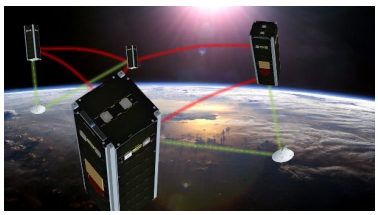
Press release 4/2020
19.9.2020



ZENTRUM FÜR TELEMATIK

Netsat: Premiere for Self-Organizing Satellites in 3D

End of September the four "NetSat" pico-satellites will be launched to demonstrate first time worldwide control of a three dimensional configuration in space. This will offer opportunities for new observation methods in climate research and for innovative communication systems.

Many of the great challenges of our time, including climate change, ensuring public safety, support in emergency, and being connected everywhere at any time, will require innovations in satellite technology. Faster reactions, more flexibility, accuracy and cost-efficiency are needed, if we are to successfully confront these challenges. NetSat is about to make a crucial step into this direction by distributed, cooperative control.

At noon on 28. September 2020 a Soyuz-Rakete will lift-off into orbit with three Russian Gonets telecommunication satellites and 19 small satellites. Also included are the four NetSat pico-satellites from Würzburg. At the size of a shoebox with a mass of 4 kg each, their objective is to test first time all crucial techniques for optimal self-organization of a satellite formation in a three dimensional configuration. This will not only enable new approaches to Earth observation, but also to future telecommunication networks – while reducing the high costs that hamper today's space missions.

The four pico-satellites are already integrated in the Soyuz rocket in the Russian cosmodrom Plesetsk. On 28.9. they will be transferred into an orbit at 600 km altitude. „The scientific objective is the capability to autonomously coordinate and control the formation in order to realize an optimum configuration in three-dimensional space for observations", Professor Klaus Schilling explains, who received 2,5 Mio € for „groundbreaking research in networked control in space" through a distinguished Advanced Grants from the European Research Council (ERC). The significant application potential of this mission was supported by additional funding through the Bavarian Ministry of Economics.

The satellites were realized by the „Center for Telematics (ZfT)" in Würzburg in cooperation with the start-up company „S^4 – Smart Small Satellite Systems GmbH" because of its outstanding test infrastructure for multi-satellites-systems. „In addition to the extreme technology challenges in the areas of miniaturization, and attitude / orbit control, our team had to handle COVID-19 related complications for delivery of components from all over the world" emphasizes Daniel Eck, CEO of ZfT. The satellites use a very efficient electrical propulsion system (from the Austrian company Enpulsion) and very small precision reaction wheels (from S^4–Smart Small Satellite Systems and Wittenstein Cyber Motor) to achieve high accuracy pointing. The radio link between satellites supports data exchanges with respect to position, pointing and planned maneuvers. This enables coordination of the four NetSat satellites in combination with advanced networked control methods. While the long-term task planning is done by the ground control center in Würzburg, the reaction on disturbances and fine tuning of the formation is realized autonomously by software on-board the satellites.

In July the satellites left ZfT / S4 facilities in Würzburg, were integrated in the launch adapters and tested again. Finally the launch provider Exolauch delivered them to the launch site in Plesetsk, where it was fixed on the Soyuz rocket.

The inovative further use of NetSat results is assured by already-contracted future application missions in Earth observation (TIM, TOM) and climate prediction (CloudCT). Thus, it is expected that the information for decisions in emergency situations and for challenges like climate change will be improved by networks in orbit composed by many small satellites.

Press contact: Prof. Dr, Klaus Schilling, Zentrum für Telematik,
Magdalene-Schoch-Str. 5, 97074 Würzburg, Germany
e-mail presse@telematik-zentrum.de, Tel. +49-931-615 633 10

further information: www.telematik-zentrum.de/netsat

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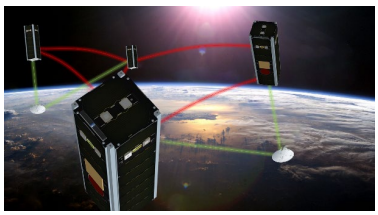

Our background: Our team launched the first German pico-satellite UWE-1 (with a mass of 1 kg) in 2005 for experiments on "Internet from space". Its engineering model is now on display in the Deutsche Museum, Munich. The UWE-program (***U***niversity ***W***ürzburg's ***E***xperimental satellites) launched CubeSats to demonstrate innovative technology in orbit targeted to prepare the formation flying technologies of the NetSat mission. Our team received many scientific awards (ERC grants, consulting professor at Stanford, Walter-Reis-Awards, ...), and founded the independent research company ZfT (2007) and the spin-off company "S^4 – Smart Small Satellite Systems GmbH" (2017).

Zentrum für Telematik (ZfT) is an independent research institute, focusing on applied research for industry and basic research with focus on development of interdisciplinary and innovative telematics solutions in the application fields space exploration, industrial production and robotics. Telematics (= ***tele***communication + auto***mati***on + informa***tics***) enables efficient control of equipment in remote areas and is a key technology for "Internet of Things", but also for distributed networked space missions like NetSat. Research in the field of space exploration concern small satellites, self-organizing satellite formations, as well as innovative applications of these technologies in Earth observation and telecommunication.

The SME **S^4 - Smart Small Satellite Systems GmbH** (founded 2017) focusses on advanced commercial products for pico- and nano-satellites in the "New Space" market. In particular, its combined hard-/software solutions address high-end performance at minimum mass and power needs. Emphasis is on subsystems like reliable miniature on-board data handling systems or precision 3-axis attitude control systems. These are essential technologies for small satellite formations. S^4 owns and operates two high performance turntables, which offer extremely dynamic performance as well as precision pointing to simulate space conditions for satellites.

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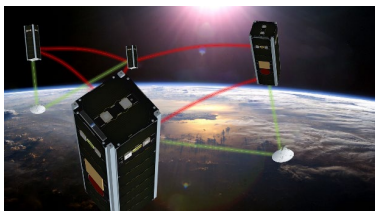

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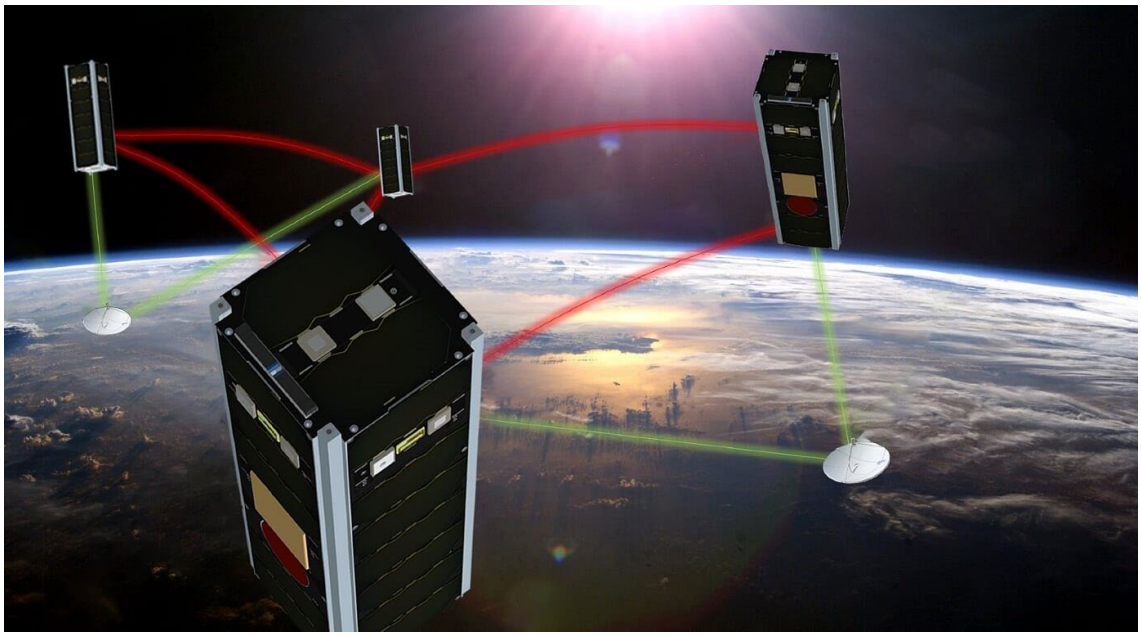
Illustration material

We are pleased to send you on request (to presse@telematik-zentrum.de) related high resolution images from ZfT for use without fees.



NetSat: 4 nano-satellites with dimensions 10 cm x 10 cm x 30 cm for formation flight in an orbit at 600 km altitude (source: ZfT).

The NetSat-team: caring about prescribed Corona distances, here 3 images were superimposed to gether the complete team with the 4 NetSat nano-satellites in one picture. (source: ZfT)

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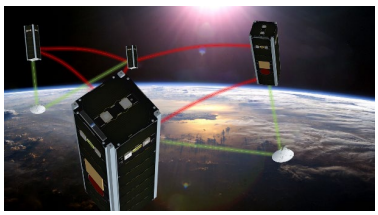

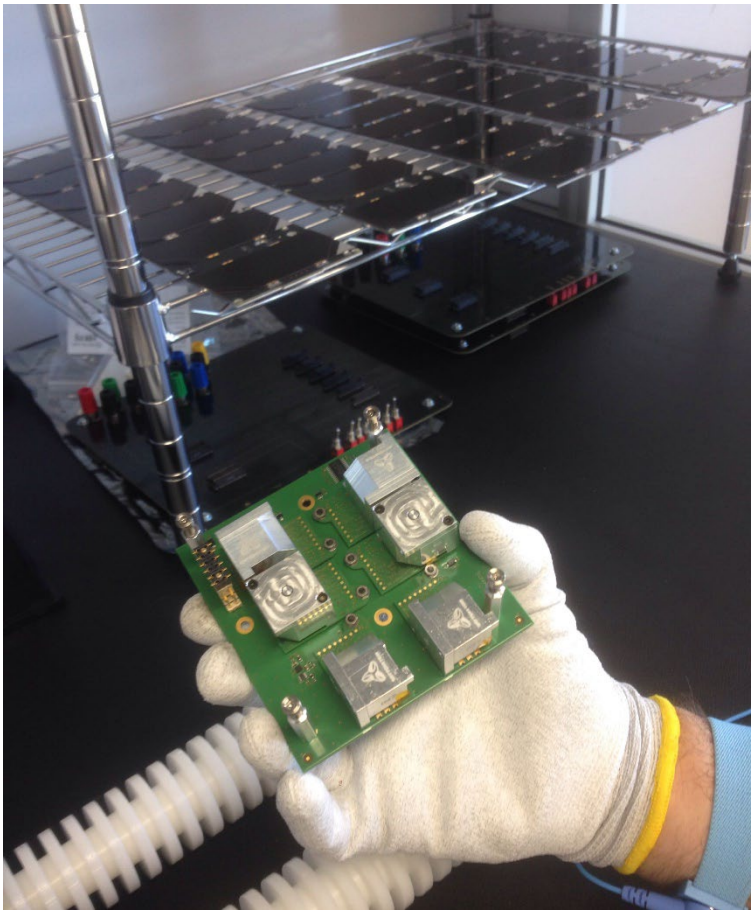

The attitude control system, composed of 6 miniature reaction wheels, guaranteeing by redundant components extreme robustness as well as precision pointing of the satellite. In the background the sidepanels equipped with are stored (source: ZfT).

One of the 4 NetSat nano-satellites completely integrated (source: ZfT).

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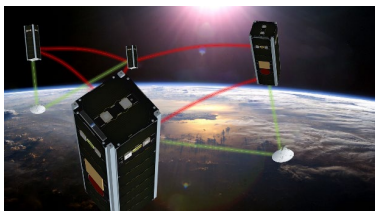

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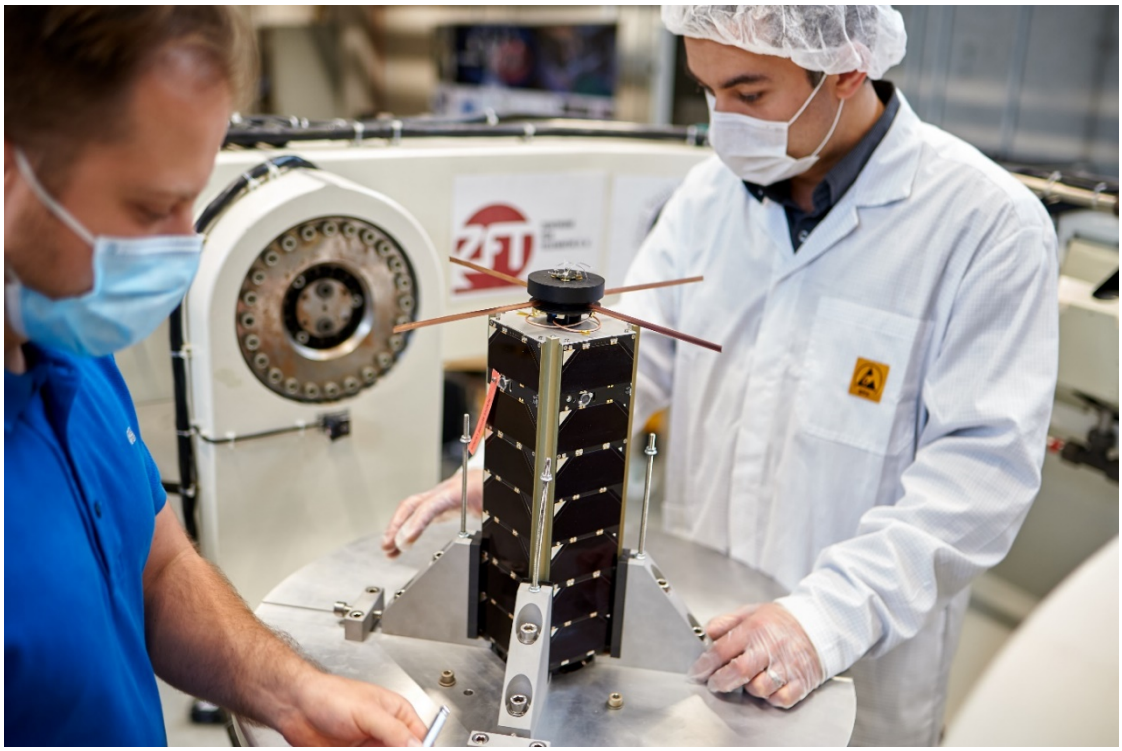

Preparation of a NetSat satellite for testing on an extremly dynamic turntable (source: S^4 GmbH)

Rotation test of a NetSat on the turntable (Quelle: S^4 GmbH)

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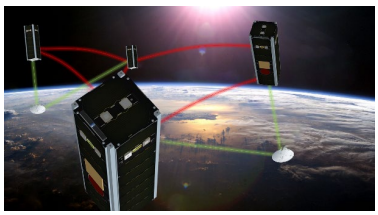

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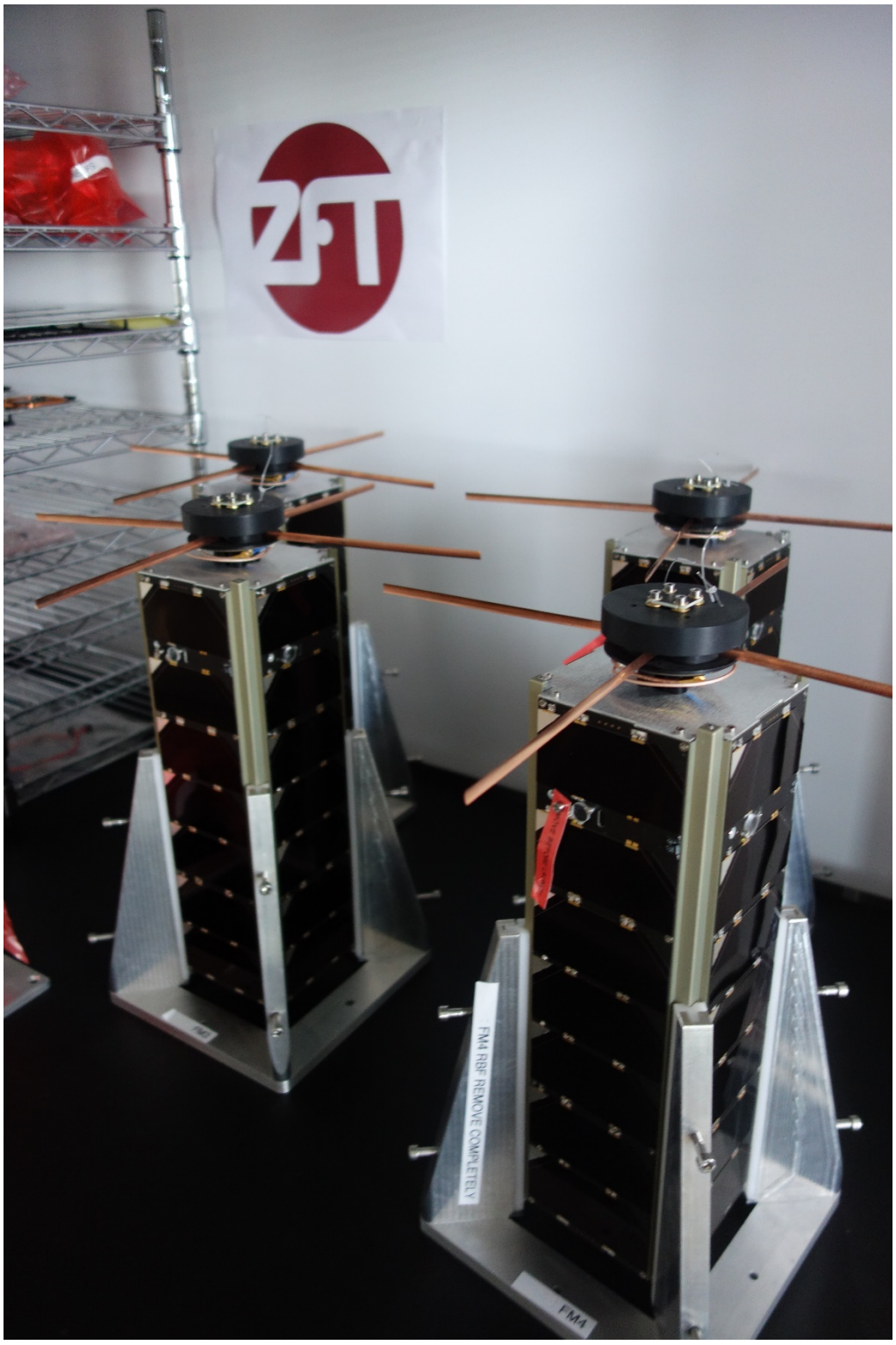

The 4 NetSat satellite are waiting in the cleanroom for delivery to the launch site. (Quelle: ZfT)

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