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Annex 1 : Service Catalogue

Version 0.4

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Version history

Vers.	Date	Description
0.1	29.09.2025	Initial draft

List of abbreviations

Abbreviation.	Explanation
GA	Grant Agreement
SAC	Silicon Alps Cluster
SAL	Silicon Austria Labs
AIT	Austrian Institute of Technology
MCL	Materials Center Leoben
PCCL	Polymer Competence Center Leoben
TUG	Technische Universität Graz
FFG	Forschungsförderungsgesellschaft
Chips JU	Chips Joint Undertaking
PO	Project Officer
RTO	Research and Technology Organisation
SME	Small and Medium-sized Enterprises
WP	Work Package

Introduction to the technical services offered by AT-C³ consortia

The Austrian Chips Competence Center (AT-C³) offers a comprehensive portfolio of services across technology, education, and community engagement. These services are generally accessible to all interested parties, with specific provisions applicable to large enterprises.

Technological Services

AT-C³ covers the entire value chain of electronic systems by offering services including consulting, evaluation, prototyping, and testing. These services are based on the competences, experiences and solutions of the consortium partners.

- **Advanced Materials**

AT-C³ addresses all aspects of materials research, including modelling, analysis, synthesis, simulation, and data-driven methods. The focus lies on the sustainable development of new materials, component analysis, lifetime and reliability prediction, and process and condition monitoring. Material-based design and simulation are also key elements.

- **Thin-Film Technology**

This serves as the core technology for semiconductor device fabrication. It includes the development of specialized layers, processing of hetero-integrated wafers, and associated analysis and testing.

- **Photonics Technology**

Includes technologies for the development and production of photonic systems, such as integrated photonic circuits, sensors, modular and on-chip systems, specialized light sources, and miniaturized (on-chip) lasers.

- **Quantum Technology**

Focuses on high-precision methods for developing and manufacturing components based on quantum effects, with applications in quantum computing, communication, and sensing.

- **IC and System Design**

A wide range of EDA tools are employed to develop analog frontends, photonic-electronic circuits, photodiodes, and SPADs. PCB design for specific applications is also part of the offering.

- **System Integration**

This area focuses on the physical assembly and testing of electronic systems, including packaging, wafer-level integration, module and system construction, and comprehensive testing procedures.

Cross-Cutting Technologies

AT-C³'s technological portfolio is complemented by key cross-cutting domains:

- **Power Electronics**

Encompasses the design and manufacturing of power semiconductors, electronic converters, charging solutions, and integrated control systems.

- **Secure Connectivity**

A dedicated technological field within AT-C³, Secure Connectivity is based on advanced analysis and penetration testing technologies. Services include security and risk assessments, modelling of penetration processes, and hardware penetration testing, aimed at strengthening the security of software and hardware solutions.

1. Advanced Materials

Development and application of new materials with improved properties, built on the closely interconnected cross-cutting topics of modelling, simulation, synthesis, analysis and innovation. The synthesis can be dissociated or carried out at the partner's site; innovation enables the use of competencies from different partners. Sustainability is a key consideration in both the selection of materials and their use within the production environment and final application.

1.1. Material Synthesis

1.1.1. Technology Description

Technology Definition

Practical methods to produce materials

Problem Solvers

- Provision of samples and testing of synthesis technologies
- Replace and optimize materials and material production process
- Provide knowledge
- Recognize complex relationships

Value Drivers

- New and improved materials and material-based products
- Access to new markets
- Rapid ramp-up of new processes through verified base processes
- Access to new raw material sources
- Time-efficient and well-founded material development

1.1.2. Service Offering – Material Synthesis

1.1.2.1. Material development (SG_1)

Service Description

Development of novel materials for specific applications — from concept to market-ready product — with a focus on efficiency, reliability, and sustainability

Problem Solvers

- Atomic-level analysis and design
- Substitution of critical materials

Value Drivers

- Accelerated material development
- Scalable synthesis processes

Result

- Metal oxide layers and heavy metal-free perovskites
- Surface modifications
- Test samples on substrates and components
- Basic processes
- Product-relevant results, information, and measurement values

1.1.2.2. Development of polymer-based materials (SG_10)

Service Description

Development of sustainable polymer-based materials and processes for functional surfaces.

Problem Solvers

- Testing and evaluation of synthesis technologies
- Detailed analyses of surfaces and interfaces
- Improved surfaces and photoresists
- Pretreatment, cleaning and etching processes

Value Drivers

- New and improved products
- Access to new raw material sources
- Competitive advantage through sustainability by design
- Sustainable materials and products

Result

- Samples of new materials
- Tests of synthesis technologies
- Life cycle analyses

1.1.2.3. Study on laser micromachining of permanent micromagnets (SG_14)

Service Description

Manufacturing, characterisation, and magnetisation of permanent micromagnets (NdFeB, SmCo) by laser micromachining for MEMS applications

Problem Solvers

- Material manufacturing processes and characterisation

Value Drivers

- Access to special laboratory services
- The strong magnetic properties of the permanent micromagnets allow for compact designs without sacrificing performance
- The permanent micromagnets can be integrated directly into microfabricated structures, enabling actuation, sensing, or energy harvesting
-

Result

- Characterized samples of permanent micromagnets
- Miniaturized solution for space limited application
- Solution directly integrated into microfabricated structures

1.2. Analytics and Test

1.2.1. Technology description

Technology Definition

Analysis provides the experimental data necessary for creating and validating models, information for assessing errors and for verifying all experiments.

Problem Solvers

- Safe identification of errors and their causes
- Ensuring the desired quality
- Safe, quality-tested material data
- Test procedures and experimental data for lifetime assessment
- Specific material and system tests

Value Drivers

- Access to specialized laboratory services
- Specific accredited and standard-compliant analyses.

1.2.2. Service Offering – Analytics and Test

1.2.2.1. Materials and component analysis (SG_3)

Service Description

Material analysis and simulation for deep understanding of materials, surfaces and interfaces. This data enables robust solutions from nano to macro, from structure to property. Experiment and simulation in harmony.

Problem Solvers

- Multiscale analysis methods
- Accredited, standard-compliant test methods

Value Drivers

- Physically in-depth material models
- Making complex relationships visible—through data-driven analysis and interdisciplinary expertise

Result

- Non-destructive defect analysis
- Material data and validated FE models
- Structural and chemistry-related information on materials, surfaces, and interfaces
- Detailed reports with root-cause analysis and concrete action recommendations

1.2.2.2. Material based lifetime and reliability (SG_4)**Service Description**

Testing, simulation and guidelines for reliable and durable products. Understanding lifetime, designing reliability – with simulation, analysis and systems thinking

Problem Solvers

- Reliable use of components and assemblies
- Lifetime analyses for realistic prediction
- Identification of thermo-mechanical weaknesses

Value Drivers

- Basis for robust design
- Knowledge-based optimization
- Reduction of design loops, shorter time-to-market

Result

- Meaningful reports and design FMEA
- Thermal and mechanical design guidelines
- Validated models and physical material data
- Specifically prepared samples for targeted analyses

1.2.2.3. High-frequency properties of materials (SG_6)

Service Description

Characterization of high-frequency parameters (dielectric constant, losses) of materials in the frequency range 10 MHz to 1 THz

Problem Solvers

- Improved models – hardware matching

Value Drivers

- Basis for robust product design
- Knowledge-based optimization
- Reduction of design loops, shorter time-to-market

Result

- Characterized materials
- Improved models
- Robust product design

1.2.2.4. Material properties under external load (SG_11)

Service Description

Analysis, modelling, and physical description of the long-term stability of plastics and composites in microelectronics.

Problem Solvers

- Non-contact inspection methods for materials

Value Drivers

- Safe material selection and design of components and assemblies
- Deep understanding of long-term physical properties
- Model-based predictions
- Exact maintenance intervals

Result

- Long-term data of materials under external loads such as temperature, radiation, chemical and mechanical influences
- Local material properties
- Physics of failure (degradation mechanisms)

1.3. Simulation and Modelling

1.3.1. Technology description

Technology Definition

Generation of theoretical foundations and predictions for material behaviour.

Generation of theoretical models to describe processes for material production and prediction of effects on these properties.

Analysis of process influences on the respective material used and enables statements about process control to achieve certain properties.

Enables optimization and testing of designs and the use of material-based products in a virtual environment.

Generates simulation methods and material models from analysis results for predicting material properties during, at, and after loading.

Problem Solvers

- Provide knowledge & well-founded models
- Development of physical and data-driven models
- Perform quality optimizations
- Waste reduction
- Recognize complex process relationships
- Time reduction in the introduction of new procedures and processes
- Reduction of experiments
- Provide knowledge & basic models
- Perform quality optimizations
- Recognize complex relationships

Value Drivers

- Time-efficient and well-founded material development
- High-quality models for research, development and software
- Extension of knowledge
- Physical description of material behaviour
- Safely introduce new processes
- Optimal use of capacities
- Process control tailored to material properties
- Multi-factor optimizations in complex process sequences
- Efficient creation of simulations

1.3.2. Service Offering – Simulation and Modelling

1.3.2.1. Material based lifetime and reliability (SG_4)

Service Description

Testing, simulation and guidelines for reliable and durable products. Understanding lifetime, designing reliability – with simulation, analysis and systems thinking

Problem Solvers

- Reliable use of components and assemblies
- Lifetime analyses for realistic prediction
- Identification of thermo-mechanical weaknesses

Value Drivers

- Basis for robust design
- Knowledge-based optimization
- Reduction of design loops, shorter time-to-market

Result

- Meaningful reports and design FMEA
- Thermal and mechanical design guidelines
- Validated models and physical material data
- Specifically prepared samples for targeted analyses

1.3.2.2. Material-based design (SG_7)

Service Description

Tools and designs for the use of plastics and composites in microelectronics.

Problem Solvers

- Detailed information for polymer materials in simulation environments

Value Drivers

- Saving design loops
- Products that meet quality requirements
- Accelerating time-to-market

Result

- Material-specific optimization suggestions
- Root cause analysis
- High-quality, relevant material models for specific simulation programs

1.3.2.3. Process modelling and analysis (SG_8)

Service Description

Tools and designs for high-performance processes using plastics and composites in microelectronics.

Problem Solvers

- Scrap reduction
- Knowledge and modelling concepts

Value Drivers

- Identifying complex relationships
- Safe introduction of new processes
- Optimal use of capacity

Result

- Detailed process analysis
- Process models and simulation tools
- Kinetic, structural, and mechanical models
- Prediction of residual stresses and material properties

1.3.2.4. Automation of simulation routines (SG_9)

Service Description

Simulations for maximum throughput and resource efficiency by automating simulation routines.

Problem Solvers

- Efficient simulations

Value Drivers

- Effective transfer of designs and requirements into simulation environments
- Seamless digital availability of process and product information
- Low-threshold access to simulations
- Broad use of simulation tools

Result

- Tools for automatic creation of simulation routines from designs
- Automated post-processing routines
- Simulation-based DoE analysis routines

1.3.2.5. Study on heterogeneous integration (SG_12)

Service Description

Feasibility, requirements and implementation study on thin film processes with various materials for optical, power, and quantum applications.

Materials: e.g. Diamond, Silicon Carbide (SiC)

Problem Solvers

- Bridging the gap between materials research and deployable systems

Value Drivers

- Custom system-level solutions integrating quantum sensing
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge

Result

- Study report on material and / or process
- Optimized and robust system design for optical, power or quantum applications
- Enables process / product optimization for competitive differentiation

1.3.2.6. Study modelling and testing magnetic position and orientation systems (SG_13)

Service Description

Modelling of magnetic position and orientation systems (MPO) for industrial applications (automotive, consumer electronics, etc.) through fast vectorized analytic simulations.

Testing of MPO systems (e.g., magnetic rotary encoders) using high-precision test benches

Problem Solvers

- Providing knowledge and basic models
- Testing magnetic materials and samples
- Improved models – hardware matching

Value Drivers

- Time-efficient simulations
- Reduction of design loops, shorter time-to-market
- Access to special laboratory services

Result

- Characterized MPO system for industrial applications (automotive, consumer electronics, etc.)
- Improved models
- Robust product design

1.4. Material Design

1.4.1. Technology description

Technology Definition

Enables optimization and testing of designs and the use of material-based products in a virtual environment.

Problem Solvers

- Product requirements corresponding to quality requirements
- Closing knowledge gaps in models and simulation technologies

Value Drivers

- Acceleration of time to market
- Efficiency through no-over-design
- Saving design loops
- High customer satisfaction through co-development

1.4.2. Service Offering – Material Design

1.4.2.1. Material development (SG_1)

Service Description

Development of novel materials for specific applications — from concept to market-ready product — with a focus on efficiency, reliability, and sustainability

Problem Solvers

- Atomic-level analysis and design
- Substitution of critical materials

Value Drivers

- Accelerated material development
- Scalable synthesis processes

Result

- Metal oxide layers and heavy metal-free perovskites
- Surface modifications
- Test samples on substrates and components
- Basic processes
- Product-relevant results, information, and measurement values

1.4.2.2. Study on heterogeneous integration (SG_12)

Service Description

Feasibility, requirements and implementation study on thin film processes with various materials for optical, power, and quantum applications.

Materials: e.g. Diamond, Silicon Carbide (SiC)

Problem Solvers

- Bridging the gap between materials research and deployable systems

Value Drivers

- Custom system-level solutions integrating quantum sensing
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge

Result

- Study report on material and / or process
- Optimized and robust system design for optical, power or quantum applications
- Enables process / product optimization for competitive differentiation

1.4.2.3. Study on modelling and testing magnetic position and orientation systems (SG_13)

Service Description

Modelling of magnetic position and orientation systems (MPO) for industrial applications (automotive, consumer electronics, etc.) through fast vectorized analytic simulations.

Testing of MPO systems (e.g., magnetic rotary encoders) using high-precision test benches

Problem Solvers

- Providing knowledge and basic models
- Testing magnetic materials and samples
- Improved models – hardware matching

Value Drivers

- Time-efficient simulations
- Reduction of design loops, shorter time-to-market
- Access to special laboratory services

Result

- Characterized MPO system for industrial applications (automotive, consumer electronics, etc.)
- Improved models
- Robust product design

1.5. Sustainable Materials

1.5.1. Technology description

Technology Definition

Evaluates and verifies the effects of materials in production, use and recycling on environmental compatibility, sustainability and availability.

Development and application of new materials with improved properties in sustainability.

The materials are developed based on eco-design and predictive life cycle analysis and can be examined for, e.g., biodegradability.

Problem Solvers

- Safe, future-proof material selection
- Substitution of critical or environmentally harmful materials
- Life cycle analysis for assessing environmental impacts
- Reduction of energy and material consumption in production
- Reduction of harmful substances
- Provide basic knowledge about eco-design and sustainability, as well as environmental cost-benefit analysis

Value Drivers

- Durable and low-maintenance materials
- Securing raw material availability through recycling
- Building material cycles
- Energy-efficient production processes
- Use of renewable raw materials
- More sustainable materials and material-based products
- New circular products
- Innovative material development based on eco-design guidelines
- Regulatory compliance (e.g., REACH - chemicals; eco-design guidelines, etc.)
- Marketing advantage through sustainability
- Cost-effective manufacturing through additive manufacturing

1.5.2. Service offering – Sustainable Materials

1.5.2.1. Process development (SG_2)

Service Description

Material-based process analysis, modelling, optimisation which results in less waste, higher quality and optimised processes.

Problem Solvers

- Reduction of waste
- Reduction of process / product variability
- Specialised, accredited, and quality-assured testing procedures
- Knowledge-based insights

Value Drivers

- Systematic process development
- Validated process data and lab analyses
- Scalable process solutions – designed with efficiency, quality, and resource use in mind

Result

- Material-related process analysis
- Data-driven and physically based models
- Optimization suggestions
- Reduction of process / product variability
- Reduced waste

1.5.2.2. Material-based design (SG_7)

Service Description

Tools and designs for the use of plastics and composites in microelectronics.

Problem Solvers

- Detailed information for polymer materials in simulation environments

Value Drivers

- Saving design loops
- Products that meet quality requirements
- Accelerating time-to-market

Result

- Material-specific optimization suggestions
- Root cause analysis
- High-quality, relevant material models for specific simulation programs

1.5.2.3. Development of polymer-based materials (SG_10)

Service Description

Development of sustainable polymer-based materials and processes for functional surfaces.

Problem Solvers

- Testing and evaluation of synthesis technologies
- Detailed analyses of surfaces and interfaces
- Improved surfaces and photoresists
- Pretreatment, cleaning and etching processes

Value Drivers

- New and improved products
- Access to new raw material sources
- Competitive advantage through sustainability by design
- Sustainable materials and products

Result

- Samples of new materials
- Tests of synthesis technologies
- Life cycle analyses

1.6. Control & Automation

1.6.1. Technology description

Technology Definition

Data and model-based condition monitoring. This technology is also used for virtual sensors.

Problem Solvers

- Exactly known maintenance intervals and conditions
- Maintenance as needed

Value Drivers

- Personnel-optimized manufacturing
- Optimal capacity utilization

1.6.2. Service offering – Control & Automation

1.6.2.1. Process development (SG_2)

Service Description

Material-based process analysis, modelling, optimisation which results in less waste, higher quality and optimised processes.

Problem Solvers

- Reduction of waste
- Reduction of process / product variability
- Specialised, accredited, and quality-assured testing procedures
- Knowledge-based insights

Value Drivers

- Systematic process development
- Validated process data and lab analyses
- Scalable process solutions – designed with efficiency, quality, and resource use in mind

Result

- Material-related process analysis
- Data-driven and physically based models
- Optimization suggestions
- Reduction of process / product variability
- Reduced waste

1.6.2.2. Material based lifetime and reliability (SG_4)**Service Description**

Testing, simulation and guidelines for reliable and durable products. Understanding lifetime, designing reliability – with simulation, analysis and systems thinking

Problem Solvers

- Reliable use of components and assemblies
- Lifetime analyses for realistic prediction
- Identification of thermo-mechanical weaknesses

Value Drivers

- Basis for robust design
- Knowledge-based optimization
- Reduction of design loops, shorter time-to-market

Result

- Meaningful reports and design FMEA
- Thermal and mechanical design guidelines
- Validated models and physical material data
- Specifically prepared samples for targeted analyses

1.6.2.3. Process and condition monitoring (SG_5)

Service Description

Digital process intelligence – with high-precision models for maximum transparency and control.

Creation and implementation of high-fidelity models for critical processes and products.

Problem Solvers

- Knowledge-based optimization
- Model-based maintenance strategies

Value Drivers

- Real-time condition monitoring
- Digital twins
- Precise predictions and adaptive process control

Result

- Validated high-fidelity models and event algorithms
- Implementation of models on customer systems
- Detailed reports and FMEA
- Condition forecasts based on current measurement data

1.6.2.4. Process modelling and analysis (SG_8)

Service Description

Tools and designs for high-performance processes using plastics and composites in microelectronics.

Problem Solvers

- Scrap reduction
- Knowledge and modelling concepts

Value Drivers

- Identifying complex relationships
- Safe introduction of new processes
- Optimal use of capacity

Result

- Detailed process analysis
- Process models and simulation tools
- Kinetic, structural, and mechanical models
- Prediction of residual stresses and material properties

2. Thin film technology

Thin-film technology refers to processes for producing and processing very thin (nanometre to micrometre range) layers of metallic, dielectric or semiconducting materials on solid substrate surfaces.

Typical applications can be found in microelectronics (e.g. integrated circuits, sensors) as well as in photovoltaics (thin-film solar cells) or in optical coating.

The layers are usually produced by physical vapour deposition (PVD, e.g. sputtering, evaporation) or chemical vapour deposition (CVD).

2.1. Thin-Film Processing

2.1.1. Technology description

Technology Definition

Physical and chemical vapor deposition of thin films for piezoelectric, photonic, magnetic and other applications

Problem Solvers

- Long-lasting and stable functions

Value Drivers

- New functionalities on different kinds of materials
- Standardized processing routines
- Scalable processing technologies

2.1.2. Service Offering – Thin-Film Processing

2.1.2.1. Study on heterogeneous integration (SG_15)

Service Description

Feasibility, requirements and implementation study on thin film processes with various materials for optical, power, and quantum applications.

Materials: e.g. Diamond, Silicon Carbide (SiC)

Problem Solvers

- Bridging the gap between materials research and deployable systems

Value Drivers

- Custom system-level solutions integrating quantum sensing
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge

Result

- Study report on material and / or process
- Optimized and robust system design for optical, power or quantum applications
- Enables process / product optimization for competitive differentiation

2.1.2.2. Study on the modelling of mixed-crystal characteristics and their deposition and etch processes (SG_43)

Service Description

Feasibility, requirements and implementation study on the modelling of mixed-crystal characteristics and their deposition and etch processes.

Problem Solvers

- Improved definition of Design of Experiments (DOEs)

Value Drivers

- Modelling of mixed-crystal characteristics and their deposition and etch processes
- Reduction of design loops, shorter time-to-market
- Competitive Differentiation – ability to model product design and manufacturing process gives a technological edge

Result

- Study report on the modelling of mixed-crystal characteristics and their deposition and etch processes
- Enables time effective process / product optimization for competitive differentiation

2.2. Characterisation and Test

2.2.1. Technology description

Technology Definition

Characterisation techniques are available to evaluate the properties of thin films, including structural, electrical, optical and mechanical analyses.

All measurements can be performed on up to 200 mm wafers under various temperatures and atmospheric conditions, enabling testing under application-relevant conditions.

Problem Solvers

- Understand and optimize the performance of complex material behaviour
- High reliability in actual use cases
- Wafer size compatibility up to 200 mm
- Comprehensive characterization enables informed material selection and design

Value Drivers

- Accelerated development cycles – rapid and thorough characterization reduces trial-and-error
- Improved material performance – fine-tuning and optimization enabled by detailed insights into material properties
- Improved cost efficiency – early detection of material issues under realistic conditions prevents costly failures later in the production or deployment stages
- Quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance

2.2.2. Service Offering – Characterisation and Test

2.2.2.1. Study on heterogeneous integration (SG_15)

Service Description

Feasibility, requirements and implementation study on thin film processes with various materials for optical, power, and quantum applications.

Materials: e.g. Diamond, Silicon Carbide (SiC)

Problem Solvers

- Bridging the gap between materials research and deployable systems

Value Drivers

- Custom system-level solutions integrating quantum sensing
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge

Result

- Study report on material and / or process
- Optimized and robust system design for optical, power or quantum applications
- Enables process / product optimization for competitive differentiation

2.2.2.2. Failure analysis, non-linear spectroscopy (SG_16)

Service Description

Methodologies for defect and reliability analysis of interfaces, materials and component level devices by non-linear spectroscopy.

Problem Solvers

- Identification of fabrication errors and defects
- Enables process / product optimization

Value Drivers

- Access to special analysis methods based on laser spectroscopy

Result

- Failure Analysis Report
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance

2.2.2.3. Failure analysis – other methods (SG_19)

Service Description

Methodologies for defect and reliability analysis of materials and component level devices to detection of sub-pm changes at the surface of semiconductors

Problem Solvers

- Non-destructive quality control in semiconductor industry

Value Drivers

- Detection of defects/impurities in semiconductors

Result

- Failure Analysis Report
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance

2.2.2.4. Characterisation of magnetic and magneto-transport properties of magnetic thin films and multilayer structures (SG_44)

Service Description

Methods and requirements for characterising magnetic and magneto-transport properties of magnetic thin films and multilayer structures.

Characterisation of the magnetic and magneto-transport properties of magnetic thin films and multilayer structures combining magnetic and non-magnetic materials (typically for sensor applications).

Problem Solvers

- Testing of magnetic materials and samples
- Understanding complex magnetic behaviour
- Understanding interface effects in multilayers – combining magnetic and non-magnetic layers introduces interface phenomena that affect performance. Characterization reveals how these interfaces influence transport and magnetism
- Performance prediction in real conditions – enables accurate performance modelling
- Material optimization for sensitivity and stability – enables tuning of materials for high sensitivity, low noise, and long-term stability in sensor applications.
- Device miniaturisation – with shrinking device size, the magnetic and transport properties can deviate from bulk behaviour. Characterization ensures reliable function at micro/nano scales

Value Drivers

- Access to special laboratory services
- Enhanced Sensor Performance
- Innovation in Spintronics and MEMS – supports development of advanced devices like magnetic memory (MRAM), spin valves, and magnetic field sensor
- Accelerated R&D and Prototyping
- Quality Assurance and Reliability
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge in high-performance sensor markets

Result

- Report on characterised magnetic properties of material / multilayer structures / product design
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance
- Enables process / product optimization for competitive differentiation

2.2.2.5. Lifetime testing (HALT, HAST, ...) (SG_45)

Service Description

Lifetime testing methods like HALT (Highly Accelerated Life Test) and HAST (Highly Accelerated Stress Test) are essential tools in product development and reliability engineering. They help identify design flaws or material weaknesses early and ensure long-term performance under application-relevant, real-world conditions.

Problem Solvers

- Early failure detection
- Accelerated aging simulation
- Design validation under stress
- Process and material weakness identification

Value Drivers

- Low-effort characterization of long-term behaviour
- Improved Product Reliability
- Reduced Warranty Costs
- Faster Time-to-Market
- Compliance and Certification Support - many industries require lifetime testing for regulatory approval or quality certification
- Data-driven design improvements - provides actionable insights for iterative design enhancements and risk mitigation

Result

- Lifetime test report
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance
- Enables process / product optimization for competitive differentiation

2.3. Thin-film modelling

2.3.1. Technology description

Technology Definition

Generation of theoretical foundations and predictions for material behaviour.

Generation of theoretical models to describe processes for material production and prediction of effects on these properties.

Analysis of process influences on the respective material used and enables statements about process control to achieve certain properties.

Enables optimization and testing of designs and the use of material-based products in a virtual environment.

Generates simulation methods and material models from analysis results for predicting material properties during, at, and after loading.

Problem Solvers

- Provide knowledge & well-founded models
- Development of physical and data-driven models
- Perform quality optimizations
- Waste reduction
- Recognize complex process relationships
- Time reduction in the introduction of new procedures and processes
- Reduction of experiments
- Provide knowledge & basic models
- Perform quality optimizations
- Recognize complex relationships

Value Drivers

- Time-efficient and well-founded material development
- High-quality models for research, development and software
- Extension of knowledge
- Safely introduce new processes
- Optimal use of capacities
- Process control tailored to material properties
- Multi-factor optimizations in complex process sequences
- Efficient creation of simulations

2.3.2. Service Offering – Thin-Film Modelling

2.3.2.1. Study on heterogeneous integration (SG_15)

Service Description

Feasibility, requirements and implementation study on thin film processes with various materials for optical, power, and quantum applications.

Materials: e.g. Diamond, Silicon Carbide (SiC)

Problem Solvers

- Bridging the gap between materials research and deployable systems

Value Drivers

- Custom system-level solutions integrating quantum sensing
- Competitive Differentiation – ability to characterize and optimize multilayer structures gives a technological edge

Result

- Study report on material and / or process
- Optimized and robust system design for optical, power or quantum applications
- Enables process / product optimization for competitive differentiation

2.3.2.2. Study on the modelling of mixed-crystal characteristics and their deposition and etch processes (SG_43)

Service Description

Feasibility, requirements and implementation study on the modelling of mixed-crystal characteristics and their deposition and etch processes.

Problem Solvers

- Improved definition of Design of Experiments (DOEs)

Value Drivers

- Modelling of mixed-crystal characteristics and their deposition and etch processes
- Reduction of design loops, shorter time-to-market
- Competitive Differentiation – ability to model product design and manufacturing process gives a technological edge

Result

- Study report on the modelling of mixed-crystal characteristics and their deposition and etch processes
- Enables time effective process / product optimization for competitive differentiation

3. Quantum technology

Quantum technology refers to the targeted technical use of quantum physical effects such as superposition, entanglement, and quantum tunnelling to create systems whose functionality fundamentally surpasses that of classical technologies.

It forms the basis for novel applications in quantum computing, quantum communication, quantum sensor technology, and quantum metrology.

3.1. Design & Fabrication

3.1.1. Technology description

Technology Definition

Designing and manufacturing a quantum chip involves a complex, multi-step process that spans from concept to final packaging. The key development steps are system and architecture design, device concept and Qubit architecture, material selection, selection of fabrication techniques, quantum chip design, layout of control circuit, verification and validation, fabrication, packaging, testing, qualification and release.

Problem Solvers

- Provide knowledge & well-founded models & tools and IP
- Decoherence and Noise – advanced materials and fabrication techniques help mitigate decoherence, a major obstacle in maintaining quantum states
- Precision Control and Readout – quantum chip development includes innovations in control electronics and readout mechanisms to improve accuracy and reduce latency

Value Drivers

- Technological Leadership - gain a competitive edge by making use of the CHAMPION network
- Time-efficient development
- Low-threshold availability of quantum chips

3.1.2. Service Offering – Design & Fabrication

3.1.2.1. QKD Hardware implementation (SG_52)

Service Description

Design, development and test of Quantum Key Distribution (QKD) systems.

We offer various protocol implementations (DV-QKD, CV-QKD and entanglement-based QKD) and encoding schemes (polarization, time-bin and phase).

Problem Solvers

- For full QKD prototyping a wide range of skills is needed (e.g. physicists, optical and electronics engineers, software developers). The required resources and skills will be provided IP.

Value Drivers

- Access to various QKD implementation and test bench

Result

- Design of QKD
- Fabrication of QKD
- Test of QKD

3.1.2.2. Design and development of QRNG (SG_55)

Service Description

Simulation and design services for Quantum Random Number Generators (QRNGs). Services for physical implementations of QRNGs based on various quantum entropy sources (path superposition, photon number statistics and vacuum fluctuations). Implementation of entropy extraction via software.

Problem Solvers

- For full QRNG prototyping a wide range of skills is needed (e.g. physicists, optical and electronics engineers, software developers). The required resources and skills will be provided.

Value Drivers

- Access to various quantum entropy sources

Result

- QRNG models
- Simulations of QRNG architectures
- Design support
- Post-processing algorithms

3.1.2.3. PIC design for Quantum receivers and transmitters (SG_57)

Service Description

Feasibility study on PICs and PIC/IC combinations

Problem Solvers

- Simplification of QKD setups – less bulky components and fiber optics
- Enabling higher SKR
- Integrated CV-QKD receivers with high bandwidth and low excess noise

Value Drivers

- Small footprint
- Reduced parasitics
- Better noise performance of CV-QKD receivers

Result

- Feasibility results on PIC/IC integration to allow smaller solution size and improved performances of Quantum RX-TX

3.1.2.4. Monolithically integrated CV-QKD receivers (SG_60)

Service Description

Development of a monolithically integrated Continuous-Variable Quantum Key Distribution receiver (CV-QKD receiver).

Problem Solvers

- Provides lowest excess receiver noise additional functionalities for improved CMRR possible, or reconfiguration for calibration

Value Drivers

- Lowest parasitics cost effective and compact design
- High bandwidth and/or low-noise operation

Result

- Design for analog low-noise front ends
- Design and development of QRNG
- Monolithically integrated balanced receivers (photonic + electronics on the same wafer)
- QKD simulation and security proofs
- QKD Hardware implementation

3.2. Quantum Communication

3.2.1. Technology description

Technology Definition

Design, development and testing of quantum communication components and systems, mainly Quantum Key Distribution (QKD) and Quantum Random Number Generator (QRNG).

Problem Solvers

- Replacement of vulnerability of classical encryption – QKD solves the problem of potential future attacks by quantum computers on classical encryption (e.g., RSA, ECC).
- Quantum Random Number Generators – eliminate the risk of pseudo-randomness in classical RNGs, which can be exploited in cryptographic systems.
- Secure Key Exchange Over Public Channels – QKD enables secure key exchange without relying on computational assumptions, making it provably secure against eavesdropping.
- Improved data integrity and confidentiality – quantum communication ensures that any interception attempt is detectable, preserving data integrity.

Value Drivers

- Quantum-Safe Security – future-proof encryption for governments, financial institutions, healthcare, and critical infrastructure.
- Trust and Compliance – meets emerging regulatory requirements for post-quantum cryptography and secure data handling.
- Technological Leadership – forefront of quantum innovation and cybersecurity.
- Integration with Existing Infrastructure – CV-QKD and QRNGs can be integrated with classical telecom systems, reducing deployment barriers.

3.2.2. Service Offering – Quantum communication

3.2.2.1. QKD Simulation and Security proofs (SG_51)

Service Description

Simulation of QKD system performance and theoretical analysis of security proofs.

Problem Solvers

-
- Real-world performance is hard to predict given only the components of a QKD system

Value Drivers

- Performance prediction of the full QKD system based on realistic component specifications

Result

- Quantum Bit Error Rate (QBER) during transmission (range and stability)
- Behaviour under attacks (e.g. Photon Number Splitting)

3.2.2.2. QKD Hardware implementation (SG_52)

Service Description

Design, development and test of Quantum Key Distribution (QKD) systems.

We offer various protocol implementations (DV-QKD, CV-QKD and entanglement-based QKD) and encoding schemes (polarization, time-bin and phase).

Problem Solvers

- For full QKD prototyping a wide range of skills is needed (e.g. physicists, optical and electronics engineers, software developers). The required resources and skills will be provided IP.

Value Drivers

- Access to various QKD implementation and test bench

Result

- Design of QKD
- Fabrication of QKD
- Test of QKD

3.2.2.3. QKD Postprocessing (SG_53)

Service Description

Implementation of QKD postprocessing software to calculate a secure key from the measured data. Software can be adapted to run on various computational platforms (CPU, GPU, embedded processors).

Problem Solvers

- Platform-Specific Optimization Challenges – adapting the software to run on CPUs, GPUs, and embedded processors solves performance bottlenecks and enables deployment in diverse environments (e.g., data centers, satellites, mobile devices).

Value Drivers

- Modular software stack for post-processing that can be adapted to customer needs.

Result

- QKD post processing software adapted to the client's QKD system.

3.2.2.4. Key Management System and QKD applications (SG_54)

Service Description

Implementation of QKD network software in form of Key Management Systems. Development of QKD aware application systems both in hardware and software. Deployment of demonstrations.

Problem Solvers

- Integration with Classical Infrastructure – QKD-aware applications bridge the gap between quantum-secure key generation and classical systems (e.g., VPNs, secure messaging, IoT).

Value Drivers

- Possibility to test QKD system in real-world scenarios and interfacing them to customer specific applications.

Result

- QKD Network Software
- Demonstrator can be used for application tests

3.2.2.5. Monolithically integrated CV-QKD receivers (SG_60)

Service Description

Development of a monolithically integrated Continuous-Variable Quantum Key Distribution receiver (CV-QKD receiver).

Problem Solvers

- Provides lowest excess receiver noise additional functionalities for improved CMRR possible, or reconfiguration for calibration

Value Drivers

- Lowest parasitics cost effective and compact design
- High bandwidth and/or low-noise operation

Result

- Design for analog low-noise front ends
- Design and development of QRNG
- Monolithically integrated balanced receivers (photonic + electronics on the same wafer)
- QKD simulation and security proofs
- QKD Hardware implementation

4. Photonics technology

Photonics technology encompasses the generation, conduction, modulation, detection, and utilisation of light (photons) for technical applications. It forms the basis for key technologies such as optical communication, laser technology, sensor technology, image processing, quantum optics, and integrated optical circuits.

4.1. Photonic Integrated Circuits

4.1.1. Technology description

Technology Definition

The technology covers design of photonic components and circuits on a given integration platform.

The technology entails simulation, optimisation, modelling, and layout of integrated photonic components and circuits.

Investigation if certain optic/photonic functionality can be integrated in a Photonic Integrated Circuit (PIC) or PIC/IC combination.

Possible architectures are proposed and suitable concepts for key-components are evaluated based on preliminary simulations. The results from the latter investigations together with feedback from several fabs with respect to fabrication feasibility results in a detailed study, if a certain optic/photonic and electronic functionality can be efficiently translated in an according chip.

This service spans high level design of the photonic circuitry, design of individual and optimized PIC components resulting in fabrication ready layouts including optimized structures for testing and benchmarking for various platforms.

Problem Solvers

- Translating fibre or free-space based optic/photonic functionality in combination with detectors and other discrete electronics straightforwardly into a PIC is typically either not possible, or not the most efficient way. It is necessary to exploit the full potential of integrated waveguides and IC technology to obtain an optimized device as offered by AT-C³ service.
- Large toolbox of concepts for optimized component functionality available.
- Dedicated key-components for specific PICs to maximize performance.
- In-depth simulation methods to ensure fast transition from an idea to a working PIC based device.

Value Drivers

- Working PIC/IC architectures are derived. The study reveals the feasibility of a concept with respect to both aspects: Functionality and costs.
- By taking over the communication with the fabs, all aspects with respect to the fabrication are covered by AT-C³.
- One-stop shop for PIC design based on various platforms, starting from a rough idea of the functionality, leading to an optimized PIC design.
- Our offer spans waveguides based on silicon (mature platform in the NIR, allowing for high-speed modulation and detection).
- Indium phosphite (suitable for telecom with integrated modulators, detectors, light sources and non-linear components).
- SiN for sensors and CMOS-compatible PICs in the VIS.
- Polymer waveguides suitable for cost-effective fabrication by means of nano imprint lithography.

4.1.2. Service Offering – Photonic Integrated Circuit

4.1.2.1. Failure analysis – Spectroscopy (SG_18)

Service Description

Methodologies for defect and reliability analysis of materials and component level devices by using different spectroscopies (UV-VIS, NIR, FT-IR, Raman), as well as data interpretation.

Problem Solvers

- Identification of design / fabrication errors and defects.
- Enables design / process optimization.

Value Drivers

- Robust capabilities enabling multimodal analysis of samples of interest, both in solid and liquid phase.

Result

- Failure Analysis Report.
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance.

4.1.2.2. Study on design and prototyping photonic lab-on-chip (SG_22)

Service Description

Engineering study on design and prototyping photonic lab-on-chip.

Integration of photonics and microfluidic systems for life sciences/pharmaceutical industry.

Problem Solvers

- Miniaturization of lab processes – integration enables lab-on-a-chip systems that replace bulky lab equipment with compact, portable devices.
- Low sample volume requirements – microfluidics allows precise handling of tiny fluid volumes, solving the challenge of limited or expensive biological samples.
- Capability for multiplexing and/or use of samples of high value (e.g. cerebrospinal fluid)
- Real-time, high-sensitivity detection – photonic components (e.g. waveguides, interferometers) enable fast and sensitive detection of biomolecules, pathogens, or chemical reactions.
- Integration with data systems - photonic sensors can be directly linked to digital systems for real-time monitoring and analysis, solving data acquisition and interpretation challenges.

Value Drivers

- High precision and sensitivity – photonic detection offers superior resolution and sensitivity compared to traditional optical methods.
- Scalability and customization - systems can be tailored for specific applications (e.g., cancer diagnostics, genomics, personalized medicine).
- Point-of-Care diagnostics – compact, integrated systems support rapid, on-site testing in clinics, remote areas, or emergency settings.

Result

- Proof of concept of lab-on-chip
- Demonstrator can be used for application tests

4.1.2.3. Photonic wafer-level testing (SG_23)

Service Description

Automatized wafer-level (up to 12") testing of photonic integrated circuits and other photonic components on the chip to wafer level.

Problem Solvers

- Manual testing bottlenecks – automation eliminates slow, error-prone manual probing and alignment, solving throughput and repeatability issues.
- High complexity of photonic devices – PICs often involve multiple optical ports, polarization states, and wavelength dependencies. Automated systems handle complex test protocols efficiently.
- Wafer-level scalability – enables testing of hundreds or thousands of devices per wafer, solving the challenge of scaling up production and quality control.
- Precision alignment and measurement - automated systems solve the difficulty of aligning optical fibers or probes with micron-level accuracy across large wafers.

Value Drivers

- Accelerated Time-to-Market – faster testing cycles enable quicker feedback to design and fabrication teams, reducing development time.
- Improved yield and reliability - early detection of defects and performance deviations improves overall product quality and reduces waste.
- Cost efficiency – reduces labour costs and increases throughput, especially critical for high-volume manufacturing.
- Integration with Foundry workflows – seamless integration with photonic foundries and packaging lines supports end-to-end production pipelines.

Result

- PICs tested with automatized wafer-level tester (up to 12")

4.1.2.4. Study on development of Quantum Sensing solutions (SG_24)

Service Description

Engineering study on the development of Quantum Sensing solutions.

Experimental quantum sensing research and engineering using point defects (e.g. NV centers) in wide-bandgap materials like Diamond and SiC, applied to magnetometry and inertial sensing, combining system-level and material-level innovations.

Problem Solvers

- Enhancing precision sensing (magnetic, inertial) beyond classical limits

Value Drivers

- Demonstrator development for industry or government clients

Result

- Proof of concept of magnetic/inertial quantum sensing
- Demonstrator can be used for application tests

4.1.2.5. Study on PICs (SG_42)

Service Description

Feasibility, requirements and implementation study on PICs.

Integration of optoelectronic capabilities on the chip-scale aiming reducing complexity or enhancing functionality of the device.

Problem Solvers

- The scalability of existing tabletop solutions is very limited, and many applications cannot be addressed due to bulky systems.

Value Drivers

- Miniaturisation of existing tabletop photonic solutions to unlock new fields of applications in sensing and telecommunication

Result

- Proof of concept of new integrated photonic feature for sensing and/or telecommunication applications
- Demonstrator can be used for application tests

4.1.2.6. Study on PICs and PIC/IC combinations (SG_46)

Service Description

Feasibility study on PICs and PIC/IC combinations. Investigation, if certain optic/photonic functionality can be integrated in a PIC or PIC/IC combination.

Proposed architectures and key component concepts are assessed based on initial simulations.

The results from the latter investigations together with feedback from several fabs with respect to fabrication feasibility results in a detailed study, if a certain optic/photonic and electronic functionality can be efficiently translated in an according chip.

Problem Solvers

- Translating fibre or free-space based optic/photonic functionality in combination with detectors and other discrete electronics straightforwardly into a PIC is typically either not possible, or not the most efficient way. It is necessary to exploit the full potential of integrated waveguides and IC technology to obtain an optimized device as offered by our service.

Value Drivers

- Working PIC/IC architectures are derived. The study reveals the feasibility of a concept with respect to both aspects: Functionality and costs. By taking over the communication with the fabs, all aspects with respect to the fabrication are covered.

Result

- PIC design feasibility study report from design to prototype including cost / value assessment, technology and fabrication selection, definition of the PIC/IC architecture, simulation models

4.1.2.7. Design of PICs (SG_47)

Service Description

This service spans high level design of the photonic circuitry, design of individual and optimized PIC components resulting in fabrication ready layouts including optimized structures for testing and benchmarking for various platforms.

Problem Solvers

- Large toolbox of concepts for optimized component functionality available.
- Dedicated key-components for specific PICs to maximize performance.
- In-depth simulation methods to ensure fast transition from an idea to a working PIC based device.

Value Drivers

- One-stop shop for PIC design based on various platforms, starting from an initial idea of the functionality, leading to an optimized PIC design.
- Offer spans
 - waveguides based on silicon (mature platform in the NIR, allowing for high-speed modulation and detection).
 - Indium phosphite (suitable for telecom with integrated modulators, detectors, light sources and non-linear components).
 - SiN for sensors and CMOS compatible PICs in the VIS.
 - Polymer waveguides suitable for cost-effective fabrication by means of nano imprint lithography.

Result

- PIC concepts
- PIC design development
- Waveguide integration
- Simulation models

4.1.2.8. PIC chip level characterisation (SG_48)

Service Description

Characterization of P(IC)s with electrical probes and edge or vertical coupling on a wafer probe station

Problem Solvers

- Fast and reliable selection of best samples for further system integration, provides necessary inputs for documentation and postprocessing.

Value Drivers

- Validating the P(IC) performance in terms of coupling loss and functionality.

Result

- Characterization of P(IC)s on chip level

4.1.2.9. Functional characterisation of PICs (SG_49)

Service Description

Automized measurement of waveguide structures with edge or grating couplers.

A broad variety of light sources are available as well as additional equipment such as motorized polarization controller, spectrometer and wavemeter.

Problem Solvers

- Our service aims specifically at the development of prototypes, where profound insight into PIC functionality and desired application scenarios is needed.

Value Drivers

- We offer the possibility to combine the optic/photonic characterization with additional non-photonic parameters/functionality covering a wide range of applications in the field of e.g. sensing, telecommunication, and quantum optics.
- Moreover, the optic/photonic measurements can be accompanied by topographic characterizations by means of AFM and SEM gaining insight in possible loss of functionality caused by fabrication deviations.

Result

- Functional properties of PIC

4.1.2.10. System characterisation of PICs (SG_50)

Service Description

Testing of PIC based components in quantum communication applications. The PIC is inserted into working QKD or QRNG prototypes to test its performance in a system environment.

Problem Solvers

- Component-level validation in system context – testing PICs within full QKD or QRNG prototypes solves the challenge of verifying real-world performance, not just isolated lab metrics.
- Integration compatibility – ensures that PICs function correctly with other quantum components (e.g. detectors, modulators, sources), solving potential interface or signal integrity issues.

Value Drivers

- Accelerated Development Cycles - early system-level testing of PICs speeds up validation and integration, reducing time-to-market for quantum communication products.

Result

- System characterization results of optical / protonic integrations in quantum communication applications.

4.1.2.11. PIC design for Quantum receivers and transmitters (SG_57)

Service Description

Feasibility study on PICs and PIC/IC combinations.

Problem Solvers

- Simplification of QKD setups – less bulky components and fiber optics
- Enabling higher SKR
- Integrated CV-QKD receivers with high bandwidth and low excess noise

Value Drivers

- Small footprint
- Reduced parasitics
- Better noise performance of CV-QKD receivers

Result

- Feasibility results on PIC/IC integration to allow smaller solution size and improved performances of Quantum RX-TX

4.2. Integrated Photonic Systems

4.2.1. Technology description

Technology definition

The key components of integrated photonic systems comprise are light sources (e.g. laser, LED), optical waveguides or fibers, sensing elements (e.g. interferometer, resonator, grating) and photo detectors to convert light into electrical signals. Integrated photonic systems are used in applications like communication, sensing, and quantum technologies.

Problem Solvers

- Bulky and complex optical setups – PICs replace discrete optical components (e.g. lenses, modulators, waveguides) with integrated, chip-scale solutions, solving space and complexity issues.
- Scalability and Manufacturability – PICs enable scalable production using semiconductor-like processes, solving the challenge of mass deployment in telecom and quantum systems.
- Power Consumption and Heat Management – PICs are more energy-efficient than electronic or discrete optical systems, solving thermal and power constraints in data centers and mobile platforms.
- Integration with Electronics and Quantum Devices – PICs can be co-packaged with electronics or quantum components, solving the challenge of hybrid system integration.
- Environmental Sensitivity – PICs offer better robustness against environmental factors (e.g., vibration, temperature) than traditional optical setups.

Value Drivers

- High-Speed and High-Bandwidth Performance - supports ultra-fast data transmission and processing, critical for 5G/6G, data centers, and quantum communication.
- Cost Efficiency – reduces material and assembly costs through wafer-scale fabrication and integration.
- Miniaturization and Portability – enables compact, lightweight systems for mobile, aerospace, and wearable applications.

4.2.2. Service offering – Integrated Photonic Systems

4.2.2.1. Study on specific solutions with high power lasers (SG_17)

Service Description

Engineering study regarding miniaturized high-power laser for various applications.

Problem Solvers

- Scalability and manufacturability
- Various applications such as laser ignition, LIBS, etc.

Value Drivers

- Miniaturization and Portability – enables compact, lightweight systems for various applications.

Result

- Feasibility results on high-power lasers optimized for the target applications

4.2.2.2. Engineering study on design and prototyping of fiber-optics based sensors (SG_20)

Service Description

Engineering study on design and prototyping of fiber-optics based sensors.

Development of fiber-optics based sensors, exploiting linear and non-linear behaviour and their integration at system level.

Problem Solvers

- Distributed sensors in fiber-optics enable compact, portable and high sensitive systems

Value Drivers

- Measurement of different parameters in harsh conditions

Result

- Feasibility study report of the fiber-optics based sensor from design to prototype including cost / value assessment, technology and fabrication selection, definition of the PIC/IC architecture, simulation models

4.2.2.3. Study on design and prototyping of a photonic lab-on-chip (SG_22)

Service Description

Engineering study on design and prototyping of a photonic lab-on-chip.

Integration of photonics and microfluidic systems for life sciences/pharmaceutical industry.

Problem Solvers

- Miniaturization of lab processes – integration enables lab-on-a-chip systems that replace bulky lab equipment with compact, portable devices.
- Low sample volume requirements – microfluidics allows precise handling of tiny fluid volumes, solving the challenge of limited or expensive biological samples.
- Capability for multiplexing and/or use of samples of high value (e.g. cerebrospinal fluid)
- Real-time, high-sensitivity detection – photonic components (e.g. waveguides, interferometers) enable fast and sensitive detection of biomolecules, pathogens, or chemical reactions.
- Integration with data systems - photonic sensors can be directly linked to digital systems for real-time monitoring and analysis, solving data acquisition and interpretation challenges.

Value Drivers

- High precision and sensitivity – photonic detection offers superior resolution and sensitivity compared to traditional optical methods.
- Scalability and customization - systems can be tailored for specific applications (e.g., cancer diagnostics, genomics, personalized medicine).
- Point-of-Care diagnostics – compact, integrated systems support rapid, on-site testing in clinics, remote areas, or emergency settings.

Result

- Proof of concept of lab-on-chip
- Demonstrator can be used for application tests

4.2.2.4. Study on development of Quantum Sensing solutions (SG_24)

Service Description

Engineering study on the development of Quantum Sensing solutions.

Experimental quantum sensing research and engineering using point defects (e.g. NV centers) in wide-bandgap materials like Diamond and SiC, applied to magnetometry and inertial sensing, combining system-level and material-level innovations.

Problem Solvers

- Enhancing precision sensing (magnetic, inertial) beyond classical limits

Value Drivers

- Demonstrator development for industry or government clients

Result

- Proof of concept of magnetic/inertial quantum sensing
- Demonstrator can be used for application tests

4.2.2.5. Non classical light sources (SG_56)

Service Description

Development of entangled photon sources (various degrees of freedom, hyper entanglement) and squeezed light sources. These light sources are foundational for quantum communication, quantum computing, and quantum sensing.

Problem Solvers

- Secure quantum communication – entangled photons solve the challenge of secure key distribution in Quantum Key Distribution (QKD) by enabling protocols like E91 and device-independent QKD. Hyperentanglement (entanglement in multiple degrees of freedom – e.g., polarization, time-bin, orbital angular momentum) increases channel capacity and robustness.
- Measurement precision limits - squeezed light solves the problem of quantum noise in precision measurements (e.g., gravitational wave detection, interferometry) by reducing uncertainty in one quadrature below the standard quantum limit.
- Environmental Sensitivity – advanced source designs improve robustness against decoherence and environmental noise, solving reliability issues in real-world deployment.

Value Drivers

- Experimental setups of various optical quantum sources that can be tailored to customer demands.
- Enabling quantum technologies – these sources are core enablers for quantum networks, quantum-enhanced sensors, and quantum computing platforms.

Result

- Design of tailored light sources for target quantum applications.

4.2.2.6. PIC design for Quantum receivers and transmitters (SG_57)

Service Description

Feasibility study of PICs and PIC/IC combinations.

Problem Solvers

- Simplification of QKD setups – less bulky components and fiber optics
- Enabling higher SKR
- Integrated CV-QKD receivers with high bandwidth and low excess noise

Value Drivers

- Small footprint
- Reduced parasitics
- Better noise performance of CV-QKD receivers

Result

- Feasibility results on PIC/IC integration to allow smaller solution size and improved performances of Quantum RX-TX

4.2.2.7. Study on optical (wireless) receivers with PIN, APD & SPAD (SG_59)

Service Description

Feasibility study on optical (wireless) receivers with different options for the photo detector:

- PIN Photodiode: fast response time, low noise, but moderate sensitivity, no internal gain
- Avalanche Photodiode (APD): high sensitivity but higher noise than PIN
- Single-Photon Avalanche Diode (SPAD) True single-photon sensitivity, fast timing resolution, but dead time after each detection, higher dark count rate

Problem Solvers

- Offers highest transmission reach – highest sensitivity for a given photodetection area

Value Drivers

- Cost-effective – Standard Bi(CMOS) processes
- Offers highest transmission reach
- Highest sensitivity for a given photodetection area
- Compact solution
- Single optoelectronic platform

Result

- Feasibility results on optical (wireless) receivers optimized for the target application

4.3. System Level Integration

4.3.1. Technology description

Technology definition

Integration of photonics at system level.

Problem Solvers

- Avoid the use of different suppliers or long supply chain with the inevitable technological mismatches

Value Drivers

- One-stop-shop for the development of photonic systems
- Plug-and-play capabilities for end-users

4.3.2. Service offering – System Level Integration

4.3.2.1. Failure analysis – Spectroscopy (SG_18)

Service Description

Methodologies for defect and reliability analysis of materials and component level devices by using different spectroscopies (UV-VIS, NIR, FT-IR, Raman), as well as data interpretation.

Problem Solvers

- Identification of design / fabrication errors and defects.
- Enables design / process optimization.

Value Drivers

- Robust capabilities enabling multimodal analysis of samples of interest, both in solid and liquid phase.

Result

- Failure Analysis Report.
- Enables process / product optimization for quality assurance and reliability – materials meet stringent performance criteria, boosting customer confidence and regulatory compliance.

4.3.2.2. Engineering study for design and prototyping of fiber-optics based sensors (SG_20)

Service Description

Development of fiber-optics based sensors, exploiting linear and non-linear behaviour and their integration at system level.

Problem Solvers

- Distributed sensors in fiber-optics enable compact, portable and high sensitive systems

Value Drivers

- Measurement of different parameters in harsh conditions

Result

- Feasibility study report of the fiber-optics based sensor from design to prototype including cost / value assessment, technology and fabrication selection, definition of the PIC/IC architecture, simulation models

4.3.2.3. Study on the design and prototyping of multiphoton spectroscopy for life sciences (LG_21)

Service Description

Engineering study on the design and prototyping of multiphoton spectroscopy for life sciences. Use of advanced spectroscopies (Time-gated, time-resolved, multiphoton) for detection of minute amounts of aetiological agents.

Problem Solvers

- Increase of the sensitivity of the existing analytical systems

Value Drivers

- Decrease of the Level of Detection (LOD) by several orders of magnitude as compared to the standard spectroscopic methods

Result

- Proof of concept of multiphoton spectroscopy
- Demonstrator can be used for application tests

4.3.2.4. Study on PICs and PIC/IC combinations (SG_46)

Service Description

Feasibility study on PICs and PIC/IC combinations. Investigation, if certain optic/photonic functionality can be integrated in a PIC or PIC/IC combination.

Proposed architectures and key component concepts are assessed based on initial simulations.

The results from the latter investigations together with feedback from several fabs with respect to fabrication feasibility results in a detailed study, if a certain optic/photonic and electronic functionality can be efficiently translated in an according chip.

Problem Solvers

- Translating fibre or free-space based optic/photonic functionality in combination with detectors and other discrete electronics straightforwardly into a PIC is typically either not possible, or not the most efficient way. It is necessary to exploit the full potential of integrated waveguides and IC technology to obtain an optimized device as offered by our service.

Value Drivers

- Working PIC/IC architectures are derived. The study reveals the feasibility of a concept with respect to both aspects: Functionality and costs. By taking over the communication with the fabs, all aspects with respect to the fabrication are covered.

Result

- PIC design feasibility study report from design to prototype including cost / value assessment, technology and fabrication selection, definition of the PIC/IC architecture, simulation models

4.3.2.5. Design of PICs (SG_47)

Service Description

This service spans high level design of the photonic circuitry, design of individual and optimized PIC components resulting in fabrication ready layouts including optimized structures for testing and benchmarking for various platforms.

Problem Solvers

- Large toolbox of concepts for optimized component functionality available.
- Dedicated key-components for specific PICs to maximize performance.
- In-depth simulation methods to ensure fast transition from an idea to a working PIC based device.

Value Drivers

- One-stop shop for PIC design based on various platforms, starting from an initial idea of the functionality, leading to an optimized PIC design.
- Offer spans
 - waveguides based on silicon (mature platform in the NIR, allowing for high-speed modulation and detection).
 - Indium phosphite (suitable for telecom with integrated modulators, detectors, light sources and non-linear components).
 - SiN for sensors and CMOS compatible PICs in the VIS.
 - Polymer waveguides suitable for cost-effective fabrication by means of nano imprint lithography.

Result

- PIC concepts
- PIC design development
- Waveguide integration
- Simulation models

4.3.2.6. PIC chip level characterisation (SG_48)**Service Description**

Characterization of P(IC)s with electrical probes and edge or vertical coupling on a wafer probe station

Problem Solvers

- Fast and reliable selection of best samples for further system integration, provides necessary inputs for documentation and postprocessing.

Value Drivers

- Validating the P(IC) performance in terms of coupling loss and functionality.

Result

- Characterization of P(IC)s on chip level

4.3.2.7. Functional characterisation of PICs (SG_49)**Service Description**

Automized measurement of waveguide structures with edge or grating couplers.

A broad variety of light sources are available as well as additional equipment such as motorized polarization controller, spectrometer and wavemeter.

Problem Solvers

- Our service aims specifically at the development of prototypes, where profound insight into PIC functionality and desired application scenarios is needed.

Value Drivers

- We offer the possibility to combine the optic/photonic characterization with additional non-photonic parameters/functionality covering a wide range of applications in the field of e.g. sensing, telecommunication, and quantum optics.
- Moreover, the optic/photonic measurements can be accompanied by topographic characterizations by means of AFM and SEM gaining insight in possible loss of functionality caused by fabrication deviations.

Result

- Functional properties of PIC

4.3.2.8. System characterisation of PICs (SG_50)

Service Description

Testing of PIC based components in quantum communication applications. The PIC is inserted into working QKD or QRNG prototypes to test its performance in a system environment.

Problem Solvers

- Component-level validation in system context – testing PICs within full QKD or QRNG prototypes solves the challenge of verifying real-world performance, not just isolated lab metrics.
- Integration compatibility – ensures that PICs function correctly with other quantum components (e.g. detectors, modulators, sources), solving potential interface or signal integrity issues.

Value Drivers

- Accelerated Development Cycles - early system-level testing of PICs speeds up validation and integration, reducing time-to-market for quantum communication products.

Result

- System characterization results of optical / photonic integrations in quantum communication applications.

4.3.2.9. Die-level balanced receiver for CV-QKD or QRNG (SG_61)

Service Description

Printed circuit board (PCB) subassembly of die level optoelectronics.

Problem Solvers

- Fast prototype for high clearance balanced homodyne receivers.

Value Drivers

- High CMRR Low-noise high-bandwidth (1GHz)
- Accelerated Development Cycles due to fast prototype.

Result

- Fast prototype for high clearance balanced homodyne receivers.
- Prototype can be used for application tests

5. IC and system design

Know-how in simulation and layout of integrated microelectronic circuits, each transistor and passive component within an analog or mixed-signal integrated circuit is individually specified.

Proposal of best technology platform and topology for a given application. PCB design and use of existing known-good dies for optics and electronics.

5.1. Analog low-noise Front Ends

5.1.1. Technology description

Technology Definition

Design (theoretical and analytical analysis as well as simulation and layout) of analog integrated amplifiers that are interfacing with sensitive nodes.

Problem Solvers

- Versatile solutions in low-input signal applications.

Value Drivers

- Custom low-noise design offers the lowest input-referred electrical noise i.e. high sensitivity, while managing other analog performance metrics such as linearity, gain and power consumption.

5.1.2. Service offering – Analog low-noise Front Ends

5.1.2.1. AMS – chip design consulting (SG_37)

Service Description

Analog Mixed Signal Top-down design from system engineering to physical design and tapeout.

Problem Solvers

- Avoiding design loops
- Avoiding long simulation times
- Eliminating chip design hurdles

Value Drivers

- Improved simulation time
- Efficient design activity
- Accelerated Development Cycles
- Reduction of design loops, shorter time-to-market
- Reduction in R&D costs

Result

- New Chip design - from system definition to silicon
- Simulation models and simulation results
- Verification results

5.1.2.2. Chips design flow implementation and support (SG_38)

Service Description

Feasibility, requirements, and implementation study on chip design flow. Combined design flow with PDK technology and EDA tools for chip design.

Problem Solvers

- Elimination of bugs with EDA tools and PDK integration

Value Drivers

- Efficient design work in a functional interface

Result

- Functional and efficient Chip Design Environment

5.2. Custom Integrated Photodiodes

5.2.1. Technology description

Technology Definition

Design of PIN, APD and SPAD photodiodes monolithically integrated on (Bi)CMOS platforms:

- PIN Photodiode: fast response time, low noise, but moderate sensitivity, no internal gain
- Avalanche Photodiode (APD): high sensitivity but higher noise than PIN
- Single-Photon Avalanche Diode (SPAD) True single-photon sensitivity, fast timing resolution, but dead time after each detection, higher dark count rate

Problem Solvers

- Compact and cost-effective solution - Single platform for optoelectronic circuit, no need for external photodiode chip.
- Monolithic integration of vertically coupled photodiodes offers higher sensitivity and reliability than heterogeneous integration.

Value Drivers

- Smaller solution size, improved footprint
- Reduced parasitics
- No bond wire at the sensitive input node

5.2.2. Service offering – Custom Integrated Photodiodes

5.2.2.1. Study on optical (wireless) receivers with PIN, APD & SPAD (SG_59)

Service Description

Feasibility study on optical (wireless) receivers with different options for the photo detector:

- PIN Photodiode: fast response time, low noise, but moderate sensitivity, no internal gain
- Avalanche Photodiode (APD): high sensitivity but higher noise than PIN
- Single-Photon Avalanche Diode (SPAD) True single-photon sensitivity, fast timing resolution, but dead time after each detection, higher dark count rate

Problem Solvers

- Offers highest transmission reach – highest sensitivity for a given photodetection area

Value Drivers

- Cost-effective – Standard Bi(CMOS) processes
- Offers highest transmission reach
- Highest sensitivity for a given photodetection area
- Compact solution
- Single optoelectronic platform

Result

- Feasibility results on optical (wireless) receivers optimized for the target application

5.3. Integrated Photonic Electronic Circuits

5.3.1. Technology description

Technology Definition

Design of electronics and photonics monolithically integrated on (Bi)CMOS platform

Problem Solvers

- Compact and cost-effective solution that combines photonics (waveguide structures and photodiodes) and electronics on a single platform - highest speed or highest sensitivity (ultra-low noise operation enabled due to waveguide coupled photodiode)

Value Drivers

- Extremely reduced parasitics, compact design, no bond wire at the sensitive input node, suitable for both low-noise and high-speed designs

5.3.2. Service offering – Integrated Photonic Electronic Circuits

5.3.2.1. Monolithically integrated CV-QKD receivers (SG_60)

Service Description

Development of a monolithically integrated Continuous-Variable Quantum Key Distribution receiver (CV-QKD receiver).

Problem Solvers

- Provides lowest excess receiver noise additional functionalities for improved CMRR possible, or reconfiguration for calibration

Value Drivers

- Lowest parasitics cost effective and compact design
- High bandwidth and/or low-noise operation

Result

- Design for analog low-noise front ends
- Design and development of QRNG
- Monolithically integrated balanced receivers (photonic + electronics on the same wafer)
- QKD simulation and security proofs
- QKD Hardware implementation

5.4. PCB Design

5.4.1. Technology description

Technology Definition

PCB (Printed Circuit Board) design involves the layout, routing, and integration of electronic components onto a physical board substrate. It includes key elements such as Schematic capture, layout and routing, signal integrity & EMC analysis, thermal management, design for manufacturability

Problem Solvers

- Reduces design iterations and development time
- Solves signal integrity and thermal challenges in complex systems
- Supports compliance with EMC and manufacturing standards

Value Drivers

- Accelerated prototyping and system validation
- Optimized signal and power routing for high-performance applications
- Seamless integration of analog, digital, and photonic components
- Design flexibility for custom and application-specific hardware

5.4.2. Service offering – PCB Design

5.4.2.1. Antenna design service (SG_36)

Service Description

Methods, requirements and implementation of antenna characterisation.

Metrological determination of antenna parameters such as directional pattern and efficiency in the frequency range 10 MHz - 1 THz

Problem Solvers

- The characterisation of integrated antennas (on-chip or in the package) enables rapid development progress without having to build up your own resources for this purpose.

Value Drivers

- Smaller solution footprint – integrated antennas save space and costs
- Enables performance optimised Antenna
- Accelerated Development Cycles – shorter time-to-market

Result

- Antenna characterisation report

6. System integration

6.1. Wafer level

6.1.1. Technology definition

Technology Definition

Wafer Level Integration refers to the process of assembling, bonding, and interconnecting components directly on the wafer before dicing. It includes frontend and backend processing steps. These processes enable high-density packaging, heterogeneous integration, and system miniaturization. Wafer level integration supports scalable manufacturing for photonic, electronic, and quantum devices, and is essential for enabling 3D stacking and robust system prototyping.

Wafer level packaging (WLP) or 3D/2.5D integration is a critical enabler for advanced semiconductor devices. It allows multiple components (logic, memory, sensors, etc.) to be integrated directly on or within a single wafer, improving performance, reducing size, and enabling new functionalities.

Problem Solvers

- Interconnect density & performance Bottlenecks – WLP enables high-density interconnects with shorter signal paths.
- Form factor constraints – wafer level integration reduces package size and thickness with reduced footprint.
- Thermal management - advanced WLP techniques (e.g. TSVs, micro-bumps) help distribute and dissipate heat more effectively. This results in an enhanced thermal/electrical performance.
- Heterogeneous integration – wafer level integration allows co-packaging of diverse components/technologies (e.g. photonics, electronics).

Value Drivers

- Performance enhancement – faster data transfer, lower power consumption, and improved signal integrity.
- Miniaturization – enables smaller, lighter devices with more functionality per unit area.
- Scalability – facilitates modular design and easier scaling of system complexity.
- Integration of advanced functions – supports integration of AI accelerators, RF components, and sensors directly on the wafer.
- Cost Efficiency (at Scale) – reduced cost per unit through parallel processing.

6.1.2. Service Offering – Wafer level

6.1.2.1. Study on Wafer bonding and debonding (SG_32)

Service Description

Feasibility, requirements and implementation study on wafer bonding and debonding.

Precise bonding of wafers to wafers and wafers to chips with high adhesive strength, thermal stability, and minimal mechanical stress using various methods: anodic bonding, thermocompression bonding, eutectic bonding, glass frit bonding, adhesive (temporary and permanent) bonding, and direct bonding.

Problem Solvers

- Prevention of adhesion failure, delamination and thermomechanical stresses.
- Prevention of poor electrical contact and mechanical instability.
- Thermal and mechanical stress – backend processes like underfill dispensing and encapsulation mitigate stress during operation and handling.

Value Drivers

- Opening flexible process routes for complex back-end-of-line integrations and 3D stacking.

Result

- Feasibility study report on requirements and implementation of wafer bonding and debonding.

6.1.2.2. Study on Wafer Level Backend Processes (SG_33A)

Service Description

Feasibility, requirements and implementation study on wafer level backend processing. The backend processes for chips and chips include backside metallization, bumping, passivation, dicing and testing. These process steps are crucial for enabling advanced packaging and integration. These processes bridge the gap between front-end wafer fabrication and final system-level integration.

Problem Solvers

- Die size and thickness constraints – wafer thinning solves the issue of bulky dies, enabling ultra-thin packages for mobile and wearable applications.
- Interconnect reliability - redistribution layers (RDLs) and micro-bumping address the need for robust, high-density interconnects between dies and substrates.
- Yield optimization – wafer level testing identifies defective dies early, reducing downstream waste and improving overall yield.
- Thermal and mechanical stress – backend processes like underfill dispensing and encapsulation mitigate stress during operation and handling.

Value Drivers

- Miniaturization & form factor optimization – enables compact, lightweight designs critical for consumer electronics and medical devices.
- Performance enhancement – shorter interconnects and better thermal paths improve speed and power efficiency.
- Cost efficiency – wafer level backend processes reduce packaging steps and material usage, especially in high-volume production.
- Scalability & flexibility – modular backend processes support various package types (e.g. chiplets, 2.5D/3D ICs), allowing design flexibility.
- Improved reliability – advanced backend techniques enhance mechanical robustness and long-term reliability of packaged devices.

Result

- Feasibility study report on requirements and implementation of wafer level backend processing.

6.1.2.3. Study on co-packaged optics (SG_35)

Service Description

Feasibility, requirements and implementation study on co-packaged optics.

Following processes are covered: fibre & optical elements alignment to PIC, PIC to substrate chip alignment, optical D2D, D2W bonding.

Problem Solvers

- Moving away from the limitations of purely electronic systems towards opto-electronic systems.

Value Drivers

- Optical and electronic connection technologies and associated potential.

Result

- Feasibility study report on requirements and implementation of co-packaged optics.

6.1.2.4. Functional characterization of devices and systems (SG_39)

Service Description

Methodologies and requirements for the functional characterization on wafer level such as static parameter characterization of power devices, dynamic parameter characterization of power devices.

Problem Solvers

- Uncertainties in the modelling of power electronic components

Value Drivers

- Device characterisation beyond datasheet; verification of datasheet.
- Quality Assurance and Compliance – ensures devices meet industry standards and customer specifications, critical for certification and market acceptance.

Result

- Characterized Device

6.2. Module Level

6.2.1. Technology definition

Technology Definition

All backend processes related to packages including testing.

The backend processes for chips packaging include substrate and lead frame preparation, die attach, interposer integration, die stacking, interconnection (e.g. hybrid bonding, wire bonding, flip chip bonding), encapsulation and molding.

Testing technologies at various integration levels (wafer, module, system) to validate functionality, reliability, and performance under real-world conditions. Includes electrical, optical, thermal, and mechanical testing, as well as accelerated lifetime and failure analysis.

Problem Solvers

- Heterogeneous Integration Technologies – combines diverse components (e.g., logic, memory, sensors, RF) into a single module or package and enables integration of chips from different process nodes or materials (e.g. silicon, GaN, photonics).
- Solves integration challenges in heterogeneous systems
- Reduction in system size and complexity
- Interposer Integration – 2.5D packaging uses a silicon, glass, or organic interposer to connect multiple dies side-by-side whereas 3D Packaging stacks dies vertically using Through-Silicon Vias (TSVs). The interposers provide high-density routing and thermal management.
- Prevention of electrical contact problems and mechanical weak points
- Avoidance of premature component failure through robust packaging

Value Drivers

- Performance optimization – tight integration reduces latency and power consumption and enables high-speed data transfer and real-time processing.
- Miniaturization and space efficiency – enable small and compact form factors.
- Flexible, reliable, and cost-effective integration solutions across different performance classes and form factors.
- Design flexibility for rigid, flexible, and stretchable systems.
- Accelerated development of functional modules for prototyping and production.

6.2.2. Service Offering – Module Level

6.2.2.1. Defect and reliability analysis (SG_29)

Service Description

Methodologies for defect and reliability analysis of materials and component level devices.

A broad range of analysis and measurement techniques are used for failure analysis and characterisation: Scanning Acoustic Microscopy (SAM), Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB), Shear tests, Leakage tests, Metallography, Cross-section Analysis, Electrical Measurements and Wafer probing.

Problem Solvers

- Reduction of downtime and production costs.
- Insights into material integrity, structural defects and failure mechanisms.

Value Drivers

- Quality assurance and reliability – increase in product quality and reliability through early fault detection and process optimisation.

Result

- Defect and reliability analysis report.

6.2.2.2. Study on Interconnection Technologies (SG_30)

Service Description

Feasibility, requirements and implementation study on manufacturing of electrical and mechanical connections for various semiconductor and electronics applications using scalable technologies. These interconnection technologies include wire, ribbon, clip bonding, die attach (solders, ACP/NCP, ACF/NCF), encapsulation (globtop, molding), parylene coating (C, AF4), underfill and overmolding, Sinterconnects®, sintering (pressure-less & pressure-assisted Ag, Cu, TLP).

Problem Solvers

- Prevention of electrical contact problems, mechanical weak points and premature component failure.

Value Drivers

- Flexible, reliable and cost-effective integration solutions across different performance classes and form.

Result

- Feasibility study report on requirements and implementation in respect of manufacturing of electrical and mechanical connections for various semiconductor and electronics applications using scalable technologies.

6.2.2.3. Study on Module Level Backend Processes (SG_33B)

Service Description

Feasibility, requirements and implementation study on integration, packaging and system prototyping regarding backend processing. The backend processes for chips packaging include substrate and lead frame preparation, die attach, interposer integration, die stacking, interconnection (e.g. hybrid bonding, wire bonding, flip chip bonding), encapsulation and molding. Testing and characterization include final functional testing.

Problem Solvers

- Heterogeneous Integration Technologies – combines diverse components (e.g., logic, memory, sensors, RF) into a single module or package and enables integration of chips from different process nodes or materials (e.g. silicon, GaN, photonics).
- Interposer Integration – 2.5D packaging uses a silicon, glass, or organic interposer to connect multiple dies side-by-side whereas 3D Packaging stacks dies vertically using Through-Silicon Vias (TSVs). The interposers provide high-density routing and thermal management.

Value Drivers

- Performance optimization – tight integration reduces latency and power consumption and enables high-speed data transfer and real-time processing.
- Miniaturization and space efficiency – enable small and compact form factors.
- Cost efficiency – reduces PCB complexity and assembly costs.
- Enhances yield through reuse of validated modules.
- Reliability and robustness - integrated modules reduce interconnect failures and improve thermal management.

Result

- Feasibility study report on requirements and implementation of module packaging.

6.2.2.4. Study on co-packaged optics (SG_35)

Service Description

Feasibility, requirements and implementation study on co-packaged optics.

Following processes are covered: fibre & optical elements alignment to PIC, PIC to substrate chip alignment, optical D2D, D2W bonding.

Problem Solvers

- Moving away from the limitations of purely electronic systems towards opto-electronic systems.

Value Drivers

- Optical and electronic connection technologies and associated potential.

Result

- Feasibility study report on requirements and implementation of co-packaged optics.

6.2.2.5. Functional characterization of devices and systems (SG_39)

Service Description

Methodologies and requirements for the functional characterization on wafer level such as static parameter characterization of power devices, dynamic parameter characterization of power devices.

Problem Solvers

- Uncertainties in the modelling of power electronic components

Value Drivers

- Device characterisation beyond datasheet; verification of datasheet.
- Quality Assurance and Compliance – ensures devices meet industry standards and customer specifications, critical for certification and market acceptance.

Result

- Characterized Device

6.3. System Level

6.3.1. Technology description

Technology Definition

System Level Integration encompasses the holistic assembly and prototyping of complete systems, combining electronic/photonic, passives and mechanical components into functional demonstrators.

It includes advanced packaging, interconnects, and integration strategies such as flip-chip, chip-on-board (CoB), system-in-package (SiP), and system-in-module (SiM) technologies. The System Level Integration supports rigid, flexible, and stretchable platforms, enabling compact, high-performance, and application-specific solutions. It also covers feasibility studies, design validation, and implementation of system-level architectures.

Problem Solvers

- Reduces system size and complexity through high-density integration
- Solves challenges in electrical contact reliability and mechanical stability
- Enables rapid prototyping and validation of complex systems
- Addresses integration mismatches and supports heterogeneous component assembly

Value Drivers

- Accelerated development of compact and integrated system prototypes
- Enhanced electrical and thermal performance through optimized packaging
- Design flexibility for rigid, flexible, and stretchable systems
- Scalable integration for diverse application domains (e.g., sensing, quantum, telecom)

6.3.2. Service Offering – System Level

6.3.2.1. Study on Electromagnetic & Thermomechanical Management (SG_28)

Service Description

Engineering study on device and system simulations through electromagnetic and thermo-mechanical simulations, 3D FEM and CFD simulations, multi-domain simulations, reduced order models, and system simulations.

Problem Solvers

- Prevention of overheating, signal interference and mechanical stress, which can lead to product failure.
- Safe use of components
- Prevention of late-stage fault detection.

Value Drivers

- Improved reliability and performance through efficient heat dissipation.
- Reduced sensitivity to electromagnetic interference.
- Time to Market Saves time and money when creating customised solutions.

Result

- Engineering study report on Electromagnetic & Thermomechanical Management
- Simulation models and simulation results

6.3.2.2. Study on Interconnection Technologies (SG_30)

Service Description

Feasibility, requirements and implementation study on manufacturing of electrical and mechanical connections for various semiconductor and electronics applications using scalable technologies. These interconnection technologies include wire, ribbon, clip bonding, die attach (solders, ACP/NCP, ACF/NCF), encapsulation (globtop, molding), parylene coating (C, AF4), underfill and overmolding, Sinterconnects®, sintering (pressure-less & pressure-assisted Ag, Cu, TLP).

Problem Solvers

- Prevention of electrical contact problems, mechanical weak points and premature component failure.

Value Drivers

- Flexible, reliable and cost-effective integration solutions across different performance classes and form.

Result

- Feasibility study report on requirements and implementation in respect of manufacturing of electrical and mechanical connections for various semiconductor and electronics applications using scalable technologies.

6.3.2.3. Study on prototyping of compact rigid and flexible systems (SG_31)

Service Description

Feasibility, requirements and implementation study on prototyping of compact rigid and flexible systems.

Manufacturing of compact, highly integrated, and powerful rigid, flexible and stretchable electronic systems using various assembly and connection technologies such as flip chip, chip on board (CoB), system in package (SiP) and system in module (SiM), quad flat no-lead package (QFN), and lead frame.

Problem Solvers

- Avoidance of inaccurate placements or unstable connections
- Reduction in system size

Value Drivers

- Improvement of electrical and thermal performance
- Integration of complex functionalities in the smallest of spaces
- New design freedoms for future-oriented product innovations

Result

- Feasibility study report on requirements and implementation in respect of prototyping a compact, rigid and flexible system.

6.3.2.4. Study on Wafer bonding and debonding (SG_32)

Service Description

Feasibility, requirements and implementation study on wafer bonding and debonding.

Precise bonding of wafers to wafers and wafers to chips with high adhesive strength, thermal stability, and minimal mechanical stress using various methods: anodic bonding, thermocompression bonding, eutectic bonding, glass frit bonding, adhesive (temporary and permanent) bonding, and direct bonding.

Problem Solvers

- Prevention of adhesion failure, delamination and thermomechanical stresses.
- Prevention of poor electrical contact and mechanical instability.
- Thermal and mechanical stress – backend processes like underfill dispensing and encapsulation mitigate stress during operation and handling.

Value Drivers

- Opening flexible process routes for complex back-end-of-line integrations and 3D stacking.

Result

- Feasibility study report on requirements and implementation of wafer bonding and debonding.

6.3.2.5. Study on System Level Backend Processes (SG_33C)

Service Description

Feasibility, requirements and implementation study on integration, packaging and system prototyping.

System Level Integration encompasses the holistic assembly and prototyping of complete systems, combining electronic/photonic, passives and mechanical components into functional demonstrators.

It includes advanced packaging, interconnects, and integration strategies such as flip-chip, chip-on-board (CoB), system-in-package (SiP), and system-in-module (SiM) technologies. The System Level Integration supports rigid, flexible, and stretchable platforms, enabling compact, high-performance, and application-specific solutions.

Problem Solvers

- Reduces system size and complexity through high-density integration
- Solves challenges in electrical contact reliability and mechanical stability
- Enables rapid prototyping and validation of complex systems
- Addresses integration mismatches and supports heterogeneous component assembly

Value Drivers

- Accelerated development of compact and integrated system prototypes
- Enhanced electrical and thermal performance through optimized packaging
- Design flexibility for rigid, flexible, and stretchable systems
- Scalable integration for diverse application domains (e.g. sensing, quantum, telecom)

Result

- Feasibility study report from design to prototype on requirements and implementation of integration, packaging and system prototyping.
- Prototype can be used for application tests.

6.3.2.6. Study on co-packaged optics (SG_35)

Service Description

Feasibility, requirements and implementation study on co-packaged optics.

Following processes are covered: fibre & optical elements alignment to PIC, PIC to substrate chip alignment, optical D2D, D2W bonding.

Problem Solvers

- Moving away from the limitations of purely electronic systems towards opto-electronic systems.

Value Drivers

- Optical and electronic connection technologies and associated potential.

Result

- Feasibility study report on requirements and implementation of co-packaged optics.

6.3.2.7. Functional characterization of devices and systems (SG_39)

Service Description

Methodologies and requirements for the functional characterization on wafer level such as static parameter characterization of power devices, dynamic parameter characterization of power devices.

Problem Solvers

- Uncertainties in the modelling of power electronic components

Value Drivers

- Device characterisation beyond datasheet; verification of datasheet.
- Quality Assurance and Compliance – ensures devices meet industry standards and customer specifications, critical for certification and market acceptance.

Result

- Characterized Device

6.3.2.8. Study on Electromagnetic Compatibility (SG_40)

Service Description

Feasibility, requirements and implementation study on design and characterization of electromagnetic compatibility. Various mathematical and computational models are used to simulate and analyse EMC behaviour.

Typical measurements, tests and analysis used to characterize EMC:

- Conducted Emission Measurements
- Radiated Emission Measurements
- Bulk Current Injection Tests
- Vector Network Analysis with De-Embedding Impedance
- Analysis with De-Embedding Simulation of EMC for electronic circuits

Problem Solvers

- Detection of faults caused by design, circuit layout and topology

Value Drivers

- Accelerated Development Cycles – shorter time-to-market due to savings in product development through proper EMC-compliant design using EMC modelling

Result

- Access to special laboratory services
- EMC/EMI (ESD) failure mode detection
- Prevention of design loop with circuit model enabling simulation of design performance incl. EMC

6.3.2.9. Die-level balanced receiver for CV-QKD or QRNG (SG_61)

Service Description

Printed circuit board (PCB) subassembly of die level optoelectronics.

Problem Solvers

- Fast prototype for high clearance balanced homodyne receivers.

Value Drivers

- High CMRR Low-noise high-bandwidth (1GHz)
- Accelerated Development Cycles due to fast prototype.

Result

- Fast prototype for high clearance balanced homodyne receivers.
- Prototype can be used for application tests

6.4. Test

6.4.1. Technology description

Technology Definition

Testing technologies at various integration levels (wafer, module, system) to validate functionality, reliability, and performance under real-world conditions. Includes electrical, optical, thermal, and mechanical testing, as well as accelerated lifetime and failure analysis.

Problem Solvers

- Detects hidden defects and performance bottlenecks
- Prevents late-stage failures and warranty risks
- Solves integration mismatches and environmental sensitivity issues
- Enables robust design through validated data

Value Drivers

- Quality assurance and reliability – ensures product reliability and compliance
- Accelerates time-to-market through early validation
- Reduces development costs by identifying issues early
- Prevents costly failures later in the production or deployment stages

6.4.2. Service offering – Test

6.4.2.1. Study on Electromagnetic & Thermomechanical Management (SG_28)

Service Description

Engineering study on device and system simulations through electromagnetic and thermo-mechanical simulations, 3D FEM and CFD simulations, multi-domain simulations, reduced order models, and system simulations.

Problem Solvers

- Prevention of overheating, signal interference and mechanical stress, which can lead to product failure.
- Safe use of components
- Prevention of late-stage fault detection.

Value Drivers

- Improved reliability and performance through efficient heat dissipation.
- Reduced sensitivity to electromagnetic interference.
- Time to Market Saves time and money when creating customised solutions.

Result

- Engineering study report on Electromagnetic & Thermomechanical Management
- Simulation models and simulation results

6.4.2.2. Defect and reliability analysis (SG_29)

Service Description

Methodologies for defect and reliability analysis of materials and component level devices.

A broad range of analysis and measurement techniques are used for failure analysis and characterisation: Scanning Acoustic Microscopy (SAM), Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB), Shear tests, Leakage tests, Metallography, Cross-section Analysis, Electrical Measurements and Wafer probing.

Problem Solvers

- Reduction of downtime and production costs.
- Insights into material integrity, structural defects and failure mechanisms.

Value Drivers

- Quality assurance and reliability – increase in product quality and reliability through early fault detection and process optimisation.

Result

- Defect and reliability analysis report.

6.4.2.3. Functional characterization of devices and systems (SG_39)

Service Description

Methodologies and requirements for the functional characterization on wafer level such as static parameter characterization of power devices, dynamic parameter characterization of power devices.

Problem Solvers

- Uncertainties in the modelling of power electronic components

Value Drivers

- Device characterisation beyond datasheet; verification of datasheet.
- Quality Assurance and Compliance – ensures devices meet industry standards and customer specifications, critical for certification and market acceptance.

Result

- Characterized Device

6.4.2.4. Study on Electromagnetic Compatibility (SG_40)

Service Description

Feasibility, requirements and implementation study on design and characterization of electromagnetic compatibility. Various mathematical and computational models are used to simulate and analyse EMC behaviour.

Typical measurements, tests and analysis used to characterize EMC:

- Conducted Emission Measurements
- Radiated Emission Measurements
- Bulk Current Injection Tests
- Vector Network Analysis with De-Embedding Impedance
- Analysis with De-Embedding Simulation of EMC for electronic circuits

Problem Solvers

- Detection of faults caused by design, circuit layout and topology

Value Drivers

- Accelerated Development Cycles – shorter time-to-market due to savings in product development through proper EMC-compliant design using EMC modelling

Result

- Access to special laboratory services
- EMC/EMI (ESD) failure mode detection
- Prevention of design loop with circuit model enabling simulation of design performance incl. EMC

6.4.2.5. Test-environment for wireless communication (SG_41)

Service Description

Developing, testing, validation and transfer of deployments in an industrial environment

Problem Solvers

- Wide range of wireless communication tools and resources for testing in many domains.

Value Drivers

- Time-efficient and well-founded wireless communication development
- High-quality testing for research, development and use case validation
- Expansion of knowledge

Result

- Access to special laboratory services
- Tested and Validated wireless design



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