Technical Security in Smart Metering Devices: A German Perspective

S4 SCADA Security Scientific Symposium
2012-01-18, Miami Beach FL / USA

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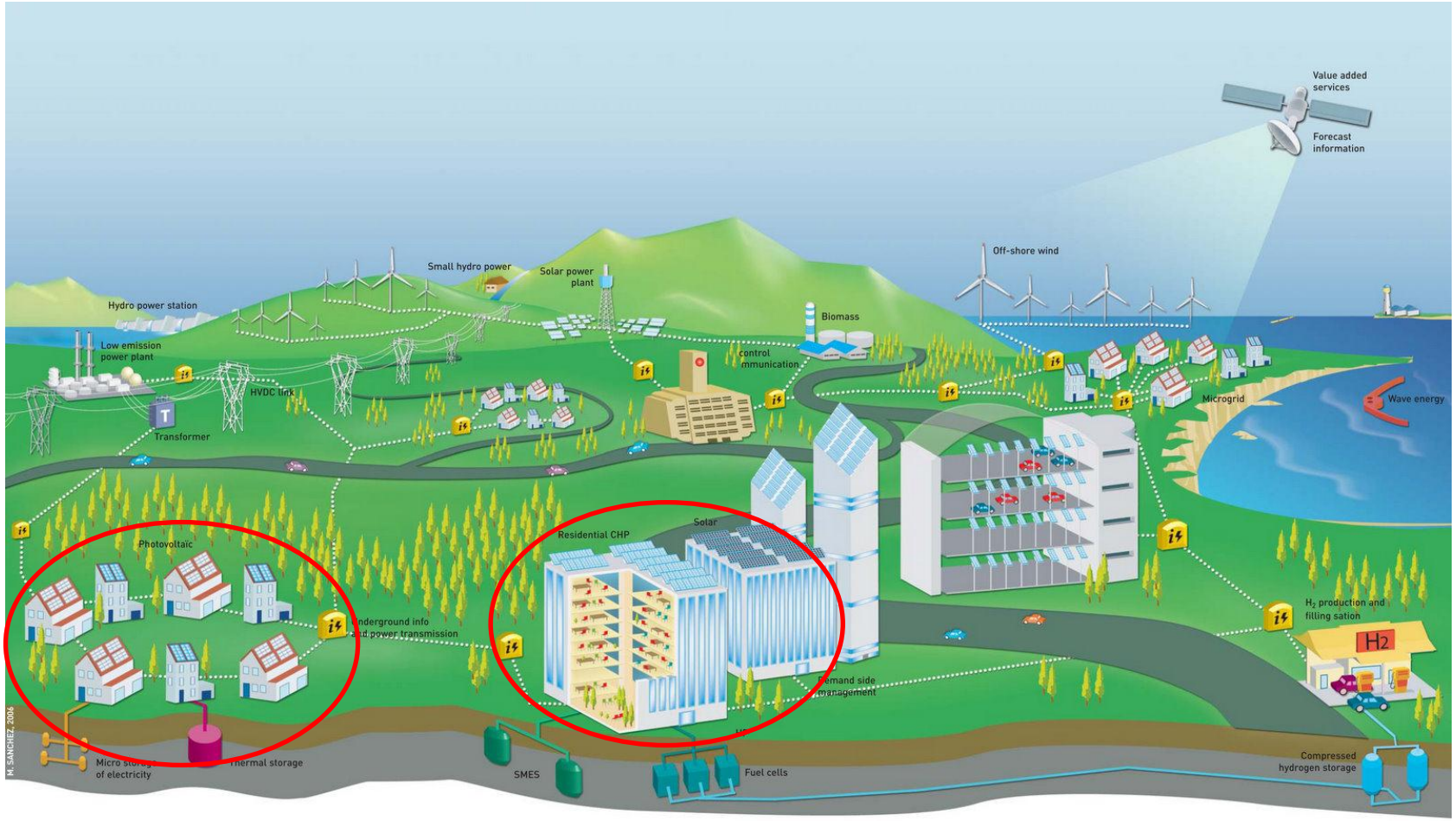
Agenda

- Background of the Protection Profile development
- A (very) short introduction to Protection Profiles / Common Criteria
- The German Smart Meter Protection Profile: an overview
- Future development and roadmap

Smart Metering in the Smart Grid

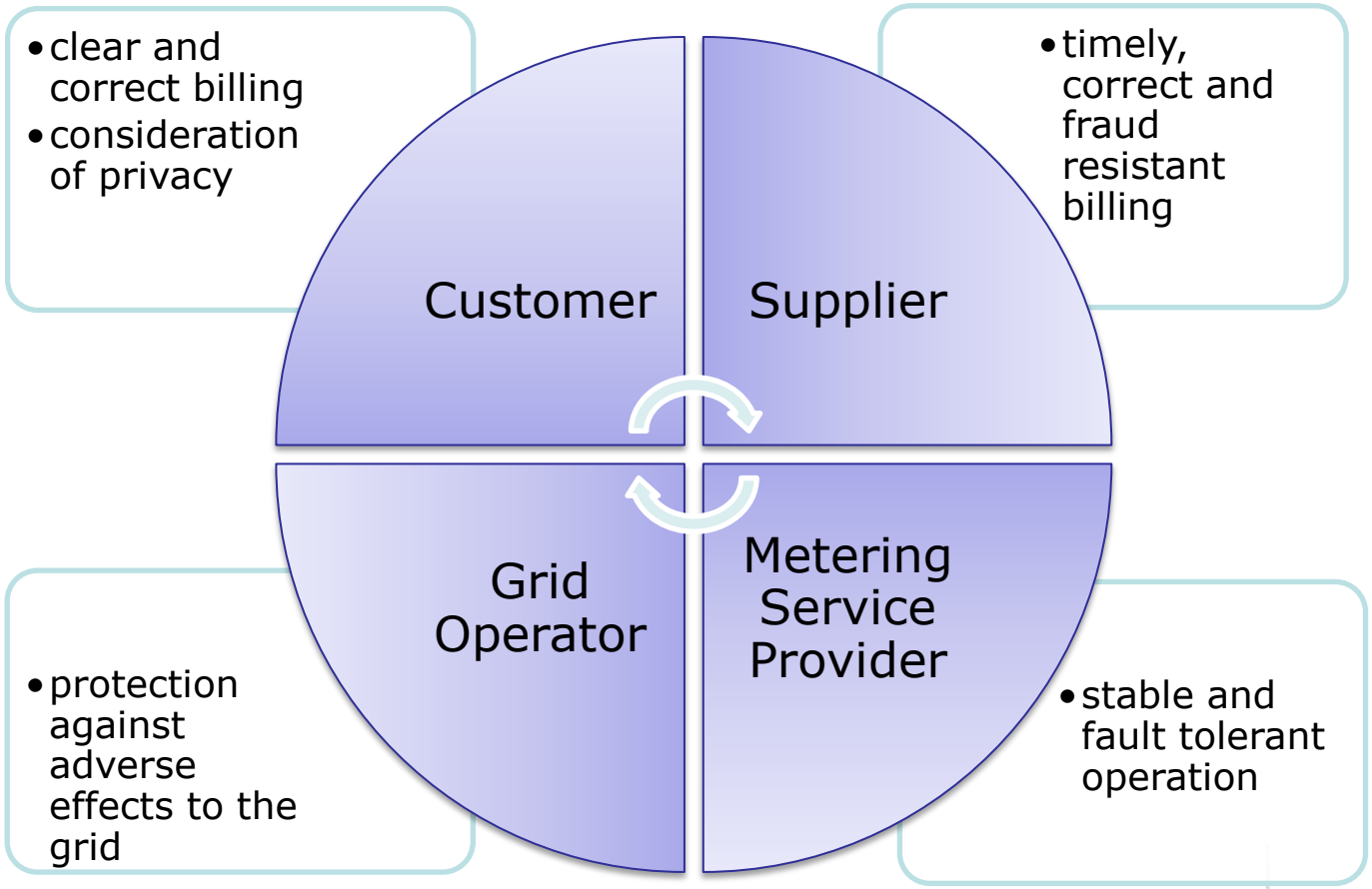


SRC: smartgrids.eu

- Smart Metering devices are the link between the future Smart Grid and the consumer and local small-scale generation

Security Goals for Smart Metering

- Which expectations do stakeholders associate with the term „Secure Smart Metering“?



Background – the EDeMA Project

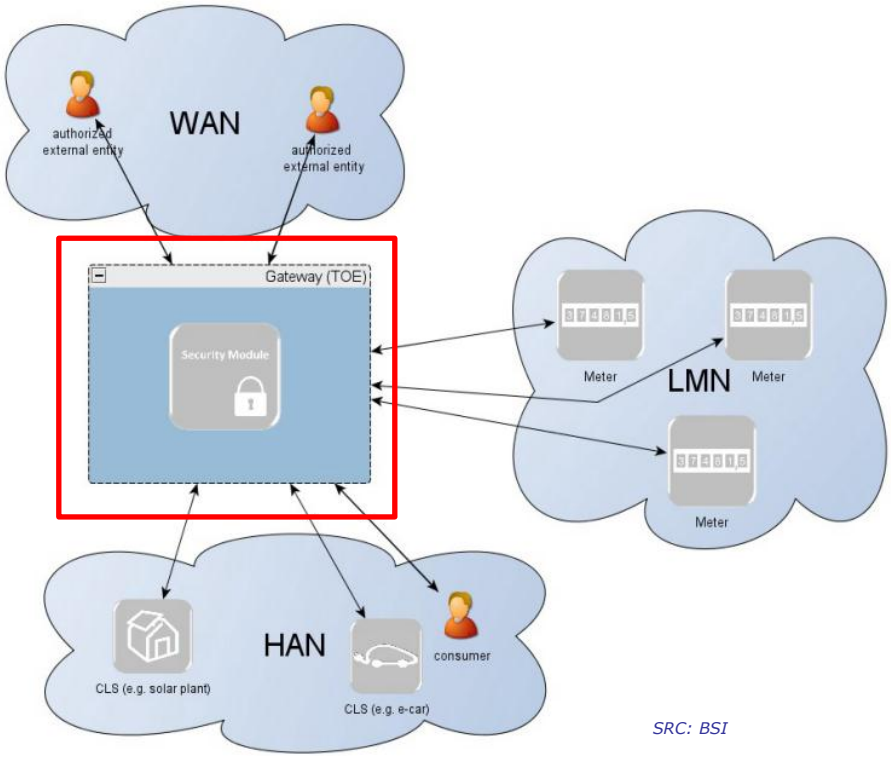
- First version of the Smart Meter Protection Profile is one deliverable of the „e-energy / EDeMa“ research project (2009)
  - Funded by the German Federal Government
  - Participants: Utilities, vendors and academia

- Main goals of the EDeMa project (very simplified)
  - deal with dynamics of distributed generation by stimulating flexible demand on the client side
  - develop a marketplace for automatic energy trade that includes the “prosumer” (producer & consumer) as an active trader
  - develop a Smart Metering gateway for home installations that is capable of the required functions **and secure**

The Smart Metering Gateway

- TOE is the **gateway** between:
  - WAN, i.e. external parties
  - the local meters for electricity, gas, heat..
  - Automation devices, e.g. home automation and local generation (solar power system, CHP etc.)

- Gateway Function:
  - Securely relay metering data
  - Provide secure access to automation gear, e.g. for load shedding



SRC: BSI

Background - Motivation

- Current legislation requires to deploy remote accessible Smart Meter devices in every new installation
  - Discussion about mandatory replacement of existing meters
- As German consumers may be forced by law to accept Smart Meter devices …
  - it is necessary that a federal agency defines the security standards
  - high level security and privacy standards are required to gain commitment from
    - Federal Commissioner for Data Protection and Freedom of Information
    - Federal Ministry of Consumer Protection
    - several consumer protection NGOs and …
    - **the general public**
  - German "BSI" issued a revised version of the EDeMa PP: "*Protection Profile for the Gateway of a Smart Metering System*"

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Common Criteria

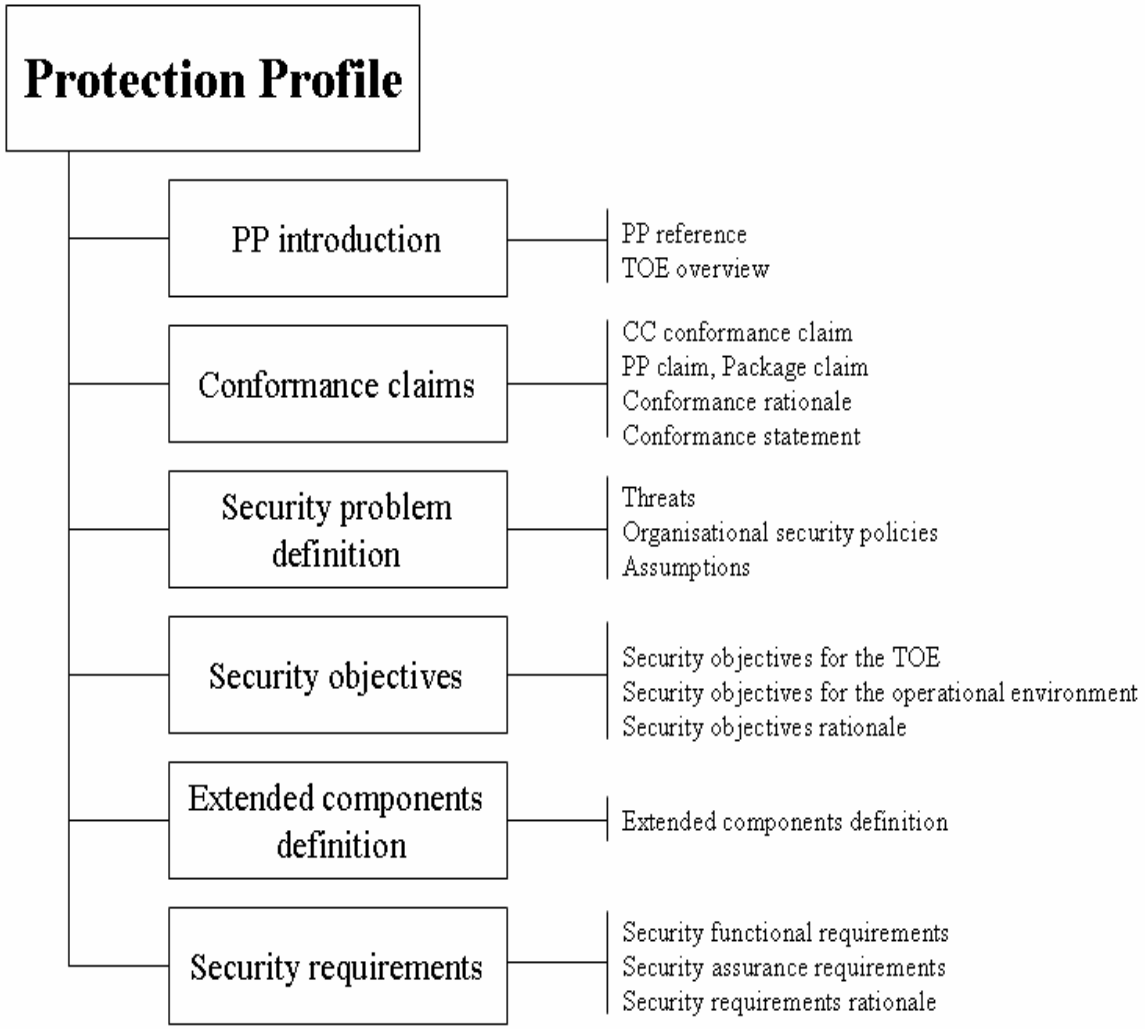
- Common Criteria (CC): „Common Criteria for Information Technology Security Evaluation“
  - Current Version: 3.1 (ISO/IEC 15408 is still V2.3!)
  - Joint project of AU, NZ, DE, FR, UK, JP, CA, ES, US
- Goal:
  - development of a formal language for the definition of security requirements for technical products
  - definition common methodology for the evaluation
  - mutual recognition of evaluation results among contributing countries
- non-Goal:
  - aspects of information security in large IT environments or secure IT operations in general (contrary to ISO 27001, IEC 62443, ISA 99 etc.)

Protection Profile

- Protection Profile = specification of security requirements for a group of products
  - Definition of the “security problem” (threats, assumptions, ..) and the requirements to address that problem
  - Requirements for the assurance measures that the TOE meets the security specifications
  - A PP does not dictate detailed specifications
    - but it may give hints on preferred implementations for the author of the final „security target“

Structure of a Protection Profile

- Which **threats** do we consider?
- Which **assumptions** must be considered as being provided?
- Which **security objectives** shall we focus on?
- Required security features of the TOE



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- Essential threats considered:
  - an attacker (local or remote) tries to **gain access** to the metering data or the Smart Meter configuration / firmware
  - an attacker may try to **intercept** meter readings or configuration / firmware **data during transmission**
  - an external attacker may try **to gain control** over the gateway, the meter(s) or controllable local systems (e.g. controllable loads, generation units or lockdown devices)
  - an external party may try to **obtain more detailed information** from the gateway than actually required to fulfill the tasks defined by its role or the contract with the consumer.

Contents of the Smart Meter Protection Profile
Security Objectives and Requirements

- Essential security objectives and requirements:
  - Encrypted and authenticated communication with all parties (also with meters if not physically the same device!)
  - Protection of integrity / authenticity of meter data and SW updates
  - Control transmission of meter readings and access to configuration data according to a predefined (updatable) Access Control Profile
  - Pseudonymization of transmissions if applicable (e.g. current load information for the grid operator)

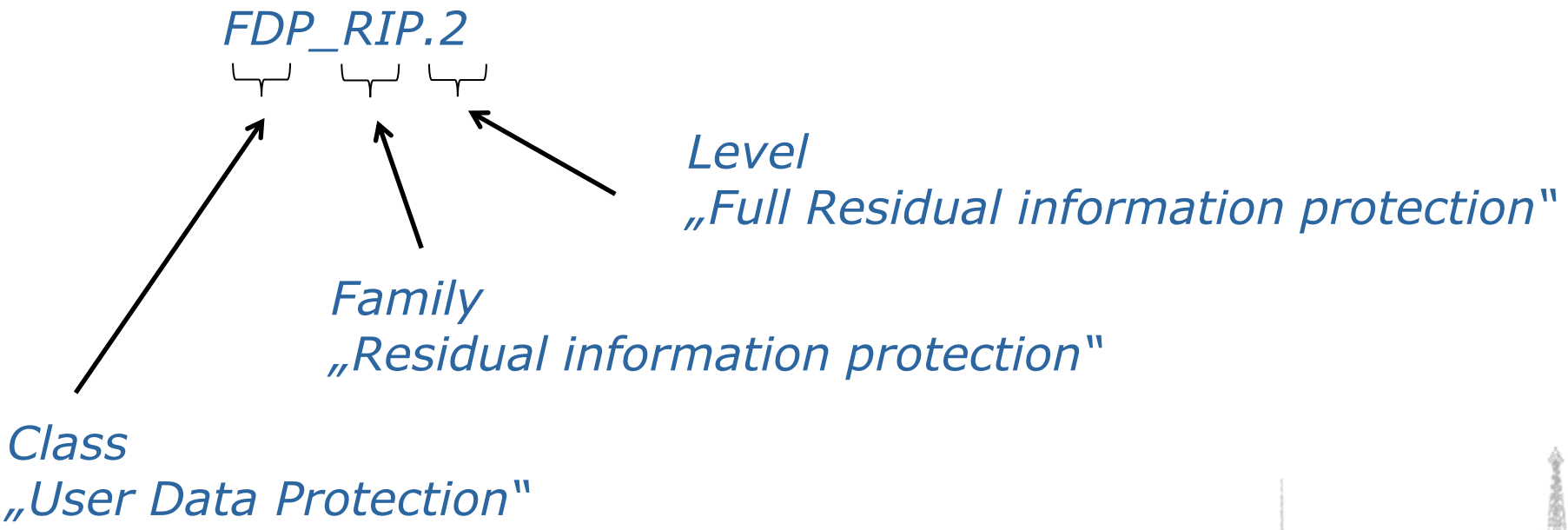
- Essential security objectives and requirements (cont'd.):
  - Enforce establishment of communication from GW to external parties only (wake-up service for triggering connection establishment)
  - Usage of a security module (e.g. „Smart card") for crypto functions
  - Detection of physical tampering
  - Comprehensive logging features
  - Concealment of communication [!]

Quelle: willhackforsushi.com / Joshua Wright

Security Functional Requirements

- The Common Criteria use a certain nomenclature to describe "Security Functional Requirements" (CC V3.1 Part 2)

- Example:



Security Functional Requirements

- Some important “Security Functional Requirements” of the PP:
  - Several items from class Security Audit (FAU_*)
    - responsible to enable the user to monitor communication and the admin to maintain the device
  - Enforced proof of origin (FCO_NRO.2)
    - functions to ensure non-repudiation of transmitted meter readings
  - Several items from class Cryptographic Support (FCS_*)
    - responsible for communication encryption, signing, signature verification and key management (the utilization of an additional security module is mandatory for the majority of these functions)
  - Communication concealing (FPR_CON.1)
    - extended (custom) component to describe concealment functions

Security Functional Requirements

- Some important "Security Functional Requirements" of the PP (cont'd.)
  - Several items from class User Data Protection (FDP_*)
    - rules for access to meter and configuration data
  - Several items from class Identification and Authentication (FIA_*)
    - e.g. for access to controllable loads and generation
  - Passive detection of physical attack (FPT_PHP.1)
    - physical tampering must be detectable (e.g. broken seals)
    - the highest level "Resistance to physical attack" (FPT_PHP.3) has not been chosen in order to reduce manufacturing costs
  - … and many more

Development and Evaluation

- The Smart Meter PP expects the implementation of „Assurance Components“ according to package EAL4 („Evaluation Assurance Level“)
- Augmented by two additional components (EAL 4+):
  - ALC_FLR.2 Flaw reporting procedures
  - AVA_VAN.5 Vulnerability Assessment (higher level than in EAL4)

- Aspects of Evaluation in EAL4:
  - Development
  - Guidance Documents
  - Life-cycle support
  - Tests
  - Vulnerability assessment

Example „Life-cycle Support“

	Assurance components
in EAL4 included	ALC_CMC.4 Production support, acceptance procedures and automation
	ALC_CMS.4 Problem tracking CM coverage
	ALC_DEL.1 Delivery procedures
	ALC_DVS.1 Identification of security measures
	ALC_LCD.1 Developer defined life-cycle model
	ALC_TAT.1 Well-defined development tools
augmented by (EAL4 +)	ALC_FLR.2 Flaw reporting procedures

Example ALC_TAT.1 (Well-defined development tools)

Developer action	Evaluator action
The developer shall identify each development tool being used for the TOE.	The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.
The developer shall document the selected implementation-dependent options of each development tool.	

- Example AVA_VAN.5 "Advanced methodical vulnerability analysis" (highest order Assurance Component from „Vulnerability Assessment")

Developer action	Evaluator action (The evaluator shall ...)
The developer shall provide the TOE for testing.	- perform a search of public domain sources to identify potential vulnerabilities in the TOE.
	- perform an independent, methodical vulnerability analysis of the TOE using the guidance documentation, functional specification, TOE design, security architecture description and implementation representation to identify potential vulnerabilities in the TOE.
	- conduct penetration testing based on the identified potential vulnerabilities to determine that the TOE is *resistant to attacks performed by an attacker possessing high attack potential*.

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Future development and roadmap

- Current status
  - Version 1.1.1 „Final Draft“ is published
  - Evaluation started 2011/08/26
  - A technical guideline for the assurance of interoperability of Smart Metering gateways and the PKI is currently in development

- Summer 2012: Decision about mandatory replacement of existing meters
  - based on a cost/benefit analysis which is currently being carried out by the Ministry of Economics and Technology

Further Information

- Further information
  - www.bsi.bund.de/DE/Themen/SmartMeter/smartmeter_node.html
    (German only)
  - www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/SmartMeter/PP-SmartMeter.html
    (Protection Profile, English)

Summary

- Smart metering gateways are an important part of the future Smart Grid infrastructure
  - Secure processing of metering data
  - Secure control of loads and distributed generation
- A *Protection Profile for the Gateway of a Smart Metering System* has been developed by the German BSI
- The German Energiewirtschaftsgesetz (energy industry act) will require the use of CC certified gateways for future installations

Q & A