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FOREWORD

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The Times They Are A-Changin'...

Bob Dylan has always been an out-of-the-box thinker. In 1965 he shocked the visitors of the traditional Newport Folk Festival, and the whole music world, by plugging in an electric guitar and alienating folk purists - and he continued to confound expectations ever after. The lyrics of his song “The Times They Are A-Changin’” are relevant more than ever. In an ever changing world, the way we live and act is also constantly changing and we either change with the times, or we are left behind. This applies in particular to the space sector.

Within Space 4.0, the area covered by space activities, already very broad, is now expanding in the direction of commercialisation, public and private activities, spin-off and spin-in, and more direct interaction with society. This also leads to new roles for agencies and industry that transcend the traditional definitions of purchaser and supplier.

Space is evolving from being the privilege of the governments of a few space faring nations to a sector seeing engagement from governments around the world, the emergence of private actors and inclusive interaction between governments, the private sector, society and politics. Industry is entering into a new era characterised by revolutionized design, production and management mechanisms; space as a sector will follow, and in some areas is already following, this trend, as a result “commoditizing” spacecraft manufacturing while all other strategic features are retained.

As the space sector matures and becomes more interconnected with other technology fields, innovation in space technologies and applications is increasingly linked to innovation in other

fields and parts of society; and vice-versa: many general use technologies – such as artificial intelligence, advanced robotics and three dimensional printing – have great potential for applications in space. In this dynamic, evolving scenario, the seeds of future economic growth are planted.

It is the role of ESA to shape this new era.

At the Council at Ministerial level on 1-2 December 2016 (CM16) in Lucerne, Switzerland, this role has been reassured. Ministers in charge for space matters from ESA's 22 member states plus Slovenia and Canada allocated €10.3 billion for space activities and programmes based on the vision of a United Space in Europe in the era of Space 4.0.

The high level of subscriptions demonstrated once more that ESA's Member States consider space as a strategic and attractive investment with a particularly high socio-economic value. It also underlines that ESA is THE European Space Agency capable of channelling their investment to respond effectively to regional, national and European needs by covering all elements of space: science, human spaceflight, exploration, launchers, telecommunications, navigation, earth observation, applications (combining space, airborne and terrestrial technology), operations and technologies; as well as responding to the needs and challenges of Europe and the Member States by bringing together all stakeholders.

Ministers confirmed the confidence that ESA can conceptualize, shape and organize the change in the European space sector and in ESA itself. While also acting as a global player, broker and mediator at the centre of international cooperation in space

activities, in areas ranging from the far away in exploration (with the concept of a Moon Village for instance) to supporting closer to home the international global climate research effort following the Paris Agreement of 2015.

At CM16, the Earth Observation optional programmes received a total funding of about 1.4 billion euros, providing a solid basis for many activities across the Earth Observation Directorate. Copernicus overall is continuing its success story. By 24 November 2016, 55,346 users had self-registered on the Sentinels Open Data Hub, and more than 14 PB of data had been downloaded in total.

Already this year we have launched Sentinel 2-B. Sentinel-2 carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands for a new perspective of our land and vegetation. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times provides unprecedented views of Earth.

The mission is based on a constellation of two identical satellites in the same orbit, 180° apart for optimal coverage and data delivery. Together they cover all Earth's land surfaces, large islands, inland and coastal waters every five days at the equator.

Later this year Sentinel 5-P will be launched. The Sentinel-5 Precursor mission is intended to provide data continuity for the SCIAMACHY instrument aboard the Envisat satellite and NASA's OMI instrument aboard the Aura satellite in the interim between the end of the Envisat and Aura missions and the launch of Sentinel-5. With no other missions capable of obtaining the data acquired by SCIAMACHY and OMI, Sentinel-5P fills what would be a five-year gap until the launch of Sentinel-5. The mission will perform atmospheric monitoring at high temporal and spectral resolution, and increased cloud-free observation. It is a joint initiative between ESA and the Kingdom of the Netherlands providing the TROPOMI UV-VIS-NIR-SWIR instrument.

And another Sentinel is standing in line. In coordination with the EC as part of the Copernicus constellation for Earth observation in Europe, the second Sentinel-3 satellite will be lifted into orbit

on a Rockot launcher early next year. The main objective of the SENTINEL-3 mission is to measure sea surface topography, sea and land surface temperature, and ocean and land surface colour with high accuracy and reliability to support ocean forecasting systems, environmental monitoring and climate monitoring.

By the end of the year ADM – Aelous will be launched. ADM-Aeolus is the first space mission to acquire profiles of the wind on a global scale. These near-real-time observations will improve the accuracy of numerical weather and climate prediction and advance our understanding of tropical dynamics and processes relevant to climate variability. Many aspects of our lives are influenced by the weather. It goes without saying that accurate forecasts are important for commercial undertakings such as farming, fishing, construction and transport – and in general make it easier to plan the days ahead.

ESA astronaut Thomas Pesquet performed his first spacewalk on 13 January together with NASA astronaut Shane Kimbrough to complete a battery upgrade to the ISS' power system. He returned to Earth on 2 June. The next ESA Astronaut on the ISS will be Paolo Nespoli with the 'VITA' mission. Chosen by ASI, who provides the mission through a barter agreement with NASA, the acronym stands for Vitality, Innovation, Technology and Ability. And another Astronaut joined ESA's astronaut corps. Matthias Maurer was officially announced to the press on 2 February. He was among the 10 finalists in the 2009 selection, and is now undergoing basic training at the European Astronaut Centre (EAC) in Cologne.

Early this year we've taken steps forward in telecommunications. With Hispasat 36W-1 the first telecommunications satellite to use the SmallGEO platform was launched on 28 January. SmallGEO is a telecommunications satellite platform capable of accommodating a wide range of commercial payloads and missions, from TV broadcasting to multimedia applications, internet access and mobile or fixed services in a wide range of frequency bands. SmallGEO's new, modular and flexible design boosts European industry's ability to play a significant role in commercial satcoms by easing entry into the lower mass class telecom satellite market.