

**INFSO-ICT-316384 SEMAFOUR****D6.4*****Report on Dissemination, Exploitation and Liaison Activities During Year 1***

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Authors	<i>Kristina ZETTERBERG</i> , Sana BEN JEMAA, Hans VAN DEN BERG, Andreas EISENBLÄTTER, Beatriz GONZÁLEZ RODRÍGUEZ, Thomas KÜRNER, Remco LITJENS, Bart SAS, Christoph SCHMELZ, Ana Maria SIERRA DIAZ, Kathleen SPAEY, Colin WILLCOCK
Reviewers	Beatriz GONZÁLEZ RODRÍGUEZ, Thomas KÜRNER
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Abstract: During the first year of the SEMAFOUR project, dissemination activities have mainly focused on making the project visible and accessible in the research community as well as in the telecom industry, and spreading information on the vision and the high level objectives of the project, as well as facilitating communication within the project. The SEMAFOUR project has also monitored related activities in 3GPP, NGMN and IEEE 802 through liaisons. Exploitation plans have been made by each partner describing how results will be exploited for research, business decisions and education.

Keywords: SEMAFOUR, Self-organisation, Dissemination, Exploitation, Scientific community, Publications, EU projects cooperation, Standardisation, Industry cooperation

Executive Summary

The SEMAFOUR project is expected to result in gained knowledge and important results for the partners involved in the project. With an effective dissemination, both within and outside the project, the gains from the project will multiply. During the first year of the SEMAFOUR project, dissemination activities have mainly focused on making the project visible and accessible in the research community as well as in the telecom industry, and spreading information on the vision and the high level objectives of the project.

A number of dissemination instruments have been set up/created to facilitate dissemination both externally and internally within the project. External dissemination instruments include a project website, a LinkedIn group, project presentation and poster. For internal dissemination, tools like email reflectors, a team collaboration site and phone conference bridges have been set up. In addition, regular meetings among all project partners are scheduled roughly every 3 months.

During the first year of the project, SEMAFOUR members have presented the SEMAFOUR project, the project vision and its first results at scientific meetings, conferences and workshops. A number of publications have been submitted and accepted. Information exchange and cooperation with other EU projects have been performed resulting in, among other things, the organisation of the first SEMAFOUR workshop in cooperation with EU projects UniverSelf and COMMUNE at the Future Network Mobile Summit 2013 in July 2013. In addition, demonstrations of the project achievements have been given at three different events. The demonstrations exemplified how the network behaviour could be controlled by enforcing different parameter settings corresponding to different business and strategic high-level objectives, hence giving an insight to the vision of using high-level policies to manage the network.

Contacts and cooperation with the industrial community have been done through interaction with the SEMAFOUR Advisory Board consisting of major European operators, and through meetings with industry analysts. A questionnaire on importance and relevance of different aspects and use cases within radio network management has been answered by the Advisory Board and results have been analysed and interpreted within the project. Further, the industrial relevance of the SEMAFOUR project has been widely recognised, leading to a number of requests for demonstrations at various events and indeed requests from Telecommunications industry analysts. The SEMAFOUR project has organised meetings with industry analysts to disseminate our future vision for SON, among other things leading to providing major input to the widely read document Signals Ahead, April 25, 2013, Vol. 9, No.4, 'Everything Under the SON'.

In relation to standardisation, SEMAFOUR is monitoring RAN WG2, especially the Minimization of Drive Testing (MDT), and is closely coordinating with the ongoing SON work in RAN3, with the rapporteur of this study item in 3GPP being directly involved in the project. The SEMAFOUR project is also following the developments within SA5, IEEE 802 and NGMN.

Gains of the SEMAFOUR project are realised through the partners' exploitation of project results and gained knowledge within the project. The exploitation plans made by each partner have already led the way in exploiting the results from the project within the partners' organisations, and as the project continues, more results will be exploited for research, business decisions and education.

The dissemination during the first year of the SEMAFOUR project can be seen as successful. The project has been visible within the scientific community and contact with industry has been established.

List of Authors

Partner	Name	E-mail
NSN-D	Colin Willcock Christoph Schmelz	colin.willcock@nsn.com christoph.schmelz@nsn.com
ATE	Andreas Eisenblätter	eisenblaetter@atesio.de
EAB	Kristina Zetterberg	kristina.zetterberg@ericsson.com
iMinds	Bart Sas Kathleen Spaey	bart.sas@uantwerpen.be kathleen.spaey@uantwerpen.be
FT	Sana Ben Jemaa	sana.benjemaa@orange.com
TID	Beatriz González Rodríguez Ana María Sierra Díaz	bgr@tid.es asd@tid.es
TNO	Hans van den Berg Remco Litjens	j.l.vandenberg@tno.nl remco.litjens@tno.nl
TUBS	Thomas Kürner	kuerner@ifn.ing.tu-bs.de

List of Acronyms and Abbreviations

2G	2nd Generation mobile wireless communication system (GSM, GPRS, EDGE)
3G	3rd Generation mobile wireless communication system (UMTS, HSPA)
3GPP	3rd Generation Partnership Project
CAPEX	CAPital Expenditure
CO ₂	Carbon Dioxide
CT	Core Network and Terminals
EC	European Commission
EDGE	Enhanced Data rates for GSM Evolution
EPC	Evolved Packet Core
E-UTRAN	Evolved UTRAN
FDD	Frequency Division Duplex
FP7	Seventh Framework Programme
FP7-SME	Small and Medium-sized Enterprise
FTP	File Transfer Protocol
GERAN	GSM EDGE Radio Access Network
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
HeNB	Home eNodeB
HSPA	High Speed Packet Access
IEEE	Institute of Electrical and Electronics Engineers
LTE	Long Term Evolution
MD	Monitoring and Diagnosis
MDT	Minimisation of Drive Testing
MLB	Mobility Load Balancing
NGCOR	Next Generation Converged Operations Requirements
NGMN	Next Generation Mobile Networks
NM	Network Manager
NMM	Network Monitor Module
OAM	Operation, Administration and Maintenance
OPE	Operational Efficiency
OPEX	Operational Expenditure
OSS	Operations Support System
PBSM	Policy-Based SON Management
PM	Performance Management
QoS	Quality of Service
RAN	Radio Access Network
RAS	Radio Access and Spectrum
RAT	Radio Access Technology
RPC	Remote Procedure Calls
RSOnc	Radio SON Coordinator
SA	Service and System Aspects
SDO	Standards Development Organisations
SI	Study Item
SON	Self-Organising Network
SONCO	SON Coordinator
SON-F	Block of SON functions
SO-RRIM	Self-Optimising Radio Resource and Interference Management
TDD	Time Division Duplex

TSG	Technical Specification Group
UMF	Unified Management Framework
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
VDE/ITG	Verband der Elektrotechnik / Informationstechnische Gesellschaft
WG	Working Group
WI	Work Item
Wi-Fi	Any WLAN product based on the IEEE 802.11 standards
WLAN	Wireless Local Area Network
WP	Work Package
XML	eXtensible Markup Language

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1 Introduction

The SEMAFOUR project is expected to result in gained knowledge and important achievements for the partners involved in the project. With an effective dissemination, both within and outside the project, the gains from the project will multiply. Through good dissemination within the project, collaboration between partners will increase and be more efficient leading to more confident and relevant results. With the spread of information such as vision, objectives, results, gained knowledge and conclusions also outside of the project, more interaction with the scientific and industrial community can be expected, and the awareness of the work done within the project will give more constructive feedback during the project, increase the possibilities to collaborate and discuss around the areas of interest to the project and lead to that results and conclusions reach a larger audience.

Gains of the SEMAFOUR project are realised through the partners' exploitation of project results and gained knowledge within the project. In order to ensure a fruitful exploitation, each partner has made a plan describing how the results will be used in their own area of business activities. The exploitation plan will be developed progressively during the course of the project, and will result in an exploitation roadmap at the end of the project.

This document describes the dissemination, exploitation and liaison activities during the first project year. The document is structured as follows. First, dissemination instruments used for information spreading both internally within the project, and externally are presented in Chapter 2. In Chapter 3, dissemination to the scientific community, through participation in scientific conferences, publications, cooperation, demonstration and workshops, is described. In Chapter 4, contacts and cooperation with the industrial community are described, and in Chapter 5, contacts towards 3GPP standardisation and other related activities are presented. Chapter 6 then gives the exploitation plans for the project partners. Finally, some concluding remarks are given in Chapter 7.

2 Dissemination Instruments

This chapter gives an overview of the dissemination material (website, LinkedIn group, project presentations, logo and templates) that has been developed during the first months of the project. Further, it discusses the collaboration tools (email reflectors, team site, meetings and phone conferences, tools for exchanging simulation data) that are used for the dissemination of information among the project partners.

2.1 SEMAFOUR Website and LinkedIn group

A project website has been created and launched at project kick-off. It is accessible at:

<http://www.fp7-semafour.eu>

The project website is the main dissemination channel towards the public. It serves as a source of information for external parties that are interested in the work, results and events of the SEMAFOUR project. Figure 1 shows a screenshot of the main page of the SEMAFOUR website, on which the navigation structure can be seen on the right.

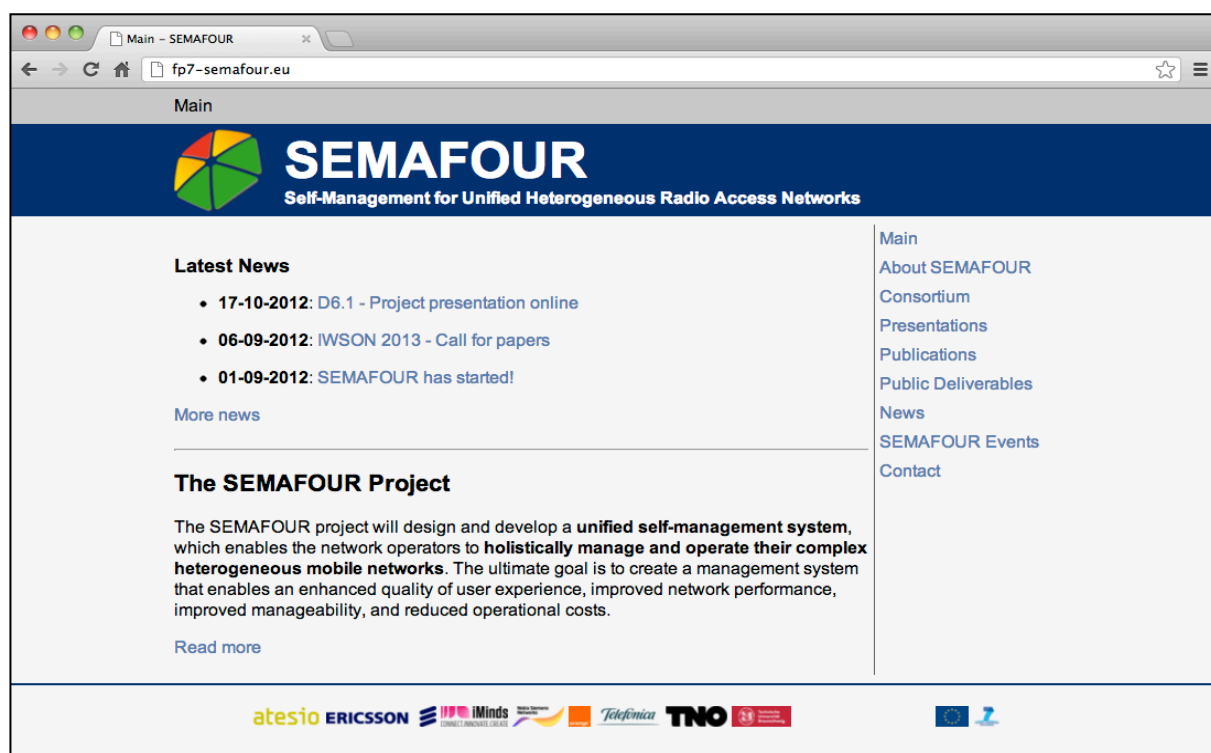


Figure 1: Screenshot of the main page of the SEMAFOUR website.

The website is a dynamic environment to which information will be added as it becomes available. All partners provide content to keep the information on the website up-to-date. In particular, the sections ‘Presentations’, ‘Publications’, ‘Public Deliverables’, ‘News’ and ‘SEMAFOUR Events’ will be updated frequently.

The website is hosted by the University of Antwerp and maintained by iMinds. Statistics about its visitors are collected using Google Analytics [1]. These statistics learn that between 01-09-2012 and 31-07-2013, the website attracted 1608 visitors, of which 829 unique visitors. The average duration of a visit was 3:38 minutes, and all visits together correspond to 6368 page views. A bit more than half of all visits (53.7%) originated from search traffic (with ‘semafour’ and ‘eu semafour project’ as most popular search phrases), 16.5% from referral traffic (where 45% of the referrals originate from fp7-socrates.org), and 29.9% are direct visits.

Besides the website, also a LinkedIn group has been created for the project:

<http://www.linkedin.com/groups/SEMAFOUR-5009706?gid=5009706&trk=group-name>.

This LinkedIn group is used to promote the SEMAFOUR project using social media. SEMAFOUR events will be announced on this page, which can be joined by both members of the project as well as externals.

2.2 Project Presentations

A 2-page SEMAFOUR project presentation [2] has been created to introduce the SEMAFOUR project and to disseminate its main objectives, its technical approach and expected impact. This document is available for download on the SEMAFOUR website (<http://fp7-semafour.eu/en/public-deliverables/>) and printed copies will be made available at events where SEMAFOUR will participate.

Further, also a SEMAFOUR poster presentation has been created, which can also be used at events where SEMAFOUR participates (e.g., with a demo stand), to introduce the project to the audience. The SEMAFOUR poster presentation can be found in Appendix A.

2.3 Logo and Templates

An important item to establish the project's identity is the project logo. This logo is used in all presentations, posters, the website, etc. A PowerPoint template that includes the logo and is used to develop slides for SEMAFOUR presentations has been designed (see Figure 2). Also a Word template for writing reports is available.

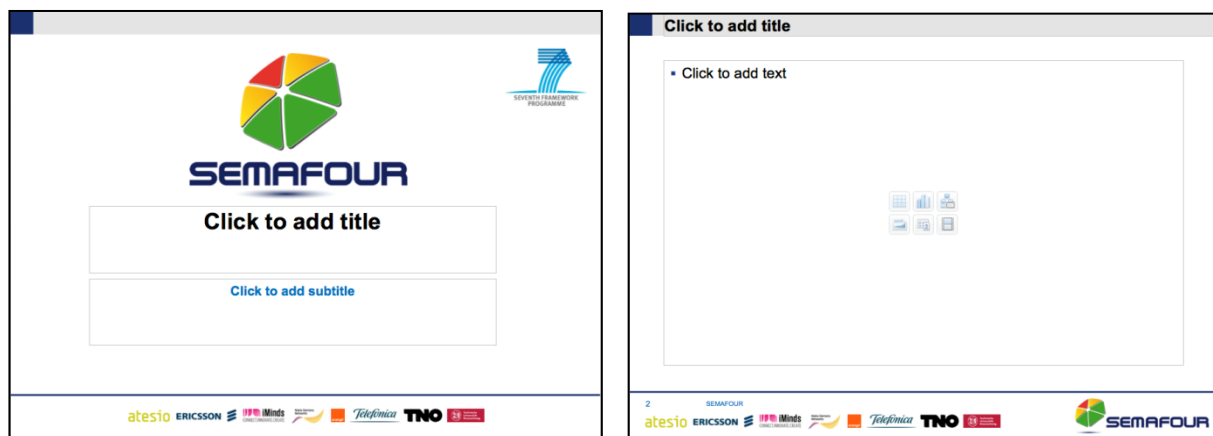


Figure 2: SEMAFOUR slide template including the SEMAFOUR logo.

2.4 E-mail Reflectors and Team Site

For easy communication among all project members, closed-access email reflectors have been created by TUBS. In total there are nine reflectors which forward e-mails to the subscribed members:

- A general reflector which forwards e-mails to all SEMAFOUR members
- A reflector for each of the SEMAFOUR work packages (WP1 - WP6)
- A reflector for the SEMAFOUR project board
- A reflector for the SEMAFOUR advisory board

For safe and easy document sharing and collaboration, TUBS has also set up a team site for the project, using the Alfresco platform [3], which is an enterprise content cloud platform. Access to the team site is password protected, and limited to SEMAFOUR members. The team site is the main dissemination channel among the project partners. It is used for collaboration on deliverables, reports, publications, etc. Besides this, the site is also used for management and financial reporting, and for building Wikis, e.g., a Wiki about calls for papers on SEMAFOUR topics.

The team site is typically exploited in combination with the SEMAFOUR email reflectors: after a document has been uploaded, an email including a link to the document on the site is sent out using one of the e-mail reflectors. Applying this policy avoids sending around large documents, but also makes sure that at the same time all project documents are archived.

2.5 Meetings and Phone Conferences

The SEMAFOUR e-mail reflectors and team site are very useful tools for collaboration and dissemination among the project partners. But from time to time also ‘live’ interaction is needed. Therefore regular meetings among all project partners are planned roughly every 3 months. These regular meetings include plenary sessions, Work Package (WP) meetings and a Project Board meeting. To optimise the possibility for all partners to be present, dates and places of the meetings are established well ahead. Below is the list of passed and already planned plenary meetings.

- September 17 – 19, 2012, NSN – Munich (project kick-off meeting)
- December 10 – 12, 2012, TUBS – Braunschweig
- March 11 – 13, 2013, TID – Madrid
- June 17 – 19, 2013, EAB – Linköping
- September 16 – 18, 2013, iMinds – Antwerp
- December 11 – 13, 2013, FT – Paris
- March 19 – 21, 2014, ATE – Berlin
- June 16 – 18, 2014, NSN – Aalborg
- September 30 – October 2, 2014, TNO – Delft
- December 17 – 19, 2014, FT – Paris

Besides the planned regular project meetings, there are also intermediate phone conferences or meetings as the need arises. Every third Monday of the month, a Project Board meeting is scheduled. Additionally, phone conferences are set up regularly for technical discussions among all partners or among a subgroup of the partners, if required. For this purpose, NSN provides a phone conference platform and, if required, a Cisco WebEx solution for the sharing of documents.

2.6 Dissemination of Scenario Data

Scenario data that is used in WP4 and WP5 is shared among the partners that perform simulation studies. To exchange static data, an FTP server is used, and for dynamic data atesio’s SONLAB platform is employed.

The FTP server contains a collection of XML files, which represent the scenario data. This includes data on path loss, the location of base stations and user mobility traces. The data is structured in folders which allow distinguishing between different data sets. The format of this data is described on a Wiki, and the definitions of the data agreed within Activity 2.4 (Definition of reference scenarios, modelling assumptions and methodologies) have served as a basis. The Wiki allows easy updating of this information when partners make changes or additions to the data.

The SONLAB platform developed by atesio provides a dynamic environment, which also contains the scenario data that is available on the FTP server. SONLAB pre-processes this data and presents it to the simulation engines in an easier accessible way. In order to acquire the data, simulation tools communicate with SONLAB via XML-RPC.

3 Dissemination to the Scientific Community

This chapter provides information about the dissemination activities of SEMAFOUR towards the scientific community, during the first project year. An overview of the active participation (e.g., presentations, demonstrations, and panel sessions) in meetings, conferences and workshops is given, the SEMAFOUR publications are listed, and contacts and cooperation with other European projects are discussed. Further, information about the SEMAFOUR demonstrations and workshops is given.

3.1 Participation in Scientific Meetings, Conferences and Workshops

During the first year, SEMAFOUR members have presented the SEMAFOUR project, the project's vision and its first results at scientific meetings, conferences and workshops. A list of the presentations and demonstrations that have been given and that are already planned for the future is given below.

- 06.11.2013 - 08.11.2013: ICT 2013, Vilnius, Lithuania
Accepted demonstration: Self-management and decision support in heterogeneous mobile radio networks
- 03.07.2013 - 05.07.2013: Future Network & Mobile Summit 2013, Lisbon, Portugal
 - Demonstration by Sören Hahn and Dennis M. Rose: SON management through high-level objectives
 - Presentation by Remco Litjens: Integrated self-management for future radio access networks: vision and key challenges
 - Presentation by Colin Willcock: Challenges for SON functions and SON management
- 27.06.2013: Conference call with the NGMN P-RANEV project
Presentation by Thomas Kürner and Hendrik Hoffmann: Dynamic spectrum allocation & interference management use case
- 02.06.2013: 3rd International Workshop on Self-Organizing Networks (IWSON 2013), Dresden, Germany
 - Demonstration by Sören Hahn and Christoph Schmelz: SON management through high-level objectives
 - Presentation by Andreas Eisenblätter: Self-management for unified heterogeneous radio access networks
- 08.05.2013 - 10.05.2013: Future Internet Assembly (FIA) 2013, Dublin, Ireland
Demonstration + poster presentations by Sören Hahn and Christoph Schmelz: SON management through high-level objectives (demonstration + poster), SEMAFOUR (poster)
- 23.04.2013 - 25.04.2013: Wireless World Research Forum Meeting 30, Oulu, Finland
Presentation by Colin Willcock: Vision and key challenges for unified self-management of future radio access networks
- 06.02.2013 - 08.02.2013: COST IC1004 6th MC & Scientific Meeting, Malaga, Spain
Presentation by Remco Litjens: Self-management for unified heterogeneous radio access networks
- 20.11.2012 - 21.11.2012: Mobile Network Optimisation 2012, Amsterdam, Netherlands
 - Invited presentation by Hans van den Berg: Understanding why SON and the three key areas in which SON operates offer benefits to the operator
 - Hans van den Berg, invited member of panel session: Next steps for self-organising networks
- 16.11.2012: 19th IEEE Symposium on Communications and Vehicular Technology in the Benelux (SCVT 2012), Eindhoven, Netherlands
Presentation by Remco Litjens: Self-management in cellular networks - Achievements and challenges
- 10.10.2012 - 11.10.2012: Future Networks 10th FP7 Concertation meeting (RAS cluster), Brussels, Belgium

Presentation by Christoph Schmelz: Self-management for unified heterogeneous radio access networks

- 03.10.2012 - 04.10.2012: 3rd annual Self-Organising Networks Conference (SON 2012), Cannes, France
 - Presentation by Ljupco Jorguseski: Analysing SON from a deployment perspective - Why, When and How
 - Presentation by Irina Balan: Handover parameter optimisation in LTE self-organising networks
- 03.09.2012: International Workshop on Self-managing and Autonomous Networks (SAN 2012), Krakow, Poland
Invited presentation by Hans van den Berg: Developments on self-organization in mobile access networks

3.2 List of Publications

Below is a list of the SEMAFOUR publications of the first project year:

- 1) Andreas Eisenblätter, Beatriz González Rodríguez, Fredrik Gunnarsson, Thomas Kürner, Remco Litjens, Bart Sas, Berna Sayrac, Lars Christoph Schmelz, Colin Willcock. Integrated Self-Management for Future Radio Access Networks: Vision and Key Challenges. Future Network & Mobile Summit 2013, July 2013.
- 2) Hans van den Berg, Remco Litjens. Mobiele netwerken onderhouden zichzelf. Automatiseringsgids, June 2013.
- 3) Remco Litjens, Fredrik Gunnarsson, Berna Sayrac, Kathleen Spaey, Colin Willcock, Andreas Eisenblätter, Beatriz González Rodríguez, Thomas Kürner. Self-Management for Unified Heterogeneous Radio Access Networks. 3rd International Workshop on Self-Organizing Networks (IWSO 2013), June 2013.
- 4) Andreas Eisenblätter, Beatriz González Rodríguez, Fredrik Gunnarsson, Thomas Kürner, Remco Litjens, Bart Sas, Berna Sayrac, Lars Christoph Schmelz, Colin Willcock. Vision and Key Challenges for Unified Self-Management of Future Radio Access Networks. Wireless World Research Forum Meeting 30, April 2013.
- 5) Remco Litjens, Fredrik Gunnarsson, Berna Sayrac, Kathleen Spaey, Colin Willcock, Andreas Eisenblätter, Beatriz González Rodríguez, Thomas Kürner. Self-Management for Unified Heterogeneous Radio Access Networks. COST IC1004 TD(13)06022, February 2013.

3.3 Contacts and Cooperation with Other European Projects

In the SEMAFOUR dissemination plan (D6.3) [4], a number of European research projects considering topics relevant to the content of the SEMAFOUR project have been identified. The dissemination plan discussed what each of the identified projects is (was) about, how this relates to SEMAFOUR and how the liaison between SEMAFOUR and the particular projects is ensured. In the next paragraphs, the focus is on the concrete interaction SEMAFOUR had with other projects during its first project year.

The EU FP7 project *UniverSelf* (Universal Self-management) has developed a Unified Management Framework (UMF) capable of managing autonomic functions. There are interrelations to SEMAFOUR WP5 (Integrated SON Management) which aims at the management and coordination of several individual SON functions. To enable SEMAFOUR WP5 contributors to understand the UniverSelf UMF approach, a conference call presentation has been given on February 28, 2013, that explained the different parts of the UMF in detail. The CELTIC project *COMMUNE* (COgnitive network ManageMent under UNcErtainty) has as main objective to help avoiding and resolving uncertainty in network management and operation by the use of knowledge-based reasoning techniques and other relevant cognitive networking methods, which can be seen as an evolution of SON by adding cognition (reasoning / learning). Also between COMMUNE and SEMAFOUR WP5 there are interrelations, for example regarding policy-based SON management (improving SON

function policies) and SON coordination, but also with respect to a Decision Support System. Because of its interrelations with the UniverSelf and COMMUNE projects, SEMAFOUR has organised its first workshop together with these projects (see Section 3.5.1).

The CELTIC-plus project **SHARING** (Self-organised Heterogeneous Advanced Radio Networks Generation) has started in January 2013. The goal of SHARING is to provide solutions for adaptive coverage and capacity techniques, efficient integration of relevant transmission systems, and cell densification with corresponding resource management and backhauling mechanisms. There are interrelations between SHARING and SEMAFOUR WP4 use cases in particular. Since an important part of the research work of the two projects consists in defining new SON functionalities, it was agreed that it is beneficial for both projects to join forces for a common means/synergy of dissemination on this topic.

The FP7 STREP **iJOIN** (Interworking and JOINT Design of an Open Access and Backhaul Network Architecture for Small Cells based on Cloud Networks) project has started in November 2012. There are no public deliverables yet, but TID, who participates in both iJOIN and SEMAFOUR, has organised an internal meeting between colleagues working in both projects. Technical challenges related to SEMAFOUR have been identified in the main scenarios of iJOIN.

GreenNets (Power consumption and CO₂ footprint reduction in mobile networks by advanced automated network management approaches) is an FP7 project running within the FP7-SME scheme. The objective of the project is to establish new models and methods for energy saving in the operation of established 2G and 3G networks as well as upcoming 4G networks by adjusting the operated capacity to the actual demand. This comprises the development of tools for analysing the energy efficiency in existing radio network deployments; for finding measures to improve the efficiency; and for implementing those measures through commonly available OSS interfaces. (That is, no dedicated support by the network equipment is presumed.) Furthermore, the GreenNets project is investigating models and methods that allow for optimising network deployments such that they can be operated in a particular energy efficient manner. With atesio and TUBS two SEMAFOUR partners are also participating in GreenNets. Additionally, the SEMAFOUR and GreenNets projects benefit from each other when jointly participating in events such as COST IC1004 meetings and the IWSON workshop hosted by VTC Spring 2013.

COST IC1004 is a COST Action on Cooperative Radio Communications for Green Smart Environments. WG3 (Radio Networks) of COST IC1004 is also covering SON aspects. The concept and basic ideas of SEMAFOUR have been presented to COST IC1004 during its 6th Management Committee & Scientific Meeting in Málaga, February 2013. For the future, joint workshops are planned in a similar way as it was done with the predecessor projects COST 2100 and SOCRATES.

As the **BeFEMTO** (Broadband evolved FEMTO Networks) project finished in June 2012 (i.e., before the SEMAFOUR project started), there has strictly speaking been no cooperation. But TID, who also participated in BeFEMTO, identified results that could be interesting for the SEMAFOUR project:

- In the BeFEMTO HeNB architecture, functional blocks similar to the modules defined in SEMAFOUR WP5 have been identified: the Self-Optimising Radio Resource and Interference Management (SO-RRIM) functional block can be linked to the Policy-Based SON Management (PBSM) module and to the block of SON functions (SON-F), the Radio SON Coordinator (RSONC) functional block can be linked to the SON Coordinator (SONCO) and PBSM modules, and the Network Monitor Module (NMM) and Performance Management (PM) functional block with the Monitoring and Diagnosis (MD) module.
- The BeFEMTO method to determine the location of indoor user-deployed femto cells based on the concept of relative positioning, which could be useful for the SEMAFOUR Dynamic Spectrum Allocation and Interference Management use case.
- The BeFEMTO discussion of the stable concurrent operation of multiple self-organisation algorithms. This topic is also under study in SEMAFOUR WP5, mainly within the scope of both the SONCO and PBSM, with the aim of minimising conflicts among different SON instances. Both projects seem to be aligned on the system stability aspect, and similar concerns have been identified.

Several other BeFEMTO results could be valuable for SEMAFOUR. TID will discuss with the SEMAFOUR use case leaders if there are further connections for which it is worthwhile to look deeper into the BeFEMTO results.

Also the **SOCRATES** (Self-Optimisation and self-ConfiguRATion in wirelEss networkS) project has already finished. As six partners of the SEMAFOUR project have also been involved in the SOCRATES project, it is a natural evolution that the SEMAFOUR project exploits the results and expertise gained in the SOCRATES project. The Mobility Load Balancing (MLB) algorithm used in the ‘SON management through high-level objectives’ demonstrator (see Section 3.4) is based on the MLB algorithm that has been developed in SOCRATES. Furthermore, the SON coordination concept delivered in SOCRATES is taken as background for the SEMAFOUR WP5 work.

Besides the interactions of SEMAFOUR with other European projects that were mentioned above, the project has also taken an active part in the **RAS cluster** work. At the Future Networks 10th FP7 Concertation Meeting in Brussels, 10-11 October 2012, an overview of the SEMAFOUR project was presented. At the 11th FP7 Concertation Meeting, 27-28 February 2013, in Brussels, a presentation on the project’s application scenarios, system requirements and standardisation objectives was given. In addition to these meetings, the SEMAFOUR project also provided input to the RAS cluster structure and organisation. RAS cluster projects are grouped into two working groups, where SEMAFOUR will contribute to WG2 on ‘High Capacity Radio Network Architecture’. SEMAFOUR provided input to the structure of the white paper on the European view of high capacity radio network architecture for 5G, proposed by WG2. SEMAFOUR has two members in the editorial board for this white paper and is planning to take a leading role in the section on ‘New Enabling Technologies: SON’. Lastly, due to the excellent coordination of the SEMAFOUR project with the ongoing 3GPP standardisation, it has been agreed that the project will present a 3GPP standardisation update in the 12th Concertation Meeting, 22-23 October 2013.

3.4 Demonstrations

In the first year of the SEMAFOUR project, demonstrations on the project achievements have been given at three different events (see Section 3.1): Future Internet Assembly (FIA) 2013, 3rd International Workshop on Self-Organizing Networks (IWSON 2013), and Future Network & Mobile Summit (FNMS) 2013. At all three events, essentially the same demonstration ‘SON management through high-level objectives’ is given, which is briefly described below. Figure 3 shows the SEMAFOUR demonstration stand at the FNMS 2013.

The central objective of the SEMAFOUR project is to develop a unified self-management system, which enables the network operators to holistically manage and operate their heterogeneous access networks. One of the key research items is to map the operator-formulated high-level objectives to concrete settings of the different SON functions, such that the network best complies with the formulated objectives. Note that this setting assumes that a working SON system is in place. This work on policy enforcement is one out of the three principal tasks within SEMAFOUR’s WP5.

The ‘SON management through high-level objectives’ demonstration showcases how changing control parameters for one popular SON function, namely Mobility Load Balancing (MLB), drives the behaviour and performance of an LTE network into different directions. The purpose is to illustrate, by means of specific examples, how a mobile network operator may control the network’s behaviour through enforcing different parameter settings and how those settings correspond to different high-level objectives. This is a first step into operating a network with the support of high-level objectives, which shall be manageable via some Graphical User Interface. The underlying system-level network simulations (see screenshots in Figure 4 and Figure 5) for this showcase employ a realistic network scenario for the German city of Hannover, which is used with, amongst others, high-resolution ray-tracing signal level predictions and realistic vehicular as well as pedestrian user mobility.



Figure 3: SEMAFOUR demonstration stand at the FNMS 2013.

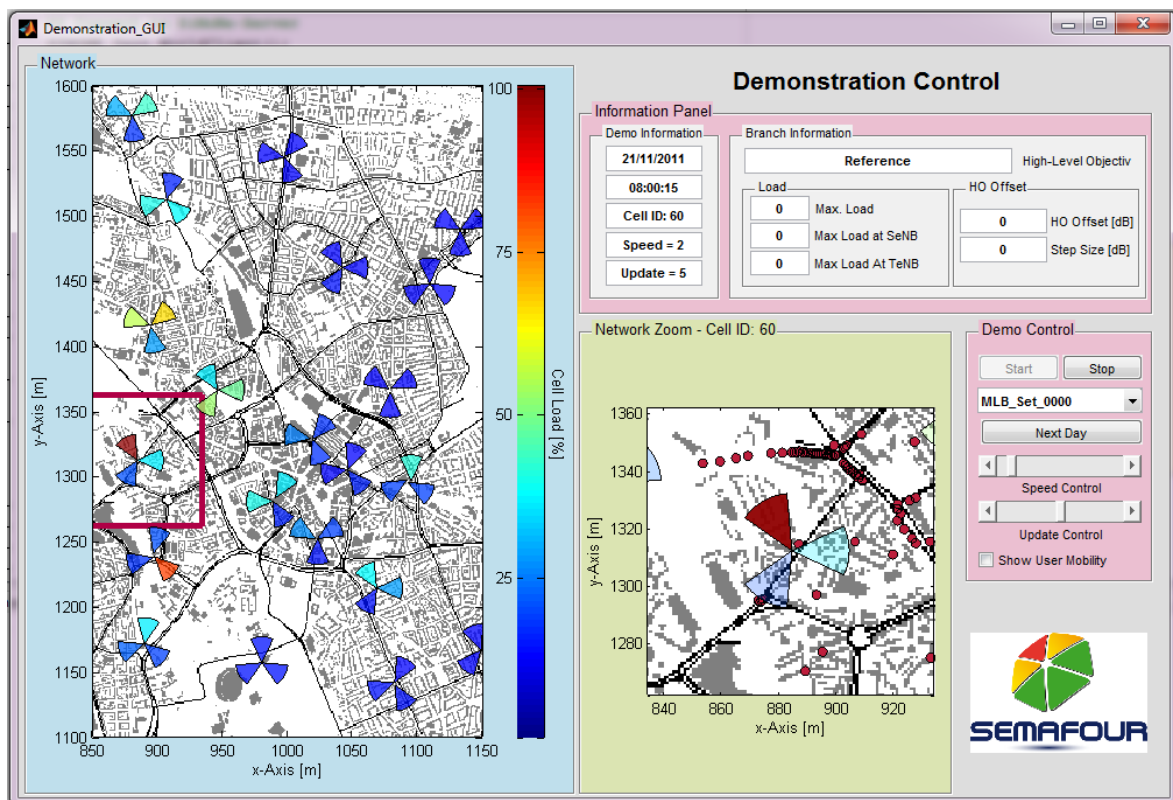


Figure 4: Screenshot of the 'SON management through high-level objectives' demonstration.

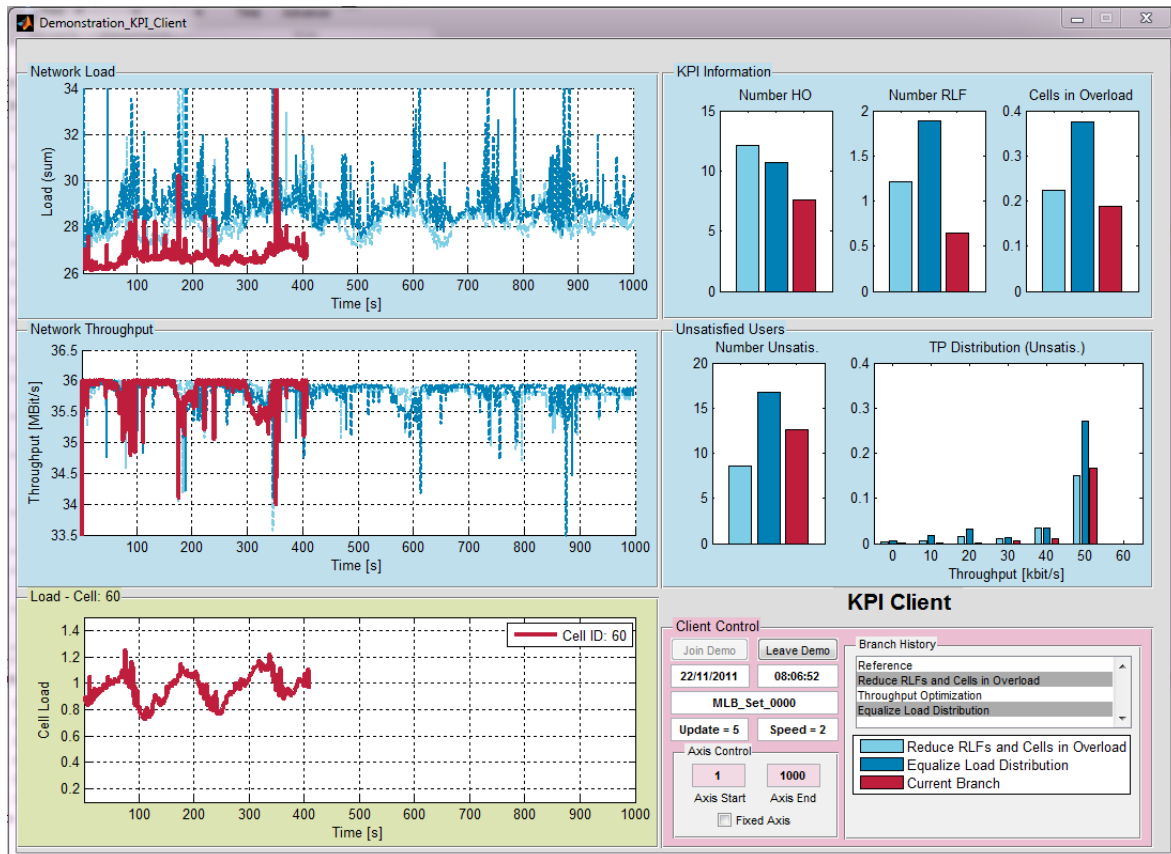


Figure 5: Screenshot of the ‘SON management through high-level objectives’ demonstration.

Further, a demonstration application has been submitted and accepted to ICT2013, which will take place in Vilnius, Lithuania, on 6-8 November, 2013. This demonstration ‘Self-management and decision support in heterogeneous mobile radio networks’ will show the visitors three key elements of the SEMAFOUR self-management system for heterogeneous mobile radio networks, i.e., (i) the transformation of performance objectives to harmonised configuration settings of the different self-optimisation functions; (ii) the operation of the self-optimisation functions themselves and the combined effect they have on the performance of the network (with respect to the objectives); and (iii) the forecasts of performance bottlenecks and recommendations for network upgrades as derived by the decision support system.

3.5 SEMAFOUR Workshops

The SEMAFOUR project has committed to organise at least two public dissemination workshops. The goal of these workshops is to disseminate the project’s results towards the different stakeholders and to stimulate feedback.

3.5.1 First Workshop

The first SEMAFOUR workshop on “*Management Frameworks for Future Mobile Communication Networks*” took place on July 4, 2013, as two different sessions at the Future Network and Mobile Summit 2013 conference in Lisbon, Portugal. It was organised jointly with the FP7 project UNIVERSELF and the CELTIC project COMMUNE, and had as target to give an overview of the main challenges of management frameworks for future mobile communication networks. It comprised presentations by members of the three organising projects on the viewpoints, approaches and results of each of the projects, two invited talks and a discussion panel. The complete program can be found in Appendix B.

The workshop addressed both academic and industrial researchers and engineers interested in the management of mobile communication networks. To mobilise participation, email invitations have

been sent out and the workshop program has been announced on the SEMAFOUR, UNIVERSELF and COMMUNE project websites. In both sessions there were approximately 30 participants, of which only a limited number belonging to the consortia of the organising projects. The presentations were well received and triggered lively and interesting discussions. Also during the panel discussion, different points of view on management of future mobile networks were discussed



Figure 6: SEMAFOUR first workshop at the Future Network and Mobile Summit 2013.

3.5.2 Other Workshops

A SEMAFOUR final workshop will be organised near the end of the project. Options on the format, time and place of this workshop will be investigated during future project meetings, and concrete plans will be reported in the future deliverables D6.5 ('Report on dissemination, exploitation and liaison activities during Year 2') and D6.8 ('Final report on dissemination and liaison activities'), which are due in August 2014 and 2015 respectively.

A joint workshop together with COST IC 1004 in conjunction with a regular meeting of COST IC 1004 is planned for 2014. The date and locations have to be agreed with COST IC 1004. It is expected that date and place can be fixed until end of September 2014, when both project have held their next face-to-face meeting.

Further, contacts with VDE/ITG have been established to investigate the possibility to organise a SEMAFOUR workshop with the support of VDE/ITG. This could be a stand-alone event, but also the possibility to organise the workshop collocated with another VDE/ITG event is being examined. A potential event to collocate with is the yearly workshop on "Future Networks" organised by VDE/ITG working group 5.2, which will take place end of September 2014. Events organised by VDE/ITG have typically a significant attendance, including industry participants.

4 Contacts and Cooperation with the Industrial Community

4.1 Advisory Board

A questionnaire on how radio network management should be done in RANs and on the SEMAFOUR use cases that were identified in the first months of the project was sent to the Advisory Board members in October 2012. These use cases were also presented to the Advisory Board during a phone meeting on the 15th of October 2012. The following European mobile radio network operators provided answers to the questionnaire: Deutsche Telekom (Germany), KPN (The Netherlands), France Telecom / Orange (SEMAFOUR partner) (France), Telefónica (SEMAFOUR partner) (Spain), Telenor (Norway) and Vodafone (United Kingdom). The project's analysis and interpretation of the results were included in the restricted deliverable 2.3 "State-of-the-art in Radio Network Management" and presented to the Advisory Board members during a phone meeting on the 20th of March 2013. It was also announced during this meeting that the next Advisory Board meeting will be held before the end of 2013 to present to the Advisory Board the first project results.

4.2 Industrial Analysts

The industrial relevance of future SON in general and the SEMAFOUR project in particular has been widely recognised. This has led to a number of requests for demonstrations at various events and indeed requests from Telecommunications industry analysts for meetings to understand where this technology is going.

The SEMAFOUR project has organised meetings with industry analysts to disseminate our future vision for SON. The most notable of these meetings was with Michael W. Thelander, Founder and CEO of the Signals Research Group. This provided major input to the Signals Ahead, April 25, 2013, Vol. 9 No. 4 'Everything Under the SON'. In this widely read document there are dedicated sections on the SEMAFOUR project's requirements and vision. Considering the relatively early stage of the project we consider this form of industry wide dissemination as exceptional.

5 3GPP Standardisation and Related Activities

5.1 3GPP

3GPP (3rd Generation Partnership Project) is organised in four different Technical Specification Groups (TSGs), each focusing on standardisation within a given area¹. Each TSG is organised into a series of working groups (WG) which cover various technical aspects and a plenary where the final approval of the work plan and results of the WGs takes place. The plenary meeting can be considered the steering group for the working groups. As such it controls explicitly the scope of the work in the WG though approval of the work items (WI) and study items (SI). As well as approving the scope the plenary monitors the progress of each WI and SI and takes action when issues regarding delay or conflict take place. Finally the plenary approves all standardisation proposals from the WGs. The work in 3GPP is organised as a series of releases. Currently, 3GPP is working on release-12.

The TSGs relevant for SEMAFOUR are the TSG Radio Access Network (RAN) and the TSG Service and System Aspects (SA).

5.1.1 3GPP TSG RAN

The 3GPP TSG RAN is responsible for the definition of the functions, requirements and interfaces of the HSPA and LTE network in its two modes, FDD & TDD. For the SEMAFOUR project the most relevant meetings are the RAN Plenary and the RAN WG 2 and 3.

5.1.1.1 3GPP RAN Plenary

Currently 3GPP is working on release 12. The timing, contents and completion of the releases are decided within the RAN plenary meetings (see Figure 7 for the timeline). As any work within the associated RAN WGs is dictated by the RAN plenary it is important for SEMAFOUR to be aware of what is going on there and to influence the meeting if particular technical areas are wished to be standardised. There are four RAN plenary meetings a year and a SEMAFOUR representative is always present to report back on the latest status and influence future work. From the project point of view the most important event so far was the release 12 SON study item [5] that was approved at the 3GPP RAN plenary meeting #58 in December 2012.

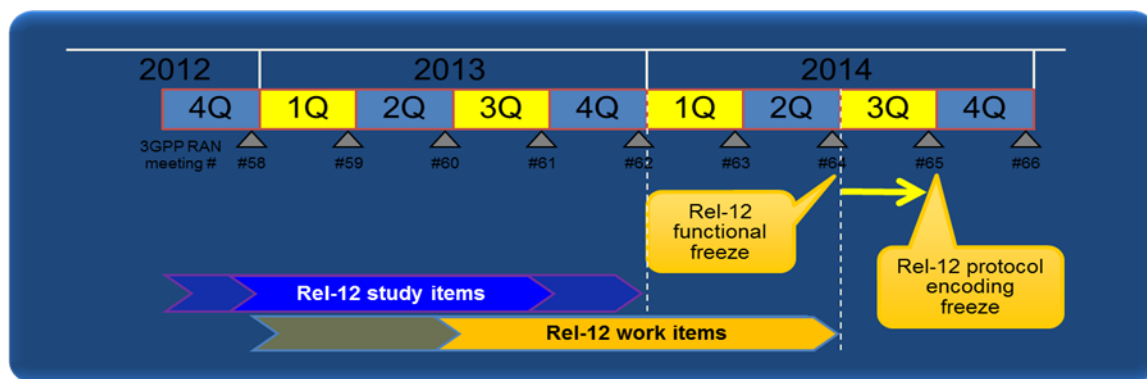


Figure 7: 3GPP Release 12 timeframe in RAN.

¹ TSG GERAN - GSM EDGE Radio Access Network, TSG RAN - Radio Access Network, TSG SA - Service & Systems Aspects, TSG CT - Core Network & Terminals

5.1.1.2 3GPP RAN2

RAN WG2 is in charge of the Radio Interface architecture and protocols, the specification of the Radio Resource Control protocol, the strategies of Radio Resource Management and the services provided by the physical layer to the upper layers. For SEMAFOUR it is important to understand what is going on in this working group to understand how the future mobile communication network will function. SEMAFOUR is monitoring RAN WG2 especially the Minimization of Drive Testing (MDT) which can be seen as a monitoring part for the overall SON system. At the time of writing, the release 12 MDT work item proposal has not yet been approved to start. The most recent proposal [6] is a logical progression from the work done in release 11, it contains two main technical areas to enhance, Quality of Service (QoS) use case support and enhanced data interpretation.

5.1.1.3 3GPP RAN3

RAN WG3 is responsible for the Overall UTRAN/E-UTRAN architecture and the specification of protocols for the Iu, Iur, Iub, S1 and X2 interfaces. For SEMAFOUR the most important work is associated with the release 12 SON study item which is led by RAN3. It will be this study item and associated study items and work items in later releases that the results from the SEMAFOUR project can be fed into. The SEMAFOUR project is closely coordinating with the ongoing SON work in RAN3 with the rapporteur of this study item in 3GPP being directly involved in the project.

5.1.2 3GPP TSG SA

The TSG SA is responsible for the overall architecture and service capabilities of systems based on 3GPP specifications, and has responsibility for cross TSG coordination. For SEMAFOUR the most relevant meetings are the SA WG5 meetings.

5.1.2.1 3GPP SA5

In SA WG5 (SA5), requirements, architecture and solutions for provisioning and management of the network and its services are specified, with focus on the interface *itf-N* between the Network Manager (also referred to as OSS) and the Domain Manager. In release 12, the focus of SA5 is mainly on four different areas: enhanced multi-vendor plug and play of eNB, study of enhanced Network Manager (NM) centralised coverage and capacity optimisation, study on Operation, Administration and Maintenance (OAM) aspects of network sharing, and describing the SA5 solutions fulfilling Next Generation Mobile Networks (NGMN) top OPE recommendations. The SEMAFOUR project is continuously following the progress and important milestones reached in SA5 through the liaison, who is participating in the SA5 meetings.

5.2 NGMN

Two current activities within NGMN are of interest for SEMAFOUR. The NGMN activity on SON is done through the liaison work named “NGMN / NGCOR project Implementation Guide, from requirements to products & solutions” as a follow up work. The main purpose is to track how Standards Development Organisations (SDOs) and NGMN partners (Vendors) are translating or mapping the “NGMN Top OPE requirements” deliverable released in 2010 [7] into implementation phase. This work is done in the framework of 3GPP SA5 Work Item No. 560034 [8], started in January 2013 with completion date September 2013. The SEMAFOUR project is continuously following the progress of this activity both on the NGMN and the SA5 sides. The other activity is the NGMN project “RAN evolution” (P-RANEV), which contains also Dynamic Spectrum Allocation (DSA). Members of the SEMAFOUR DSA use case team are actively participating in this NGMN activity. On June 27, 2013 a presentation of the SEMAFOUR activities on Dynamic Spectrum Allocation has been done to NGMN via phone conference. At the same phone conference it was agreed to prepare a formal liaison statement between NGMN and SEMAFOUR.

5.3 IEEE 802.11

SEMAFOUR has not yet actively contributed to IEEE 802 but is following the developments within this group. There are three Plenary and three Interim Meetings per year. At least for the Plenary

Meetings a representative from SEMAFOUR is attending through partner TUBS. Two interesting activities which might become of interest to the SEMAFOUR use case on Traffic Steering have been launched since November 2012. In November 2012 the EC-Study Group Omniran has been initiated, which targets at providing an abstraction of access networks based on IEEE 802 technologies [9]. Within this activity interfacing to 3GPP networks is discussed [10],[11] and SON in the context of Wi-Fi offloading is subject to discussions in the group [12]. The second activity is the launch of the IEEE 802.11 High Efficiency WLAN Study Group during the March 2013 plenary meeting. This study group had its first meeting in May 2013 [13]. The use cases discussed within this study group [14] explicitly mention scenarios of cellular off-loading.

6 Exploitation

Exploitation of the expected SEMAFOUR results is addressed in the WP6 Activity 6.2 ‘Exploitation’. In this activity a plan for the take-up and exploitation of the project results and gained knowledge will be created. This plan will be based on how the different partners intend to use the results to their own area of business activities. It is developed progressively during the course of the project, and will result in an exploitation roadmap (D6.7) in Month 36.

In this chapter, a first description of the use intentions of all consortium partners is included. These will be further refined during the second and third project year.

6.1 *Nokia Siemens Networks (Germany and Denmark)*

Nokia Siemens Networks plans to exploit the results from SEMAFOUR work in several ways.

The outcome of the work on WP4 (SON for Future Networks) use cases and scenarios will influence the definition of research and innovation activities and concepts for multi-RAT and multi-layer networks. The Nokia Siemens Networks research & technology departments plan to make use of the results of use case and scenario definitions as well as simulator and algorithm development. Furthermore the definition of new measurements and parameter settings for the developed SON functions will influence the corresponding developments within Nokia Siemens Networks, and this also applies for the developed SON architecture and interfaces.

The outcome of the work on WP5 (Integrated SON Management) will influence the definition of research and innovation activities and concepts for SON Operation & Management. The Nokia Siemens Networks research & technology departments plan to make use of the results for SON Coordination, Policy-based SON Management and Monitoring & Diagnosis, in particular, architecture and interface definitions, methods and algorithms for SON conflict detection and resolution, methods and algorithms for the objective/policy-driven control and setup of individual SON functions and the SON system as a whole, and finally simulation scenarios and results for the different WP5 tasks.

Generally, all results from the SEMAFOUR project, and the associated methods, methodologies and simulation scenarios and environment, are planned to be used for the verification of SON concepts and as input to SON feature development within the corresponding Nokia Siemens Networks products. The SEMAFOUR results will furthermore be used as input to ongoing cooperation projects with different German universities, and as potential input to new internal research projects at Nokia Siemens Networks.

The self-organisation results jointly developed within SEMAFOUR will also support Nokia Siemens Networks to push SON in 3GPP standardisation, mainly in RAN2, RAN3 and SA5 working groups.

6.2 *atesio*

atesio intends to exploit results from the SEMAFOUR project primarily in three domains.

1. The project will deepen atesio’s insights into how to efficiently perform simulations of multi-RAT networks with distributed SON functionalities. These insights will be valuable in extending atesio’s SONLAB.
2. The project will establish know-how on policy-driven network management. atesio will use this know-how for developing own or third-party software solutions for dedicated tasks in the context of policy-driven network management (or for consulting on that matter).
3. The project, furthermore, will improve atesio’s insights into the interplay of classical network planning / optimisation, automation of various tasks in that context using a “SON-light approach,” and the capabilities of proper SON functions. The resulting know-how shall be exploited in consultancy projects on efficient processes for network operations.

In addition to the above technical/business objectives, atesio uses the project to train existing and new staff.

6.3 Ericsson

Ericsson will exploit results from the SEMAFOUR project and knowledge gained during the project in the different steps of the work towards developing SON features and management system for SON features for future mobile networks. To start with, the outcome from the SEMAFOUR project will be used as input to research studies on SON in multi-RAT and multi-layer, as well as on SON management functionality. This will apply for internal research studies, but also for cooperation between Ericsson and academia, such as PhD and master thesis projects. Further, the knowledge gained and the results and conclusions reached within the SEMAFOUR project will lead the way for product decisions and the development of SON functionality and SON management functionality within Ericsson product development.

Through the SEMAFOUR project, a network with research organisations and companies working within the SON field is established. This network will be useful also outside the SEMAFOUR project work, enabling research cooperation and contacts important for future standardisation.

The knowledge gained in the SEMAFOUR project will give insights and point the direction for work within standardisation, and standardisation proposals can be given as a result of the findings within SEMAFOUR.

The scenarios and the simulator developed within the SEMAFOUR project will be reused also for internal simulations. Finally, the demonstrator developed within the SEMAFOUR project will provide a means to show the gains of SON and SON management both internally within Ericsson and externally.

6.4 iMinds

iMinds will exploit the results and knowledge obtained in the SEMAFOUR project mainly in research and educational activities. Within the project, iMinds has and will gain knowledge on LTE, self-management, and SON functions for multi-RAT and multi-layer scenarios in general, and on how to optimise the performance of highly mobile users, on idle mode mobility optimisation, and on LTE/Wi-Fi traffic steering techniques in dense urban deployments in particular. Further, the SEMAFOUR project enables the iMinds teams to enlarge their experience with the OMNET++ simulation tool and the simulator developed with it and with the openEPC emulation platform. Also additional components for these tools will be developed, and expertise in building demonstration tools will be gained.

Results and experience achieved in the SEMAFOUR project have an immediate positive impact on the research of PhD students working on planning, optimisation and performance modelling of wireless access networks at the PATS - iMinds research group of the University of Antwerp and the IBCN - iMinds research group of the University of Ghent. Additionally, participation in the SEMAFOUR project also results in the definition of new topics for master theses and research internships at these research groups. Research results will be presented at conferences and workshops and in appropriate journals.

The obtained knowledge and competences, as well as the increased experience with simulation, emulation and demonstration tools, will be exploited and used for participation in and the definition of new national and European R&D projects, with partners from academia and industry. Further the building up of knowledge on the mentioned areas has an immediate impact on teaching activities, and as such on the education of the students that follow the telecommunication courses at the University of Antwerp or the University of Ghent. In particular the content of the courses “Mobile and Wireless Networks” in the master Computer Science at the University of Antwerp and the course “Mobile Broadband Access Networks” in the master Computer Science Engineering at the University of Ghent will be updated with new insights obtained from participation in the SEMAFOUR project.

6.5 France Télécom - Orange Labs

The SEMAFOUR results will be exploited by France Télécom - Orange Labs as follows:

1. By assessing the performance of evolved SON functions proposed in SEMAFOUR, France-Télécom - Orange Labs can determine which SON function will bring a significant gain.

SEMAFOUR project results will then help to define the functions that should be required in network equipment as well as the related requirements to be provided to network vendors.

2. Considering SON coordination and management research activity, France Télécom - Orange Labs will use the expertise gained in the project to ensure that SON functions are used optimally, in a coordinated manner. The unified management framework aims at guaranteeing that the whole SON system fulfils the high level operator objectives and hence is in line with the vision of France Télécom - Orange Labs on SON management. The definition and performance evaluation of the unified SON management framework will be used by France Télécom - Orange Labs for promoting this framework both in standardisation (by defining the corresponding requirements) and internally (to be part of the required future network components).

6.6 *Telefónica I+D*

Telefónica I+D (TID), as a part of the Telefónica Group, is in charge of innovation and strategic vision in emerging network technologies, with its main goal in applying new ideas, concepts and practices in addition to developing advanced products and services. With this global view TID will disseminate and seek for application opportunities (mainly in trials and tests) of the project research results within the relevant Telefónica business units in Europe and worldwide, promoting the results and ideas inside their strategic roadmaps.

SON technology is expected to fulfil Telefónica's business and technology requirements for the increasingly demanding mobile broadband world, and the research work that will be carried out in SEMAFOUR, mainly in the field of integrated SON management, represents for Telefónica I+D an excellent opportunity to be aware of and learn more about the latest progress in bringing SON implementation into the future real mobile broadband world, where highly condensed mobile networks are expected, simplifying the combination of different technologies and layers working and being managed all together as a whole. This knowledge acquired during the SEMAFOUR project will be transferred to the Telefónica Group (through internal dissemination sessions) and will help Telefónica to go ahead in the SON world with the leading companies, having the possibility to automate many LTE activities including roll-out, operations and optimisation, with the business gains in CAPEX and OPEX that these would entail. High-skilled field engineers would not be required on site, since configuration and integration processes of eNodeBs would be performed remotely in an automated way thanks to the adoption of SON technology. Self-organising features could be negotiated globally with big vendors and included in annual all-inclusive software fees of the operator.

For the longer term a new customer-centric network operating model is envisioned in Telefónica. Telefónica I+D is very interested in the concept of a Decision Support System with the aim to help the Telefónica business units on the decision making process when the current network deployment is not enough to offer the users the Quality of Experience they are demanding and it is mandatory then to modify or enhance the networks to reach the expected quality objectives. With the knowledge obtained in SEMAFOUR Telefónica I+D will improve its in-house dimensioning tool for traffic and capacity predictions. The new improvements could be applied then in the short/medium term by any Telefónica business unit mainly for optimising the CAPEX, just upgrading the networks where it is really needed (where the users are demanding it).

6.7 *TNO*

As a non-profit organisation for applied research it is TNO's mission to initiate and support innovations in the ICT industry (and in other businesses where ICT plays a crucial role) through contract research and consultancy. The SEMAFOUR project provides an excellent opportunity for TNO to expand its leading-edge expertise on ('traditional') human involved mobile network operations to the promising field of self-management of heterogeneous (multi-layer, multi-RAT) mobile networks. The gained knowledge, both on heterogeneous networking technologies in general and on self-management, will in particular be used to support and advise mobile network operators.

We distinguish roughly three phases in the envisioned role of TNO regarding the introduction of self-management in heterogeneous mobile networks.

- Phase 1 (2013-2015): Provide consultancy regarding (i) the (potential) benefits of self-management (ii) the actually available functionalities on the short and medium term based on the state-of-the-art of this technology, and (iii) the main implications for network operations. Based on this TNO will support network operators in taking strategic decisions regarding future investments in network equipment and the organisation of their network operations.
- Phase 2 (2015-2018): Support network operators in making concrete introduction plans, and in preparing tenders and assessing offers from vendors. Simulation tools, assessment methodologies and deep knowledge on self-management concepts and methods as being developed in SEMAFOUR will be used here to evaluate and trade-off different scenarios and solutions.
- Phase 3 (2018-2022): Provide consultancy on expansion and optimisation of self-management concepts and functionalities, incl. decision support systems for network evolution and other major network modifications that require human involvement.

In addition, cooperation with equipment vendors is envisioned in the design or enhancement of algorithms and architectures for self-management.

As an important spin-off, our research results will be exploited in the form of scientific papers (several ones have already appeared) and patents, which are useful for strengthening TNO's technological position.

Finally, besides application to (heterogeneous) mobile networks, the generated knowledge and experience will also be applied in the context of other systems and domains where the need for self-management is also emerging.

6.8 Technische Universität Braunschweig

The main task of Technische Universität Braunschweig is higher education and research. The results from SEMAFOUR will be used both in education and research. In education results will be integrated into various courses on Mobile Communications - especially the ones on radio network planning/optimisation and modelling/simulation of mobile radio. Furthermore two Ph.D. students are working in SEMAFOUR and their results will contribute significantly to their Ph.D. thesis. On the research side results will be published at international conferences (e.g. ICC, VTC, PIMRC, IST Mobile Summit, etc.) and journals (e.g. European Transactions on Telecommunications, IEEE Transactions on Vehicular Technology, IEEE Transactions on Wireless Communications, etc.). Furthermore results knowledge exchange will be done with international bodies e.g. COST IC 1004, NGMN and IEEE 802. Both the publications and the results knowledge exchange will strengthen the position of TUBS within the scientific communities working of cellular networks. Of specific value will be the gained knowledge and the simulation software developed within the project. The expertise and availability of the software tools will form a solid basis for the acquisition and execution of further projects. Furthermore the availability of software tools and scenario data as developed within the project will also be an ideal starting point for final student projects enabling TUBS' students to do projects using cutting edge technology.

7 Concluding Remarks

During the first year of the SEMAFOUR project, dissemination activities have mainly focused on making the project visible and accessible in the research community as well as in the telecom industry, and spreading information on the vision and the high level objectives of the project. This has been done through creating accessible information material such as the SEMAFOUR web page, the SEMAFOUR presentation and the SEMAFOUR poster presentation, but also through publications and by participating and giving presentations in different scientific meetings, conferences and workshops.

Further, demonstrations have been given exemplifying how the network behaviour could be controlled by enforcing different parameter settings corresponding to different high-level objectives, hence giving an insight to the vision of using high-level policies to manage the network.

The work with setting up a structured and easy way to cooperate between partners through email reflectors, the team collaboration site and phone conference bridges have highly facilitated and encouraged the dissemination within the SEMAFOUR project. Another contributing factor for well working collaboration is the quarterly face-to-face plenary meetings.

The exploitation plans made by each partner have already led the way in exploiting the results from the project within the organisations, and as the project continues, more results will be exploited within the partners' organisations e.g. for research, business decisions and education.


Dissemination during the first year of the SEMAFOUR project can be seen as successful. The project has been visible within the scientific community, both through publications, presentations and demonstrations and through cooperation with other projects and organisation of the first SEMAFOUR workshop. Further, contact with industry have been established, both through regular meetings with the project advisory board and through meetings with industry analysts, disseminating our future vision for SON.

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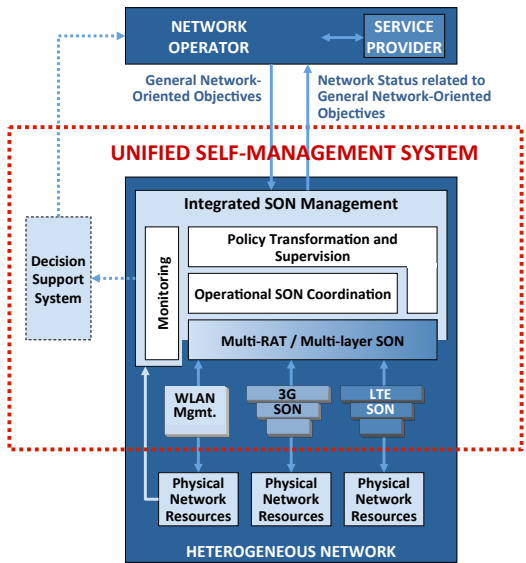
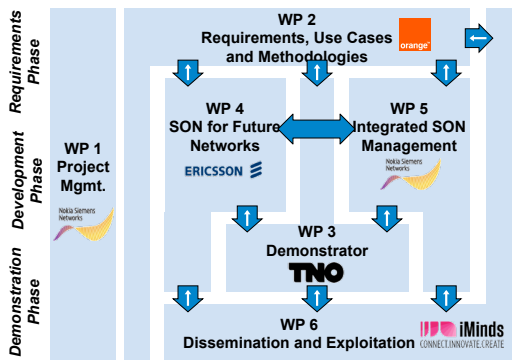
Appendix A SEMAFOUR Poster Presentation


This appendix shows the SEMAFOUR poster presentation (see Section 2.2).



SEMAFOUR

Self-Management for Unified Heterogeneous Radio Access Networks

Objectives and Goals	Vision
<p>Holistically manage heterogeneous radio access networks with multiple RATs / layers:</p> <ul style="list-style-type: none"> Develop concepts, methods and algorithms for a selected set of multi-RAT / multi-layer SON functions Develop concepts, methods and algorithms for an integrated SON management, to control and coordinate individual SON functions according to high-level operator objectives Proof-of-concept through extensive simulations and a demonstrator <p>Simplify the operation of heterogeneous radio access networks:</p> <ul style="list-style-type: none"> Considerably improve the manageability of the network Provide performance and capacity gains Reduce the network management costs 	
Facts & Figures	Use Cases
<ul style="list-style-type: none"> Website: www.fp7-semafour.eu Scheme: EU FP7 STREP (No. 316384) Duration: 09/2012 – 08/2015 Effort: 500 Person Months Budget: 6.1 M€ (total), 3.8 M€ (funding) Coordinator: Dr. Colin Willcock Nokia Siemens Networks, Germany 	<p>WP4 SON for Future Networks</p> <ul style="list-style-type: none"> Resource Management Supporting Dual Connectivity Dynamic Spectrum Allocation and Interference Management Multi layer LTE/WiFi Traffic Steering Tackling the Problem of High Mobility Users Active/Reconfigurable Antenna Systems <p>WP5 Integrated SON Management</p> <ul style="list-style-type: none"> Operational SON Coordination Policy-based SON Management Monitoring and Diagnosis Decision Support System <p>➤ The evaluation of all use cases is performed on simulators using a common realistic network layout</p> <p>➤ A selection of the developed solutions will be shown with a common demonstrator</p>



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Appendix B First SEMAFOUR Workshop: Program

This appendix shows the program of the first SEMAFOUR workshop (see Section 3.5.1).



This workshop presents an overview of the **main challenges of management frameworks for future mobile communication networks**. It is organized by the following projects:

- **UNIVERSELF**: providing a unified management framework capable of managing intelligent autonomic functions
- **COMMUNE**: using knowledge based reasoning and learning techniques to cope with uncertainty in network management
- **SEMAFOUR**: providing a unified self-management system through a set of SON (Self-Organizing Network) functions and an integrated SON management system.

Program:

First Session (90 min)

- *Management frameworks for future mobile communication networks: main challenges*
Henning Sanneck (Nokia Siemens Networks – Germany)
- *Challenges for heterogeneous network management and coordination* –
Pierre Peloso (Lucent-Alcatel - France)
- *Challenges for network management frameworks dealing with uncertainty* –
Seppo Hämmäläinen (Nokia Siemens Networks – Finland)

Second Session (90 min)

- *Challenges for SON functions and SON management* –
Colin Willcock (Nokia Siemens Networks – Germany)
- *The development of SON for future mobile networks* -
Neil Scully (Vodafone – UK)
- *Discussion panel on next steps: filling the standardization and industry gaps, foster industry adoption, roadblocks*