



Sounding Observation Missions for the Future EUMETSAT Polar System

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Post-EPS candidate observation missions

Mission	Approach
High-Resolution Infrared Sounding	Phase 0 Study by ESA and CNES, Phase A study by CNES
Microwave Sounding	Phase 0/A Studies by ESA, Accommodation of ATMS (NOAA)
Radio Occultation Sounding	Phase 0/A Studies by ESA
Nadir viewing UV/VIS/NIR/SWIR Sounding	GMES Sentinel-5 accommodation
VIS/IR Imaging	Phase 0 Study by ESA, Accommodation of DLR <i>METimage</i>
Scatterometry	Phase 0/A Studies by ESA
Microwave Imaging – Precipitation and Clouds	Phase 0/A studies by ESA
Multi-viewing, -channel, -polarisation Imaging	Phase 0/A studies by ESA
Radiant Energy Radiometry	Accommodation of CERES (NOAA)
Low Light Imager	Accommodation of LLI (NOAA)
Space Environment Monitoring	Accommodation of SEM-N (NOAA)
Radar Altimetry	GMES Sentinel-3, JASON f/o
Dual View Radiometry	GMES Sentinel-3
Ocean Colour Imaging	GMES Sentinel-3

Post-EPS candidate missions

High-Resolution Infrared Sounding

Objectives

- temperature/humidity profile at high vertical resolution
- sea/land/ice surface temperature
- clouds, minor/trace gases

Heritage

- IASI, AIRS

Baseline performance

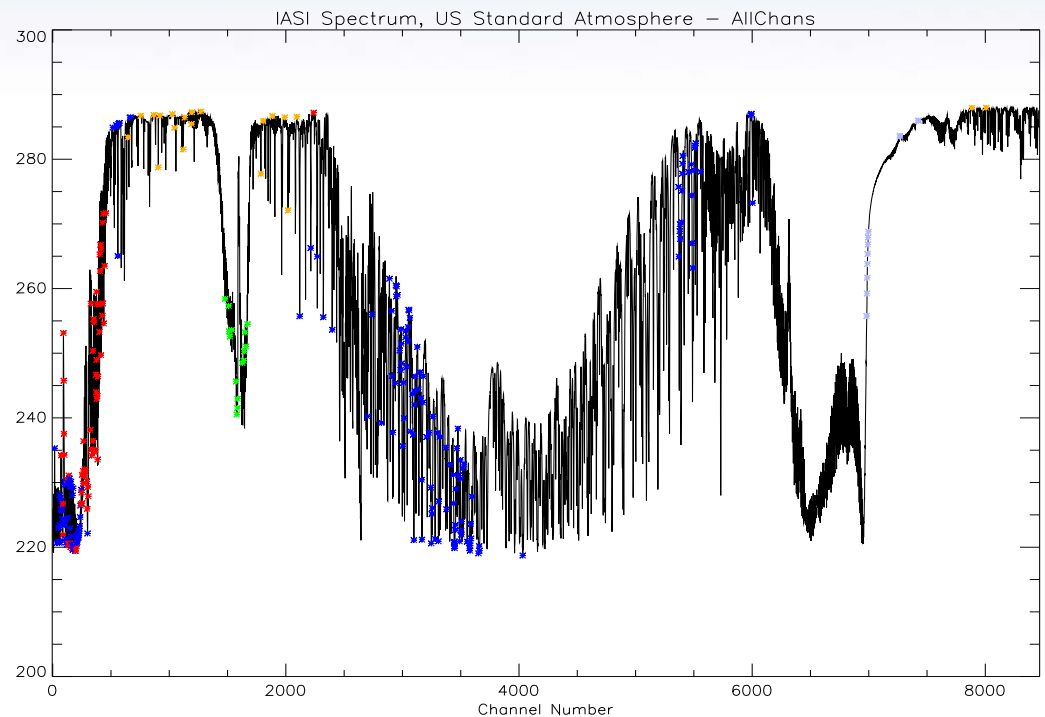
- as IASI

Breakthrough

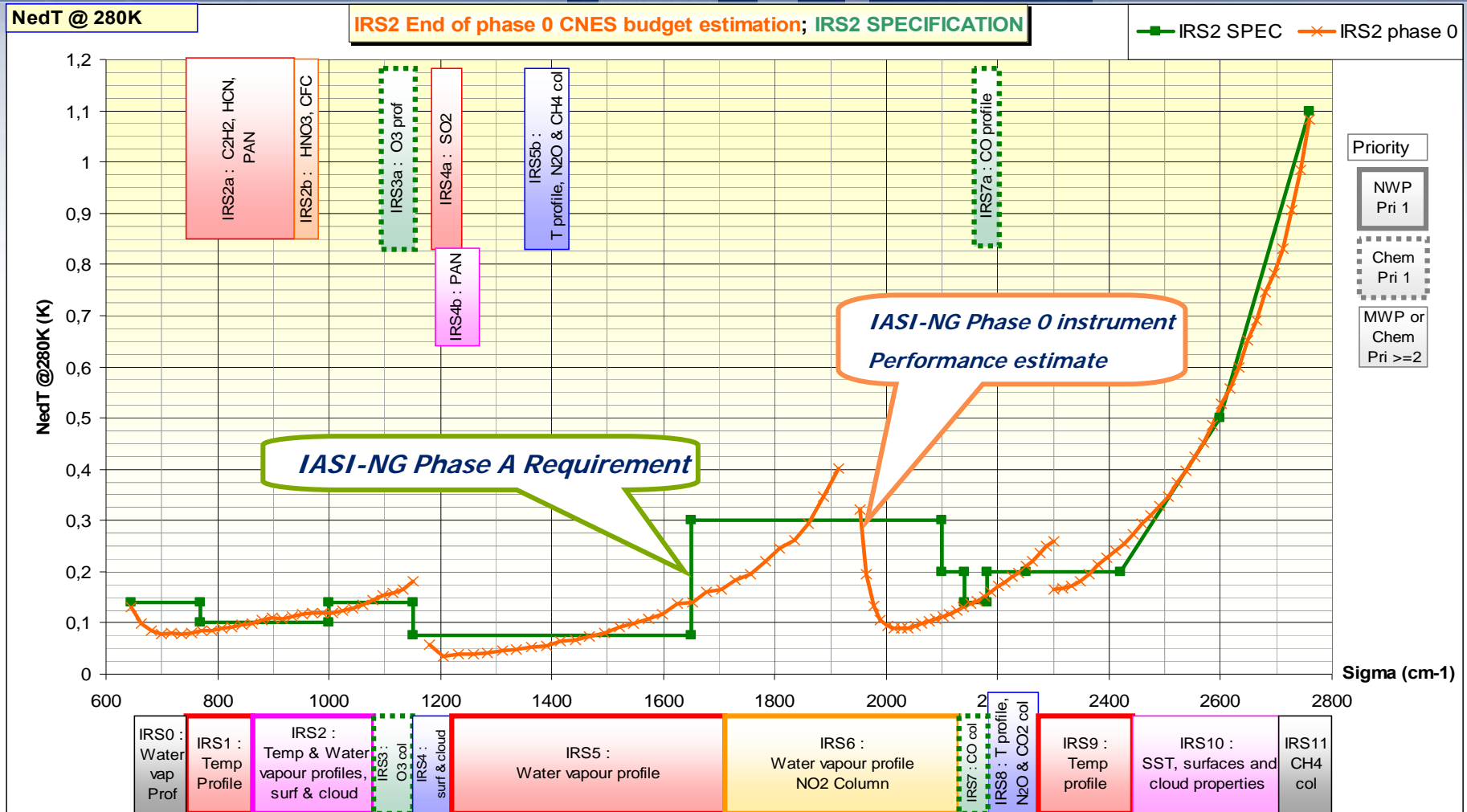
- 2 x radiometric and 2 x spectral resolution

Implementation

- Phase-A study of IASI-NG by CNES



IASI-NG: baseline characteristics (courtesy: CNES)



Spectral resolution: 0.15 cm⁻¹ unapodized, 0.25 cm⁻¹ apodised

Post-EPS candidate missions

Microwave Sounding

Objectives

- temperature/humidity profiles in clear and cloudy air
- cloud liquid water total column
- imagery: precip, cloud liquid

Heritage:

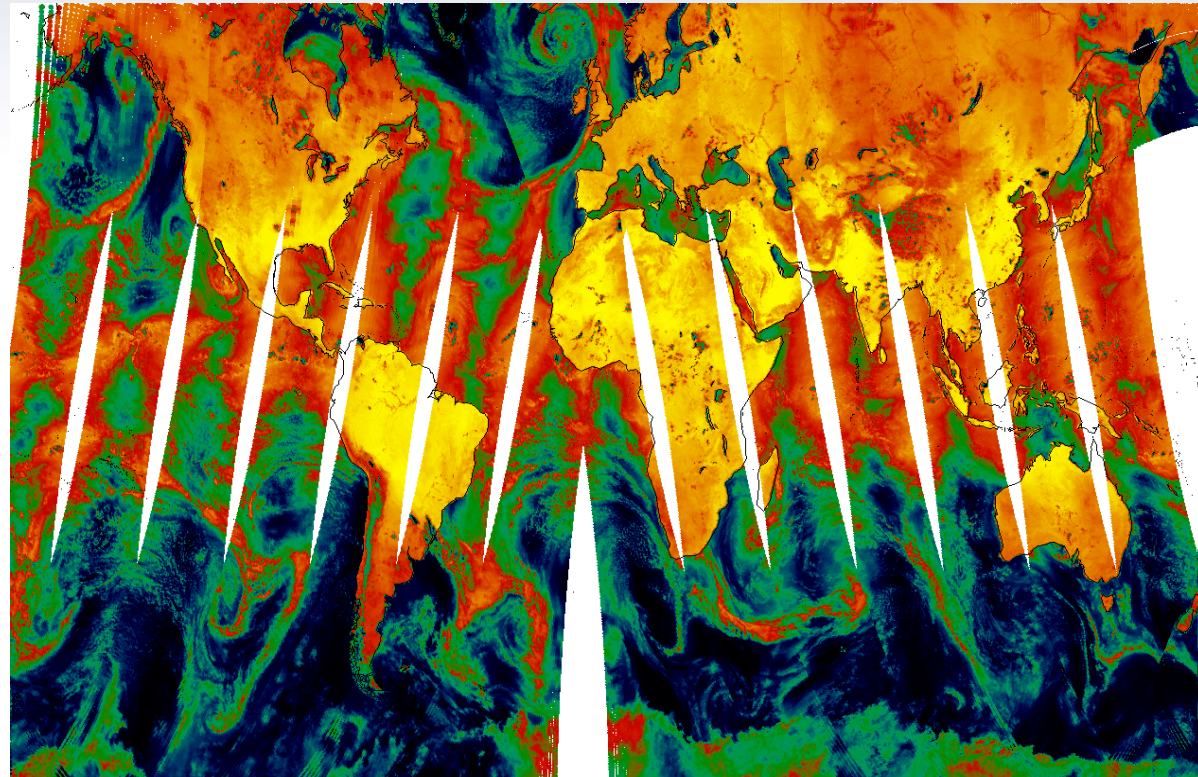
- AMSU-A, MHS

Baseline performance:

- as AMSU/A, MHS
- horizontal resolution as ATMS

Implementation:

- embarkment of ATMS+ envisaged
- ESA development at Phase A



MWS channels

<i>Spectral Range (GHz)</i>	<i>Number of channels</i>	<i>Purpose</i>
23.8 – 31.4	2	water vapour column
50.3	1	quasi window, surface emissivity
52.8 – 57.29	13	temperature profile
89, 165.5	2	quasi windows, cloud liquid water
183.311	5	water vapour profile
229	1	quasi window, cirrus detection
118.7503	9	temperature profile optional (low priority)

Post-EPS candidate missions

Radio Occultation Sounding

Objectives

- refractivity profiles at high vert. resolution
- **temperature / humidity profiles**
- PBL top and tropopause height
- ionospheric electron content

Heritage

- GRAS, COSMIC

Baseline performance:

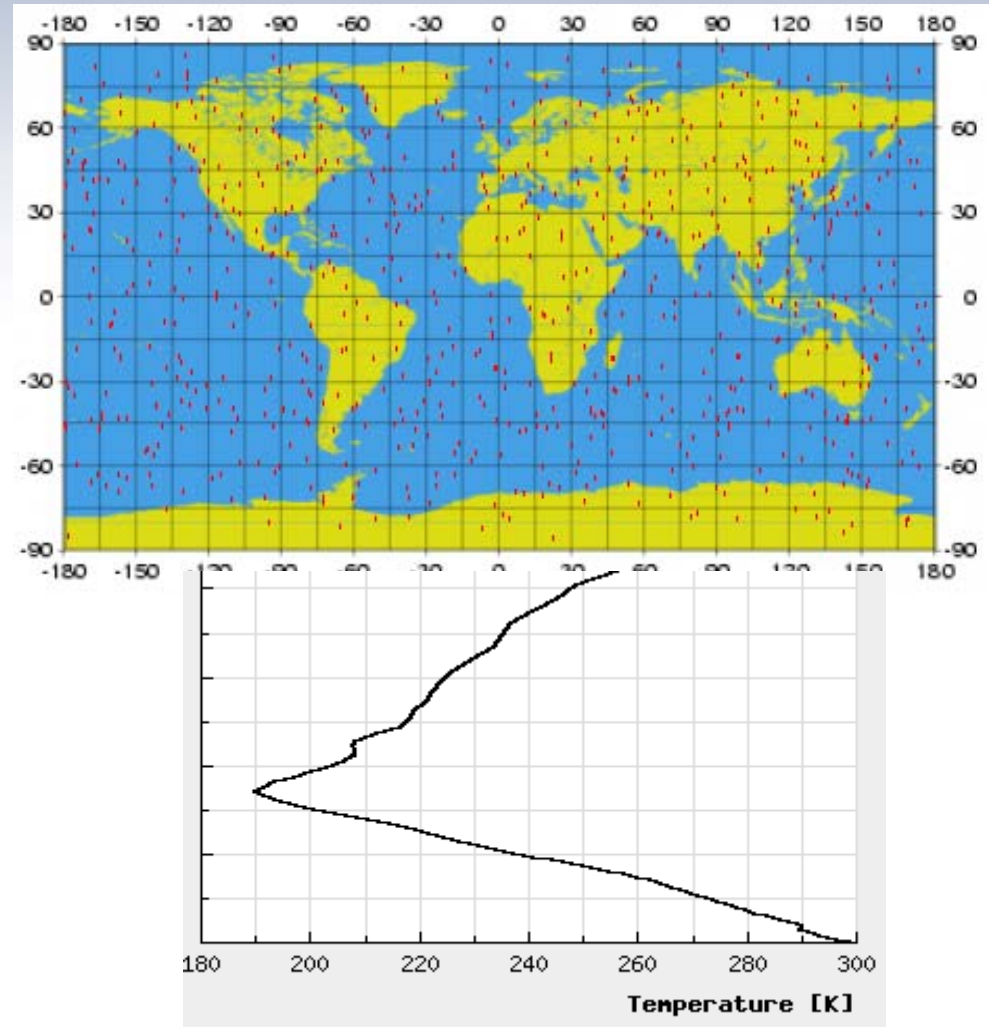
- GRAS (instrument), COSMIC (coverage)

Breakthrough

- > 4000 occultations per day
- tracking GPS and Galileo

Implementation

- virtual constellation
- ESA development for Post-EPS satellites



Post-EPS candidate missions

Nadir Viewing UV/VIS/NIR/SWIR Sounding

Objectives

- ozone profile and column
- columns of SO₂, NO₂, H₂O, CO, CH₄
- columns of BrO, HCHO, OCHCHO, CO₂
- aerosol optical depth

Heritage

- GOME-2, SCIAMACHY, OMI

Baseline performance:

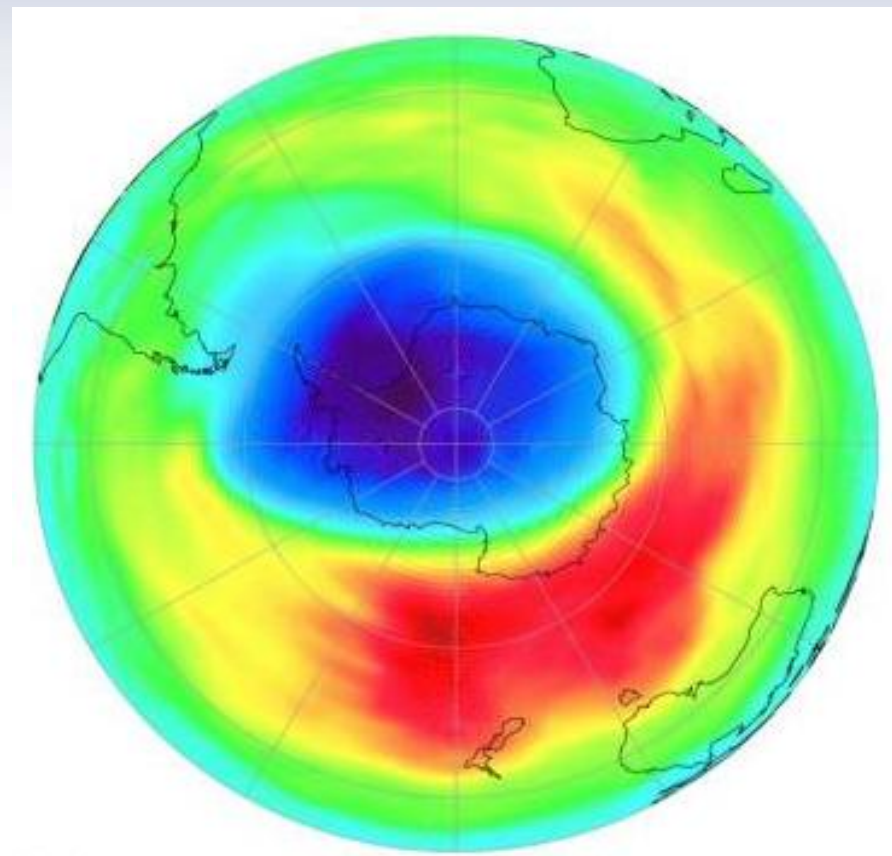
- as GOME-2

Breakthrough

- extension of spectral range into NIR/SWIR
- horizontal resolution 15 km

Implementation

- GMES Sentinel-5 to be embarked on Post-EPS satellite, ESA development



EPS versus Post-EPS: mission evolution

Instrument	Metop	Post-EPS
IASI → IRS	645 to 2760 cm⁻¹ NEΔT 0.1 - 0.6 K (<2400 cm⁻¹) Δv = 0.35 - 0.5 cm⁻¹ pixel size 12 km	645 - 2760 cm⁻¹ NEΔT ≤ 0.5 NEΔT(IASI) Δv ≤ 0.5 Δv(IASI) pixel size 12 km
AMSU → MHS / MWS	15 + 5 channels: 23 - 190 GHz	33 channels (incl. low prior.): 23.8 - 229 GHz
GRAS → RO	GPS tracked 650 occultations / day	GPS and Galileo tracked breakthrough @ 4000 occultations / day
GOME-2 → Sentinel-5	0.29 – 0.74 μm 80x40 km² resolution	14 bands: 0.27 – 2.385 μm 15 km resolution
AHRR → VII	6 channels: 0.58 – 12.5 μm	≥ 20 channels: 0.41 – 14.2 μm spatial sampling 500 m, 2 solar channels sampled at 250 m
ASCAT → SCA	spatial resolution 50 km dynamic range 4 - 25 m/s	spatial resolution 25 km dynamic range 4 - 25 m/s

EPS versus Post-EPS: new missions

Instrument	Post-EPS
MWI	up to 28 channels: 18.7 - 668 GHz spatial resolution 50 km at low frequencies to 7 km at high frequencies
3MI	12 channels: 342 - 2130 nm multi-channel, multi-viewing, multi-polarization Spatial sampling 4 km
RER	3 broad spectral bands angular sampling ≥ 3 views spatial resolution 20 km
LLI	one broad-band channel 0.4 - 1.1 μm spatial sampling 0.55 – 2.7 km

Mission requirements (1/2)

Radiometric: dynamic range, bias, noise, polarisation

Spectral: spectral range and resolution

Geometric: coverage and spatial resolution

Threshold → **Breakthrough** → **Objective**

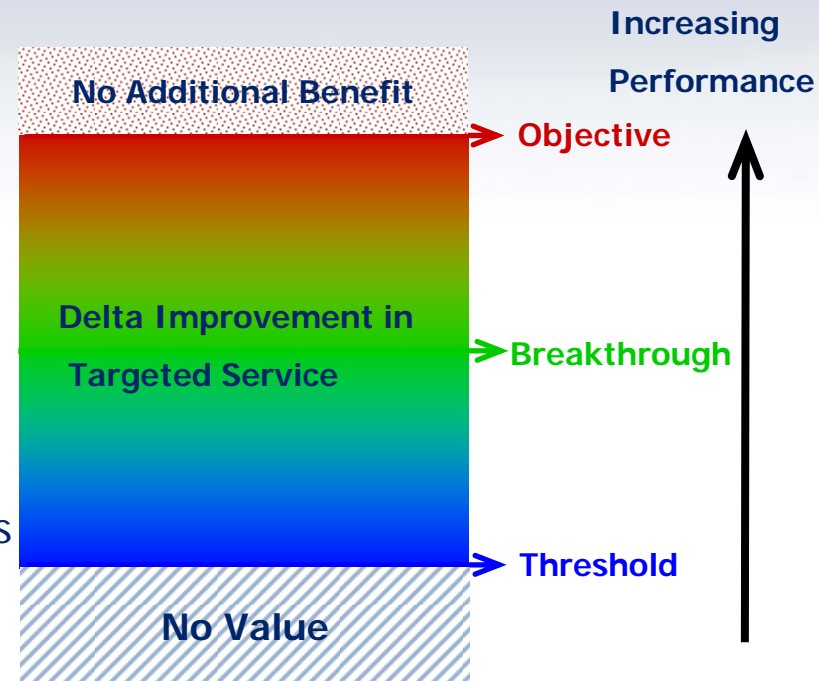
Prioritisation:

ranking of the above categories
prioritisation of spectral bands/channels
to identify and remove undesired design drivers

Generic requirements for climate monitoring

Orbit stability: variations of systematic radiance errors in any single orbit

Long-term stability: variations of running average over one orbit
of systematic radiance errors





Mission requirements (2/2)

Post-EPS Mission Requirements Document

prepared with strong support of PMET (chair: John Eyre)

endorsed by EUMETSAT Council

basis for industrial studies at Phases 0 and A

www.eumetsat.int/Home/Main/What_We_Do/Satellites/Future_Satellites/Post-EPS

industrial studies aim at achieving breakthrough levels

requirements will be relaxed in case of unwanted design drivers

Post-EPS End User Requirements Document (in preparation)

includes committed mission requirements for Phases B, C, D, E

derived on the basis of mission requirements and programmatic constraints