MASP Chapter on Safety and Security

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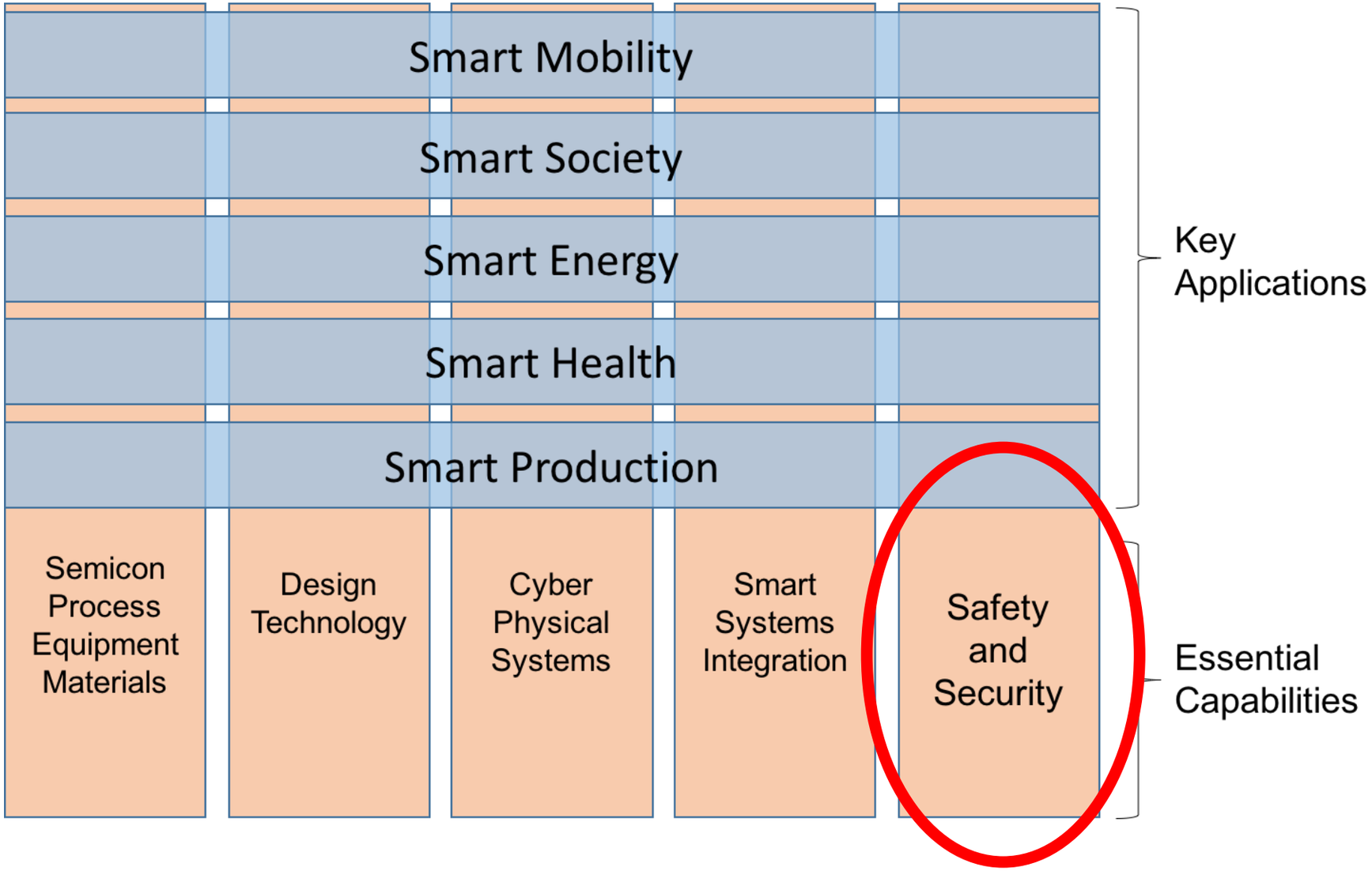
MASP 2017


Smart Mobility
Smart Society
Smart Energy
Smart Health
Smart Production
Semicon Process Equipment Materials
Design Technology
Cyber Physical Systems
Smart Systems Integration
Safety and Security
Key Applications
Essential Capabilities

Scope

Safety

Absence of catastrophic consequences on humans and the environment

Security

Degree of resistance to or protection from harm

are both important criteria for **dependability** of

- Cyber-physical system (CPS)
- Embedded systems
- Industry 4.0 or Internet-of-things (IoT) environments

Heterogeneous & **contradictory** requirements: 24/7 reliability, 100% availability, 100% connectivity, real-time response, safety-critical …

Goal: Achieve acceptable compromise between all criteria of reliability.

Scope

Domains

- Systems engineering
- Software engineering
- Hardware engineering
- Electric/electronic systems
- Extended scope for complex systems:
  Mechanical, thermo-dynamic, mechatronic, …

	Safety	Security
Concept phase	Hazards	Threats
System	Systematic faults	Vulnerabilities
Hardware	Faults, safety mechanism	Open HW interfaces, security mechanism
Software	Software architecture correct	Software architecture correct

Methods

- Safety/security/reliability/dependability engineering

Challenges:

1. Exploit expertise from each needed domain
2. Merge multiple aspects into single product

Objectives

Design challenges

- Low-cost, reliable, minimally redundant hardware
- Reliable software

Rigorous qualification procedures

- Assess known failures, system malfunctions, subsequent failures
- New product development vs. changes & modifications
- Minimize re-certification cost

Verification & validation

- Especially for connected and highly networked systems
- Better methods and tools
- Supporting (incremental) certification
- Achieve cost-savings

Objectives

Security & privacy by design

- Affects entire product life cycle, not just development
- Data loss, misuse, unwanted modification, unauthorized access

Quantified verification

- For safety & security
- Definition of standard metrics & targets
- Measurable methods needed

Long term security

- Increased availability of cheap, powerful hardware
- New threats and attacks appear, new interfaces used for attacks
- Low entry barriers for hackers & criminals, e.g. spoofing, jamming, eavesdropping

Selected Strategy Bricks

Systematically reduce complexity, increase reliability, robustness

- Strategies: Enforce overall system views, re-use mechanisms, application of safety & security patterns, new cryptographic techniques & algorithms

New design tools

- Strategies: Safety & security co-analyses, new metrics, simulation for safety & security analyses, specification of building blocks for safe & secure systems

Dynamic reconfiguration

- Strategies: Virtual components, connection establishment & release

Robust control & self-diagnostics

- Strategies: Adapt under security attacks, react to random faults and unpredictable events, deal with sensor misinterpretations

Selected Strategy Bricks (2)

Evaluation and experimentation

- Strategies: Extended simulation & test bed infrastructure, interfaces to human decision making

New architectures

- Strategies: Integration of security by design, modularity and re-use of safe and secure components, secure HW building blocks, SW libraries & components

Safe & secure real-time systems

- Strategies: Safe & secure fault diagnosis & maintenance, wireless protocols, dynamically reconfigurable systems, fault tolerance

(Re-)Certification

- Strategies: Modular certification of composable designs, proof absence of high-impact failure modes, worst-case-execution time research

Selected Strategy Bricks (3)

Identity & access management

- Strategies: Identity management & authentication mechanisms, key generation & management, anti-counterfeiting techniques, trusted devices

Data protection

- Strategies: Protection & update in the field, transmission and distribution, E2E security, secure storage, protection agains HW trojans

Safe & secure execution platforms

- Strategies: Trusted platform modules (TPM), trusted execution environments (TEE), embedded secure elements, secure boot processes

Infrastructures

- Strategies: Vehicle interconnections (Car2X), infrastructure protection & monitoring, detection of abnormal behaviour, safe & secure behaviour

Selected Strategy Bricks (4)

Cryptography

- Strategies: homomorphic encryption, quantum cryptography, post quantum cryptography

Protocols

- Strategies: Mathematical analyses to design new scalable protocols for mass distribution (connected smart devices)

Chip architecture

- Strategies: Design of monolithic or distributed secure enclaves, dedicated processors plus additional protection units

Impact

Increased competition

Business success
by absence of theft, fraud, closure, downtime

Scalability effects

New markets

New investments
by saved costs

High rated value-added chain
by understanding and awareness

Connected & smart systems:

Products, applications, services, devices

Smart cities

Smart energy solutions

Connected vehicles

Smart grids

Smart health care

Safety & Security

Cross-References

Safety & security are valid criteria for all applications addressed in the MASP

- Cyber-physical systems
- Smart systems integration

Relevant for all MASP key applications (Smart X)

Standardization activities: some examples

- ISO 26262: 2nd edition for automotive E/E engineering, Spring 2018
- ISO PAS 21448 SOTIF (Safety of the intended functionality)
- SAE J3061: “Cybersecurity Guidebook for Cyber-Physical Vehicle Systems”, 19.1.2016
  - Rationale: To provide **a cybersecurity process framework** and guidance to help organizations identify and assess cybersecurity threats and design cybersecurity into cyber-physical vehicle systems **throughout the entire development lifecycle process**
  - Relation to Safety: The process framework described in this document is **analogous to the process framework described in ISO 26262** Functional Safety Road Vehicles. These two processes are different, but are related and require integrated communications in order to maintain consistency and completeness between an organizations safety process outputs and their Cybersecurity process outputs.

Roadmap: 2017 – 2019 – 2020+

11 topics are currently adressed

- **Safety, security & privacy by design**
- **Authentication**
- **Distributed models of trust**
- **Decentralized trust frameworks (blockchain)**
- **Data Protection**
- **Network Protection**
- **Safety and security risks related to infrastructures (systems of systems, cloud, new generation networks)**
- **Safe and secure execution platforms**
- **Safe and secure updates in the field**
- **Safety and security aware development**
- **Safe and secure services**

Roadmap - Summary

11 topics adressed

Example topic:

Safety, security & privacy by design

2020+

Fully integrated requirements, frameworks, tools and standards
Advanced authentication
Unified computational trust models
Continuous monitoring and certification
Privacy and security by design
Standardized models for most effective solutions
Rollout of updateable systems

2018-2019

Advanced security schemes & safety patterns
Multiple authentication options
Integration of secure architectures
Deployment of trust models
Secure data storage & management
Safe & secure architectures, virtualization
Increased automation in development

2017

Requirement specification
Scenario definition
Architecture analysis
Theoretical model studies
Existing technology evaluation
Identification of criteria, threats, metrics

Safety, security & privacy by design	Requirement specification for safety, security, privacy and trust	Advanced tools and methods to support security schemes and safety patterns for focused problem areas	Fully integrated safety and security requirements & generic components and frameworks

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