



Hardware–Secured Configuration and Two–Layer Attestation Architecture for Smart Sensors

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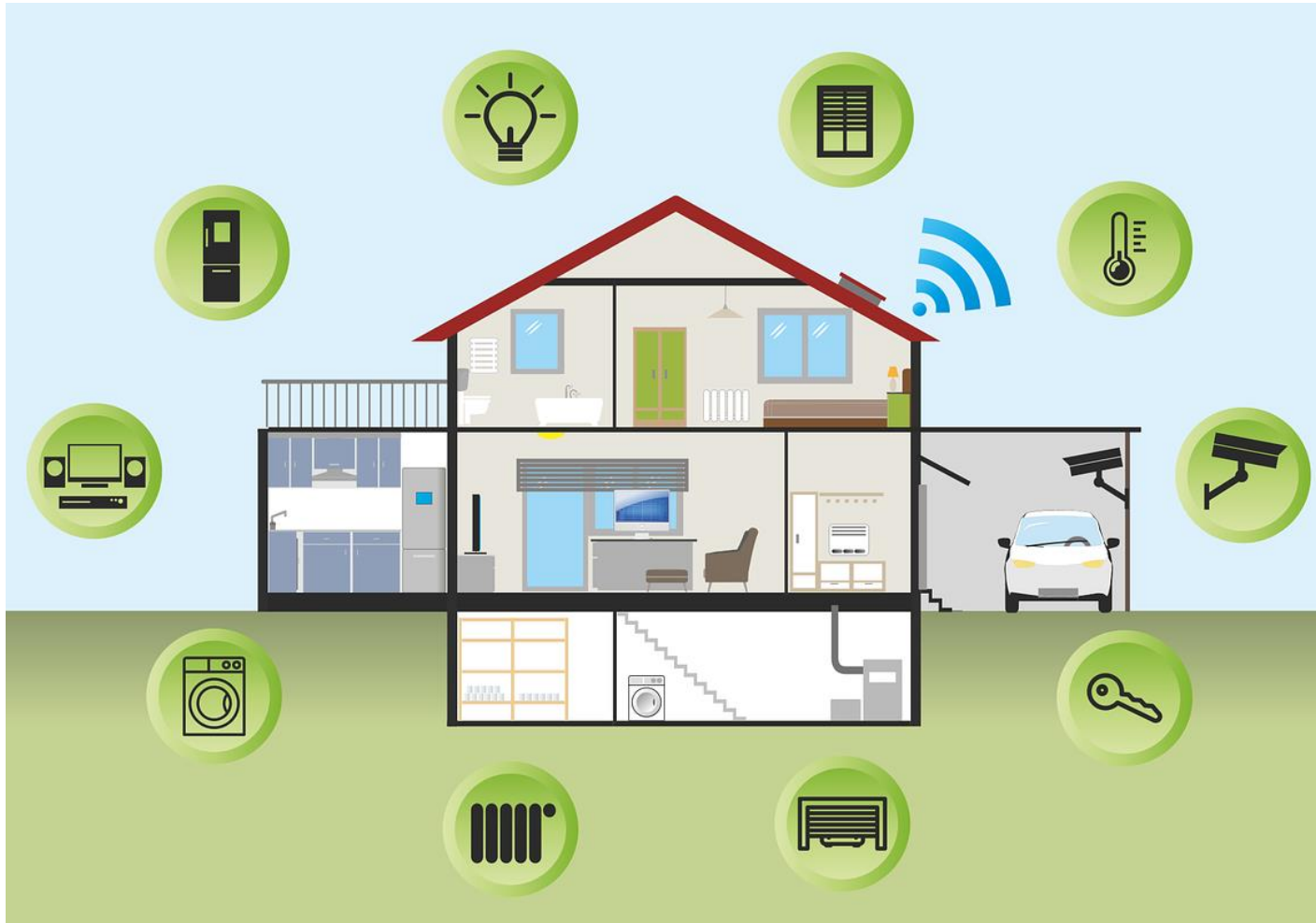
Outline

1. Motivation, State-of-the-art
2. Secured Configuration
 1. NFC-Interface
 2. Protocol
 3. System Model
3. Hardware Architecture
 1. Two-Layer Attestation
4. Evaluation
5. Conclusion and Future Work

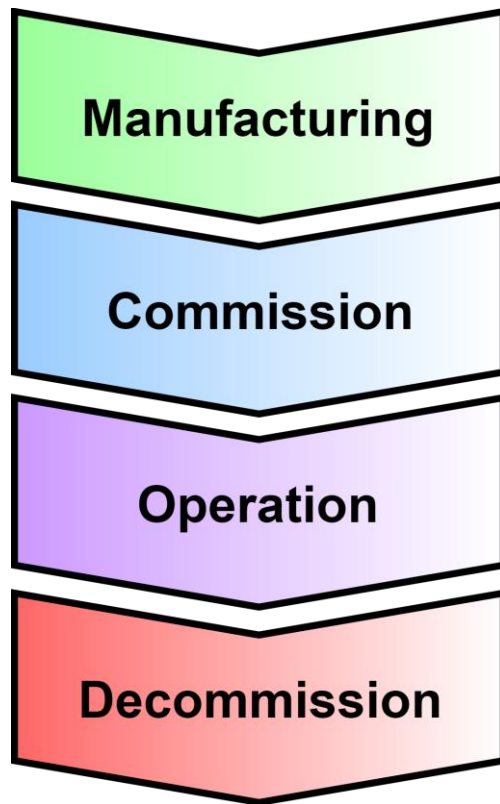
Motivation – Industry 4.0 / Smart Homes



Motivation – Smart Homes



Motivation – Smart Sensor Configuration



- Initial manufacturer keys
- Initial configuration
- Device owner key update
- Specific configuration updates
- Recurrent configuration updates
- Reconfiguration for changing tasks
- Reconfiguration for resale
- Deletion of confidential data

Motivation – Requirements I/II

- Secured transfer of configuration data
 - Confidential information
- Tamper resistant
 - Stored data must be protected
- Easy and intuitive to use
 - Applied in industrial and smart home settings
- Attestation mechanism to verify correct config

Motivation – Requirements II/II

- Energy efficient
 - Smart sensors might be operated on battery power

- Configuration update without power source
 - E.g. during manufacturing of sensor

State-of-the-art

- Various configuration interfaces
 - Wired
 - Wireless (WiFi, Bluetooth, ...)
 - Buttons, Displays, DIP Switches

- Often limited security considerations

- No arbitrary payloads but firmware, pairing info, ...

- No attestation of applied configuration



Contributions

- Define a secured configuration interface
 - Easy and intuitive to use
 - Protocol and hardware

- Suitable for existing devices and new devices

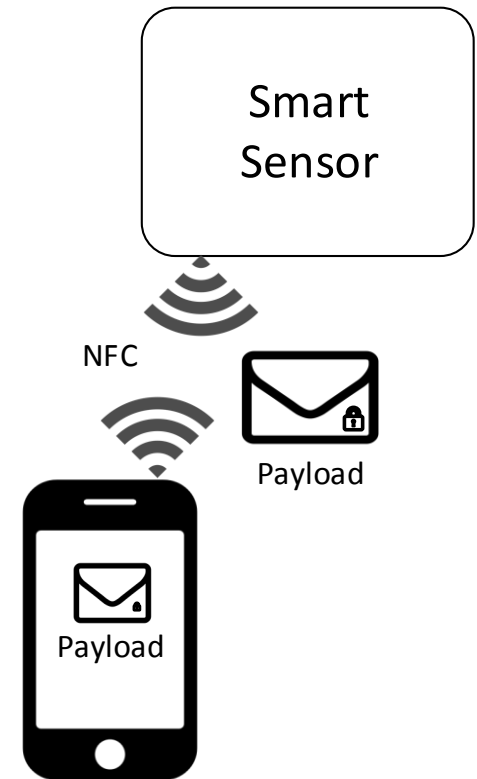
- Show how our proposed architecture can be used for configuration attestation

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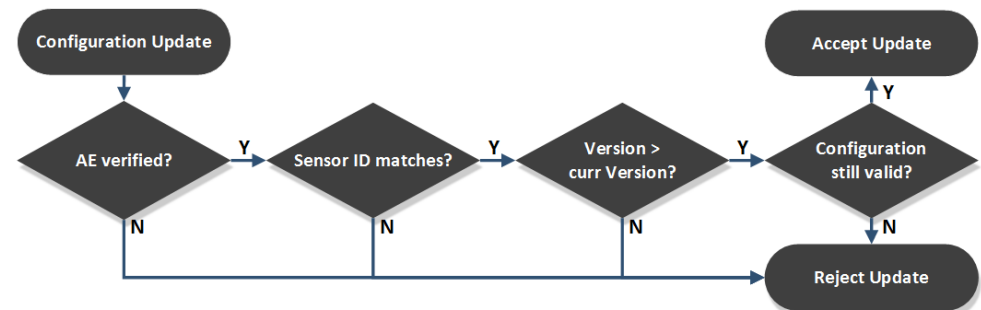
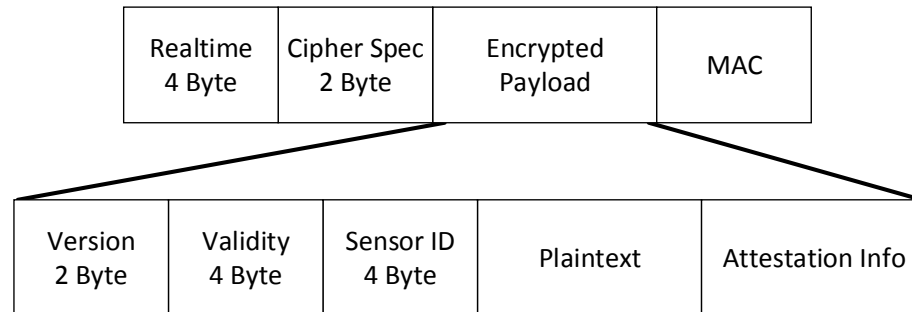
Secured Configuration – NFC Interface

- Use NFC as configuration interface
 - Intuitive to use
 - Little interference compared to other technologies such as WiFi
 - NFC operates at 13.56 MHz
 - „Security by proximity“
 - Roughly 10cm, Eavesdropping 10m!
 - Configuration interface not accessible for remote attackers
 - But no security by protocol!

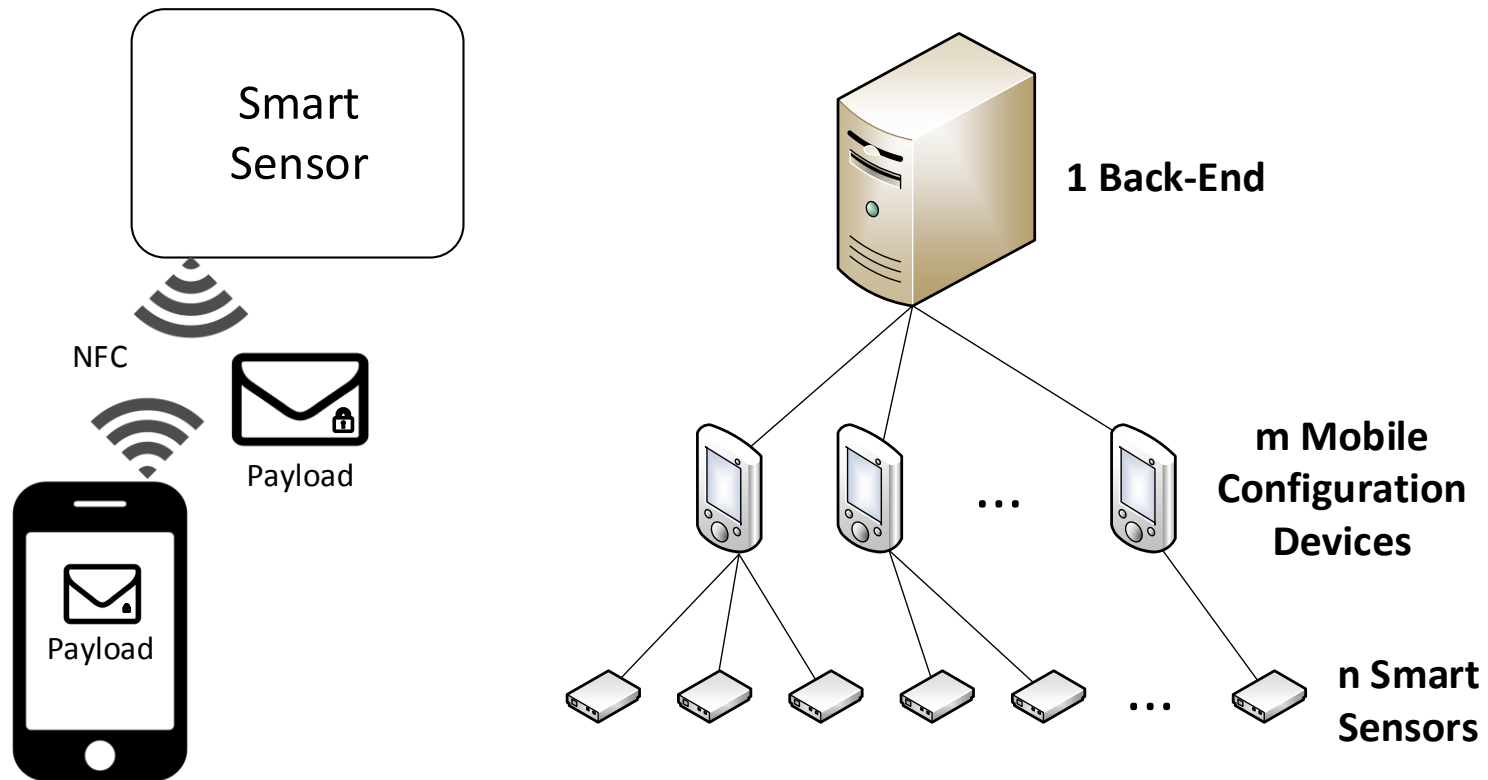


Secured Configuration – Protocol

- NDEF-based protocol for configuration transport
- Data protected by authenticated encryption
- „Ticket“ information to mitigate replay attacks



Secured Configuration – System Model

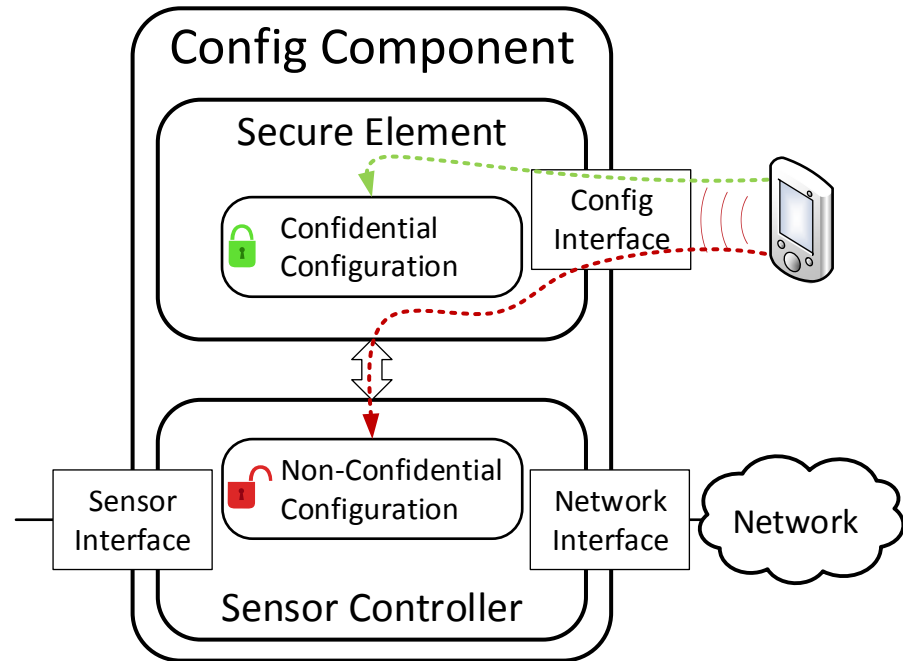


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Hardware Architecture

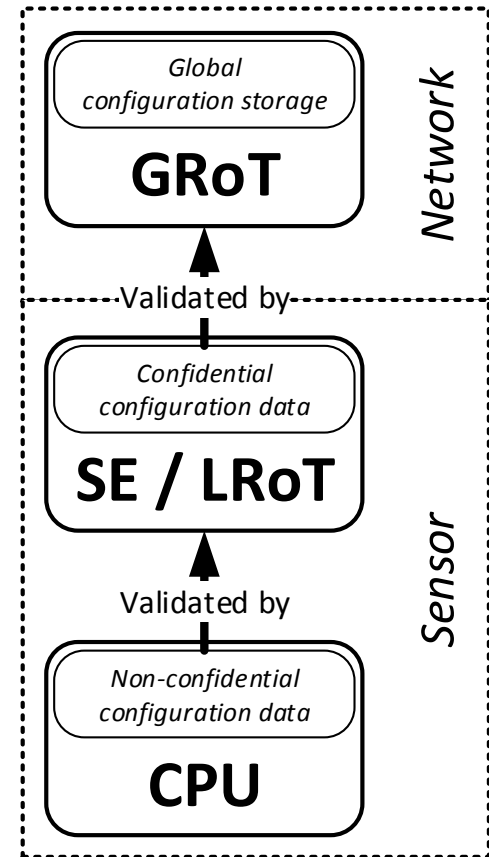
- Component split into two worlds
 - Secured world
 - Normal world
- Security by isolation
- Secure Element
 - Storage
 - Cryptographic Operations



Configuration Attestation / Validation

- Based on hardware architecture
 - Local Root of Trust (LROt) in any Smart Sensor

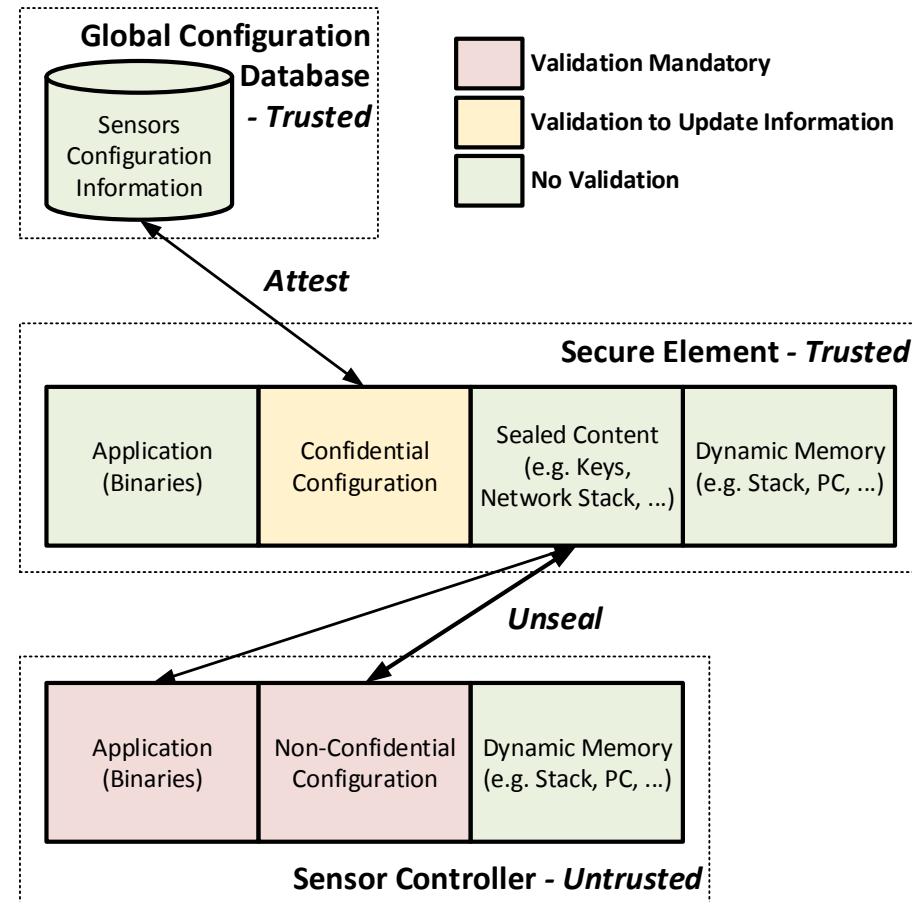
- Based on system architecture
 - Global Root of Trust (GRoT) given by global configuration storage present in system model



Configuration Attestation / Validation

- Non-Confidential data
 - Binary attestation
 - Property based attestation
 - „Seal“ network access

- Confidential data
 - Stored in trusted SE
 - Only validation by GRoT to verify update



Design Decisions

- SE over TPM
 - Provides same functionality as TPM
 - Low power consumption (used in smartcards)
 - In addition
 - NFC interface
 - Can be powered through NFC interface
 - Trusted execution environment

- By „sealing“ network access
 - Malicious smart sensor is isolated
 - If data received: sensor and data is trustworthy

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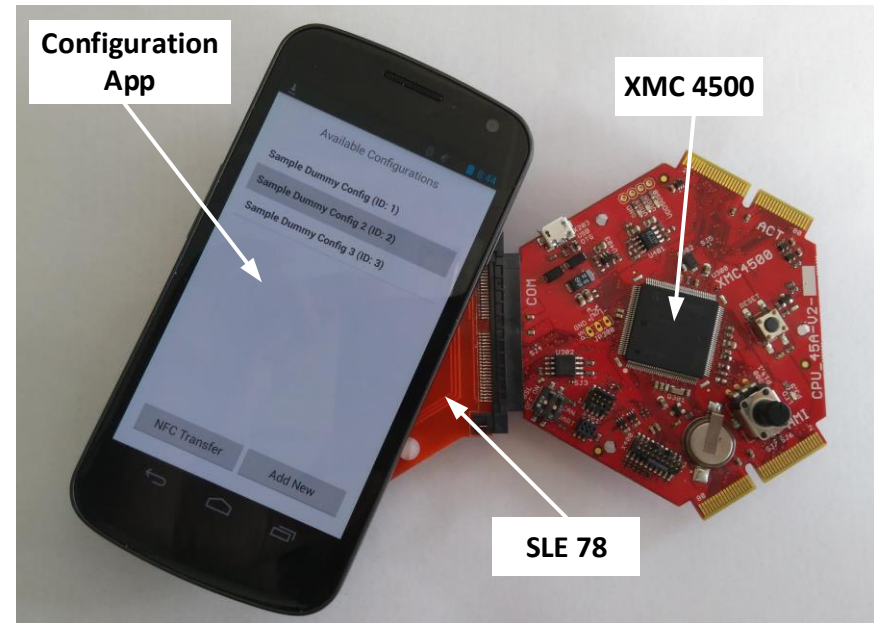
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Evaluation

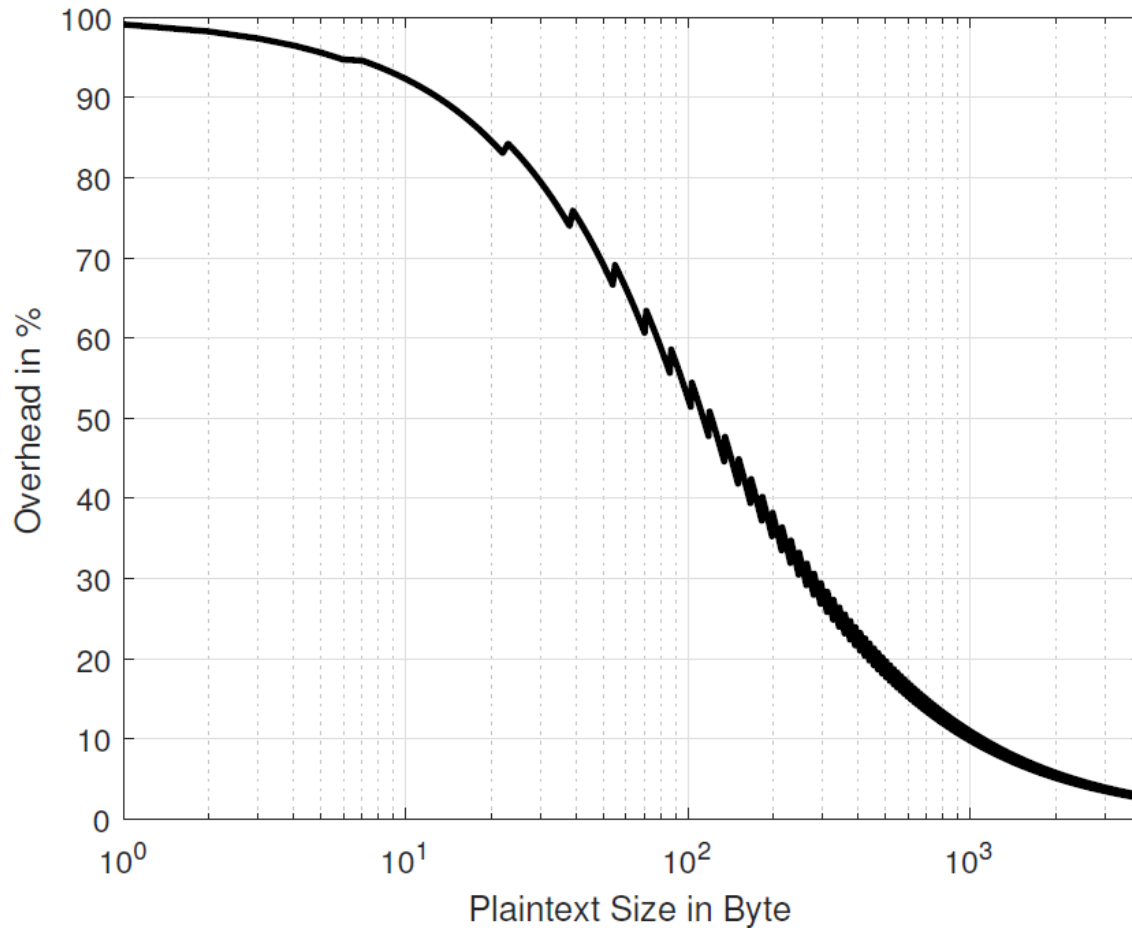
- Feasibility: Prototypical implementation
- Performance: Timing measurements
- Security improvements: Threat analysis

Evaluation – Prototype

- Infineon components
 - XMC4500
 - SLE78
- Android smartphone
- Performance
 - 5-10 parameters
 - 200ms
 - Similar to TLS over WiFi on Raspberry PI3



Evaluation – Protocol Overhead by Security



Evaluation – Threat Analysis

- Not exhaustive, most important threats identified
- Overall 8 threats identified that are mitigated by countermeasures implemented in our approach
- Mitigated: malicious configuration updates, replay attacks, DoS attacks (using configuration interface), and physical attacks

Evaluation – Threat Analysis

- Malicious updates, replay attacks
 - Mitigated by protocol

- Malicious configuration or software
 - Mitigated by attestation

- Remote attacks
 - Mitigated by only allowing updates via NFC

- Adversary with physical access to smart sensor
 - Mitigated by using tamper resistant SE

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Conclusion and Future Work

- Secured and easy-to-use configuration approach
 - Suitable for confidential and non-confidential data
- Can be retrofit into existing sensors and new devices
- Configuration solution is „attestation aware“
 - Attestation is considered in data transfer protocol
- 8 potential threats mitigated by our approach
- Future work: further investigate methods for granting or denying network access to smart sensors

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More information: <https://iktderzukunft.at/en/>



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Questions?

Thank you!