DIGITIZATION OF MEASURES CASCADING FOR THE SYSTEM SAFETY OF POWER GRIDS BY OPENKONSEQUENZ PROCESS FOR DEVELOPMENT OF OPEN SOURCE SOFTWARE

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New Software Flexibility Needed For Energy System Transition

The steadily growing integration of decentral renewable energy resources, the changing regulation, its business pressure in the unbundled energy sector and the transformation to smart grids drive the need of up-to-date software systems of grid operators for managing and operating their electrical network [1] [2] [3]. These systems have to be flexible enough to integrate and support new functionalities to cope with fast regulation updates in the field of distributed renewable energy resources as well as coordinated flexibility measures in grid operation. This is challenging in the field of Supervisory Control and Data Acquisition Energy Management Systems and Distribution Management Systems (SCADA-EMS/DMS) software, which has grown historically over decades and it is originally not designed for short software update cycles, driven by changes in regulation or business models.

The development of new functionality in the context of SCADA, EMS/DMS and GIS systems is cost intensive and often very slow because of system complexity, vendor lock-ins of distribution system operators (DSO) to their software manufacturers and highly individualized customer installations requiring the adaption of functionality from software vendors. DSOs depend on their corresponding software vendors for expanding the functionality of subsystems in the software landscape. This has an enormous impact on development efforts, development quality and development costs [4].

openKONSEQUENZ-Processes for Consortial Development of Open Source Solutions for Grid Operators

These problems are addressed by an industry consortium of five major DSOs, software development companies and researchers – the openKONSEQUENZ e.G.[3]. In this consortium, technical and processual standards have been developed to facilitate the development of modular open source software in SCADA-EMS/DMS. First, a micro service based approach [5] makes interfaces explicit but preserves flexibility in implementation. Second, standardized interfaces based on the established Common Information Model (CIM – IEC 61970, 61968, 62325) [6] are developed. This usage of open and standardized interfaces allows common data exchange between proprietary subsystems from different vendors and Open Source-based subsystems. Third, a reference architecture provides a framework, where several grid operators together can develop / let develop new functionality and all grid operators use the same software from the same source. Fourth, based on the reference architecture a reference platform is established for development, branch integration, quality assurance, demonstration and roll-out of productive systems, which can in mid-term significantly speed up software development and delivery cycles. Fifth, rules for quality assurance, software architecture and graphical user interface, software tools and documentation have been developed in openKONSEQUENZ to ensure high quality software and seamless handover of software artefacts between developers. Sixth, the software is developed in Eclipse Foundation Projects under Eclipse Foundation License – this yields open source software, which can be refined by software development companies for deriving of commercial versions from Open Source modules.

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New openKONSEQUENZ-Module “Cascading of Measures for the System Safety of Electrical Power Supply Networks (VDE-AR-N 4140)”

In this paper we will show how openKONSEQUENZ processes for consortial software development are applied for conceptualization and implementation of an Open Source software tool for "Cascading of Measures for the System Safety of Electrical Power Supply Networks (VDE-AR-N 4140) [7]. This VDE application rule specifies how network operators must work together in a cascade in the event of cross-network hazards and faults. At the present state, these requirements are mostly implemented analogue using a telephone cascade from TSO to first level DSOs and often to lower level DSOs. A complete digitization and thus automation of this functionality with system and architecture concepts of classical EMS/DMS would require a synchronized upgrade of practically all network control system installations (several hundreds) in Germany. openKONSEQUENZ is currently working on the conception and development of an Open Source **Cascade Information Tool** (CIT) that implements the requirements of VDE-AR-N 4140. CIT will allow cross-company digitization of the cascade process through simple deployability and loose coupling with SCADA-EMS/DMS. This simplifies and accelerates the automation of central Smart Grid functionality to eliminate network wide hazards and faults. Existing openKONSEQUENZ software modules such as standby planning and operation diary, already meaning an important digitization benefit to users, are used house-internally. In the present work, the above mentioned core ideas and concepts of the openKONSEQUENZ processes and the openKONSEQUENZ reference architecture are applied to the digitization of information exchange between grid operating companies in the event of cross-network hazards and faults, showing the challenges and the strength of this vendor-decoupled solution, especially in such cross-company scenarios.

Summarizing, this paper will introduce the openKONSEQUENZ process for the development of modular open source software using the Cascade Information Tool (CIT) as a case study. After then we will discuss the advantages and shortcomings of the adaption Open Source and related methodologies in grid operation and why in case of CIT it will significantly speed up the digitization of the “Cascading of Actions for the System Safety” [7] by DSOs in Germany.

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