DOMINO – Laser Communication between SOTA, onboard SOCRATES satellite, and MEO Optical Ground Station. D-H. Phung[1], E.Samain[1], N. Maurice[1], H. Mariey[1], C. Courde[1], G. Artaud[2], J-L. Issler[2]
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Introduction:

In the presentation, we will describe the laser communication project we are involved in: DOMINO (**D**emonstrator for **O**ptical tele**M**etry at h**I**gh data rate i**N** low earth **O**rbit). The project is conducted in collaboration between the French national centre for space studies (CNES), the Cote d'Azur observatory (OCA), Thales Alenia Space, Airbus Defense & Space, ONERA and NICT. GeoAzur is the project general contractor. DOMINO project aims to demonstrate the feasibility of a communication link (the establishment of 10 Mbps) between SOTA [1] (Small Optical Transponder) onboard SOCRATES microsatellite (Space Optical Communication Research Advanced Technology Satellite), and the MeO station located at Caussol, France. The main challenges of the project are the characterization of the turbulent atmosphere and the detection at ground of the signal coming from the satellite. We will first describe SOCRATES and SOTA characteristics and then present the MeO station and the measurement benches.

SOCRACTES and SOTA characteristics: The SOCRATES microsatellite, engineered by AES, was launched (altitude = 628 km, inclination = 97.69 °) on May 24, 2014. The main objectives of SOTA, developed by NICT, are: in-orbit verification of acquisition, tracking and pointing performances; data acquisition of laser beam propagation at various wavelengths; and laser communication experiments with coding. Development of SOTA started based on the bread board model with an optical part and a controller [2].

For a given passage of the satellite over the MeO station, MeO points the satellite according to the predicted orbital information. As soon as the uplink is acquired, the satellite turns on the transmission laser (Tx1 or Tx4) and points back the beam in the Meo orientation. When both uplink and downlink are acquired and slaved together, the communication link is established, Fig.1.

MeO optical ground station: The MeO station, based on a 1.54 meter Cassegrain telescope installed on an Alt-Az mount, is dedicated for researches on Lunar laser ranging, satellites laser ranging [3], time transfer [4], astronomy and laser communication. The main characteristics of MeO station are given in table 1. It comprises an important experimental setup for laser ranging and also an adaptive bench well suited to analyze the turbulent atmosphere

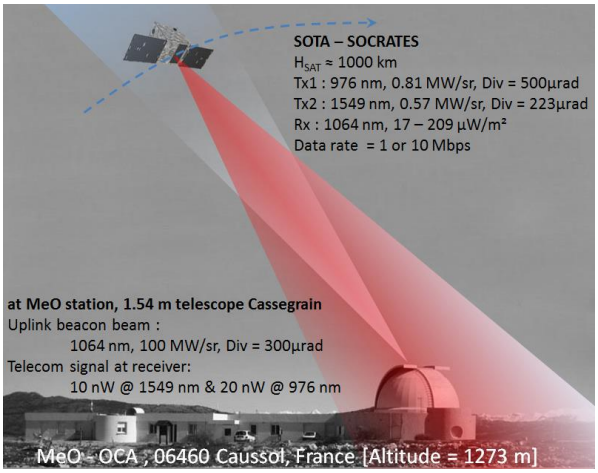

Fig.1. Configuration of the MeO station-to-SOTA laser link

Table1.MeO station parameters

Telescope type		1.54 m Cassegrain
Weight of the mobile elements		20 tons
Diameter of the dome		9 m
Motorization – Dome	**maximum speed**	5°/s
	pointing accuracy	< 1 arcsec
	pointing precision	0.01 arcsec
	Pointing stabilization	0.2 arcsec at 1000 s
Coudé : M4-M7 (Laboratories)	**diameter &type**	200 mm plat fold mirror
	bandwidth	350 - 1200 nm
	damage threshold	10 J/cm² for ns pulse
Equivalent Focus length		32 m
Field of view		5 arcmin
Station altitude		1323 m

Geoazur together with the industrial partners will design the demonstrator instruments. It comprises the uplink beacon; the downlink receiver; the equipments for atmospheric turbulence analysis and the software to control the whole experiment. We also implement a closed loop system to slave the pointing of the telescope on the SOTA beacon signal. This work also includes the integration of a SOCRATES searching algorithm.

[1] Koyama Y. et *al.* (2013) *AIAA - ICSSC.*
[2] Koyama Y. et *al.* (2011) *ICSOS,* 99-101.
[3] Courde C. et *al.* 2012) *I.W on laser ranging.*
[4] Samain E. et *al.* (2013) *I.W on laser ranging,* 13, 47.