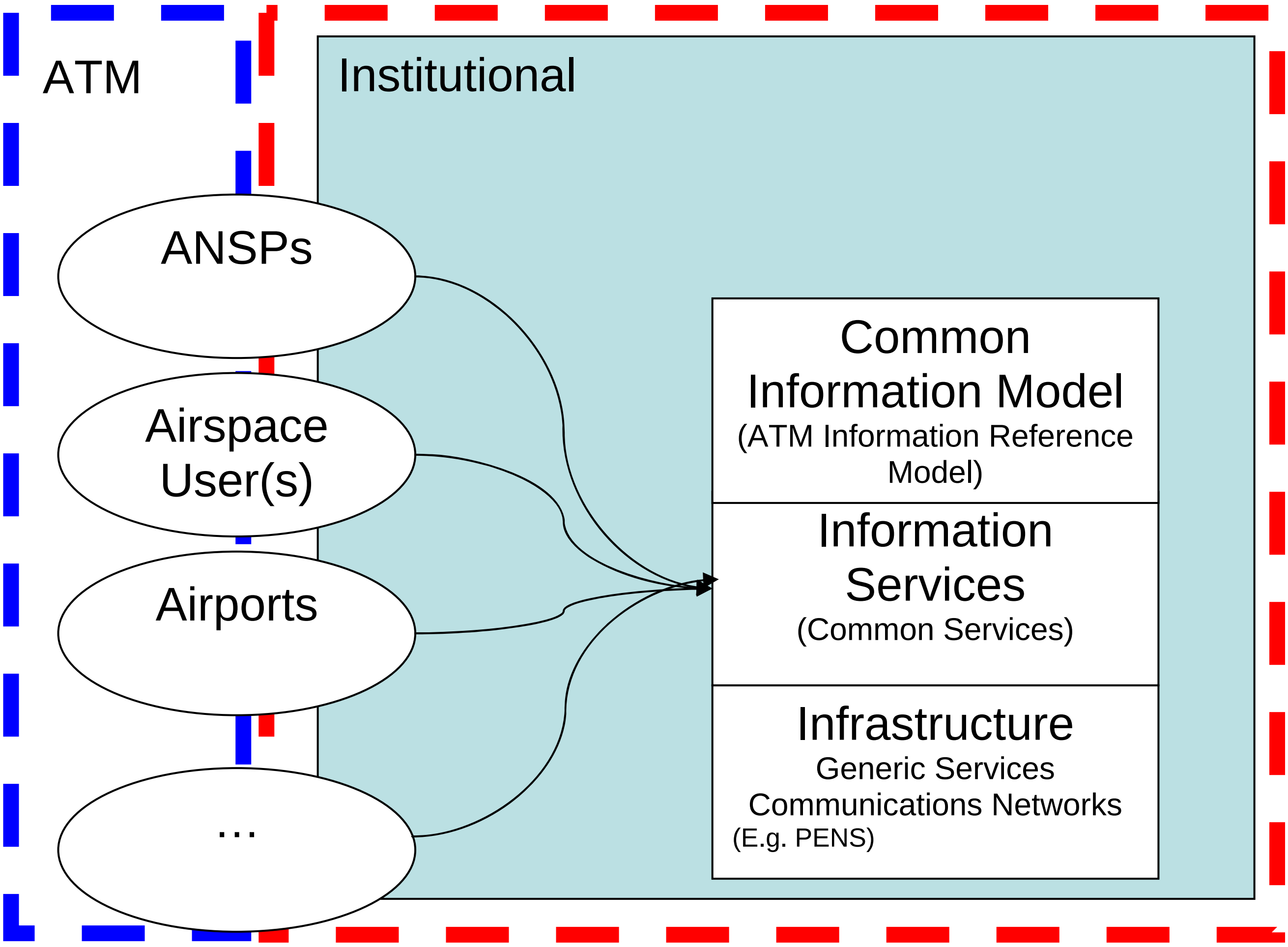
- SWIM infrastructure and SWIM specific services
- Information/exchange models

Only the information/exchange models are ATM specific. For the SWIM infrastructure and SWIM specific services, industry standard solutions must be used.

6 The elements of SWIM

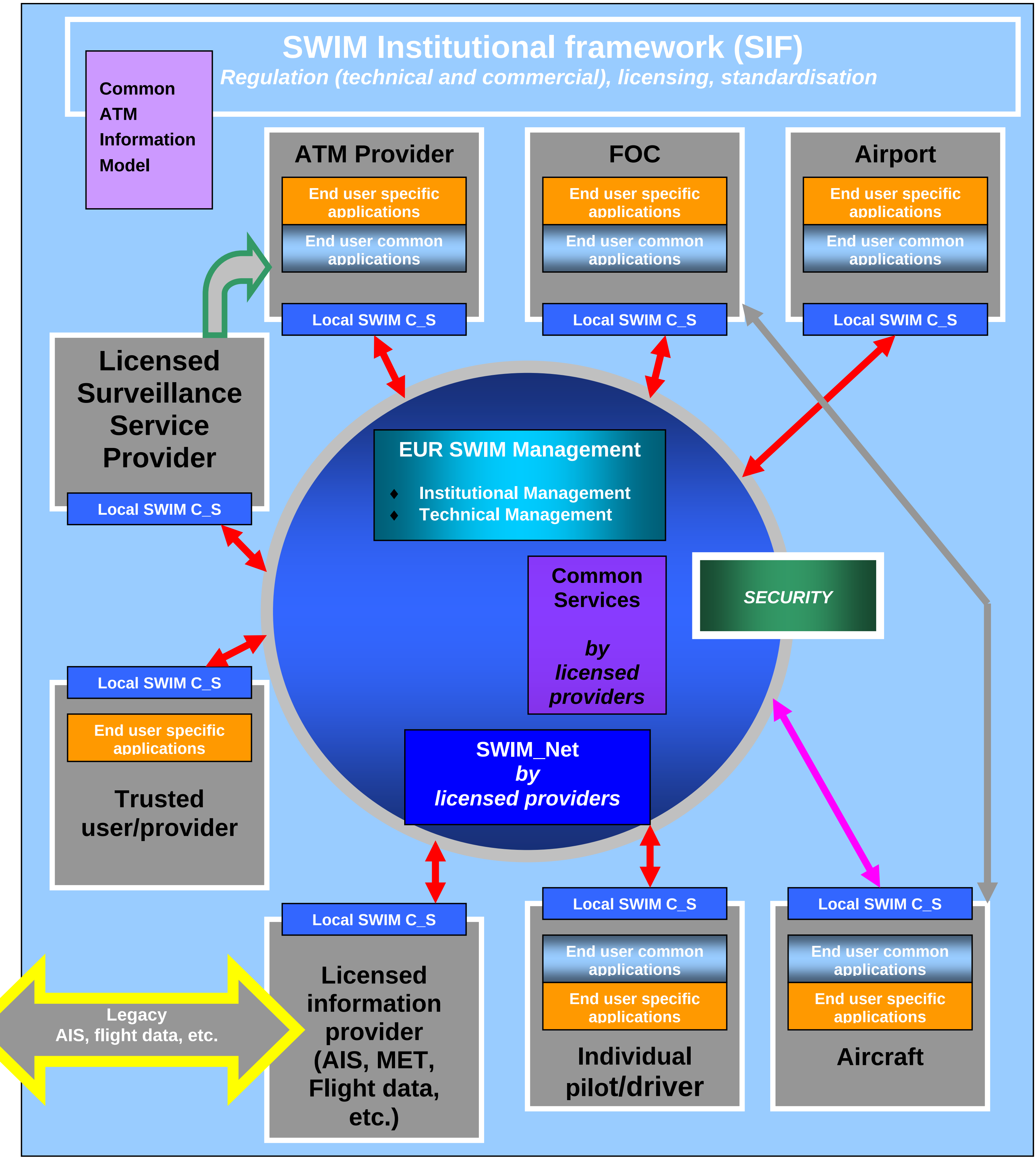
6.1 The simple high level view

The following figure shows a simple, high level depiction of the main conceptual elements of SWIM.



The blue Institutional background signals the fact that SWIM is as much a set of roles, rules and responsibilities that apply to SWIM itself and to its users, as it is a technical facility. It also shows that the users of SWIM, like for example ANSPs and airspace users, are in part under the SWIM institutional background as users and providers of information. Clearly, SWIM is external to ATM, however it supports ATM as the enabler of the end-user applications implemented in the various user systems.

6.2 The more detailed view



The figure above represents the same SWIM concept as the one in para. 6.1, however, with more detail on the information providers and users as well as the management and provision of SWIM specific services. In the following, a detailed explanation of the different elements shown in this more detailed depiction is given.

6.2.1 SWIM Institutional framework (SIF)

SWIM Institutional framework (SIF)
Regulation (technical and commercial), licensing, standardisation

The Institutional Framework encompasses all enabling activities required to create the technical and commercial regulatory environment in which cost efficient, safe and secure information sharing for ATM purposes can be practiced. This includes also the necessary standardisation and the rules for licensing on the European regional level. This framework serves also as the high level regulatory interface to the rest of the world.

It is in this framework that necessary amendments to ICAO and European provisions (e.g. Annex 11, 3, 15, 10, Doc. 4444, 7030 etc.) on which SWIM has an impact are initiated and carried to approval. This includes extending the scope of aeronautical information and integrating MET information in the extended scope. The Common ATM Information Model is also developed under the stewardship of the SIF.

6.2.1.1 Who “owns” SWIM?

The concept of SWIM recognizes the ownership of the data managed in it, but there is no “owner” of SWIM itself. It is also against the SWIM principles to allow any particular organisation or group of organisations to become a monopoly for providing any service on any level in the SWIM environment. Service provision on all levels in SWIM is open to competing providers as long as they meet the published requirements (and are duly licensed if applicable).

It is also against the SWIM concept to prescribe to any ATM partner which provider to use for any service on any level.

6.2.2 SWIM_Net (by licensed providers)

SWIM_Net
by
licensed providers

SWIM_Net is the underlying network infrastructure supporting system wide information management in all its network aspects. It is NOT a dedicated network but an industry standard networking capability without proprietary solutions, run by cost-efficient providers, meeting the requirements posed by ATM and appropriate to the different kinds of data being exchanged.

It is important to note that different ATM data have different needs and SWIM_Net enables this differentiated service. This reduces overall costs on the one hand and enables the early implementation of services and applications that do not pose the highest requirements which will only be possible to satisfy in later phases of SWIM implementation.

6.2.3 Common services (by licensed providers)

Common services encompass those network services that are required for the data services on the network (directory, discovery, security, etc.). These common services also ensure the interoperability with other SWIM-type environments (e.g. USA). These services are provided by providers licensed according to the applicable rules defined under the SIF.

6.2.4 EUR SWIM Management

EUR SWIM Management is the European entity (i.e. not under an ANSP or other user) charged with the daily supervision of all aspects of the SWIM operation. This entity is responsible for the evaluation of license requests, issuing and withdrawing licenses, dealing with details of the security arrangements, quality issues, etc. It operates in accordance with the applicable rules defined under the SIF. EUR SWIM Management could possibly take the form of a not-for-profit consortium looking after the interests of all users of the system.

6.2.5 Traditional users and providers of information (ATM, FOC, Airport)

ATM provider (includes also ATFCM), FOC and Airport are instances of traditional ATM users and providers of information. Using their systems, they publish their information into SWIM_Net and obtain necessary information from SWIM_Net in a number of different ways (subscription, direct query, etc.)

6.2.6 Local SWIM Connectivity Service

The Local SWIM Connectivity Service represents those changes required in local systems (including aircraft systems) that enable them to exchange data (publish, receive) via SWIM_Net. Local SWIM Service is NOT a set of people or local supervisors, it is purely a system provision. There is no need to supervise any aspect of SWIM locally!

6.2.7 End-user common applications

End user common applications are NOT in fact part of SWIM as such. They only make use of the information sharing capability. They are called common applications because they fulfil certain functions common to several ATM partners.

Note that these applications are specified in accordance with a performance based approach to their design. This means that they request data of the required quality without specifying the source. This ensures early benefits since data of the required quality from ANY source can be used (e.g. if trajectory data is available from the FOC only, it is accepted the same way as that from the FMS via air ground data link, if the quality is otherwise identical. This is an example of the early benefits of SWIM based information sharing that can bridge the gap until air/ground data link is more widely available.

An example of a common application is the arrival manager. While the core algorithm may differ from location to location, the data it needs and the data it outputs is subject to all the information sharing rules.

Another example is the Network Operations Planner (NOPLA) or trajectory/flight data submission applications that replace the ICAO new flight plan for flight in the SESAR area.

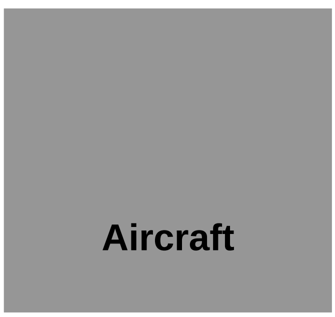
6.2.8 End-user specific applications

End user specific applications are NOT in fact part of SWIM as such. Different end users may have different and even unique needs in respect of their particular operation. End user specific applications are built to cater for such needs in as much as they are able to use information available in SWIM_Net and can also be charged for chargeable services/information. The output of such an application is not necessarily shared. If it is, it is subject to all the information sharing rules.

An example of such an application is for example a local trajectory modelling tool, which may or may not feed a trajectory submission tool where this latter is an end user common application.

These applications are also performance based, as described above.

6.2.9 The aircraft



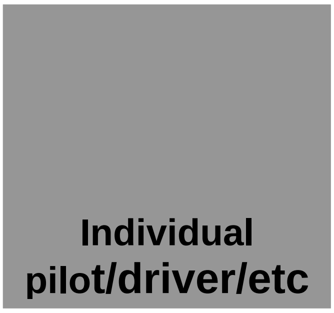
The aircraft are data users and providers, with applications of similar characteristics to all other users/providers. It should be noted that MET observations made by an aircraft will be published into SWIM_Net like any other information and there is no need for any special interface between aircraft/FOC and the MET providers.

On the SWIM figure, a direct link is shown between the aircraft and the FOC. This signifies the possible desire of airspace users to retain such a direct link for their own purposes. This is not contrary to the SWIM principles as long as the SWIM defined rules, roles and responsibilities assigned to the FOC and the aircraft are duly observed.

Connection between an aircraft and SWIM_Net can take several forms and this is also specified on a performance basis. Hence a GA aircraft will be required to possess a link appropriate for their needs only.

Note that air/air information exchange is not shown separately here. While such exchange will happen directly between the aircraft concerned, information of ATM relevance will be published into SWIM_Net by the aircraft concerned and hence from a logical perspective, there is no difference between this kind of data exchange and that via SWIM_Net.

6.2.10 Individual pilots, drivers, etc.



These entities are typically people or ground vehicles accessing information via mobile devices. Examples would be a private pilot submitting a trajectory and other flight data from a PDA or the operator of a de-icing truck consulting the pre-departure sequence on mobile device in the truck. Applications on such devices will be optimised for the more limited capability but otherwise the performance based approach applies.

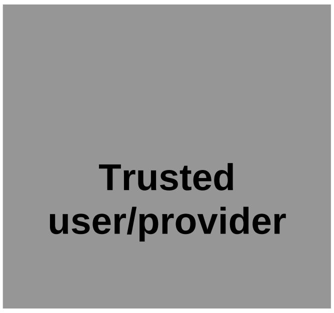
It is also envisaged that under this category data may be sold/made available to enthusiasts, researchers, etc., eventually with a time lapse to protect real time operations. The eventually ensuing revenue can be used for various agreed purposes.

6.2.11 Licensed information providers (AIS, MET, flight data, etc.)

Licensed information providers are the entities duly authorised under the provisions of the SIF, as shown by the license issued by the EUR SWIM management, to provide essential data into SWIM_Net. They are responsible for the quality of the information they provide.

Such providers include State organisations (formerly known as AIS) fulfilling an obligation of the State to provide aeronautical information, MET information providers, value added providers like Jeppesen to-day, etc. Such an entity will be charged with the reception of aeronautical and flight data from non-SESAR areas as well as the provision of legacy information to non-SESAR areas. Note that “entity” here does not mean a single, centralised entity per-se.

6.2.12 Trusted user/provider



Trusted users and providers are entities who are not appropriate for licensing or are not required to be licensed as they will only ever use data from SWIM_Net, never supplying data into it. They need to be registered only to ensure charging, if applicable.

A trusted user would be the FAA for instance, with privileges to use and submit information. An airport taxi company wishing to purchase arrival information would be an example of the second category.

6.2.13 Licensed Surveillance Service Provider

In the future, surveillance may very well be outsourced for reasons of cost efficiency. Such providers will have to be properly licensed of course. However, on this illustration the important element is the direct connection between the surveillance service provider and the ATM provider. This is in recognition of the fact that initially SWIM_Net may not be suitable for handling all the surveillance information available in Europe to-day. With the optimisation of the surveillance infrastructure, however, SWIM based operation should be possible.

It is important to note that abbreviated/limited surveillance information should nevertheless be provided into SWIM_Net right from the start to support applications requiring it.

6.2.14 High-speed network connections

Red arrows represent high speed network connections into the network, with sufficient bandwidth to cater for the needs of the applications being used.

6.2.15 Link between aircraft and SWIM_Net

A pink arrow represents the connection between an aircraft and SWIM_Net. This being a performance based system, the link to be used is specified from a SWIM point of view in terms of performance only.

The grey arrow is shown only as a reminder that airspace users may retain legacy links for their own use.

6.2.16 Security

The SWIM security concept is based on the fact that not all data and the information that can be deduced from it is equally sensitive and hence the level of security to be provided must be carefully calibrated to the actual need and not some perceived “importance” to certain interest groups.

This approach ensures that costs and system complications are kept low, information availability and accessibility is not adversely impacted by security overkills while the legitimate protection needs are fully catered for.

A system similar to that developed by the US National Security Agency called Multiple Independent Levels of Security could be envisaged. MILS specifies how information should be partitioned and protected while running on the same server. Levels are from 1 to 7, where 7 is the most secure.

7 Illustrative SWIM deployment plan

7.1 Considerations to be taken into account

The deployment sequence of SWIM must be defined taking the following considerations into account:

1. SWIM is an enabler of end-user applications needed in ATM. It is not in itself an ATM category.
2. SWIM creates the conditions for advanced end-user applications based on extensive information sharing.
3. SWIM does not recognise ATM Capability levels. It handles information irrespective of the capability of its source.
4. SWIM does not recognise ATM Service levels. However, different service levels need more advanced and/or widespread implementation of SWIM.
5. The deployment of SWIM must be such that benefits start to accrue at the earliest possible time. This means that end0user applications, starting with simpler and going towards the more advanced, must be implemented as early as possible.
6. The deployment of SWIM should not be dependent on the deployment of ATM changes. SWIM benefits are available even in a largely legacy environment.

7.2 Deployment phases

SWIM deployment is split into phases that are defined for achieving early benefits and the most cost efficient building up of SWIM capability. The phases are described in terms of the four top-level aspects of SWIM, namely “Institutional”, “Network”, “Systems” and “Applications”. It should be noted that network in this context refers to the data networks and not the ATM network as such while “systems” include both ground and airborne systems. The phases are sequential but with possible overlaps (see deployment chart later). The sequence of steps inside the individual phases may be different in actual implementation. The dates for the various phases aim to ensure that SWIM implementation leads the rest of SESAR and also to make sure that benefits can be had already in the legacy environment.

As highlighted earlier, end-user applications are not a part of SWIM, their more efficient operation is enabled by SWIM. The examples given here under the category “Applications” are only examples for illustration purposes only.

The entries under the other categories are not meant to be exhaustive. They illustrate the types of enablers that would need to be defined for the category concerned and in the timeframe indicated.

7.2.1 SWIM Deployment Phase 1 – 2008-2012

P1 - Institutional

P1.I1 - Set up SIF, designating the European authority to define new rules and amendments to existing rules (E.g. updates to Annex 3, 15, 10).
P1.I2 -Identify standards to be used and new standards to be defined (including exchange formats, etc.), develop standards.
P1.I3 – Agree security levels
P1.I4 - Establish EUR SWIM Management
P1.I5 – Agree legacy service provision arrangements

P1.I6 – Identify and organise provider categories
P1.I7 – Start issuing licences
P1.I8 – Organise charging (in accordance with established principles)

P1 – Network

P1.N1 - Identify common services and assign to providers. Ensure compatibility with other SWIM-like environments.
P1.N2 - Select network providers (on the basis of quick start need), build initial connectivity
P1.N3 - Promulgate network side standards for "Local SWIM Service"

P1.N4 – Start deploying mobile connectivity

P1 – Systems

P1.S1 - Start implementing "Local SWIM Service" in partner systems or identify and use existing capability. In particular, start A-CDM internetworking

P1 – Applications

P1.A1 *– Transition A-CDM applications from message based to data based operation*
P1.A2 *– Develop and implement flight data/flight plan input applications (e.g. for GA)*
P1.A3 *– Develop and implement applications for accessing MET information*
P1.A4 *– Update FDP applications to accept shared trajectory information from outside sources (e.g. FOC or later FMS)*
P1.A5 *– Develop first version of the interactive Network Operations Planner (NOPLA)*
P1.A6 *– Update airspace user applications to enable use of NOPLA*

7.2.2 SWIM Deployment Phase 2 – 2013-2015

P2 – Institutional

P2.I1 – Update institutional provisions based on P1 experience

P2 – Network

P2.N1 – Finalize high speed connectivity for all partners
P2.N2 – Finalize mobile connectivity at all locations when needed

P2 – Systems

P2.S2 – Finalize implementing "Local SWIM Service" in all partner systems

P2 – Applications (timing of some applications in P2 will depend on the ATM implementation schedule)

7.2.3 SWIM Deployment Phase 3 – 2016-2020

P3 – Institutional

By this time, all the institutional details concerning SWIM should be well established and functional. Eventual new requirements are handled as part of the routine operation.

P3 – Network

All the elements of SWIM_Net must be in place, with only the air/ground segment still not fully deployed everywhere. However, adding new nodes in the form of additional aircraft (or in fact any other user) is a routine operation.

P3 – Systems

The local SWIM service has been implemented in all existing systems and all new systems contain this element as a baseline feature. Operating using SWIM_Net is the normal mode for all systems.

P3 – Applications (timing of some applications in P3 will depend on the ATM implementation schedule)

SWIM is now able to support even the most advanced ATM applications, even real time surveillance applications. It is ATM requirements that drive the implementation of the ATM applications with information management not forming a limitation of any kind.

7.3 Transition considerations

The concept of Local SWIM Connectivity Services (LSCS) entails that systems in which LSCS has been implemented are able to exchange information using legacy interfaces as well as via SWIM_Net. Built in logic ensures that for any given information need (either outgoing or incoming) the interface that provides the best quality will be used.

As SWIM_Net and the connected capabilities expand, LSCS is used more and more, until all the legacy interfaces can all be dismantled. Interaction with legacy environments via the designated entity will of course be retained.

This way, the speed with which end-user applications are introduced can be different from the speed of SWIM deployment. SWIM must always lead and this results in two kinds of benefits. On the one hand, SWIM related benefits can start to accrue even in mainly legacy environments (giving added impetus to further expanding SWIM) and on the other, there is no limitation at any time on the end-user applications as a result of insufficient data.

8 Refernce material

EUROCONTROL Operational Concept Document (OCD), 2004, EUROCONTROL

EUROCONTROL ATM2000+ Strategy, 2003, EUROCONTROL

Airspace User Objectives for the Future Air Traffic Management Network – First Edition March 2006

SESAR Operational Scenarios and Explanations – Network Airline Scheduled Operation – 2007 EAE-PCP

SWIM in a Nutshell. Extracts from the SWIM Strategy for 2000+ - EUROCONTROL

SESAR Concept of Operations – 2007, SESAR

SWIM Europe/US Common Services Definitions Project – 2005, EUROCONTROL

Concept of Operations for the Next Generation Air Transportation System – 2007, FAA

PENS Business Case - EUROCONTROL

Attachment A

1 Pan European Network Services – PENS

In the following a short description is given of PENS in terms of its strategic background, main features and relationship to System Wide Information Management as described in this document. The description is given for information only and it does not constitute an endorsement or otherwise of PENS.

1.1 The strategic background to PENS

EUROCONTROL's European Air Traffic Management communications strategy has identified the need for a pan-European network service covering both voice and data communications to support more efficiently the existing services and to enable new service requirements arising from e.g. SESAR to be met. The introduction of the Single European Sky (SES) concept, with its emphasis on transnational functional blocks of airspace and rationalisation of services will lead to more demand for international communications. The SESAR Concept of Operations expands on this even further. Both developments represent important upcoming requirements for enhanced pan-European communications.

EUROCONTROL and the Air Navigation Service Providers (ANSPs) have examined the available solutions for providing a consolidated international communication infrastructure. They were mindful of the fact that it would not be acceptable to the industry to provide a service that was exclusive, closed and/or monopolistic and hence the solution being offered by them is to be seen as a cost efficient, but nevertheless just one possible, service option, with users free to choose other available options if they wish.

Initially the network service was envisaged as being open to ANSPs and EUROCONTROL and for ground/ground communications only. It was however realised that for maximum benefit, the proposed network service should be available also for other partners (airspace users, airports, etc.) should they wish to join. The technical and institutional arrangements for this are in the process of being agreed.

1.2 The technical aspects of PENS

Technical studies have shown the feasibility of IP based technology for a number of ATM applications and these have been made the subject of Interoperability Rules under the Single European Sky initiative.

The international IP based communications network is the basis for migrating from obsolete X.25 communications to TCP/IP. It also enables transition from legacy AFTN/CIDIN to the new Aeronautical Message Handling System (AMHS).

The intention is to have all ATM infrastructure and regional networks migrate to IP based services, however, full integration of voice will depend on the maturity of suitable standards and network performance.

With such a common network, the existing point-to-point links between partners used only for data services would no longer be required neither would new links have to be created for new services (e.g. AMHS).

1.3 The scope of PENS

PENS was originally envisaged to be an IP based network for international ground-to-ground communications between ANSPs and between ANSPs and EUROCONTROL only.

In its original concept it encompasses the following:

- CFMU network
- European AIS Database (EAD) network
- Radar data exchange (ASTERIX over IP)
- Flight data exchange (FMTP over IP)
- Aeronautical message handling service (AMHS over IP)
- Test and validation applications for research activities

Support for ground-to-ground voice communications depends on the progressive maturity of IP services for voice.

With the opening up of PENS for optional use by other partners (e.g. airports, airspace users), support for additional services may need to be agreed and implemented.

1.4 PENS governance

The network will be operated by a commercial network provider, selected for a pre-determined period via a tendering process. This network provider may sub-contract some of the activities, as necessary.

Overall management is provided by a PENS Management Unit (PMU), which is organisationally part of the EUROCONTROL Agency.

The policy making governance body is the PEN Service Steering Group (PSSG) in which the users/user organisations are represented.

The PSSG is supported by a PENS User Group (PUG) which is a forum for PENS users to exchange ideas and experiences.

1.5 PENS pricing

As mentioned above, the franchise for operating the network is given for a pre-defined period. Nevertheless, pricing is subject to review at least yearly and will follow market developments to ensure a continuously competitive service.

1.6 PENS in the context of SWIM

1.6.1 Positioning PENS

The term SWIM signifies the umbrella concept that encapsulates every aspect of managing ATM information. Underneath, SWIM is in fact composed of two closely related but uniquely identifiable elements, namely Information Management (IM) and the SWIM Infrastructure.

The SWIM concept foresees a European SWIM Institutional Framework and a European SWIM management entity, which together ensure the required level of regulation and daily operational supervision.

The actual provision of services on all levels is entrusted to licensed providers.

PENS as currently envisaged belongs to the SWIM Infrastructure element and the selected provider is equivalent to the network service/generic service provider category (para. 6.1 in the main section refers). Until SWIM itself is implemented, PENS will also have to provide the Information Services (Common Services).

1.6.2 Relationship to other networks

Clearly, under the SWIM concept, no network provider may be given an exclusive monopoly and users are at all times free to contract with any provider that meets the prescribed quality of service and other interoperability requirements. PENS, in keeping with its nature of being only one of several possible solutions for ATM users, must ensure proper interconnection with other providers' networks (as must those networks also ensure interconnection with PENS).

1.6.3 Governance

The governance bodies foreseen for PENS map well onto the overall governance arrangements proposed for SWIM while obviously reflecting the more limited scope of PENS (dealing with infrastructure only).

Clearly, it is not efficient to maintain several governance bodies dealing with essentially the same issues and therefore, as SWIM implementation progresses, PENS and SWIM governance will need to converge into a single European entity.

Having overall, European governance is important in view of the principle of not granting exclusive rights to any provider of services. As a result of this, several providers may be present in the market and they need to be subject to the same governance and standards.

1.6.4 The PENS business case

PENS implementation is taking place against a background of several imperatives that make migration to a new networking solution unavoidable (e.g. the need to migrate from X.25). Parallel with this, a number of opportunities are coming up in the form of the expiry of the contracts to provide the EAD and CFMU networks.

The need for efficient, reliable and flexible international communications, able to respond to ever evolving requirements, is fully recognised by the ATM community and is seen in fact as one of the most important enablers of the new ATM concepts.

The PENS Business Case, dated 26 April 2007, demonstrates that PENS as a solution to the communications requirements provides cost savings (although these will be limited until voice is integrated) but more importantly, it creates the enabler for short and longer term services essential to support the new ATM concept being implemented in Europe.

The PENS Business Case in its current version includes only benefits as they will apply to ANSPs and EUROCONTROL and hence benefits to airports and airspace users are present only indirectly. It does not consider the wider implications of the implementation of the SWIM concept either.

It would appear essential that the business case to be developed for SWIM take due account of PENS and the opportunities it provides to eliminate duplication in governance as well as the technical details.
