TECHNICAL POSITION PAPER 2023

ABSTRACT
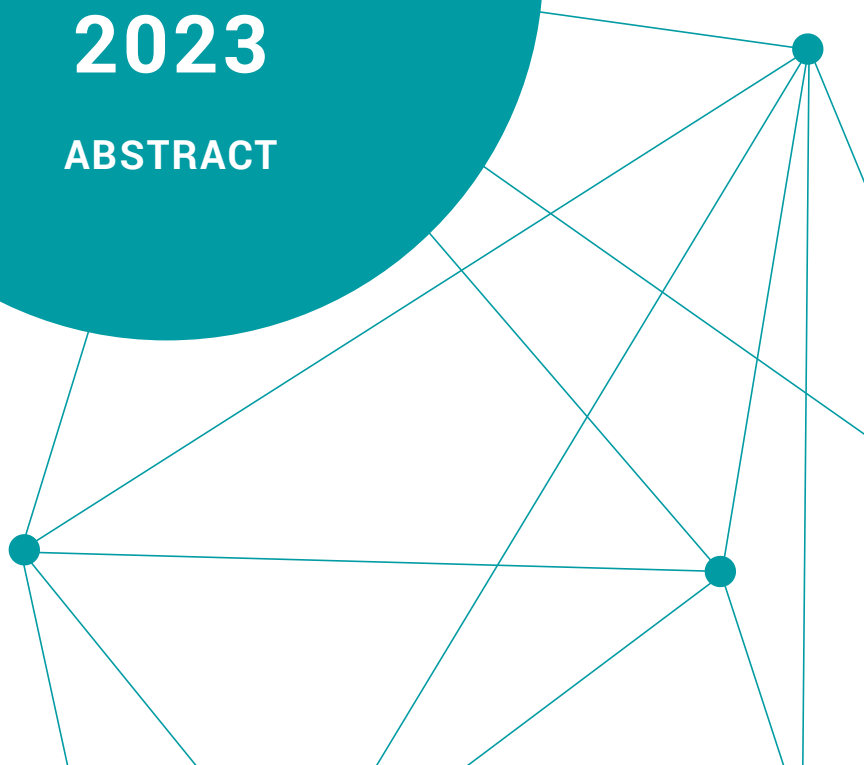
The Austrian community in the important field of ESBS has joined forces to promote, optimize and coordinate collaboration in Austria and with partners in Europe through the industry-driven national research, development and innovation platform ESBS-AUSTRIA.

This **Technical Position Paper** aims to give a comprehensive survey of the positions of the Austrian ESBS community, outlay its importance, identify the relevant R&D topics and indicate how activities in these areas will create a significant contribution to the challenges of today's society with positive effects on Austria in a European context.

Six innovative, equally important focus areas were identified by the community with high potential for global technology leadership of Austrian companies.

1 POWER ELECTRONICS AND CONTROL (SRIA 3.2)

Austrian players cover the complete value chain for solutions for power efficient applications from new materials to IC development and production, PCB integration and system solutions. This generates a major impact for the Green Deal in the field of renewable and clean energy, e-mobility, digitalization and de-carbonization.

Research topics:

- New materials for higher power efficiency
- Advanced charging & battery management
- Next level of design and validation methods and production technologies/processes, AI methods
- Heterogeneous integration for SOC, SiP, Chips and Package in PCB solutions
- High level of sustainability of products by excellent quality, reliability, and life time monitoring
- CO_2 neutrality of production systems

2 HYBRID INTEGRATION & PROCESS (SRIA 1.1)

Next generation computing chips and sensors will use smaller CMOS nodes to achieve increased performance with reduced power consumption, form factor and system cost. Essential enablers for these next generation devices are hybrid integration and dedicated technologies as well as requirements for green production and sustainability.

Research topics:

- Next generation packaging technologies (e.g. TSV)
- New optical (hybrid) filter technologies
- Metrology methodology (e.g. adaptive and additive manufacturing) and digital twin techniques for green production including AI/ML approaches.
- FC-BGA (flip chip – ball grid array) miniaturization
- New materials and processes for CO_2 neutral and sustainable production systems
- Advanced equipment for microelectronics production, metrology and testing
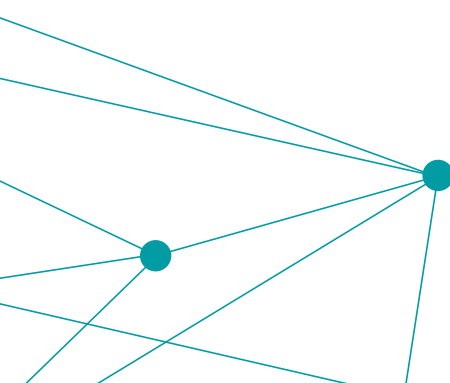
3 SENSING, PHOTONIC SENSORS, QUANTUM SENSORS (SRIA 1.2)

The area of sensors comprises a large variety of systems including sensors for ambient light, color, distance, proximity, position and image sensors. These devices are essential for next-generation devices e.g. for mobile and wearable consumer electronics, automotive, horticulture, communication and future photonics computing technologies.

Research topics:

- High-performance optical sensors (e.g. ambient light, color, spectral sensors)
- Fast and precise distance, proximity and 3D sensing for mobile applications and AR/VR technologies
- Photonic telecommunication and computing, coherent optics, convergence of photonics & RF, neuromorphic photonics
- Time-of-flight LIDAR, coherent LIDAR, optical antennas for agile beamforming, fiber-based acoustic-optical sensing
- PICs (photonic integrated circuits)
- Usage of Quantum effects for sensing tasks
- Next level of accuracy in sensor technologies like magnetics, power or inertia at very low power

4 OPEN SOFTWARE VEHICLE PLATFORM (SRIA 3.1)

Future vehicles will be electric, autonomous, service-oriented and connected. Features are more and more defined by software, can be continuously extended and updated over the air. All this requires powerful semiconductors, many more sensors, integration into the cloud-edge continuum and an advanced control software. A new automotive middleware and hardware/software abstraction for software defined vehicles plays a strategically important role. It provides backward compatibility between new hardware and existing software as well as allowing new functionality on existing hardware.

Research topics:

- Common architecture with defined interfaces at strategic touch points supporting the upcoming new automotive architectures
- Abstraction interface layer for the integration of new ADAS and AD software functions
- Service oriented architecture of modular middleware supporting reliable over the air updates
- Powerful and secure communication of very huge amounts of data as LIDAR point clouds, images, object lists; AI support; integration of infotainment
- SOTIF compliant open reference automation architecture with support of testability and new hardware components from Chips4EU initiative
- Provide backward compatibility with the main currently used Car OS (operating system)
- Foster collaboration on non-differentiating automotive ESBS aspects, such as an open reference architecture and reusable components.

5 DEVELOPMENT AND TESTING OF TRUSTABLY AI BASED REAL-TIME SYSTEMS (SRIA 2.3, 2.4, 3.1)

These topics have a high importance for the Austrian eco-system, e.g. in predictive maintenance, object classification & detection, smart control of plants/ machines, or decision support systems. These and many applications rely on AI technology. Ensuring trustworthiness through new AI-designs and/or validation and verification approaches and new tools is amongst the most important challenges in safety critical systems.

Research topics:

- Design methods for AI-enabled ESBS to reduce the uncertainty of the AI method and to enforce safety and security; this is needed for all application areas
- Continuous monitoring based on safety specification and safeguarding of adaptive and/ or dynamic changes in the system or evolving threads
- Robustness-testing of AI components
- Developing, optimization, validation and verification approaches for running complex AI models at the edge, partially also in real-time
- Efficient methods preserving privacy and guaranteeing security for distributed learning, model-updates; new methods and tools for safety argumentation supporting over-the-air-updates
- HW-acceleration: accelerate AI computation and also cut down on the energy consumption
- New design and testing methodologies for system modelling, model identification and verification

6 SECURE & ENERGY EFFICIENT CONNECTIVITY, COMMUNICATION & PROCESSING (SRIA 2.2, 2.4)

Reliable, secure and power efficient connectivity solutions will have a big impact on the success of the Digital Transformation and will strongly support the Green Deal. Austria has a strong footprint of worldwide leading academic and industrial players in this promising field, at the intersection of connectivity and security.

Research topics:

- Advanced low-power wireless connectivity and localization solutions including next Generation Networks and Services (e.g. UWB)
- Advanced (embedded) security concepts incl. PQC (post quantum cryptography)
- Ultra-low power IC design incl. embedded SW and system integration aspects
- Advanced processing architectures, e.g. RISC V and beyond processing platforms, quantum computing and communications hardware, tool chains
- High-speed access networks such as FTTH and 5G
- Optical, photonic and electrical Gbit/s interconnects
- Cyber security research at all levels of the electronic systems
- Mixed signal chip design in the nm technologies

Further Information about ESBS can be found
at **www.esbs-austria.eu**

Download the full document at
www.esbs-austria.eu/positionpaper1

ESBS
AUSTRIA