International Civil Aviation Organization

AN-Conf/12-WP/33
3/10/12

WORKING PAPER

TWELFTH AIR NAVIGATION CONFERENCE

Montréal, 19 to 30 November 2012

Agenda Item 1: Strategic issues that address the challenge of integration, interoperability and harmonization of systems in support of the concept of "One Sky" for international civil aviation
1.1: Global Air Navigation Plan(GANP) – framework for global planning

DEVELOPMENT OF AN ATM ARCHITECTURE

(Presented by the Presidency of the European Union on behalf of European Union and its Member States[1]; and by the other Members States of the European Civil Aviation Conference[2]; and by the Member States of EUROCONTROL)

SUMMARY

There is a need to derive from the Global ATM Operational concept and the blocks/modules a common representation of the ATM system and its main components (with a comprehensive performance based approach), in order to facilitate the identification of specific interoperability requirements, map the planned evolutions, and be able to visualise the status of capabilities at different times. This architecture could be used for the electronic GANP and would also benefit the emergence of a global "One Sky" understanding. The experience of SES and SESAR and other programmes suggests ways forward.

Action: The Conference is invited to agree to the recommendation in paragraph 4.

1. INTRODUCTION

1.1 At the Eleventh Air Navigation Conference (AN-Conf/11), when discussing and adopting the Global ATM Operational Concept, a certain number of interrelated descriptions of ATM were identified, illustrated by the diagram from AN-Conf/11-WP/21 reproduced in Figure 1 below. This diagram shows the relationship between operational concept, performance, requirements and global and regional plans amongst other facets of ATM, as complementary descriptions to provide a comprehensive view of ATM and its evolution through time. The ATM requirements will have to drive the implementation of the ATM Operational Concept while maintaining or increasing the safety of the global aviation 'system of systems'. Safety will have to be considered when balancing the requirements for achievability and cost-effectiveness. Finally, interoperability will enable the incremental deployment of ATM capabilities.

[1] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. All these 27 States are also Members of ECAC.

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Iceland, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

1.2 In particular, it is important for both system developers and those implementing the systems that an approach is applied to CNS/ATM which can break it down into services which shield the end users from their internal complexity/differences, and allow (as far as practicable) seamless usage across the ICAO regions. There should also be a clear link between the required end-to-end performance of the CNS/ATM system and the components of the architecture, especially in the context of performance-based specifications.

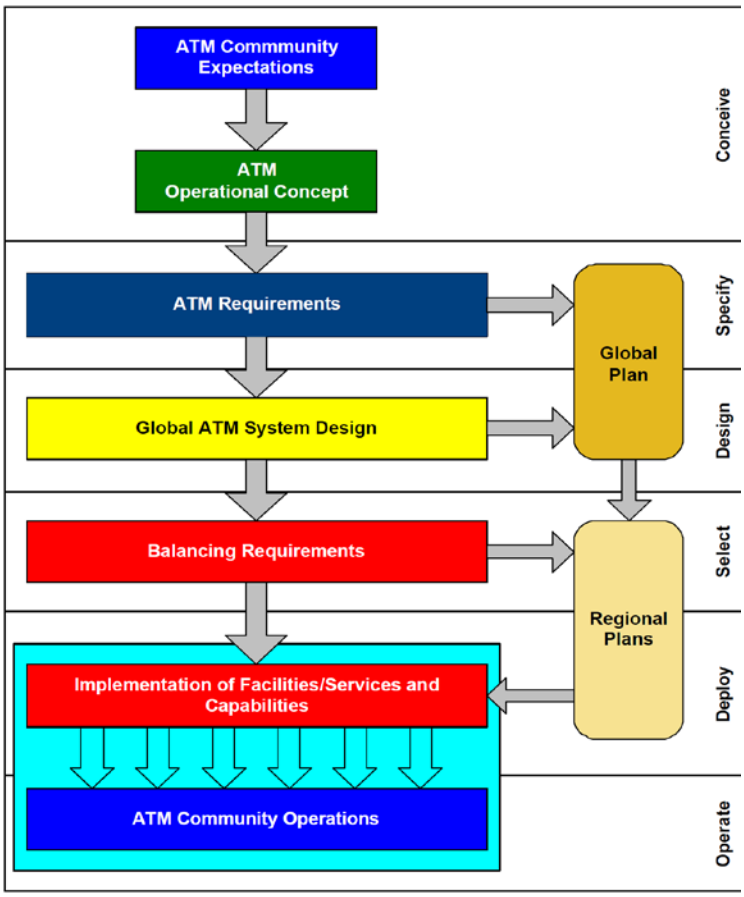

Figure 1. Development dependencies for the development and evolution of the global ATM system

1.3 Since AN-Conf/11, progress has been achieved on several items of the diagram, culminating in particular at the present Conference in the renewed Global Air Navigation Plan. The proposed aviation system block upgrades (ASBUs) are instrumental in describing the main steps of change and are related to performance improvements. The technology roadmaps are also clearly connected to the ASBUs and modules. However, they focus mainly on CNS and information, whereas the discussions during the ASBU work also clearly identified the need to have a form of logical architecture for the ATM system in order to properly map and check the suitability and completeness of the requirements placed by the modules on ground, airborne or space systems. Such an ATM logical architecture would, in particular, have to address services used by aircraft, aircraft operators and airport operators.

1.4 This paper proposes that an ATM logical architecture be developed, to constitute a technical framework assisting the planners and engineers with a shared common understanding of the ATM system, including related aircraft avionics for addressing requirements, standardization, design and deployment issues.

1.5 This architecture would also help with checking the consistency and completeness of the activities, identifying gaps and/or overlaps; as well as facilitating comparisons between systems and the identification of the impact of proposed evolution steps, and enabling opportunities to be found for cooperation and synchronization.

1.6 A common logical architecture, representing the ATM system and its main components (with a comprehensive performance-based approach), would also facilitate the identification of the specific interoperability requirements, and the mapping of the planned evolutions and the status of capabilities at different times. It could be used for the electronic GANP.

1.7 Particular attention should be paid ensuring that the logical architecture is conceived in a way which can accommodate the planned evolution of the ATM systems and the heterogeneous level of deployment and capabilities at any given time. In particular, it should be able to accommodate greater modularity or new business models for the provision of ATM services, for example with an extended notion of service orientation no longer based on the traditional collocation of ATM facilities and systems. Such a model would enable to

distinguish the data flows from the processing: it would, therefore, highlight the information exchange requirements within the ATM services themselves and on the aircraft.

1.8 To improve operations while reducing fragmentation and ensuring cost efficiency, the rationalization of the ATM infrastructure needs to be addressed. It shall also address the required standardization of the technology that will support more flexibility for the ATM operations. Interoperability is one of the aspects contributing to reducing fragmentation; the way technical ATM services would be delivered should be looked at. A common concept should be looked at to support the rationalization of implementation aiming at reducing the number of systems and at having standard working positions, based on new technology, open system architecture and a strong network communication backbone.

1.9 This paper outlines the notion of logical architecture and suggests a way of proceeding. Experience with SES, SESAR and other programmes contain valuable learning for the way forward.

2. OUTLINE OF THE PROPOSED ARCHITECTURE

2.1 The proposed architecture should:

a) be logical in character, not addressing local deployment or physical implementation (e.g. identifying specific hardware and/or software component deployment);

b) address the variety of needs of all global ATM users. It should not be “one size fits all”, and it should identify optional and/or alternative functionalities;

c) encompass all the ATM systems and actors (civil and military ATC, AIM, airport operations, MET, aircraft and crew) but only describe in any detail those elements that contribute directly to ATM and its performance, or which impinge on interoperability. It should identify the external interfacing partners;

d) identify and define the systems, the services implemented in the systems, the data exchanges between these systems, and the standards supporting these data exchanges. The logical data dependencies should be identified in order to derive minimum specifications for interoperability. These standardized data exchanges should also be to be analysed in the scope of minimum specifications to cater for contingencies and allow for easy retrieval of CNS data by safety investigation authorities; and

e) be focused on global interoperability and consistency issues, and on the ability to deliver services meeting the agreed performance targets. It should not go into design options where these can be left to industry and have no impact on interoperability.

2.2 The proposed architecture should therefore remain at a high level while providing the possibility of more detailed architecture being developed as needed. In this respect it is suggested that while the ground ATM could require a breakdown of the functionality that allows States to achieve an unambiguous allocation of the modules and understanding of the impact of a given module onto the architecture, the aircraft might be seen initially as simply a user and sometimes provider of services. Likewise, it might be enough to indicate which services have to be implemented by an airport authority or airspace user.

2.3 A top level architecture diagram derived from SESAR is provided in figure 2 below as an example. The “capability/configuration (pink boxes if internal, orange if external) are supported by systems (blue boxes).The main human operators roles are also identified.

3. ARCHITECTURE DEVELOPMENT

3.1 It is proposed that the global ATM logical architecture should be modelled on existing high-level logical architectures. The architecture descriptions for SESAR, NextGen and other regional/national modernization projects are valuable inputs and should be analysed with a view to arriving quickly at a common model, rather than starting from scratch with an entirely theoretical approach.

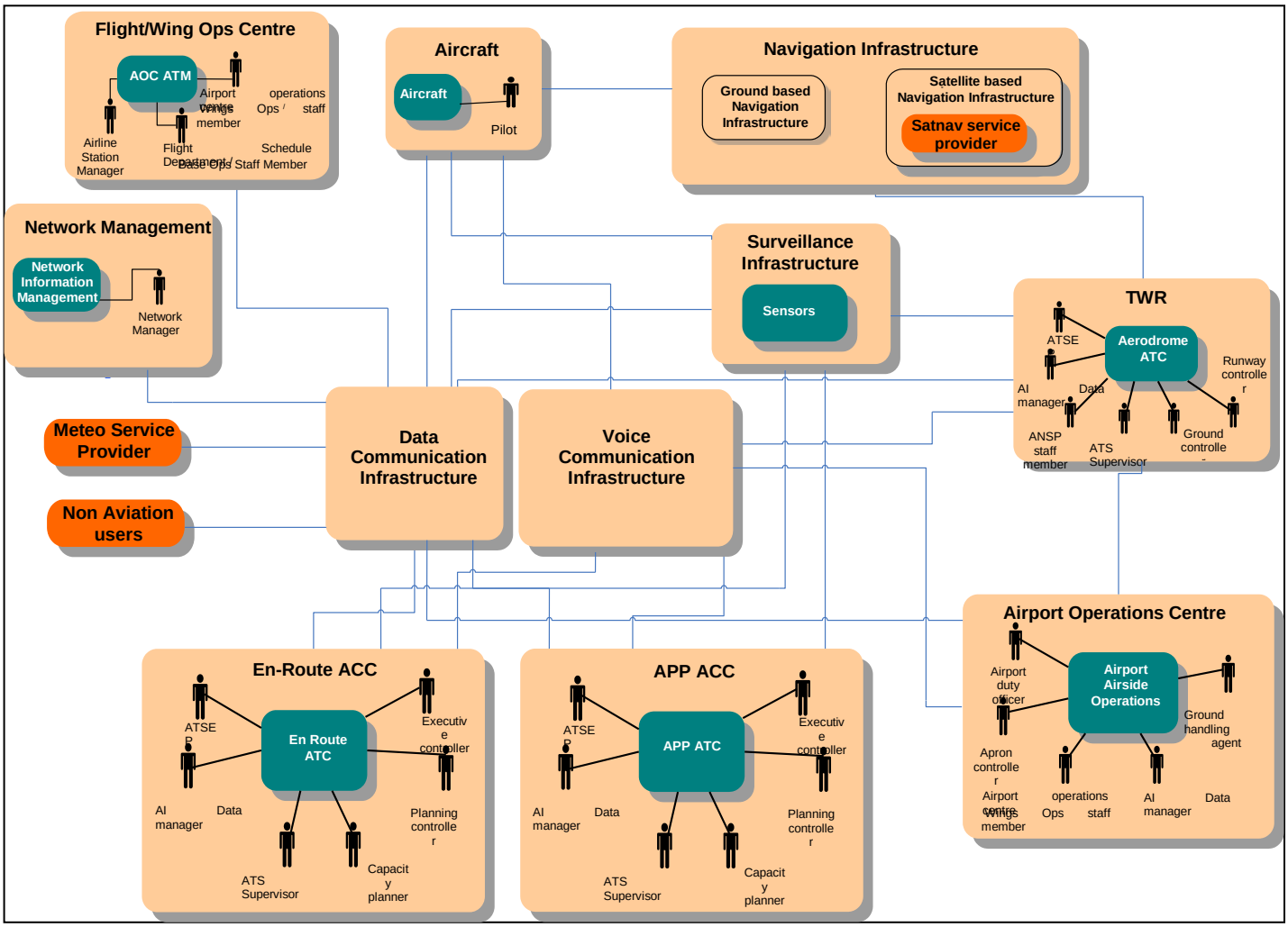

Figure 2: Example of a top level architecture diagram (extracted from ongoing SESAR work)

4. RECOMMENDATION

4.1 The Conference is invited to request ICAO to:

a) develop, for inclusion in the first update of the GANP after AN-Conf/12, a global ATM logical architecture representation in support of the GANP and planning work by States and regions; and

b) develop, in a second step, a further breakdown of the logical architecture of the ground system to the level needed to best address the global interoperability issues.

— END —