International Civil Aviation Organization

A40-WP/383[1]
EX/154
19/8/19

WORKING PAPER

ASSEMBLY — 40TH SESSION

EXECUTIVE COMMITTEE

Agenda Item 26: Other high-level policy issues to be considered by the Executive Committee

THE POTENTIAL OF OPEN-SOURCE SOFTWARE FOR THE IMPLEMENTATION OF THE GLOBAL AIR NAVIGATION SYSTEM

(Presented by the Dominican Republic)

EXECUTIVE SUMMARY

This paper presents the potential of free and open-source software (FOSS) for the development of the global air navigation system, as well as the importance of alliances with open-source software foundations to assist in this process.

Action: The Assembly is invited to:

a) request ICAO to consider open-source projects to support the implementation of future air navigation systems; and
b) request ICAO to consider partnerships with open-source software foundations to assist in the planning, development and/or implementation of open-source software for the global aviation system.

Strategic Objectives:	This working paper relates to the Air Navigation Capacity and Efficiency Strategic Objective.
Financial implications:	The activities referred to in this working paper will be undertaken subject to the resources available in the 2020-2022 ICAO Regular Programme Budget, to contributions from other States, and/or from extra budgetary contributions.
References:	Doc 9750, *Global Air Navigation Plan*

[1] Spanish version provided by the Dominican Republic.

1. INTRODUCTION

1.1 The global air navigation system described in the *Global Air Traffic Management Operational Concept* (GATMOC, Doc 9854) will require services that, to date, are not being used widely, if at all, within a typical air navigation environment. It is expected that the services will be offered under the system wide information management (SWIM) concept, which represents a major leap and a radical break from the paradigm of the current air navigation scenario.

1.2 Reaching this stage almost certainly requires using the currently available technology, which is not being applied commonly to the air navigation systems. That said, the implementation of this technology must be designed from the outset to be adaptable to the environment described by the GATMOC. This working paper proposes that consideration be given to open-source software that could close the gap between the current and future air navigation systems, as well as to strategic alliances to make it possible.

2. DISCUSSION

2.1 It is a common notion that SWIM represents the future paradigm of the aviation network, a service-oriented architecture (SOA) where applications will communicate among one another to achieve the expected performance of the aviation system. The challenges along the path to this ideal are many, one of the most notable being the need for this network to be global and interoperable with all the services destined to communicate through their means.

2.2 The transformation required by a State to be part of this environment will vary, but in most cases, it could be overwhelming. All the systems must adapt to this paradigm, with important updates expected for the software and infrastructure. This may be prohibitive in terms of implementation in the medium and long terms. Therefore, this SWIM environment probably only provides partial benefits until a significant number of stakeholders participate, which results in more difficult sustainability of the service.

2.3 This is just the example of SWIM, but it applies to a greater or lesser extent to other services, such as collaborative decision-making (CDM).

2.4 Future implementations are expected to use open standards and technology that have not been traditionally applied to aviation systems. These may have matured enough to be well managed in other industries. In the case of SWIM, cloud computing and application messaging come to mind, along with solutions that have been used for some time in other areas. An option to consider when selecting a solution is open-source software.

2.5 Open-source software is, by definition, software whose source code is available for anyone to view and modify. There is also the concept of free software, in which the *free* term relates to the freedom to use the software as considered favourable, not to the price. Both concepts relate almost to the same thing, that is why they have been included under a broader term, free and open-source software, or FOSS. With FOSS there are no copyrights that prohibit users from doing what they need with the software, except to prevent their source code from being available to other users. Normally, FOSS is also free, since there should be no restrictions on the distribution of the source code, but this is not a strict rule.

2.6 FOSS is no stranger to the aviation industry. Many of the available solutions use FOSS to some extent, the best example being Linux, an operating system used almost universally in solutions

offered by air navigation service providers (ANSPs). The wealth of FOSS tools is used by the industry to facilitate that its software development is concentrated on specific aspects of air navigation.

2.7 The use of FOSS in general for the implementation of future services could greatly benefit the process. It could reduce the initial costs of implementation, allowing States with fewer resources to participate earlier. The availability of FOSS can make it possible to achieve global implementation with ease. The possibility of modifying the software can allow each State to adapt the solutions to their particular needs.

2.8 However, there are drawbacks to be considered regarding this approach. If FOSS is implemented and modified in an uncontrolled manner, it is certain that interoperability issues will arise, since the changes in one State could make the solution incompatible with another. The choice of solution must also be taken into account to ensure interoperability since States can be using different standards.

2.9 To overcome these drawbacks and to take advantage of the potential of FOSS, two considerations are proposed:

a) Implementing FOSS at a high level of the system, in a unified manner. This will mean that, for instance, if cloud computing will be used for the implementation of the global aviation network, the cloud could run on FOSS in a distributed cluster, and access to the cloud will be done through defined protocols and standards implemented throughout the cloud. The endpoints can be what the State considers, proprietary software or FOSS, as long as the cloud interfaces follow the standard.

b) Forming alliances with organizations that sponsor open-source projects of interest. There are foundations that group notable representatives in different areas, with the objective of developing open-source projects that meet the requirements of the industry. Some examples are:

1) Open Stack Foundation, which develops an ecosystem oriented to the implementation of cloud computing environments. This foundation has corporate members such as AT&T, Ericsson, Intel, Red Hat, Dell EMC, Google, IBM, BBVA, as well as a company known in our industry, Thales.[2]

2) Linux Foundation, with its own group of projects in the field of virtualization, security and blockchain, to name a few. This foundation also has important members, such as Google, Microsoft, Huawei, Cisco, Amazon, Deutsche Bank and many more.[3] Recently, the Linux Foundation partnered with the Academy of Motion Picture Arts and Sciences to promote the development of open-source software for use in the film industry.[4]

3) edX, a joint venture between Harvard University and the Massachusetts Institute of Technology (MIT) which offers massively open online courses (MOOCs). edX transfers the FOSS concept to education, with free courses on a variety of topics, offered by institutions such as Berkeley, Sorbonne, Caltech, UAM in Madrid, the Smithsonian Institute, *inter alia*.[5] The knowledge required to manage

[2] https://www.openstack.org/foundation/companies/
[3] https://www.linuxfoundation.org/membership/members/
[4] https://variety.com/2018/digital/news/academy-software-foundation-open-source-1202901261/
[4] https://www.edx.org/schools-partners

the new technology could be more available to all the States through a partnership with this foundation, or even as it is.

2.10 The above is just a sample of what is available in terms of possible FOSS alliances. A more thorough inquiry should be carried out to identify the most beneficial options; however, the exercise is revealing. In addition, the concept of implementing a standard 'core' of software to be used by all States guarantees a higher level of interoperability and, if this core could be implemented at a reduced cost, a greater possibility of global implementation.

2.11 A discussion on air navigation software could not be complete without consideration of cybersecurity. A common myth about open-source software has been that it is no safer than proprietary software. This has been debunked a long time ago, and at some point the opposite was believed.[6] A careful selection of open-source software, those that are reviewed and updated regularly as needed, possibly with the contribution of the same IT community, will facilitate maintaining the solution at a desired level of security. In addition, open-source projects applied globally to the air navigation system could be designed taking into account ICAO cybersecurity initiatives such as the Trust Framework.

3. CONCLUSION

3.1 A constant factor within each development in the aviation field has been the need for resources. As a fact, it is expensive to implement aviation systems. While one of the means to allow members of the air traffic management (ATM) community to do so is to plan the business case, where the efficiency of the solutions could provide enough benefit to cover the costs, another is, indeed, to reduce the cost of implementation. Carrying out a well thought out open-source implementation project is something that should be considered and at least explored, for the benefit of the industry and stakeholders, and as a means to level the field so that no country is left behind in the future. Therefore, the Assembly is invited to consider and to adopt the following recommendation: The implementation of open-source projects to support the future aviation system through alliances with international partners that promote open-source software.

— END —

[6] https://www.techrepublic.com/article/open-source-vs-proprietary/
https://www.zdnet.com/article/six-open-source-security-myths-debunked-and-eight-real-challenges-to-consider/
https://rubygarage.org/blog/open-source-software-security