

# Agenda



- Earth Explorer
- Copernicus
- Meteorological
- Small and Nano Sats
- **ESA EOP Technology vision**
- CMIN-22



## EO Technology vision : It is part of ESA's Technology Strategy



### Higher **performance** / **cost** ratio

- **New Measurements/instruments** (enabler)
  - **Higher spatial, temporal, radiometric** resolution
- Lower **recurring** cost
  - **Platform Standardisation** & multi source suppliers
  - **Spin-in** techno: e.g. COTS ; Lifetime & flexibility (FPGAs)
- **Big Data** (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.





# EOP in ESA TECHNOLOGY PROGRAMME LANDSCAPE



EOP Technology under 3 programmes:

- **TDE** (former TRP): up to TRL 3-4
- **GSTP** : higher TRLs
- **EOEP/FutureEO** : all TRLs

EOEP : Earth Observation **Envelope** Programme

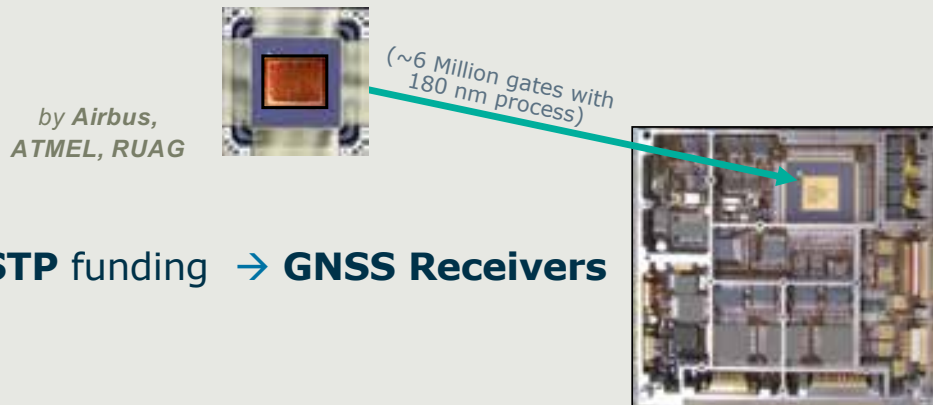
TRL 9					for projects							TRL 9 Actual system "flight proven" thru successful mission operation
8												TRL 8 Actual SYS completed & accepted for flight ("flight qualified")
7												TRL 7 Model demo the element perform. for the operational environment
6												TRL 6 Model demo. the critical functions of the element in a relevant envir.
5												TRL 5 Component and/or BB critical function verific. in relevant environ.
4												TRL 4 Component and/or breadboard functional verification in Lab. Envi.
3					for concepts Ph. 0/A/B1							TRL 3 Analytical and experimental critical function and/or characteristic PoC
2												TRL 2 Technology concept and/or application formulated
TRL 1												TRL 1 Basic principle observed and reported
	<b>TDE</b>	CTP	<b>GSTP</b>	ARTES CC	ARTES ScyLight	<b>Future EO</b>	SciSpacE	ExPeRT	EGEP	NAVISP	FLPP	



# Successful model

## Advanced GPS-Galileo ASIC (AGGA-4)

EOEP funding → ASIC (enabler)



GSTP funding → GNSS Receivers

### Many Programs adopting AGGA-4:

- MetOp-SG (P/F & RO inst.), S1c/d, S2c/d, S3c/d, **S6**, Proba-3, Neosat, Biomass, Flex, LSTM, CRISTAL, CO2M, ...
- CSO, SARah, + Comp.Adv Sat. 500 (S Korea), **Mohammed VI**
- Vega-C

## 26 GHz (K-band) data downlink (up to 10 Gb/s)

- EOEP funding **System studies (enabler)**

- EOEP, GSTP, TRP, ARTES, for development for **OB / OG** Antennas, OB Tx / OG Rx), Propagation, ...



Tesat

Gbit/s Transmitter

Konsberg

Antenna



### Programs adopting the 26 GHz band:

- MetOp-SG, MTG, EDRS, Euclid → HPCM Sentinels
- military (not disclosed)

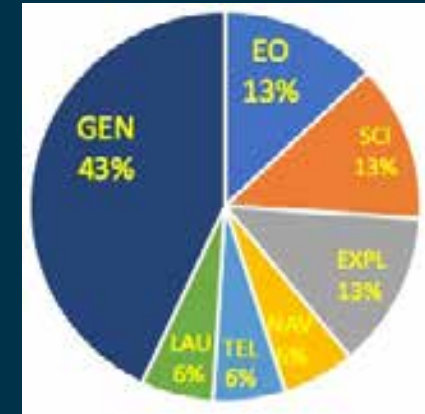
# EOP Technology

## Development Technology Element (TDE)

- 6.5 M€/year (13%) for EO 2021-22

TDE 2021-2022

Similar % for GSTP



**GSTP** : ~10% in EOP (~10 M€/year) ,

but also substantial part of Generic line: (e.g. GNSS Rx → adopted by many missions)

**FutureEO Block-1** : about 7 M€/year in **technology** (managed by EOP-ΦM)

- mainly in **Instruments** for missions under study
- but also Platform and Ground Station Network



# EOP technology (across and beyond ESA missions)

## In Instruments (RF + Optical) from **components** to **full Models**

### SWIR Gratings

- Designed for CarbonSat (EE-8) and ACADIA
- Candidate for CO2M



### 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)



## In Platform & Instrument

### accelerometers

- CHAMP & GRACE, GOCE,
- candidate for NGGM



### AGGA ASIC

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



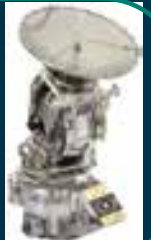
### FEEP Thrusters

- candidate NGGM
- Iceye (NewSpace)



### K-band downlink

- MetOp-SG, HPCM,
- commercial



## Also in Airborne campaigns

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



## and Big Data

- Acquisition / Organization / Analysis / Infor.
- $\Phi$ -lab



# Future EO passive optical missions for small sats

Team 1. SSTL, Univ. Leicester (UK)  
Team 2: Cosine, ISIS, TU Delft (NL)

Similar studies done for small RF instruments

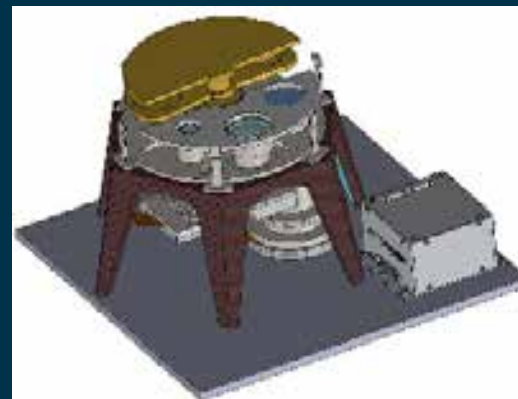
- Review optical technology (optics, detectors, Cal/Val) usable in small sats
- Derive instruments and mission concepts (operational, scientific, detection applications)

## Status:

- Final presentations held in July-Aug. 2020 ; Final Reports available
- Ideas for future developments being analysed



Example from Cosine



Example from SSTL

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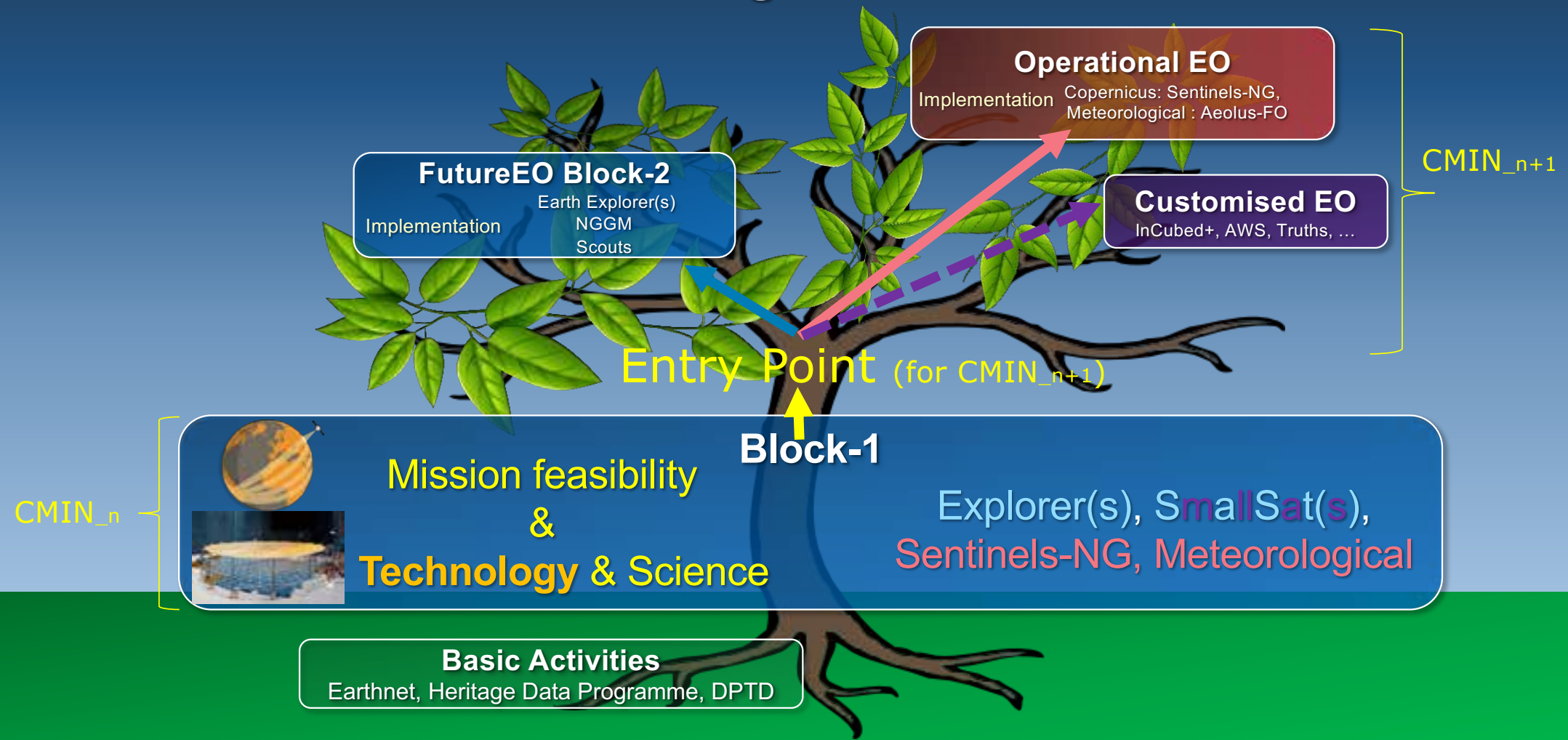


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- Technology coordination
- **CMIN-22**





# FutureEO Block-1 : Strategic Enabler



# CMIN and Earth Observation



CMIN-2019			
3 EO-Programmes	Proposed (M€)	Subscribed (M€)	Subscription Rate
FutureEO <small>4 Blocks EO backbone</small>	650	572 <small>(incl. 19 M€ from FR in 2020)</small>	88%
Operational EO <small>Copernicus, Meteorological</small>	1402	1811	129%
<small>ALTIUS, TRUTHS, AWS, ...</small>		184	
<small>InCubed+ Earth Watch</small>		61	
TOTAL CUSTOMISED EO		245	71 %
<b>TOTAL</b>	<b>2394</b>	<b>2628</b>	<b>109%</b>

## UNDER SUBSCRIBED FutureEO

- Competing against the other 2 EOP programmes
- unless general growth

FutureEO is the backbone (4 blocks):  
ESTEC-driven

- Blk 1) Foundations, **concepts, Technology**
  - Blk 2) Research Missions, incl. Scouts
- ESRIN-driven:
- Blk 3) Mission Management
  - Blk 4) Earth Science for Society

D/EOP objective for CMIN-22 (Nov.2022): 3000 M€ (25% increase)

Higher complexity (ESA, EC, NewSpace, National)

→ coordination is essential - with CEOI is a good example

