GSAW 2009

Why does it take so long to deploy new technology in Ground Segment Data Systems?

N Peccia – ESA/ESOC

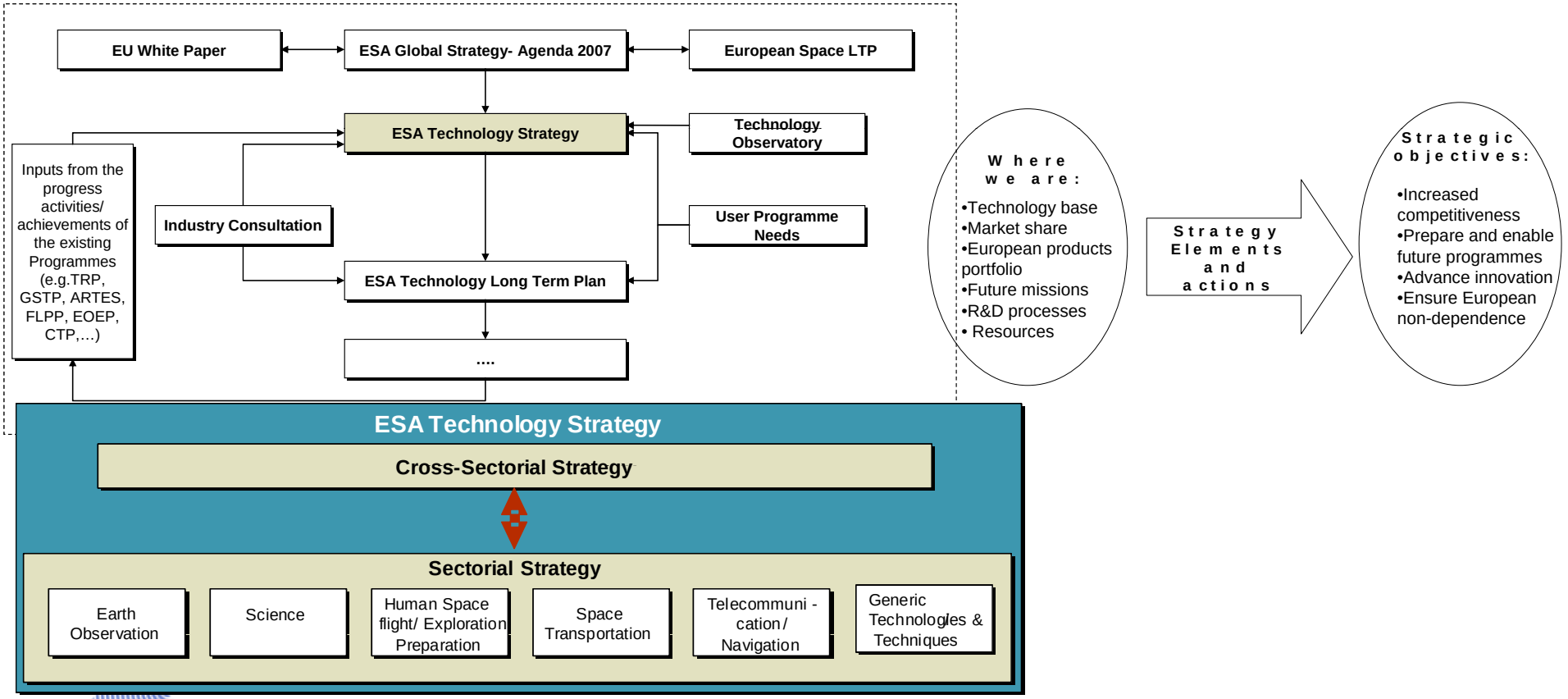
25th March 2009

Outline

- The Top-Down Approach
  - The European View
  - The Operations Centre View
  - The Industry View
- The Bottom-Up approach
- Collision of Approaches in the “Legacy Systems” arena
- How to find the right balance ? Main Issues

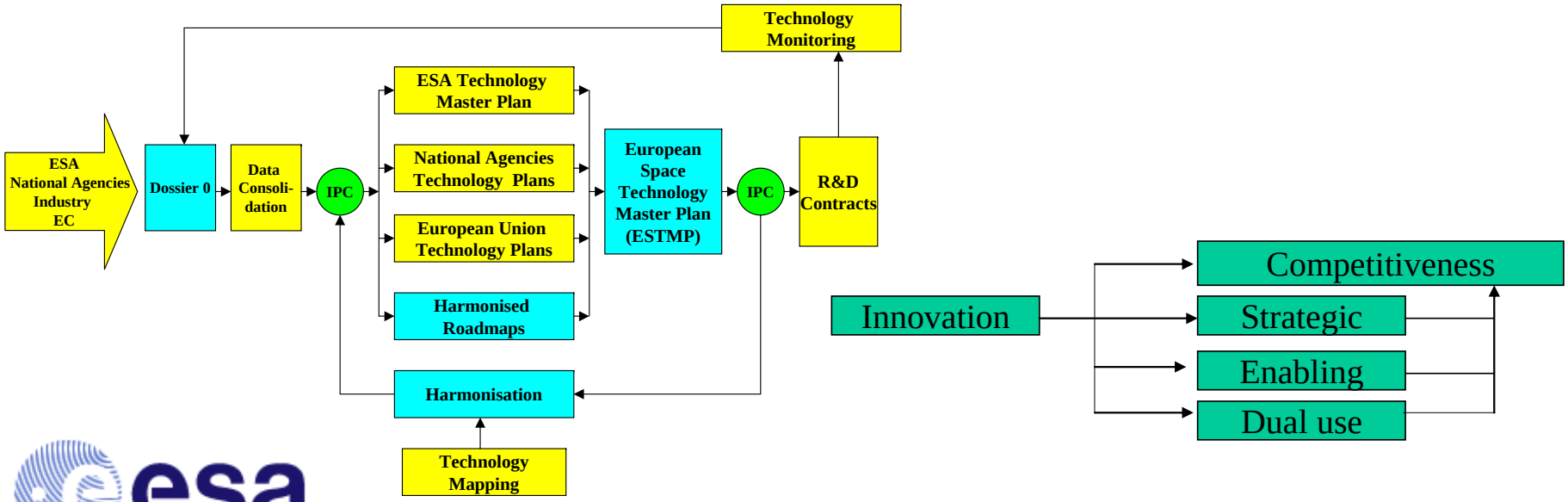
The European Vision

- The ESA Technology Strategy is derived from ESA overall strategy (Agenda 2007 + 2011), the European Space Long Term Plan and EC White paper
- It presents the technology Cross-Sectorial strategy (i.e. High level strategic objectives applicable transversally to all technology programmes and domains) and the technology Sectorial strategies (i.e. service domains).



The European Vision

- Technology is key strategic element within ESA R&T objectives (including European non dependence)
- ESA has recognized experience and expertise in technology and makes it available to Participating States (i.e. National Agencies, Industry, University)
- Technology often key element in attracting new Cooperating or Member States to ESA
- ESA successfully demonstrating a coordinating role recognized on European level for requirements coordination (Dossier 0), technology harmonization and European Space Technology Master Plan (ESTMP)

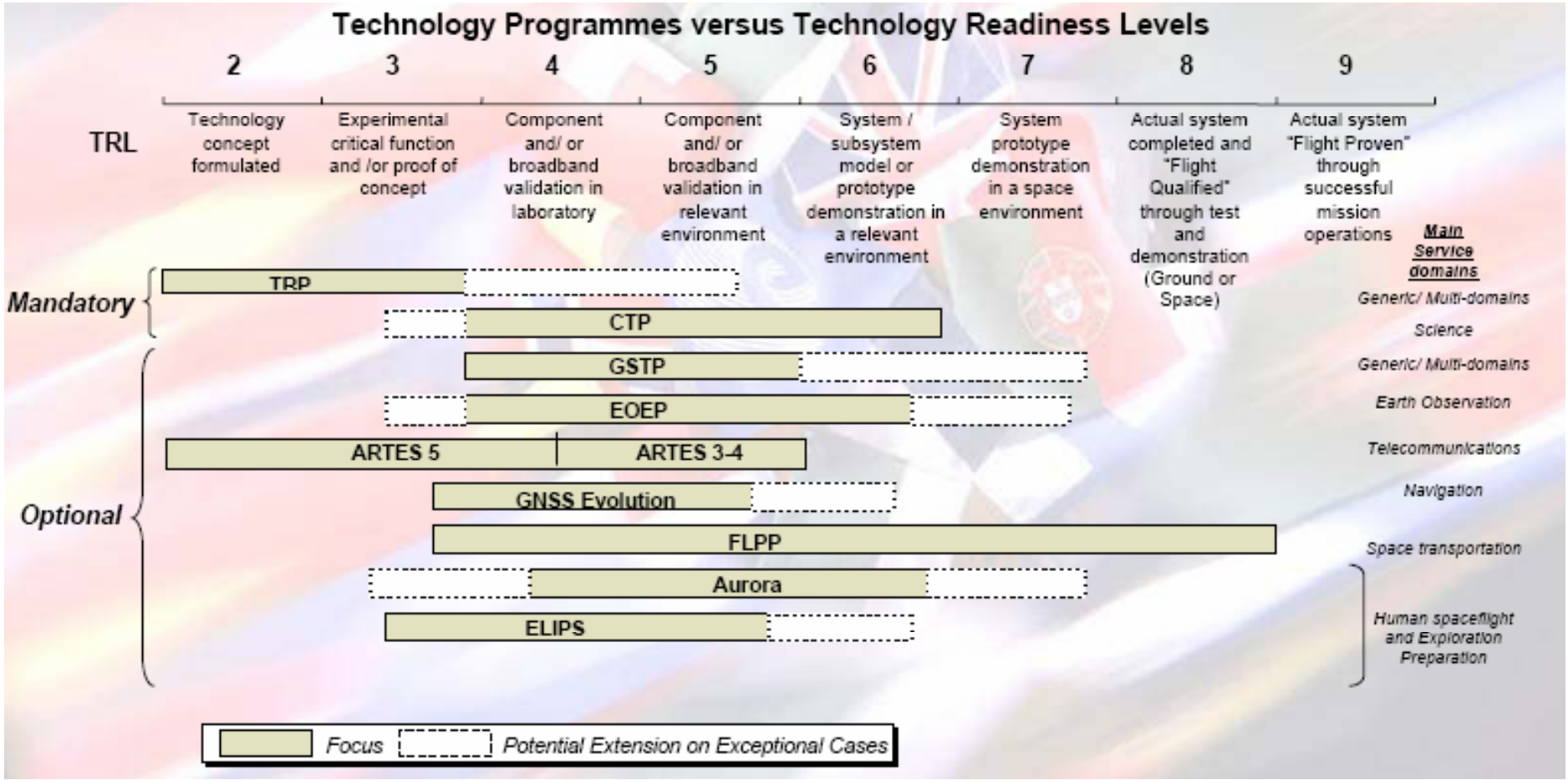


The European Vision

- ESA is actually
  - ⇨ Supporting industry competitiveness on the market (short term)
  - ⇨ Preparing and maturing technologies for future projects (medium term, according to ESA LTP)
  - ⇨ Stimulating innovation (long term)

- Main Criticisms
  - Too much reliant by funding for market driven activities
  - Funding not guaranteed at the right time and at the right place
  - No ESA-wide (and even less European-wide) product policy
  - No sufficient use of ESA tech. products (product readiness on time)
  - No evaluation of the outcome of technology programmes
  - Further dispersion Europe wide (in spite of the efficient harmonization process, because of far-from-complete implementation, leading to gaps and duplications, insufficient volume and insufficient competitiveness of industry)
  - Lack of efficiency of the more than 500 M€ invested in Europe every year in technology activities

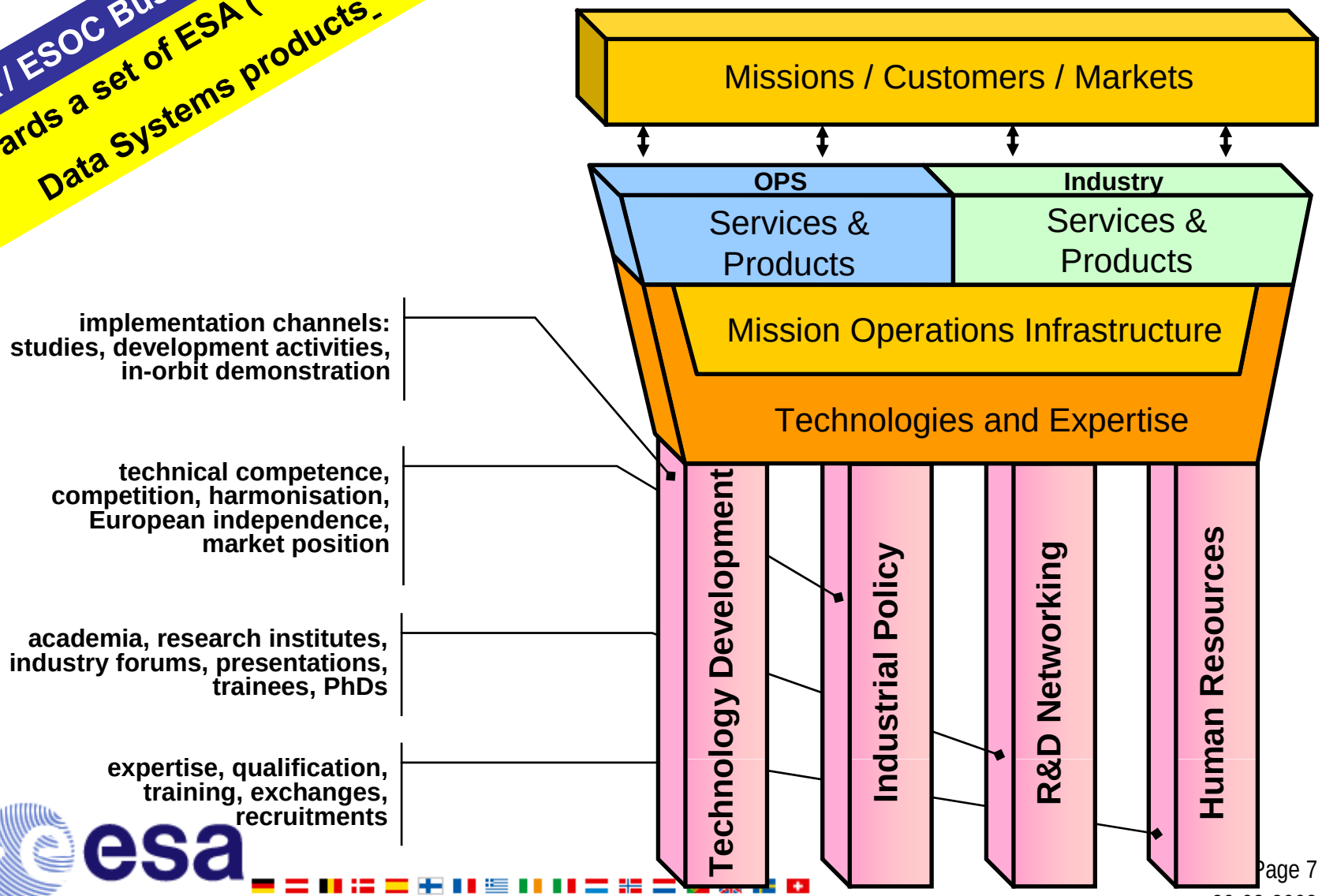
The European Vision: Suitable Implementation Tracks



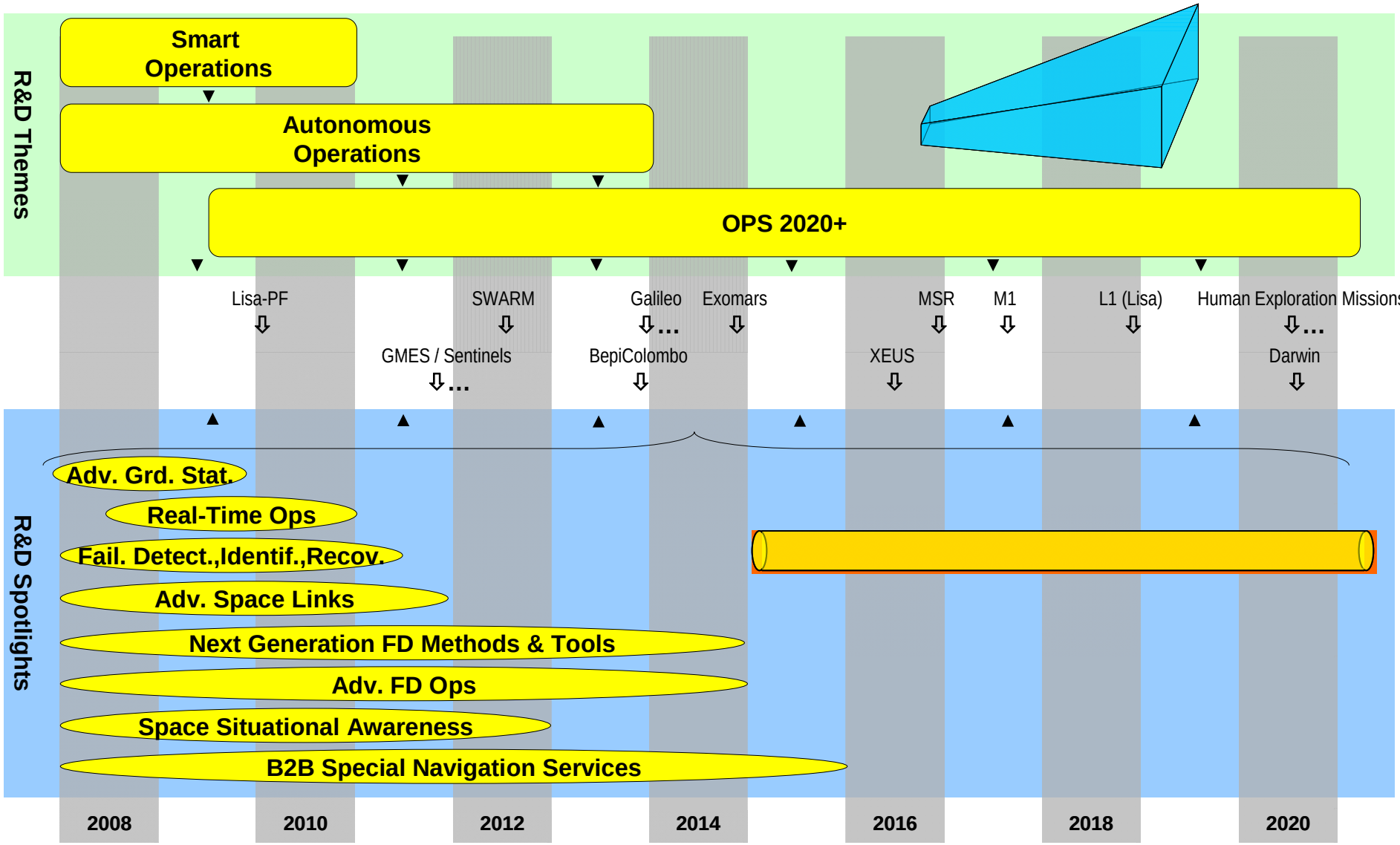
Ops Centre Vision: Elements of ESA/ESOC R&T Initiative

ESA / ESOC Business Model

Towards a set of ESA ("full IPR") Data Systems products

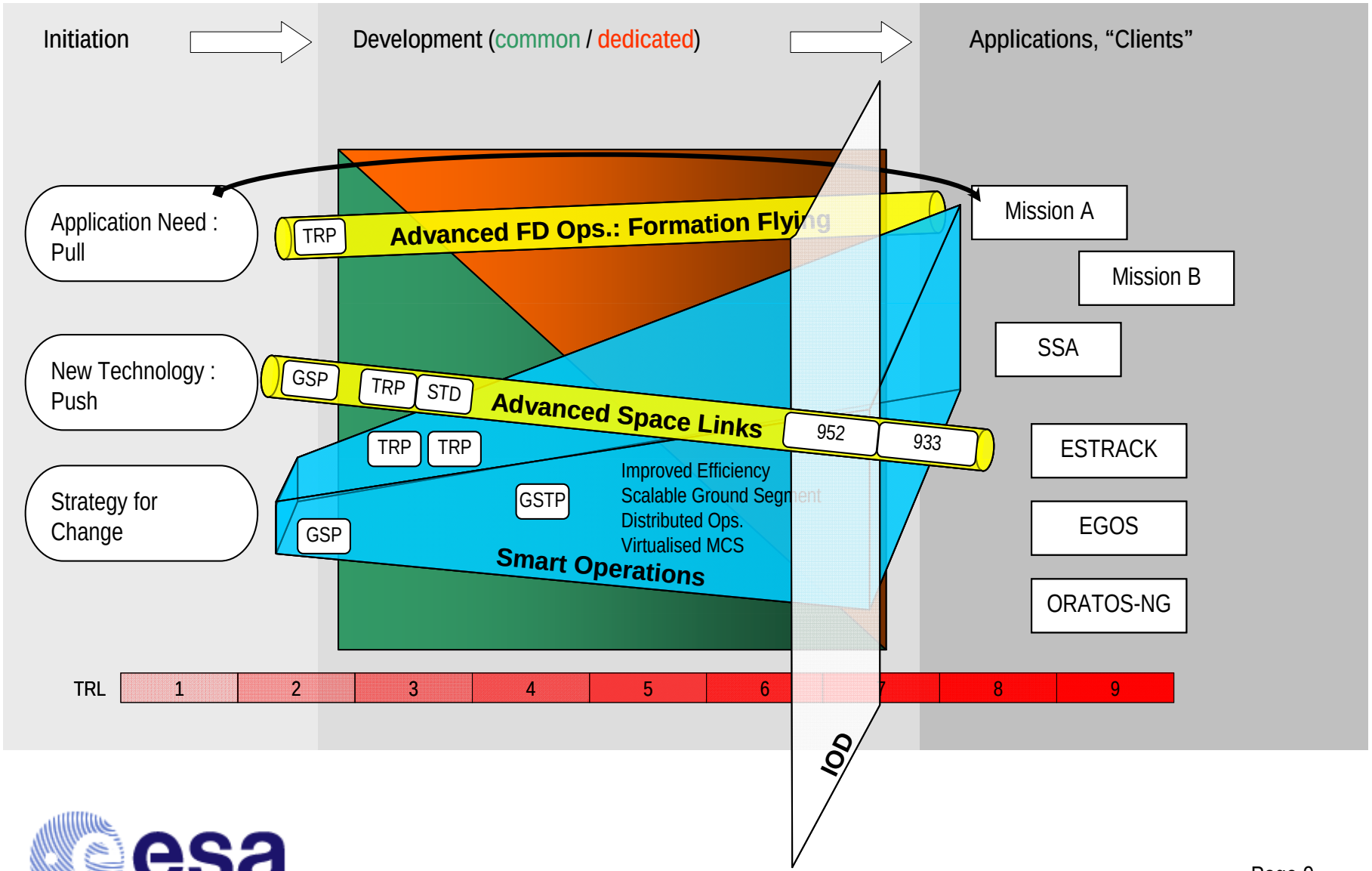


OPS Centre Vision: D/OPS R&T Top-Level Roadmap



OPS Centre Vision: D/OPS R&T Top-Level Roadmap

Spot Lights and Themes



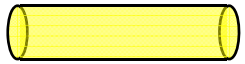
R&D Theme Example: Autonomous Operations

"How to evolve current operations and infrastructure"

Autonomy in Operations is a change in paradigm

- Key subjects:
  - Autonomous Operations – concepts, processes and tools (planning and re-planning, execution, monitoring, diagnosis & repair)
  - Offline space systems operations
  - Autonomous ground stations
- Customers / users
  - Potentially all missions
  - first clients: exploration and science missions
  - Reduced requirements missions
  - Infrastructure (for ground stations)
- Time Horizon:
  - 2008-2015

Example Spot Light 2: Advanced Space Links



Develop space link technologies and topologies for future needs

- Key subjects:
  - IP-type network topologies, disruption- / delay-tolerant networks (DTN)
  - Flexible communication and data relay architectures
- Customers / users
  - Future science and exploration missions
  - New Avenue: European Data Relay System
- Time Horizon:
  - 2008-2013

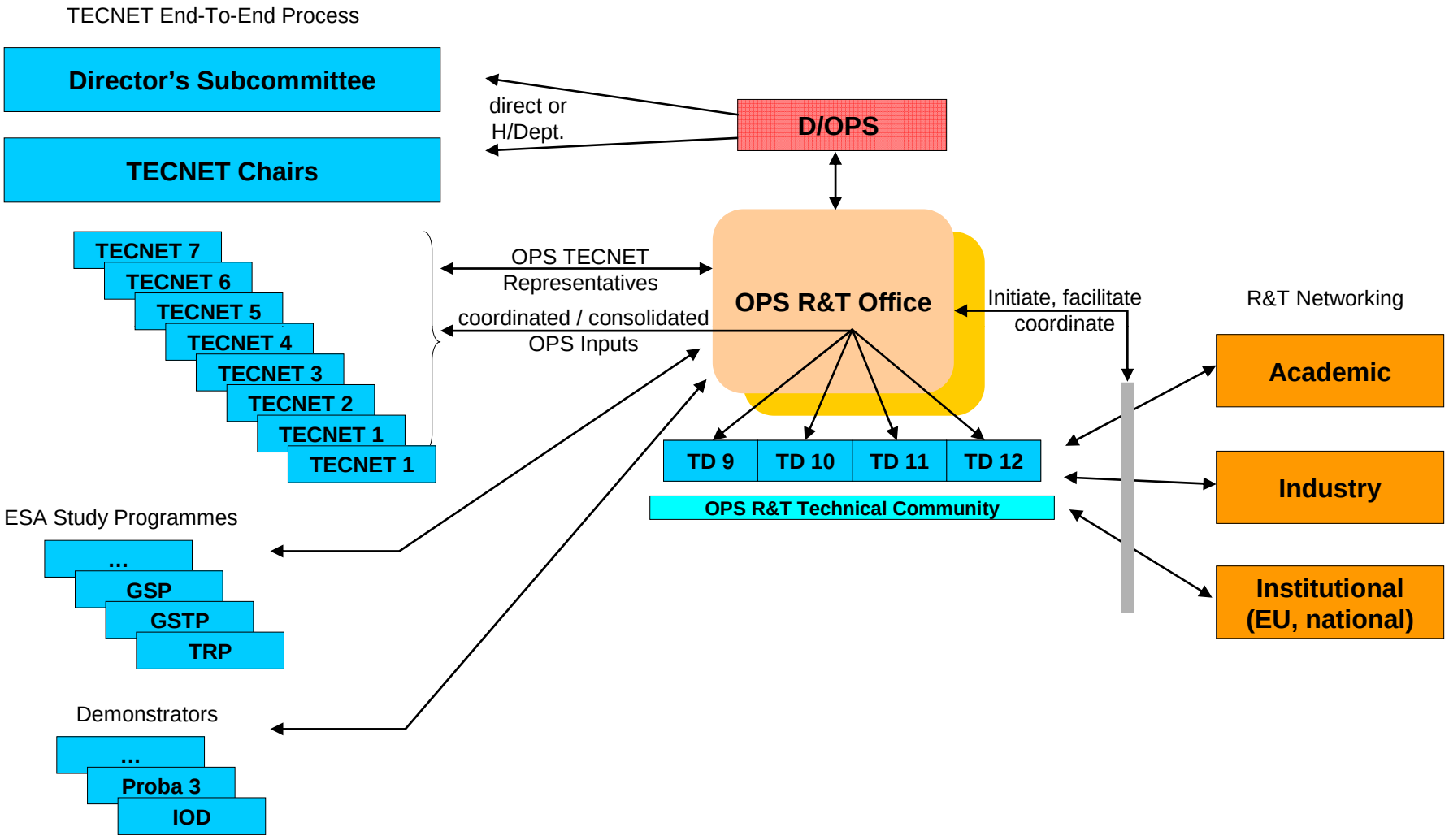
Ops Centre Vision: Why can R&T help ???

- R&T is "producing" technologies and expertise
  - Enabling new services for a broader customer base
  - "homework" when addressing the new opportunities ("New Avenues")
    - ⇨ Integrated Applications
    - ⇨ SSA
    - ⇨ European Data Relay System
    - ⇨ Security
  - new business models: push/pull effects for customers
  - Enabling potential reductions in fixed cost through higher efficiency, increased flexibility, disruptive changes
- R&T only can help when combined with the right mind set:
  - Re-orient and be open for new customers, opportunities, technologies
  - Apply / offer already available technologies for scaled/flexible services
  - Be targeted and consequent for implementing R&T results in infrastructure, e.g.
    - ⇨ Single platform / OS convergence
    - ⇨ Virtualization

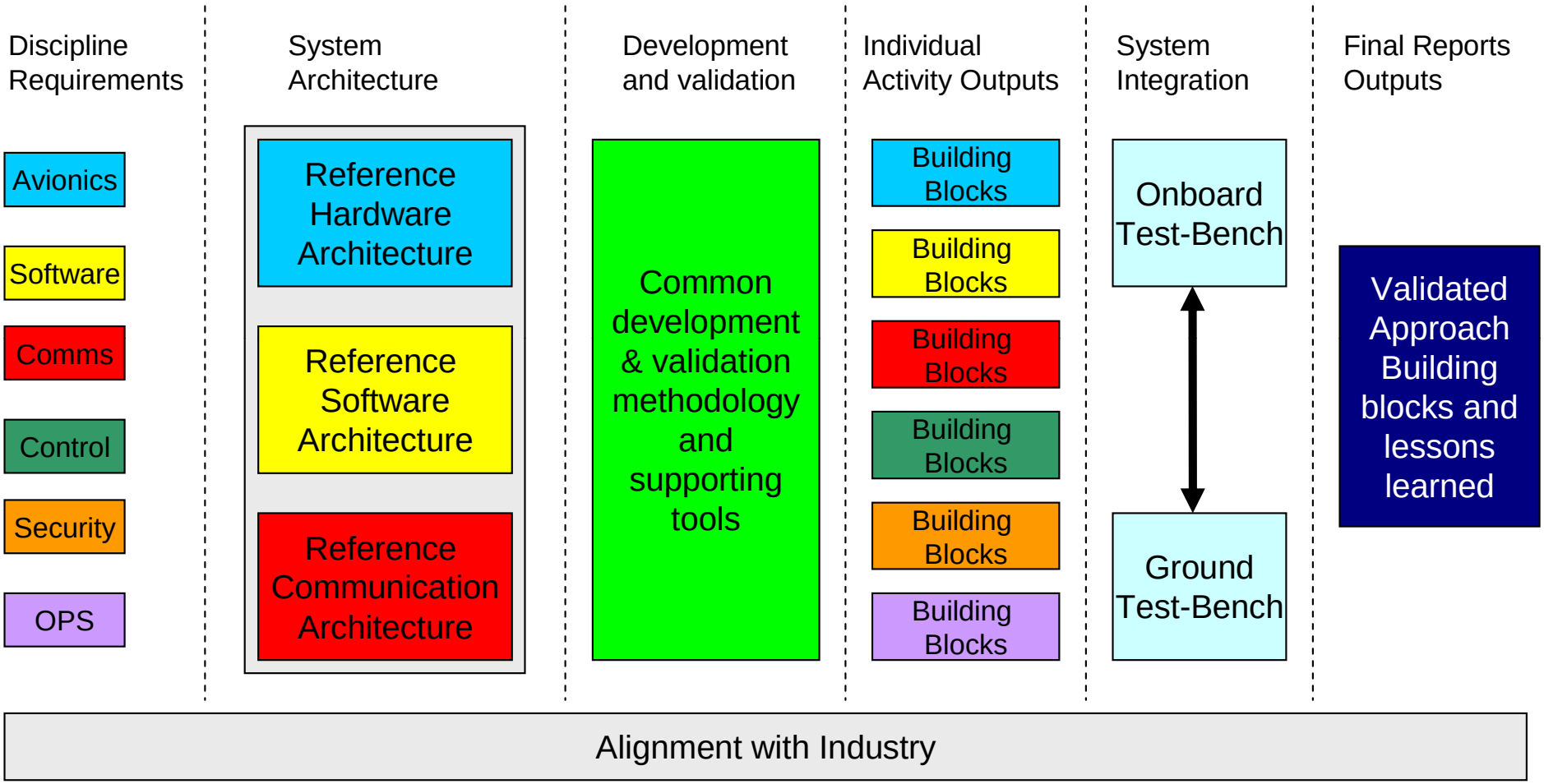
Ops Centre Vision: Why can R&T help ???

- Complement D/OPS portfolio of services: “scalable ground segments”
  - functions, performance, reliability, availability, cost, risk
  - based on negotiated user requirements (performance vs. cost and risk), “Advanced”, “standard”, “lower requirements / different risk level”
- Enable new operations concepts, services and expertise
  - Future mission needs (mission model)
  - New Avenues
  - Shared / distributed operations concepts (ESA, agencies, commercial operators)
  - Fully transparent ground segment
- Enable improved efficiency
  - Provision of OPS services
  - Development, maintenance, operation of OPS infrastructure
- Develop competitivity of European industry in the ground segment
  - EU industry to succeed on global market
  - ESA to access best industry products at best price

OPS Centre Vision: R&T IFs and its high entropy

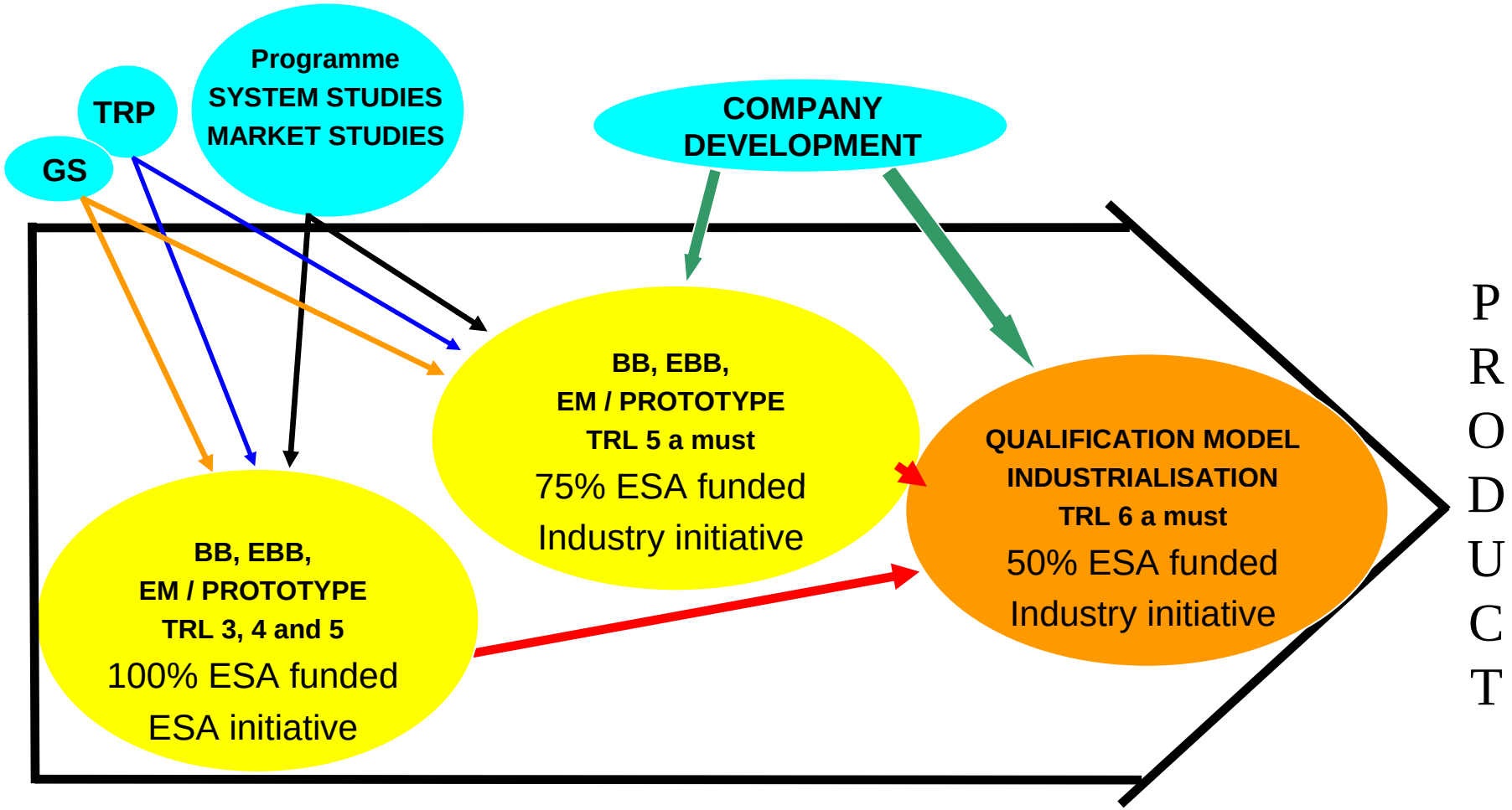


OPS Centre Vision: An Example of Avionics Cross Sectorial



D/TIA View: An Example for Telecoms

Another ESA Business Model



The Industry Vision

- KEY TO SUCCESS: COMMON UNDERSTANDING OF COMPLEMENTARY ROLE OF INSTITUTIONS, INDUSTRY and RESEARCH ORGANISATIONS IN EACH AREA.
- Emerging technologies and innovative architectural concepts are generally kept confidential at company level in a first stage.
- Transition from confidential status to European recognition needs in depth technical exchanges. Comparison with alternative technologies needs specific efforts.
- Space Industry tends only to support Short / Mid Term Innovation
  - Many projects in internal industry R&D plans correspond to innovation.
  - Innovation in the Technology
    - ⇨ Facilities and Tools for Concurrent Engineering Tools, Simulation, Software / Hardware design and development, AIT, Harmonization, Standardization approaches.
  - Innovation in Ground System Concept & Architecture
    - ⇨ Small missions / Single satellite(s) versus Constellation
    - ⇨ Overall Ground System Architecture (fostering standardization / Interoperability)
    - ⇨ Low cost HW / SW (use of COTS) and Low cost of operation
    - ⇨ Low cost of EO Data acquisition and rapid access to data
    - o Synergies between meteorology and earth observation systems

Models and Policies influencing Technology

- Several factors are influencing the Technology deployed at ESA, National Agencies and / or Industry
  - Customer Procurement Policy
    - ⇨ Space / Ground Procurement (all in one)➔ Multiple OCC / Lack of Ground Synergy
    - ⇨ Space and Ground are procured separately➔ Towards Common Ground Systems
  - Customer Ground Segment Facilities
    - ⇨ Common Areas for different satellites / family of satellites
    - ⇨ One facility per procured satellite
  - Customer / Industry Ground Segment Data Systems (SW and HW)
    - ⇨ Use of a common infrastructure
      - ➙ For MCS
      - ➙ For all Data Systems
    - ⇨ Re-usability of previous projects
    - ⇨ Re-invention of the wheel
  - Organizational aspects
    - ⇨ Only 1 group responsible of infrastructure / Data Systems Development
    - ⇨ Different teams responsible of Data Systems Procurement
  - Innovation, proof of concept, prototype, TRL increase, deployment in Data Systems lead by
    - ⇨ ESA and / or National Agency
    - ⇨ Institutional + Industry
    - ⇨ Only Industry

The Bottom-Up Approach

- The SW engineer (without "managerial" dreams (yet)) working as a "civil servant" in ESA or a National Agency thinks wrt Technology in a 180 degrees apart direction when compared to his managers

New Technology ➔ On which Space Ops Domain? ➔ Maps any existing driver?

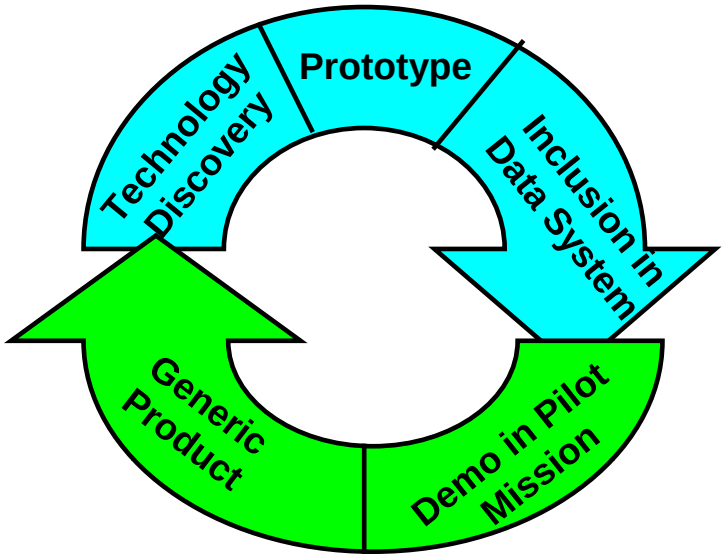
- **Hybrid Technology for behavioural SIM**
- **SOA / MDA / MDD**
- **Virtualization**
- **Thin Clients**
- **Model based Sys Eng and Ops Val**
- **Statistical analysis**
- **Data Warehousing + BI**
- **AI Planning + automation**
- **Genetic Algs**
- **3D VR**
- **Web based applications**

- **RT Ops**
- **Off-line Ops**
- **Performance Assessment**
- **Diagnostics**
- **Optimisation**
- **Visualisation**
- **Reporting**
- **Mission planning**
- **Training**
- **Automation**
- **Decision Making**
- **etc.**

- **Innovation**
- **Cost reduction**
- **Competitiveness**
- **Quality of service**
- **Reduced time to Ops**
- **Reduced Requirements**
- **Low cost of data acquisition**
- **Short time to access data**
- **etc.**

The Technology Deployment saga

- A long process



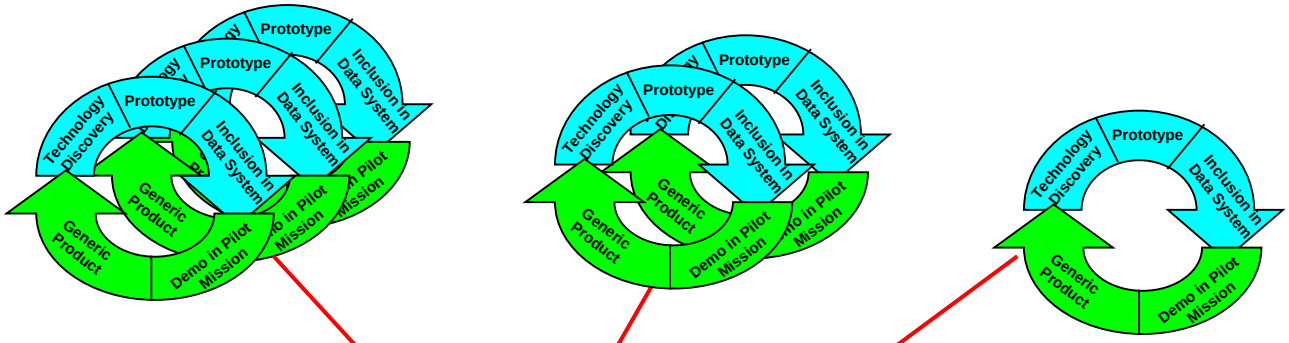
+ Conservative Users
Not willing to have their Systems as the guinea pig
Pilot project

Technology Discovery	T0
Activity in Tech Programme	T0 + 1 year
Start + Prototype TRL 3	TO + 3 years
Enhanced Tech Development TRL 6	TO + 4 years
Inclusion in Data System Delivery	T0 + 5 years
Pilot Mission Usage	T0 + 6 years
Generic Product	T0 + 7 years

Collision of Approaches in the "Legacy Systems" arena

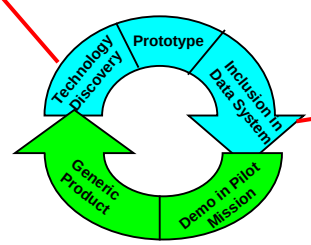
Simple technologies takes until 5 years to be deployed in the ESA/ESOC Data Systems,

and 7 years to be operationally demonstrated



Top-Down

ID	Task Name	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	Data System Release 1																
2	Data System Release 2																
3	Data System Release 3																
4	Data System Release 4																
5	Data Systems Release 5																
6	Data System Release 6																



And every release shall be mature 3 months prior to Mission SVT0 (normally 1.5 / 2 years before Launch

Other technologies (C++ , CORBA) are kept for 10 – 20 years

Bottom-UP

How to find the right balance

Vision, Strategy, Roadmap, Objectives, Plans

Industry & R&D Budget

Fast Prototyping

Is it possible to speed up Tech Programmes ?

Learning, Formation

What is important for a manager And / or a technology Engineer ?

Business Model

Secure Funding

Technology Deployment

Technology Discovery

!! Organizational High Entropy!!

How can we convince users To deploy technology in their systems?

Balance between Products and a "good prototype"

!! Gaps & Duplications !!

Long Term Maintainability

SUCCESS ORIENTED

How many technologies are failing to be deployed ?