Market Sounding SCADA/EMS

White Paper

DETAILED EVALUATION AND KEY LEARNINGS

Content

Abbreviations

CMS	Congestion Management System
EMS	Energy Management System
ENTSO-E	European Association for the Cooperation of Transmission System Operators
LFC	Load and Frequency Control
OSS	Open Source Software
OT	Operational Technology
SCADA	Supervisory Control and Data Acquisition
UI	User Interface
UX	User Experience

Introduction

About 50Hertz

50Hertz operates the electricity transmission system in the north and east of Germany, which it expands as needed for the energy transition. Our extra high voltage grid has an electrical circuit length of about 10,325 kilometers or the distance between Berlin and Rio de Janeiro. The 50Hertz control area covers the german federal states of Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia, as well as the city-states of Berlin and Hamburg. Within these regions, 50Hertz and its 1,400 employees ensure that 18 million people are supplied with electricity around the clock. 50Hertz is a forerunner in the field of secure integration of renewable energy: Until 2032 we want to integrate 100 percent securely. The shareholders of 50Hertz are the Belgian Elia Group (80 percent) and the KfW bank group 20 percent. As a European transmission system operator, 50Hertz is a member of the European association ENTSO-E.

About MCCS NextGen

With MCCS NextGen, 50Hertz plans to completely replace all application software systems and integration technologies in its system operation, including SCADA, EMS, LFC, CMS, scheduling, etc., as well as adding or enhancing relevant capabilities such as dynamic system analysis, dynamic voltage maintenance, automated topology optimization, online analytics and more. Associated with MCCS NextGen is a strict focus on the modularization of applications, loose data- and event-driven coupling of modules, and flexible integration of modules.

MCCS NextGen will be shared by 50Hertz as a vision, architecture, and reference solution with peers (e.g., other international TSOs) in a MCCS NextGen community, becoming a blueprint for 50Hertz and other TSOs and community partners to quickly respond to the increasing change needs in electric (and other) infrastructure management applications. MCCS NextGen is explained in more detail later in this document.

The objective of the Market Sounding

This market exploration has two goals, which we will define in more detail below:

1.) Inform the market about 50Hertz's investment into a complete replacement of potentially all IT/OT[1] software applications related to the system operation, and share the vision, architecture, and guiding principles of MCCS NextGen

2.) Gain market insights. 50Hertz likes to gain insight into the offerings of suppliers (product and service providers), their sentiments, and capabilities regarding the topics of architecture, delivery, collaboration, and other aspects into MCCS NextGen.

Therefore, we want to create transparency and ensure non-discrimination. At the same time, we would like to check to which level suppliers would be willing and capable of cooperation and delivery of products fitting into MCCS NextGen.

The specific objectives of the market sounding can be classified as follows:

- Discuss with providers the validity/acceptance of MCCS NextGen in the supplier market
- Clarify the willingness of providers to integrate their products or services with MCCS NextGen or to make the various possible contributions to MCCS NextGen
- To validate the interoperability of MCCS NextGen with other ideas and products in the market, and the interoperability and potential interchangeability of available modules
- Clarify the readiness of providers to deliver into MCCS NextGen that might in parts become OSS

Tenders and RfPs

50Hertz is a regulated company within the energy industry and is subject to the German SektVO (Sektorenverordnung) regulation. Follow-up activities of 50Hertz such as potential tenders will comply with the regulation.

Target audience

The market investigation addresses potential providers who want to supply solutions or services into the environments of TSO system management, including but not limited to

- Providers of large-scale SCADA/EMS/LFC/Scheduling/State Estimation, Online Grid Calculation, (Electrical) grid monitoring systems, etc.

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[1] OT – Operational Technology – hardware and software that detects or causes a change, through the direct monitoring and/or control of industrial equipment, assets, processes and events.

- Suppliers of similar products who have previously supplied other utilities (e.g., SCADA/ADMS) or customers in sectors other than Energy (e.g., industry SCADA, automation, gateways)
- Innovators, and disruptors, who can make contributions to technical tasks of system management with novel solution approaches
- Development service providers with experience in system management who can provide individual development of modules in MCCS NextGen.

MCCS NextGen – a view from 3000 feet

Motivation for MCCS NextGen

The current situation is characterized by numerous political, social, and technical challenges and changes. The energy system is transforming and requires a higher and better integration of renewables. This also implies the increase of measurable and controllable units and at the same time the need to deal with rapidly growing data. There is a need for new complex functionality, and likewise, an increasing need for system monitoring, system assessment, decision support, and automation to deal with the volume of events and actions in the electrical system.

Grid operators also have to consider the implementation of recast EU and national regulations and tightening coordination needs between the market and grid to ensure system stability. With a corresponding increase in the need for coordination between the system and the market, coordination with network partners in the European transmission network and subordinate networks further grows, and thus adds demand for relevant software capabilities.

These challenges, require new solutions to maintain IT/OT software applications within system operation and to cope with the increasing demand for change, particularly the need to responsively implement and deploy the changes.

MCCS NextGen Vision and high-level architecture

For 50Hertz's system operation as well as contributors and partners in the MCCS NextGen community, 50Hertz is planning MCCS NextGen as the vision, architecture, and reference solution for the IT/OT of system management of the future.
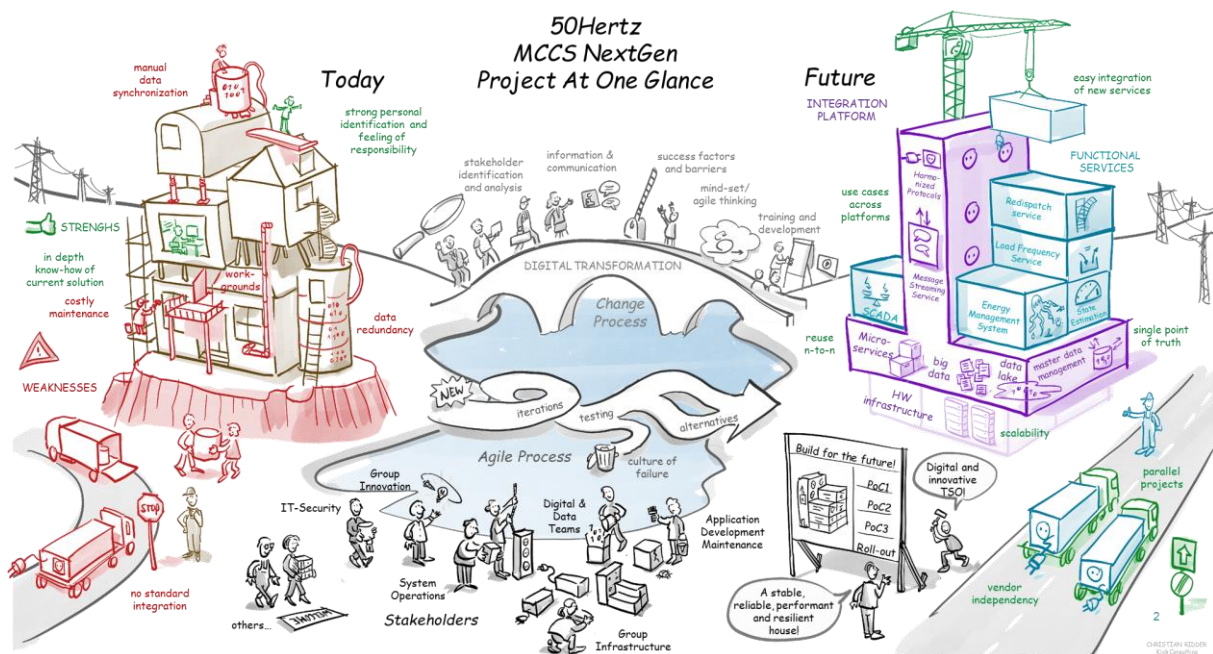

Fig 1 MCCS NextGen vision – a fully modular control center system

50Hertz's vision is a sustainable and modularized application landscape that can be flexibly adapted to changing requirements by replacing, modifying, expanding, or adding relevant modules (see Figure 1). Integration shall be lightweight, loose, and event and data-driven. Complex and tedious changes of heavily individualized monolithic software as is the common case today shall be avoided where possible, and economically meaningful.

MCCS NextGen is therefore designed to meet change requirements quickly and securely at any time when new features are added efficiently.

In particular, 50Hertz expects the implementation of MCCS NextGen to:

- allow significantly faster implementation of requirements
- better adapt to the specific individual needs of 50Hertz or the respective TSOs
- broaden capabilities, including improved potential to integrate systems of any systems of a pace layered architecture (systems of record, system of differentiation, systems of innovation) in an orchestrated manner
- implement a new level of security-by-design, and increase scalability, and overall system availability in systems used to operate critical infrastructure
- Security by design - Security, availability improve, reduce the impact of failures, lower risk
- Simple upgrades, update, flexible maintenance, frequent changes

MCCS NextGen is based on a platform concept whose essential components are shown in a simplified and schematized form in Figure 2 below:

- Event stream processing for a fast and open event and data-driven integration
- Harmonized MDM derived from CIM/CGMES standards as a single point of truth
- Harmonized UI based on Micro-Frontend Pattern for a consistent UX
- High focus on customization: Best possible scalability

A guiding principle for MCCS NextGen is the division of previously monolithic or vertical applications into modules within well-defined edge contexts that can work together on an event-by-event basis but can be developed separately to allow the separation of concerns. Disaggregation takes place where it makes sense and where the potential for further use of modules is high, or where vertical consolidation would prevent other modules to apply relevant data otherwise available only within monoliths. As an example, formerly vertically integrated and monolithic SCADA is refactored into complementary modules comprising data acquisition, monitoring, control, alarming, and others, each of them communicating with each other by events. A monitoring module (visualization of the system and state) might be replaced with another monitoring without changing data acquisition, control, etc. when the MCCS NextGen reference solution is applied in a TSO different from 50Hertz. Alternatively, the monitoring module might be complemented with another monitoring module that adds specific capabilities, e.g., adding detailed views on special assets not covered by the original monitoring module. Different alarming tools (modules) can be delivered to different users within the same instance of MCCS NextGen depending on the users' workplace or role.
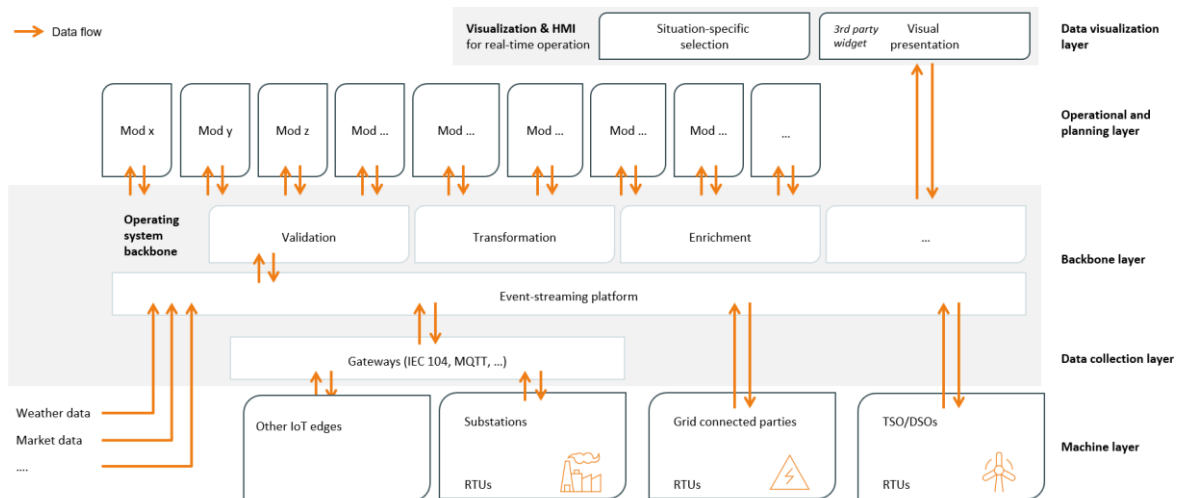
Figure 2: High-level architecture of MCCS NextGen as a modular and event-stream-based system[2]

Modules can be leveraged to become "shared services" within an instance of MCCS NextGen. E.g., a time-series or event archive originally provided with the SCADA capabilities could be multiply reused to store other time-series and event data from and to other modules.

MCCS NextGen envisions all events, and relevant data forwarded by an event-streaming platform (ESP) thus available for every (application) module that could make use of these events and data. Role-based access management controls which modules are allowed to produce or consume from the event stream. This data is validated on the event stream using event-stream processing, and anomalies are detected and converted into alerts or alarms based on rules configured into the event stream. As a result, raw data, validation status (data qualifiers), and refined and enriched data are consumable by all modules in close to real-time and without the need to pass-through monolithic applications introducing unnecessary latency and application interdependencies.

Master data and configuration/parametrization shared by modules are propagated as increments in form of events to allow fast and consistent updates of applications. MCCS NextGen native applications will consume their master data from the stream, while more traditional applications may still cache master in their proprietary data stores.

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[2] Modules are labeled for illustration only. They do not necessarily reflect modules that will actually be integrated with MCCS NextGen.

MCCS NextGen community

50Hertz is also an incubator of the MCCS NextGen community, a managed community to facilitate MCCS NextGen.

In collaboration with other TSOs and partners, 50Hertz is designing MCCS NextGen as many TSOs are in the same situation and face similar challenges. We, therefore, expect MCCS NextGen to be adopted as a strategy and architecture blueprint, an integration concept, a platform, and an ecosystem of modules from a wide range of contributors. Participating peers can apply MCCS NextGen elements, make use of the platform and/or modules but also contribute their platform extensions, modules, or experiences. The open ecosystem is therefore expected to rapidly increase the potential to introduce new products (modules) into TSOs or other peers' IT/OT landscapes and remove barriers to quickly implement new requirements.

First TSOs (besides 50Hertz) are already participating in MCCS NextGen to apply the architecture and blueprints when renewing or expanding their IT/OT landscapes. 50Hertz is talking with them on different levels of cooperation within the community ranging from knowledge exchange, participation by use, contribution, or co-creation to MCCS NextGen. In this network-oriented approach, we see the potential to simplify digitization projects in the sector in the future and to leverage the effects of scale and scope across companies.

Use Cases

To explain the idea of MCCS NextGen, 50Hertz presents several use cases as examples below. Examples can be used by the supplier to explain approaches, challenge MCCS NextGen, and illustrate their considerations.

Selected illustrative MCCS NextGen use cases:
1. Hybrid alarming
2. Modular SCADA: separate control module
3. LFC integration

Hybrid alarming: MCCS NextGen is centered on the general concept of events. Alerts and alarms are specific interpretations of events depending on the type of event, and the role of the consuming entity. Field equipment (RTUs, PMUs, others – source A) or application modules (source B) may originally create and propagate alerts or alarms to the control center (1). Such original alert or alarm events are collected by gateways and produced onto the event stream into dedicated topics (2). Consumers may subscribe to such topics and display or handle alerts and alarms appropriately and restricted by their role-based privileges. In addition, event-stream processing may be applied to evaluate single events or compounds of events and generate alert or alarm events if defined conditions are met (3). Such generated alerts or alarms (source C) will then be propagated the same way as the original alerts or alarms (4). Consumption of alerts or alarms is not limited to singular applications such as traditional vertically integrated or monolithic SCADA but is immediately possible for all modules that need to process alerts or alarms.
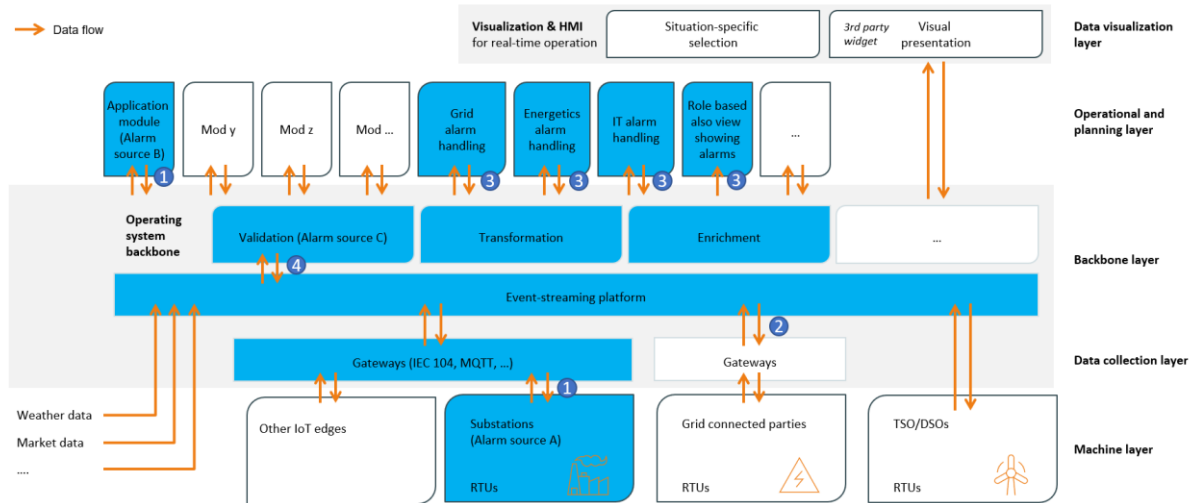
Figure 3: Use case hybrid alarming

Modular SCADA: Traditional vertically integrated SCADA is disaggregated into complementary modules such as Data Acquisition, Monitoring, Alarming, Control, Logging, etc. within MCCS NextGen. A few shared components including master data management, event-streaming platform, and UI provide fundamental capabilities to integrate modules at the data, event, and frontend levels. The frontend is composed of a coordinating UI delivery framework, and visual elements/web components implemented according to the Micro-Frontend pattern. The system state is delivered with the Monitoring module and its web components to the operator. If the operator likes to change state in the system (e.g., to mark assets, or to perform switching) the UI delegates operator interaction to web components of the Control module. These web components trigger relevant activity within the control module (e.g., authorization, switch state validation, rule checking, checking of interlocking, technical clearance to perform switching) that produces an event into the event-streaming platform. A connected gateway will consume events and perform switching with the field devices. Feedback from the field is gathered with the gateway and produced to the event stream to be consumed by the Monitoring module for updating the system state shown to the operator, and to the Control module to update the switch state model.
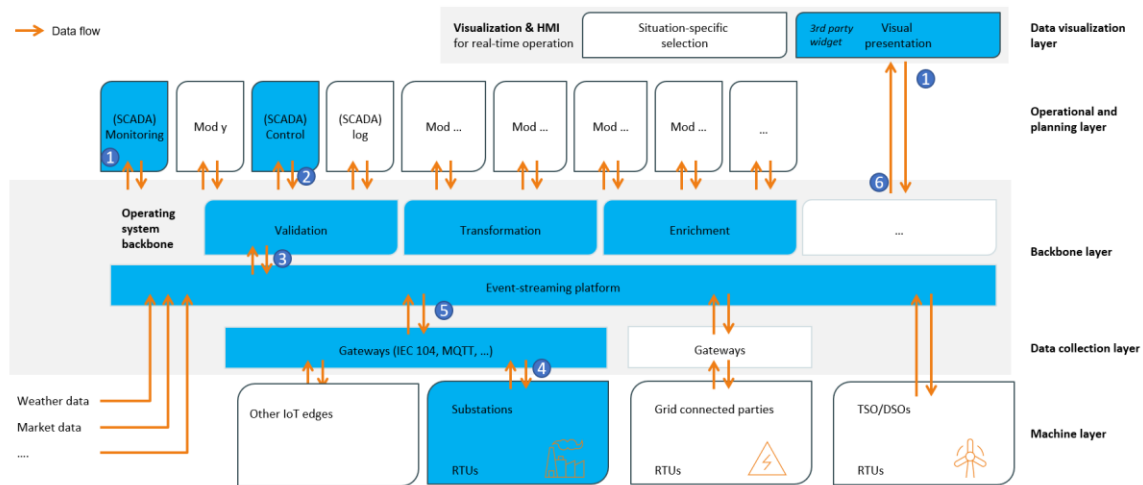
Figure 4: Use case modular SCADA

LFC integration: LFC is assumed as a modular application comprising several modules including market communication, optimization of energy products (merit order procedure), load and frequency control core, activation of energy products, and others. LFC core and activation act like automated users changing set-points in the systems to request adjustments power infeed or consumption of energy providers by changing their set-points, and to perform settlements related to these adjustments in the system. LFC core will not directly communicate over the gateway to the energy providers (3) but produce events into the event stream (1) consumed by the Control module that will perform its validations (2). By looping the Control module in, the LFC cannot request set points interfering with interlocking or other rules that shall prevent changes in the system that might result in adverse system conditions.
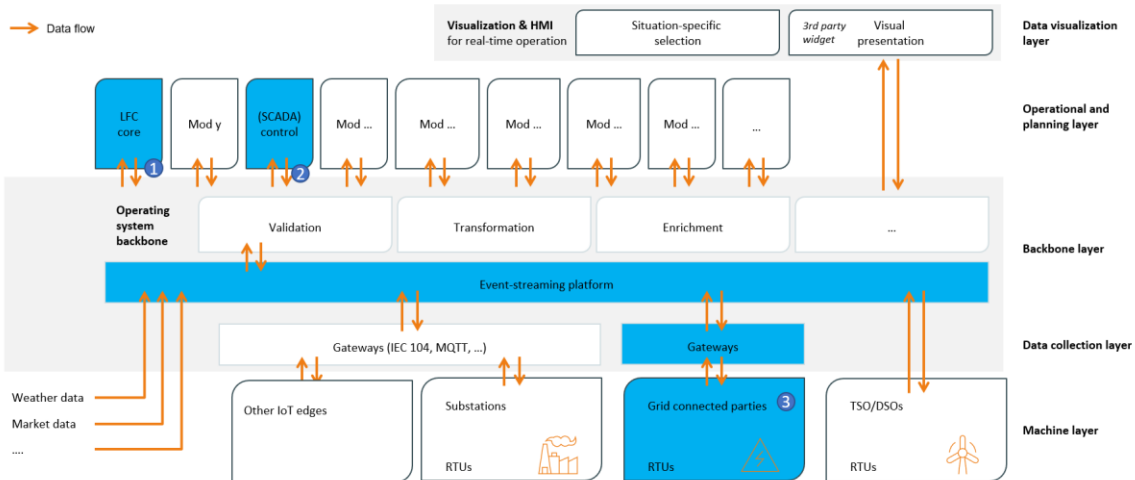

Figure 5: Use case LFC integration

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Market Sounding: Findings

The NextGen Market Sounding was an insightful exercise whose results strongly support NextGen as a vision, architecture, and product

The provider market is attracted by NextGen and providers are interested to find their position within NextGen

What we believe:

- Unexpectedly high response rate
- Predominantly positive feedback of NextGen vision and architecture by providers
- Active contributions, active suggestions of providers on how to integrate their products into NextGen

Why we believe:

- 29 of 62[3] providers responded by investing uncompensated effort, and without the promise of 50Hertz to contact them in any form for NextGen
- 27 of 29 providers explicitly commented positively on NextGen's vision, architecture, and approach
- 26 of 29 providers provided detailed answers of high quality and valuable feedback for NextGen
- All responding providers are interested in NextGen

The majority of providers will be able to quickly deliver into NextGen, and many will evolve their products to harmonize with NextGen

What we believe:

- Providers will deliver to NextGen
- NextGen increases competition among providers and enlarges the relevant provider market for 50Hertz
- Products will be rapidly available as modules for NextGen
- Some providers will join NextGen to create „genuine" NextGen modules

Why we believe:

- NextGen itself is designed to interoperate with any type of product and including legacy

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[3] Numbers presented correspond to the market sounding state as per 20th of September 2022.

- Providers present vast capabilities to directly deliver modules of different consolidation levels
- Providers quote NextGen modularization with their roadmaps to modularize and utilize event streaming as means of integration
- Several providers offer to build products for NextGen
- „Newcomers", providers other than the established for TSO SCADA/EMS showed an active interest responding the sounding

NextGen can reliably plan for the evolution and transition of the system operations IT/OT with sufficient providers willing to contribute

What we believe:

- NextGen can assume received provider responses trustable

Why we believe:

- Many providers **responded after reassuring** that their non-originally SCADA/EMS products are relevant for NextGen
- 28 of 29 providers provided high-quality responses **discussing NextGen architecture**, and not plainly showing sales catalogs
- The majority of providers (26 of 29) **share both, architectural and technological concepts**

With the acquired insights, NextGen will now be able to approach advanced productization and marketing strategies.

Further findings

- The majority of providers see the increasing role of streaming technology in industrial solutions
- High flexibility on the legal, project methodology, OSS, and support aspects
- Traditional SCADA/EMS providers do still believe in their proprietary system suites
- It is not to be expected, that the suppliers, even supporting NextGen concepts, will abandon their existing integrated systems soon
- The importance of standards is clear to suppliers, still, a significant number of them do as few as necessary in this area (data interfaces only)
- About 1/3 of vendors are „agile-ready", others prefer classical or hybrid project methodology; 1/5 staying by „waterfall-only"
- Part of the suppliers is still unsure about their position concerning OSS. A clear strategy from the NextGen side will be welcomed.

Market Sounding Detailed Evaluation

It was clear also in 2022 that the industry would continue to change, with utilities and vendors needing to take strategic decisions to ensure their further development.

Our market sounding of the utilities suppliers' landscape shows that facing the same challenges in the energy market development, vendors choose different market strategies, which leads to a clear grouping among 29 vendors analyzed:

On one hand, there are vendors, aiming for the highest possible flexibility, openness, and compatibility with the latest IT developments, meaning also undertaking disruptive architectural and technological steps;

On the other, the vendors aim to protect their traditional solution areas and technological decisions, resulting in further active utilization of the OT stack;

The third groups are the components and service providers of various profiles, interested in a market that is as open and dynamic as possible.

This grouping determined strongly the answers, given during the market sounding, and can be seen in the evaluation, presented below.

The answers are grouped according to the following cathegories:

1.   Service Provider Profile & Portfolio
2.   MCCS NextGen Vision & Architecture
3.   Other aspects

Service Provider Profile & Portfolio

Question: What products and services do the service provider offer in the system operation or extended SCADA/EMS environment?

Background: With the market survey, 50Hertz is trying to gain an understanding of the perception and sentiment of different service providers in the market to align MCCS NextGen sustainably, also taking into account the supplier market. The brief introduction of the service provider and its products and services allows 50Hertz to interpret the further answers more precisely.

Interests: From the service provider's point of view, what is its professional and technical market positioning in the market today? On which relevant experience history does the service provider build? Which products or which product or service portfolio is relevant for MCCS NextGen does the service provider offer?

For the market sounding, initially, 66 potentially interesting companies were identified with a wide range of profiles – from large industry providers to small and medium companies.

Of the addressed companies, more than half confirmed their participation in the market sounding.

Experience showed that at highest confirmation and answering quote was by the companies, where the direct contacts were available, at the lowest in the cases where information was sent to the default info@ addresses.

Unclear responsibility areas and internal communication deficits could be observed by the larger concerns.
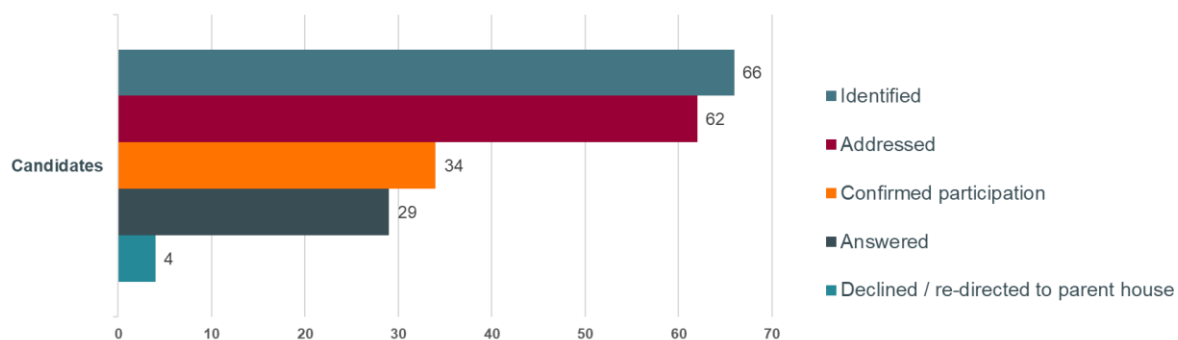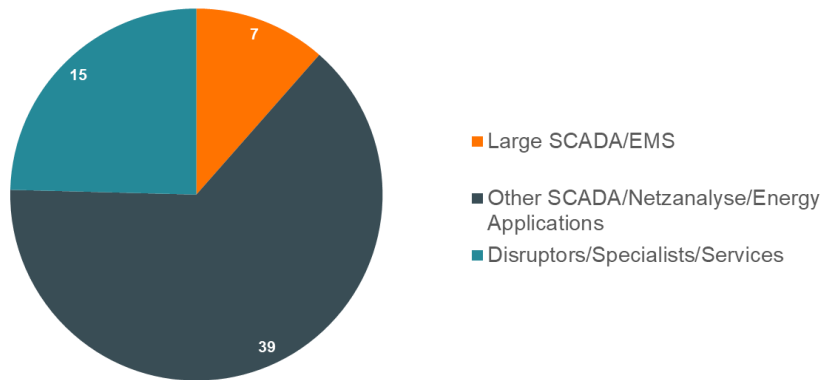
29 vendors and disruptors have participated in the market sounding, including the major TSO providers.

The selection of answers was representative, companies covering a wide range of profiles that can be roughly grouped into three categories:

Large SCADA/EMS – large and medium vendors of SCADA and analysis systems for power utilities.

Other SCADA / Network Applications / Energy Applications – a wide spectrum of industrial automation solutions, power systems analysis tools, and market operation.

Disruptors / Specialists / Services – the cluster of various service providers and disruptors, bringing technologies not yet widely used by large utilities.

Summary of the answers: Initial contacts showed that in spite of the architectural statement of MCCS NextGen: *involvement of the wider range of smaller providers*, those hesitated to participate, as the previous experience showed them, that they are of low interest for the TSO.


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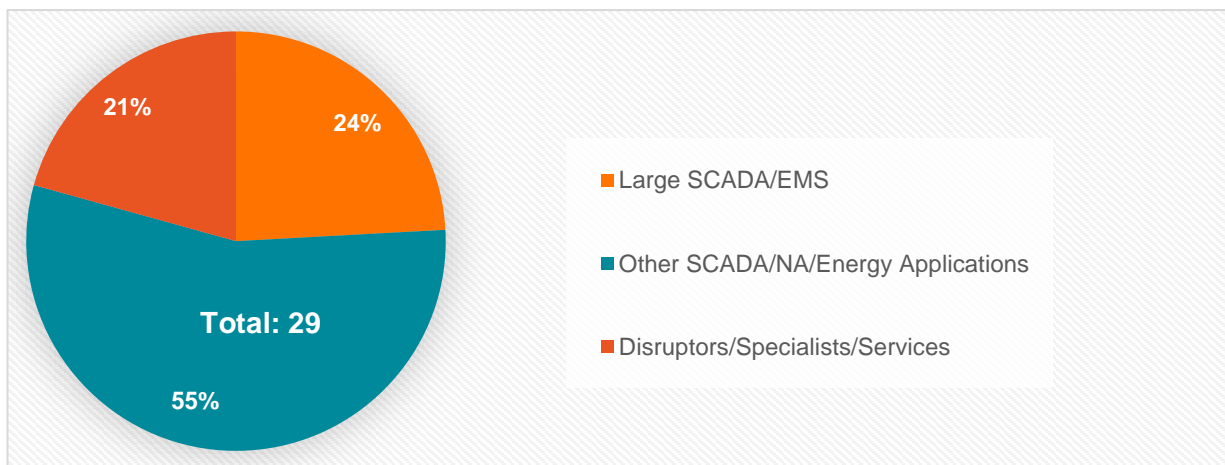
Question: How or with which products or services would the service provider position itself in the open eco-system of MCCS NextGen, e.g., as a supplier of platform components, supplier of business or shared mod-ules, supplier of specialized applications (modules bundled into applications, integrated solutions), provider of services, etc.?

Background: Via the self-positioning of the service provider, 50Hertz would like to understand which perspective the service provider takes on MCCS NextGen and how its further answers are to be interpreted.

Interests: What positioning/roles would the service provider potentially realize? What parts of the MCCS NextGen Ecosystem would the service provider potentially deliver into?

Summary of the answers: Providers that share the NextGen vision see their role in MCCS NextGen eco-system as…
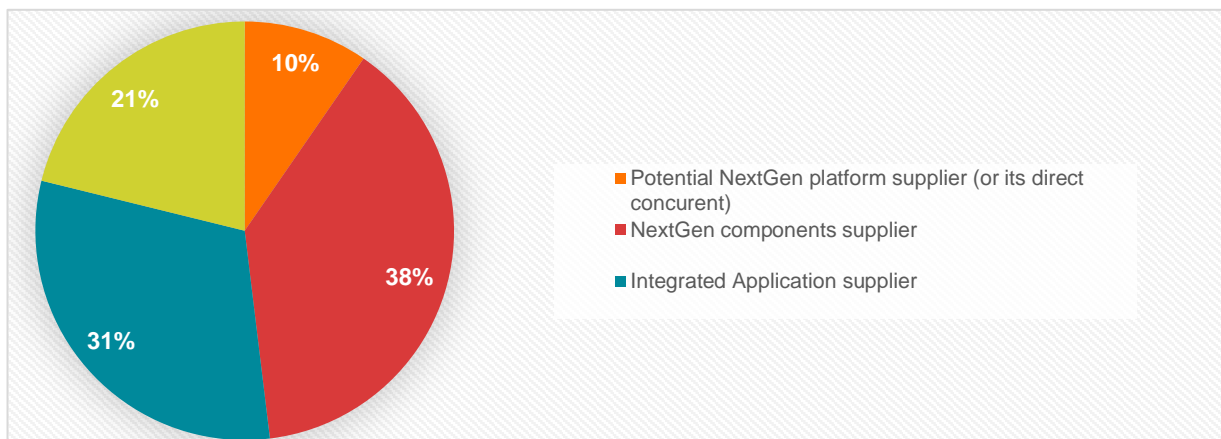
Multiple answers were possible.

Explanations:

- Potential NextGen platform supplier or direct concurrent – supplier offers a (streaming) platform for energy applications or similar, of various levels of specialization; some of them are generic, and some of them real-ize the similar concepts as NextGen and will prefer to develop their platform instead of cooperation;
- NextGen Components / Modules supplier – the "sweet spot" of the NextGen market – suppliers, supporting NextGen concepts and willing to provide different kinds of NextGen-compatible modules
- Integrated application suppliers – share the NextGen vision, but still, trust in their integrated application suites
- Services/Consulting providers – do not provide the SW products or components, but diverse services (archi-tecture, project management, SW development, etc.)

Question: What is the service provider's perspective on the SCADA/EMS market and how does it respond with its products and services?

Background: From its perspective, 50Hertz sees MCCS NextGen as the answer to various changes in the energy system, the required differentiation of capabilities using new technological potentials. Through the service provider's response, 50Hertz would like to plausibilize how MCCS NextGen fits with the views of the supplier market, where the views of suppliers and 50Hertz overlap and where they diverge.

Interests: What major challenges and trends does the service provider see about system landscapes in the SCADA/EMS environment of energy companies, specifically grid operators? How does the service provider address these challenges? What adjustments to the portfolio and/or products and services does the service provider foresee and in what time horizons?

Summary of the answers:

All the market sounding participants do realize that the energy sector is undergoing a strong transformation process, which calls for innovative and even disruptive solutions, even in the traditionally "sacred" field of SCADA/EMS.

With seemingly few exceptions, vendors are revising the architectures of their SCADA/EMS solutions towards more modularity and the use of more modern technologies. In terms of technologies, in particular, there is a tendency to switch to commercially available platforms and replace proprietary data buses with, for example, event streaming. Vendors are more open to providing modules instead of complete solutions and to designing solutions more individually. However, this is not yet a break from their existing business models. Vendors still tend to prefer to offer their solutions around their integration rails and master data solutions, which limits the flexibility for customers to put together their solutions.

MCCS NextGen Vision & Architecture

Question: How does the service provider assess the vision and the presented high-level concept of MCCS NextGen and what advantages/disadvantages does it see for the use of its products/services in MCCS NextGen?

Background: MCCS NextGen is a vision of 50Hertz to enable, and empower reacting quickly and flexibly to changing needs/changing requirements at any time. Changes shall be possible by adapting modules and integrating them, but also by replacing or adding modules quickly and with minimal impact on other modules. The vision can be better realized if service providers can have comfort accepting the architecture and have a good foresight of how to integrate their products or services into MCCS NextGen.

Interests: How does the service provider assess its solution in relation to MCCS NextGen as well as possible interoperability between its own product and MCCS NextGen? What advantages and disadvantages does the service provider see in MCCS NextGen for the provision of its products or services? What complexity and effort drivers does the service provider see for the delivery of its products or services? What effects does the service provider see in the form of additional or reduced effort in the provision in this case compared to the provision of its standard solutions adapted to customer needs and direct integration with products from other service providers?

Summary of the answers:

With a total of 93% the absolute majority of the participants do share the architectural concept of MCCS NextGen: *modularity, data-centric approach, and multi-vendor solutions*, while 36% are also sharing the technological concept – switch to market standard streaming platforms, Kafka in particular.
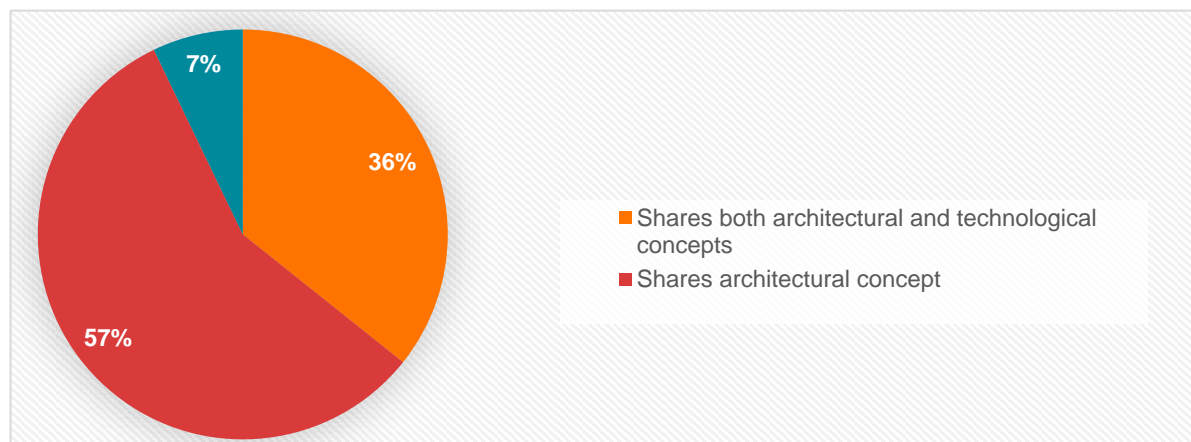
Question: Can the service provider already deliver modularly in the sense of the MCCS NextGen vision or are there significant dependencies within its products that require the provision of bundled systems (e.g. SCADA with its SCADA bus and its own master data management or its own UI; e.g. analytical functions relying on own bundled proprietary data store)?

Background: MCCS NextGen aims at extensive modularization of solutions and orchestration of modules to applications in loose coupling by event streaming as well as the use of (master) data from a managed source (single point of truth). MCCS NextGen can technically integrate more complex systems up to classic monolithic applications and associated proprietary data stores. However, 50Hertz is targeting the disaggregation of monoliths and can only tolerate corresponding solutions in MCCS NextGen to a limited extent. MCCS NextGen seeks a trade-off between modularization and continued use of conventional application systems that is compatible for the supplier market.

Interests: Which dependencies exist in the products or services of the service provider that are relevant in the SCADA/EMS environment? Which products or services must be included to obtain selected products/services (cf. above, SCADA with own SCADA bus, own MDM, own UI). What does the service provider envisage in the future in terms of modularization and unbundling of its products/services?
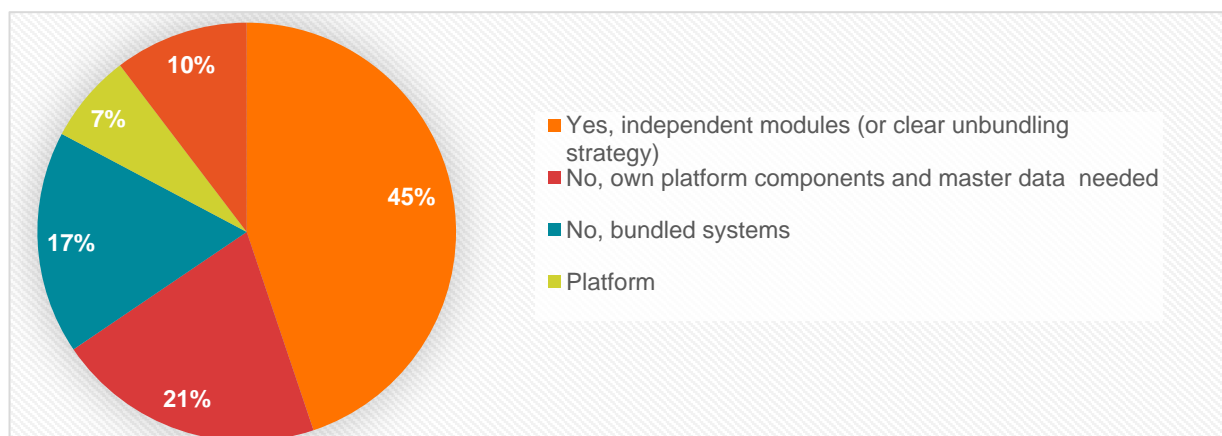
Summary of the answers:

Suppliers are increasing their ability to provide modules instead of complete solutions and to complete solutions more individually.

Almost the half of participants offer their products as modules or run currently the modularization strategy. Other 7% see themselves as platform providers enabling modularity.

However, this is not yet a break from their existing business models. Almost 40% of suppliers still tend to provide their solutions centered around their integration and master data solutions, which limits the flexibility for customers to assemble their solutions.

Pie chart legend:
- 45% — Yes, independent modules (or clear unbundling strategy)
- 21% — No, own platform components and master data needed
- 17% — No, bundled systems
- 7% — Platform
- 10%

Question: What integration options does the service provider foresee for its products or services today and what does it plan for the future?

Background: MCCS NextGen aims at the loose coupling of modules (or applications). The orchestration of modules is event-based and asynchronous via the event stream. Direct synchronous calls of services between modules shall be avoided as far as possible. 50Hertz would like to validate which options for orchestrating modules and exchanging data in MCCS NextGen are well compatible with solutions on the supplier market.

Interests: What forms and technologies for integrating its products or services do the service provider envision today (e.g., API/technology stack, WebServices, file, databases, event streaming)? What is the content and mode of these interfaces (e.g. asynchronous/synchronous data exchange, asynchronous/synchronous triggering of activities), and what is the resolution of the interfaces (e.g. load network model vs. load single asset)? What does the service provider envision for the future, possibly with a roadmap? What experience may the service provider have with event streaming in conjunction with its products?

Summary of the answers:

Addressing the topic of data-streaming platforms in general, and Kafka in particular, suppliers confirm the importance and acceptance of the technology, with almost 46% already supporting Kafka integration and other 33% planning to support it in the following releases – summing up to almost 80% support.

Additionally, industrial seaming standard OPC was mentioned by 12% of respondents as a technological alternative to Kafka in the industrial segment.

12%　Kafka-based
34%　Kafka-enabled / supports Kafka integration
33%　Streaming support planned
21%
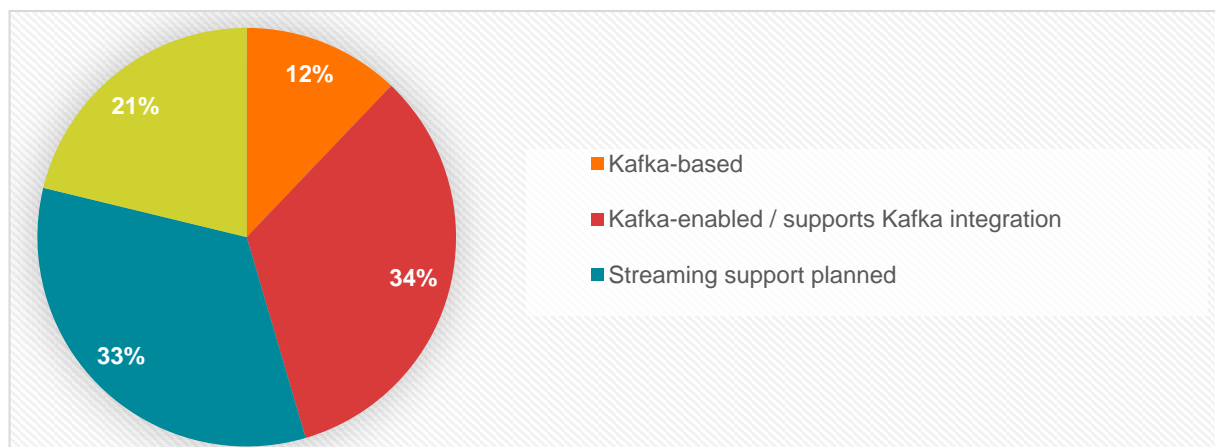
Question: What is the service provider's strategy regarding the use of CIM/CGMES in its products?

Background: CIM and the CIM derived CGMES are comprehensive and extensible data specifications and standards for modeling the electrical system in almost all aspects relevant to MCCS NextGen, as well as for communicating the data between relevant software systems. MCCS NextGen strives for a very extensive alignment with CIM/CGMES as a semantic model in its master data model, for the identification of data and events, and for access or queries to data. Formats and serializations of CIM/CGMES are implemented in an optimized way according to their purpose (e.g. schemas on Kafka, XML/RDF for files, LPG for graphDBs). The advantage from the harmonization of data on CIM/CGMES grows when the products/services of the service providers can directly handle CIM/CGMES, or are implemented "CIM/CGMES native" rather than mapping proprietary data from and to CIM/CGMES.

Interests: Where and how does the service provider use CIM/CGMES in or between its products or services? Does the service provider use CIM/CGMES native or does it transfer data between CIM/CGMES and proprietary models? If proprietary models are used: Where does the service provider see the main structural and content-related differences to CIM/CGMES.
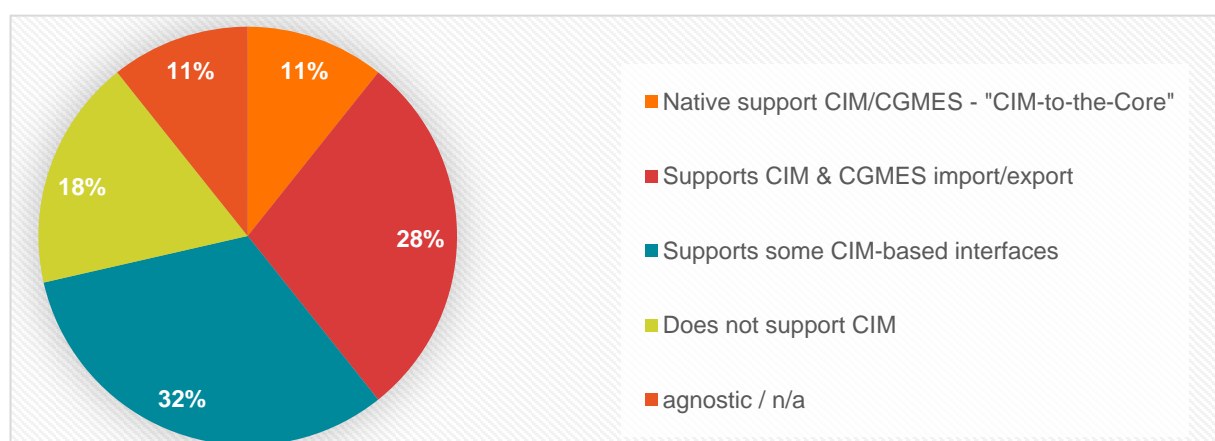
*The total picture of CIM/CGMES support among suppliers*

Summary of the answers:

Suppliers do realize the importance of modeling and data-exchange standards.

Approximately one-third of suppliers did not address the TSO market, or are not offering services, directly connected to TSO grid modeling and relevant data exchange – and hence are not even always CIM/CGMES-aware.
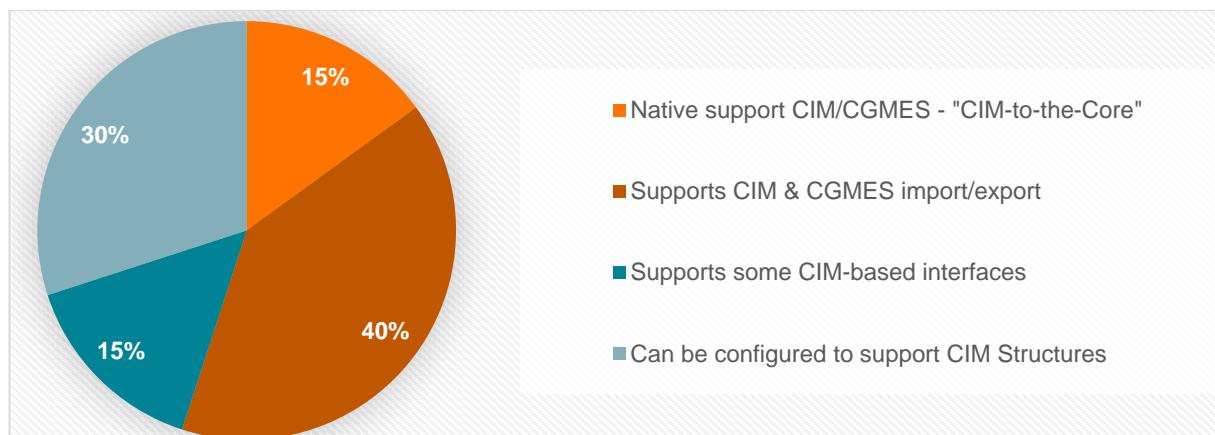
Levels of CIM support among the CIM-aware suppliers

Summary of the answers:

Among the CIM/CGMES-aware suppliers, the majority (40%, mainly modeling and analysis products suppliers) supports the import/export of diverse CIM datasets (full and incremental models, messages, etc.).

A large number of systems can be configured to cope with CIM/CGMES imports/exports. Others provide some CIM/CGMES interfaces, mainly on a project basis.

Still, about one-sixth of suppliers not only support CIM, but see their products as CIM-to-the-core, or completely CIM-based. This is an important step forward, compared with the majority, still using CIM as merely a data exchange format to being converted into the internal proprietary data model.

Question: Can the product or service be fully configured and parameterized externally today (i.e., for example, import configuration from a master data management system not provided by the service provider)?

Background: 50Hertz considers the inconsistency of data due to redundant data management and the necessity of distributed manual data entry as a major impairment of system adaptation and system use as well as a major operational risk. Configurations and parameterizations are often only a subset of data associated with the electrical system model. MCCS NextGen envisions managing essential configurations and parameterizations centrally and linked to the electrical system model. As a result, MCCS NextGen modules will receive their configurations and parameterizations from a central source. 50Hertz would like to assess how well this vision can be realized with solutions in the supplier market.

Interests: Do service providers support external, automated configuration and parameterization of their products or services? Which technologies (e.g. web service, file), standards and data models (flat lists, XML, SCL, CIM) do the service providers support? Which contents still have to be configured/parameterized manually with the provider's products or services? Are the service providers willing to disclose their configuration/parameterization data models to 50Hertz as a customer of their products or services and under which further conditions, restrictions?
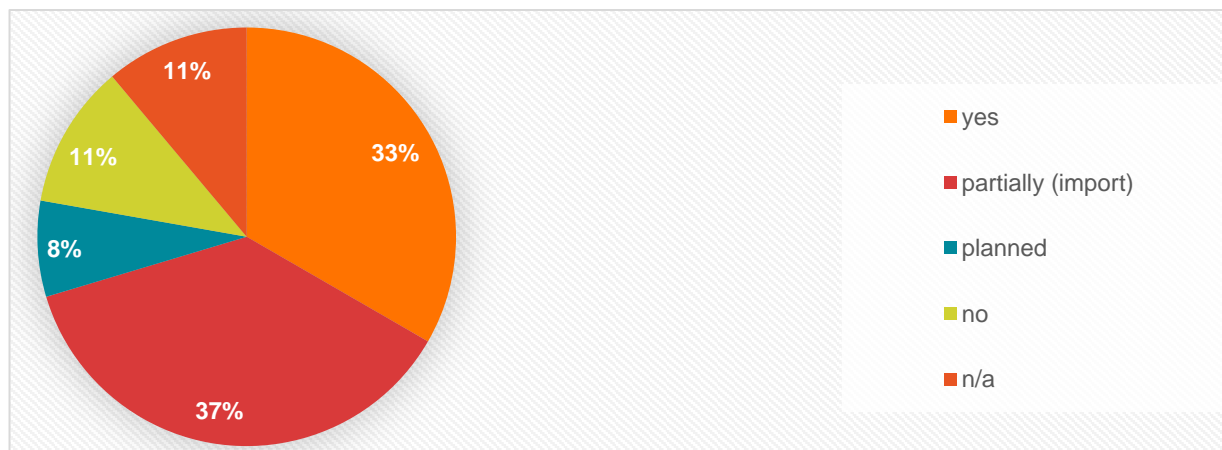
Readiness for external parametrization (external Master Data and Configuration Management)

Summary of the answers:

One-third of suppliers see their systems as supporting external master data management and parametrization, hence simplifying their integration into enterprise landscapes, and supporting the MCCS NextGen concept.

Majority of suppliers offer (or plan) import capabilities for initial set-up or regular updates of their master databases.

Other aspects

Question: Which delivery and service forms can be agreed upon with the service provider?

Background: 50Hertz follows a hybrid development strategy for MCCS NextGen. Parts of MCCS NextGen are classically procured as products or services from service providers, other parts are developed independently within 50Hertz, and other parts can be created in partnerships in a co-creation approach by the service provider and 50Hertz. 50Hertz would like to determine the readiness of service providers to provide the various forms of delivery and performance to better align the strategy with the supplier market.

Interests: What forms of delivery/service does the supplier support (e.g., classic license & work contract, turn-key project, integration/development as service or work, custom development for customers (cession of rights), co-creation of products (joint, independently exploitable rights for service provider and 50Hertz), etc.)? What organizational form of project-related collaboration does the service provider support (waterfall, agile/which methodology, separate or mixed teams of supplier and 50Hertz), etc.? Can the supplier imagine providing services without specifications or pre-filled backlogs?

*What **project** forms can be agreed upon with the service provider (multiple choices possible)*

Pie chart:
- Classic / Waterfall: 34%
- Agile: 32%
- Hybride: 31%
- n/a: 3%
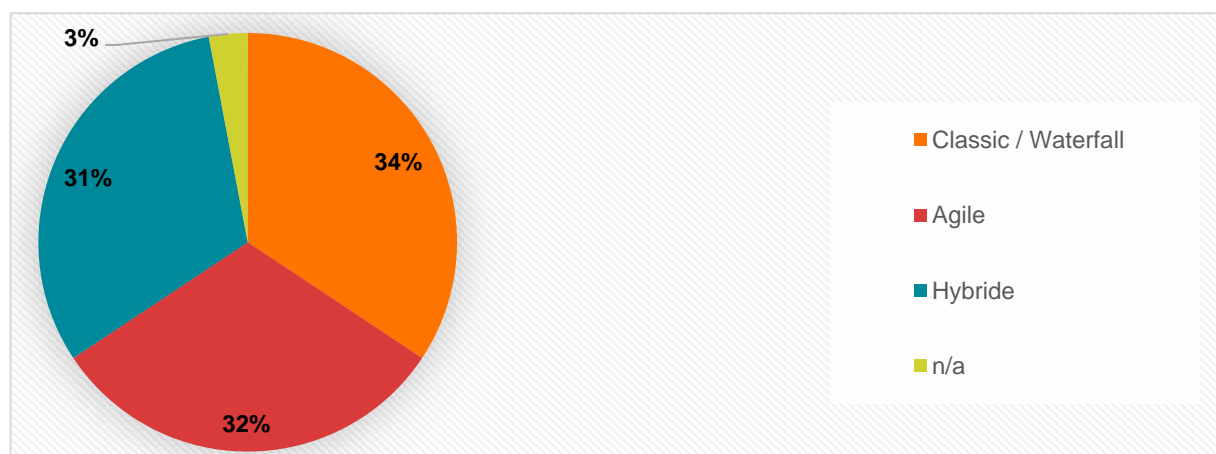
Almost all vendors recognize the growing demand for agile project methods.

Summary of the answers:

The majority of classical utilities' vendors prefer the hybrid project approach, combining elements of the waterfall and agile methods (mostly not specified to what extent).

The absolute majority of the providers are ready to discuss the project methodically with the customer and to adapt it correspondingly.

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Question: What law does the service provider consider to be the contractual basis for the provision of its products or services?

Background: Standardized contracts may be developed for MCCS NextGen to reflect the permanent change contained in its vision, and the expected resulting a large number of procurements of products and services. 50Hertz, as a regulated company, cannot enter into contracts on an arbitrary legal basis and would like to learn what legal basis can generally be assumed.

Interests: Indication of applicable national, supra-regional law under which service providers are willing to contract plus an indication of service provider preference.

Summary of the answers:

Suppliers´ feedback shows very high flexibility on the legal aspects, with the majority of vendors supporting either the German or other European countries´ laws, with the absolute minority sticking to the non-EU laws only.

NextGen can count on a representative European market for tendering.
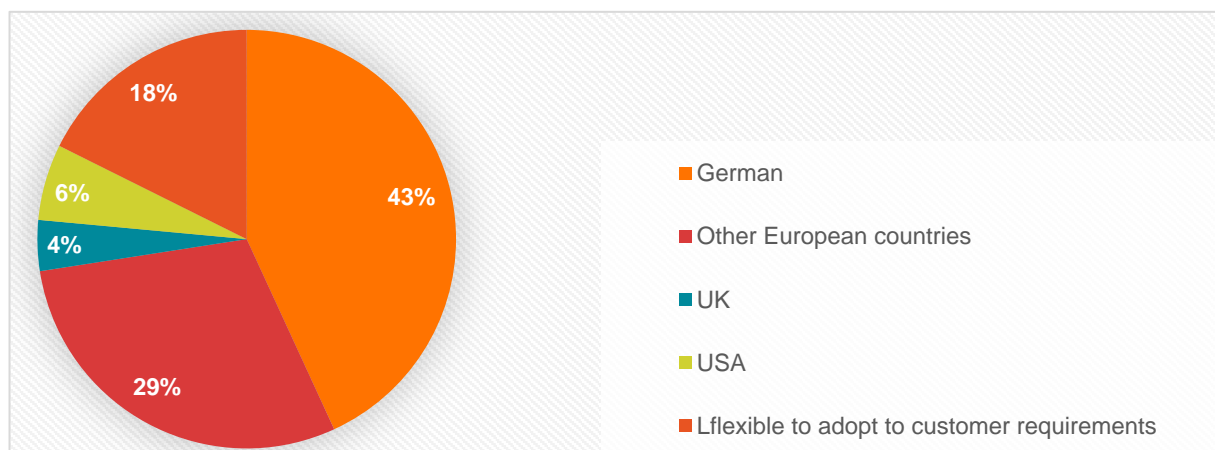
Main contractual basis national laws, proposed by suppliers (multiple countries per supplier possible)
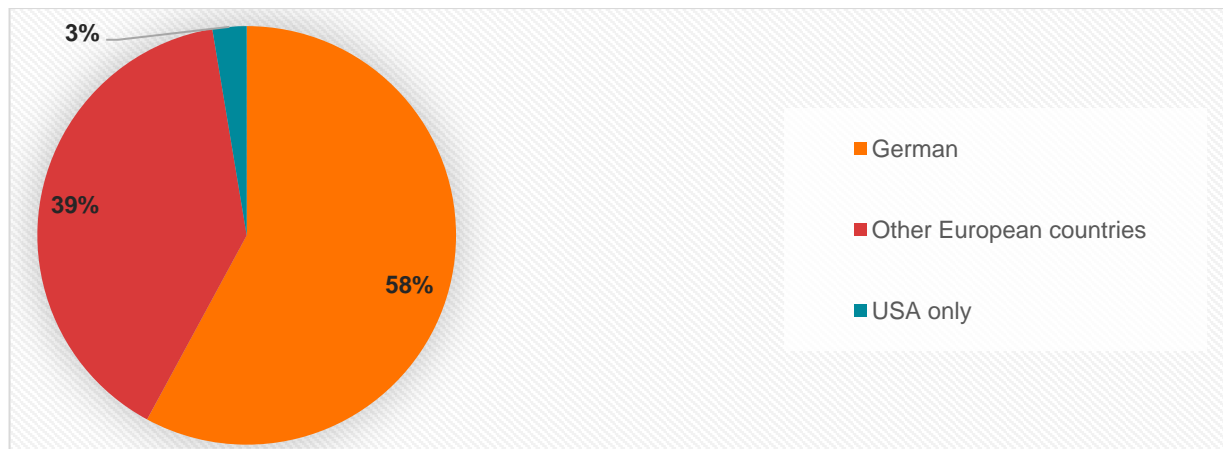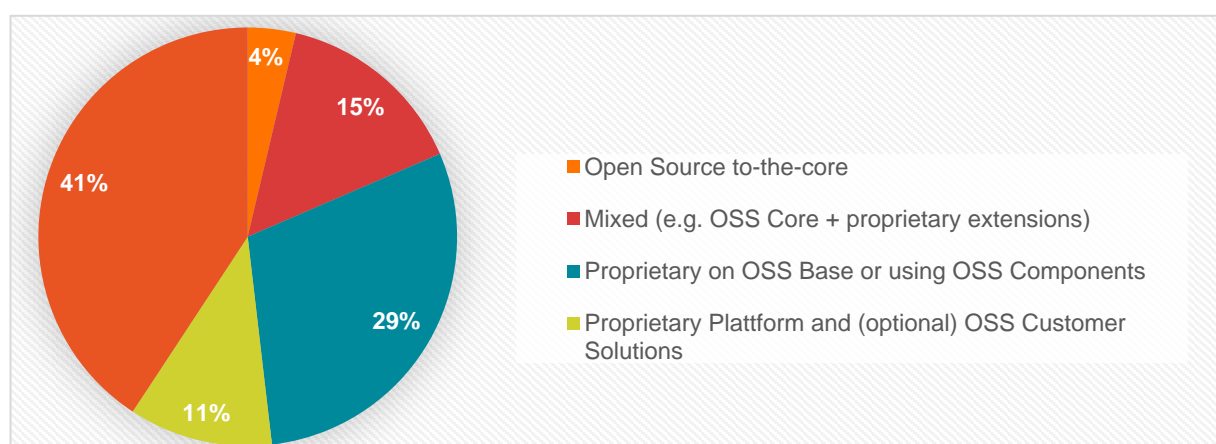
Main contractual basis national laws, proposed by suppliers (German, other European, and non-European-only)

Question [13]: If parts of MCCS NextGen are realized as open-source, which participation in open source and which governance of open source can the service provider accept?

Background: MCCS NextGen is building a community in which community partners (peers of 50Hertz, other users of platform or modules of MCCS NextGen, service providers, interested parties) can participate in the development of platform and modules. Parts of these developments, focusing on the platform and selected modules, will be shared within the community or publicly as open-source (commercial-friendly license, no copyleft). Other parts, expected to be mainly specialized technical modules, may persist as proprietary or closed source solutions.

Interests: 50Hertz would like to find out what the service providers' attitude is to open source participation, and what delimitations they demand from open source for their products and services. If the service providers are willing to participate in open source, 50Hertz is interested in what conditions the service providers place on the open-source model and governance.

- ■ Open Source to-the-core
- ■ Mixed (e.g. OSS Core + proprietary extensions)
- ■ Proprietary on OSS Base or using OSS Components
- ■ Proprietary Plattform and (optional) OSS Customer Solutions

Open Source and provider´s products (for 27 product providers)
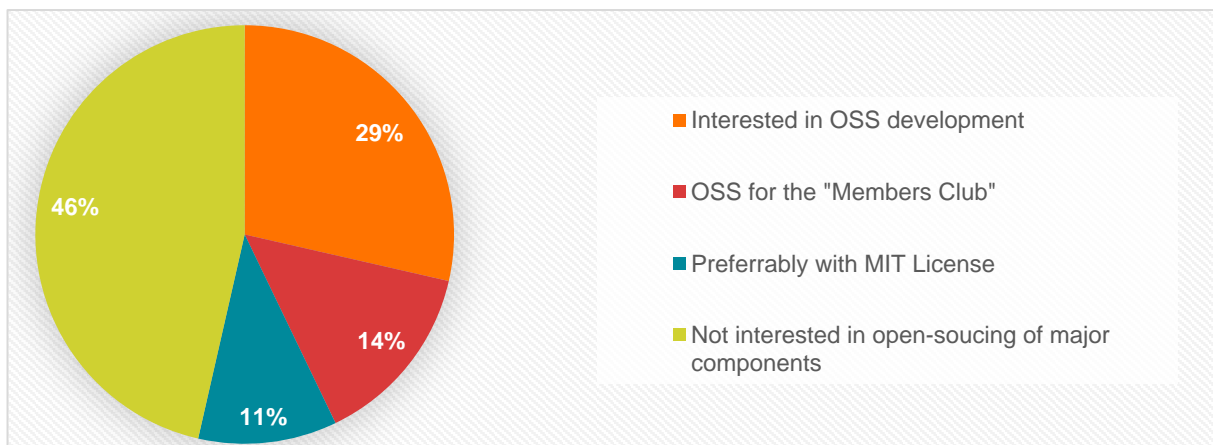
Summary of the answers:

Most of the vendors see the necessity to consider the topic of open source software (OSS) in their activity.

Based on the responses, which vary strongly in their content and formulation, it can be assumed, that the topic is not completely settled by most providers.

The interest and readiness to cooperate – especially in the case of customer-based extensions – are given. Readiness to share the code in an uncontrolled way is low, but to share it in some closed community (between "club members") is rather high.

Role of OOC in the system´s architecture (approx. 60% using open source vs. 40% developing completely proprietary / closed-source systems) corresponds well to the readiness of suppliers to participate in the project-based OOC development – here we see approx. 55% were interested vs 45% showing no interest to the topic.

Provider´s interest in Open Source product development (for 27 product providers)

Summary of the answers:

Part of the suppliers is still unsure about their position concerning OSS. A clear strategy from the customer side will be welcomed.

Conclusion – General assessment after market sounding

The market is in a state of upheaval and is moving towards a platform-driven and collaborative strategy.

Suppliers are refocusing on their core competencies, and the full coverage of all requirements at the same time is no longer the goal.

Many suppliers are looking for a coordinated strategy with customers because their strategy no longer sufficiently taps into the market. Harmonization in the market is therefore necessary.

Overall, it can be seen that the willingness for new technologies is growing, and plans for modularization and more flexible integration are well received.

This leads to an opening towards OSS, because (all) use OSS themselves – but established suppliers are hardly willing to provide their sources as OSS.

It is not to be expected that the vendors will come to a new standards and common architectures by themselves, and hence the new component-based market for utilities´ applications will be formed.

As also in case of other energy industry standards, joint activities of group of motivated utilities, with leading role of TSOs, will be necessary to establish the new set of standards for application modularization.

Those shall be based upon common and open standards, technological, modelling and architectural.