TESTING COMMUNICATION IN VIRTUAL POWER PLANTS ENVIRONMENT WITH STANDARDIZED TEST APPROACH TTCN-3

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Agenda

• Introduction
• Involved Standards
• Test Specification
• Technical Realization
• Summary and Outlook
INTRODUCTION
Introduction
Scope – Version 4.0

- Published by: Industry Alliance VHPready e.V.,
  [https://www.vhpready.de/de/home/](https://www.vhpready.de/de/home/)
- Communication: Control Room ↔ Technical Unit(s)
- Critical Infrastructure
  - Reliability
  - Resilience
  - Affordability
- Utilization
  - System reserve (primary control~, secondary control~, minute~)
  - Accumulate DER (distributed energy resources) → market access
VHPready Entities

**VPP**

- Control Center
  - Technical Unit 1
  - Technical Unit 2
  - Technical Unit 3
  - ... (indicated by ellipsis)
  - Technical Unit n

**Technical Unit**

- Gateway
- Controller
  - Energy Providing Units
- Support Units
INVOLVED STANDARDS
Involved Standards

VPP ↔ Gateway

- IEC 60870
- IEC 61850
- TCP/IP
- TLS
- VPN
- (S)NTP

Gateway ↔ Controller

- Profibus
- ModBus
- ...

User Conference on
Advanced Automated Testing
TEST SPECIFICATION
Functional Test Requirements: Communication

• Device Under Test Initialization
• Send / Receive Sequence Number handling
• Disturbed message order handling
• Timeout Protection
• Loss of Connection handling
• Request confirmation
• Data transfer
• Clock Synchronization

And more...
Functional Test Requirements: Information Security

- Device Under Test Secure Initialization
- Secure Connection handling
- VPN handling
- Functioning features to support patch management
- Certificate distribution / revocation

And more...
Test Requirements

- 32 Test purposes specified
  - Conformance (17)
  - Negative (5)
  - Security (7)
  - Clock Sync (2)
  - Documentation (1)
TECHNICAL REALIZATION
Language and Tooling

- **TTCN-3**
  - Internationally standardized testing language for formally defining test scenarios by ETSI
- **TTworkbench (by Spirent)**
  - IDE for TTCN-3 testcase development and execution
- Java-based Adaption Layer
- openVPN
Technical Realisation

• **Adaptors:**
  - IEC 60870
  - Modbus RTU
  - Modbus TCP (prepared)
  - Network Time Protocol (NTP) Server

• **Out of scope:**
  - IEC 61850
  - Profibus
SUMMARY AND OUTLOOK
Research Project VHPready

• 4 Project Partners, 2 years running time

• Artefacts:
  • VHPready compliant Gateway Prototype (Hard- and Software)
  • VHPready compliant Gateway alternativ layout
  • Control Center Emulation Software
  • Test Specifications
  • 2 different Test Systems
Research Project VHPready

- **Test System development:**
  - Around 2 PM developing (TTCN-3 Testcases and Adaptors)

- **Test System Benefits:**
  - Findings and Discussion about ambivalences and gaps in VHPready 4.0 Standard
  - Corrections in RefBox implementation
  - Re-usabilty of Adaptors
  - Simple Extensibility (e.g. IEC 61850)

- **Future:**
  - Using Test System in Certification Process
  - Follow-up project planned
THANK YOU FOR YOUR ATTENTION