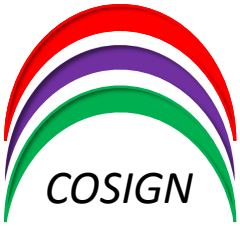

Grant Agreement No. 619572

COSIGN

Combining Optics and SDN In next Generation data centre Networks

Programme: Information and Communication Technologies

Funding scheme: Collaborative Project – Large-Scale Integrating Project

Deliverable D6.2bis

Dissemination and standardization plan

Due date of deliverable: June 30, 2015
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Lead contractor for this deliverable:
IBM

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

D6.2bis Executive Summary

This updated deliverable is based on the original D6.2 and is amended according to the recommendation in the TECHNICAL REVIEW REPORT for Period No. 1, from 01/01/2014 to 31/12/2014.

Major goal of the update is to detail the plans for COSIGN contribution to and participation in the relevant OpenSource communities, specifically OpenStack and OpenDaylight. In addition, this document introduces updates on level of commitment by the involved project partners regarding adoption of cloud computing use cases and on expected interaction with relevant industry groups and organizations, e.g. ETSI.

The update is structured as follows: Section 2.3 is added to cover the Open Source Software (OSS) involvement plans; Section 3 is updated with current partners' commitment status; Section 2.2.1 is updated with a broader list of targeted scientific and academic communities. In addition, minor changes have been made to improve the overall quality of the document. Beyond this, the structure and the contents of the report remain unchanged from the initial submission.

Executive Summary

COSIGN objective is to innovate the Data Centre network architectures, proposing a solution based on advanced optical technologies controlled by a Software Defined Networking (SDN)-based control plane, integrated with orchestration mechanisms in support of converged virtualization of optical and IT infrastructures and automated delivery of cloud services. WP6 is in charge of coordinating the consortium activities dedicated to guarantee a wide impact of the project results in the most relevant research and industrial communities. Three main types of activities have been planned in this direction:

- *Dissemination:* the project will activate a variety of dissemination channels, from the web-site to the publications in international conferences, magazines and journals, up to the participation in workshops and commercial events and the presence in the social networks, to promote the COSIGN scientific and technical outcomes to large communities in the academic and industrial arena. Moreover, the project has setup tools to facilitate the collaboration among the different partners in the consortium and to encourage the internal dissemination.
- *Standardization:* the project has identified a set of relevant standardization bodies, mostly focused on the SDN field, that will be monitored to ensure the alignment of the COSIGN solution with the latest standards and to identify potential contributions to the ongoing standardization activities. Preliminary plans have been defined for target standardization bodies like IETF and IRTF, ONF and ETSI.
- *Exploitation:* the project will define suitable exploitation plans, for individual partners or the consortium as a whole, for both industrial and scientific results. Exploitation activities will start in the second year of the project.

This deliverable describes the dissemination (section 2) and standardization (section 3) strategies that have been initially planned. The consortium will periodically update this original plan depending on the availability and maturity level of the project results, also considering the evolution of the research directions and standardization outcomes.

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1 Introduction

The COSIGN project will deliver a new architecture for Data Centre networks adopting the latest advanced optical technologies and introducing the Software Defined Networking (SDN) paradigm for the control, virtualization, and service orchestration for modern Data Centres. The COSIGN approach for Data Centre networks will result in innovative automated, scalable, and vendor-independent solutions supporting the growing operational demands of the next generation Data Centres.

The role of Work Package 6 in COSIGN is to ensure a high level of visibility of the project outcomes in the most relevant industrial and research communities and to maximize the impact of COSIGN achievements to facilitate a wide adoption of COSIGN principles and concepts. WP6 activities are structured in standardization, dissemination, and exploitation tasks, with dissemination and standardization active from the beginning of the project and exploitation starting in the second year. These activities will jointly contribute to generate a relevant impact in the areas of technologies for Data Centre optical networking and SDN-based solutions for control and management of Data Centre environments and orchestration of end-to-end cloud services.

This deliverable describes the initial plan for dissemination and standardization work, taking into account the expected project outcomes and the current trends and activities in the main related communities, at the academic, research and industrial levels, in Europe and beyond. : The plan will be reviewed annually, and any updates necessary to adapt to the latest research and standardization directions will be handled in D6.4 and D6.5 (Reports on Dissemination and Standardization Activities).

The COSIGN dissemination activities target a large audience that spans from the academic to the industrial communities, and includes also the wider public through dedicated dissemination channels. The geographical dimension will cover Europe mostly, but will address also other areas like US and Asia, where Data Centre network and cloud computing markets are well established. The COSIGN web-site will constitute the primary channel to advertise the project outcomes, providing a centralized access to all the public dissemination material that will be produced across the project lifetime. Dedicated tools will be also setup to facilitate the internal dissemination and collaboration among the partners in the consortium. Publications in international conferences, magazines and journals are planned, as well as the participation in industrial events, scientific workshops and panels organized by other research initiatives and projects. A detailed description of COSIGN dissemination plan is provided in section 2.

Standardization activities will be fundamental to guarantee the interoperability and applicability of the COSIGN solutions in the industrial Data Centre environments, and will promote the acceptance and adoption of the new Data Centre network technologies proposed by the project. The preliminary standardization plan is mostly focused on guaranteeing the visibility of the SDN solutions for the Data Centre optical network control and virtualization in key Standard Developing Organizations (SDOs) like Open Networking Foundation (ONF) and Internet Engineering Task Force (IETF). The collaboration for the presentation and submission of COSIGN contributions to the standards will strongly rely on consortium partners already active in the selected standardization bodies. The involvement of the project in the standardization activities is also expected to be beneficial for the industrial exploitation of COSIGN outcomes. The standardization plan is described in section 3.

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	http://www.etsi.org/images/files/Events/2013/2013_CSC_Delivery_WS/CSC-Final_report-013-CSC_Final_report_v1_0_PDF_format-.PDF
[4]	Network Function Virtualization White Paper, http://portal.etsi.org/NFV/NFV_White_Paper.pdf
[5]	Network Function Virtualization Updated White Paper, http://portal.etsi.org/NFV/NFV_White_Paper2.pdf
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[12]	IETF Interface to the Routing System Working Group web-site, http://datatracker.ietf.org/wg/i2rs/charter/
[13]	IETF Service Function Chaining Working Group web-site, https://datatracker.ietf.org/wg/sfc/charter/
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[22]	M. Lasserre, F. Balus, T. Morin, N. Bitar, Y. Rekhter, “Framework for DC Network Virtualization”, IETF Internet Draft, Work in progress, January 2014
[23]	D. Black, J. Hudson, L. Kreeger, M. Lasserre, T. Narten, “An architecture for overlay networks (NVO3)”, IETF Internet Draft, Work in progress, February 2014
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1.1.2 Acronyms and Abbreviations

Most frequently used acronyms in the Deliverable are listed below. Additional acronyms can be specified and used throughout the text.

ABNO	Application Based Network Operations
DC	Data Centre
DCN	Data Centre Network
DMTF	Distributed Management Task Force
ETSI	European Telecommunications Standards Institute
I2RS	Interface to the Routing System
ICT	Information and Communications Technologies
IETF	Internet Engineering Task Force
IRTF	Internet Research Task Force
ISG	Industry Specification Group
NETCONF	NETwork CONFiguration
NFV	Network Function Virtualization
NGN	Next Generation Networks
NVO	Network Virtualization Overlays
ONF	Open Networking Foundation
OSS	Open Source Software
PCE	Path Computation Element
PCEP	Path Computation Element Protocol
RFC	Request For Comments
RG	Research Group
RIB	Routing Information Base
SDN	Software Defined Networking
SDO	Standards Developing Organization
SFC	Service Function Chaining
ToR	Top of Rack
VM	Virtual Machine
WG	Working Group

1.2 Document History

Version	Date	Authors	Comment
00	February 26, 2014	See the list of authors	ToC
01	March 20, 2014		Added IETF/IRTF section
02	March 27, 2014		Added ONF and intro section
03	March 28, 2014		Added dissemination section
04	March 31, 2014		Added ETSI section
05	March 31, 2014		Completed document
10	April 4, 2014		Reviewed document
D6.2bis-v1	May 18, 2015		First version of the amendment
D6.2bis-v2	June 8, 2015		Added IETF SFC and NV03 updates
D6.2bis-v3	June 10, 2015		Incorporated NXW updates
D6.2bis-v4	June 15, 2015		Incorporated UPC updates
D6.2bis-v5	June 18, 2015		Incorporated UnivBris updates, prepare to the

			internal review
D6.2bis-v6	June 28, 2015		First review round completed
D6.2bis-v7	July 9, 2015		Review and comments by the quality team
D6.2bis-final	July 10, 2015		All the comments addressed, ready

2 Plans for dissemination activities

Task 6.2 is devoted to the dissemination activities of the COSIGN project. The goal of T6.2 is to properly promote the concepts and technical outcomes of COSIGN, both internally among the consortium partners, and globally to the industrial and scientific communities.

The objective of the internal dissemination is to spread the ongoing achievements of the COSIGN technical WPs, to foster the cooperation, and to provide the consortium partners with a global vision on all the aspects of the project. On the other hand, external industrial and scientific dissemination is aimed at spreading the project results to a global scale. COSIGN dissemination activities are therefore focused on publicly promoting the project architectural solutions and results and will have an impact on the community by fostering the development of optical technologies and SDN-based control and management solutions for Data Centres infrastructures, in concert with the standardization activities simultaneously carried on in Task 6.1.

2.1 Internal dissemination

A first version of the website of the COSIGN project has been set up (www.fp7-cosign.eu) and it is at the moment still under construction. It is foreseen to have, at least, a section for *public documents*, such as public deliverables, and a restricted area with limited access only for the consortium partners for the internal cooperation. Besides, an *events* section is dedicated to publish news and announcements as well as to organize and share logistics information for the plenary meetings. It is also planned to have a Wiki-based section to create a collaborative environment in which partners can easily share technical information and contribute to the creation of a collective knowledge-base of the project.

Mailing lists have been set up for all the project participants (cosign-all@i2cat.net) and for WP-specific recipients (e.g., cosign-wp1@i2cat.net) to enable the communication among project members. Conference calls are scheduled to take place periodically, and plenary meetings are foreseen to take place on a regular basis (both plenary and WP-specific). The aim of both conference calls and meetings will be twofold: on one hand, they will improve the coordination among the different partners and, on the other hand, they will help to follow the evolution of the project towards the achievements of the objectives. Ad hoc task forces can be activated on specific activities when needed, as another tool to foster the collaboration and work on specific aspects arisen during the project development.

2.2 Scientific and industrial dissemination

External scientific and industrial dissemination of the COSIGN vision and concepts is of primary importance for the project consortium. To this objective, several tools have been considered to disseminate the project results; they include the realization of the project website (as detailed above), the organization of workshops/symposia and other technical events, publications in journals, magazines, and on-line technical periodicals, technology transfer seminars, booths at major international conferences, professional social networks, media and press.

The outcomes of the COSIGN project will be externally disseminated mainly through publications, presentations, white papers, and press releases. An official poster of the COSIGN project has been already produced and presented in the Future Internet Assembly 2014 in Athens (18-20 March 2014).

Prestigious international journals and magazines will be considered for publication. Moreover, the COSIGN project partners will both submit architectural and experimental results to relevant conferences. Workshops and demo sessions will be also organized, possibly co-located with other European and international conferences (e.g. ECOC, EUCNC, etc.). The possibility to organize joint workshops in cooperation with other European projects focusing on similar or complementary technical areas (e.g. the FP7 LIGHTNESS project [1]) will be also investigated.

The project website will recollect and link the dissemination activities, to provide a unique information point. Social networks, such as Twitter and LinkedIn can be used to quickly spread information on the project and announce news, activities and events, and help the collaboration both inside the consortium as well as provide visibility to a potentially high number of actors. Both twitter and linkedin accounts have been setup.

2.2.1 Dissemination targets

The targets for the dissemination activity include, but are not limited to, peer-reviewed Journals, Magazines, and Conferences that are considered in topic with the project outcomes, such as:

Journals

- IEEE/OSA Journal of Lightwave Technology (JLT)
- OSA Optics Express (OpEx)
- IEEE/OSA Journal of Optical Communications and Networking (JOCN)
- IEEE Photonics Technology Letters (PTL)
- OSA Optics Letters (PL)
- Elsevier Computer Networks (ComNet)
- Elsevier Computer Communications (ComCom)
- Transactions on Emerging Telecommunications Technologies (ETT)
- Springer Photonic Network Communications (PNC)
- Springer Journal of Network and Systems Management

Magazines:

- IEEE Network Magazine
- IEEE Communication Magazine
- IEEE Communications Surveys&Tutorials

Conferences:

- European Conference on Optical Communication (ECOC)
- IEEE/OSA Optical Fiber Communication Conference (OFC)
- IEEE Optical Interconnects Conference (OI)
- IEEE/OSA Photonics in Switching (PS)
- IEEE Global Communications Conference (GLOBECOM)
- IEEE International Conference on Communications (ICC)
- IEEE Hot Interconnects (HOTI)
- IEEE Cloud
- IEEE CloudNet
- IEEE CloudCom
- International Conference on Optical Network Design and Modeling (ONDM)
- European Conference on Networks and Communications (EUCNC)
- European Conference on Networks and Optical Communications (NOC)
- ACM Co-Next – Conference on Emerging Networking EXperiments and Technologies
- ACM Sigcomm Hotnets – Hot Topics in Networks
- COMSNETS – International Conference on Communication Systems and Networks
- IEEE INFOCOM
- IEEE IM/NOMS – Symposium on Integrated Network Management (IM) & Network Operations and Management (NOMS) (alternating years)
- IFIP Networking Conference
- ACM SOSR – ACM SIGCOMM SYMPOSIUM ON SDN RESEARCHACM SIGCOMM

- USENIX NSDI

2.3 Open Source Software

Open Source Software (OSS) is playing a significant role in Software economy, making it very important to all the ICT stakeholders, both European and worldwide [26]. OSS facilitates faster times to market, helps standards adoption, and drives novel business models, e.g. OSS vendor, OSS integrator, OSS distributor. As such, OSS has strong potential to improve the Software quality on one hand, while driving business opportunities for organizations and individuals, on the other. OSS can both foster new initiatives in the ICT area by providing high quality codebase and tooling for software development and help disseminating new ideas and results through community code and documentation.

COSIGN, being a large integrated project, aims at creating a novel DCN architecture and at demonstrating its end-to-end capabilities. Such endeavor would not be possible to achieve in a void, building only on artifacts developed by COSIGN partners. Therefore, the COSIGN team plans to build upon the established and the recent OSS results, such as architecture blueprints, software platforms, development tools, etc. A non-exhaustive list of OSS that COSIGN is going to exploit and extend is presented in *Table 1*, where the last column specifies the potential of the COSIGN team to contribute to the respective community. In general, COSIGN OSS potential is limited by several important factors: 1) IPR and/or license related restrictions by one or more project partners; 2) OSS community openness and readiness to accept contributions; 3) relatively short project lifespan as compared to development/production cycles of the OSS communities; 4) integrative nature of the COSIGN project and, as a result, the lack of a single, well defined candidate for potential contributions.

OSS Product and Governing Organization	Description	Planned Exploitation and Extensions	Contribution Potential
OVS (Open vSwitch Community)	Open vSwitch is a production quality, multilayer virtual switch licensed under the open source Apache 2.0 license, designed to enable massive network automation through programmatic extension	Overlay encapsulation termination. To be deployed in hypervisors connected to COSIGN DCN and, potentially, in ToRs. To be extended with flow discriminating capabilities, to utilize COSIGN OCS.	Mailing list participation, bug reports and fixing, individual features
OVN (Open vSwitch Community)	OVN complements OVS to add native support for virtual network abstractions, such as virtual L2 and L3 overlays and security groups.	Overlay encapsulation control and management. To be extended with flow discriminating capabilities, to utilize COSIGN OCS.	Mailing list participation, bug reports and fixing, individual features
OpenDaylight (The Linux Foundation)	OpenDaylight is an open platform for network programmability to enable SDN and create a solid foundation for NFV for networks at any size and scale. OpenDaylight software is a combination of components including a fully pluggable controller, interfaces,	A basis for developing the COSIGN SDN controller layer. To be extended with multiple components: optical devices South-bound support; OSC support; network virtualization support – both overlays and slicing; enhanced integration with the	Mailing list and summits participation. Bug reporting and fixing, introduction of individual features

	protocol plug-ins and applications.	orchestration layer, and more.	
OpenStack (The OpenStack Foundation)	OpenStack is a cloud computing software platform, created primarily to be deployed as an infrastructure as a service (IaaS) solution. The technology consists of a series of interrelated projects that control pools of processing, storage, and networking resources throughout a data centre	A basis for developing the COSIGN DCN orchestration layer. Extensions are planned mainly to the networking service –Neutron, and related subprojects – Group based policy, Heat, Ceilometer, and more. In addition, Horizon extensions are planned to enable showcasing the end-to-end COSIGN scenarios.	Mailing list and summits participation. Bug reporting and fixing, introduction of individual features

Table 1 – Overview of relevant OSS products and potential COSIGN contributions

As can be seen from *Table 1*, major contribution potential is coming from individual project members' activity in the respective OSS communities, such as following the mailing lists, attending online and other meetings, reporting and fixing bugs, etc. It is therefore planned to encourage COSIGN partners to join the communities on an individual level and work towards earning community recognition through the above activities. COSIGN partners that are also members of these communities on organizational level are encouraged to leverage the benefits of their membership towards COSIGN dissemination whenever possible, e.g. through summit participation, to showcase capabilities and scenarios enabled by COSIGN. For example, IBM is currently a platinum member of OpenStack Foundation and a silver member of the OpenDaylight project. In Addition, the IBM team working on COSIGN participate individually in the above communities and follow up on the developments of OVS/OVN communities.
COSIGN project nature calls for exploiting and extending several different codebases towards achieving its goals. Therefore, it is more appropriate to contribute code developed as part of COSIGN through channels unrelated to either of the exploited communities, e.g. standalone open repository like GitHub or the recommended European resource [27]. To begin with, the project team will be working on internally hosted code repositories and the decisions regarding opening up the code or its parts will be made by the involved partners, according to the CA terms.

3 Plans for standardization activities

3.1 Methodologies and approaches

The standardization process is a very intensive effort and long-term task, normally spanning more than a single research project lifetime, i.e. at least 1-2 years from initial submission to acceptance and adoption of a given initiative. However, COSIGN expects to play an active role in the international standardization bodies related to the thematic areas of interest of the project. All the potential initiatives will start with an analysis of the ongoing activities in the proper bodies, with the aim of identifying relevant topics to which the project could contribute: an initial survey is presented in the next sections. In a second phase, the consortium will define a detailed standardization plan, selecting a more restricted set of target SDOs where the effort will be concentrated. For each of them, the most suitable collaboration methodology will be identified, in terms of reference partners, participation in the key SDO activities and events, selection of the COSIGN outcomes to be proposed for standardization and related material preparation. These standardization activities will be planned considering two crucial objectives: the validation of the COSIGN architectural and technological choices and results through the feedback received from the different actors represented in the SDOs and, as a second step, the promotion of a wider adoption of some relevant COSIGN solutions in operational Data Centre infrastructures.

The cooperation with standardization bodies can have a variety of benefits in COSIGN: for the ongoing work, it assures the alignment between the COSIGN technical activities and the latest standardization results and is a source of technical inputs from a large pool of interested experts. For completed work, the submission to standards is a very concrete form of dissemination (and exploitation), since it can form the basis for actual implementations at a large scale.

As a general principle, the plan for each standardization initiative will cover the following activities:

- Identification of standardization bodies, specifications and normatives that could be interested in or impacted by the COSIGN research activity.
- Liaisons with the targeted bodies in order to qualify and determine the appropriate course of action.
- Creation of a specific standardization plan for each impact area (SDO/working group/technical area).
- Implementation of the standardization plans, with periodic reviews and feedbacks from/to the COSIGN consortium.
- Review, assessment analysis and implementation of recommendations gathered from standardization bodies for any continuation or future related standardization initiative.
- Dissemination of active COSIGN standardization activities.

COSIGN will communicate and interact with standardization bodies at three different levels:

- *Observation*
  Getting input from standardization bodies through observation of mailing list activities or reports from members who are active in the targeted bodies. This is the fastest way to gain an insight into whether activities of a given body are relevant to COSIGN research topics, but requires on the other hand a certain degree of familiarity with the given body and usually membership (and active participation) by at least one member of the project.
- *Liaison*
  Official communication activities between COSIGN and standardization bodies, with the goal of exchanging information, providing critical feedbacks on standards tracks, and pinpointing

specific issues of new standards that need to be solved. This approach tends to be very formal and slow.

- *Contribution*
  Cooperation on standards tracks, proposing enhancements to existing architectures and solutions. Bringing COSIGN results into a given body track for inclusion into a standard tends to be much more immediate and responsive than liaisons, and is indeed the most direct and effective way to bring project results into standards. Contributions cannot be brought by the project as a whole, but only by project members (individually or jointly) that are represented in the selected bodies.

While observation and liaison activities can be easily and independently carried out for each COSIGN research topic, contributions need to be carefully planned and evaluated, and an active presence in the given standardization body of at least one COSIGN member has to be ensured well ahead of time. For this reason, the identification of areas for potential contribution and target standardization bodies takes a crucial priority for fruitful and successful standardization work in COSIGN.

3.2 ETSI

ETSI, the European Telecommunications Standards Institute, produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies. ETSI organizes its work into clusters representing major components of a global ICT architecture. Networks is one such technology cluster devoted to fulfilling the promise of unlimited bandwidth driven by the increasing need for connectivity and data availability. ETSI is a recognized key player in the international standards landscape, producing freely available high quality standard documents, test and interoperability platforms, and proof of concept stages. ETSI also collaborates with other global standardization bodies – ONF, DMTF, OASIS, etc, acting together towards internationally accepted ICT processes, standards and norms.

3.2.1 Target Specification Groups

Specific technologies under the ETSI Networks cluster relevant to the COSIGN project are: Grid and Cloud Computing, Next Generation Networks (NGN), and Network Functions Virtualization (NFV).

Grid and Cloud Computing technology is widely regarded as a key element in tomorrow's interconnected world, and is expected to foster the creation of jobs, commercial products, new business roles and businesses. The recently published CISCO Global Cloud Index (GCI) backs this up by projecting an annual growth of 30% in cloud data centre workloads between 2012 and2017 [2]. ETSI runs two technical committees, GRID and Cloud, which address issues of interoperability between the multitude of devices and technologies coexisting in these novel data centre environments. ETSI has delivered the Cloud Standards Coordination report [3] defining major roles in the cloud computing industry, presenting cloud computing Use Cases, and listing relevant organizations in cloud computing Standardization, together with associated documents, Standards & Specifications. This report is of relevance to the COSIGN project and will help guide the project in terms of choosing use cases, deriving requirements, and adhering to the right set of standards.

The next-generation network (NGN) enables the deployment of access independent services over converged fixed and mobile networks. Recently, ETSI activities in NGN became focused on integrating existing and upcoming technologies into a heterogeneous and highly dynamic resource pool, by means of virtualization and federation, allowing for operation of multiple distinguished networked services, tailored to different needs, on the same physical infrastructure. Programmable networks and elastic infrastructures, SDN, and OpenFlow-based networks were among the topics covered in 3rd ETSI Future Networks Workshop, making these activities highly relevant to COSIGN ambitions.

NFV is an ETSI Industry Specification Group (ISG) created by several leading European telecommunication providers in 2012 and joined by multiple vendors and technology providers since then. The group has published a white paper [4] covering the goals and the challenges in converting the dedicated network functions equipment into flexible and automatically provisioned software

services. The white paper was recently updated [5] and the first official standard documents were made available as well: Network Functions Virtualisation (NFV); Use Cases [6], Network Functions Virtualisation (NFV); Architectural Framework [7], Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV [8], and Network Functions Virtualisation (NFV); Virtualisation Requirements [9], with more documents in the pipeline. ETSI NFV ISG is working in several work groups, most relevant for the COSIGN project are Architecture of the Virtualisation Infrastructure WG and Management & Orchestration WG.

3.2.2 COSIGN standardization topics

COSIGN will architect and demonstrate the future data centre network based on optical interconnect technologies and programmable flexible SDN-based control. While there is no current ETSI activity in the area of optical communication technologies, COSIGN covers many topics of relevance to ETSI, as summarized in Table 2:

ETSI	Standardization element	Type of contribution	Schedule	Priority	Partners
Grid and Cloud Computing	Use cases, requirements, architectures for cloud services and data centres running cloud services	Presentations at meetings and events.	Year 2	Medium	To be discussed
Next-Generation Network	Use cases, requirements, architectures for next generation access and data centres networks	Presentations at meetings and events, contribution to documents.	Year 2 / Year 3	Medium	To be discussed
NFV ISG; Architecture of the Virtualisation Infrastructure	Defining architectural role of virtual network functions as part of overall data centre IT and network resources.	Presentations at meetings and events, contribution to documents.	Year 2 / Year 3	Medium	To be discussed
NFV ISG; Management & Orchestration	Defining interfaces required for management and orchestration of virtual network functions as part of overall IT and network resources.	Presentations at meetings and events, contribution to documents.	Year 2 / Year 3	High	IBM

Table 2 – Preliminary overview of potential COSIGN standardization topics in ETSI

In Cloud and Grid Computing and in Next Generation Networks, the COSIGN consortium will mainly observe the standardization activities and strive to create architecture supporting the use cases of most importance for today and upcoming key ICT drivers.

In the NVF working groups, COSIGN has a potential of contributing novel approaches for delivering virtualized network services over the optical data centre network and managing them through the COSIGN converged IT and network resource orchestrator.

3.2.2.1 Update for D6.2bis

At the time of writing this update, the first two entries in the above table have become of less relevance to the COSIGN consortium. The first, ETSI Grid and Cloud Computing has stopped to be

active publishing new developments and goals. The second, ETSI Next-Generation Network has stabilized on its focus on evolution towards 5G and is not currently impacting the DCN developments.

The ETSI NFV ISG and all of its WGs are very active and of great relevance to COSIGN. Although the driving use cases and the majority of ETSI NFV focus are in Telco networks, data centre, and thus COSIGN, the relation is obvious. The COSIGN consortium will therefore continue to follow the activities of this ISG and its publications, looking for opportunities to present COSIGN ideas and outcomes to the ISG members and influencers. The IBM team participating in COSIGN follows the group and its results – documentation, white papers, proofs of concepts. Due to team's Data Centre focus, it cannot commit to attending the meetings and/or giving presentations there. NXW is participant and observing member - non voting - in ETSI NFV ISG and, as such, the team involved in COSIGN is following the latest NFV outcomes about architectural specifications of the Virtual Infrastructure Management and Orchestration components. Their impact on DC requirements and functionalities will be continuously analysed and taken into account in COSIGN architectural choices for network control and cloud orchestration.

The updated ETSI liaisons plan is summarised in *Table 3*:

ETSI	Standardization element	Type of Interaction	Schedule	Priority	Partners
NFV ISG; Architecture of the Virtualisation Infrastructure	Defining architectural role of virtual network functions as part of overall data centre IT and network resources.	Observation of and alignment with the ISG developments	Year 2 / Year 3	High	NXW, IBM
NFV ISG; Management & Orchestration	Defining interfaces required for management and orchestration of virtual network functions as part of overall IT and network resources.	Observation of and alignment with the ISG developments	Year 2 / Year 3	High	IBM

Table 3 – Updated overview of potential COSIGN standardization topics in ETSI

3.3 ONF

3.3.1 Target Working Groups

Open Networking Foundation (ONF) [10] is a user-driven organization, emphasizing an open, collaborative development process, and dedicated to the promotion and adoption of Software-Defined Networking (SDN) through open standards development. UNIVBRIS is going to join ONF in 2014, and will present the COSIGN solutions to the community. COSIGN's achievements will be well expressed to the industrial collaborators in the ONF community, which can significantly promote COSIGN's vision.

The ONF Working Groups (WG) tackle the most important issues related to SDN, continue to analyze SDN requirements, evolve the OpenFlow Standard to address the needs of commercial deployments, and research new standards to expand SDN benefits. As a member of ONF, UNIVBRIS can collaborate with the world's leading experts on SDN and the OpenFlow™ Standard regarding SDN concepts, frameworks, architecture, and standards, with great benefits for the potential impact of the COSIGN outcomes in ONF.

The most promising target WGs for the standardization of COSIGN outcomes are the Architecture and Framework WG, mostly dedicated to the definition of SDN use cases, requirements and architectures, and the Optical Transport WG for the modeling and control of optical transport networks through OpenFlow protocol extensions. An additional WG that may be of interest for COSIGN results is the

Northbound Interfaces WG, where the interface between SDN applications and network controller is investigated.

3.3.2 COSIGN standardization topics

COSIGN can contribute in three ONF WGs, that is, Architecture and Framework WG, Optical Transport WG, and Northbound Interface WG, as summarized in Table 4:

ONF WG	Standardization elements	Type of contribution	Schedule	Priority	Partners
Architecture & Framework WG	Requirements/use cases for SDN controlled hybrid optical data centres	Collaborate with industrial entities, presenting and reflecting COSIGN point of view and achievements. Contributes on Framework and Architecture documents.	Year 2 / Year 3	High	UNIVBRIS, IBM
Optical Transport WG	SDN-based architectures for supporting heterogeneous optical infrastructures	Contributes on specifications. Recommend solutions and extensions to the OF protocols that address the identified requirements for SDN and the OpenFlow Standard control of COSIGN DCN.	Year 2 / Year 3	High	UNIVBRIS
	OF extensions for low loss beam steering switches, InP Fast optical switches, 3D-stacked transceivers and ToR				
Northbound Interface WG	Interface requirements and specifications.	Contributes on documents describing northbound interface.	Year 2 / Year 3	High	NXW, IBM

Table 4 – Preliminary overview of potential COSIGN standardization topics in ONF

The ONF Architecture and Framework WG was created to help to standardize SDN by defining the broad set of problems that the SDN architecture needs to address. COSIGN proposes a new DC architecture empowered by advanced optical technologies and will demonstrate novel solutions capable of sustaining the growing resource and operational demands of next generation DC Networks. In this WG, COSIGN can contribute to the requirement analysis and use cases for future DCNs. Also, COSIGN can contribute to the service orchestration framework for optical network and IT infrastructure abstraction and virtualization.

COSIGN introduces disruptive transformations in the data plane by leveraging novel optical components. The project will develop OpenFlow extensions for the low loss beam steering switches, InP Fast optical switches, 3D-stacked transceivers and ToR switches, which can directly contribute to the Optical Transport WG.

In the Northbound Interface WG, COSIGN can contribute to the requirements and interface specifications according to the conducted research and also the know-how gained through the implementations in the project.

3.3.2.1 Update for D6.2bis

Assigned partners continue to monitor the outcomes and participate in ONF activities related to SDN architecture in general and to SDN for optical transport in particular.

UNIVBRIS presented SDN activity of COSIGN in Transport WG Group meeting in ONF 2015 member meeting (Feb. 2015) (including the extension we implemented with OF protocol and OpenDaylight controller) and was very well received. Also, UNIVBRIS attended a day-long joint workshop on 'Programmable Cities' by Bristol Is Open (BIO) and the Open Networking Foundation (ONF) (in 7th July 2015) to discuss Software Defined Networking (SDN) deployment in the new and exciting use case of Smart Cities where SDN enabled optical technology will be employed. UNIVBRIS helped to organize this event and Prof. Dimitra Simeonidou from UNIVBRIS (as BIO Chief Technology Officer) gave a keynote talk.

IBM and NXW will continue to monitor the ONF activities in the areas of SDN architecture, OF specifications, and Northbound Interfaces. During the project duration, IBM team members participating in COSIGN have already attended numerous ONF presentations and events.

The updated ETSI liaisons plan is summarised in Table 5:

ONF WG	Standardization elements	Type of Interaction	Schedule	Priority	Partners
Architecture & Framework WG	Requirements/use cases for SDN controlled hybrid optical data centres	Collaborate with industrial entities, presenting and reflecting COSIGN point of view and achievements. Contributes on Framework and Architecture documents.	Year 2 / Year 3	High	UNIVBRIS IBM
Optical Transport WG	SDN-based architectures for supporting heterogeneous optical infrastructures	Contributes on specifications. Recommend solutions and extensions to the OF protocols that address the identified requirements for SDN and the OpenFlow Standard control of COSIGN DCN.	Year 2 / Year 3	High	UNIVBRIS
	OF extensions for low loss beam steering switches, InP Fast optical switches, 3D-stacked transceivers and ToR				
Northbound Interface WG	Interface requirements and specifications.	Monitor WG activities to ensure proper alignment of COSIGN outcomes	Year 2 / Year 3	High	NXW, IBM

Table 5 – Updated overview of potential COSIGN standardization topics in ONF.

3.4 IETF and IRTF

3.4.1 Target Working and Research Groups

Standardization activities around the SDN topics are very active in IETF (Internet Engineering Task Force) and IRTF (Internet Research Task Force), mostly related to SDN architectures, use cases and standardization of protocols applicable at the south-bound interface of SDN controllers, beyond the OpenFlow protocol under specification in ONF.

IRTF has chartered a Software-Defined Networking Research Group (SDN-RG) [11] in 2013, with the objective of investigating SDN key issues from various perspectives and identify suitable SDN solutions for the short term as well as future research challenges in areas like network modeling and abstraction, scalability and security.

Several SDN-based Internet Drafts and RFCs have been recently submitted in IETF, and the activities of several Working Groups are now focusing on a variety of SDN aspects. Some Working Groups (WGs) have been established in the last couple of years with the explicit objective of targeting specific SDN-related areas. Examples are the Interface to the Routing System (I2RS) WG [12] or the Service Function Chaining (SFC) WG [13]. The I2RS WG has the objective of standardizing the interaction with the routing system for programming the Routing Information Base (RIB) in the network devices and extracting information about the network topology following an abstract multi-layer information model including both virtual and physical elements. This is an interesting approach to allow the device programmability with a higher level of granularity if compared to the OpenFlow solution, where the network controllers operate at the routes and policies level instead of the per-flow level. On the other hand, the SFC WG is focusing on architectures and protocols for the instantiation of Service Function Chains. Service functions like firewalls, load balancers or IDS, whether physical or virtualized, are deployed in the network and the traffic is steered along the required Service Function Path. This approach may be of interest at the Data Centre level for the provisioning of cloud services integrating dedicated service functions, as well as for managing the internal traffic.

Other less recent WGs are moving their attention to the applicability and the required evolution of the originally targeted technologies to allow their integration in SDN environments. An example is the progress done in the Path Computation Element (PCE) WG [14] towards the definition of a stateful and active PCE [15], where the resulting PCEP protocol can be adopted at the south-bound interface of the SDN controllers to trigger network path setup. In the same WG the on-going specification of the ABNO (Application Based Network Operation) architecture [16] is clearly oriented towards the SDN paradigms. The NETCONF WG [17] is defining YANG topology models ([18], [19]) that are applicable to the topology manager modules within the SDN controllers, while NETCONF itself can be considered as a possible protocol to be adopted at the south-bound interface for the data plane configuration.

Another technical area covered by IETF standardization effort that is extremely relevant for COSIGN is the network virtualization. The Network Virtualization Overlay (NVO) Working Group [20] is currently defining use cases [21] and frameworks [22] for Data Centre network virtualization and an architecture for overlay networks [23], proposing also Internet Drafts focused on more specific cloud challenges, like VM mobility [24].

3.4.2 COSIGN standardization topics

The COSIGN expected outcomes that may be promoted in IETF and IRTF are mostly related to the SDN-based control plane of the Data Centre optical network and the converging abstraction, virtualization and orchestration of network and IT resources. A preliminary analysis of the possible contributions in IRTF and IETF has identified some target WGs and a list of potential contributions, as detailed in Table 6.

IETF WG IRTF RG	Standardization element	Type of contribution	Schedule	Priority	Partners
IRTF SDN RG	Use cases, requirements, architectures for SDN-based control of optical DC networks.	Presentations to SDNRG meetings and workshops, Internet Drafts.	Year 2	High	NXW UPC UNIVBRIS IBM
IETF I2RS WG	Optical network topology models.	Internet Drafts.	Year 2 / Year 3	Medium	NXW
IETF SFC WG	Use cases and architectures for SFC in DC networks.	Internet Drafts.	Year 2	Medium	NXW UNIVBRIS IBM
IETF PCE WG	Path computation in SDN-based optical DC networks. Applicability of ABNO architectures for orchestration of network and IT resources.	Internet Drafts. Participation in PCEWG meetings.	Year 3	High	NXW UPC
IETF NETCONF WG	Optical extensions for YANG topology models.	Internet Drafts.	Year 2 / Year 3	High	To be evaluated
IETF NVO3 WG	Virtualization of Data Centre networks.	Internet Drafts.	Year 2 / Year 3	High	UNIVBRIS IBM

Table 6 – Preliminary overview of potential COSIGN standardization topics in IETF and IRTF

Members of the COSIGN consortium already active in IETF (i.e. NXW, UPC, IBM and UNIVBRIS) will continuously monitor the on-going activities and the progress in the selected WGs during the first year of the project. The objective is to review and refine the preliminary list of topics reported in Table 3, in order to coordinate and concentrate the standardization efforts on a focused group of key WGs. The potential impact of the COSIGN innovations will be evaluated considering the relevance of the identified COSIGN outcome as well as the level of involvement of the consortium partners for the specific WG. The latter aspect is particularly important for the acceptance and the impact achievable in the medium term in a given standardization field; where needed, potential cooperation with external partners or other projects will be considered to strengthen the promotion of converging results. For example, contributions to the IETF PCE WG can be more effectively promoted through a collaboration with the PACE (PACE: Next Steps in PAth Computation Element (PCE) Architectures: From Software-Defined Concepts to Standards, Interoperability and Deployment) project [25], a CSA (Coordination and Support Action) project where COSIGN partners NXW and UPC are also involved.

3.4.2.1 Update for D6.2bis

The IETF I2RS WG has been defining an interface towards the routing system with the objective of enabling unified mechanisms for the distribution of information about network topology and network status. In this framework, the WG has continued to be very active with recently updated Internet Drafts defining YANG models for the description of a generalized network topology [28], as well as L2 [29] and L3 [30] network topologies. Moreover, a novel individual Internet Draft, published in March 2015, is also addressing the YANG model for a L1 network topology [31]. NXW is following these activities to ensure the standard alignment of the topology services developed as OpenDaylight plugins in WP3. If needed, NXW will participate in the WG mailing list discussions in order to

contribute with the COSIGN results to the standardization work in this area, with particular focus on the modelling of optical network topologies, evaluating the possibility of submitting contributions to the related Internet Draft.

The applicability of PCE concepts to SDN environments is currently investigated in the IETF PCE WG, through an Internet Draft which discusses the usage of PCE as a Central Controller [32]. This concept is strongly related to the path computation functions which will be implemented in the COSIGN SDN controller, so NXW and UPC teams will follow up on the WG results in order to guarantee the consistency of COSIGN path computation components with the related standard in terms of architectural splitting, interfaces and information models.

The main relevance of the IETF NETMOD WG for COSIGN is related to the definition of YANG models for a variety of network aspects, including management or control services. The COSIGN consortium, and in particular the WP3 team, will monitor the WG results in order to identify YANG models (or part of them) which can be integrated or used as starting point in the OpenDaylight plugins developed to implement the COSIGN SDN controller functions. The team will also consider proposing the standardization of COSIGN-specific augmentations of existing YANG models (e.g. dealing with optical resources or optical connection constraints), where relevant for the whole WG scope.

IETF work related to overlay network virtualization – IETF NVO3 and SFC WGs – is very active and continues to be relevant to COSIGN. This year IETF SFC WG has finalized the problem statement document (RFC 7498) and is actively progressing towards finalizing the use cases and architectural approaches. Specifically, IETF community works together with IESG to finalize the Service Function Chaining (SFC) Architecture, and a draft has been updated very recently which describes an architecture for the specification, creation, and ongoing maintenance of SFC in a network, as well as components used in the construction of composite services through deployment of SFCs. IBM and UNIVBRIS continue to follow up on the developments by periodically reviewing the published and updated RFCs. The IETF NVO3 WG is more advanced and is currently exploring the solution space, after publishing the problem statement (RFC 7364) in July 2013 and the framework program (RFC 7365) one year later. The IBM team participating in COSIGN continues to follow up on the WG's mailing list.

The COSIGN WP6 team continues to monitor the broader scope of IETF/IRTF activities watching for developments relevant to our work. In this area the following new liaison candidates have been identified:

- IETF Bmwg WG – Benchmarking Methodology – is developing a document investigating benchmarking related to network functions virtualization and infrastructures where these virtual functions are deployed (draft-ietf-bmwg-virtual-net)
- IETF Bess WG – BGP Enabled Services – is actively exploring the possibility of employing eVPN technology in the control plane of tunneling-based overlays (e.g. draft-ietf-bess-evpn-overlay).
- Network Function Virtualization Research Group (NFVRG) was charted on 2015-1-20 and has just started gaining traction.

The updated IETF/IRTF liaisons plan is summarised in *Table 7*:

IETF WG IRTF RG	Standardization element	Type of Interaction	Schedule	Priority	Partners
IRTF SDN RG	Use cases, requirements, architectures for SDN-based control of optical DC networks.	Follow up the SDNRG mailing list and meetings. Look for opportunities to contribute to workshops and Internet Drafts	Year 2	Low. The group was not very active recently except for a mailing list.	NXW UPC UNIVBRIS IBM

IETF I2RS WG	Optical network topology models.	Internet Drafts.	Year 2 / Year 3	Medium	NXW
IETF SFC WG	Use cases and architectures for SFC in DC networks.	Internet Drafts	Year 2	Medium	NXW UNIVBRIS IBM
IETF PCE WG	Path computation in SDN-based optical DC networks. Applicability of ABNO architectures for orchestration of network and IT resources.	Internet Drafts, participation in PCEWG meetings	Year 3	High	NXW UPC
IETF NETCONF WG	Optical extensions for YANG topology models.	Internet Drafts	Year 2 / Year 3	Very Low. YANG models for L1 topologies are now covered in I2RS WG	--
IETF NVO3 WG	Virtualization of Data Centre networks.	Internet Drafts	Year 2 / Year 3	High	UNIVBRIS IBM

Table 7 – Preliminary overview of potential COSIGN standardization topics in IETF and IRTF

4 Conclusions and next steps

This deliverable has described the dissemination and standardization strategies planned to ensure the widest possible impact of the COSIGN project outcomes in the most relevant European and worldwide communities.

The COSIGN dissemination activities target a wide audience of the academic and the industrial communities in areas of optical communications, data centres, and clouds, spanning from individual researchers and developers to providers and users. The project consortium will be active in publishing the major scientific results in international journals and conferences. In addition, the project will be present in key events like workshops and special sessions or panels at international conferences. Dedicated workshops may be considered, potentially in cooperation with other related EU projects and research initiatives.

The involvement in standardization activities in the SDN technical area (e.g. in IETF or ONF), led by partners already active in these SDOs, will be a key point to increase the visibility of the COSIGN concepts and the impact of the project outcomes. A plan with potential contributions for target SDOs has been defined and presented in this document.

The consortium will periodically review and revise these initial plans, taking into account the evolution of the research and standardization directions as well as the maturity of the COSIGN outcomes at the different stages of the project. The related updates will be reported in future WP6 deliverables.