PLANETARY NETWORKS BASED ON NANOROUTERS

ASI WORKSHOP

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PLANETARY AND LUNAR COMMUNICATIONS

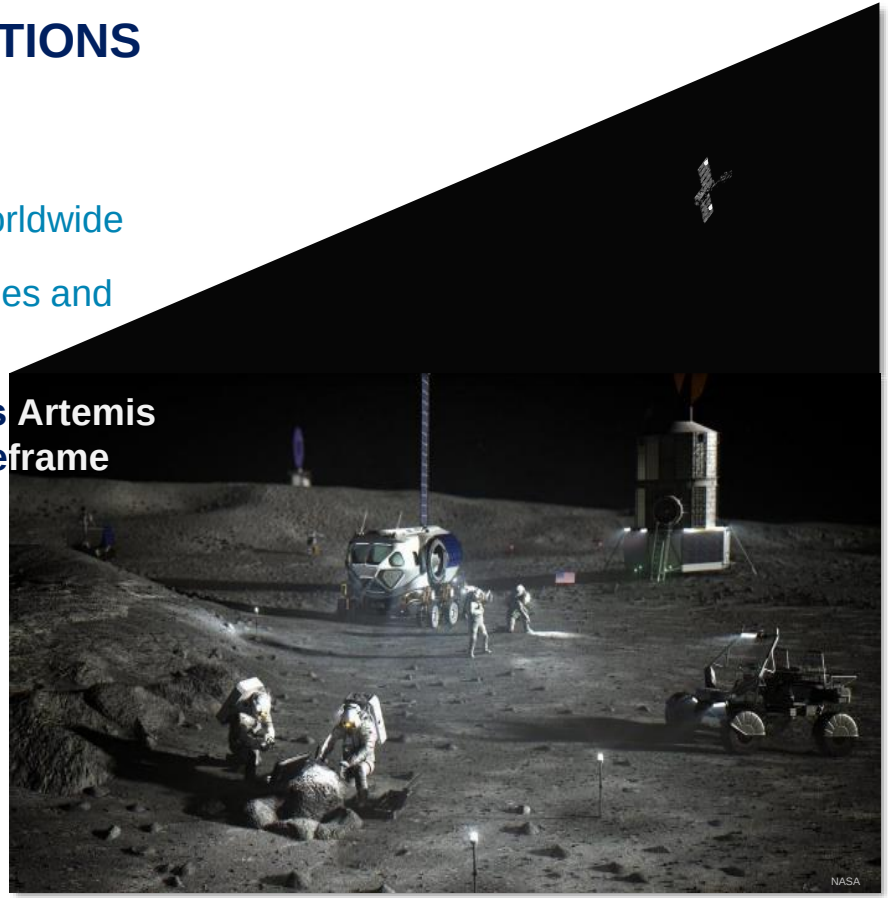
/// Lunar Exploration interest has grown considerably worldwide

/// Moon is an ideal place to develop required technologies and capabilities for human Space exploration.

/// **Lunar communications traffic growth with NASA's Artemis program to return to the Moon in the 2024-2028 timeframe**

/// Moon exploration emerging as priority in space

/// TAS-Italia in primis is supporting the successful Moon Exploration and future Colonization with multiple initiatives including orbiters, landers and international orbiting lunar stations



LUNAR MISSIONS AND MOONLIGHT

/// **Future Lunar Communication missions with support of associated satellites products**

/// **Exploration and Communications long experience**

/// **Interoperability Network for Lunar Communications**

ESA: Lunar Communication and Navigation System (LCNS) - Moonlight

NASA: Near Space Network /LunaNet Interoperability Network Assets- Artemis

Multi Agencies/ Commercial ventures
Lunar Communication

Network Communications Solutions for Lunar Exploration

LUNAR COMMUNICATIONS NEEDS

/// The need to continuous transfer data to and from the Moon led to the development of:

- **Broadband Band Data Transfer Services** transferring data between multi-nodes
- Communications Network concept based on **DELAY TOLERANT NETWORK** (DTN) architectures
- **COMM satellites** with Flexible and **Open Architecture** capable to interface multiple networks

- Development of **new technologies** able to support data traffic, enabling technologies that appear of great interest
- **Technologies** for the segment of the increasingly emerging Low Earth Orbit (LEO) constellations.

Photo: ©ESA

Communications would be a significant service in Cislunar Space

MOONLIGHT: NETWORK CONSTELLATION ON THE MOON

/// Initiative aimed at establishing a Lunar Telecommunications and Navigation System

/// Provide reliable communication services for future lunar missions, and enhance navigation capabilities on the Moon

/// Reliable telecommunications ensured by robust multiusers links, with extended coverage including areas as Far side and poles not visible from Earth

/// Necessity of P/L processors capable to provide dynamic multiuser service at high data rates

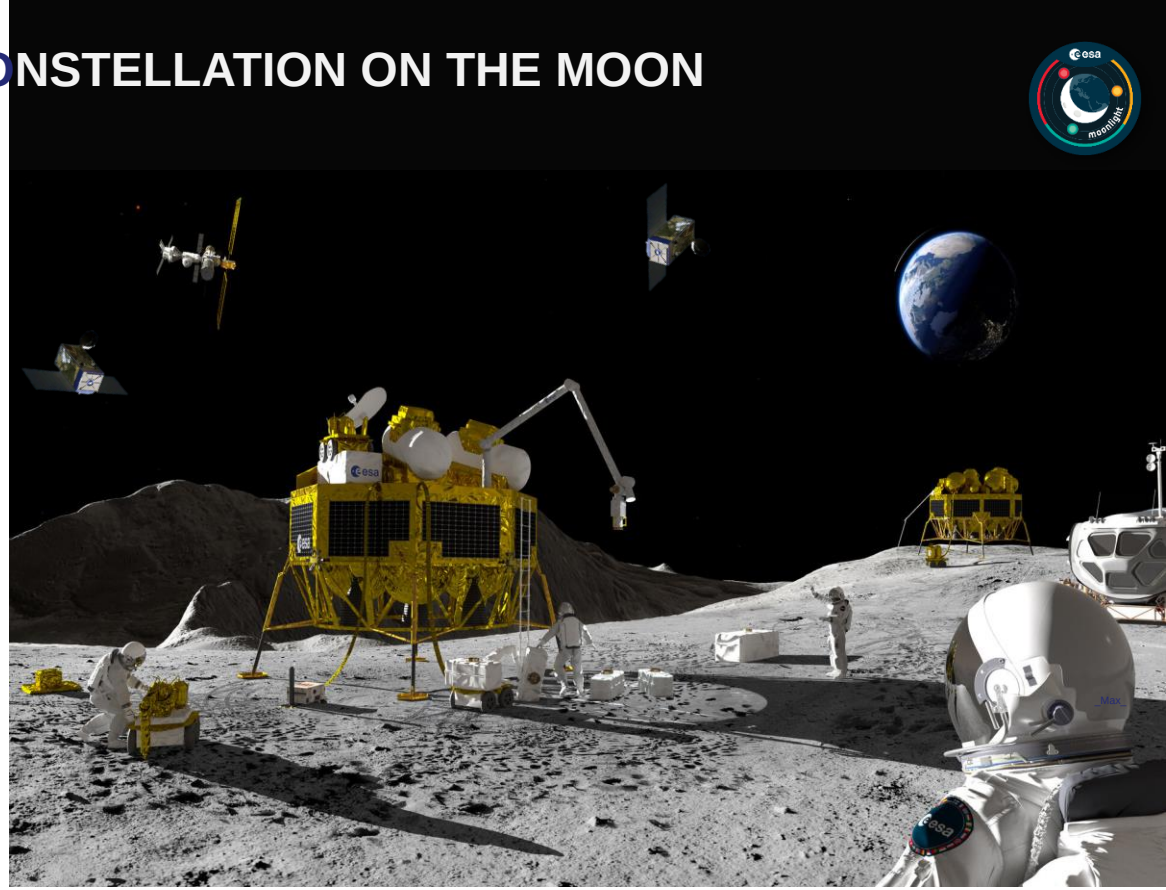
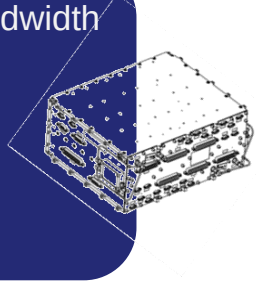


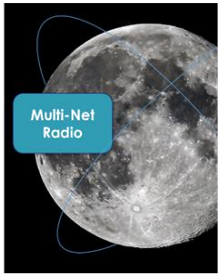
Photo: ©ESA

PLANETARY NETWORKS BASED ON NANOROUTER

/// The technologies necessary to support new systems based on digital processors and routers (e.g. **Nanorouter**) shall have:

1. High-performances→Reliable Data Delivery/ Efficient Bandwidth Usage
2. Small size/mass→ Compatibility with micro and cubesat
3. Reduced Power and Energy consumptions
4. Reprogrammability and reconfigurable → interoperable





/// Features and functionalities that simplify the design of constellations even of **CubeSat**, able to manage broadband communications, while acting as a baseline for future lunar and planetary constellations of nano and micro satellites.

/// The future **Payload Data Processing and Routing function** is designated to receive/or store data coming from the TAS-I transponder RF (e.g. **MultiNet Radio**) and to send or retrieve stored data back to RF transponders for transmission to different orbiting or surface users.

TECHNOLOGY FOR CUBESATS CONSTELLATIONS

/// Small satellite constellations are driving innovation in space services.

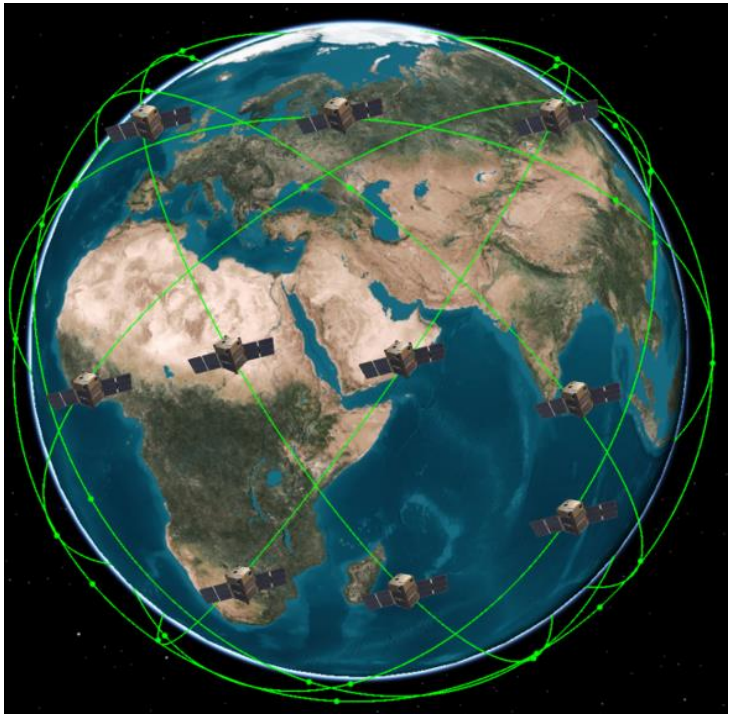
/// **Micro** satellites and **CubeSats** constellations based on new technologies can deliver unique services from **LEO**.

/// The combination of their unique advantages, such as:

- Advanced communications
- Extensive coverage
- Cost-effective operations

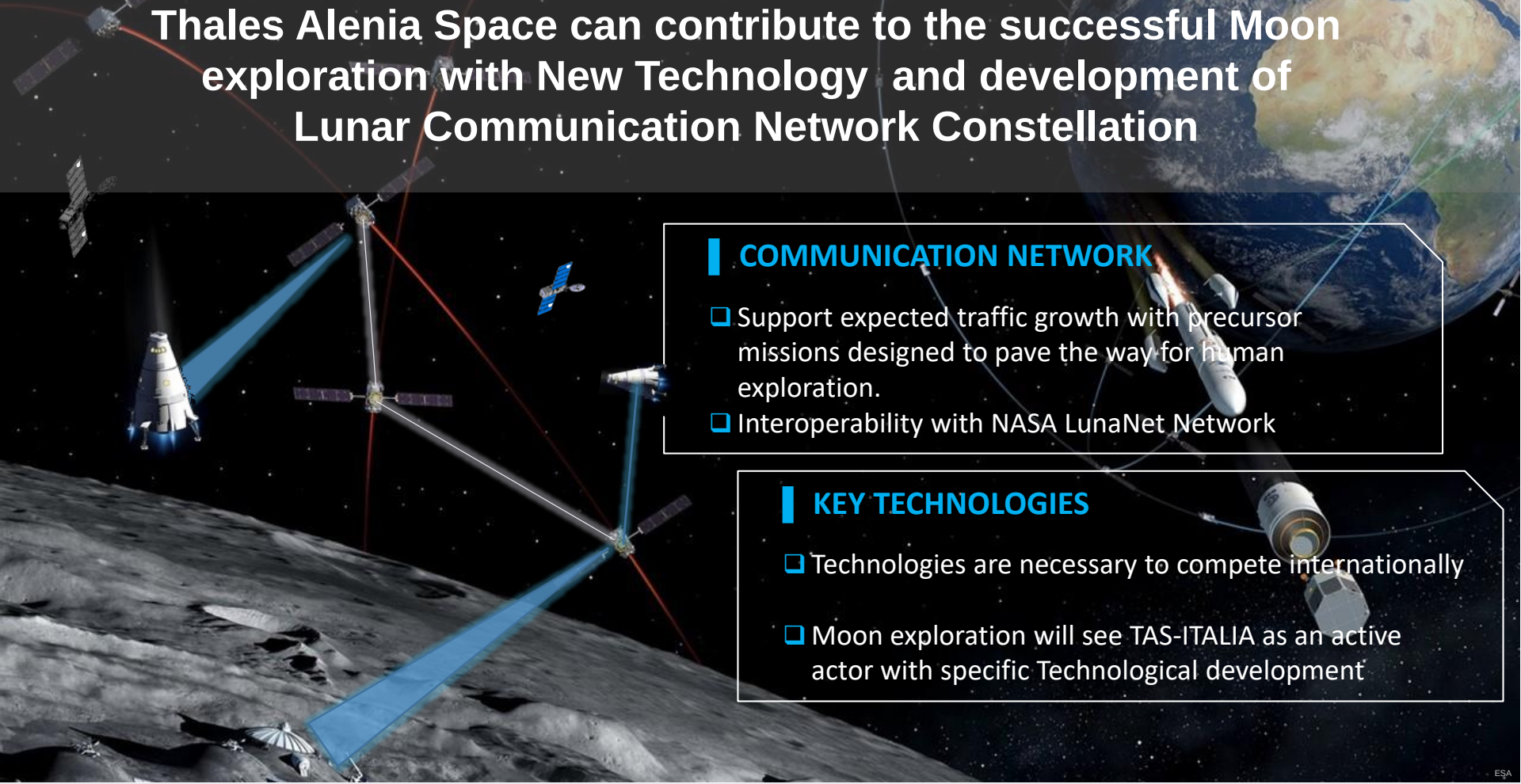
providing global broadband connectivity as supporting **IoT** missions.

/// **Processors/Routers** are designed to be compatible with **CubeSats** in terms of mass power dimensions, however offering very high performances.



Developing Technology for Microsat in LEO missions

Thales Alenia Space can contribute to the successful Moon exploration with New Technology and development of Lunar Communication Network Constellation



COMMUNICATION NETWORK

- Support expected traffic growth with precursor missions designed to pave the way for human exploration.
- Interoperability with NASA LunaNet Network

KEY TECHNOLOGIES

- Technologies are necessary to compete internationally
- Moon exploration will see TAS-ITALIA as an active actor with specific Technological development

ESA