A 3-D APPROACH TO THE IMPLEMENTATION OF GROUND SEGMENTS IN CLOUDS

EUMETSAT

Comments from 2014 GSAW

More relevance to ground systems
Very important topic! Lots of great info!
More focus on enablers and ground system examples
Cloud use cases and differentiating the type of ground systems and cloud
Less slides
Political issues with technical innovation
Bigger room
Less presentation, more actively facilitating discussion
Practical applications
Theory, presentation of theoretical setups
Not enough seats for those signed up
Policy and culture change
Security – access and limitations; risk protection of data
More specifics on solutions and security
Application of cloud architecture and lessons learned
Everyone introducing themselves wasted time
Examples were not ground systems
Better control of time
Performance trades affecting cloud implementation
Room too small for group

Content

- EUMETSAT Corporate Presentation
- EUMETSAT Technical Infrastructure
- Recent Projects: EPS upgrade
- Recent Projects: MSG upgrade
- Lessons learnt–what would we like to have
- A more generic approach
- Concrete implementation steps
- Risks/Caveats
- Q&A

EUMETSAT Mission

- To establish, maintain and exploit European operational meteorological satellite systems, while considering the recommendations of WMO as much as possible
- A further objective is to contribute to operational climate monitoring and detection of global climatic changes
- By fulfilling these objectives, contribute to environmental monitoring, where interactions with the ocean and the atmosphere are involved

EUMETSAT Mission

- Deliver cost-effective operational satellite data and products that satisfy the meteorological and climate data requirements of its Member States

- Encourage more users to benefit from the increasing range of EUMETSAT data and products

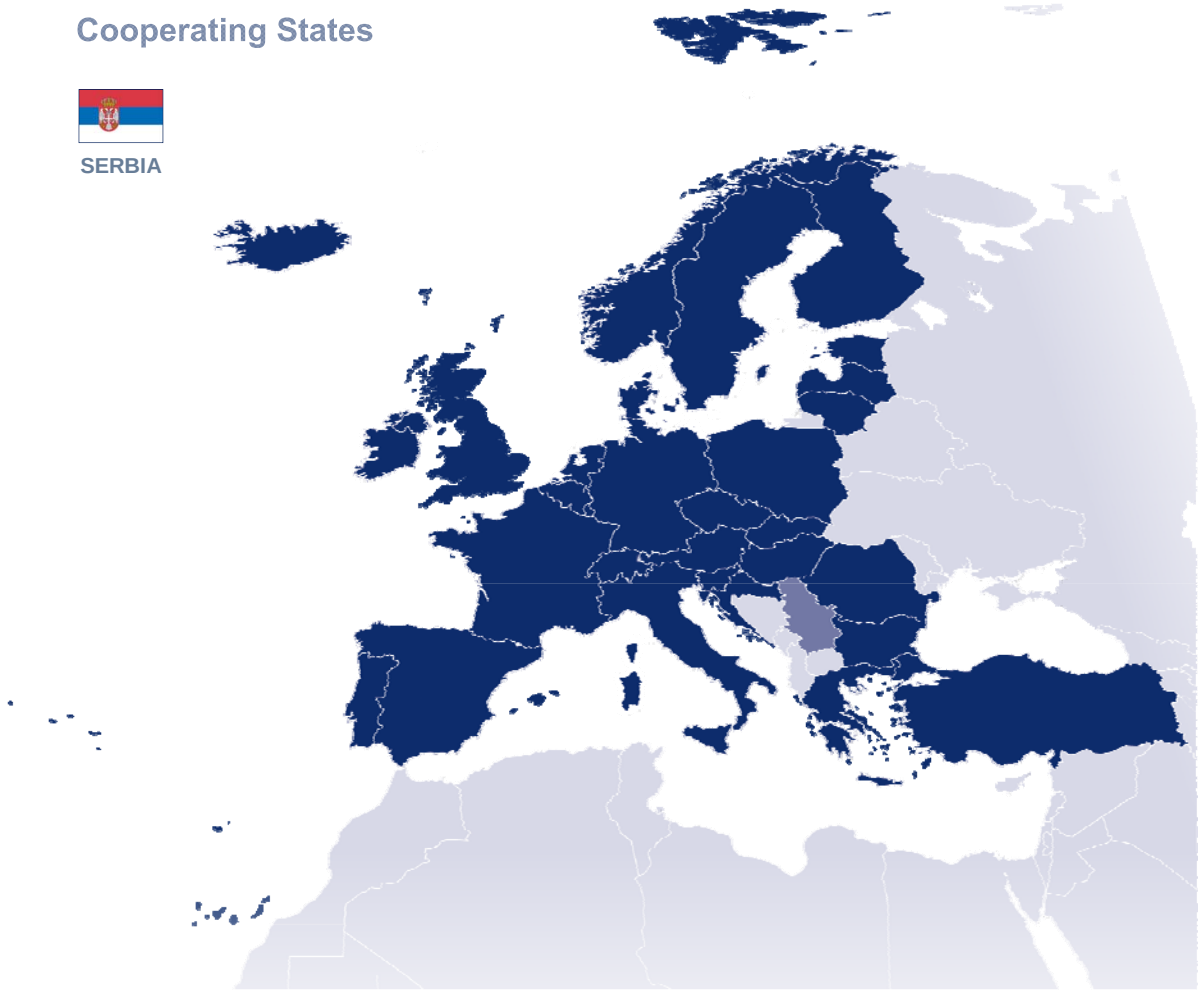
EUMETSAT is an intergovernmental organisation with 30 Member States and 1 Cooperating State

Member States

AUSTRIA
BELGIUM
BULGARIA
CROATIA
CZECH REPUBLIC
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ITALY
LATVIA
LITHUANIA
LUXEMBOURG
THE NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

Cooperating States

SERBIA



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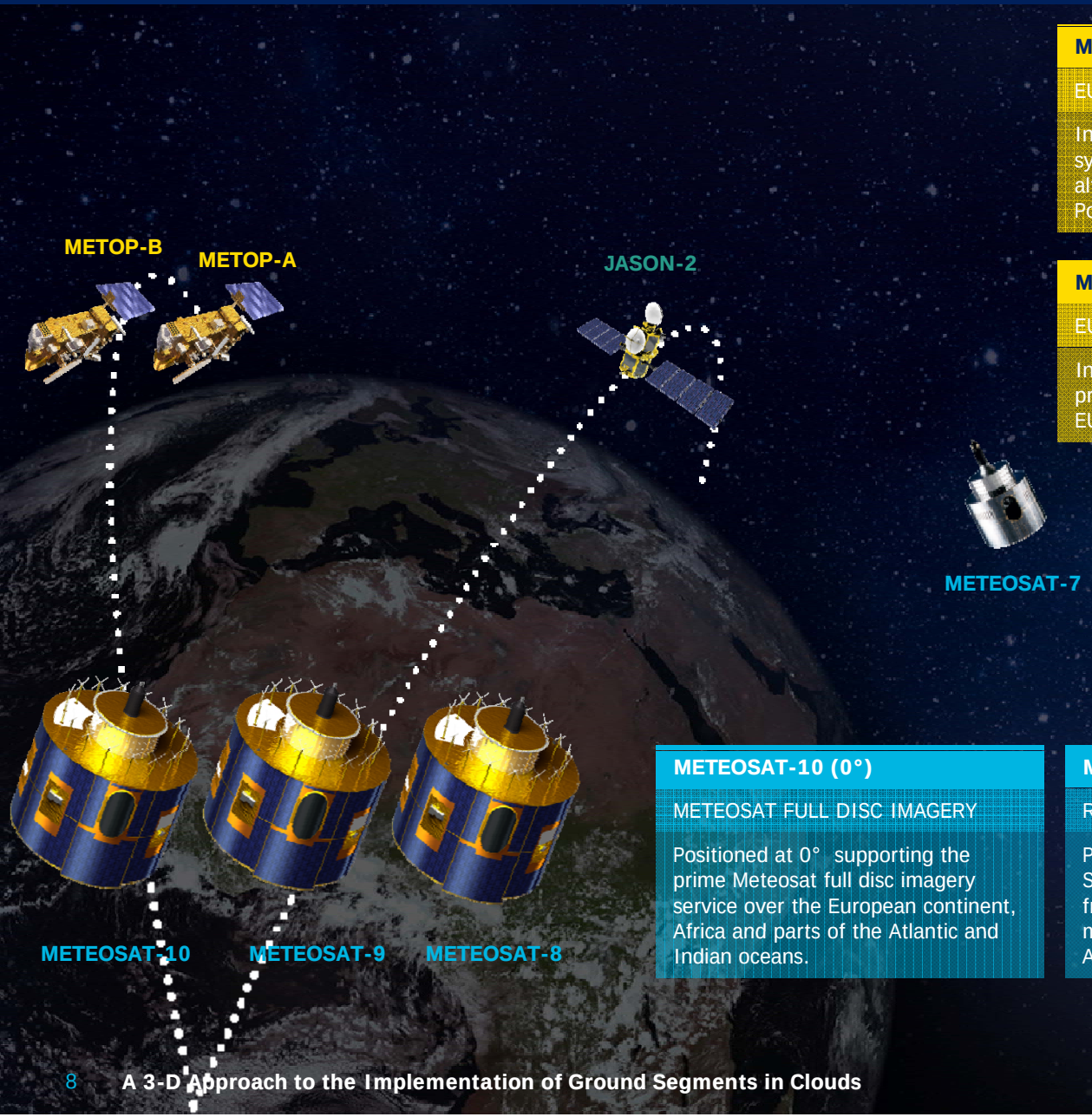
EUMETSAT headquarters

Current EUMETSAT satellites



METOP-A (98.7° incl.)

EUMETSAT POLAR SYSTEM

In nominal mid-morning sun synchronous orbit at 817km altitude ,as part of the EUMETSAT Polar System (EPS) .

JASON-2 (66° incl.)

OCEAN SURFACE TOPOGRAPHY

In nominal non-synchronous low Earth orbit at 1,336km altitude, in support of the Ocean Surface Topography Mission.

METOP-B (98.7° incl.)

EUMETSAT POLAR SYSTEM

In orbit at 817 km altitude, the primary operational satellite of the EUMETSAT Polar System (EPS).

METEOSAT-7 (57.5° EAST)

INDIAN OCEAN DATA COVERAGE

Operated in support of the Indian Ocean Data Coverage (IODC) mission, bridging an observational gap in this region.

METEOSAT-10 (0°)

METEOSAT FULL DISC IMAGERY

Positioned at 0° supporting the prime Meteosat full disc imagery service over the European continent, Africa and parts of the Atlantic and Indian oceans.

METEOSAT-9 (9.5° EAST)

RAPID SCANNING SERVICE (RSS)

Provides the Rapid Scanning Service (RSS) delivering more frequent images every five minutes over parts of Europe, Africa and the adjacent seas.

METEOSAT-8 (3.5° EAST)

BACKUP SERVICE

Serves as a back-up to both the Meteosat-9 and -10 spacecraft for full disc imagery and rapid scanning.

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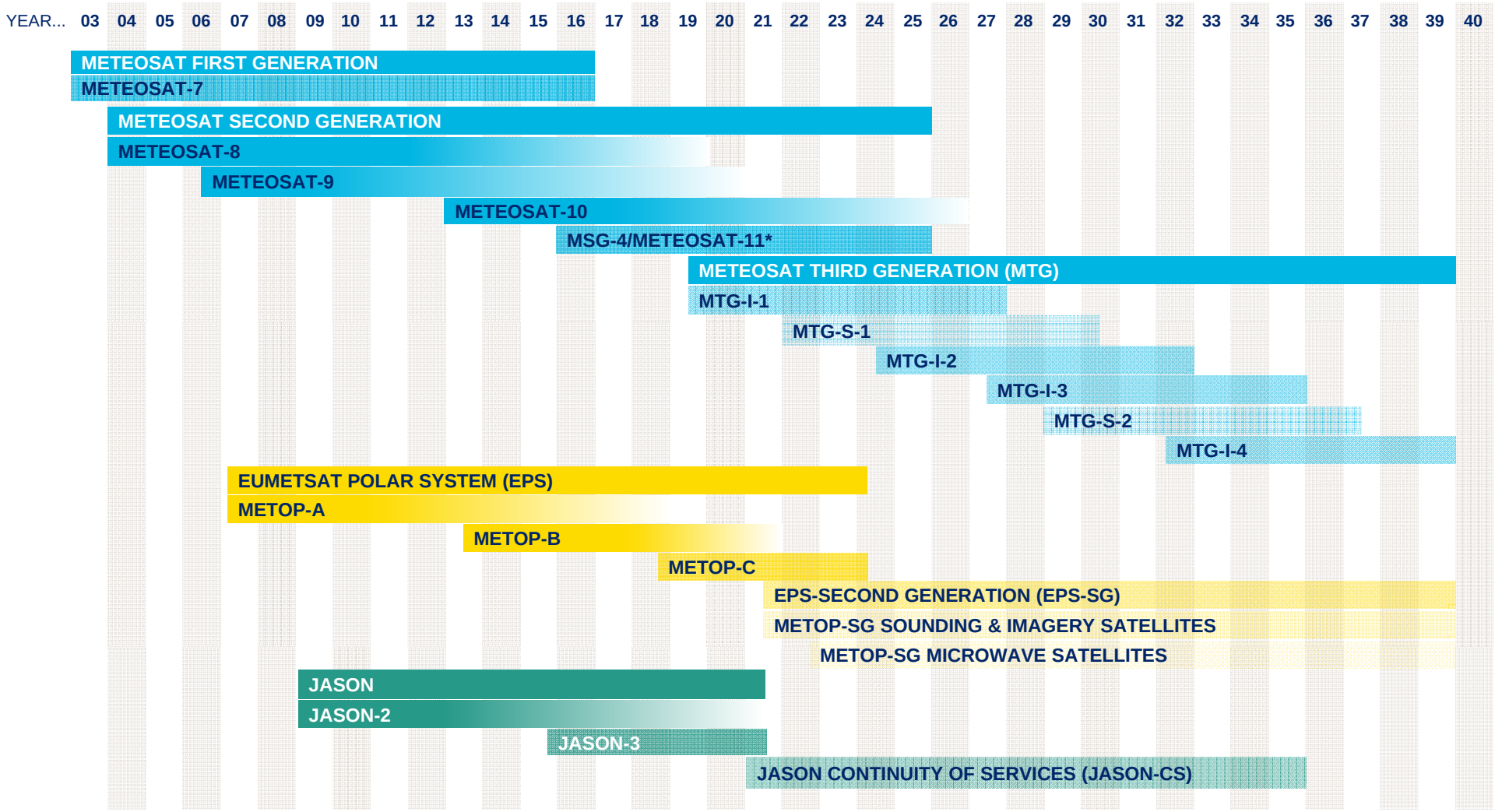
EUMETSAT mission planning



Only the full operational phase of each mission is represented, excluding commissioning.
*** MSG-4/Meteosat-11 will be stored in orbit, before replacing Meteosat-10**

EUMETSAT ground stations across Europe

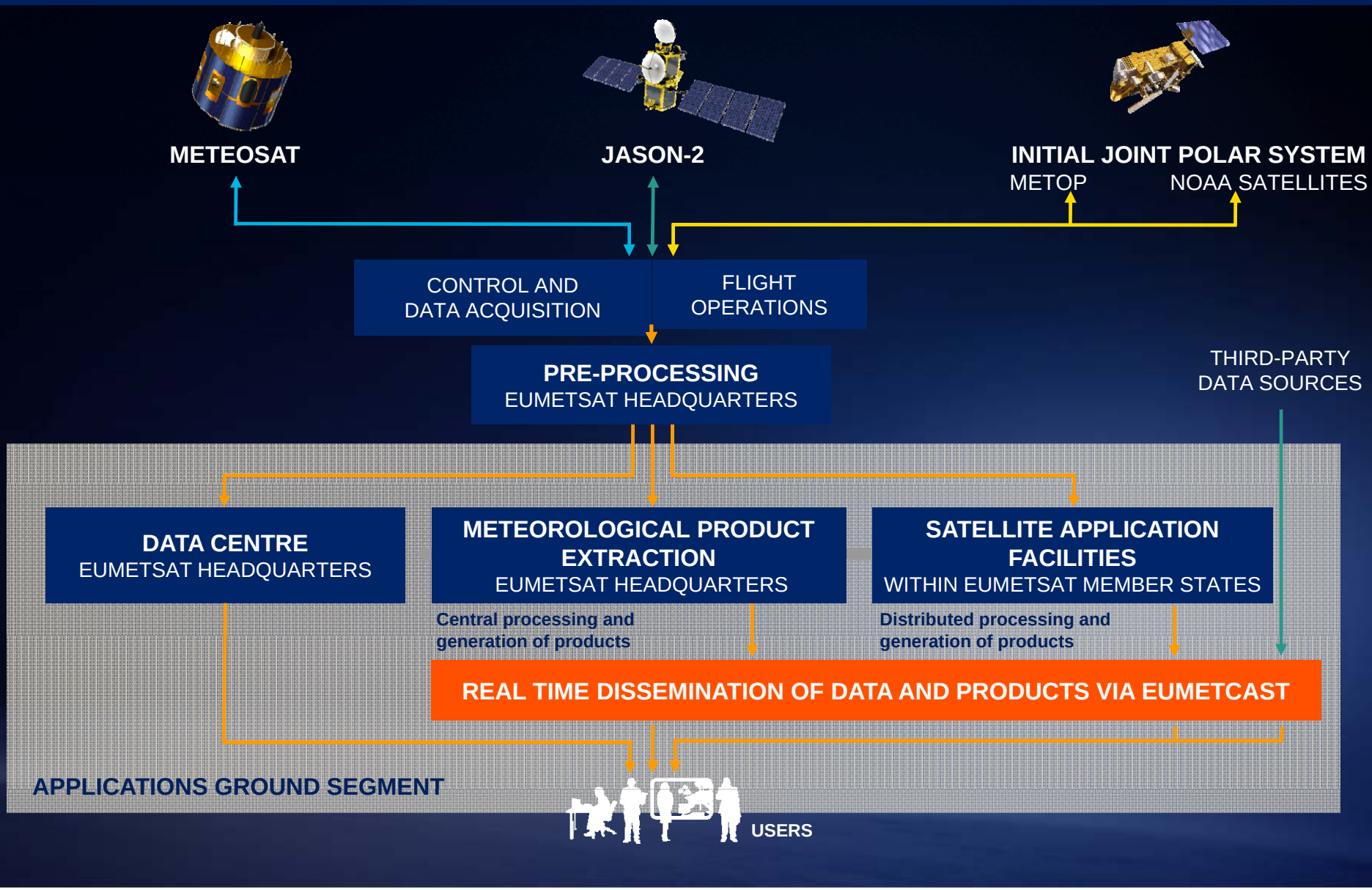
Meteosat antenna
Usingen, Germany

Meteosat antenna
Fucino, Italy

Metop antenna
Spitzbergen, Norway

Jason antenna
Usingen, Germany

EUMETSAT ground segment overview

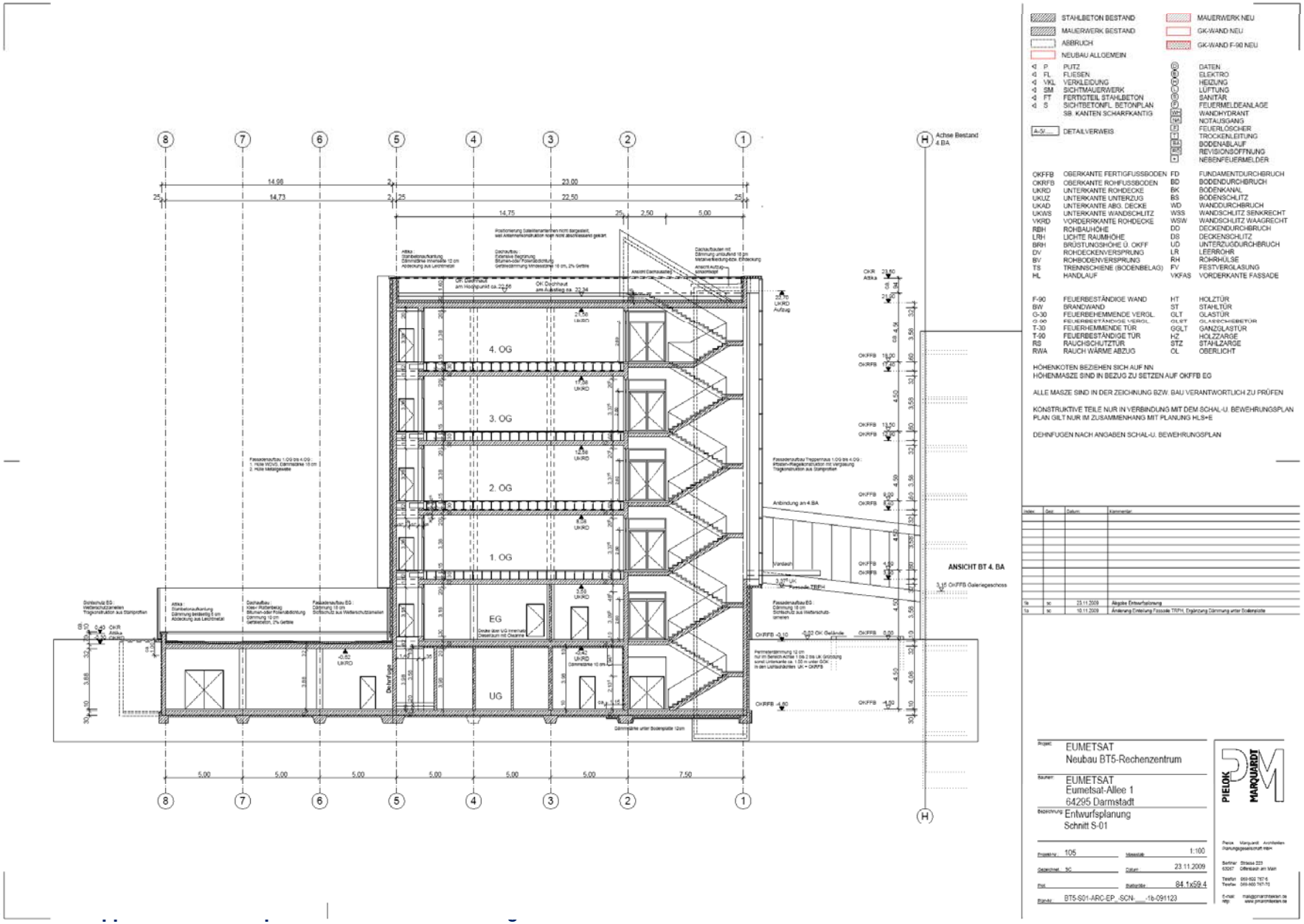


EUMETSAT Technical Infrastructure: Building

More resilience to failure and fire, use of green computing than previous building.

Migration of all ground segment HW/SW began in 2012 and is planned for completion in 2015: MSG, S3, EPS, Jason-2/3

EUMETSAT Technical Infrastructure: Floor Plan



EUMETSAT Technical Infrastructure: Computing

- Around 1000 Servers mostly mid-range systems
- A mix of many platforms and operating systems:
  - VMS/Alpha
  - HP-UX/PA-Risc
  - Solaris/Sparc
  - Solaris/Intel
  - Linux/Intel
  - AIX/Power
- Main platforms are now Linux/Intel and AIX/Power
- Software is a mix of bespoke software and COTS software

EUMETSAT Technical Infrastructure: Storage

- EMC/Brocade based infrastructure
- VMax, VNX and CX FC disk systems
- Isilon NAS system
- VPLEX virtualisation
- Connetrix Director switches
- Brocade departmental switches
- Partly integrated with VSANs
- Fully redundant over two floors
- No replication site
- Backup archive on Oracle StorageTek SL8500 with Netbackup and SamFS

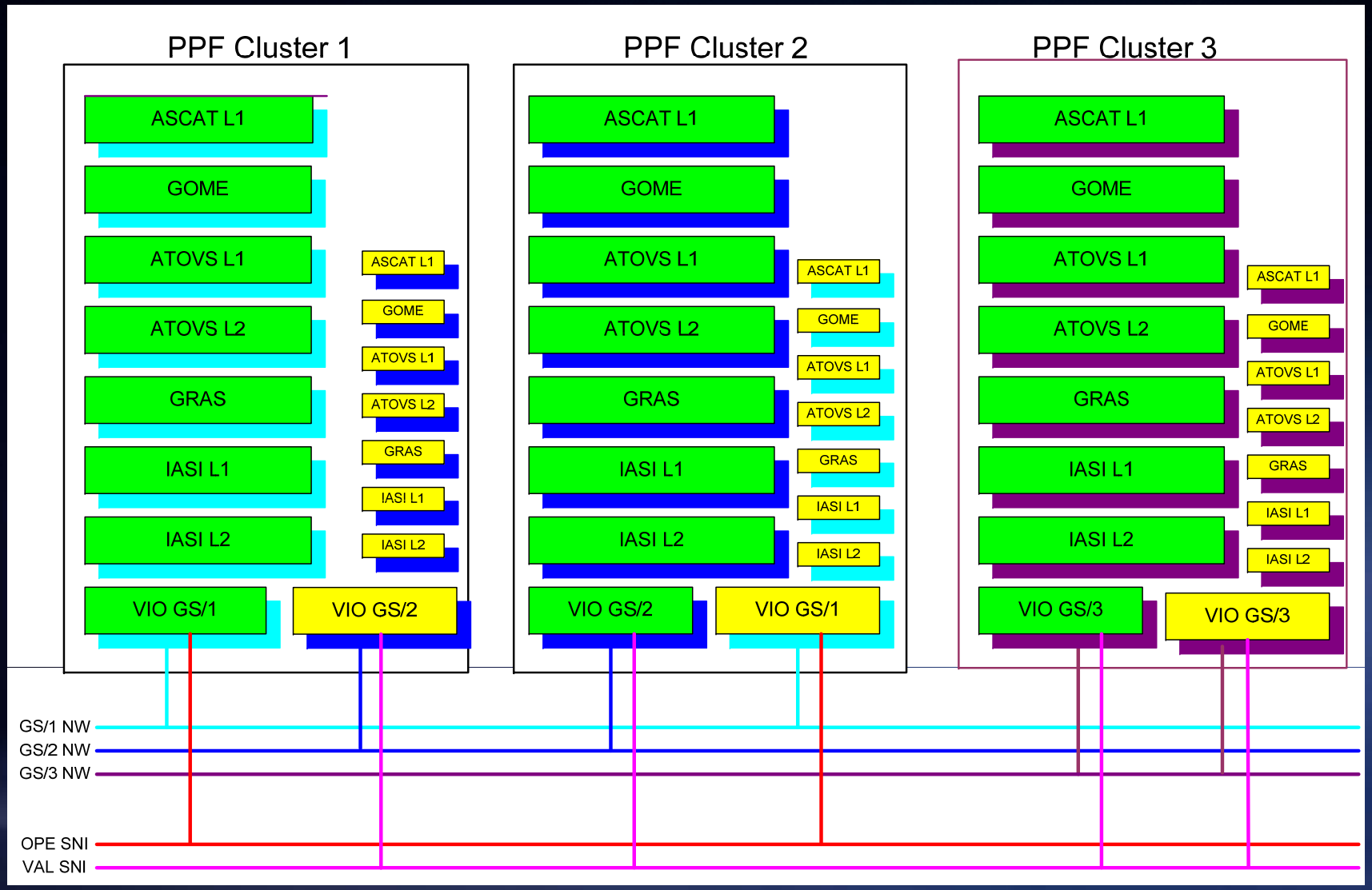
EUMETSAT Technical Infrastructure: Networking

- Mainly Cisco with some exceptions
- New Technical Infrastructure building is equipped with Nexus 5000 and Nexus 2000
- Quite complex set of external links
- New infrastructure can support Converged Network / FCoE

EPS upgrade

- Original procurement in 2005, upgraded in 2008/2009
- IBM Power-4 infrastructure replaced with Power-6
- Hardware mix of blade nodes and p-575 HPC systems
- All systems virtualised
- No life migration
- Traditional one-two-one redundancy partly on shared infrastructure
- Next upgrade to power-8 hast just started

EPS upgrade - shared redundancy



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EPS upgrade – Lessons learnt

Achievements

- Virtualised Infrastructure
- Automatic assignment of resources
- Usage of shared I/O paths
- No more physical allocation of resources (partly)
- Virtual Workstations
- Some infrastructure verification done upfront

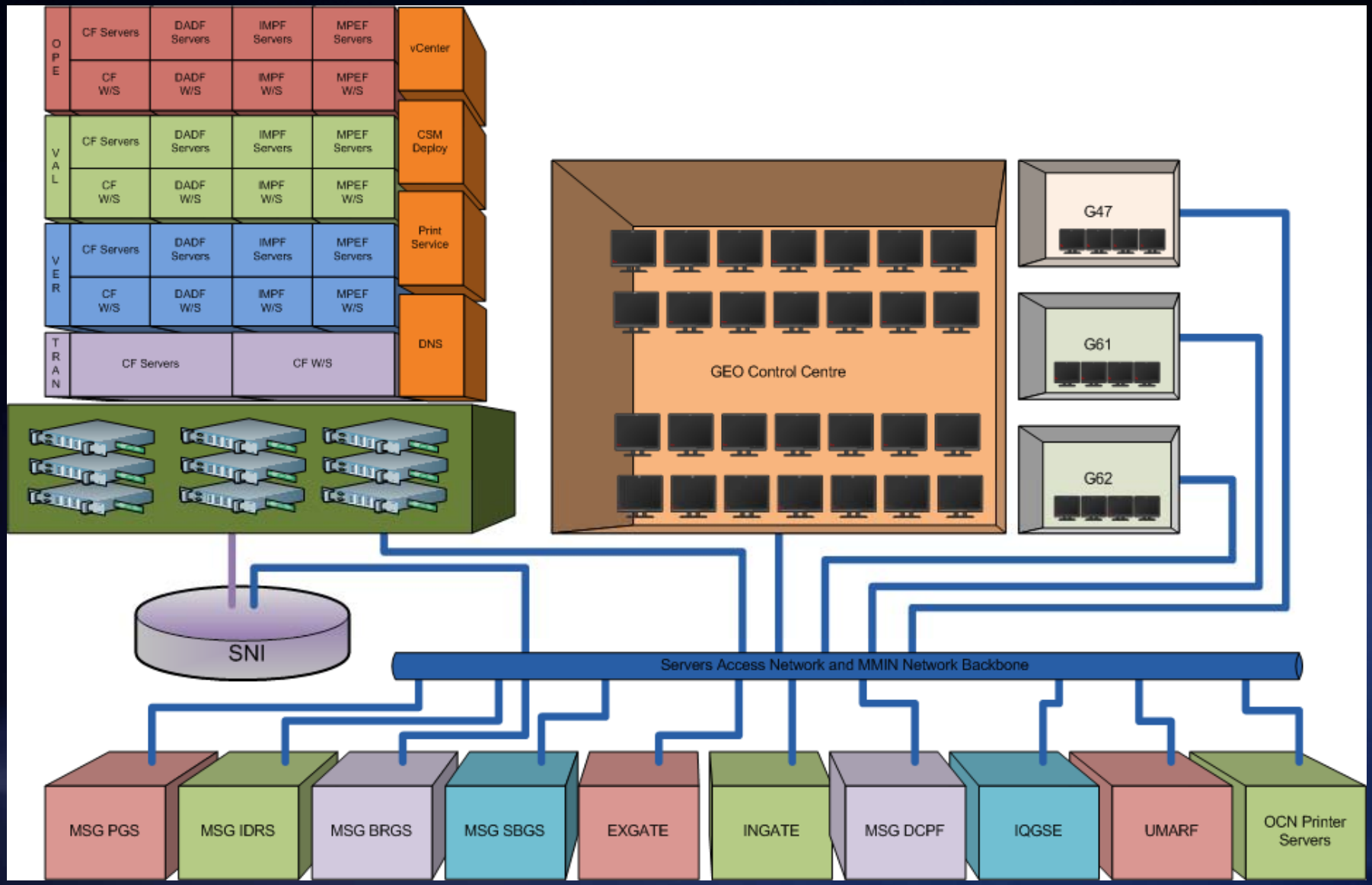
Shortcomings

- One-to-one redundancy still used
- No life migration
- No virtualisation HA features needed
- Huge amount of I/O paths (8 Blade Centres, 88 Blades, 3 HPC machines)
- No sharing of resources in nominal operational scenario
- V&V to be done for infrastructure and application service

MSG upgrade - MCIUP

- Original Procurement in 2000, a number of upgrades since then
- Replaced by a virtualised system 2013/2014
- Intel/VMWare ESX with SLES and Windows
- Hardware IBM/Lenovo PureFlex
- Converged Ethernet
- vSphere HA
- vSan
- Virtual Switches
- All environments in the same cluster
- On full floor replaced by four racks
- Virtual Terminals with X2Go

MCIUP – Overall Architecture



MCIUP – Lessons learnt

Achievements

- No physical allocation of resources
- No one-to-one redundancy
- Usage of shared I/O paths
- Complete separation between physical and logical LAN/SAN
- Main infrastructure verification done upfront

Shortcomings

Technically none, but:

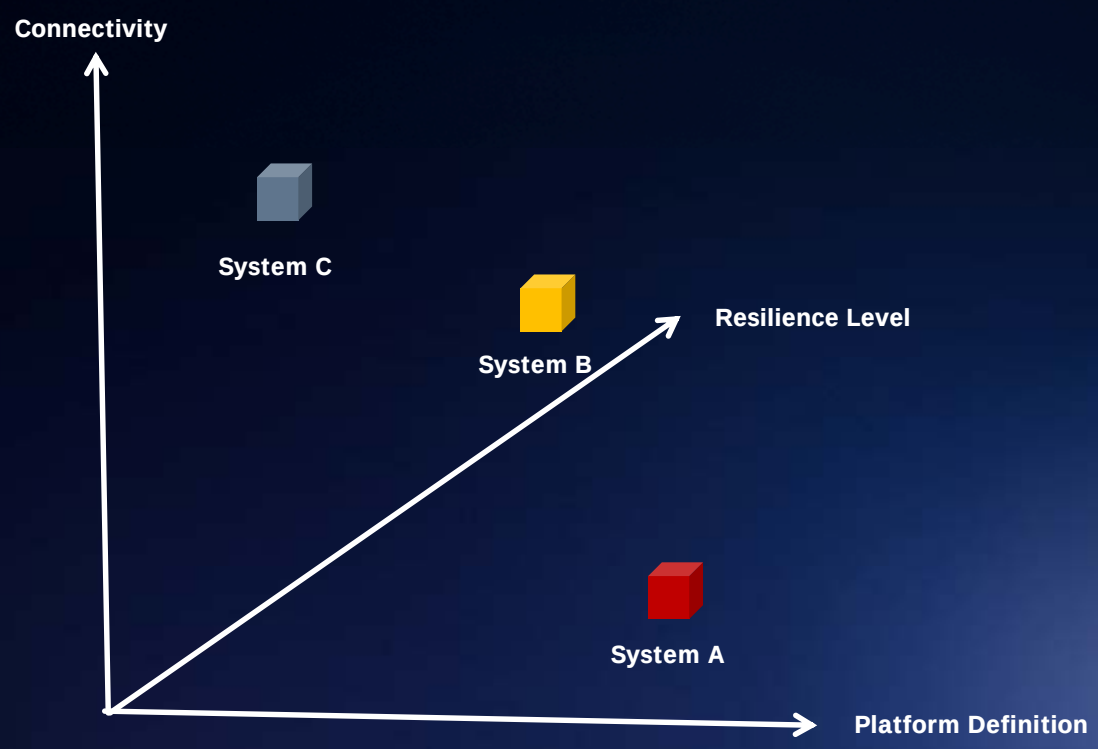
- System usage and infrastructure deployment still needs to be co-planned
- Software deployment is still work intensive
- System is limited to ‘hard’ operations – no side systems included
- Length of the project (2 yrs)

Lessons learnt – what would we like to have in future

- Full independence between system usage and infrastructure deployment
- Automatic installation of pre-defined systems
- Automatic placement depending on function
- Hardware upgrades on the fly
- Flexible response to computing/storage requests
- Full operational protection for certain systems
- Faster infrastructure upgrades
- Simpler software deployment

-> We need an abstract definition of systems that can be technically implemented an which is respecting the specific needs of S/C operations and data processing

The three dimensions defining a system



Dimension 1: Platform Definition

What it encompasses:

- Classical definition of a virtual machine: CPUs, Memory, Disk Size
- Exclusive or shared resources
- Operating System
- COTS
- Bespoke Software
- Configuration Data

What is available:

- The software and data configuration is in the CM database
- The installation instructions are stored in the deployment server

What is missing:

- The exact technical system config which could also be stored in the CM database
- Some manual steps need to be replaced by automatic ones

Dimension 2: Resilience Level

What it encompasses:

- Physical placement and failover policy
- Failover conditions
- Restart mode
- Disk protection level (RAID level)
- Disk redundancy – one floor, two floors, mirrored (internal or external)

What is available:

- The technical infrastructure is available and in use, the definitions are hold inside the virtualisation manager

What is missing:

- A description of the different levels
- A place to hold the definitions and a mechanism to use them

Dimension 3: Connectivity

What it encompasses:

- The list of logical networks a node is allowed to connect to
- Potential failover modes - if they have impact on node level
- IP number(s)
- DNS
- Routing

What is available:

- The technical infrastructure is available and in use, the definitions are hold inside the different network devices and the virtualisation layer

What is missing:

- A place to hold the definitions and a mechanism to use them

Example 1: S/C Server

Platform:

- 2 CPUs, 16 GB RAM, 500 GB disk, SLES, Corba, SCOS-2k, S/C database, guaranteed resources

Resilience:

- F90, two floors, failover to a different floor, RAID5, mirror internally

Connectivity:

- Ground Station N/W
- Image processing N/W
- Deployment LAN

What it results to:

- 500 GB RAID 5 disk storage on two VPLEX nodes generated, mirrored and virtualised
- VM is created on a physical machine in one F90 floor
- HA rules set to fail over to a different node in other floor
- Access to three LANs via vswitch enabled
- OS, COTS, application SW and data automatically deployed as per CM info
- Network configuration
- System brought up to predefined level

Example 2: Scientific data analysis workstation

Platform:

- 4 CPUs, 32 GB RAM, 1 TB disk, SLES, IDL, shared resources

Resilience:

- None for computer, RAID5 w/o mirror for disk, backup

Connectivity:

- Ground Station N/W
- Image processing N/W
- Deployment LAN
- Backup N/W (automatic)

What it results to:

- 1 TB RAID 5 disk storage on VNX in 3rd floor generated and virtualised
- VM is created on a physical machine in non-F90 floor
- No HA rule, minimum uncapped resources
- Access to four LANs via vswitch enabled
- OS, COTS, application SW and data automatically deployed as per CM info
- Network configuration
- System brought up to predefined level

Use Cases: User-induced changes

- Operational users hardly ever need new systems for flying missions only if a new scratch installation is requested
- For missions under preparation systems can be created according to deployment/integration progress: VER-VAL-OPE; they can be changed and re-installed whenever needed but under strict CM control
- In case of anomalies or special operations additional systems can be easily created to support special engineering tasks based on predefined configurations

Use Cases: Infrastructure-induced upgrades

- Main drivers are obsolesce and addition of resources
- Virtual machines are moved from old to new nodes by the virtualisation layer
- Storage volumes are exchanged using storage virtualisation
- Network changes are highly dependant on the network infrastructure - live upgrades are possible but non-trivial
- Change of virtualisation platform is possible if upgrade path is foreseen by the vendor and live migration is part of it

-> Some risks for the long-term that need to be analysed
-> All other users of the same technologies are facing the same problems

From Service Definition to Infrastructure Definition

What has been said so far covers a (new) system that does only use existing elements /definitions:

- But where and how are the potential values for the three dimensions specified for additional systems ??
- How, when and why are they implemented?
- And is it sufficient information to describe the system infrastructure?

-> Program system requirements must be specified in a way that they can be as service definitions for computing infrastructure (as detailed by my colleague Michel Horny yesterday in the Plenary)

-> A sort of program-independent planning is needed that is making sure that services are available and tested when needed

V&V approach: The Key Element

To be able to break the link between infrastructure life cycle and application system life cycle we need:

- To decouple infrastructure V&V from application system V&V
- The capability to verify the complete set of requirements for computing, storage and network without impact or risk for running missions
- A set of infrastructure validation tests that deal with complex failure scenarios
- A set of application system V&V tests that are not including infrastructure components tests like cable failures or power problems

Impact on Anomaly Handling

- Currently all anomalies of operational systems and underlying infrastructure are handled together by Operations
- As there is no visible connection between infrastructure and (un)affected application this needs to be changed
- As long as the infrastructure redundancy is working it should not be made visible to operations (computing is like electricity!)
- System maintenance teams need to deal with anomalies in line with the defined SLA
- More need for remote access and specific maintenance arrangements

EUMETSAT's GCI project

A new project started begin of this year with the following target:

- Extending the existing virtualised Intel based system for operational and non-operational systems
- Automatic deployment, configuration and placement of systems based on the 3 dimensions
- Full independence between system usage and infrastructure deployment cycles: Hardware upgrades on the fly
- Self-provisioning for authorised user groups
- Extendibility to external sites
- Implemented as private or hybrid cloud

The plan is to migrate the biggest part of the current operational and non-operational systems to it during the net 5 years.

EUMETSAT's GCI project – Status

- Virtualised computing: VMWare ✓
- Virtualised SAN: EMC VPLEX /VMWare ✓
- Virtual Network Infrastructure: Cisco Nexus ✓
- SW definition: As per CM database ✓
- Computing resource definition: Implicitly available -
- Resilience definitions: Implicitly available –
- Connectivity definition: Implicitly available –
- Automatic deployment: Partly available –
- Infrastructure V&V plan: Missing ✗
- Rework of application system V&V plans: Missing ✗

We are currently writing the System Requirements

Questions

Thank you for your attention!

Any Questions?