

Overview of platform and communications technology for future EO in ESA

(Session-B9.04 – B9.04 Platform and Communications technology for future EO)

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- ESA EO Technology : Overview
- Focus on non-instruments → enable more & setup the efficient path for constellations
 - Standard Platform
 - Space-Ground Communications & Operation
 - CleanSpace (5th presentation of the session)

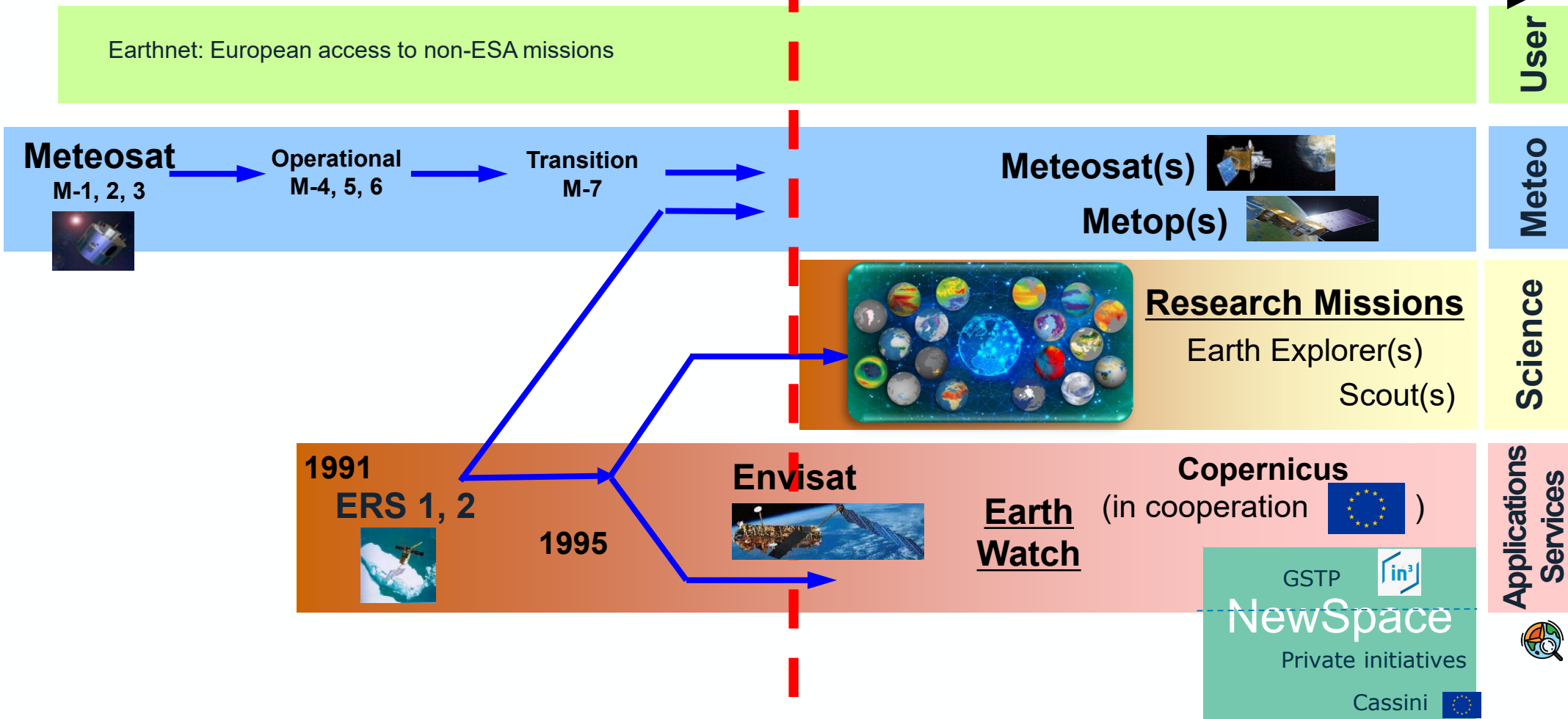
Evolution = more technology



Living Planet Framework



1977 1991 1995 1997 1998 2022



ESA EO Satellites

Science + Copernicus + Meteo

15 in operation
39 under development
12 under preparation

Small Sats



Living Planet Programme (user driven)

Research Missions

EE, Scouts

Earth Watch Missions

Copernicus, Meteo, CustomisedEO (InCubed, National-driven)



Science

Copernicus

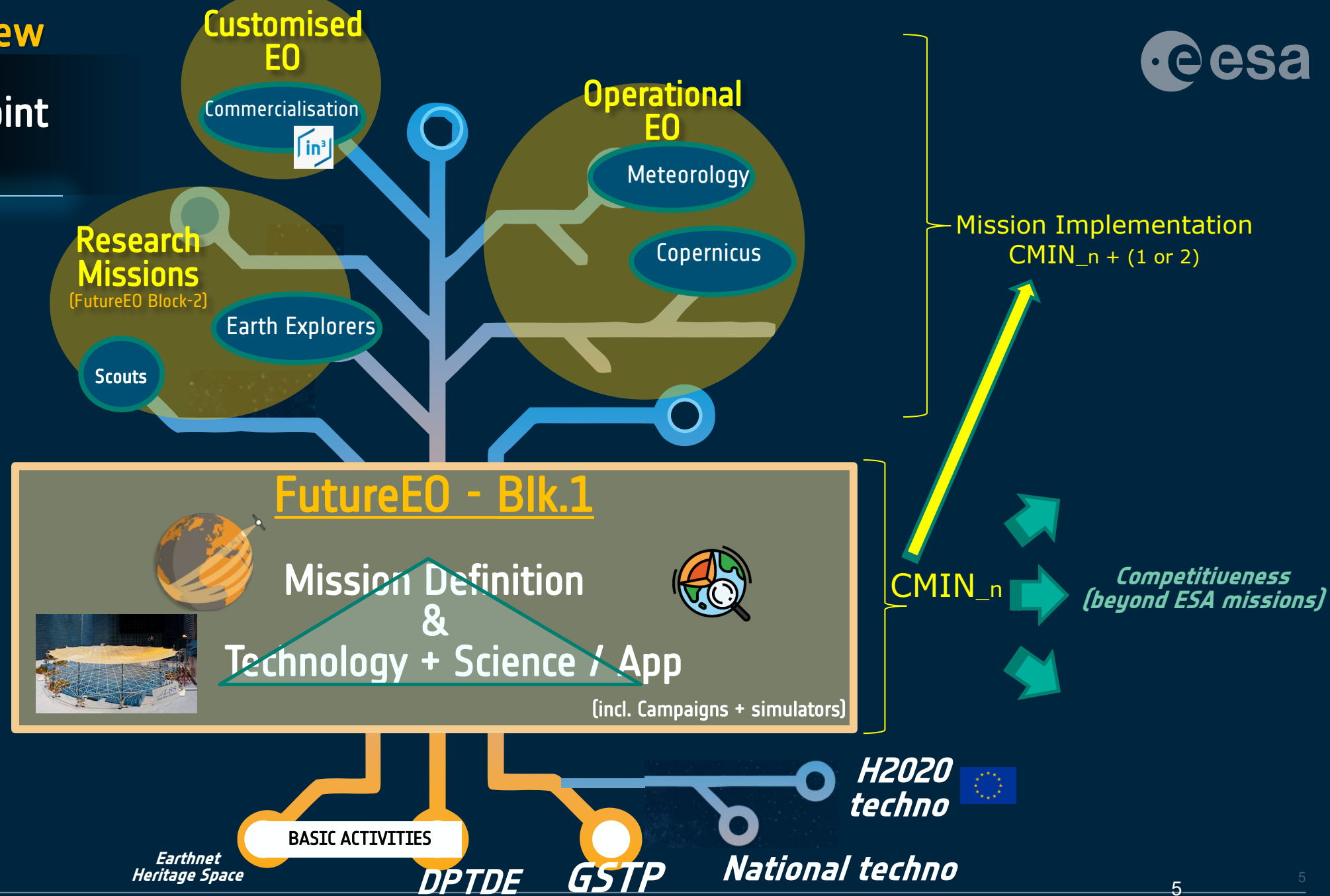
Meteorology



→ THE EUROPEAN SPACE AGENCY

FutureEO Block-1 view

- [Foundations and Concepts]
- strategic entry-point
 - synergetic effect



Higher performance / cost ratio

Largest part

- **New Measurements/ EO instruments** (enabler)
 - **Higher spatial, temporal, radiometric** resolution
 - **Full spectrum** – from 10's of MHz (RF) to UV (optical)
 - Disruptive: e.g. from the "2nd Quantum Revolution"

Generic

- Lower recurring **development cost / faster adoption**
 - **Platform Standardisation** & multi source suppliers
 - **Spin-in** techno: e.g. COTS
 - Lifetime & flexibility (FPGAs)
 - Digitalisation (e.g. MBSE)
- **CleanSpace (e.g. demisable)**
- **Big Data & Analytics (AI enabler)** & Data continuity



Miniaturisation and constellations

- More **autonomous** platform & operations & synchronisation
- **Distributed** Ground Segment

Not limited to LEO: also HEO & GEO orbits relevant for EO

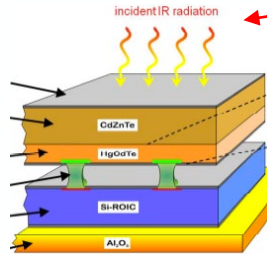


Instruments (Optical + RF)

from **components** to **full models** - the largest investment

Detectors

- SWIR for CO2M
- TIR for LSTM
- Hyperspectral for CHIME
- Others



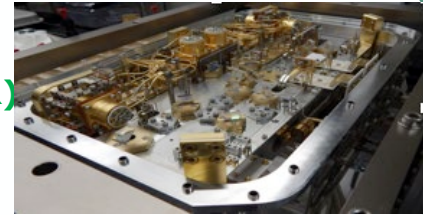
Large Deployable Antenna

- Designed for CIMR, ROSE-L, Hydroterra, S1NG
- Candidate for National/Commercial



FULAS (Laser source)

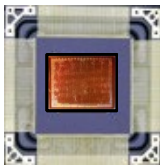
- Candidate for Aeolus-FO
- Baseline for **Merlin (CNES, DLR)**



Platform & Space-Ground Communications

AGGA ASIC

GPS/Galileo receiv.
all Sentinels, MetOp-SG RO
Earth Expl.,
many commercial



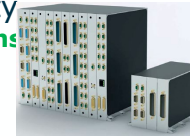
MiniRIT e-propulsion

→ candidate for **NGGM commercial**



ADHA & Std P/F

- Increased modularity & interchangeability
- **All future EO missions!**



K-band downlink

MetOp-SG, HPCM,
→ **commercial**



DataFlow-Ground I/F

Sentinel-NG,
Constellations



Also Airborne Campaigns

- Aeolus collocations
- ACADIA for CO2M
- OSCAR – Ku-band (SEASTAR)



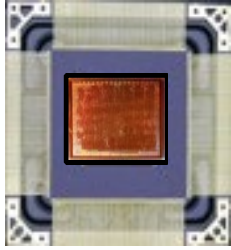
and Big Data Analytics

- Acquisition / Organization / Analysis / Infor.
- Φ-lab



Platform and space-to-ground communication technologies

Some achievements:



AGGA-4 ASIC

GPS/Galileo receiver
all Sentinels, MetOp-SG RO
most Earth Explorers,
 also **Commercial** applications
 (courtesy ADS and Microchip-FR)

Next Gen: O/B reprogrammable FPGAs



MiniRIT e-propulsion

enabler
 → candidate for **NGGM-MAGIC**
 (courtesy Mars Space-UK)
 → **commercial**



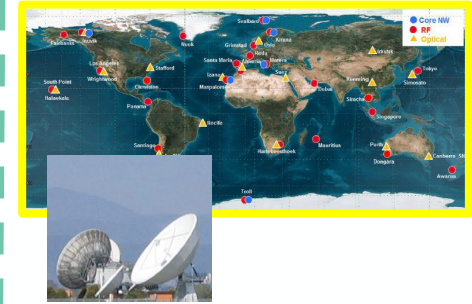
ADHA & Standard P/F

→ Adv. Data Handling Archit (ADHA)
 → Increased modularity &
interchangeability
 (for **Sent.-NG & commercial**)



K-band downlink

~ up to **12 Gbit/s**
MetOp-SG, 4 HPCMs,
 → Also **commercial** application
 (courtesy Kongsberg-NO)



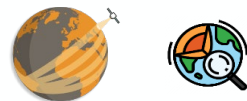
Data Flow & Ground I/F

→ **scaling** to constellations
 → Ground I/F and protocols
 → **Sent.-HPCM, Sent-NG, + commercial**

(new CleanSpace regulations coming)

• Multi-mission purpose (with impact beyond ESA missions) - synergetic

- Funded under **TDE + GSTP + FutureEO** (only **Optional Programs** can **compensate** the **TDE effective-budget decrease** – while ESA-wide Projects doubled these years)
- **FutureEO** Programme **flexibility** – brings EO focus



LEGEND

TDE = Technology Development Program, part of Mandatory Budgets
 (former name was TRP) – up to TRL=4

Objectives:

- Reduce cost in recurring platform
- Reduce development & adoption time

Status :

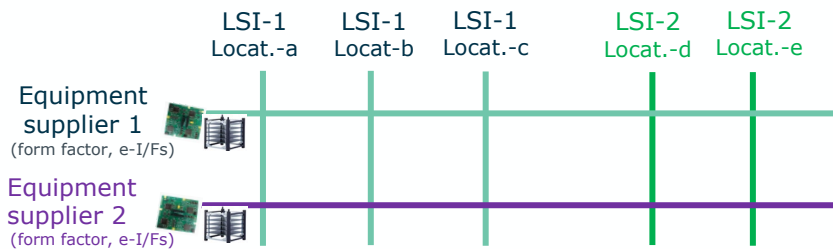
- 2021-2024: Develop + integrate (multi-source) modules – EM (TRL=6)
- Co-funded FutureEO + DPTDE (Corporate) – 2 parallel studies running

Inspirational **Cubesats**

- Standard Interfaces
- COTS enabler

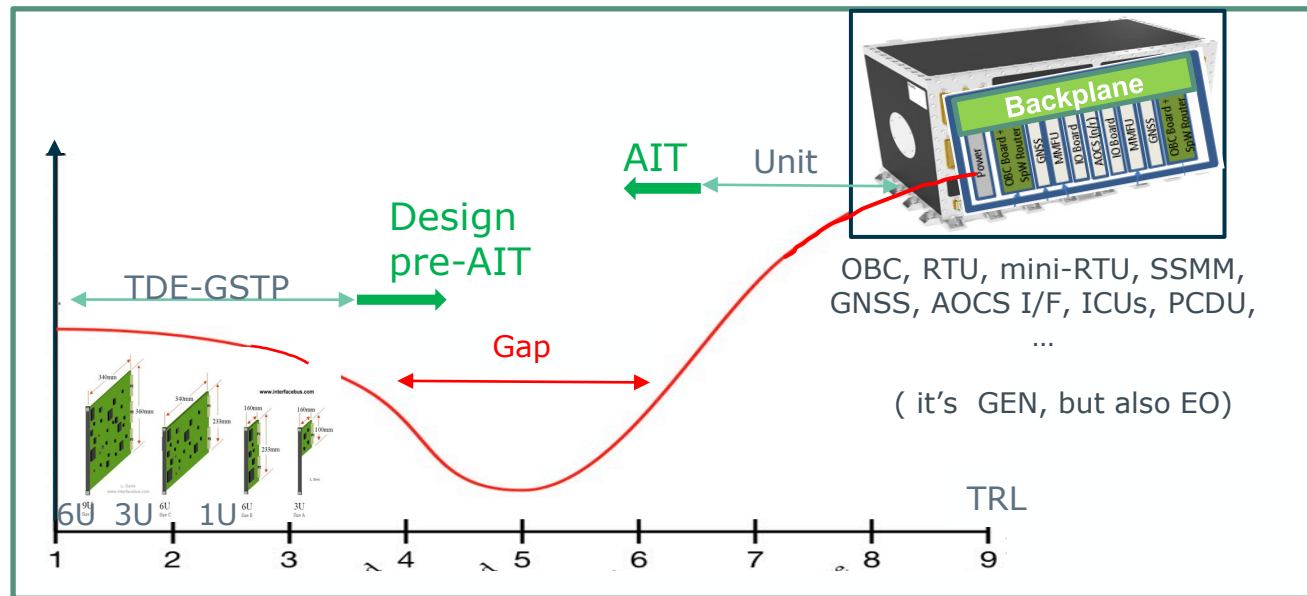
STEPS TO ENABLE IT :

- Common Requirements – by LSIs and ESA
- Standardisation - by ESA and Industry
- Development of Units with interchangeable modules



What to standardize ?

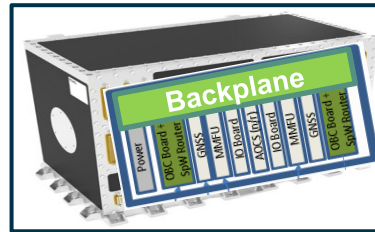
- **Interfaces: Electrical, mechanical, thermal, ... incl. backplane**
 - **AIT approach (modules & units)**
- ➔ Minimise the **Death Valley gap**



Same objectives as for ADHA:

- Reduce cost in recurring platform
- Reduce development & adoption time

→ Also standardize Interfaces & AIT



Scope is the PCDU

(Power Conditioning and Distribution Unit)

- Reduce cost
- Adoption time

→ Different modules wrt ADHA :

- Solar Regulator for battery bus.
- Battery Management Module.
- DHS Module.
- Distribution Module

STATUS :

- June 2022 IPC : Procurement Proposal for APA
- KO expected within 2022
- Same co-funding scheme as ADHA (DPTD+FutureEO)

Long Term vision for Ground Segment with > 30 operational sats:

• Current + Expansion + Next-Gen Sentinels

→ need to **do much more** with similar resources → **automation**, but also **new Challenges** → **Innovation with New technology**:

- Higher data rates → K-band downlink (~ 10 Gb/s)
- Data relay → optical at 100 Gb/s (Hydron by D/TIA)
- Simultaneous downlink and TTC every orbit:
 - X-band (TTC) instead of S-band → simpler antenna if multi-band
 - protocols
- More distributed systems + cloud technologies
- Timeliness & Higher autonomy (24/7) : e.g. IoT
- Federating systems (institutional – NewSpace)

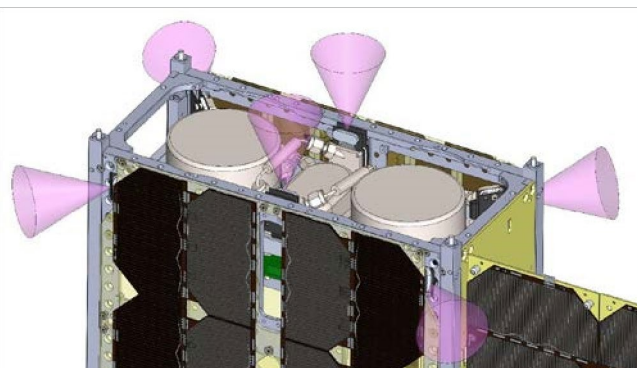


See 6th presentation of the session

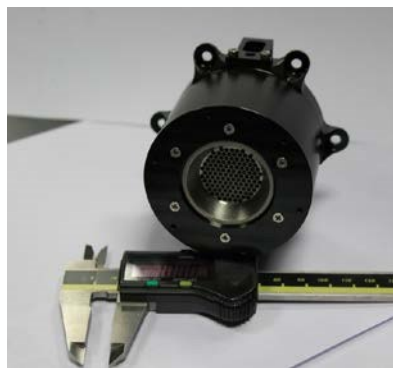
Examples of Technology Developments for CubeSats

FutureEO: only EO instruments – also for Small Sats (Scout type)

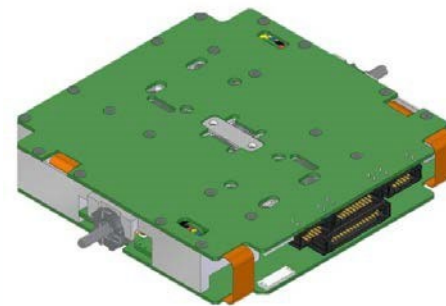
TDE/GSTP : Platform and Instruments



**6 DoF
Cold Gas Propulsion
(GomspaceSE)**



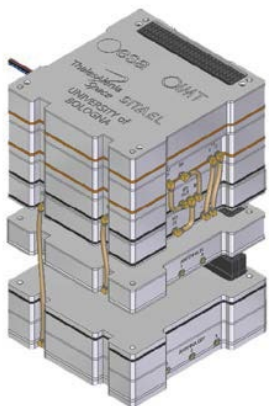
**RIT 3.5 Gridded Ion Engine
(Mars Space UK)**



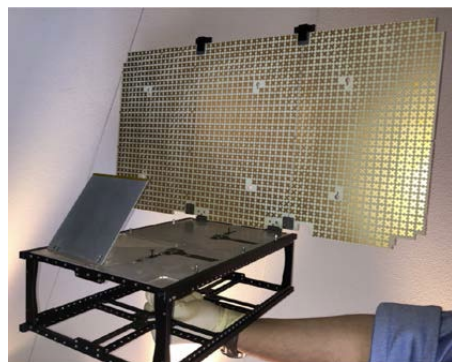
**Solar Array Drive Assembly
(IMT IT)**



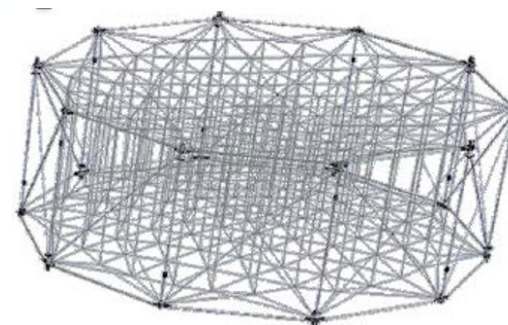
**Multi-Parallel Micro-Pumped
Loop(Demcon, NLR, ISIS NL)**



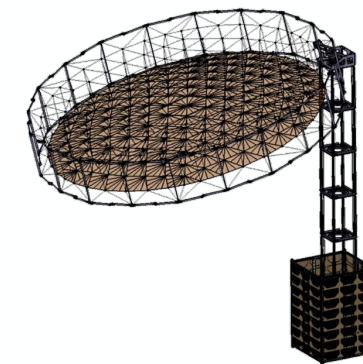
**X-band Deep Space Transponder
(IMT, TAS-I, Sitael, UniBoIT)**



**X-band Reflectarray antenna
(TICRA, GomspaceDK)**



**Ka-band Reflector antenna
(LSS DE)**



**X to Ka-band Reflector
antenna
(Comet IngenieriaES)**

EOP Technology needs

- New + higher performance (EO instruments)
- Higher efficiency (incl. platform / operations) → key to grow towards constellations

Driven by **institutional (Large Satellites)**,
and paving the path to **constellations** (incl. Standard Platform, **Communication Network**)



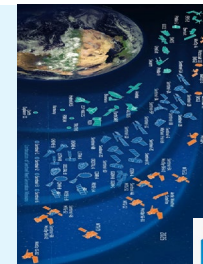
FutureEO - Blk.1

Mission Definition

Technology + Science/Apps

FutureEO Programme

- Unique **synergizer** to build the EO ecosystem
- **Enabler** / entry to the **whole range of ESA EO missions**
- more ideas than resources (TDE complement insufficient)



→ competitiveness and beyond



B9.04 Title	Presenter
Overview of platform and communications technology for future EO in ESA	ESA D/EOP
Airbus platform and communication technology for the future EO	Airbus
EOS - OHB's LEO Standard Platform	OHB
M.I.L.A Platform product line and its application for HPCMs	TAS
CleanSpace : ESA's solution for a sustainable space sector	ESA D/TEC
(R)evolution of EO satellite communications	ESA D/OPS

ID	Session Title	Theme	Nb. Sessions	Day	Time	Room
B9.07	Technologies in National Agencies for EO	Space Techno	1	Mon	13:30	H1.01
B9.04	Platform and Communications technology for future EO	Space Techno	1	Mon	15:40	H1-01
B9.02	New Mission Concepts	Not selected missions	2	Tue	08:30	H1-01
B9.06	AI@edge and Emerging Computing Paradigms for the Future of EO	Space Techno	1	Tue	10:40	Garden Room
B9.05	Microwave Instrument Technology for EO	Space Techno	1	Tue	13:30	H1-01
B9.03	Optical Instrument Technology for EO	Space Techno	1	Tue	15:40	H1-01
B7.04	CubeSats at NASA	NewSpace	1	3-Wed.	10:40	H2-02
B7.03	New Space missions with small and nanosatellites	NewSpace	2	4-Thu	13:30	H2-02
B7.05	GNSS RO – GNSS-R	NewSpace	1	5-Fri	08:30	Berlin
E1.05	New Space missions in InCubed	NewSpace	1	5-Fri	10:40	Berlin
C3	Emerging EO Technology in ESA and fostering European non-dependency		Agora	Wed.	12:30	