

SAPHYRE — Sharing Physical Resources Mechanisms and Implementations for Wireless Networks

This is our vision: (i) to show how voluntary sharing of physical and infrastructure resources enables a fundamental, order-of-magnitude gain in the efficiency of spectrum utilisation; (ii) to develop the enabling technology that facilitates such voluntary sharing; and (iii) to determine the key features of a regulatory framework that underpins and promotes such voluntary sharing.

At a glance: SAPHYRE

**Sharing Physical Resources –
Mechanisms and Implementations
for Wireless Networks**



Project co-ordinator

Hrjehor MARK

Technische Universität Dresden

Phone: +49 351 463-32230

Fax: +49 351 463-37236

Email: info@saphyre.eu

Website: www.saphyre.eu

Partners

Alcatel-Lucent Deutschland AG (DE),
 Consorzio Ferrara Ricerche (IT),
 České vysoké učení technické v Praze (CZ),
 EURECOM (FR),
 Fraunhofer Institut HHI/MCI Berlin (DE),
 Linköpings universitet (SE),
 TNO (NL),
 Technische Universität Ilmenau (DE),
 Wrocławskie Centrum Badań EIT+ (PL).

Duration: 01/2010–12/2012

Total costs: €5.3m

EC contribution: €3.8m

Funding scheme: STREP

Contract number: INFISO-ICT-248001

Main objectives

In current wireless communications, radio spectrum and infrastructure are typically used such that interference is avoided by exclusive allocation of frequency bands and employment of base stations. SAPHYRE will demonstrate how equal-priority resource sharing in wireless networks improves spectral efficiency, enhances coverage, increases user satisfaction, leads to increased revenue for operators, and decreases capital and operating expenditures.

SAPHYRE aims at developing new approaches to make better use of the spectrum resources that are available for mobile communication services. Development will be focussed on new principles and enabling technology for resource sharing in wireless networks, specifically for sharing of spectrum and infrastructure.

The main topics emphasised in the SAPHYRE project are: *Self-organising infrastructure sharing, new adaptive spectrum sharing models, efficient autonomous co-ordination, and high spectral efficiency.*

SAPHYRE will develop *modern and novel physical layer techniques*, including network and interference aware modulation/coding, multi-antenna, spatial scheduling, multi-hop, and relay co-operative transmission, leading to a high spectral efficiency for wireless communications.

The common background is that different users can all gain from a collective approach, if they voluntarily share the spectrum between them. But also operators will earn increased revenue by spectrum and infrastructure sharing due to a higher quality of the services they can offer. Furthermore, the SAPHYRE project will show how the different options for making more efficient use of spectrum resources will fit within the regulatory frameworks as they currently exist and recommendations will be made assisting ongoing regulation processes, which changes in the regulatory framework would be required or beneficial in order to provide optimal opportunities for the identified innovations.

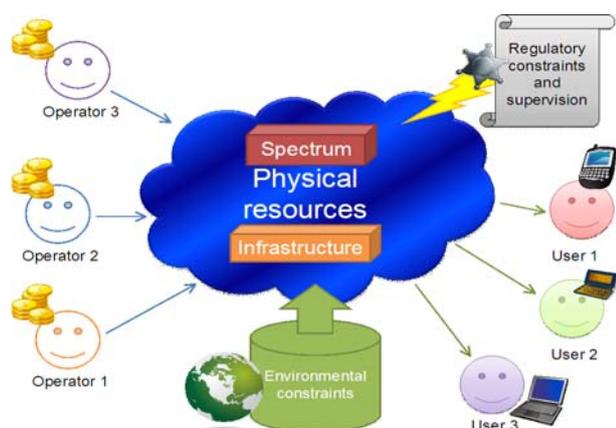
SAPHYRE

*paving the way
for paradigm
change from
exclusive
resource
allocation
to voluntary
physical
resource
sharing*

Key issues

SAPHYRE's main objectives are listed in the following and they are conceptually illustrated in the figure below:

1. SAPHYRE will analyse and develop **new adaptive spectrum sharing models** by a generalised **cross-layer** and **cross-disciplinary** approach.
2. SAPHYRE will propose and analyse **efficient co-ordination** mechanisms which require as less regulation as possible (to counteract selfish, malicious users). In particular in sharing scenarios, **incentive based design** is applied in order to reduce regulatory complexity.
3. SAPHYRE will develop a framework for **infrastructure sharing** to support a **quality of service** (QoS) with sufficiently wide carrier bandwidths and **competition** between different operators.
4. SAPHYRE will develop **modern and novel physical layer techniques**, including MIMO, SDMA, multi-hop, relay co-operative transmission which lead to **high spectral efficiency**.

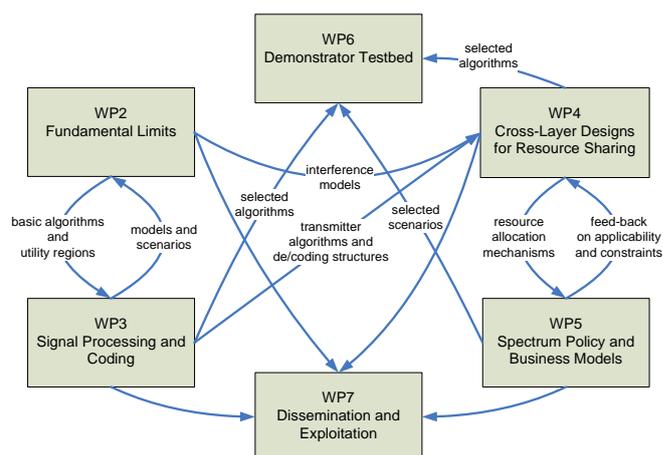


The physical resource sharing problems are interdisciplinary and require input from regulatory and political bodies, business and market experts, and communication and network engineers.

Technical approach

The development of novel sharing mechanisms and implementations requires a cross-disciplinary approach. SAPHYRE will enable operators to guarantee cost-effective and energy-efficient high quality services and to earn increased revenue by spectrum and infrastructure sharing.

The technical work packages and their inter-relationships are shown in the following figure.



- WP2 “*Fundamental Limits*” comprises basic limits for system design, game theoretic approaches, and interference and utility modelling,
- WP3 “*Signal Processing and Coding*” consists of applied signal processing, network and interference aware coding and decoding, and model design and evaluation,
- WP4 “*Cross Layer Design for Resource Sharing*” includes joint PHY/MAC and self organisation, network protocol design, and system level assessment,
- WP5 “*Spectrum Policy and Business Models*” develops reference scenarios, business models and pricing, regulation and spectrum policy,
- WP6 “*Demonstrator Testbed*” incorporates scenarios and different test cases, platform development, and test case implementation.

Expected impact

SAPHYRE will reinforce European research and industrial competitive position in spectrum and infrastructure sharing by enabling operators to adapt to the new business opportunities, enabling regulatory bodies to agree on easily maintainable sharing mechanisms, and enabling vendors to develop the new base stations and mobiles using the required radio technologies. The approach of SAPHYRE underlines the systematic collaboration of all sector actors within a consistent framework and a shared vision.

Much has changed since GSM was introduced including user requirements, markets, competition, regulations and policies, and the technology option. SAPHYRE recognises this need for a holistic approach to implement the idea of resource sharing in a timely, efficient, and successful way.