

Product Description

Landis+Gyr Converge 4.1



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1 | Introduction

For more than a century, Landis+Gyr is helping the world to manage energy better. Our meters and solutions empower utilities and end-customers around the world to improve their energy efficiency, reduce their energy costs and contribute to a sustainable use of resources.

As the largest global player in smart metering with one of the broadest portfolios in the industry, our products, solutions, and services empower utilities and consumers with the data necessary to make informed decisions about energy usage.

1.1 | Document Purpose

Purpose of Landis+Gyr Converge system description is to explain the application range, system structure, hardware and software requirements and the main functionalities of the system. The document also includes the information how to integrate Converge with other systems, what interfaces are being used and what are the main system modules.

The aim of this document is to support decision makers and sales personnel in choosing the right solution fitting their purpose and customer needs and tailored to a specific customer project.

The functionality described in this document may vary slightly depending on the type of release. This document describes Landis+Gyr Converge 4.1 vanilla version.

1.2 | Landis+Gyr Gridstream Solution

Gridstream Solution is a combination of technology and services that help utilities manage energy better. At Landis+Gyr, we have been investing in it and shaping its evolution in the global marketplace for more than a decade. Our unique suite of proven solutions encompasses big data, infrastructure, applications, and expertise, bringing intelligence to all levels of the utility universe. From generation, to distribution, to consumption, we provide the tools to address the challenges of today and tomorrow.

Gridstream is interoperable, expandable, and future proof – providing utilities with a solution that meets their specific needs and priorities. This offers utilities customers a modular approach to configure a tailored solution of products that work intelligently together.

Landis+Gyr Converge is an end-to-end software solution for industrial, commercial and grid energy companies. It covers the whole chain from data acquisition through meter data management, all the way to a flexible interfacing to 3rd party systems.

Landis+Gyr Converge 4.1 is the newest and innovated solution having extensive references from more than 130 customers on three continents. The Landis+Gyr Converge system can support meter reading and processes from electricity meters as well as gas meters, heat meters and water meters. The system offers flexible licensing model enabling tailor-made configuration according to specific customer needs.

1.3 | Benefits for Business Processes

Landis+Gyr Converge enables data from many different meters to be easily read, edited, processed, and passed to various market players. This type of processed data provides the basis for utilities to develop solid customer relationship and billing of services that they provide. Furthermore, Landis+Gyr Converge enables automatic acquisition of customer-specific data, and the production of clearly laid-out graphs, tables, reports, and tariff structures.

Key business benefits

- Extensive meters support enables independency of the meter vendor
- Genuine Landis+Gyr product delivered and supported by Landis+Gyr
- Proven system performance means low risk for decision maker
- Continuous product development to meet security, regulatory and operational needs
- Strong and proven references from more than 100 installations worldwide

Strong key features

- Implementation as HES only or as combined end-to-end system
- Automatic or manual data collection from ICG meters and smooth data transfer
- Communication technology agnostic solution also supporting a back-up line to maximize the success ratio of data acquisition
- Up to date in cybersecurity.
- Support of latest modern secure browsers (Google Chrome, Mozilla Firefox, Microsoft Edge, Apple Safari)
- User-friendly and modern UI
- Landis+Gyr and 3rd party device support: over 150-meter types supported from more than 40 different manufactures
- Supports of all major meter protocols
- High performance system handling large amounts of data and for meter simultaneous reading
- High scalability, from low hundreds to up to 1 000 000 metering points
- Supporting electricity, gas, heat/cold, water and oil devices
- Reliable Oracle database
- Easy and transparent support plan
- Flexibility for integration with third party systems
- Support of high availability solutions tailored exactly according to customer needs

1.4 | Licensing Model

Landis+Gyr Converge license model is very straightforward. Always provide the customers with only those components and services that are really needed for their business processes. Our system is based on modularity and allows to expand its size according to customer's growth in the future. Each customer is different, but our tailor-made solution is perfect for everyone.

The Landis+Gyr Converge solution can be purchased either as a licensed product (single payment) or SaaS option (recurring fee).

The key aspect of Landis+Gyr Converge system sizing is a Metering Point. The Metering Point is the main unit being used in the system. It defines system size as well as how the data are being organized. In a simple way Metering Point represents connected device. For one Metering Point Landis+Gyr Converge uses two data objects: “Virtual Meter” and “Container”. While Virtual Meter is always needed, the Container will only be appreciated by customers which require data processing.

On CUSTOMER side: Number of physically connected meters (devices) = number of **Metering Points**

On CONVERGE side: Number of meter definitions = number of **Virtual Meters**

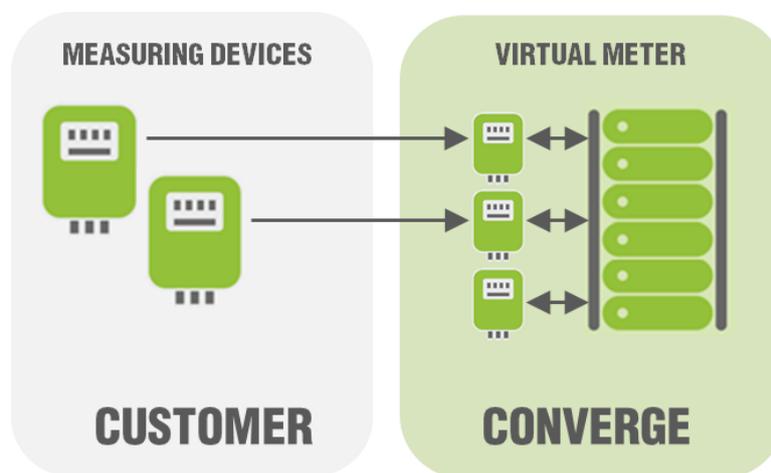


Figure 1: Landis+Gyr Converge Licensing

Typically, the ratio between the number of Metering Points and number of Virtual Meters is **1:1**.

For customer specific uses cases, additional Virtual Meters can also be ordered.

Basic License includes by default these functions:

- Acquisition of raw (original values) values, standardization, and storage
- Acquisition of load profile data, meter value status, billing data, and meter status/alarms
- Retrieving and setting meter time
- Automatic change of summer/winter season
- Communication statistics and diagnostics tools
- Viewing and configuring meter data
- One (1) named user account
- Data segmentation

- On the fly validation

for specific number of Virtual Meters.

Additionally, Customer can purchase other license components:

- Drivers for supported meters
- User management - which enables to increase number of named users defined in the system
- Active directory- which enables to synchronize users with company identity manager
- Tariff agreements - enables tariff rates to be defined and applied in the system
- Communication backup line - possibility to define back up communication path. This increases reliability by ensuring that the system can still access the meter in case of main communication path failure.
- Advance Validation – which is advanced validation module which enables different validation scenarios and automatic estimation definitions
- Export destination - definition of export destinations (such as web portal, SAP, Customer Defined Data Exchange)
- Redundant system – possibility to run HA cold standby / hot standby
- Calculation module - enables to execute automatic calculation for load profiles
- Smart functionalities - possibility to control device remotely (connect/disconnect), load limiter, TOU according to the specified parameters. Eligible only for the meters supporting this feature and having this feature implemented in Landis+Gyr Converge.
- IEC 61968-9 interface - support of IEC 9168-9 standards with communication to other systems
- Unlimited number of archive and calculation meters - archive and calculation meters can store data similarly like Virtual Meters but have limited functionality
- Converge mobile client (three performance levels)

Along with a license for productive environment, customer will get a license for TEST environment free of charge as standard.

Licenses for other environments:

For running standby or development environment, additional license key is needed.

1.5 | Landis+Gyr Life Cycle Policy

Landis+Gyr offers a wide range of advanced metering services, including turnkey deliveries and meter reading services according to your requirements. The software life cycle policy of Landis+Gyr guarantees maximum asset utilization and protects your investment. It is our commitment to support software version for the announced period. The software life cycle policy defines three different life cycle support phases with related support services:

- Active
- Extended
- Retired



After each product release, all previous versions are moved according to the rules. Customers are notified about being moved into the next phase and advised to upgrade their version to the latest one.

ACTIVE	EXTENDED	RETIRED
<ul style="list-style-type: none">• Actively sold and maintained• 1-2 years after the release (2 newest released versions)• Normal software maintenance• Correction of bugs• Software Update Subscription includes:<ul style="list-style-type: none">• New releases• Enhancement pack• Service packs• Patches & Hotfixes• Microsoft security updates tested and supported• 3rd party software updates	<ul style="list-style-type: none">• Maintained with limited support• Up to 4 years after the original released version<ul style="list-style-type: none">• (or 3 previous versions)• Correction of business critical issues• Software Update Subscription includes:<ul style="list-style-type: none">• New releases• Hotfixes	<ul style="list-style-type: none">• Support cannot be guaranteed• Subject to resource availability• Software updates available at request

Product life cycle phase changes are communicated in advance to the customers. Usually, six months prior to a new version release date

Active Mode - customers with valid service agreement are actively supported by Landis+Gyr. This phase is followed by the extended mode during which the software support timeline can last up to four years.

1.5.1 | Converge Life Cycle information

Landis+Gyr Converge life cycle policy specifies how long support will be available for the product, from when the product is available for purchase to when it is no longer supported.

The following table provides information about the current lifecycle policy. *The lifecycle policy may subject to change any time*, thus the information provided are only valid for the given release time. For up-to-date information contact a Landis+Gyr representative.

Landis+Gyr CZ SW LCP status valid from 02/2021			
Product	Active	Extended	Retired
Converge	4.1	4.0, 3.10*, 3.9**	3.8 and older

* Converge 3.10 to be retired by the end of CY22

** Converge 3.9 to be retired by the end of CY21

Landis+Gyr Converge software solution is continuously developed with new features, strengthened cybersecurity and operational robustness. To be up to date with cyber security demands and the latest standards Landis+Gyr customers are encouraged to always use the latest software versions.

1.6 | Converge Release Policy

There is usually one major general available (GA) release per year (12-month development cycle). For more information about the current releases contact a Landis+Gyr representative.

Landis+Gyr Converge development cycle is a subject to change at any time based on strategic decision of Landis+Gyr company and such change will be documented in updated in relevant product materials.

2 | Overview

System architecture allows integration with other solutions for the purpose of analysis and simulation of consumption behavior, or for energy consumption billing. Landis+Gyr Converge provides the basis for a powerful data warehouse system.

Landis+Gyr Converge is scalable and flexible system adaptable to your changing business processes, growing in steps according to your needs. With increasing competition, the demands and requirements of your large consumers also increase. Tariffs become transparent, services comparable, and the price-to-performance ratio becomes a decisive selling point.



Figure 1: Landis+Gyr Converge System Overview

Landis+Gyr Converge with its capacity up to 750 000 metering points is perfectly suitable from small (hundreds of MPs) to large-scale deployment of point-to-point smart metering projects. Variety of supported devices makes Landis+Gyr Converge one of the most flexible systems worldwide.

2.1 | System Architecture

Landis+Gyr Converge system structure is based on the three-tier architecture comprising the database tier, business logic (application) tier and user interface tier.

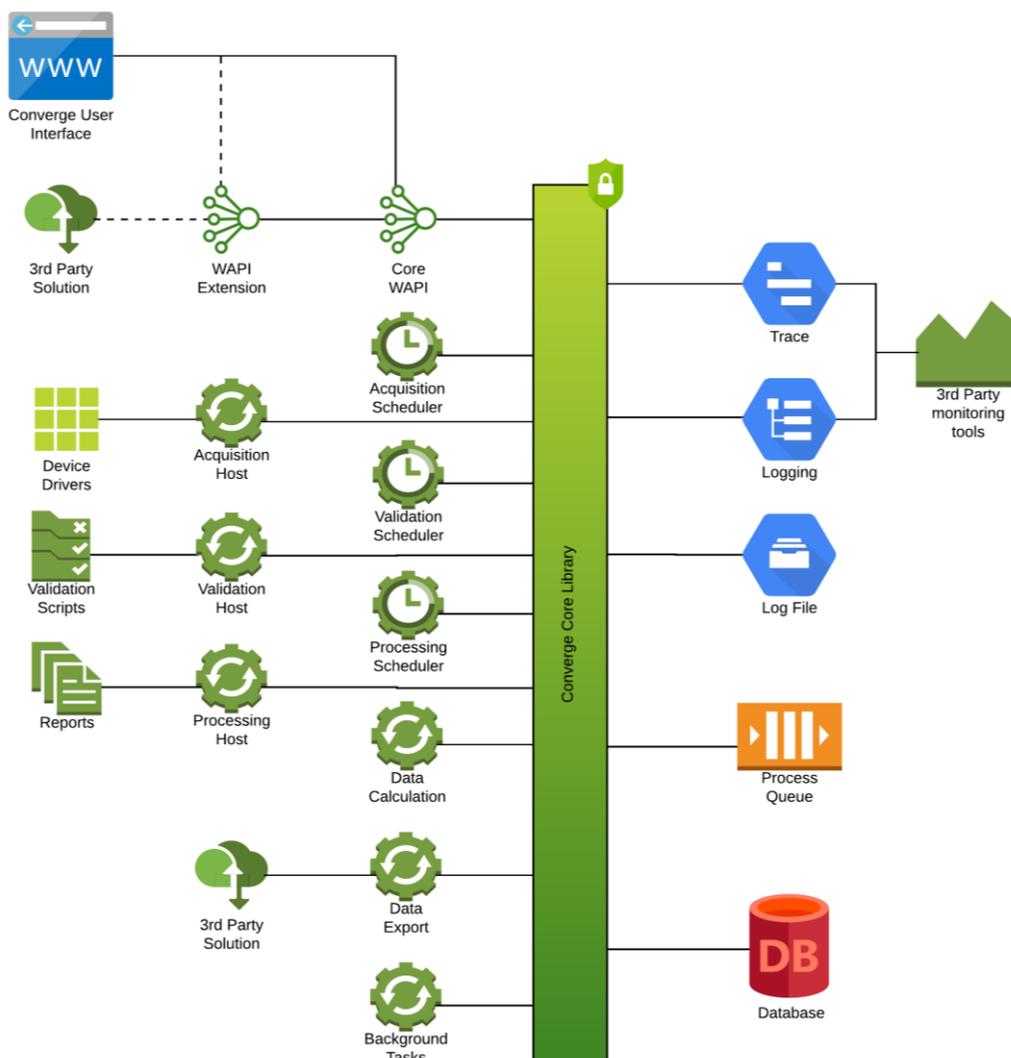


Figure 2: Landis+Gyr Converge architecture

2.1.1 | Database Layer

Database layer is based on SQL standard RDBMS system by Oracle. It can be operated on Windows or Linux environment. Database is designed for storing all data for Landis+Gyr Converge system.

Beside the main RDBMS database, there is a process queue component implemented on Advanced Message Queuing Protocol. It uses RabbitMQ message broker as the main event distribution, synchronization component.

2.1.2 | Security and Core Logic Layer

Security and core logic layer are implemented as a low-level library. The library is written as multiplatform in the Microsoft .NET Core framework. It provides database abstraction, contains low-

level caching, process queues abstractions and the core for whole system security. Other components use this layer so that the system is fully secured. This layer also implements abstract methods to enable tracing and logging interface to external systems.

2.1.3 | Business Logic Layer

Application layer is developed in the Microsoft .NET Core framework. All system services except data acquisition can be operated on various platforms. This layer is implemented by 8 services shown on the picture above. On top of those services there are custom validation scripts, reports and exports which use hosting services to provide scalability and cloud-like distributed performance.

2.1.4 | Web API Layer

This layer is implemented by secured Web API service based on the REST definition. This API supports custom plugins if custom API methods are necessary. The web API serves two purposes: It is the data interface for the web user interface and the also the interface for customer implementations.

2.1.5 | Web UI Layer

This layer provides user interface for the users in a web browser. Such solution enables users to have independent access from their location over intranet and/or internet. The Landis+Gyr Converge user interface does not contain any business logic. All data and business logic are secured by the lower system layers.

2.2 | System Scalability, Availability

A meter data management system is a central element for an energy company. It is used to model the business processes relevant to success. Therefore, the availability of such a system has a top priority. A high availability of the system is managed by VMWare vCenter HA cluster or Kubernetes. Version 4.0 introduced new possibilities of the distributed solution, where all part can be deployed with redundancies, including the user interface. Our team is experienced in solution design and can deploy variety of system configurations stating from simple all-in-one configuration up to multi-node configurations designed using high availability or disaster tolerant system patterns including geographical cluster pattern.

2.3 | Basic Features

Landis+Gyr Converge focuses on user experience, performance, and effectiveness. It is achieved thanks to its progressive design, optimized database model and improved graphical user interface.

2.3.1 | User Interface

The user interface is developed based on the User Experience Design Process (UED process). The UI was designed as an extended 3-pane view, giving the user the ability to see all the details and relevant information on a single screen. Breadcrumb bar and hierarchy tree allow for a quicker navigation in the system and greater user location awareness. The standard design is extended by the quick navigation bar on the right side. Furthermore, the menu and the navigation bar can be collapsed so

that the screen contains as much information as possible. The main content and the detail of the 3-pane view is in some cases merged to provide user as much space for the content as possible, for example meter data screen or screens with long objects lists like all devices.

Creation of new objects is simplified via the use of creation wizards. The wizard helps the user to make their work easier and faster. User only enter the required information into the wizard to create all related definitions in a single window. The overall process of creating new objects is streamlined, fast and intuitive.

2.3.2 | Dashboard

Landis+Gyr Converge includes dashboards which are made of different widgets. Widgets can be configured as graphs, tables, or external links. Different widgets can be shown based on user needs and content, size and location are user configurable.

2.3.3 | Searching and Filtering

Landis+Gyr Converge enables to search objects in the system according to different parameters and the results can be subsequently filtered and sorted. Advanced filters can be applied on multiple columns and sorting by multiple columns is also available. Results can be easily exported to Excel spreadsheet by just a single click.

The simplified functionality called Quick Search provides the possibility to search easily in data acquisition and data processing module. Out of box search attributes are:

- Object Name.
- Note (Virtual Meter, Meter, Communication Path objects).
- IP Address or Phone Number.
- Identifiers Serial Number, Metering Code or ENTSO-EIC.

2.3.4 | Localization

Landis+Gyr Converge supports multilanguage GUI. The default language is English. Localization into other languages can be done on request.

For more information about localization of Landis+Gyr Converge ask your local sales contact.

2.3.5 | Time Zone Support

Application enables data processing in different time zones including summertime. Raw values are always stored in UTC format and subsequently converted according to customer settings.

2.3.6 | Input check

Landis+Gyr Converge includes user data input validation (such as check for mandatory fields, value ranges, data types and more) and provides immediate feedback to the user.

A field with invalid input is marked and a hint providing detailed information about the invalid input is displayed on hovering over the hint icon. This feature addresses user experience in doing daily tasks. Its purpose is to assist the user and to provide valid input with minimum effort and to make the process of entering or changing definitions easier and more intuitive.

2.3.7 | Data Consistency and Integrity

Landis+Gyr Converge ensures data consistency by strictly doing all the database modifications in transactions. This ensures that either all changes are written to the database or none of them.

The Landis+Gyr Converge system contains data integrity and uniqueness of names by introducing unique name constraints. Any name of any definition of any type must be unique in its context. This is guaranteed at the database level, effectively preventing data corruption and duplicity in names.

2.3.8 | Audit

If changes are made to an object attributes the change is stored in the audit log. The information stored in the audit log includes:

- the time the change was made,
- the type of change,
- the identification who made the change,
- the attribute name, old and new value of the attribute

and can be shown on object level or in dedicated audit log page, where all changes are listed.

2.3.9 | Documentation and Context Help

The Landis+Gyr Converge user manual is currently available only as PDF file. Full Landis+Gyr Converge system documentation package is delivered within the project as a part of installation package and contains:

- Release Notes
- Installation Guides
- Administration Guide
- User Manual

Specific technical guides can be provided by Landis+Gyr customer support department on request.

2.3.10 | Application Customization

Customizations of the system are now even more flexible. There are three key pillars allowing easy customizations:

- Templates are important components of Landis+Gyr Converge system. The entire business structure is based upon already existing templates. A library of standard templates is ready to be modified according to user requirements.
- New rest API concept allows to implement safe and flexible interface towards 3rd party systems.
- Universal view feature allows to show any kind of data in UI without development, such a view can be prepared quickly by the implementation team.

3 | Converge Data Acquisition

The software supports wide range of communication methods which ensures fast, secure, and cost-efficient data acquisition. Data acquisition functions include automatic and on demand data collection (including data import from other sources such as hand-held terminals), original data secured fully audited storage.

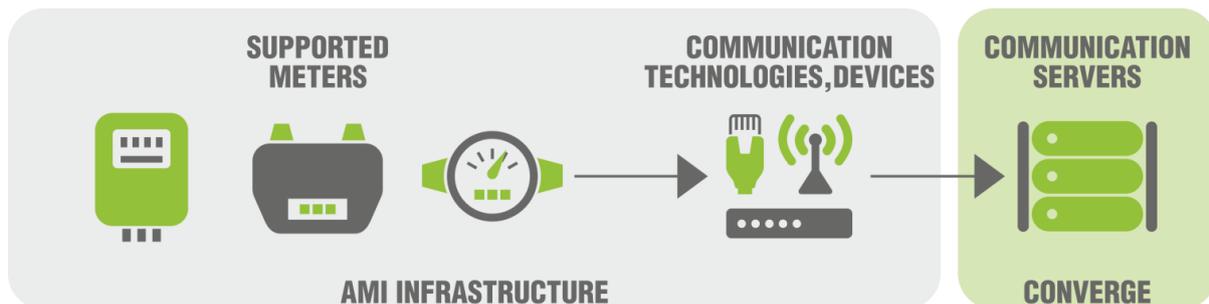


Figure 3: Basic AMI communication architecture

Landis+Gyr Converge contains definitions for connection with AMI infrastructure. Communication is provided through communication services. Services are running on designed number of acquisition servers. The number of acquisition servers is dependent on the number of metering points, data volume and the read-out frequency.

IMPORTANT: In case of multi-server installation, please always consult required hardware and software configuration with Landis+Gyr beforehand.

3.1 | Supported Devices

Landis+Gyr Converge supports a wide range of commercial and industrial meters, grid meters, residential meters, terminal units and concentrators, repeaters, modems, and routers. In addition, the system offers interoperability with third-party meters. System compatibility allows the devices to be controlled remotely through the Landis+Gyr Converge system.

The system currently supports over 150 meters and data concentrators from many different vendors, using a wide range of communication protocols i.e., DLMS/COSEM, IDIS, VDEW, ANSII, MODBUS, SCTM as well as another 23. The support extends to electricity, gas, water, and heat/cold metering.

While most of the drivers support basic features (Load Profiles, Instant Values, Historical Values, Event Logs, Time Operations, etc.) there are some devices enabling customers to use extra device functionalities (Relay Control, Connect/Disconnect, TOU upload, DIP tables, etc.).

The development of meter protocols is an ongoing process. Therefore, the Supported Devices list should not be considered complete and final. Landis+Gyr implements new protocols and meter types on a project-by-project basis and on demand.

For the most up to date information, please ask for Landis+Gyr Converge Supported Devices list from your local sales contact.

3.2 | Communication Technologies

Wide range of communication technologies are supported in Landis+Gyr Converge.

Serial Communication:

- TCP/IP GPRS (Static IP address)
- TCP/IP LAN/WAN
- GSM
- PSTN
- MODBUS
- Serial Line/Leased Line
- GPRS

IMPORTANT: In case of VoIP, it is recommended to consult all technical requirements with the respective VoIP provider in advance. In case of GPRS, meter command limitation for specific meters might exist. Please check with Landis+Gyr for further details.

3.2.1 | Backup Line

Landis+Gyr Converge can access the meter data via a variety of communication paths. The communication paths are defined within the system. Additionally, it is possible to define for each meter an alternative communication path to be automatically used if the main communication path fails. This increases reliability by ensuring that the system can still access the meter data in case of failure of a communication path for any reason.

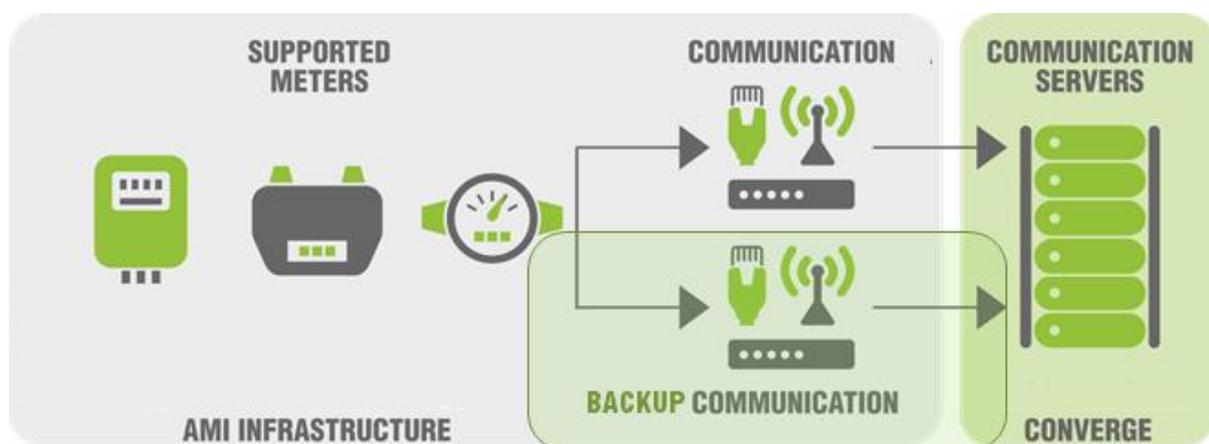


Figure 4: Communication Back Up line

3.3 | Data collection and Meter Management

Remote acquisition of metering data is done using AMI infrastructure.

Converge system includes the following functions:

- Reading of load profile data, billing data, instantaneous data
- Reading of meter status and events
- Reading and setting meter time
- Reading and resetting DIP Table
- Synchronizing control center and meter time (Set DST Parameters)
- Handling daylight saving time start and end
- Managing TOU in meters
- Disconnect operation and relay control
- Upgrading FW of selected devices
- Data calculation
- Viewing and configuring meter data
- Communication diagnostics and maintenance

Based on the communication protocol and physical meter parametrization you can use passwords to access the meter.

3.3.1 | Scheduled Jobs

Typically, metering data such as load profiles and daily profiles are acquired on daily basis. Some metering data such as billing values even on prolonged intervals like weeks and months. However, as the infrastructure and the demand for information increases so do the requirements of our customers.

Currently, the Landis+Gyr Converge system natively supports a vast range of acquisition periods (daily values, hourly values, 15-minute values, 10-minute values, 5-minute values, 1-minute values). The shorter the integration period the higher are the requirements for the server and meter hardware performance.

Standard automatic scheduled jobs are fully supported by Landis+Gyr Converge. Users may choose which data (meter variables) from which meters and/or meter groups they want to acquire (load profiles, billing values etc.) and at what intervals (hourly, daily, every other Monday etc.)

3.3.2 | On-demand Jobs

On-demand jobs are also natively supported by the system. On-demand jobs enable various meter actions to be executed ad hoc. The actions can be used by system users to test the functioning of a meter installation, acquire initial/final read during meter replacement, change TOU, connect or disconnect meter etc. On-demand jobs may be executed for a group of meters or for a single meter.

Service of On-demand Jobs is also available from integration subsystem. This concept allows flexibility of process-oriented integration.

3.3.3 | Task Prioritization

All data acquisition tasks are pushed into a queue. The queue is sorted based on each tasks priority and then pushed further to the acquisition servers. Figure 5 describes the priority levels.

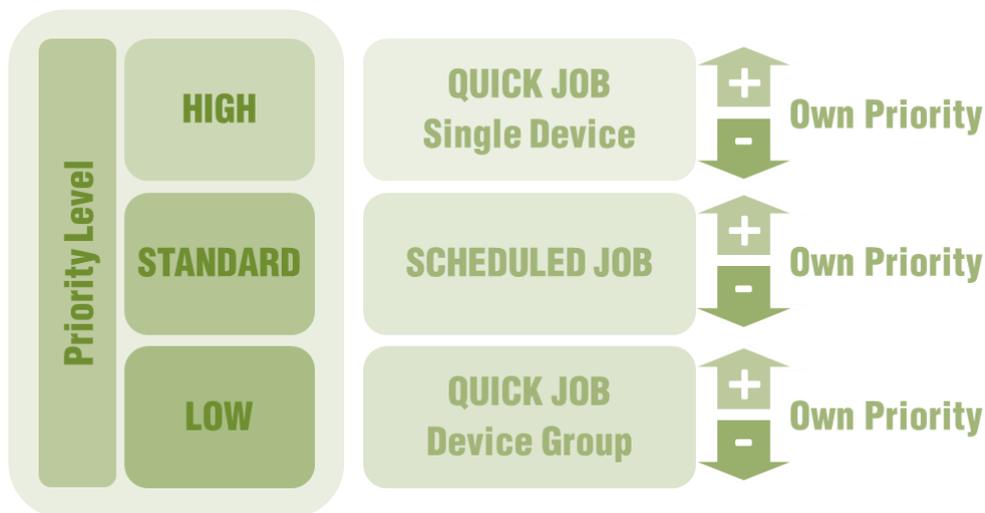


Figure 5: Acquisition Job Prioritization

- Task priority (higher priority goes first),
- Number of attempts (initial attempts first, then repetitions)
- Age (older items first).

On-demand meter reading initiated by the user (Quick job) is processed immediately. On the other hand, user-initiated tasks of large meter groups are prevented from overloading the system and blocking scheduled tasks.

Queue sorting and job prioritization allows effective utilization of available communication lines (direct lines, modems, TCP/IP sockets).

Each acquisition job may be assigned its own priority. This gives users the ability to prioritize / deprioritize given tasks.

3.3.4 | Task Error Handling

If during a meter group acquisition process a repeated error occurs, then an error group is automatically created by the system. This group only contains meters which failed to acquire data in the previous task. The same job can be repeated on the error group to acquire the missing data. This function provides for a quick and efficient response to communication errors.

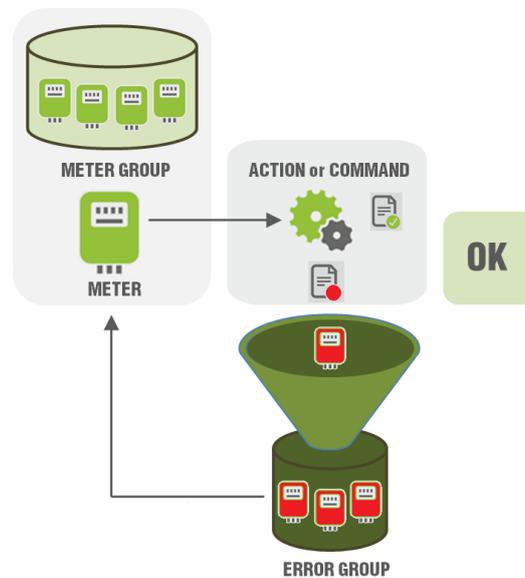


Figure 6: Task Error Handling

During the processing of the time sync command of a meter group which returns an error, a time synchronization error group is created. The error group can be scheduled later or executed manually, when only the meters which returned an error will be re-acquired.

3.3.5 | Debug Log

Data acquisition debug logs are essential in resolving issues related to meter readings. Debug logs allow users to get comprehensive set of information about a meter reading or other communication they consider as suspicious or problematic and send it to customer support center to be analyzed.

3.3.6 | Communication Statistics

The communication statistics provide a means to monitor any communication equipment over time. The statistical data enables the user to learn more about the quality of modems, communication lines, etc. This allows the operator to improve communications in the long term. Statistics can be exported to Excel format.

Statistical data is gathered at the following levels:

- Summary
- Virtual Meter
- Communication Device
- Communication Path

3.3.7 | Transaction monitoring

The acquisition transactions page enables all scheduled and manually started (Quick Job) acquisition jobs to be displayed. The information is listed according to the time when the transaction was initiated. It also shows the progress of each task.

The acquisition job processing is logged. The individual actions can be sorted hierarchically and presented for each job. This provides a quick overview of events that have already been processed or are still on-going.

Operators can make their decision based on the information presented in the transaction log. The communication problem solving is easy. The detail communications level shows communication error messages and links for the verbose debug logs. All transactions are grouped by tasks and launch dates. The user can expand a group and check the information under the various levels. The monitor also allows displaying percentage success of each job and task.

3.3.8 | Normalized Data

Raw data represents measured data as produced by a meter, processed, and stored in a remote terminal unit or tariff device and transferred as instantaneous values, daily values, or load profiles to the central station. Those data are stored in the system without possibility to be modified by the user or regular processes.

Pulse value matching (PVM) is used for calculating normalized values from raw values. It enables raw values from different sources to be unified so that individual conversion or interpretation of the results is not necessary for further processing. The raw value is evaluated with the selected criteria and presented as a normalized value. Normalized data may be overwritten by substitute values which are then processed by the central station. Typical example is unit transfer i.e., from W to kW, conversion from average demand to energy etc. Created formulas can be assigned to both single device as well as to groups of meters.

3.3.9 | Data Calculation

Data Calculation Tool is a Landis+Gyr Converge module used for calculation of load profiles. Calculations can contain different time series and mathematical functions. Result can be used as a source for further processing.

Calculations can be used to cover the following business cases:

- Data aggregation and summarization
- Balance calculation of substation (calculate imports and exports)
- Main/Check meter calculation
- Reactive energy billing
- And more custom business cases

CALCULATION FORMULA

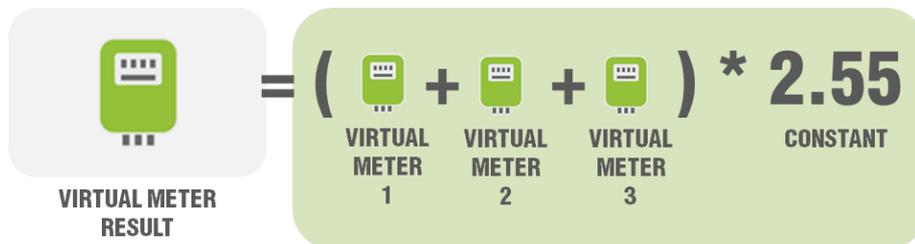


Figure 7: Example of Data Calculation Formula

3.3.10 | Data view and check

The acquired and stored metering data can be directly visualized by simple means using the meter data function. The function provides tool for flexible selection of the data objects to be presented (load profiles, billing data) as raw values and normalized values, including supplementary information (units, status) and time spans (from...to, day, month, week, year). They are displayed in tabular or graphical form.

Meter data tool allows also filtering of selected data based on specific status filters.

The function also provides a simple method for entering substitute values for individual values or entire time spans. Commands are provided for loading and storing data and copying and pasting selected values. Values that have already been corrected can be regenerated from the raw values using the recalculate function. Viewed report data can be recalculated from raw data here. On top of it, meter data dialog provides access to see and work with audit record of displayed values.

3.3.11 | Snapshot function

In Landis+Gyr Converge, acquired load profile data is never deleted. As soon as a load profile is to be overwritten, for example through a substitution of values or through data validation, the old values are stored into a history with additional auditing information (user, reason, comment).

The user has the possibility to reconstruct values of the load profile data as stored in specified time in system. Reconstructed values may be marked as currently valid.

3.4 | Meter Data Import

Landis+Gyr Converge supports to implement meter data import from common data formats (JSON, XML, etc.) The customer is required to provide all necessary data format specification.

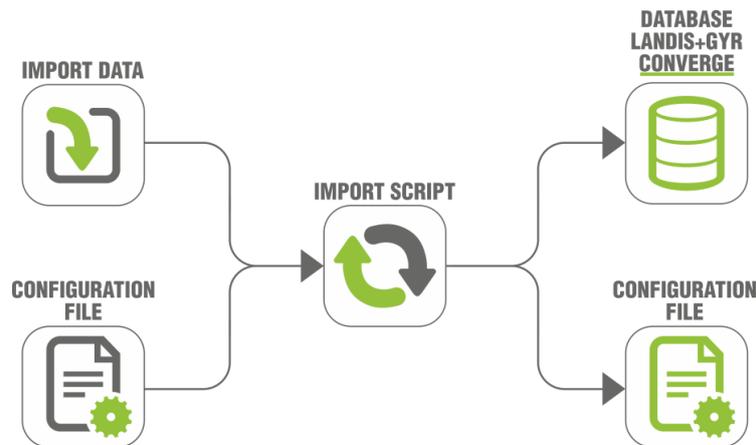


Figure 8: Data Import Structure

3.5 | Manual On-Site Readout

In areas with unreliable communications, it can occasionally be necessary to read data from meters using a handheld device. This emergency readout is a separate application for devices with the Android OS. Data read on-site are automatically transmitted to the system and stored there as read values into the system database.

3.6 | Meter Data Export

The Converge Export module provide for export of metering data (load profile data and/ or billing values) to external systems. Possible formats are text, XML, json, Binary over file share, SOAP or REST service.

For more information about data export and data exchange please refer to Chapter 6 | System Integration.

3.7 | Supported Features

3.7.1 | OBIS Code Support

The acquired metering data is initially buffered in Landis+Gyr Converge in raw value form. Many different identification code systems have historically been applied to IEC1107 billing data. The OBIS system has largely been accepted today.

Therefore, when saving raw data in the database, all values are normalized to OBIS code and saved as normalized values in a common format. The normalized values are then used for further processing.

3.7.2 | Metering Code Support (ENTSO-E EIC)

Two different identification methods have become established in Europe. Either there is an identification of the metering point via the Metering Code and OBIS identification code, or an identification of the load profile via the European Article Number (EAN).

Landis+Gyr Converge supports both methods consistently. Both the EAN and the Metering Code can be assigned at the metering point hierarchical level. EAN and Metering Code are available as identifiers for further processing and especially for data exchange.

4 | Converge Data Processing

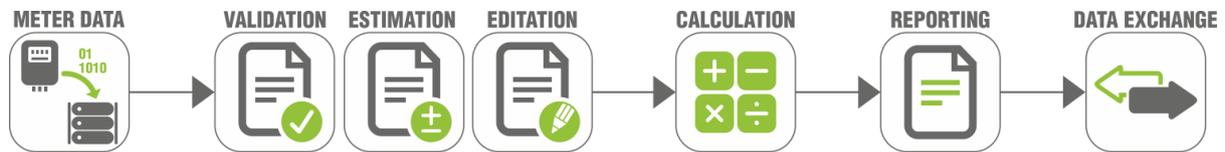


Figure 9: Meter Data Management Process

4.1 | Business Structure Management

The consumer tree enables to create multi-level hierarchy structure. Each object in the structure can contains custom specific attributes based on defined templates. The predefined templates can be modified or added with new customer attributes. Several templates can be used within one structure (according to product type, customer size, etc.).

Attributes defined in templates can be subsequently used for data processing, especially for reporting or billing creation directly from Landis+Gyr Converge. All objects contain validity controlled against the parent objects.

The consumer tree management has the following actions for each branch: enable/disable, copy, move and delete, according to user's permission rights. By this solution, all hierarchic models of customer structures or topologies can be covered.

The top node level contains only one object representing the top node of the whole structure. It is an abstractive object.

The top node and the sublevels describe distribution structure or network topology. For example, according to the location – country / region / local area..., etc. The consumer level represents the owner of consumption point or meter point.

The contract level is for physical consumption point or meter point. There can one or more contracts for one consumer. The object contract enables to connect to the data meter source.

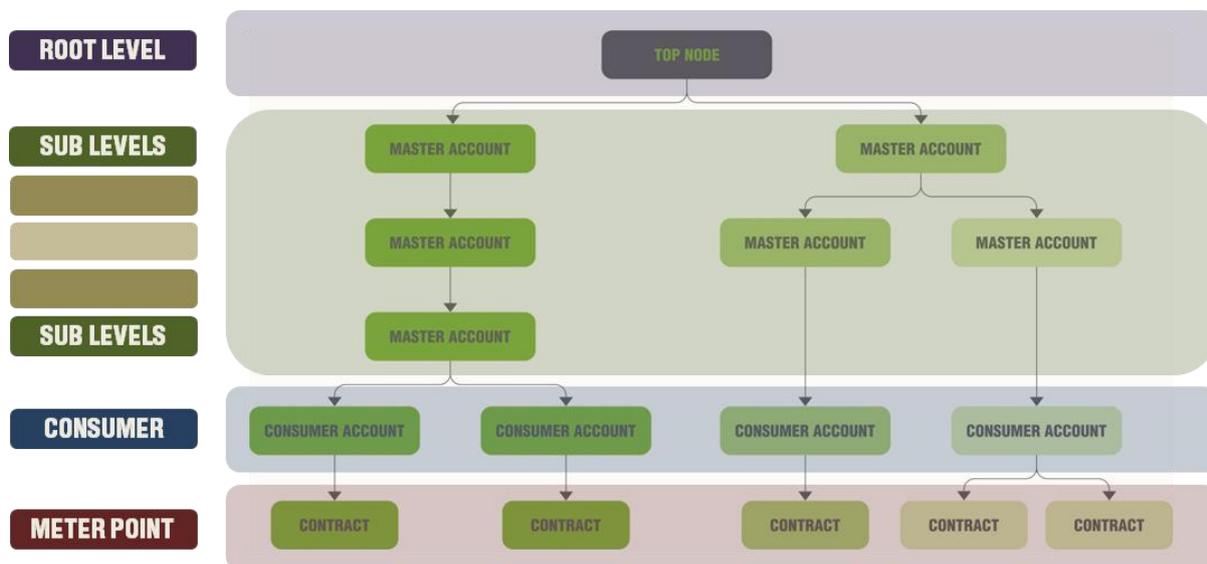


Figure 10: Business Structure Management Example

4.2 | Data Segmentation

Data segmentation enables the consumer tree to be divided according to defined data segments. This can be used for both protection and convenience by limiting user access to a defined data segment or segments.

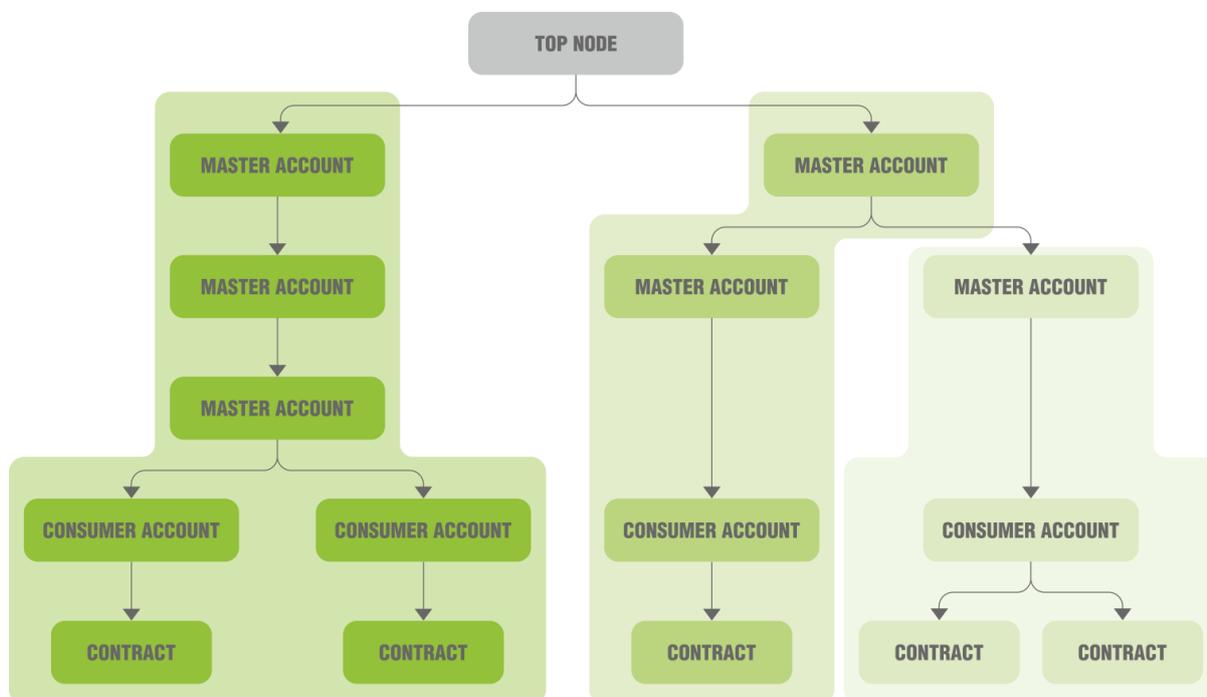


Figure 11: Data Segmentation

There is no limit to the number of data segments defined, and they can be renamed if desired.

Typical data segmentation could be according to:

- Product e.g., Electricity, Water, Gas, District Heating
- Region e.g., North, South, East, West
- Application Area e.g., Commercial, Industrial, Grid
- Distribution Area e.g., Central Belt, Highlands & Islands, Galloway, The Borders

4.3 | Validation, Estimation and Editing

Data validation is usually necessary, because only verified data can be passed to other partners on the energy market. Landis+Gyr Converge provides comprehensive data validation, estimation, and editing (VEE). If the data is incorrect or incomplete, the system can automatically fill in the gap with a substitute value using various algorithms.

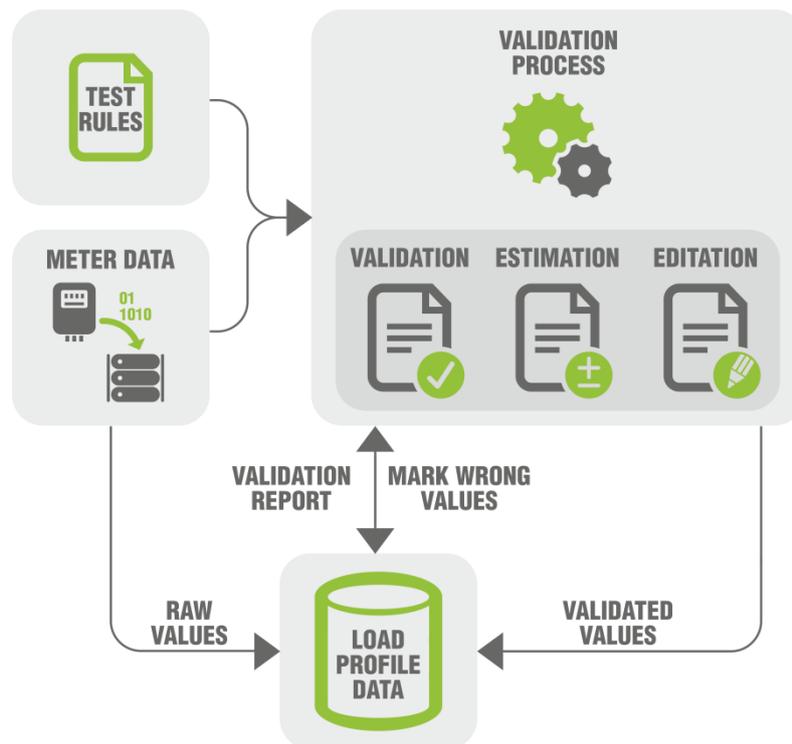


Figure 12: Concept of Data Validation

The validation in Converge has two modules:

- On the Fly Validation (default)
- Advanced Validation (license needed)

4.3.1 | On the Fly Validation



The standard limit check is performed when new data are acquired. This validation marks invalid values, which fall outside the specified range. This is a very simple but also very powerful tool sometimes referred to as technical validation. This type of validation is available as out of the box functionality, which can be used by user immediately after the solution is deployed.

4.3.2 | Advanced Validation



The data validation module permits acquired data to be checked for plausibility/validity according to the complex criteria considering different types criteria:

- Gaps in the acquired data
- Checks on status bits
- Main/check comparison
- Hierarchical comparison against data acquired in other ways

Validation scripts are customer specific and are developed separately according to the requirements based upon local legislative laws. Following advanced validation scripts are shown as example for what is possible to define in the system.

Register Comparison:

For devices which are driven by metering pulses, there is no possibility for a direct check between the sum of the load profile values and the actual meter register. Using this function, meter readings taken by the meter reader can be entered into the system periodically (e.g., once per month/year) and the system checks that the difference between the sum of the load profile readings and two manual register readings is within a defined tolerance.

Register Construction:

There is sometimes a need to re-construct a meter register value from the sum of the load profile readings, e.g., to include the register reading in an invoice for energy supply. This can be required if a meter only provides load profile values without delivering the actual register value. Using this function, an initial register value is entered with its date and time, and from that time register values are calculated periodically.

Combination function:

Examples of combining these two functions are: Make a monthly register comparison in the first week of each month and calculate the register values for the end of the month. Calculate the constructed register values each month and make a register comparison once a year.

Estimation and Editing

Based upon these checks, a substitution strategy can be implemented from the following possibilities:

- No substitution
- Insert null values
- Insert last plausible value
- Insert mean value
- Interpolate between values
- Hierarchical comparison: Insert the first plausible value in the hierarchy

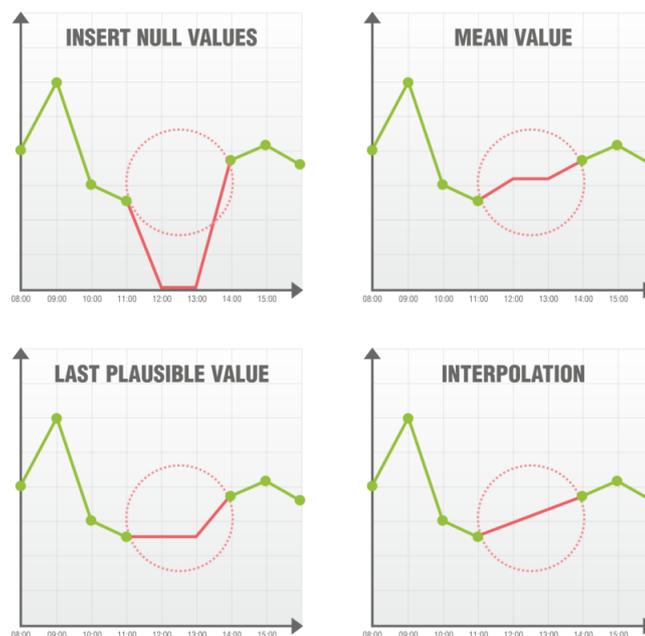


Figure 13: Estimation Strategies

4.4 | Tariff Management

A tariff governs the charges made for the supply of energy over a specified time. In many applications, the tariff rate applied depends on the time of day and if the day is a working day, weekend, holiday, or special day. Additionally, tariff rates applied in the summer are often different to those applied during winter.

The tariff definitions are ready for users via TOU tables functionality and can be used for data reporting, preparation of data exports and as the source of TOU tables for physical devices if supported by the given meter.

4.5 | Calculation

A Calculation process can calculate data from acquisition part of the system and the results can be used in other calculations and reports. A Calculation takes data values from input sources then produces new data.

From Converge 4.0 onwards, Microsoft Excel is not used to perform calculations.

4.6 | Reporting

A report takes data from various input sources and generates an output. It is also possible to execute a report without generating an output, e.g., when testing.

Reports can be published on the screen, send via email, or stored as data files on the UNC path of server file system, as desired. After selecting the output device for the report, it is also possible to select output format and/or output destination, dependent on the type of output device.

Reports can contain tables, graphics, and all features of a standard Excel spreadsheet.

Reports vary from customer to customer and are prepared during the system installation project according to the Scope of work (SoW).

4.7 | Scheduled Jobs

Scheduled events define the execution time and recurrence of an active element. This enables calculation chains to be initiated, on the completion of data acquisition, for example. These scheduled events are collected and are used by the scheduler for constructing the daily schedule and tasks to be processed.

Each scheduled event contains:

- A calendar that determines when to execute the associated active element. This includes start time and end time (window of opportunity) and periodicity of recurrence. It is also possible to make exceptions within the recurrence.
- Text runtime parameters, e.g., Automatic data range calculation that determines which data is used when executing the scheduled event. This can be different from when the scheduled event is scheduled to run, e.g., a weekly report scheduled to run every Monday at 06:00 could use data acquired the previous week. Another example of a runtime parameter is output device that determines on which device a report is to be output, e.g., e-mail.

5 | Converge Administration

5.1 | System Parameters

System parameters enable to alter some of the functionality. Such as password policies, data acquisition settings, and other system wide behavior.

5.1.1 | Password Policy

Users are required to login to the application with a unique username and password. User authentication is performed by the application. Expiration and complexity rules for passwords are configurable.

The global parameters for password processing are entered here:

- Maximum number of incorrect logins before the access is blocked
- Expiry interval: The time after which password expires if automatic expiry has been defined for a user
- Notification interval: The time before password expiry for a warning message to the user
- Minimum password length: Number of characters
- History depth: When entering a new password, the user cannot reuse any password which is present in the history
- Character complexity simple or complex

Character complexity simple

- The password may not contain the whole account name of the user (upper and lower case are taken into consideration).

Character complexity complex

- The password may not contain the whole account name of the user (upper and lower case are taken into consideration).
- The password must contain characters from at least three of the following four categories:
 - Upper-case characters
 - Lower-case characters
 - Numbers 0 to 9
 - Non-alphanumeric characters (e.g. \$, #, %)

If Active Directory feature is used instead of self-authentication none of the above is applicable.

5.2 | Users and Access Management

5.2.1 | Users

User management module enables users and user attributes to be created and managed. Each user is assigned a password and an access group. Other user attributes, e.g., access to data segments and entering a user e-mail address are optional. The permitted number of named users is determined by the license. All login credentials details are encrypted and stored in the database. By default, Landis+Gyr Converge is delivered licensed for certain number of named users.

User Profile – some user's attributes, e.g., password, current segment, time zone etc. can be edited or changed directly by the users.

5.2.2 | Roles

The Landis+Gyr Converge roles provides possibility to define permission groups, which can be assigned to the users. All system features are listed, and access can be granted for the view, change, create and delete operations. There is no limit to the number of roles defined and they can be renamed if desired.

For each role can be set up their own sets of permissions. There are several types (view only, create, edit, and delete) of permissions for objects and control types (enable, disable) for functions and actions. There are dependencies between types. For permission Delete you need also view, create, and edit.

5.2.3 | Active directory

Landis+Gyr Converge supports authentication with Active Directory (license for Active Directory is needed). If the solution is delivered in this mode, license for named users is omitted.

5.3 | Template Management

All Landis+Gyr Converge elements are created using existing templates. A library of standard templates is included in the basic license.

Templates are used to create all business structure related elements. The advantage of using templates and its instances is flexibility in storing, presenting, and utilizing customer specific attributes of each business entity used in system data model. This is a powerful instrument for the creation and maintenance of large amounts of customer information.

When an element is created, the information from the template, i.e., the attributes and active element templates it contains, are copied to the container. Certain information can be modified according to definable rules on creation of an element. However, the relationship to the element template is retained. This provides for updating of elements information when a template is modified.

6 | System Integration

A traditional task of the system integration is to integrate Landis+Gyr Converge with other Landis+Gyr or third-party systems.

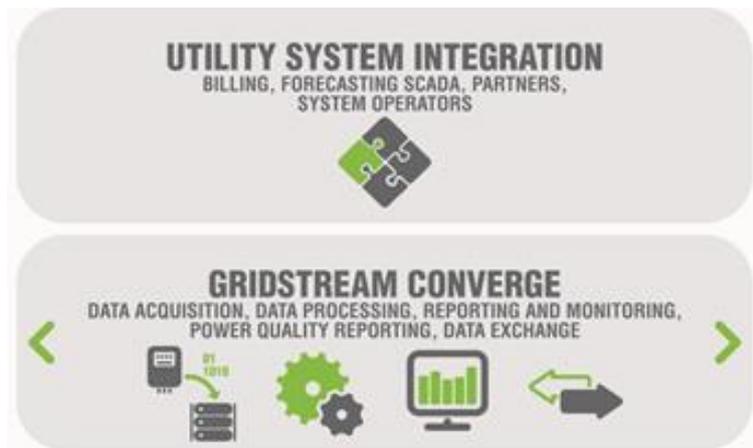


Figure 15: System Integration

6.1 | Data Exchange

Exchange of the data between Landis+Gyr Converge solution and any third-party solution can be done in several different ways and it is a matter of the discussion during the project scope definition. The standard out of the box interface is Core WAPI represented by REST API. If the end user would like to use the REST API, it is possible to do so by defining new user dedicated interface.

The REST API can provide any data stored in the Landis+Gyr Converge in the JSON format. It is not recommended to use this interface for the big data transfers. If there is requirement to transfer large amounts of data (import or export) it is necessary to design a specific solution.

The interfaces can be split basically in several groups:

- By transfer direction:
 - Import
 - Export – triggered by Landis+Gyr Converge processes or on request
 - Bi-directional
- By format of transferred data:
 - XML – Standard IEC 61968-9 or any custom XML format
 - JSON – out of the box Core WAPI or any custom XML format
 - text
- By amount of transferred data

Standard IEC 61968-9 is the exchange definition of information between a metering system and other systems within the utility enterprise.

Landis+Gyr Converge enables the following tasks in data collection:

- Data and status collection, obtained through either manual or automated means, on a scheduled or on-request basis.
- Transmission of meter data and status to a meter data management system.
- Transmission of power reliability and quality event data to outage management, network operations, and capacity planning systems.

Transmission of communication network health information to those responsible for maintaining the communications network.

7 | Services

7.1 | Consulting

Our consultants provide support for the analysis and optimization of your processes in the meter system integration field. Structured documentation of the results (situation & process analysis) is provided.

7.1.1 | Workshops

Our consulting service comes in the form of one or more workshops in which the participants learn about the functionality and operation of a modern metering data acquisition and processing system.

The workshop offers participants the following:

- Cost-effective definition of the requirements for their pending investment
- Independent determination and assessment of the necessity of variations to a standard system help to avoid expensive system adaptations.
- Detailed functional knowledge provides for efficient, fact-based creation of a performance specification for tendering.
- Expert knowledge to evaluate the different system offers and to decide on a system that is optimal for your requirements
- The project expense becomes tangible, and the risk is reduced.
- The workshop offers you a cost and time-optimized way to make the right investment decisions.

7.1.2 | System Integration

Our aim is not only to deliver the optimal metering data acquisition and processing system but also to integrate it into the existing IT environment.

Our system integration service personnel:

- Provides support in defining the necessary processes
- Defines the interfaces together with the suppliers of the other system platforms
- Coordinates the implementation and testing of the interfaces

Use of standard software tools for the interfaces to other platforms makes it easier to integrate additional software components in the future. Landis+Gyr follows current industry trends and standards, which allows for future extensions to the product and protects your investment.

7.1.3 | Migration

A part of the system integration may be migration of an existing hardware, software, and data to a new platform. Landis+Gyr can help you identify components that can be reused for a new installation.

7.1.4 | Customization

A part of system integration may be the adaptation of standard software to customer's needs.

7.1.5 | Training

Standard product training and training of operating staff is the prerequisite for reliable, efficient operation and maintenance of the product.

The standard product training includes:

- An overview of the product concept and capabilities
- Detailed operator training with examples
- System maintenance training

Standard product training is provided by our skilled instructors at our Center of Competence in Prague, Czech Republic.

7.1.6 | Customer-specific Training

Customer-specific training is available on request. The cost depends on requirements and will be the subject of a written proposal.

8 | Supported Platforms and Technology

The following table lists supported platforms and technology used in/for Converge 4.1:

Platform	Note
Application server	<p>Operating system:</p> <ul style="list-style-type: none"> ✓ Windows Server 2019 ✓ Windows Server 2016 ✓ Linux (Red Hat Enterprise) ✓ Linux (Ubuntu, CentOS) <p>Virtualization:</p> <ul style="list-style-type: none"> ✓ VMware ✓ Hyper-V <ul style="list-style-type: none"> • English • Latest service packs and patches applied • Latest .NET Core 3.1 Distribution Pack
Database	<p>Database:</p> <ul style="list-style-type: none"> ✓ Oracle 19c ✓ Oracle 18c, 18XE ✓ Oracle 12c (12.2) <p>Database Editions*):</p> <ul style="list-style-type: none"> ✓ Enterprise Edition (EE) ✓ Standard Edition 2 (SE2) ✓ Express Edition (XE) <p>Supported:</p> <ul style="list-style-type: none"> ✓ Oracle Exadata <ul style="list-style-type: none"> • Any platform/operating system supported by Oracle is supported • Oracle <i>Exadata Ready</i> certified • Oracle 12c should not run in 11g compatible-mode
Browser	<p>Microsoft Edge</p> <p>Chromium based (version 86+)</p> <p>Microsoft based (version 09/2019+)</p> <p>Apple Safari (version 13+)</p> <p>Google Chrome (version 86+)</p> <p>Mozilla Firefox (version 78+)</p> <ul style="list-style-type: none"> • Internet Explorer 11 (or any older version of Internet Explorer) is no longer supported due to lack of functionality support from Microsoft • Only 2018-year browser releases or newer are supported due to fixed issues in browsers
Excel	<p>Excel 365</p> <p>Excel 2016</p> <p>Excel 2013</p> <p>Excel 2010</p> <ul style="list-style-type: none"> • Microsoft Excel is used only on client workstation to show the report results downloaded in xlsx format • Microsoft Excel is no more required as the server installed software package for Excel Automation

9 | Terms and abbreviations

The following terms and abbreviations are used in this document.

Term	Description
AMM	Advanced Metering Management. AMM systems enable automated bi-directional communication between the energy meter and the utility. The communication is not limited to metering data, but can include information about consumption, tariffs, alerts, and complementary services.
AMR	Automated Meter Reading. AMR refers to systems that are responsible for handling tasks that require communication with metering devices, for example reading of metering values. See <i>HES</i> .
API	Application programming interface
CIS	Customer Information System
CSV	Comma-Separated Values
DC	Data Concentrator
DLMS	Distribution Line Message Specification. A messaging system defined originally as part of the application layer of the protocol stack for distribution line carrier systems. Its universality and independence of the actual communication channel has made DLMS the choice of the metering industry for any metering application.
ENTSO-EIC	Energy identification code
EOS	End of Support
FTP	File Transfer Protocol. A standard method that allows a person at one computer to login to another computer and transfer files between them.
GA	General Available release
GUI	Graphical User Interface

GPRS	General Packet Radio Service. A packet-based wireless communication service that provides data rates from 56 up to 114 kbps. It also offers continuous connection to the Internet for mobile phone and computer users.
GSM	Global System for Mobile communications. GSM is a digital mobile phone technology based on time division multiplexing technology. It is most widely deployed in Europe and throughout parts of Asia.
HA	High Availability
HTTP	Hypertext Transfer Protocol. The communication protocol used by the World Wide Web.
ICT	Information and Communication Technology
ID	Identifier
IP	Internet Protocol
IT	Information Technology
TOU	Time of Use
Vanilla version	Basic general release version without custom extensions

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