Standards and Open Source

Bringing them together

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EXECUTIVE SUMMARY

Cloud computing and Open Source Software (OSS) are two phenomena that have changed the IT landscape in the last 10 or more years in ways that have substantially altered how software and IT solutions are produced and consumed. Both cloud computing and Open Source have a close, and sometimes challenging, intersection with standardisation and standards developing organizations (SDOs). Against these market dynamics, the European Commission committed to support further use of Open Source elements by better integrating OSS communities into standard setting processes of SDOs. This study aims at supporting this commitment by providing practical answers to the question: what can the European Commission (EC) do in order to bring together SDOs and Cloud OSS communities?

This paper provides an overview of the activities developed by some SDOs. The mapping shows that for SDOs the collaboration with OSS communities may have different forms and address different aspects. First, some SDOs consider their collaboration with OSS communities as simple exchanges of methodologies; they are looking at understanding the ways of working and integrating Open Source mechanisms into standardisation. Second, SDO communities look at Open Source as a mechanism to provide implementations – often referred to as reference implementations – of a specific standard or standards based architecture. In this regard, Open Source can be a major way for the promulgation of standards. Third, some argue that the collaboration should go one step further. For them, the collaboration should be in both directions, and should imply that OSS communities also participate in the creation of standards that takes place in SDOs or transfer their results to SDOs for further formalisation.

Considering this, three recommendations are provided for SDOs and OSS communities in order to build bridges between standardisation and open source. First, parallel channels of communication, activities and partnerships can be created between SDOs and OSS communities. Second, SDOs can introduce methodological changes in order to make their development process similar or adopt additional processes which are similar to the ones used by OSS communities. Thirdly, OSS communities can be introduced in the processes of SDOs. Based on the findings of this study, a model, called the Platform Design Model, is proposed as a formalisation of the few successful examples of interaction between standard bodies, industry, and open source communities.

Finally, building on these ideas, and on the recommendations from a workshop that was organised in order to gather input from both communities, a roadmap is provided, identifying specific roles that the EC could play in bridging bridges between the SDOs and OSS communities. The roadmap includes:

The EC as a facilitator: The EC should develop an initiative aimed at raising awareness among different OSS projects of the potential benefits that could be introduced by standardisation activities. In this regard, the EC should liaise with OSS projects in the area of Cloud to promote, explain and evangelise some of the standards that may be relevant for OSS projects.

- **Short term:** Launch actions of active participation in the OSS community events. For example, the Commission could organise a session that brings together several thousands of OSS developers, to speak about the importance of standards for their work.
- **Medium term:** Create a website oriented towards OSS communities explaining the relevant standardisation processes, actively promoting standardisation to the OS community and developing communication materials.
- **Long term:** Organise further workshops / set up working groups to create more specific outputs, e.g. for vertical markets, such as health that could be published in the webpage and promoted in OSS events.

The EC as an incubator: The EC should identify a set of relevant Cloud projects that could be collectively considered as the basis for a shared Cloud ecosystem (e.g.such as the Linux Foundation, Open Stack and Cloud Foundry). Moreover, the EC should nurture the ecosystem, coordinating the different actors to evaluate up-and-coming OSS packages, Cloud standards and their potential interest. In this regard, the Commission could go as far as to prepare and train a small subset of OSS project participants on the tools and processes used in SDOs, to reduce the effort necessary (after project stabilisation) in proposing the standardisation of part or all of the OSS project's assets; promoting efforts to coordinate between the relevant projects, including the creation of "coordinated releases" (e.g., Eclipse project SimRel approach).

- **Short term:** The Commission should encourage the organisation of coordination meetings between members of the OSS and SDOs communities.
- **Medium term:** Train OSS project participants on the tools and processes used in SDOs, through specific support actions.
- **Long term:** Active mentoring to facilitate transfer from projects to standards - and vice-versa.

The European Commission as a policymaker: The EC is currently working on the identification of ICT Technical Specifications for referencing in public procurement through a structured process. Furthermore the Commission could: create guidelines and promote success stories/good practices on the use of OSS implementations of technical specifications by the public sector.

0

INTRODUCTION

Cloud computing and OSS[1] are two phenomena that have changed the ICT landscape in the last 10 or more years, and for both the relationship with standards[2] and SDOs[3]. is complex. Given the importance of OSS, it is understandable that throughout its adoption history, many have called for a strong interaction with standardization initiatives: in 2000, the European Working group on Libre Software suggested, among other actions, the *"Promotion of open source reference implementations for any protocol standard. For new protocols and protocol standards, the creation and maintenance of a reference implementation distributed under an open source licence should be encouraged. This would make it possible to have at least one implementation available for public use, and to serve as a vendor-neutral reference for any other implementor. In addition, this could mitigate the problem of proprietary implementations adding non-standard features to standard protocols, harming interoperability".*

Regulation 1025/2012 on European Standardisation creates a framework for a more transparent, efficient and effective European standardisation system for all industry sectors. This Regulation emphasises the fast evolution of ICT and the way in which new products and services, such as 'smart' or connected devices (generally referred to as the 'Internet of Things' or IoT) or the Cloud, transform markets. Building on the Regulation, in 2016 the Commission released a Communication on "ICT Standardisation Priorities for the Digital Single Market" (European Commission 2016). Priority Domain 1 (Cloud Computing) of the Communication calls for the use of open source elements, by better integrating open source communities into SDOs' standard setting processes. This is based on the recognition that open source communities do not participate sufficiently in the setting of standards.

Following this, and continuing the work of the Cloud CSC Phase 2 activities, OFE engaged with the Commission in order to analyse and make practical progress on the models for collaboration between SDOs and Cloud Open Source software development initiatives, and to develop a roadmap of actions to improve the integration of open source communities in the standard setting process. This deliverable, the result of that exercise, aims at supporting this action by providing practical answers to the question: what can the EC do in order bring together SDOs and Cloud OSS[4]? It does that by developing a roadmap of actions to improve the integration of Open Source communities in the standard setting process.

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[1] Within this report, OSS refers to software that is released under a license that is recognized by the Open Source Initiative as an approved "Open Source License".

[2] Within this report, standards refer to the output from an SDO.

[3] Within this report, SDOs refer to any entity whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting or otherwise maintaining standards that address the interests of a wide base of users.

[4] It is important to note that the controversy surrounding the (in)compatibility of FRAND and OSS licences has been left out of the scope of this paper, because they have already been well documented. Instead, this project goes beyond this controversy to look at the practical ways to encourage collaboration, seeking pragmatic synergies, and approaches which may bear fruit.

The methodology used for this paper was first to conduct a data gathering and then to operationalise it. Indeed, a fundamental part of the research included obtaining input from both SDOs and OSS communities. Therefore, the research team engaged with both of them. First, in order to get a clear view of the standardisation environment in the area of Cloud, desk research was conducted, defining which SDOs are the most relevant and how these SDOs engage with OSS communities. Aiming at testing this data, a questionnaire was sent to several OSS communities (answers can be found in an Annex to this study). This data proved very useful for mapping the environment and, following this research, for creating a model of the different methods of collaboration between SDOs and OSS based on the different answers provided to the questions. Next, the conclusions of this first section were presented and debated in the context of a workshop in Brussels, with the stakeholders. Finally, the lessons from the mapping and from the workshop were all taken into consideration for the creation of a roadmap of activities answering this study's research question.

Following the methodology presented above, this deliverable is divided into five sections[5]. Section 1 provides a background to the study, taking into account the political and economic environment, including the reasons why the Open Source community and SDOs should engage with each other. Section 2 presents the results of the mapping exercise. Building on this, section 3 presents three models that cover the different initiatives that are taking place between the Open Source and SDO communities. Section 4 presents the conclusions of the workshop on the promotion of collaboration between open source and standardisation, which - based on the work done on the previous sections - developed a list of suggestions for the European Commission. Finally, based on the results of the workshop and on the studies, OpenForum Europe (OFE) now presents a set of concrete proposals for specific actions which could be considered for guiding the activities of the Commission in these areas.

[5] Carlo Daffara has helped in the drafting of Section 2 & 3.

1

COLLABORATION BETWEEN OSS COMMUNITIES AND SDOS: THE CLOUD CASE

Aiming at providing some common ground where solutions can be built, this section looks at the relation between the OSS communities and SDOs in order to understand what they are, their similarities and differences. Building on that analysis, section 1.2 answers the question: "Why should the OSS communities and SDOs collaborate?".

1.1

WHY SDOS AND OSS MATTER FOR CLOUD COMPUTING

OSS is certainly one of the main technical underpinnings of today's technological landscape; OSS is behind the majority of internet services, 78% of companies use OSS (and 65% contribute to it (Blackduck, 2016); and an estimated 35% of all lines of source code in use are made available under an Open Source license (Daffara, 2012). Some of the most successful public companies today have leveraged Open Source components within a distributed, microservices-based architecture so as to quickly deliver new products and services that are cost-effective and responsive to market demands and changes. In sum, companies are embracing the Cloud, and the Cloud is built on OSS.

Why is this happening? The Cloud allows for producers to break applications up into microservices, or distinct, single-purpose services that are loosely coupled with dependencies and explicitly described through service endpoints. This has significantly increased the overall agility and maintainability of applications, and this improvement has been used to gain competitive advantage.

Those market participants who do not rely on Open Source solutions have scrambled to replicate this architecture and approach. In fact, many of the less "open" solutions that are out there nevertheless have been built cobbling together proprietary solutions using custom scripts and Open Source software - often using the Open Source versions of these web giants' own infrastructure (e.g., Google's borg, which became Kubernetes; Twitter's Mesos project, VMware's Cloud Foundry, etc). Brought to the extreme, many Cloud services would be unrealizable without OSS (Amazon Web Services is an example here, as it packages common OSS packages and make them available through the network, using a layer of proprietary software to control them[6]). In summary, as Cloud adoption grows, Open Source technologies will continue to be the source of innovation and the foundation for new markets and ecosystems (Linux.com, 2016), because they allow for the combination of different pieces or components that other solutions do not allow.

[6] A very recent example is the Amazon Athena search service, based on the Facebook Presto distributed search engine. Other examples are MySQL, Hadoop, Spark, PostgreSQL and many others.

However, mere use of OSS packages is not enough. Standards are also basic for the development of Cloud computing. Without them, the different components of the Cloud would not be able to work together. In this regard, for Cloud computing, the strongest push towards standardisation arrived from the need for interoperability - both as in the ability to move workloads and services in a nearly transparent way from one Cloud to another, and in the capability to interconnect different Clouds. The lack of Cloud interoperability is seen as a barrier to Cloud-computing adoption because organisations fear "vendor lock-in", the situation in which, once an organisation has selected a Cloud service provider, either it cannot move to another provider or it will incur a substantial cost in doing so, in turn either because the economic or technical offer has become inadequate, or because the vendor has ceased operations.

These different approaches share points in common between them. Both Open Source and Cloud computing projects tend to demonstrate rapid changes in the beginning, and progressively to move towards longer interval times between releases once the project reaches maturity. This is similar to the developments cycles that standards have: an initial stage of substantial R&D investment is recouped by the adopters (and partially by the creators), with a large and significant multiplicative effect that provide benefits for the whole market.

However, the full potential of this collaboration is yet to be reached. Indeed, SDOs and OSS are two different realities that could benefit from closer collaboration. Before going into debating how to make them to work together, it is necessary to recognise their differences. On the one hand, SDOs develop standards. In the area of cloud these standards allow for the integration of technologies and for ensuring interoperability. This work has developed though a structured process that often results in products using Royalty Free (RF) or Fair, Reasonable, and Non-Discriminatory (FRAND) terms to protect the Intellectual Property Rights (IPR) contributed to the specifications. On the other hand, Open Source communities work with enhanced collaborative tools and open dissemination processes that allow for the fast co-option, adaptation, and republication of the work and the work of others, under one of many Open Source licenses that generally allow for reuse, adaptation and productization of work without the need to negotiate terms with each contributor or contributing company. As concluding remark, the principles that Simon Hicks presented in the 2015 European Telecommunication Standards Institute (ETSI) summit on standardization and open source come to mind. He argued that OSS will not replace standards and that standards will not replace OSS. Instead, he considered that both can work together (Hicks, 2015).

Seeing the importance of SDOs and of OSS communities in the development of new technologies, and having understood their characteristics, section 2 will analyse the factors motivating the different actors to collaborate between them, and section 3 will present how there are projects that are bringing (or trying to bring) them together.

1.2

BENEFITS OF COLLABORATION BETWEEN OSS COMMUNITIES AND SDOS

As shown in the introduction, this study seeks to answer the question: What can the EC do in order to bring together SDOs and Cloud Open Source software? The previous section has shown that even if the SDOs and OSS communities share similarities and have differences, the economy would clearly benefit from an increasing level of collaboration. However, the adoption of cloud standards is considered low and stronger involvement of OSS communities could lead to increased levels of adoption for cloud standards (European Commission, 2016). Tentatively, we have pointed out that the reasons for this lack of collaboration could be attributable to the different working methods of these two communities. Considering that, this section looks at the reasons which the different stakeholders (i.e., the OSS and SDO communities) could have for collaborating with each other. This will provide a starting point for the discussion (developed further in Section 2) about the different models of collaboration that have been proposed.

The first reason why the OSS and SDO communities should collaborate is that, in most cases, standards provide a net advantage for adopters:

- Standards help stakeholders in the creation and management of their products and of their processes: successful standards incorporate a significant amount of research and development effort, which is thus transferred to the adopter.
- Standards efficiently reduce the variety of goods and services necessary to operate in a market, providing a basis for innovation and thus enabling the creation of new products and services.
- Standards facilitate interoperability of technologies and processes.

Studies have shown that in fact standards have a substantial economic effect (The British Standards Institution, 2015); this explains why, in any new technical context, standards tend to emerge after an initial undifferentiated period. In the absence of a pre-existing standard, there are many different reasons for individual actors to work together in the creation of one, including:

- **Market creation:** this is the most critical strategic role that a standard can play: to create a new market which would not exist "but for" broad industry agreement on a new standard.
- **Market conditioning:** few single companies have the resources required to condition a market to demand a new product, service or computing model. Combining the marketing resources of multiple companies to promote any of these — or simply announcing that the majority of the big players in an industry have committed to the new offering — can achieve that goal more reliably and at a far lower per-company cost.
- **Collaborative R&D:** in some cases, using a consortium as an extension of the members' own research and development efforts can create high-quality technology at a far lower per-member cost. Examples of such organisations and their work product include the

original Sematech (which developed semiconductor technology), the X Consortium (which developed the X Window system), and the many Open Source projects in existence today.
- **Displacing an incumbent:** standards efforts have frequently been developed and promoted in an effort to displace a powerful incumbent which has succeeded in creating a dominant market position.

The combination of these two effects (the advantage of creating a standard when no standard exists or is dominant, and the advantage of adopting an existing one) guarantees that basically in every market a standard will eventually emerge; it also suggests that during the initial period there may be many different competing standards, which (in the case of homogeneous markets) will tend to lead to consolidation.

However, one question remains: why develop standards inside an SDO? As pointed out before, proprietary technology can become a de facto standard through market dominance. Some may even argue that SDOs are a "thing of the past" and that they should become part of the OSS communities. Answering these concerns, SDOs have, since their inception, clearly laid out the many advantages that actors gain from participating in a standard development process:

- **Strategic Influence:** those that participate in the governing bodies of SDOs can influence, directly or indirectly, which standards will be created, and in what order, and to serve what purposes.
- **Technical influence:** after a working group has been chartered, many decisions remain to be made concerning (e.g.) technical details, architectural approaches and final results. The members that join the working group make these decisions, gaining a deep knowledge of the technology being developed.
- **Early access:** members have early access to information relating to an evolving standard, and can use that knowledge contemporaneously to formulate and implement their own design and product strategies based on their knowledge of where a draft specification is heading, and so enjoying a strategic advantage on non-members.
- **Messaging:** corporations often signal their commitment to markets, technologies or architectures by joining the SDOs that are creating the standards that are essential to the strategic direction being emphasised.
- **Joint marketing:** many consortia engage in marketing as well as technical activities. While consortium budgets may not be sufficient to perform marketing on a corporate scale, consortia do provide a venue within which marketing messages and strategies can be agreed upon and coordinated, sharing costs.
- **Certification and branding:** SDOs can also provide a venue for other supporting activities, such as "plugfests" that permit implementers to determine whether their standards-compliant products do in fact interoperate, and branding programs under which compliance can be certified, using trademarks created and owned by the SDO, and licensed to those that successfully pass the required tests.

Actors participating in standards can (if interested in direct monetisation of the standard adoption by end users) gain IPR protection for a specific set of patented technologies that are essential for implementing the standard; meaning that any third party interested in adopting it may ask for a licensing agreement with the patent holder or, in rare cases, with a third party (such as a patent pool) that exercises this right on behalf of the patent holders. Sometimes patent holders agree to a royalty-free (or zero-rate royalty) licensing strategy instead; under this licensing model, patentees provide broad access to their technology at no monetary charge, but expect either to gain from non-financial licensing obligations or to profit from the sale of complementary goods or technology (Greenbaum, 2016).

2

MAPPING OF SDOS

Having settled some general ideas about the relation of SDOs and the OSS communities in the area of Cloud, this section takes an individualised look at some of the most relevant SDOs in the area of Cloud. Moreover, because of its particular relevance in the context of the relation between SDOs and OSS communities, World Wide Web Consortium (W3C) is also considered. Finally, an overview of all the SDOs is presented, explaining the barriers for OSS in standardisation activities that have been identified in the mapping exercise.

2.1

STORAGE NETWORKING INDUSTRY ASSOCIATION

The Storage Networking Industry Association (SNIA) is a non-profit organisation made up of member companies spanning information technology. SNIA's mission is to lead the storage industry in developing and promoting vendor-neutral architectures, standards and educational services that facilitate the efficient management, movement and security of information. The SNIA works towards this goal by forming and sponsoring technical work groups, by producing the Storage Developers Conference and Data Storage Innovation conferences, by building and maintaining a vendor neutral Technology Center in Colorado Springs, Colorado, and by promoting activities that expand the breadth and quality of the storage networking market (SNIA, n.d.a).

In the area of Cloud, SNIA developed the CDMI specification, now an ISO Standard: ISO/IEC 17826:2012 (SNIA, n.d.b). The specification was developed without the involvement of any member of the OSS community. This contrasts with the position of SNIA towards the OSS community. Indeed, SNIA wants to work collaboratively with the Open Source community to obtain feedback and new requirements to help improve its standards. In this regard, the SNIA Cloud Storage Technical Work Groups has produced an open source reference implementation. Moreover, SNIA standards are used in Open Source projects in various stages of development. SNIA also has a contact point in place for OSS communities (Cloud Standards, 2017a).

2.2

EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE

ETSI is an independent, not-for-profit, standardization organization in the telecommunications industry (equipment makers and network operators) in Europe, with worldwide projection. ETSI produces globally-applicable standards for ICT, including fixed, mobile, radio, converged, broadcast and internet technologies, including activities in the area of Cloud computing (ETSI, 2016a).

ETSI has a long history of partnership experience in the Cloud standards community, notably in interoperability testing and Plugtests. In June 2006, ETSI's GRID technical committee was created, holding its first meeting in September 2006. Moreover, the Cloud activity that previously took place in ETSI's (now closed) Technical Commitee CLOUD is now included in the Technical Committee NTECH (e.g., Specialist Task Force 486, which dealt with Cloud Standards Coordination - Phase 2) (ETSI n.d.). In February 2016, ETSI published the report "Cloud Computing Standards and Open Source; Optimizing the relationship between standards and Open Source in Cloud Computing" as part of the Cloud Standards Coordination Phase 2 (CSC-2) work. The report investigated the relationship and the interactions between standardisation and Open Source based software and solutions in Cloud Computing, a question that had not addressed in the Cloud Standards Coordination Phase 1 (CSC-1) which had been completed in 2013. In the report, ETSI concluded that although OSS and standards have different goals, they play important complementary roles. Noting that ICT projects increasingly combine the two approaches it recognised that formalised activities within SDOs to promote collaboration were still few in number (ETSI, 2016b).

ETSI is one SDO that hopes to increase cooperation with Open Source communities. In fact, the baseline of the debate as defined in the ETSI context suggested that SDOs and OSS communities need to cooperate (Hicks, 2015). In practical terms, this means that in at least one case, ETSI engaged with OSS communities, in this case OpenStack, directly. In fact, from the answers supplied by OSS communities, we are aware that the ETSI Network Functions Virtualisation Industry Specification Group is open to the participation of OSS communities (see Annex, answers OpenStack). Therefore, ETSI has very flexible membership terms allowing for OSS communities to participate. Nevertheless, understanding that the traditional standardisation process was too slow in comparison with the pace of development in OSS communities, ETSI has tried to improve its methodology to make it faster (Muller, 2015). In this regard, the ETSI Board continues to drive the discussion on how to increase collaboration with OS communities. In September 2016 it organised a workshop on legal interactions between open source and standardisation (ETSI, 2016c).

2.3

DISTRIBUTED MANAGEMENT TASK FORCE

The Distributed Management Task Force (DMTF) is a computer software trade group which works to simplify the manageability of network-accessible technologies. The DMTF creates open manageability standards spanning diverse emerging and traditional IT infrastructures including Cloud, virtualization, network, servers and storage. Member companies and alliance partners worldwide collaborate on standards to improve the interoperable management of information technologies. The organisation is led by a diverse board of directors from: Broadcom Limited; CA Technologies; Dell Inc.; Hewlett Packard Enterprise; Hitachi, Ltd.; HP Inc.; Intel Corporation; Lenovo; NetApp; Software AG; Vertiv; and VMware, Inc (DMTF, 2017a).

The DMTF is very active in the area of Cloud. For example, DMTF created the Open Virtualization Format (OVF) – a standard for packaging and deploying virtual appliances, which was adopted in August 2010 by the American National Standards Institute. In January 2013, DMTF released the second version of the standard (OVF 2.0) which applies to emerging Cloud use cases and provides important developments over and above OVF 1.0, including improved network configuration support and package encryption capabilities for safe delivery (Business Wire, 2011). Another standard created by the DMTF is Cloud Infrastructure Management Interface (CIMI) – a self-service interface for infrastructure Clouds, allowing users dynamically to provision, configure and administer their Cloud usage with a high-level interface that greatly simplifies Cloud systems management. The specification standardises interactions between Cloud environments to achieve interoperable Cloud infrastructure management between service providers and their consumers and developers, enabling users to manage their Cloud infrastructure use easily and without complexity (DMTF, 2017a).

This activity is created by DMTF relying on its members, mainly companies. Indeed, whilst DMTF does not mention any Open Source communities (DMTF, 2017b) as participants in the standardisation, it does maintain a list of Open Source Projects using DMTF technologies (DMTF, 2017c).

2.4

ORGANIZATION FOR THE ADVANCEMENT OF STRUCTURED INFORMATION STANDARDS

The Organization for the Advancement of Structured Information Standards (OASIS) is a global nonprofit consortium that works on the development, convergence, and adoption of standards for security, Internet of Things, energy, content technologies, emergency management, and other areas (OASIS, 2017). The OASIS technical agenda is set by members, and there a number of Cloud related projects underway, notably TOSCA, CAMP, OData, and Identity on the Clouds. There are also a number of activities that are using or building upon existing standards, including: those related to security, access and identity management standards -- e.g., OASIS SAML, XACML, SPML, WS-SecurityPolicy, WS-Trust, WS-Federation, and KMIP; those related to content, format control and data

import/export standards -- e.g., OASIS ODF, DITA, CMIS, and SDD; those related to registry, repository and directory standards -- e.g., OASIS ebXML and UDDI; and those related to SOA methods and models, network management, service quality and interoperability -- e.g., OASIS SCA, SDO, SOA-RM, and BPEL (Cloud Standards, 2017b).

OASIS considers that open standards and Open Source projects work together very well (Cosgrove Sacks, 2005), and has a policy in place for OSS projects related to Technical Committee work (OASIS, 2017b). Moreover, OASIS supports the participation of OSS communities in their work. For example, it counts certain OSS communities among its members. However, it is important to note here that (as far as we are aware) those communities, are not present in the groups specifically working on Cloud computing. Moreover, OASIS is currently developing a new methodology to align the development times of SDOs with those of OSS communities (the OASIS Open Projects, see below).

In 2005, OASIS released its new IPR Policy, which allows members to select one of four IPR modes when they establish a new technical committee: RAND, Royalty Free on RAND, Royalty Free on Limited Terms, and Non-assert. This forces the individual technical committees to discuss about IPR before anything else, and thereby obligates them to the course chosen by all. OASIS recognizes that not all of these IPR modes are acceptable to the OSS communities which is why TC's operating under RAND mode cannot create an OSS repository under OASIS.documents and other supportive ones (Cloud Standards, 2017c).

2.5

OPEN GRID FORUM

The Open Grid Forum (OGF) is a community of users, developers, and vendors for standardization of grid computing. It was formed in 2006 through a merger of the Global Grid Forum and the Enterprise Grid Alliance. The OGF has two principal functions, plus an administrative function: being the SDO for grid computing, and building communities within the overall grid community (including extending it within both academia and industry). Each of these function areas is then divided into groups of three types: working groups with a generally tightly defined role (usually producing a standard); research groups with a looser role, bringing together people to discuss developments within their field and to generate use cases and spawn working groups; and community groups (restricted to community functions) (OGF, 2017).

The work of the OGF in the area of Cloud is covered by the Open Cloud Computing Interface (OCCI), a set of open community-led specifications. OCCI is a general-purpose set of specifications for Cloud-based interactions with resources in a way that aims at being explicitly vendor-independent, platform-neutral and can be extended to solve a broad variety of problems in Cloud computing. Currently it is composed by three main documents and other supportive ones (Cloud Standards, 2017c).

OGF develops its standards through an open process that gathers input and contributions from the community, and refines them through peer review and public comment to produce standards, guidance and information of value to the community through the Grid Final Document (GFD) series. The OGF is a standards group where the participation of very easy for OSS projects. In the particular case of the OCCI, some of its members are OSS communities, (eg: Open Nebula). This openness is explained by OGF as the result of its openness towards new members and of its IPR policy. This means that the OGF is ready to accommodate Open Source projects without changes (Cloud Standards, 2017c).

2.6

ITU

The International Telecommunication Union (ITU), originally the International Telegraph Union, is a specialized agency of the United Nations that is responsible for issues that concern information and communication technologies. The ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world, and assists in the development and coordination of worldwide technical standards (ITU, n.d.a).

ITU's activities in the area of Cloud are organised around ITU's Study Group 13, and around the Joint Coordination Activity on Cloud Computing. Study Group 13 leads ITU's work on standards for next generation networks (NGN) and future networks, and is the primary SG working on Cloud Computing. ITU-T Study Groups have working groups called Questions, which focus on specific areas (ITU, n.d.b). The scope of JCA-Cloud is coordination of the ITU-T Cloud computing standardization work within ITU-T and coordination of the communication with standards development organizations and forums also working on Cloud Computing protocols and standards. JCA-Cloud is open to ITU Members and designated representatives of relevant Standards Development Organizations and Forums (ITU, n.d.c).

For ITU, OSS communities and development are expected to play an important role in many areas. Therefore, bridges should be found in order to permit OSS communities to participate in the SDO's activities. However, ITU believes that this is not easy - a particularly relevant barrier to this happening being the IPR policies used by SDOs (ITU Telecom World, 2012).

2.7

ISO/IEC JTC 1

The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from various national standards organizations. Founded on 23 February 1947, ISO promotes worldwide proprietary, industrial and commercial standards (ISO, 2017a).

ISO's work in the area of Cloud is conducted by the JTC1/SC 38 committee; its scope includes standardization for Cloud Computing and Distributed Platforms. Because of ISO's central role in the development of standards, JTC1 plays a key role in the process of creation of many of the standards in the area of Cloud (ISO, 2017b).

For ISO, OSS is a useful methodology that can be used in order to improve the development of standards. Therefore, there are initiatives in ISO in order to use these methodologies. However, because of its membership (representatives from various national standards organizations (ISO, 2017c)), OSS communities find it difficult to participate in its activities. In fact, as long as ISO maintains that membership structure, it is difficult to see how OSS communities could successfully participate, unless those communities could first engage with their national SDOs.

2.8

W3C

The W3C is the main international standards organization for the World Wide Web (abbreviated WWW, or sometimes W3). Founded and currently led by Tim Berners-Lee, W3C is made up of member organisations which maintain full-time staff for the purpose of working together in the development of standards for the World Wide Web (W3C, 2017a). As of 24 May 2017, W3C has 461 members, and also engages in education and outreach, develops software and serves as an open forum for discussion about the Web (W3C, 2017b).

Although it can be argued that the activity of W3C does not cover the standardisation of Cloud computing, it is included in this list because of its particular role as an SDO with deep connections with the OSS community.

The success of W3C in bringing together OSS and SDO communities can be explained as being the result of its open approach towards its membership. Members of W3C include businesses, nonprofit organizations, universities, governmental entities, and individuals (W3C, 2016a). Membership requirements are transparent, except for one requirement: any application for membership must be reviewed and approved by W3C itself. Many guidelines and requirements are stated in detail, but there is no final guideline about the process or standards by which membership might be finally approved or denied (W3C, 2016b). Moreover, the cost of membership is given on a sliding scale, depending on the character of

the organisation applying and the country in which it is located (W3C, 2016c). The success of W3C can also be explained because of its Royalty Free patent policy and its liberal copyright (allowing for maximum reuse, something that suits the development model of open source). Moreover, W3C creates specifications with comprehensive documentation, which helps promote the implementation of its standards by OSS communities (Wenning, 2015).

2.9

OVERVIEW

The mapping conducted above show that for SDOs, the collaboration with OSS communities can imply many things. First, some SDOs consider their collaboration with OSS communities as simple exchanges of methodologies. From this point of view, the examples above have shown that SDOs consider that something is to be learned from the development processes of OSS communities.

Second, SDO communities point out that for standards to be useful, they need to be adopted by the industry through successful implementations. In this regard, OSS communities play a key role in the implementation. By providing good documentation and creating Open Source implementations of standards to be reused, SDOs succeed in having their standards adopted by the OSS communities.

Third, some argue that the collaboration should go one step further (see Open Nebula answer in Annex 1). For them, the collaboration should be in both directions, and should imply that OSS communities also participate in the creation of standards that takes place in SDOs. In this regard, the mapping has identified two barriers that hinder the participation of OSS communities in standardisation activities: first, the different structural organisations of OSS communities and of SDOs, which means that their development processes are not parallel, or even compatible; second, the IPR policies used by SDOs, which in some cases are incompatible with the licenses and the principles used by the OSS communities.

There is already considerable established literature dealing with the IPR policies used by SDOs (e.g., debating the compatibility of FRAND and Royalty Free with OSS) and also, as shown above, there are many examples of how this problem translates to practical terms. Put simply, we may say that on the one hand, excluding non-Royalty Free technology could mean to force some participants in SDOs to give up their rights. Such would be contrary to the overall policy of the EC to strengthen intellectual property rights protection. On the other hand, choosing a strict RAND policy would forbid some Open Source implementations. Any chosen definition will have a broader impact than only pushing for RAND or Royalty Free. Because of this, the remaining sections of this paper will look at the problem of the different structural organisations, and will present some recommendation covering the different strategies used by SDOs and OSS communities to collaborate to each other.

3

RECOMMENDATIONS OF HOW THE OSS AND SDO COMMUNITIES CAN BRIDGE THEIR ORGANISATIONAL DIFFERENCES

As shown above, Cloud computing is a cornerstone of the digital economy. Companies across industries now use the Cloud—private, public or somewhere in between—to deliver their products and services. 41 percent of all enterprise workloads are currently running in some type of public or private Cloud. That number is expected to rise to 60 percent by mid-2018. And some 95 percent of companies are at least experimenting in the Cloud (RightScale, 2016). For all of them, to have interoperability based on standards that allows them to assemble open source components is fundamental.

Having considered (in the previous section) the motivations that the OSS and SDO communities have for collaborating together, and observing that there are differences between them, how can we bring these two communities together? It is already evident that trying to force only one of the communities to change would be difficult; the IPR model that was shown to be a barrier at the end of the previous section is used successfully to create hundreds of standards, and has been demonstrated to be effective in promoting innovation, while maintaining a monetisation strategy that allows the recoupment of the sunk R&D investment. At the same time, any effort to adapt the OSS development model to make it more structured, like the one used by SDOs, would risk destroying the key Open Source community attributes of fast turnaround, flexibility and adaptability. It is also difficult to imagine a way to alter the Cloud market to force standards that at the moment do not exist, or to ask for industry players to create a single entity to try to address the lack of competition in the Cloud environment.

Instead, this section provides a list of structural and organisational recommendations that can be introduced by SDOs in order to lower the barrier of entry for OSS communities to participate in standards work. These changes can be based on creating parallel channels of communication between SDOs and the OSS communities, on changing the methodology used inside of an SDO so that the standardisation process becomes more similar to the one used by OSS communities, and on lowering the barrier for membership of and participation in an SDO.

3.1

RECOMMENDATION 1: BENEFIT FROM COMMON ACTORS

SDOs and OSS communities in the area of Cloud share some common stakeholders. For example, in OpenStack, although no centralised effort exists around standards, but the community participants are often the same that engage with SDOs. For example, IBM, Ericsson, GigaSpaces and others have added support or advocated for different standards while being part of OpenStack. Another relevant issue that can be taken from the OpenStack's response is that, although they are aware of some collaborations like the one described above, there are likely to be several other collaborations across its 70,000+ individual members.

Therefore, some would argue that a way to bring closer the SDO and and OSS communities is through the use of actors who are members of SDO communities and also join OSS communities. From this point of view, not all OSS community members have to participate in standardisation activities, because there are some members that already are part of SDOs. Instead, the role of OSS community members should be directed more towards implementing the standards and creating infrastructures around them.

Nevertheless, this option which is focused on the idea of implementing existing standards, is criticised by OpenNebula on the basis that this system only produces a unilateral collaboration. Standards bodies expect Open Source projects to implement their specifications. OpenNebula argues, however, that in Open Source, standards bodies should play a more active role. This is the direction of the next two proposals.

3.2

RECOMMENDATION 2: CONVERGE STANDARD SETTING AND OSS DEVELOPMENT PROCESSES

Some argue that an obstacle to bringing together the OSS and SDOs communities is the failure to update the standards setting process(es). This point of view argues that it is necessary to develop a system that, inside of an SDO, can develop standards with the speed and agility that the OSS community requires. Following this logic, and as shown above, some proposals have been suggested in the past about how to change the standardisation process. In this regard, at present OASIS is developing one such strategy, a new path to the creation of a standard, called the "Open Project" path, which is further analysed below as an example of this model.

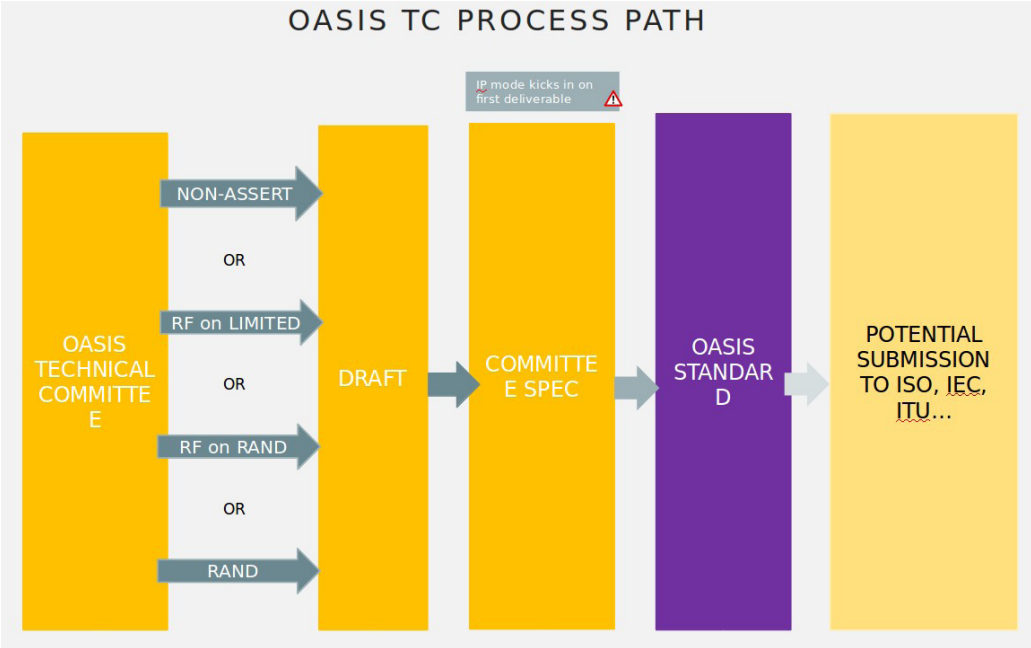

Figure 1: OASIS TC process path | Source: OASIS

In order to understand this process, one first needs to be aware of the current process that a standard needs to follow in OASIS. As shown in Figure 1 above, an OASIS Technical Committee is created when it is considered that a standard can be developed. In that stage, the Technical Committee considers the features of the proposed standard and presents its characteristics, putting all together in a draft standard, which will already have a licensing methodology defined (be it non-assert, RF on Limited, RF on RAND or RAND). Draft standards are iterated on until a Committee Specification is delivered. It is at the point that license commitments and obligations kick in with respect to the final contents for all committee members. The Technical Committee can vote to progress to the next stage; if the proposal is accepted, a new Oasis standard is published. There are cases where the new OASIS standard is then submitted to ISO, IEC or ITU. As we can see from this simplification, implementations of draft specifications risk large modifications as various drafts progress towards a stable committee specification. Moreover, from being a draft to becoming a standard can take some time and the system can be quite rigid, in the event that developers want to introduce changes.

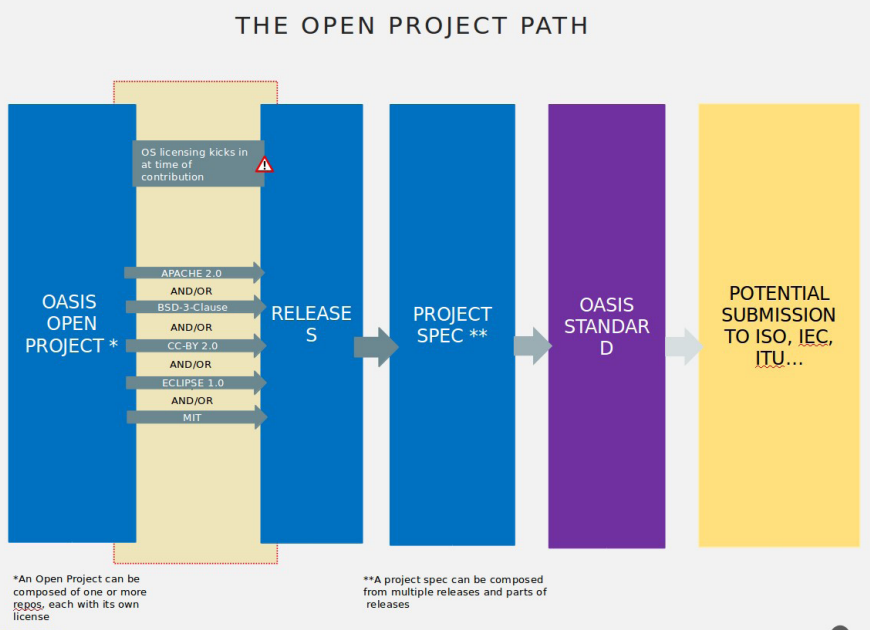

Figure 2: The Open Project path | Source: OASIS

The Open Project path is how OASIS expects to update its process, so as to being it more into line with the process used by OSS communities. The new methodology starts with the creation of an Oasis Open Project, and one or more repositories where developers can make commitments of code and other materials. At the time of the contribution, license commitments happens as is normal for OSS developments. A next step will be to develop a project specification, similar to the committee specification of the current OASIS process. In this stage, several releases or part of releases (therefore, different repositories) can be put together if necessary. If the project specification is approved, it becomes a fully-fledged OASIS standard.

This methodology has not yet finalised, but it is expected that OASIS will launch the program at the end of 2017 or at the start of 2018.

3.3

RECOMMENDATION 3: INCREASE THE CONTRIBUTIONS OF OSS COMMUNITIES IN THE STANDARDIZATION PROCESSES

One barrier that was identified through the mapping is that some SDOs have a list of requirements to be satisfied before stakeholders can become part of their membership. Such requirements can be diverse, and can go from only accepting national SDOs and part of their members (like ISO does), to allowing virtually everyone to participate after their application is revised by the organisation (e.g., W3C). For obvious reasons, some of these models lower the barrier for participation, allowing OSS communities to participate in the standardisation process.

A particularly relevant case is the framework created by the OGF, explained above. Although an in-depth explanation has been already provided, it is worth repeating that the OGF includes a group called the OCCI Working Group, which maintains the OCCI specification developed by the OGF. This group began in March 2009 and was initially led by co-chairs from the former SUN Microsystems, RabbitMQ and the Complutense University of Madrid. Today, the working group has a membership of over 250 members, including numerous individuals, OSS communities, and industry and academic parties (OCCI, 2017). This system allows for interoperability because different Cloud providers can work together without data schema/format translation, façade/proxying between APIs and understanding and/or dependency on multiple APIs. Moreover, this approach guarantees that there is no technical/vendor lock-in and enables services to move between providers, so allowing clients easily to switch between providers based on business objectives (e.g., cost) with minimal technical cost, so enabling and fostering competition. Finally, as the implementers are involved in the standards setting process, implementations of the OCCI specification can be easily be integrated with existing middleware, 3rd-party software and other applications.

The creation of these communities thus has positive consequences both for the SDOs and for the OSS communities. On the one hand, SDOs can ensure that their standards are implemented and developed by the external community. On the other hand, OSS communities can ensure that they steer the creation and development of new standards. Not only that, but this also produces the development of standards that have been tested and are improved over time, increasing the positive outcome that standardisation activities can have for society as a whole.

4

A COLLABORATION MODEL: THE PLATFORM DESIGN MODEL

In the context of this study, it was suggested that ideas could be taken from other sectors. The result of this research is the Business Model Canvas (Cicero et al., 2016), which has the important advantage of being inherently designed to model many types of relations, even those that are not strictly monetary or market-oriented in nature (such as the collaborative development model used to develop OSS), and of being able to help in understanding which elements can be changed to facilitate useful interactions for all the participants. Moreover, this model has been already tested. Although (to our knowledge) there are no practical applications yet of this model in the area of Cloud computing, it is understood that the model has been used by SWIFT (the financial mediator) and Hutchison Whampoa (a Telco).

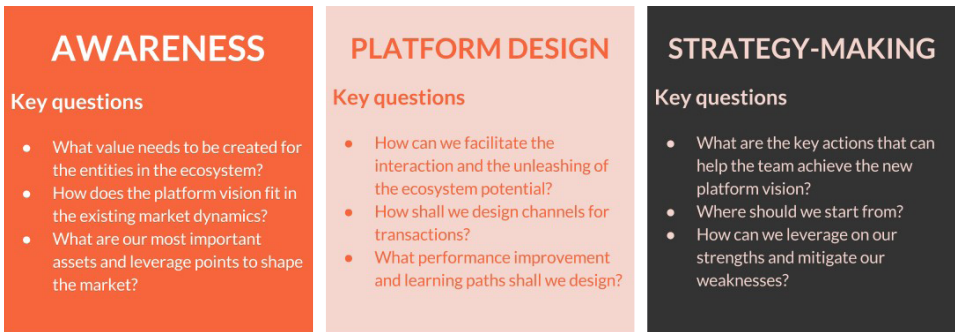

Figure 3: key topic and questions for a platform design effort

Since this paper is centered on Cloud computing, several different participants can be identified:

- Standards organizations
- Open Source communities
- Cloud partner ecosystem (vendors that take advantage of Cloud APIs to provide services)
- Cloud end users
- Cloud vendors

The target is to strengthen the ties between the actors, while maintaining their independence (to avoid the previously discussed difficulties when the role or scope of any of the participants changes). This proposal is thus a coordination effort, composed of the following actions:

- Facilitation of access to relevant standards for Open Source projects (through a "liaison"); many OSS participants are largely unaware of the substantial effort undertaken by standards organizations in creating standards for better services - and these efforts tend to have a lifetime that is much longer than common IT standards; in fact, many standards defined ten years ago are still as relevant and valid as the day they were released.
- Equally, mature and stable OSS packages which implicitly define a standard should be selected and "promoted" if possible to the rank of official standards, through the standardization of the processes necessary for such a formal step to happen.

This approach considers that it must be demonstrated that any action will be a Pareto improvement, that is, in the interest of each participant - or at least that no participant is negatively affected without a comparable or larger positive effect; to do so, we can try to identify a set of possible desired results for each participant in an hypothetical "better market" where all of the actors collaborate to a higher degree, and in which Cloud standardization is performed in coordination with a linked OSS project.

- For standards organizations, consolidation in the number of standards (reducing the so called "jungle"), while at the same time increasing the usage of the standards themselves in the market;
- for Open Source communities, an increase in the uptake of their software; implying an increase in the number of potential back contribution, and the enlargement of the market for monetization efforts on which many OSS-based companies are based (such as services, support, custom development, packaging…);
- for the cloud partner ecosystem, the availability of standards-compliant components that can be immediately used (with a great confidence on the compliance and quality) to interconnect with one or more standard-compatible Cloud services; also, reduced lock-in due to the inherent portability across different Clouds, and the ease of introducing new services thanks to the reduced R&D effort;
- Cloud end users would be able to adopt services with the certainty that the hidden cost related to a subsequent migration to a different provider is mitigated by the standards; this would allow for a better choice between providers, increased competition and lower prices, and even the possibility to "mix and match" between different providers with different offerings and price points; and

- Cloud vendors may take advantage of a global, accepted standard to participate against much larger Cloud hyperscalers, taking advantage of shared R&D of the platform, while offering a much lower lock-in risk for customers, better security and compliance.

In addition to these "active" participants, there are also external stakeholders (such as national or supranational public entities and market watchdogs) which can secure or achieve a better and fairer Cloud[7].

In the Platform Design methodology, each participant has one (or more) roles, which can be described as:

- **Platform owners:** players who own the vision behind the realization of the market and ensure that the platform exists
- **Stakeholders:** entities which have a specific interest in platform success or failure, as well as in controlling platform externalities and outcomes
- **Partners:** professional entities which seek to create additional professional value and to collaborate with platform owners with a stronger relationship
- **Peer producers:** entities interested in providing value on the supply side of the ecosystem/marketplace, seeking better performance
- **Peer consumers:** entities interested in consuming, utilizing, or accessing the value that is created through and on the platform

Which can be roughly visualized as:

Figure 4: key roles in platforms

This platform participation has effects at two levels: direct (each actor has an advantage, individually, as a participant); and indirect (one participant group to another). The direct level is easily visualized, by listing the benefits already mentioned in what is called an ecosystem motivation matrix:

gives to	Standard Orgs	OSS communities	Cloud Partners	Cloud end users	Cloud vendors
Standard Orgs Pa PP PC	Standard consolidation Increase in std usage Increased influence				
OSS communities Pa PP PC		Increased OSS uptake Growth of the potential monetizable market			
Cloud Partners Pa PP PC			Possibility to partner with different cloud providers Reduced Lock-in		
Cloud end users Pa PP PC				Reduced Lock-in More competition and lower prices More available services	
Cloud vendors Pa PP PC					Reduced R&D effort (on the supply side) More leverage against hyperscaler cloud providers Better value proposition for end users

Figure 5: direct ecosystem motivation matrix

Indirect effects can be added by taking into account each combination, and estimating the added advantage of the increased coordination[8]:

gives to	Standard Orgs	OSS communities	Cloud Partners	Cloud end users	Cloud vendors
Standard Orgs Pa PP PC	Standard consolidation Increase in std usage Increased influence				Compatibility and assurance guarantees
OSS communities Pa PP PC	Stable, mature components ready to be standardized Weak signal visibility into state of the art evolutions in the cloud sector	Increased OSS uptake Growth of the potential monetizable market	R&D reduction thanks to reusable cloud components Reduced Lock-in Faster time to market	Possibility to run some of the software services on-premise Direct feedback with the software author Facilitates lead users identification	R&D reduction Direct interaction with the software authors Possibility to steer and direct development
Cloud Partners Pa PP PC		Direct feedback to sw developers Possibility to steer and direct development Increased market for monetization	Possibility to partner with different cloud providers Reduced Lock-in	Increased certainty through adherence to standards Higher value	
Cloud end users Pa PP PC				Reduced Lock-in More competition and lower prices More available services	
Cloud vendors Pa PP PC	Expand the market of standard-adopting users Potential market for validation and certification services	Direct feedback to sw developers Possibility to steer and direct development Increased market for monetization			Reduced R&D effort (on the supply side) More leverage against hyperscaler cloud providers Better value proposition for end users

[8] Note that only some of the possible interactions have been mapped out in this paper; others may be identified through a more detailed analysis.

Following this preliminary analysis, a set of possible actions designed to facilitate the emergence of such an "open standard Cloud" could be:

- For all participants: identifying a set of relevant OSS projects that serve as building blocks for a Cloud ecosystem; promoting the value and advantages introduced by open standards (with messages differentiated towards Cloud end users and Cloud partners); and evaluating the impact of Cloud standards on compliance with European laws (supranational and national)
- For standards organisations: structuring an effort to liaise (for example, by having an official "contact point") with OSS projects - not only to help in the communication effort, but to promote and evangelise some of the standards that may be relevant for the OSS projects; and facilitating access to a small subset of relevant standards, eventually making them available with no access fee, to enable the integration of existing standards within the code and practices of OSS projects
- For OSS projects: structuring a symmetrical liaison point for interaction with standards organizations; it is advisable to make an effort to prepare and train a small subset of project participants on the tools and processes used in standards organisations, to reduce the effort necessary (after project stabilization) in proposing a standardisation of part or all of the OSS project's assets; promoting efforts to coordinate between the relevant projects, including the creation of "coordinated releases".
- For Cloud vendors: coordinating among potential peers (in the so-called "coopetition model") to evaluate up-and-coming OSS packages, Cloud standards and their potential interest. This feedback is essential for the formation of market consensus; in the traditional market acceptance theory, initial adopters signal the existence of a stable and reliable solution for third parties, thus facilitating the creation of a consolidated standard. It is of paramount importance that the promotion of OSS based standards should be facilitated, as doing so will reduce lock-in and facilitate market growth in situations where one or more incumbents hold a majority of the market share.

This set of suggested possible actions is intended only as an initial proposal, following the principle that the three actors should not be expected to adapt, change or modify their actions to try to find a "common ground", but simply facilitate the natural interactions that could happen in the optimal condition.

The proposed platform approach can be envisioned as a formalisation of the few successful examples of interaction between standard bodies, industry and open source communities. As an example, we will present the already mentioned successful liaison between ETSI and OpenStack in the context of Software Defined Networking/Network Functions Virtualisation; in this example, some of the value interactions that would be part of the ecosystem matrix are:

- industry groups and individual lead users participate and push work done by standard bodies (that organize and structure the activity) with the final result being a formalized standard that thus better matches the industry needs.
- open source projects/communities interact with standard bodies for facilitating the integration of the standard within an existing OSS platform; the end result is higher (direct or indirect) monetisable value for the platform and shorter time for technology incorporation within the platform. It is an important observation that there may be different competing components within the same platform (in the Software Defined Networking open source space for example there are individual projects like OpenDayLight, OpenContrail or ONOS, while in the Network Functions Virtualisation area there are many independent efforts that are being loosely grouped under umbrella projects like Open Platform for Network Functions Virtualisation)
- end users get the value of reduced technical effort for adoption, increased interoperability and reduction of lock-in. As the technology becomes a platform in itself, it enables the offering of additional services to be offered by third parties (as an example, the creation of SD-WAN or security platforms and services on top of the technical capabilities offered by Network Functions Virtualisation).

5

LOOKING TO THE FUTURE: A ROADMAP TO BRING TOGETHER THE OSS AND SDOS COMMUNITIES

Cloud Computing is a technical solution based on a promising economic model with a significant number of potential users: private individuals, businesses, public services etc. Its main advantage comes from the fact that it allows for the pooling of IT resources and tools, optimising their use. Moreover, Cloud Computing also enables mobility, particularly in the case of mobile workers who can have constant access to their data. This allows companies, first, to smooth out their costs during the whole cycle of their IT systems, without any large up-front investment, and second, to focus on their core business without the need to worry about the complex nature of IT systems. In sum, Cloud computing supports new digital services by providing the massive data storage and computational power needed for the digitisation of European industry and science. This is recognised in the Communication on the European Cloud Initiative, which highlights the value of widening the user base of research and education networks (European Commission, 2016).

However, there are barriers for the implementation of this new technology. Already in 2011, the European Economic and Social Committee pointed out that Cloud Computing had as a weakness 'the profusion of standards designed to regulate and control" it (European Economic and Social Committee, 2011). Indeed, proprietary solutions, purely national approaches and standards that limit interoperability can severely hamper the potential of Cloud Computing, and therefore, of the Digital Single Market. The take-up of cloud computing services by businesses, consumers, public administrations and the scientific sector requires seamless user-friendly access, but also the creation of Cloud based solutions that can work together and do not create walled gardens and lock in.

For this, as shown above, it is fundamental to increase the collaboration between SDOs and OSS communities. Indeed, as shown above, the promises above won't be delivered unless interoperability is the rule, instead of the exception in the area of Cloud Computing. In this regard, interoperability is delivered by standards, that to be useful will need to be implemented by Open Source communities, the backbone of the developing power of the Cloud Computing. For this, the EC has called, based on the recognition that Open Source communities do not participate sufficiently in the setting of standards, for the use of Open Source elements, by better integrating Open Source communities into SDOs' standard setting processes.

Considering the lessons learned during the creation of this paper, the proposals presented below are not aimed at changing the behaviour of stakeholders. Instead, we propose to the Commission a series of initiatives which could be mutually beneficial for all the relevant actors, and aims to produce a win-win situation for everyone. Indeed, through the introduc-

tion of OSS projects into the standard setting process, the whole process could be enriched, new businesses could be created and new projects could be developed. In this regard, it is important to remember the classification created by the workshop organised in the context of this study. That workshop considered that the Commission could take several roles in order to bring together the SDO and OSS communities: customer, facilitator, incubator and policy market. Following this classification, a series of concrete measures are presented.

The EC as a facilitator: The EC should develop an action aimed at raising awareness among different OSS projects of the potential benefits that could be introduced by standardisation activities. In this regard, the EC should liaise with OSS projects in the area of Cloud to promote, explain and evangelize some of the standards that may be relevant for OSS projects.

- **Short term:** Launch actions of active participation in the OSS community events. For example, the Commission could organise a session that brings together several thousands of OSS developers, to speak about the importance of standards for their work.
- **Medium term:** Create a website oriented towards OSS communities explaining the relevant standardisation processes, actively promoting standardisation to the OS community and developing communication materials.
- **Long term:** Organise further workshops / set up working groups to create more specific outputs, e.g. for vertical markets, such as health that could be published in the webpage and promoted in OSS events.

The EC as an incubator: The EC should identify a set of relevant Cloud projects that could be collectively considered as the basis for a shared Cloud ecosystem. Moreover, the EC should nurture the ecosystem, coordinating the different actors to evaluate up-and-coming OSS packages, Cloud standards and their potential interest. In this regard, the Commission could go as far as to prepare and train a small subset of OSS project participants on the tools and processes used in SDOs, to reduce the effort necessary (after project stabilisation) in proposing a standardisation of part or all of the OSS project's assets; promoting efforts to coordinate between the relevant projects, including the creation of "coordinated releases".

- Short term: The Commission should encourage the organisation of coordination meetings between members of the OSS and SDOs community.
- Medium term: Train OSS project participants on the tools and processes used in SDOs, though a specific funding project.
- Long term: Active mentoring to facilitate transfer from projects to standards - and vice-versa.

The European Commission as a policymaker: The EC is currently working on the identification of ICT Technical Specifications for referencing in public procurement through a structured process (also involving the Multi Stakeholder Platform (MSP)9. In some cases these are coming from organizations with long history with OSS (like IETF and OASIS). However, more can be done: create guidelines and promote success stories/good practices on the use of OSS implementations of technical specifications by the public sector.

[9] https://ec.europa.eu/digital-single-market/en/european-multi-stakeholder-platform-ict-standardisation

Annex 1

RESPONSES TO THE ONLINE CONSULTATION ON OPEN SOURCE CLOUDS AND STANDARDS

OpenNebula[10]

Q:The OpenNebula project focuses on Cloud platforms; is there any existing Cloud standard that you know of that has been used, incorporated or referenced by OpenNebula?

OpenNebula was designed to be Cloud-API agnostic. It provides Cloud consumers with choice of interfaces, from open Cloud to de-facto standards. OpenNebula does not try to reinvent the wheel and implements existing standards when available. Some examples:

- Compatibility with the Open Grid Forum Open Cloud Computing Interface through the rOCCI framework
- OpenNebula follows the ETSI recommendations for NFVs as their implications for SDNs in the development of virtual routers appliances
- OpenNebula follows the DMTF OVF recommendations in VM contextualization

Q: has been any interaction with a standard-defining organization (like ETSI, ISO, OASIS, IETF...)? Of what kind?

In the past we had a tight collaboration with standard-defining organizations. We co-founded the Open Grid Forum Open Cloud Computing Interface working group and provided the first reference implementation and actively participated in meetings and specifications from ETSI or DMTF. We are now more focused on delivering what the users really demand. See next question.

Q: if not, why? Is there a specific motivation? (lack of interest, IPR policies, organizational constraints...)

OpenNebula's roadmap is completely driven by users' needs with features that meet real demands, and not features that result from an agreement between IT vendors planning to create their own proprietary Cloud solution.

Q: do you think that more collaboration with standards defining organizations would help OpenNebula? In what way?

We serve the users by delivering an open-source technology to meet their needs. We have direct contact with the organizations building large-scale Cloud infrastructures in different application domains. Our experience in the past is that many standards are created as an agreement between IT

[10] OpenNebula is a cloud computing platform for managing heterogeneous distributed data center infrastructures. The OpenNebula platform manages a data center's virtual infrastructure to build private, public and hybrid implementations of infrastructure as a service.

vendors and not as a way to standardize what users really need.

Q: among the possible actions, a recurring fora dedicated to open source Cloud standards was proposed as a way to coordinate and organize further discussion. Would you be interested in being a participant?

Absolutely, as long as the fora is Cloud technology agnostic and vendor independent, and it is aimed at developing a set of conventions that would support our community's need for federation, interoperability and portability.

Q: would you like to suggest any additional action or proposal to promote a better cooperation between OpenNebula and standardization bodies?

We strongly believe that both, open-source and standards, are needed to release the full potential for innovation of Cloud computing. Driven by user needs, open-source projects produce original concepts and technology, which may be then subject to standardization, could provide a reference implementation of existing standards, or could influence existing standards through exchange of ideas and experiences.

The important aspect here is that it should not be a one direction collaboration. Standards bodies expect that open-source projects implement their specifications. However in open-source, standards bodies should play a more active role and also contribute to their implementation.

Q: If within project OpenNebula there is a public API, is there a planned maintenance process for it? Would it be possible (or desirable) to cooperate with an external standardization body to share the effort of managing said API?

Yes, this is related to the previous point. Standardization bodies should play a more active role

OW2[11]

Q: OW2 focuses on Cloud platforms (and much more). Is there any existing Cloud standard that you know of that has been used, incorporated or referenced by OW2 projects?

Here are Cloud standards used by OW2 projects:

[11] "OW2 is an independent, global, open-source software community. The mission of OW2 is to a) promote the development of open-source middleware, generic business applications, Cloud computing platforms and b) foster a vibrant community and business ecosystem. OW2 developments follow a flexible, component-based approach. These components range from specific software frameworks, protocols and applications through to integrated, service-oriented platforms for enterprise computing."

- OCCI by erocci and ProActive
- DMTF CIMI by Sirocco
- IDMEF Prelude
- ETSI GCM Application Description, GCM Fractal ADL, GCM Interoperability Deployment by ProActive
- SCIM (System for Cross-domain Identity Management) is getting considered by several projects
- OASIS XACML is used by the AuthzForce project

Q: Has been any interaction with a standard-defining organization (like ETSI, ISO, OASIS, IETF...)? Of what kind?

- Interaction with OGF on OCCI: OW2 takes part in the OGF OCCI Workgroup, it has contributed to the version 1.2 of the OCCI standard whose final version got published in October 2016. OW2 has also co-organized a Cloud Plugfest in 2015 in Paris in parallel to OW2con'15: http://www.cloudplugfest.org/events/past-plugfest-agendas
- Interaction with DMTF, ETSI, OASIS, OGF, SNIA via the OCEAN EU project during the Cloud interoperability week 2013: http://www.cloudplugfest.org/events/past-plugfest-agendas/cloud-interoperability-weekend
- Interaction with the RGI - Overall Interoperability Framework in France, via Prelude / IDMEF. https://www.secef.net/idmef-et-iodef-dans-le-rgi-v2/

Q: Do you think that more collaboration with standards defining organizations would help your projects? In what way?

It would probably help, but we got no answer from the OW2 project leaders yet, I'm afraid.

Q: Among the possible actions, a recurring fora dedicated to open source Cloud standards was proposed as a way to coordinate and organize further discussion. Would you be interested in being a participant?

We would be probably indeed.

Q: Would you like to suggest any additional action or proposal to promote a better cooperation between OW2 and standardization bodies?

Not at this stage.

Q: If within your projects there is a public API, is there a planned maintenance process for it? Would it be possible (or desirable) to cooperate with an external standardization body to share the effort of managing said API?

Many OW2 projects have public APIs with a planned maintenance. They are however maintained internally as far as we can tell following an internal survey.

Open Stack

Q1: Are there any existing Cloud standards that you know of that has been used, incorporated or referenced by OpenStack?

The OpenStack API is a de facto standard as defined in Section 2.2.2, acknowledged by international research firms such as Forrester Research and users with over 3 million cores in production. Further, OpenStack enjoys the support of over 70,000 individual members across 185 countries as well as over 650 supporting companies. The OpenStack API is an example of a well written, documented, and maintained standard specification. OpenStack maintains a commitment to a stable API, and is developed using an open, transparent process based around regular Summits and a blueprint process open to all who wish to contribute. OpenStack Powered is a program that measures successful API deployment targeted to interoperability. We've built a model that can be built upon and applied to a more general case.

Despite OpenStack supporting CDMI and OCCI, very few deployments take those up. The latest published User Survey indicates 3% support OCCI—down from 7% six months prior. CDMI was combined with "other compatibility APIs" for a total of 2% of Clouds reporting use. The sample size is 1,603 survey respondents representing 405 deployments.

Standard protocols are implemented or supported as needed in specific deployments. The OpenStack community incorporates appropriate standards to offer our users services that are secure and interoperable. Examples include:

- OpenStack Tacker, a NFV VNF Manager and general purpose NFV orchestrator, supports the OASIS TOSCA NFV Profile. The tosca-parser project has accepted a patch to allow it to be used by a server providing a pre-formatted YAML dictionary instead of a file or URL containing the template.

- OpenStack Orchestration service (Heat) also supports TOSCA. This has been used by the Horizon2020 Indigo DataCloud project.
- OpenStack configuration options allow encrypted communication between clients and APIs with transport layer security v1.3 (TLS).
- OpenStack Identity Service (Keystone) uses NIST digital authentication using tokens and credentials. OAuth, SAML, openID, X.509 certificates and Kerberos are supported.
- The data served by the OpenStack Compute (Nova) metadata server is a de facto standard that has evolved from AWS. The config drive data supplied by Nova is its own OpenStack-formed defacto standard. Both are understood by tools like cloud-init.

Q2: Has been any interaction with a standard-defining organization (like ETSI, ISO, OASIS, IETF...)? If so, of what kind?

- ETSI NFV once had direct liaison to OpenStack for who passed on written requirements. As of 2-3 years ago, ETSI NFV opened requirements to the public. Today, OpenStack members Ericsson, Red Hat, Nokia, and several others are participating in ETSI NFV and following and influencing the activities around the specifications. The OPNFV open source project, which includes and represents the OpenStack software, is instrumental in ETSI NFV collaboration. N addition, OPNFV projects such as Doctor (fault management) go beyond contributing to OpenStack by looking into the gaps between the related specifications and OpenStack APIs.
- ETSI NFV actively analyzes the OpenStack APIs for compliance, identifies the gaps are, etc. They are proactively looking into what's available in open source. Their deadline is September this year and they already identified the companies who will do the work. The info in this December 2016 document is public.
- The OpenStack Heat and Tacker projects collaborate with the OASIS TOSCA project.
- There are likely several other collaborations across our 70,000+ individual members.

Q3: If not, why? Is there a specific motivation? (lack of interest, IPR policies, organizational constraints...)

As stated in the report, the open source process and governance is different than the SDO model. In OpenStack, no centralized effort exists around standards, but community participants, for example IBM, Ericsson and GigaSpaces and others, have added support or advocated for different standards as make sense for their customer base and strategy. We actively communicate with companies participating in both SDOs and

OpenStack.
Some standardization bodies are closed, which makes collaboration harder. We're watching how these processes evolve over time, and will give feedback and guidance as we can.

There is a general concern that standards processes are slow and resource-consuming. OpenStack is a fast-moving, community-developed project, with a new release every six months. The OpenStack community prioritizes resources to develop community-requested features and solve current problems.

OpenStack offers every potential Cloud provider and equal playing field. OpenStack levels the playing field for all and encourages all deployment models as deemed optimal by the users: public, hosted, managed and private Clouds. There are several primarily European owned and operated OpenStack-based public Cloud providers with over 22 data centers operating across Europe. Most are OpenStack Powered tested for interoperability. Providers include:

- OVH - two datacenters in Europe
- UKCloud - two datacenters
- ELASTX AB - three datacenters
- Internap - one datacenter in Europe
- DataCentred - one datacenter
- Ultimum Technologies S.R.O - one datacenter
- Cloudwatt - two datacenters
- Cloud&Heat - multiple de-centralized datacenters
- Enter Cloud - three datacenters in Europe
- Numergy - one datacenter
- City Network - four datacenters in Europe
- teuto.stack - one datacenter
- Rackspace - one datacenter in Europe
- vScaler - two datacenters
- Deutsche Telekom - two datacenters
- Memset Hosting - multiple datacenters

Major European/UK companies are key OpenStack members, sponsors or infrastructure donors that help drive OpenStack direction through participation in design, development and working groups, and often, board directorship:

- SUSE
- Canonical Group, Ltd
- Deutsche Telekom
- Ericsson AB
- CERN
- OVH
- City Network
- Many more

Q4: Do you think that more collaboration with standards defining organizations would help OpenStack? In what way?

OpenStack Foundation and contributing community resources are limited. Surveys have shown that supported Cloud standards such as OCCI and CDMI are, for the most part, not used. That said, potential areas of value are to leverage open source in the standardization process, cross-country regulations, and performance guidelines, as opposed to only in development. The Foundation would look to the community to determine value as compared to other priorities. As an example, a leading-edge OpenStack telecom user is working with one of the SDOs on collaborative performance guidelines.

Q5: Among the possible actions, a recurring fora dedicated to open source Cloud standards was proposed as a way to coordinate and organize further discussion. Would you be interested in being a participant (or to have some OpenStack representative there)?

We would be interested in exploring it, but cannot make any commitments at this time since we have a small team at the OpenStack Foundation. If the fora comes together, we could also see if there are volunteers from the community who would be willing to represent OpenStack and report back to working groups and the technical community.

Q6: Would you like to suggest any additional action or proposal to promote better cooperation between OpenStack and standardization bodies?

The OpenStack Interop working group has developed working standards for OpenStack Cloud interoperability, driver compatibility, complete with API and code tests and trademark programs for those passing. Each vendor updates their compliance with every OpenStack release. We offer logos for their use as well as visible designation in our Marketplace. We are sharing our expertise on how to run an interoperability program offering with OPNFV. We have a model and are excited to share all aspects of how we roll it out to any interested project.

OpenStack is looking for SDO transformation as well, including use of successful open source programs as mentioned above. SDOs can also leverage the code produced by open source communities as reference implementations, and not begin from the bottom up. For example, discussions are in progress with OPNFV about building out performance tests based on the OpenStack Interop Working Group guideline/format.

We believe that future EU tenders will mention the OpenStack API or related interfaces directly, rather than "software that supports CDMI/

OCCI" or a future Cloud standard.

- One recent example is the Helix Nebula Science Cloud. Three of the four consortia selected for the next (design) phase include OpenStack in their solutions; the fourth may also (to be confirmed). The three consortia selected to move on to the prototype phase will be announced on April 3. Here are comments from a community member who has been involved in multiple science Cloud tenders in the EU:

    - The detailed pre-procurement criteria was developed such that proposals required "At least one of the following libraries for the management of the compute instance lifecycles: Terraform, Apache Libcloud, Apache jclouds." This allowed common tools to be used across multiple different clouds. An OCCI-compliant Cloud could have therefore been compatible with the tender but we do not believe any bidder proposed OCCI as their interface.
    - In the past, tenders have asked for one of a set of IaaS (de-facto or de-jure) APIs (e.g. OpenStack, OCCI or EC2). The sciences are tending to use open source tools to control the workflows of their Clouds and these tools often come with EC2 or OpenStack support. We have not seen significant adoption of OCCI by the tool vendors.

- Looking forward, standardization around higher level interfaces such as TOSCA seem to be gaining traction. By standardizing higher up the stack, implementations can be made for Clouds which do not provide this functionality natively.

Companies running private OpenStack Clouds are standardizing their developer tooling and deployments on top of OpenStack.

The OpenStack Heat and Tacker projects collaborate with the OASIS TOSCA project

There are likely several other collaborations across our 70,000+ individual members.

Annex 2

STAKEHOLDER MAPPING

In order to provide an overview of the current open source cloud computing environment and allow for managing, and monitoring the current and future mission-critical cloud resources, this annex provides with a list of the most useful, influential, and promising projects. Based on the methodology used by the the Linux Foundation in its 2016 Guide to the Open Cloud, this section is divided in key areas representing the different elements of Cloud computing: IaaS, PaaS, Virtualization Cloud operating systems, Container management and automation, Unikernels, DevOps (complete CI/CD, configuration management, logging and monitoring), Software-defined networking (SDN) and Software-defined storage. The list also includes a list of the most influential SDOs in the area of cloud. These SDOs have been selected based on the relevance of their standards for the area of Cloud Computing.

Open Source Projects	
Infrastructure as a service	
Apache Cloudstack	https://cloudstack.apache.org/
HPE Helion Eucalyptus	http://www8.hp.com/us/en/cloud/helion-eucalyptus.html
OpenNebula	https://opennebula.org/
Open Stack	https://www.openstack.org/
RedHat OpenForms	https://www.redhat.com/en/technologies/management/cloudforms
Platform as a service	
Cloud Foundry	https://www.cloudfoundry.org/
Deis Workflow	https://deis.com/workflow/
Flynn	https://flynn.io/
Heroku	https://www.heroku.com/
OpenShift	https://www.openshift.com/

Virtualisation, containers and cloud operating systems	
Project Atomic	http://www.projectatomic.io/
CoreOS	https://coreos.com/
Photon OS	https://vmware.github.io/photon/
Rancher OS	http://rancher.com/
KVM	https://www.linux-kvm.org/page/Main_Page
Linux Containers	https://linuxcontainers.org/
Xen Project	https://www.xenproject.org/
Apache Aurora	http://aurora.apache.org/
Apache Mesos	http://mesos.apache.org/
Cloud Foundry Diego	https://github.com/cloudfoundry/diego-release
Docker Engine	https://docs.docker.com/engine/
Kontena	https://www.kontena.io/
Kubernetes	https://kubernetes.io/
ManageIQ	http://manageiq.org/
oVirt	https://www.ovirt.org/
Skippbox	http://www.skippbox.com/
Sysdig	http://www.sysdig.org/
Weaveworks	https://www.weave.works/
Wercker	http://www.wercker.com/
ClickOS	http://cnp.neclab.eu/clickos/
Clive	https://lsub.org/ls/clive.html
IncludeOS	http://www.includeos.org/

MirageOS	https://mirage.io/
OSv	http://osv.io/
Open Container Initiative	https://www.opencontainers.org/
Rumprun	https://github.com/rumpkernel/rumprun
Runtime.JS	http://runtimejs.org/
DevOps CI/CD	
Concourse	https://concourse.ci/
HyGieia	https://developer.capitalone.com/opensource-projects/hygieia/
Jenkins	https://jenkins.io/
Shippable	https://www.shippable.com/
Travis-CI	https://travis-ci.org/
Ansible	https://www.ansible.com/
Chef	https://www.chef.io/chef/
Puppet	https://puppet.com/
Salt Open	https://saltstack.com/salt-open-source/
FluentD	http://www.fluentd.org/
Logstash	https://www.elastic.co/products/logstash
Prometheus	https://prometheus.io/
Weave Scope	https://www.weave.works/products/weave-scope/

Software-defined Storage	
Apache Cassandra	http://cassandra.apache.org/
CEPH	http://ceph.com/
Apache CouchDB	http://couchdb.apache.org/
GlusterFS	https://www.gluster.org/
MongoDB	https://www.mongodb.com/
NexentaStor	https://nexenta.com/
Redis	https://redis.io/
Riak CS	http://docs.basho.com/riak/cs/2.1.1/
SDOs	
3GPP	http://www.3gpp.org/
Atis	http://www.atis.org/
CSCC	http://www.cloud-council.org/
CSMIC	http://csmic.org/
DMTF	https://www.dmtf.org/
ETSI	http://www.etsi.org/
IEEE	https://www.ieee.org/index.html
IETF	https://www.ietf.org/
ISO/IEC JTC 1	https://www.iso.org/isoiec-jtc-1.html
OASIS	https://www.oasis-open.org/
ODCA	https://opendatacenteralliance.org/
OMA	http://openmobilealliance.org/
OMG	http://www.omg.org/

The Open Group	http://www.opengroup.org/
Open MP	http://www.openmp.org/
UEFI	http://www.uefi.org/
SNIA	https://www.snia.org/
W3C	https://www.w3.org/

Annex 3

CONCLUSIONS FROM THE WORKSHOP ON THE PROMOTION OF COLLABORATION BETWEEN OPEN SOURCE AND STANDARDISATION

Background to the workshop

The EC's Cloud and Software Unit (E.2) at DG CONNECT organised a one-day workshop on "Promoting Practical Collaboration between Cloud Open Source and Standardisation" on 17 January 2017, held in the Avenue Beaulieu 33 building in Brussels, from 10:30 to 17:00.

The "ICT Standardisation Priorities for the Digital Single Market" Communication committed the Commission, under Priority Domain 1 (Cloud Computing), to support further use of Open Source elements by better integrating Open Source communities into SDOs' standard setting processes, by the end of 2016. The overall objective of the workshop was for invited stakeholders to explore differences, highlight similarities, and identify benefits of collaboration between Cloud Open Source development projects and Standards Development Organisations. The workshop also aimed to provide the Commission with input for a future roadmap of actions to promote collaboration.

The workshop was based on personal invitation to potential participants whose attendance was expected to provide a broad representation from both Open Source and Standardisation communities. The very high attendance rate confirmed the overall interest in the subject.

Practical collaboration between OSS and SDO communities

Setting the scene

The workshop was opened by Pierre Chastanet, acting Head of Unit (E.2), who emphasised the importance of the discussion and linked the topic to the digitisation of European industry initiative and the Communication on Standards which identifies Cloud as one of five priority domains.

The Commission recognises the strategic importance of Open Source in providing market choice and independence, for dealing with complexities and for improving transparency and auditability. The Commission was confirmed both as a user and as a promoter of Open Source.

The expectation was that the workshop would bring out similarities and differences between the Open Source and standardisation communities, and would identify necessary changes. The workshop was presented as marking the beginning of the Commission's efforts to promote integration between Cloud Open Source and standardisation. The Commission was looking forward to the results of the workshop as input to a roadmap of future actions.

A keynote presentation was delivered by Mark Bohannon, Vice President, Global Public Policy and Government Affairs, Red Hat, who emphasised the disruptive effect of Open Source in many areas, not just standardisation. He maintained that Open Source and standardization each have unique roles: it is not "either/or". OSS is driven by market demands for more agility, reuse, and modularity. Problems are solved in hours, if not minutes and the focus is on collaborative innovation and network effects. In the field of software, web and Internet standards, consortia such as W3C, IETF, and Oasis have been the natural place for work on key interoperability issues because of the cultural fit and because of the de facto / de jure discouragement of patent encumbrances.

Breakout discussions

The workshop chair, Jochen Friedrich, introduced the methodology of the breakout sessions and the audience was divided into four groups to discuss; two broad themes were pursued:

- **Processes:** similarities and differences in standardisation and Open Source, and possible needs for change
- **From code to standards:** which Open Source technologies in the area of Cloud should be standardised?

A recurring theme voiced by workshop participants was a challenge to the notion of two separate communities. In fact, Open Source and standards were said to share many similarities. Increasingly, companies – and individuals – are involved in both Open Source projects and standardisation for development of technologies. The two were seen as different tools to solve different problems. Users have certain requirements, including interoperability, portability, maintenance – standardisation can possible meet these. On the other hand, standards need validation through reference implementation and market acceptance – here Open Source can play a role. While effective at developing technology, Open Source projects do not solve certain business problems that exist on top of technology, and SDOs may be better placed to tackle this. Standards are stable, defined,

and can provide a level of protection for investment on top of technology whereas there is a certain vulnerability in relying on version of API. Standards are stable, defined. Many participants emphasised that both Open Source and standardisation are needed: Cloud computing wouldn't be what it is if it were not for Open Source. On the other hand, the real potential of Cloud computing is held up by the current lack of standards.

More specifically on the relationship between the two, it was emphasised that Open Source can be used to implement standards, as well as to inspire standards. The goal must be to enable third party implementations, both of standards and of Open Source. Is an API from an Open Source project good enough? The challenge is really to know when to standardize – snapshot and document APIs into technical specs – i.e., knowing when the innovation cycle has slowed enough. In terms of specific barriers, it was pointed out that some "popular" standards have limited market uptake, some have multiple OSS packages, and some are partial solutions. The TOSCA standard could benefit from a unifying Open Source project. Common management, orchestration solutions/standards are missing.

Presentation of the study's findings

Carlo Daffara (Founder and CTO, Cloudweavers) presented the findings of a study on the Collaboration between Standardisation and Open Source – Examples and challenges. Despite efforts at integrating Open Source and standardisation communities, much has stayed the same in the last 10 years. There are reciprocal incompatibilities that are difficult to overcome, the first relating to timing: the structured process used for de jure standards is incompatible with the fast and sometimes unregulated schedule which is common for most Open Source software. Also, a well-documented barrier for the Open Source community is the limitation on use or access: patents or other IPR protection schemes, payments required to obtain a standard, licensing prevents redistribution (only applies to some SDOs).

There is an opportunity to change this trend for the better in the area of Cloud computing, but in order for collaboration efforts to be successful each actor needs a different incentive: SDOs, OSS communities, the Cloud partner ecosystem (vendors that take advantage of Cloud technologies to provide services), Cloud end users, Cloud service providers. Examples of such incentives include:

- **For standards organizations**, the consolidation in the number of standards, while at the same time increasing the usage of the standards themselves in the market – this is key: a standard has no value unless it is widely used;
- **For Open Source communities,** an increase in the uptake of

their software; implying an increase in the number of potential back contribution, and the enlargement of the market for monetization efforts on which many OSS-based companies are based (like services, support, custom development, packaging…);
- **For the Cloud partner ecosystem**, the availability of standards-compliant components that can be immediately used (with a great confidence on the compliance and quality) to interconnect with one or more standard-compatible Cloud services; also, the reduced lock-in due to the inherent interoperability and portability across different Cloud services, and the ease of introducing new services thanks to the reduced R&D effort;
- **Cloud end users** would be able to adopt services with the certainty that the hidden cost related to the combined use of multiple Cloud services or migration to a different Cloud service provider is mitigated by standards; this would allow for a better choice between providers, increased competition and lower price, and even the possibility to "mix and match" between different providers with different offerings and price points;
- **Cloud service providers** can take advantage of a global, accepted standard to participate against much larger Cloud service providers, taking advantage of shared R&D of the platform, while offering a much lower lock-in risk for customers, better security and compliance.

Presentation of the study's findings

The panel speakers featured experts with deep experience of both Open Source and standardisation.

- Martin Chapman (Director, Standards Strategy and Policy EMEA, Oracle)
- Emmanuel Darmois (President, CommLedge)
- Mike Edwards (Cloud Computing expert, IBM)
- Georg Greve (CEO, Kolab Systems)

A broad-ranging and engaging discussion brought insight to many topics, and included the following specific points:

- To stay relevant, SDOs need to be open to Open Source; on the other hand, the need for standards remains and grows naturally over time and at a certain point in the lifecycle of a technology.
- The key remains to determine how standards relate to continued innovation and at what point it makes sense to freeze functionality.
- From the point of view of business, Open Source and standardisation are both relevant to the managing of a product. The processes for involvement are slightly different but there are also striking similarities. Are strict labels even useful? For example, some Open Source projects are quite formalised.

- What qualities must APIs and other technologies display to qualify as a standard? Should there be fast-tracking procedures for turning APIs and other technologies into standards?

Conclusion: How can the EC support further collaboration?

In the final interactive session of the day, the audience was asked to discuss in small groups what practical steps the Commission could take to promote further collaboration and integration between Cloud Open Source and standardisation. To organise the discussion, the chair asked the participants to consider the Commission in four different roles: as customer, as facilitator, as incubator for R&D, and as policymaker. Outlined below are some of the resulting suggestions.

EC as customer	• Commission to be more engaged in both OS and standardisation • Business to Government relationship (B2G) to be defined • Commission as "intelligent customer" • Further clarify procurement rules

EC as facilitator	• Organise further workshops/set up working group to create more specific outputs, e.g. for vertical markets such as health
	• Outline clearer expectations from the Commission
	• Actively promote standardisation to the OS community:
	  • Develop communication materials
	  • Make use of online spaces
	  • Participate in OS events such as FOSDEM.
	  • Further clarify procurement rules

EC as incubator for R&D	• Make H2020 project results Open Source • Active mentoring to facilitate transfer from projects to standards • Contribute to long-term results after project phase
EC as policymaker	• Better recognition of fora and consortia, Open Source • Review criteria in Annex 2, Regulation 1025

Annex 4

GLOSSARY	
Standards Developing Organisations	SDOs
Open Source Software	OSS
Information Communication Technologies	ICT
Business to Government	B2G
OpenForum Europe	OFE
Restriction Free	RF
Fair, Reasonable, and Non-Discriminatory	FRAND
Intellectual Property Rights	IPR
World Wide Web Consortium	W3C
Storage Networking Industry Association	SNIA
Distributed Management Task Force	DMTF
Organization for the Advancement of Structured Information Standards	OASIS
Open Grid Forum	OGF
Open Cloud Computing Interface	OCCI
International Organization for Standardization	ISO
International Telecommunication Union	ITU
European Telecommunication Standards Institute	ETSI
European Commission	EC
Multi-Stakeholder Platform	MSP

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