

## What is GAMALINK?

GAMALINK is an FP7 space collaborative project aiming at developing an innovative solution for both space communications and attitude determination, based on multiple promising terrestrial technologies. GAMALINK will use Software-Defined Radio technology as the common hardware platform, on top of which several features will be implemented, like position and attitude determination and networking capabilities. The target system application will be the nano- and pico-satellite platforms and therefore the entire design will be made taking into account the CubeSat constraints and general requirements. Such an integration and miniaturization level will be one of the major challenges of the project.

GAMALINK will bring four different state of the art terrestrial technologies to space:

- Software-Defined Radio (SDR)
- Ad hoc networking,
- Antenna design & integration techniques
- Beam forming electronics.

## SDR-based Space Communications

GAMALINK combines expertise on satellite navigation, ad hoc networking, attitude determination, antenna design and beam forming into a common technological platform, suitable for LEO CubeSat and small satellite missions. The hardware is based on Software-Defined Radio (SDR), an innovative terrestrial concept that enables the development of various waveforms using a common hardware platform. This can result in tremendous mass and volume savings, while increasing flexibility to a point where a radio system could be completely modified by just sending a command from ground. It also allows operating different subsystems simultaneously in the same platform, such as radio communications or GNSS reception.

## GAMALINK Capabilities

On top of this radio platform, a set of different techniques will be implemented:

- Mobile ad hoc networking, an enabler for creating Inter-Satellite Links (ISLs) for distributed architecture missions, like formation flying or planetary surface exploration.
- Radio-based attitude determination, through the measurement of carrier phase delays between signals transmitted from multiple antennas.
- Software GPS waveform reading and signal decoding.
- Ranging between different satellites, based solely on the transmission of communication signals.

GAMALINK will also focus on innovative antenna and RF frontend design and beam forming techniques, trying to develop hardware solutions that can cope with the flexibility introduced by SDR.

Current State of the art	Innovations proposed by GAMALINK
SDR is mainly a terrestrial technology.	Adapt the design of a terrestrial SDR platform for space use, using radiation tolerant circuit design and robust components.
CubeSats use mainly omnidirectional antennas.	Design and develop new directional smart antennas supported by beam forming electronics to perform beam steering.
Low data rate transmissions are used in space	Propose and use a wide range of high-frequencies in support of GAMALINK functionalities as required.
Communications and attitude and position determination are made separately	Integrate communications, networking, attitude determination, ranging and position determination on a single hardware communications platform based on the flexibility of SDR.
CubeSats only transmit in one frequency.	The SDR platform together with a flexible and robust RF frontend and antenna design will enable the use of a wide range of frequencies.
RF component sizes are usually large.	GAMALINK's RF frontend design will be miniaturized in order to fit the smaller space possible to cope with CubeSat requirements.
Ad hoc networking is a terrestrial technology	GAMALINK will add ad hoc networking capabilities to CubeSats, enabling the establishment of Inter-Satellite Links.
CubeSats are performing mainly educational missions.	Propose higher quality and higher performance solutions for CubeSats to make them suitable for advanced missions like formation flying or technology validation by integrating the functionalities of ad hoc networking, attitude determination and ranging.
Radio ranging and localization systems design comes from terrestrial applications.	GAMALINK will develop a ranging system design tailored to the space application of formation flying satellites (inter-satellite ranging).
Single sensor systems for ranging measurement	Exploration of carrier phase measurements for providing increased ranging accuracy.
Ranging solutions are standalone	GAMALINK will integrate ranging techniques on top of a multipurpose SDR communications platform, where it can benefit from other implemented functionalities



[www.gamalink.eu](http://www.gamalink.eu)



The work presented herein has been partially funded by the European Community's Seventh Framework Programme (FP7) under Grant Agreement 312830.

The GAMALINK project (Generic SDR-bAsed Multifunctional spAce LINK) is a project funded under the topic "SPA.2012.3.1-01 – Bringing terrestrial SME research into the space domain", involving 6 partners and started on January 1st 2013.

