EDA R&T for Space Defence
SpaceTech Alumni Symposium, 23th of July 2021

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New AHWG Space

- Started its operation on 11th of January 2021:

- Why?
  - **Space** is recognised as a **distinct warfighting domain;**
  - **EC and ESA's** R&T work done is related to **pure civilian applications;**
  - **R&T for space defence** is done mainly **at national level by individual MS;**
  - **Cooperation** in space defence R&T **is very scarce -> need for European autonomy.**

- Aim:
  - To accommodate **the coordinating role of R&T for space defence** in Europe;
  - To **interface between MoDs and industry** for achieving European autonomy;
  - To grow-up of existing R&T activities for space defence in a distinct AHWG with finite duration that may evolve in a CapTech.

New AHWG Space

The AHWG on Space started on 11/01/2021 with the goal to: a) to appropriately accommodate the responsibility of the coordinating role of R&T for space defence in Europe and strengthen the R&T for space defence keeping up the international place, b) to interface between MoDs and industry for achieving European autonomy. It will be composed of experts coming from participating Member States, industry and academia whose task is to develop and keep up to date a Strategic Research Agenda for space R&T in defence within EDA R&T framework.

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CAPABILITY NEEDS

- **Space-based information and communications services** (Earth observation, Positioning, Navigation and Timing, Space Situational Awareness, Satellite communication)
- **Information superiority** (radio spectrum management, tactical communications and information systems, information management, and ISR capabilities);
- **Air Superiority** (e.g. Ballistic Missile Defence);
- **Cyber defence** (including in space)

TECHNOLOGIES & RESEARCH DOMAINS:

Four high level Technological domains (TD) for Space R&T will be further developed to support defence applications:

- TD1 Architectural and Interoperability
- TD2 Sensors & supporting mechanisms
- TD3 Imaging, Radar and supporting technologies
- TD4 Space-based PNT

Plus, a supporting Technology Domain (TD5) on AI aided Decision-Making & Information Management.

PROJECTS & PROGRAMMES:

- **MIRACLE II,** (cross CapTech) (~ € 2,400,000)

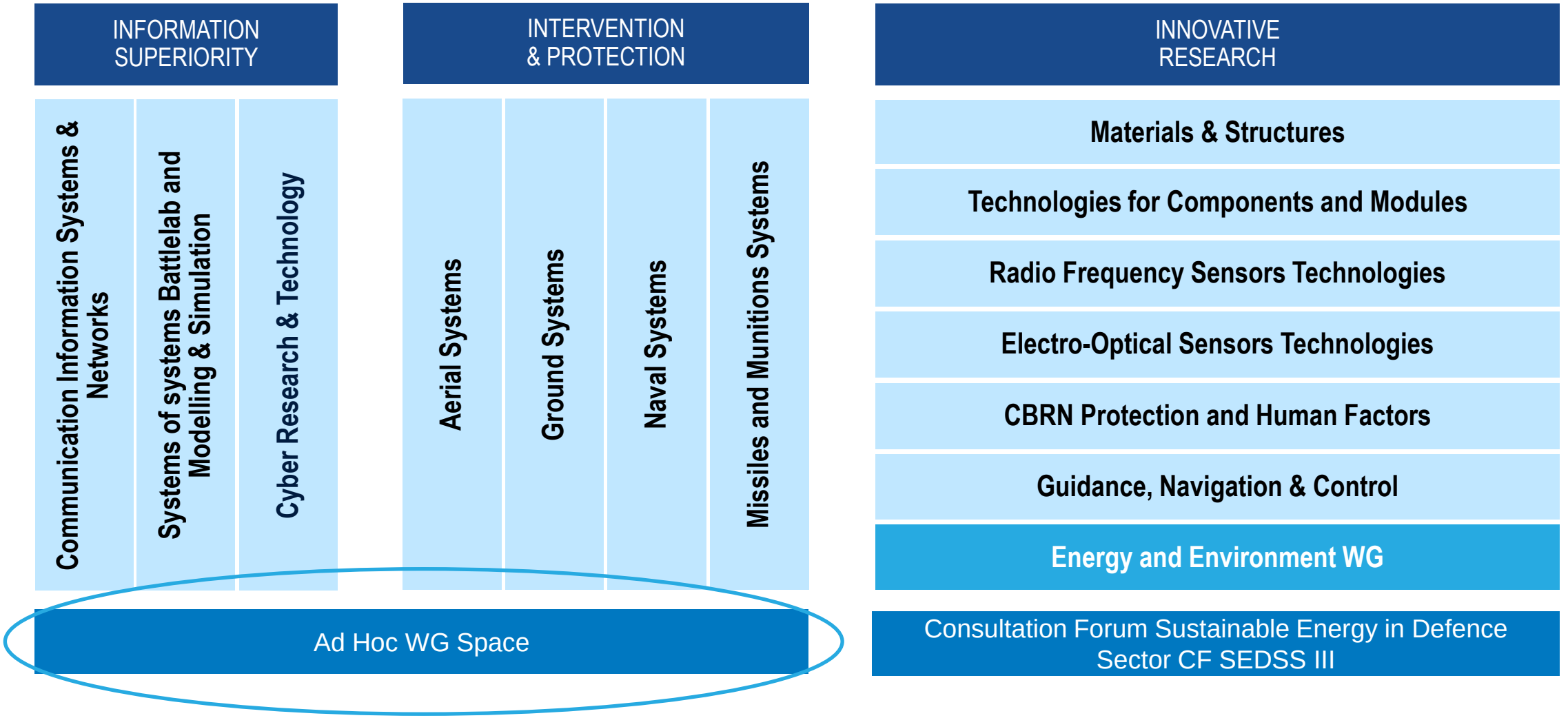
OB STUDIES:

- **SRA Space,** (€ 240,000)

New AHWG Space

- OB Study for Space SRA
  - Contract signed on 15th of March with EY;
  - Budget of 240K (March 2021 – December 2022).

CapTechs and AHWG – Technology domains & networks



The detailed technical coverage of each group is posted on ***www.eda.europa.eu***

Update on AHWG Space

- 1st AHWG Space meeting in June.
- Impressive 100 % participation of all 16 MS with designated NCPs plus EDA, EY team+ their experts working on Space SRA.
- Main meeting outcomes :
  1. **Decision to incorporate industry, universities, SMEs and other stakeholders after the 1st AHWG Space meeting. D**edicated workshop with industry was organised in June 2021.
  2. **Decision to pursue CATB projects generation if possible during 2021 and on** based on CapTech Simulation-Space TBBs and additional proposed topics.
     - **Funding for CatBs** is of vital importance: MS are already checking internally such possibility.
  3. **Decision on the participation of non-governmental and AA countries**
- Next steps:
  1. **MS feedback** on their priorities, proposed technology Domains and additional topics.
  2. List of **CGEs** per MS to be provided.
  3. Preparation of **industry and stakeholders portfolio.**
  4. **Feedback on ideas for CatB Projects** (participation/lead, indicative budget).

Update on AHWG Space

2nd AHWG Space meeting in June.

- On top of already designated MS, 2 additional MS.
- Main meeting outcomes :
  1. **Roadmap for SRA development.**
  2. **Technology landscaping activities.**
  3. **Discussions on CATB projects generation.**

1st AHWG Space Industry Workshop in June.

- Impressive participation of more than 120 experts from industry, RTOs, SMEs and universities.
- Focus on R&T needs.

Overview of Technological Activities

Challenges
Technology

Challenges	Identified Technology Needs
Precise knowledge	TN1: Space Situational Awareness (SSA)
Access to Data	TN2: Information Acquisition
Space Data Exchange	TN3: data interoperability
Efficiency in data management	TN4: automated data management including analytics
Decision-Making	TN5: decision-making tools
Space based PNT	TN5: Space-based PNT

AHWG Space: Technology needs for Space R&T & Way forward

- **Background**
- **High level Technological Domains (TD) for Space R&T based on the EDA Working Document for Space R&T in Defence**:

  1. **TD1 Architectural Analysis & Interoperability;**
  2. **TD2 Sensors & supporting mechanisms, e.g. Satellites MEO/GEO surveillance from LEO orbits;**
  3. **TD3 Imaging, Radar and supporting technologies;**
  4. **TD4 Space-based PNT;**
  5. A supporting **TD5 AI aided Decision-Making & Information Management.**

- Existing TBB8 Recognized Space Picture and TBB9 Defence Satellite Reconnaissance Systems, within CapTech Simulation.
- **New topics to be proposed as an outcome of the OB Study** during the 1st AHWG Space meeting.
- **New topics to be proposed by MS.**

AHWG Space: Technology needs for Space R&T & Way forward

TD1 Architectural Analysis & Interoperability

- Roadmap for space-based Reconnaissance & Recognised Space Picture.

- Framework Architecture ensuring Interoperability of various Space Surveillance Systems
  - to manage a high number of satellite-borne and ground-based SSA sensors.
- Network and interoperability facilities on European military level;
  - to receive and process data from multiple data sources (not just optical – optical, but optical – RF, optical – radar, and others).
- Interfaces & Standardisation:
  - e.g Agreement on standards for interfaces Ground – Space segments at least on European level or NATO level.

AHWG Space: Technology needs for Space R&T & Way forward

TD2 Sensors & supporting mechanisms

- Development of sensors and supporting mechanisms for a Recognised Space Picture;
- Novel architecture to include existing and new assets;
  - e.g. development and integration of large detection radar at low latitude
- New ad-hoc sensors, both space and non-space based to improve the data quality & sky coverage;
  - Satellites MEO/GEO surveillance from LEO orbits,
  - GEO satellite Reconnaissance/identification from GEO orbit,
  - LEO Satellite reconnaissance/identification from LEO orbits.
- Extension of the ground sensors with optical ground-based network, laser tracking, and passive RF capabilities;
- Multi-sensors constellations to provide persistent surveillance needs to be assessed.
  - Sensors as hosted PLs on constellation satellites.

AHWG Space: Technology needs for Space R&T & Way forward

TD3 Imaging, Radar and supporting technologies

- Very High-Resolution satellite imagers to obtain 3D images of targets
- Hyperspectral imaging satellites and sensors to improve the information from overhead (satellite-based or airborne) optical imagery.
- Imaging radars:
  - SAR with multichannel ISAR and InSAR capability for high resolution satellite-based imagery;
  - Spintronics for Space sensors.
- Supporting technologies for Space-based Reconnaissance
  - Technologies for satellite-based early warning (e.g. Thermal infrared imagers, etc.);
  - Fuel Cells for small payloads;
  - On board SWAP edge processors also based on quantum computing;
  - New Distributed multisensors signal/image processing.

AHWG Space: Technology needs for Space R&T & Way forward

TD4 Space-based PNT

- Inertial Navigation Systems (INS) and sensors to improve robustness of PNT information in GNSS denied or degraded environments;
- R&T on countering possible interferences, spoofing, and cyber threats;
- Advanced Fiber Optics, laser-based navigation systems, quantum or micro-PNT technologies to augment and complement GNSS;
- Techniques for multi-constellation defence GNSS receivers;
- Robust GNSS space receivers via developing Galileo PRS Space receivers;
- Secure GNSS SDR for defence via the implementation of Software Defined Radio (SDR) solutions;
- Multi-element antenna technology for antenna nulling with spaceborne GNSS receivers;
  - e.g. Controlled Radiation Pattern Antenna – CRPA for Galileo PRS Space receivers.
- Synergies with CapTech GNC.

AHWG Space: Technology needs for Space R&T & Way forward

TD5 AI aided Decision-Making & Information Management

- Support timely & efficient data administration, enable the Recognised Space Picture & make optimal decisions within short timeframes.
- Applications:
  - Space domain awareness & optimal objects tracking;
  - Detection and identification of space objects with unexpected behaviour;
  - Orbital objects' signature analysis;
  - Ground based systems for data fusion and SSA data processing (ground/space & optical/RF).
- Examples of AI technologies and analytics:
  - Edge AI: Onboard processors to provide AI at the edge;
  - AI sensors fusion and visualisation tools to support the decision-maker;
  - Synthetic rendering capabilities for reactive decisions.
- Visualisation, virtual and augmented reality in digital twins for satellites and systems.

Additional topics to be considered

- Sentinel data processing (e.g. to track changes and put out false positives)
- R&T to support satcom, e.g. data transfer from space sensors to the ground
- Micro-satellites and nano-satellites
- R&T for Space Traffic Management
- R&T related to passive and active measures (e.g. on board cameras in satellites)
- Quantum technology for space R&T
- R&T to support Copernicus improvement
- Improvement of Sentinel sensors
- Novel launch capabilities for deployment of assets in space
- Propulsion systems in the space domain
- Energy-related aspects (e.g. technologies for energy storage)
- Hypervelocity

CapTech Simulation-Space TBBs

- TBB08 Recognised Space Picture
- TBB09 Defence Satellite Reconnaisance Systems

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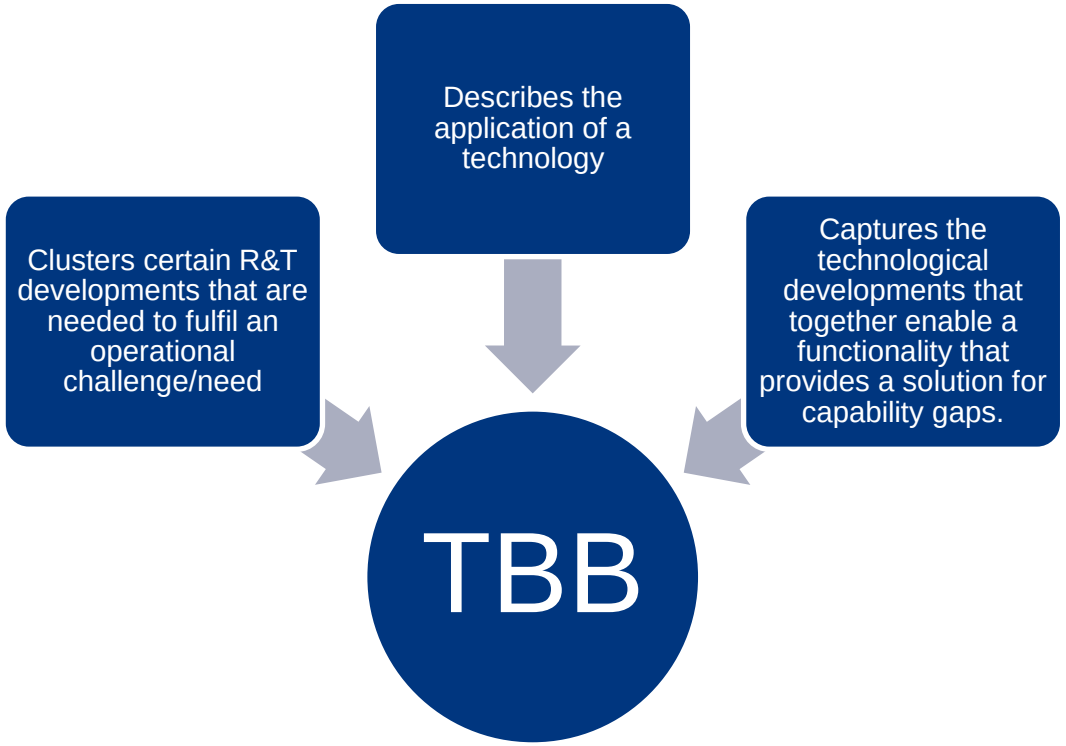
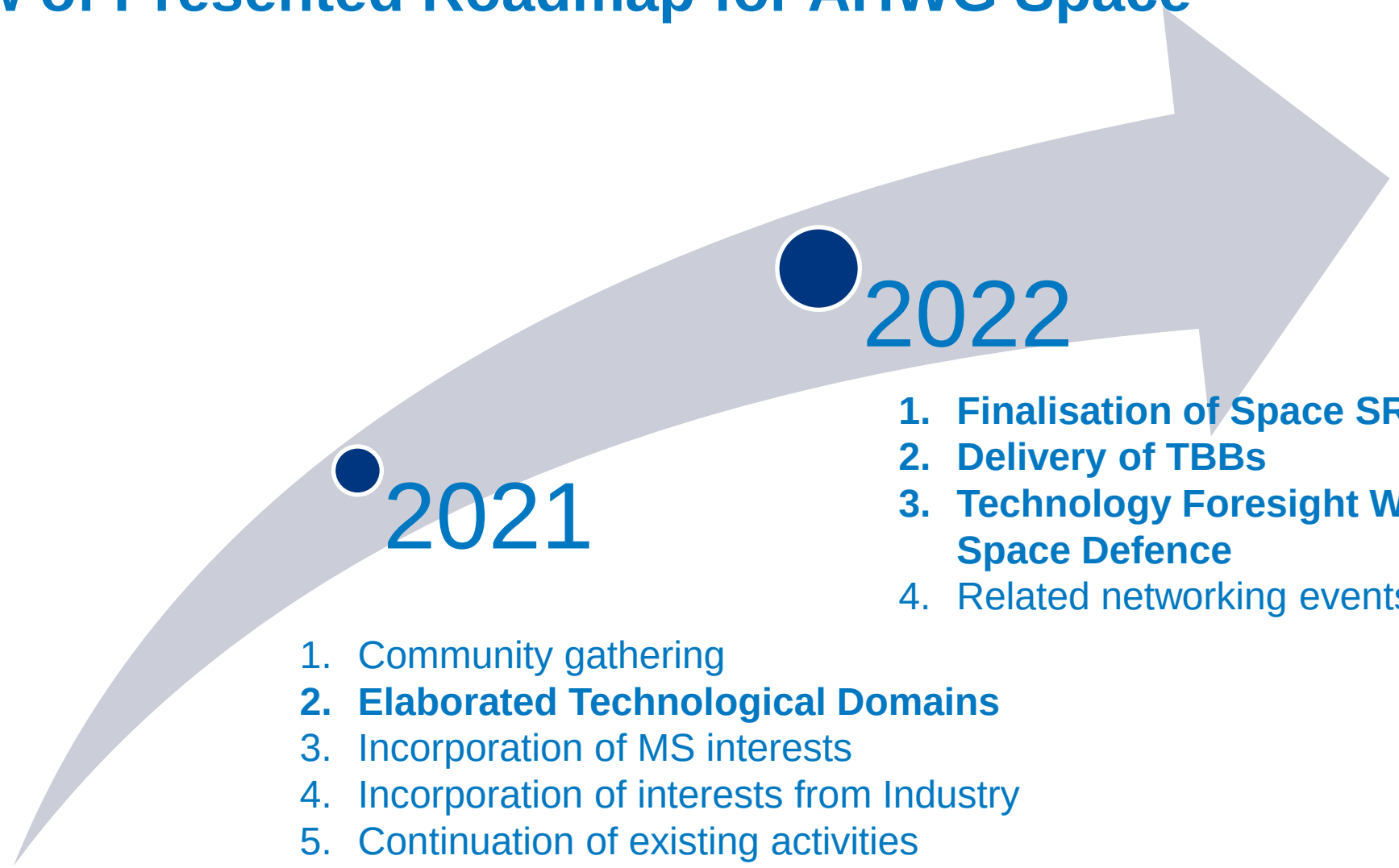
What is a TBB



A TBB helps to align and define capability pull and technology push related requirements via the specification of certain functionalities that are needed to realize such capability (via research and innovation).

Overview of Ongoing and Planned Activites

Overview of Presented Roadmap for AHWG Space



2021

1. Community gathering
2. **Elaborated Technological Domains**
3. Incorporation of MS interests
4. Incorporation of interests from Industry
5. Continuation of existing activities
6. **preparatory steps for setting up the distinct Ad hoc Working Group with finite duration**

2022

1. **Finalisation of Space SRA**
2. **Delivery of TBBs**
3. **Technology Foresight Workshop on Space Defence**
4. Related networking events

Key Aspects for AHWG Space Workplan

- Delivery of Space SRA and TBBs incorporating
  - **MS interests;**
  - **R&T needs** based on operational challenges, capability needs and technology gaps;
  - Existing **work conducted within CapTech Simulation-Space**.

Prefinal Proposed Workplan for AHWG Space

- Incorporation of industry & key stakeholders; **Ongoing**
  - After the 1st AHWG Space meeting.

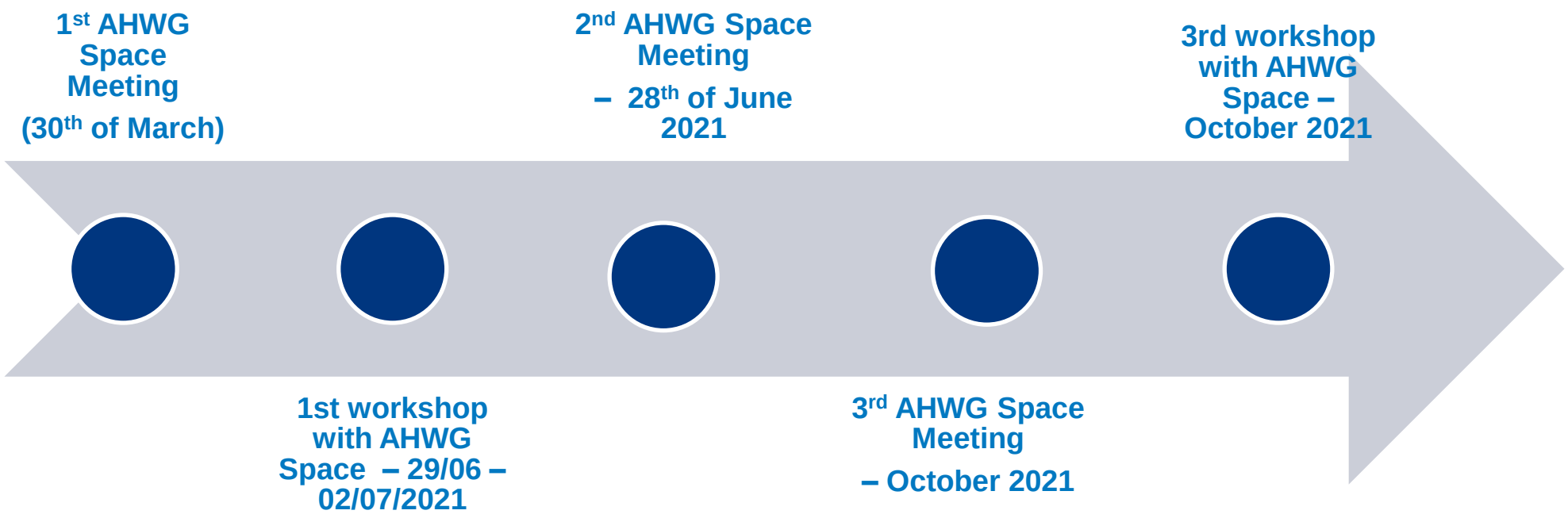
- Possible preparation of CATB projects based on the roadmaps of the TBBs of the CapTech Simulation – Space.

- OB Study for Space SRA
  - Budget of 240K for 10 months (March 2021 – October2022).

Prefinal Proposed Workplan for AHWG Space

Planning of Meetings

- To be discussed with AHWG participants & the contractor.



Activities in 2021 for AHWG Space

Part of the OB Study with EY

- Defence technology landscaping on space R&T;
- Industry & stakeholders portfolio;
- R&T Gap analysis for defence in space;
- Space SRA development.

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Thanks for your attention!