Advanced metering

SOLUTIONS

Landis+Gyr *advantis*

ADVANTIS

SHORT SYSTEM DESCRIPTION

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Revision history

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1 General

1.1 Scope of *advantis*

advantis is the Landis+Gyr end-to-end solution for Advanced Metering applications. The *advantis* system supports basic applications (e.g. automation meter reading and rate switching) as well as advanced applications (e.g. control of technical and non-technical losses, power quality supervision). The system offers backwards compatibility with existing equipment. Additionally, the system concept allows easy upgrades with new functionality when new communication technology becomes available. *advantis* is a global solution that can be customised to local market requirements.

1.2 About this document

This document contains the complete description of the *advantis* system and its applications defined for function bundle V1.5.

1.3 Terminology

Some terms used in this document have different meanings in the different markets addressed by the *advantis* system. The following list contains some of these terms.

Term	Similar Terms	Meaning
Profile	Interval data, Hourly values,	The contents of measurement registers (Energy or Power) are periodically captured (typically at the full-hour or at half-hour or at the quarter-hour) and stacked in a “profile”. Each entry in this profile contains a time stamp, a status word and several register contents.
Capture period	Integration period,	See above
Tariff	Rate, TOU (time of use)	According to the contract (tariff contract) between the energy provider and the customer the energy is priced differently over different time intervals (e.g. day tariff, night tariff). For that purpose, the consumption is measured in different registers (tariff registers). The communication unit contains a tariff switching table (schedule) which activates the different tariff registers according to the tariff contract.
Tariff switching table	TOU table, tariff schedule, rate switching table	See above
Daily Billing Values	Daily values, billing values	Typically rated registers which are captured and stored daily at midnight in the daily values profile.
Periodic consumption values	Hourly values, interval data	Typically un-rated register values captured and stored periodically in the energy values profile.
Capture period	Capturing period, Registration period, integration period, registration interval	Time interval for the periodic capturing of registers into the profiles (see above)

2 Introduction to the system solution

This section describes the functionality of the various components and their interaction.

2.1 System overview and description of the main components

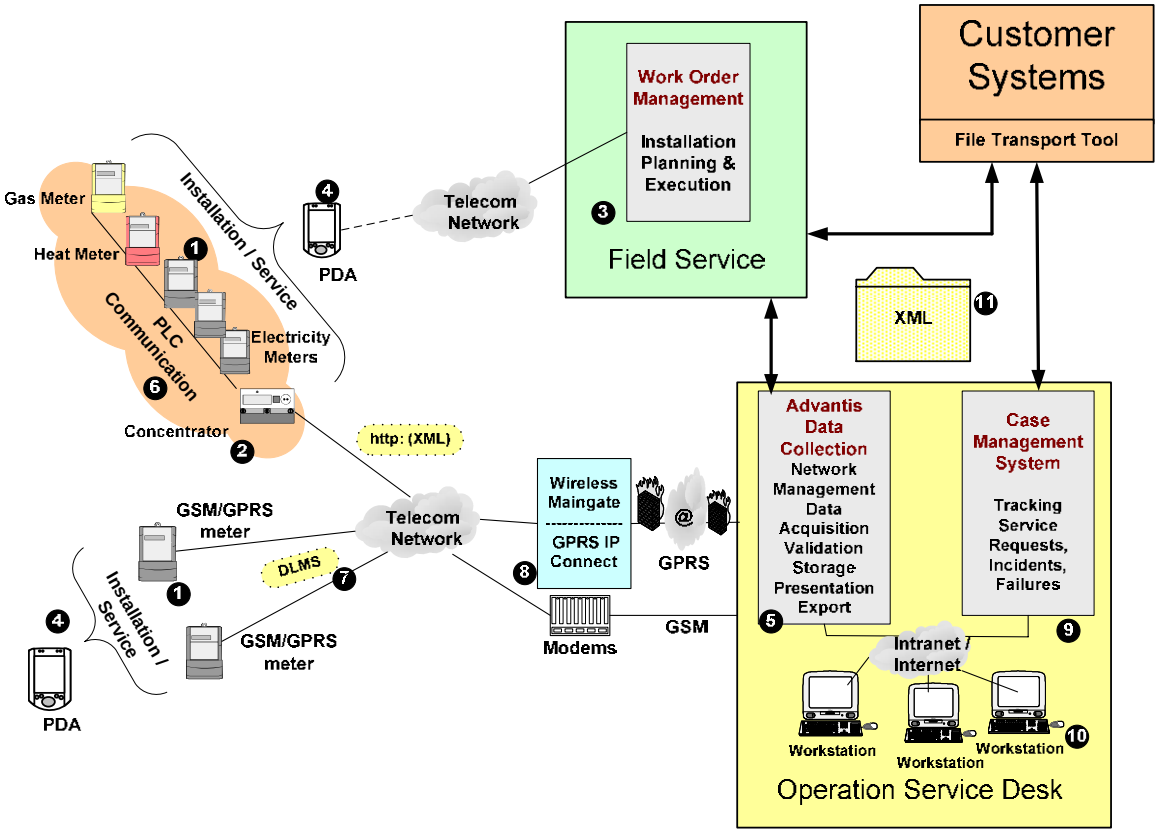

Figure 1: System overview

As illustrated in Figure 1, the *advantis* system comprises the following main components and communication channels:

1 Meters

The meters/adaptors are installed in private households and small Industrial/commercial sites. All meters/adaptors are equipped with Power Line Carrier (PLC) modules or with GSM/GPRS modules that provide the communication interface to the central system, either via concentrator (for PLC) or directly for GSM/GPRS. In case of GPRS, GPRS communication is used as the main medium, GSM as a backup medium.

The main functions of the meters are:

- register daily billing values for one tariff
- register hourly profiles
- register power outages
- provide transparent interface to read current register values
- provide tables for tariff switching
- provide status and alarm information
- for other meters (e.g. gas, heat, water): provide an interface

The registration of the measurement values is fully scheduled by the meter. The meter provides local storage for the daily billing values for up to 366 days and hourly profile values for 90 days.

PLC communication between the Meter/PLC-Module and the concentrator is based on the standard protocols (IEC61334 series).

GSM/GPRS communication (IEC 62056 series) is used as an alternative solution when PLC is not efficient (technically, economically).

2 Data Concentrator (DC)

The data concentrator is typically installed in the medium voltage (MV) / low voltage (LV) transformer station and serves as a gateway between the LV-PLC network and the public telecom network (via GPRS/GSM) or a Wide Area Network (via Ethernet). The concentrator manages the PLC communication with up to 3000 meters – this is the theoretical limit given by the addressing capabilities of the PLC protocol – over the power line. The concentrator performs scheduled or immediate readout tasks, which have been downloaded from the central system. It stores the daily billing values, hourly profile values and events locally and keeps them available for readout by the central system.

The concentrator polls the meters in regular intervals to supervise the connection to the meters, to detect new meters and to gather registered values and status information from all meters. Concentrators can exchange data with the central system over different communication channels.

The main functions of the concentrator are:

- manage the inventory and the status of the connected meters
- execute jobs according to the defined task list
- periodically gather registered values and store them locally
- provide an interface to the central system for data exchange
- provide transparent access from the CS to a single meter

The communication between the concentrator and central system is based on XML file exchange using http services.

3 Work Order Management system (provided by third party)

A Work Order Management system (WOM) is a software package for the planning of the device installation. The WOM is not part of the *advantis* solution portfolio. Typically, the choice of the WOM system is done by the installer and/or the utility.

The planning is based on the geographical grid information as well as the device and customer information delivered by the utility. After detailed planning of installation times and sites, the specific work orders for the various installers are downloaded to their Pocket PC (PDA). After installation the installation reports are uploaded from every installer to the WOM and verified and checked. Summary work orders are sent to the utility every day. The WOM is able to keep track on progress and status of all installation work and to manage all planning changes, pending installation work and tracking incidents and problems.

The WOM system is not only used during the installation but also during operation. In this phase, the WOM is the tool that executes all types of field services needed for the installed devices (e.g. manual connect/disconnect/ readout) and the tool for the change, installation and removal of meters.

advantis can support the WOM system via appropriate interfaces. The interfaces depend strongly on the WOM used. The definition of the interfaces is typically part of a specific project.

4 Pocket PC for installation/service – PDA (provided by third party)

All work orders for installation or field service are downloaded from the WOM system to the installers' Pocket PC (PDA). A standard PDA is used for the deployment support and service work. The PDA is equipped with all necessary interfaces and tools such as optical head for local readout, bar code reader etc. as well as with GPRS modem for the connection to WOM.

During installation and field service, all device specific information e.g. device type, serial numbers, fuse size, antenna type etc. as well as site information such as coordinates, addresses, containment type etc. are managed, registered with the PDA and reported to the WOM.

5 Central System (CS) – *advantis*

The *advantis* central system is a powerful network management, data acquisition and meter data warehouse application. The system communicates with concentrators in order to acquire daily register values and profile values and passes data on for further processing and presentation.

The central system operates on the base of fully automatic scheduled tasks as well as on manual human intervention via sophisticated graphical user interfaces (GUI). Configuration data, register values and status information acquired from the meters are historically stored in a relational database. This database enables access from central system application software as well as from external systems and programs.

6 PLC communication

Communication between meter and concentrator:

The PLC communication between the meter with PLC-module and the concentrator is based on standard protocols (IEC61334 series). As PLC communication in the LV network is free of charge, the network is fully available for advanced metering applications. Therefore, mission critical communication tasks can be dispersed over time in order to achieve maximum reliability. Thus PLC communication technology represents the best trade-off in the context of conflicting technological and economic requirements.

7 GPRS/GSM communication

Communication between concentrator and central system:

The central system communicates with a large number of data concentrators (DC) using different channels and technologies. Both central system and DC support standard communication technologies such as dial-up modems over GSM/PSTN, dedicated line modems, internet based technologies such as GPRS or fixed TCP/IP. The central system supports easy integration of future communication technologies. The exchange of information and data is based on XML file transfer using http services.

Direct communication between meter and central system:

GSM/GPRS communication is used as an alternative solution when PLC is not efficient due to technical or economic reasons. In this case, GPRS is the default channel and GSM is used as backup.

8 GPRS-IP connect service provider

For the communication between the central system and devices typically a service called “GPRS IP Connect” is used. This service offers a GPRS/GSM based connection from the central system over the telecom network to both the data concentrator and the meter equipped with the GPRS/GSM module. The service provider assigns a fixed IP address for each meter and concentrator. Security from the provider to the central system is achieved by means of VPN tunnels.

Main/Backup Communication:
Normally, telecom providers assign a higher priority to voice traffic or data transfer via SMS than to GPRS traffic. Therefore it can happen that at certain times a GPRS connection is not available or not stable enough. In such cases it is possible to use the more prioritized GSM channel for the communication. The central system can automatically switch from GPRS to the backup channel following rules previously defined by the operator.

9 Case Management System – CMS (provided by third party)

The Case Management System is used by the Operation Service Desk to track all service requests from the utility system. Requests that involve field service personnel are forwarded to the Work Order Management system, requests which can be executed remotely are handled by the *advantis* central system. The CMS registers all cases and reports the status of each case back to the utility.

In addition, CMS is also used to handle incidents and problems occurring in the *advantis* central system. All cases that need involvement of field service personnel are tracked by the CMS system.

The CMS system is not part of the *advantis* portfolio. However, *advantis* can provide the interfaces to support a CMS system.

10 Operation Service Desk

The Operation Service Desk is in charge of the daily operation of the whole system in the operation phase. The Service Desk engineers have access to the *advantis* central system as well as to the CMS.

The *advantis* central system provides a client-software with a graphical user interface (GUI) to enable the operator to manage the system and visualize any definitions and data within the system. The operator can access the application from his standard workstation PC located within the company network (intranet) or from external sites (internet). The access is protected by standard security policy such as user name / password, VPN, RAS, etc. In addition, the privileges to access functions and data can be managed by a super user.

11 Interface to utility systems

Both during the rollout phase and the operation phase, there is typically a centralized interface in operation between the utility systems and the three systems WOM, *advantis* central system and CMS. This interface is specified and implemented on a project specific basis.

Generally, XML files are exchanged between the involved systems on production level, trial level and on test/development level. The interface provides the requested services for the download and upload of device information, contract information, readout requests, service requests, etc.

3 Electricity metering equipment

3.1 Residential meters

Independent of the communication channel, the basic meter remains the same. The different communication media are supported by different communication modules.

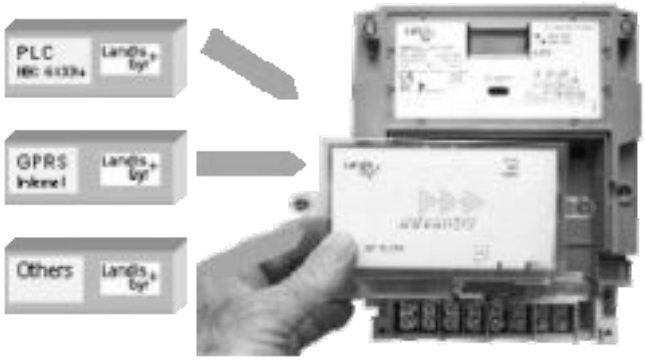

Figure 2: ZMF meter with communication modules

The meter is delivered with the communication module integrated, fully tested as a communicating meter. For the standard meter types described below no mounting of the modules in the field is foreseen (exception: upgrading to future communication media).

The modular concept of the meter node allows Landis+Gyr to cover its world wide markets with one basic product (the base meter). The base meter provides the basic functionality for billing data (tariff registers) and the raw data (energy impulses, voltages ...) for extended functions. The modules provide extended functionality and are adapted to the specific market needs. With this concept also new communication channels can be supported.

The fact that the functionality of a meter node is based on standardised data models and communication protocols enables smooth upgrades to new functions and channels.

The following communication media are currently supported:

- GPRS for rural customers.
- PLC to the concentrator and GPRS/GSM from the concentrator to the central system for urban and suburban customers.

In addition, the modular concept of the Landis+Gyr meters offers the possibility to exchange the communication module in the field without exchanging the meter. The meter is approved by the metrological bodies independent of the communication part; i.e. exchanging the communication unit does not imply a re-approval of the meter.

3.2 Polyphase meter ZMF100AC

See Technical data sheet.

3.3 Meter configuration parameters

The meter configuration parameters are set during manufacturing. They cannot be changed in the field.

3.4 Single phase meter ZCF100AC

See Technical data sheet.

3.5 Meter configuration parameters

The meter configuration parameters are set during manufacturing. They cannot be changed in the field.

3.6 Breaker

The single phase meter ZCF and the polyphase meter ZMF can be equipped with an optional breaker. Figure 3 shows the ZCF and ZMF meters equipped with breakers. The switch for local breaker operation is integrated into the terminal cover. The design of the switch is such that unintentional operation is avoided.

Figure 3: single phase and polyphase meter with breaker

4 Concentrator

See Technical data sheet.

The concentrator is typically installed in the MV/LV substation. It can also be mounted anywhere in the LV network i.e. also at the customer's premises (with the meter).

Figure 4: advantis Data Concentrator (PLC)

By default, GPRS is used to communicate with the Central System. Alternative media: direct Internet connection via Ethernet, or GSM. The concentrator is equipped with an Ethernet controller and a RJ45 socket.

The Software of the concentrator can be downloaded remotely.

4.1 Functional description

The concentrator acts as master of the underlying PLC network. For that it supports the following basic tasks:

- The fully automatic detection of newly installed meters and PLC communication units (plug and play).
- The fully automatic switching-over process in case of a feeder change in the LV network; the PLC units are released from one concentrator and re-registered at the new concentrator.
- Supervision and optimisation of the PLC communication network by computing performance statistics and by optimising the repetition credits in order to achieve maximal channel capacity.
- Automatically synchronising the clocks of the communication units in the LV network.

Besides the basic tasks which support the maintenance of the communication network (see above), all tasks for the data exchange with the meters are programmed by the CS. For that purpose the concentrator interprets task scripts which are downloaded by the CS via XML file transport. A priority scheme allows the scheduling depending on the urgency of the task.

4.2 Meter data acquisition

In order to achieve maximum reliability, the concentrator keeps a copy of the most recent part (typically the last 6 days) of the Daily Values Profile, the Energy Values Profile and of the event logs in its buffer. Such a buffer is kept for each meter node. In case of missing values in the buffer (due to temporary communication problems) the concentrator automatically re-fetches the missing values of the corresponding meters during the time of good communication conditions. Whenever the CS contacts the concentrator it has all the relevant data available; i.e. normally the CS never needs to contact the meter directly for data required periodically.

5 *advantis* Central System

5.1 General functionality

The *advantis* central system functionality is based on the Converge platform, a software dedicated for grid metering, industrial & commercial metering as well as residential metering. The whole platform includes the following general functions:

- Data acquisition
- Data validation
- Data processing
- Data exchange
- Scheduling
- Basic Configuration

Based on this platform a number of functions were specifically implemented for the handling of devices and measurements in residential metering and are discussed in more detail in the following section.

Graphical User Interface

The graphical user interface (GUI) enables the operator of the system to display, edit and manage all relevant functions and definitions within the system. Powerful search filters can be used to directly access groups or individual data objects in order to display metering values, present and modify object properties, parameters etc.

The administrator can define automatic tasks and schedules according to needs of the daily operation. Spontaneous tasks, functions and actions can be executed manually or as a background job.

The user interface for daily operation is based on the Internet Explorer. This means that the operator only needs a browser on his personal workstation in order to use this WEB based application. The GUI includes a context sensitive online help. The operator gets quick information on the specific tasks or functions. In addition, the online help also offers index search for specific topics.

Multi user system

The system is built as a multi user system. Each user must log on with his username and password. Every user is assigned to a user group. Privileges to access data and functions can be defined for such user groups. Typical privileges are functions like view, create, modify and delete, which can be individually assigned to groups of data objects. The population of data objects and metering values can be assigned to different data segments. Therefore any user may have limited access or unrestricted access to these data segments. Any access to the application can be secured by standard security mechanisms such as https, VPN or SSL.

5.2 Data acquisition

5.2.1 General

The central system supports direct communication to meters connected over GPRS/GSM using the standardized dlms protocol or to meters connected to concentrators over PLC. The communication to concentrators is done over GPRS/GSM or Ethernet based on XML file exchange over http protocol.

Metering data is stored in the database in a normalized format. All meter nodes are identified by the manufacturer serial number the utility serial number (EAN Code). The values are identified by their OBIS Code.

The data acquired and further processed from category 1 and 2 electricity meters, gas and heat meters corresponds to the tables listed in the chapters describing the meters.

5.2.2 Task management

The system includes a set of predefined tasks for automatic acquisition of metering data and device information by the central system. All parameters of these tasks can be modified by the operator to achieve maximum efficiency for the specific need, of each system or part of the system.

Tasks are needed for automatic operation, manual execution (spontaneous readout) as well as for ordered readout. Automatic task execution can be predefined for different intervals (daily, weekly, monthly; note that weekly tasks are not supported by the DC, i.e. weekly tasks are mapped by the CS accordingly) and specific start times. They can be defined for groups/types of meter nodes as well as for individual lists of meter nodes.

Tasks are also used to download schedules to the concentrators, setting parameters to the devices, download time of use table or download new firmware versions to devices.

Figure 5: Task management

5.2.3 Network management

A major challenge of residential metering is the administration and management of a high number of concentrators and meter nodes. This core functionality of the central system is based on its highly efficient and powerful network management offering the following tools:

- Visualisation of the network structure with regions, sub-stations and concentrators. The depth and the layout of hierarchical structures can be defined at system setup and influenced by the operator.
- Search filter for quick access to all communication and meter nodes. Search criteria and attributes of the nodes can be predefined at system setup and modified by the operator.
- Display of parameters, attributes, statistics, status etc. of all communication and meter nodes.
- Summary reports of new, failed, lost etc. communication and meter nodes.
- Summary reports of statistic information, status of communication and meter nodes.
- Search for nodes with different criteria such as gaps, failed, specific status.

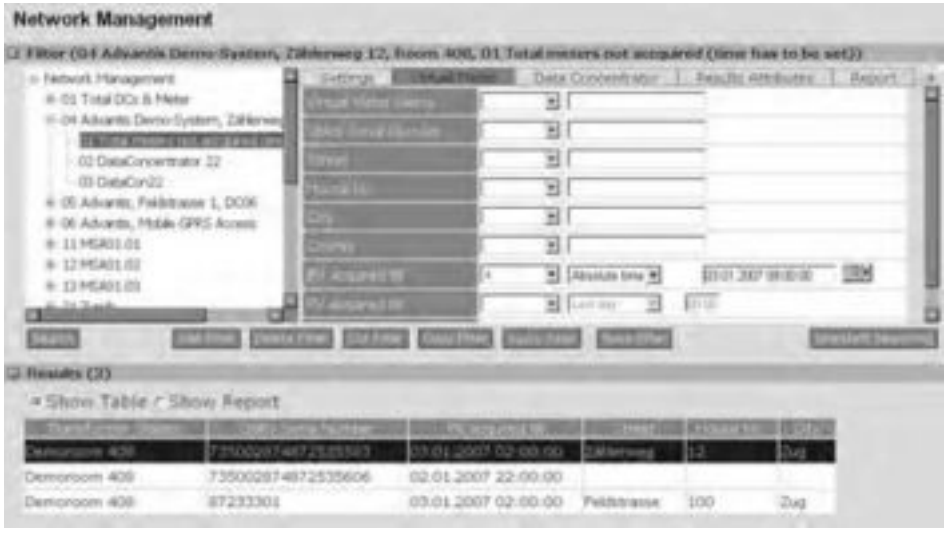

Figure 6: Network management

5.2.4 Manual acquisition

The central system software allows direct interactive connection to a single meter node or to the data concentrator. Two different modes are available:

Call centre mode This mode is used by the operator to quickly display the measurements of a meter node and optionally to actualize periodic meter data or spontaneously acquire the current register values of the device.

Maintenance mode This mode is used to interact with the meter or the concentrator for detailed maintenance and administration purposes.

Call Centre mode

In the Call Centre mode the operator selects a specific meter and the software retrieves the current measurements stored in the data base such as:

- Daily billing values
- Current register values
- Profile values
- Event Logs

If the operator needs more recent values he can easily establish an on-line connection to the selected meter device and interactively retrieve the necessary data by actualizing the periodic measurements or retrieve the current values of pre-defined register sets.

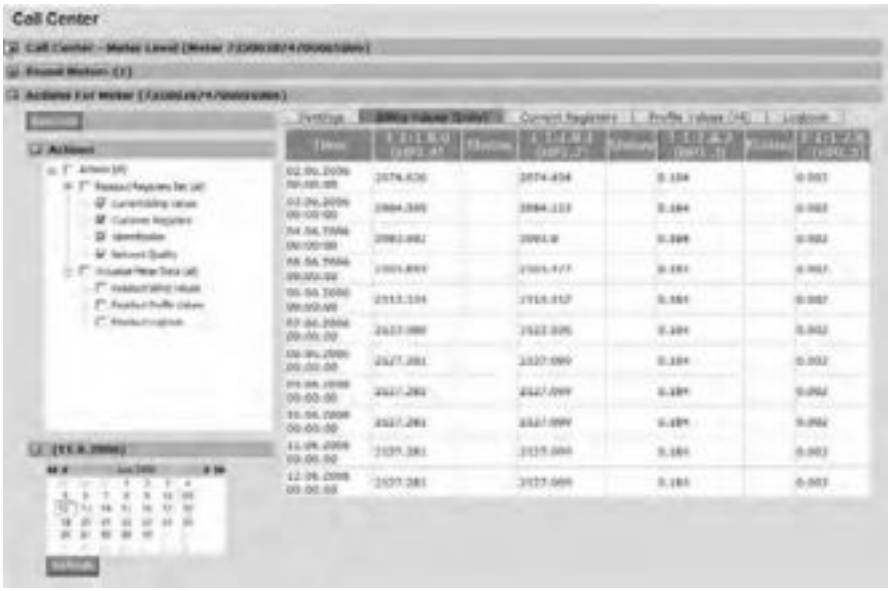

Figure 7: Call centre mode

Maintenance mode

The Maintenance Mode offers detailed administration and analysis functions for the interactive maintenance of both the data concentrator and the directly connected meter. Functions include:

- Display and update of current device settings and parameters
- Remote update of firmware versions
- Manage different meter lists in the concentrator
- Parameter check and download of parameters
- Read status, event log and communication statistics
- Download time of use tables for tariff switching and load shedding
- Check and download periodic tasks to the concentrator
- Initialize concentrator by downloading data dictionary, basic and time parameters

The debugging option enables the monitoring of the data flow between the central system and devices on the communication protocol level.

Figure 8: Maintenance Mode

5.2.5 Transaction logging

The acquisition job processing is logged in detail. 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 current.

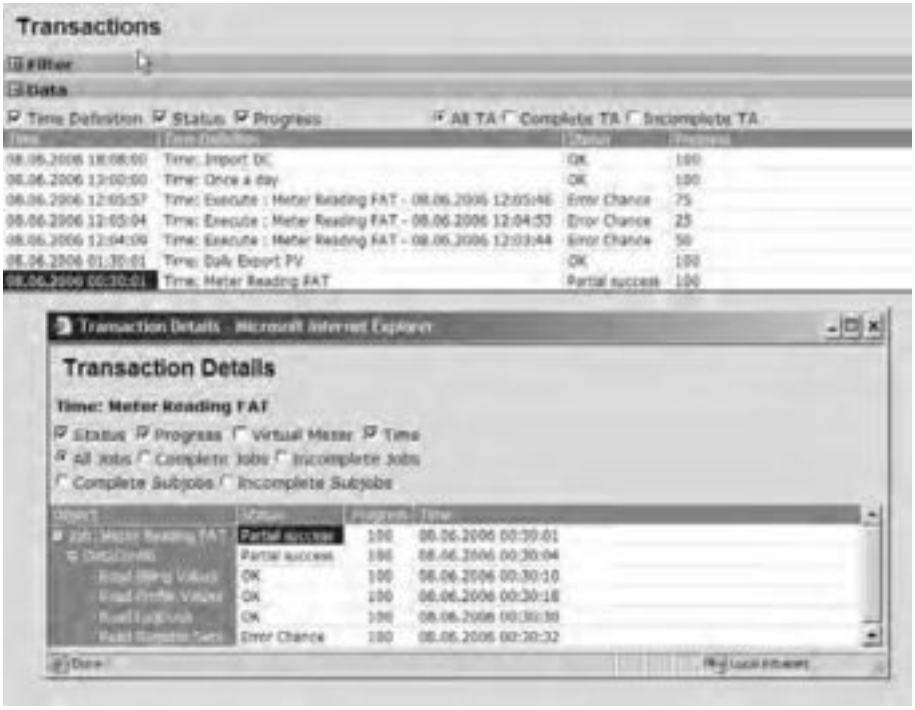

Figure 9: Transaction Logging

5.3 Data validation

The central system features a range of different validation functions that can be individually applied to metering data.

Values which fail validation checks are marked with the according status information and can be monitored and possibly corrected by manual substitution of values or sophisticated automatic interpolation of values.

Data validation is indispensable, because only verified data can be further processed. The central system provides comprehensive data validation and substitute value generation features.

The central system includes a range of different validation functions and plausibility checks that can be individually applied to meter data.
The main functions and checks are:

- Identification and reporting of missing meter data.
- Identification and reporting of gaps in meter values.
- Checking of consumption values for non-zero, non-negative and continuously increasing values.
- Comparing meter values with maximum consumption (according to fuse size).
- Identification and reporting of any communication error.
- Identification and reporting of status of meter (event logs).

Meter data which fail validation checks are marked with the according status information and can be monitored and possibly corrected by manual intervention, repetition of query, substitution of values or sophisticated automatic interpolation of values.

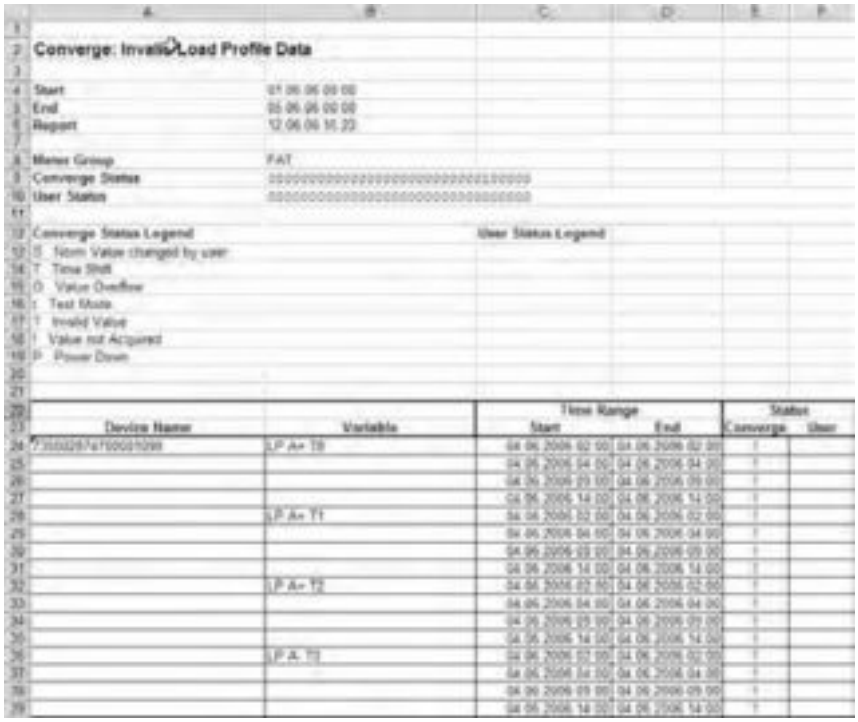

Figure 10: Validation report

5.4 Data processing

5.4.1 Reports and calculation

The data processing functionality offers a wide range of reporting and calculation functions to monitor and process metering data.

Reports are based on embedded Microsoft Excel with a special interface from the Converge software. The design of the reports is fairly freely configurable by the operator including the selection of the values for the report and the layout of the report. Any type of calculation and display functions offered by Excel can be used to handle values and information.

Reports can be generated manually or automatically. Output can be directed to the GUI, e-mail, printer or export file. The format of the output can be HTML, Excel Workbook, Text-format.

Reports can contain both tables and graphics.

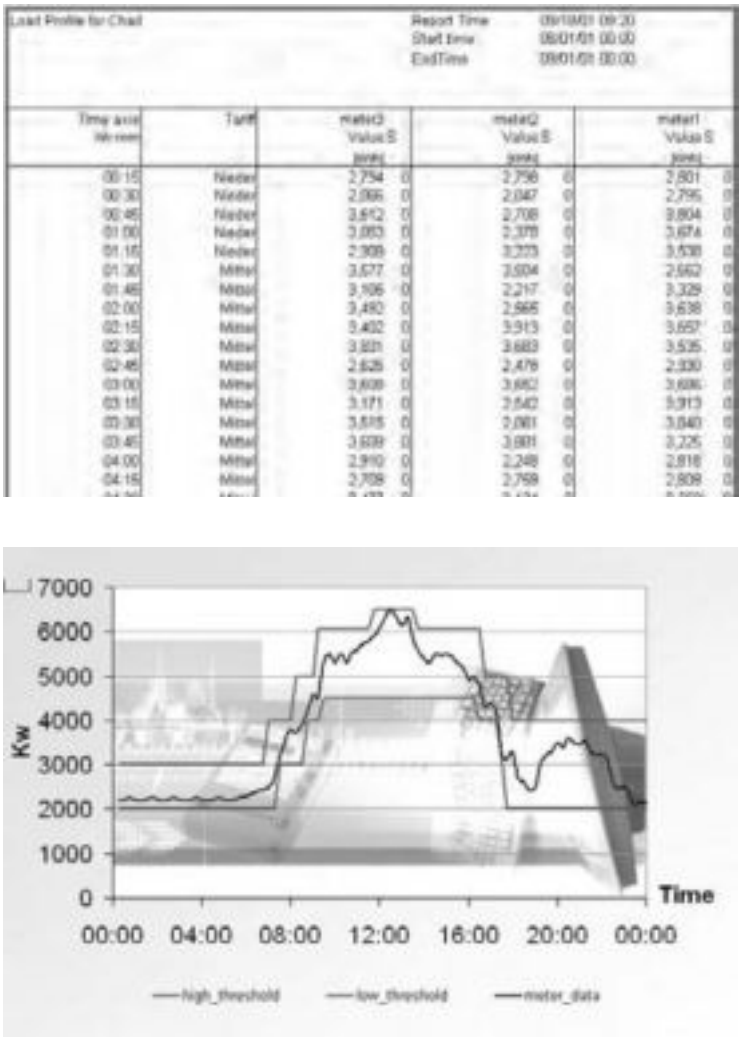

Figure 11: Tabular and graphic report

5.5 Data exchange

There are three types of interfaces used in the central system:

1. Interfaces to import device information
2. Interfaces to export metering data
3. Interfaces for command input

5.5.1 Import device information

Residential metering usually comes along with large numbers of devices. The aim is to import device information from external systems, e.g. the device management system, rather than to enter all information manually.

The central system software includes an import interface for device information of data concentrators and meter nodes (PLC or direct meters). Device information includes identification numbers (manufacturer/utility serial number, parameterization, etc.), device info (device type, configuration, antenna type, etc.), location info (location name, address, coordinates, etc.) and any other customer information needed on the central system to clearly identify and manage this number of devices efficiently.

The import tool supports both .csv and .xml import files. The format, ordering, content and row/field naming can be customized to the specific needs through a simple configuration file. Import can be performed automatically by the scheduler or executed manually.

Details on the file format and on the devices supported are specified on a customer project basis.

5.5.2 Export metering data

Metering values can be exported to different destinations in different formats, with different content and in different schedules. Standard formats to export text or xml files are available as library functions and can be customized to the specific needs of the target system.

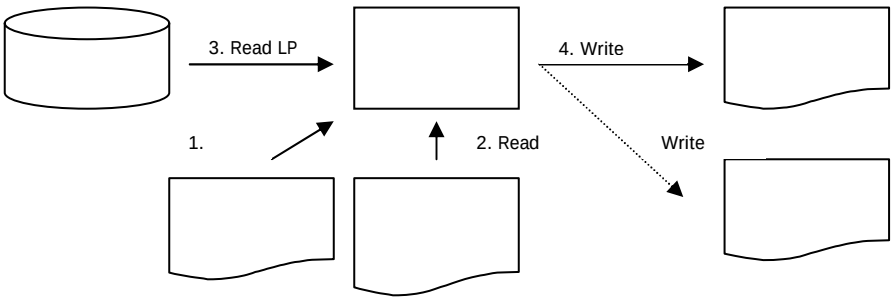

Figure 12: Export process

For each destination the respective metering values can be assigned individually.

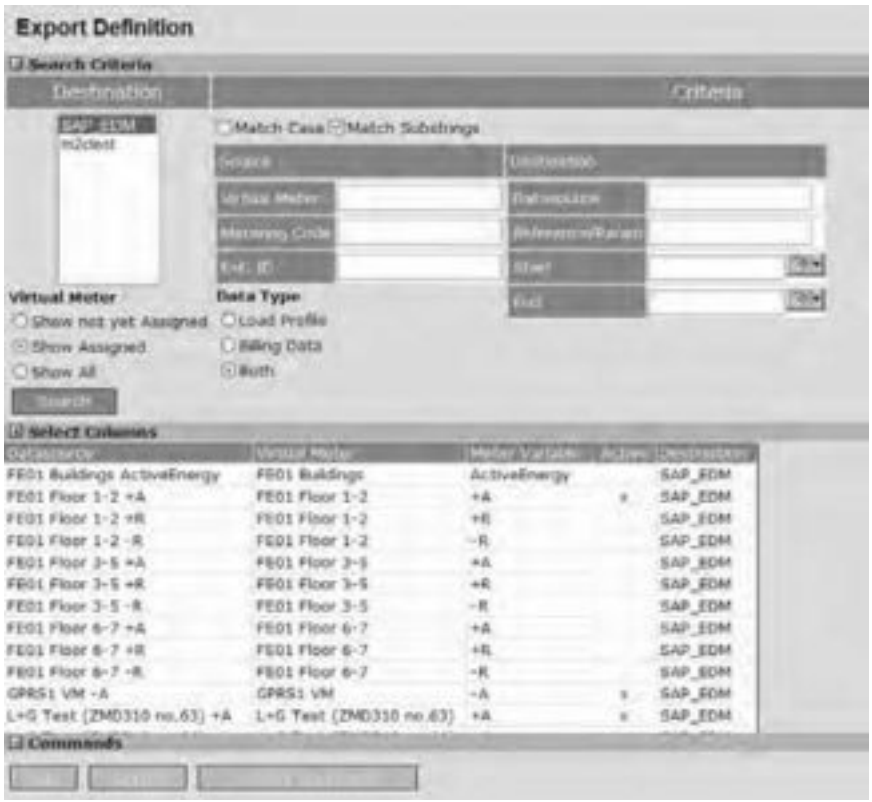

Figure 13: Export definition

NB: exporting/importing of data concerning the communication modules and the concentrator is not supported.

5.5.3 Command input

There are several functions that need to be initiated by the overlaying system, most probably the billing system. Changes of contract, changes of tariffs, spontaneous readout of current registers for customers that move in/out or change supplier, remote change of parameters etc. are examples of such functions.

The central system offers an interface for an external system to trigger such functions and receive the according feedback (meter values, execution status,...). As far as the other interfaces are concerned, there are several standard interfaces available based on file exchange (text and xml format) that can be customized to the project needs.

5.6 Scheduling

All major function to support the daily acquisition and processing within the central system can be automatically executed by the scheduler. For the acquisition the scheduler is based on the functionality of the task management (see 5.2.2). For the other functions, such as processing reports and calculations or import / export the standard scheduler function can be used.

The scheduler offers time definitions to execute jobs daily, weekly, monthly or at predefined start times. The jobs can be Converge functions such as validation, reporting, export, database maintenance etc. or the execution of an external program.

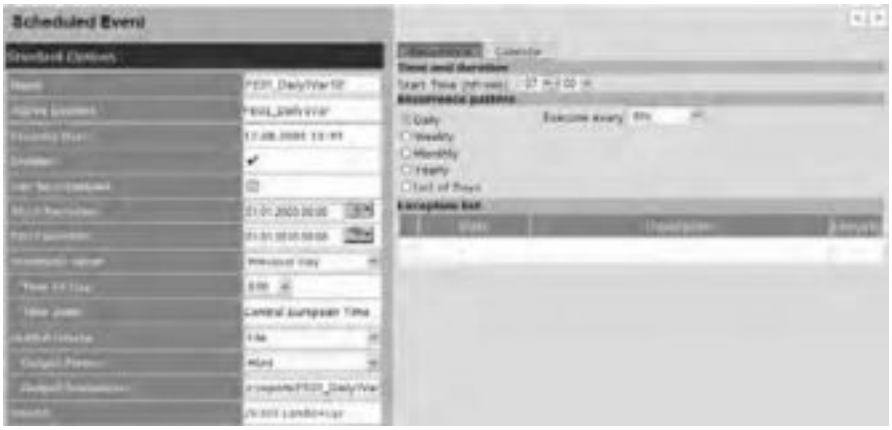

Figure 14: Scheduling reports

5.7 Basic configuration

There are several basic configurations used by the system administrator to customize the system to the specific needs of the utility. Some configuration examples are described in the following chapters.

5.7.1 User definition, access rights, segments

Every user is defined with username, password, language and other attributes and belongs to a user group. For each user group, the system administrator can define individual access rights to the different functions. Every access to a data object can be restricted to create, view, modify, delete. These access rights can be applied individually to all types of data objects in the system. For specific functions, the administrator can assign execution privileges to user groups. The graphical user interface is automatically adapted to the user's individual access rights.

In addition, data objects can be assigned to different data segments. Users can be assigned to a number of data segments so that the user can only access data he is authorized to.

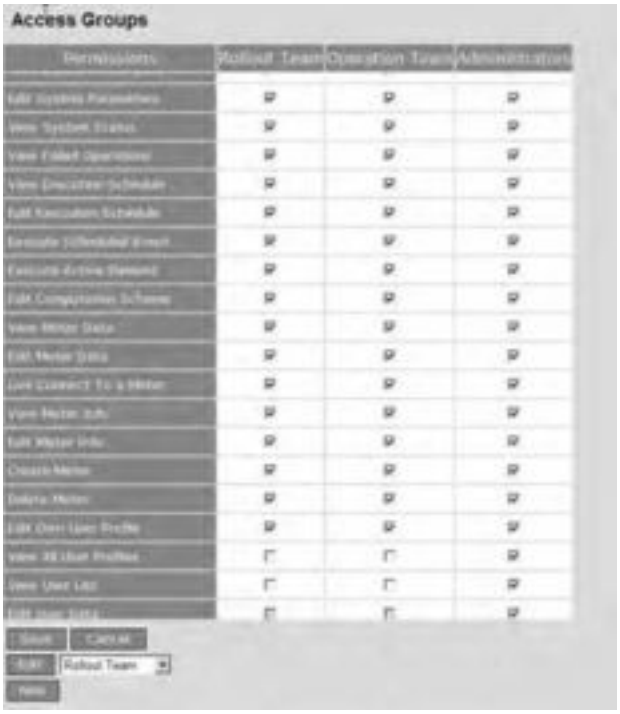

Figure 15: Access Groups

5.7.2 Meter/register configuration

All metering values are normalized to OBIS Code. The different registers and their individual naming can be customized by the system administrator. For each meter type it is possible to define which registers are delivered and handled in the central system. There are different register sets for identification numbers, network management, billing registers etc. that can be configured to the needs of the utility.

For each data object such as a concentrator or a meter the necessary customer specific attributes can be defined on a basic level. User defined

attributes can vary from individual address information up to specific device or contract information that needs to be monitored within the system.

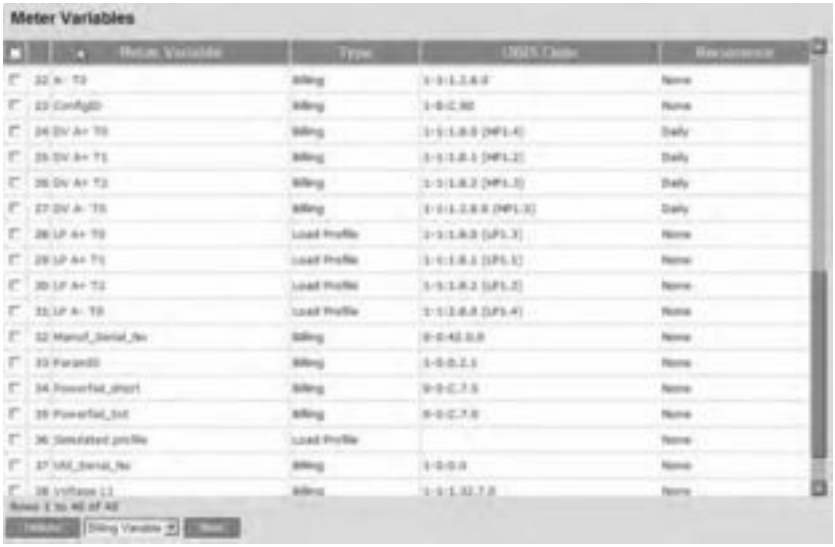

Figure 16: Meter Variables

5.7.3 Unique identification

The unique identification of a meter node and its values is a requirement throughout the whole system. There is both a unique manufacturer serial number and a unique utility serial numbers referenced from the meter node up to the central system and used to identify the meter values in the export to the billing system.

The following description shows the usage of EAN code as an example. Of course, it is also possible to use a “conventional” utility serial number defined by the utility.

Cross-references between databases, concentrators and metering unit are:

- Utility serial number of meter
- OBIS
- Timestamp

Utility serial number of meter

Utility’s serial number of metering unit: This unique number allows an explicit identification of the metering unit. This number is the link between the meter data and the consumer. It is owned by the utility. The value is set in the meter during manufacturing according to the data given by the utility. The number is taken from the readout of the meter and updated in the module after every successful communication. The two meter registers 'Customer ID' (display code 0.0) and 'Manufacturer ID' (display code C.1.1) are added to a register in the module.

The utility serial number is typically defined as an EAN number, see following example. The number is represented differently on the bar code sticker, the meter plate and the readout:

Bar code: 80047350028740014881

Clear view: (8004)7350028740014881

Readout: 735002874840014881

(8004)	Application Identifier: 4 digits defining the type of number. The AI is shown inside brackets in the clear view but not in the barcode.
73	Country code: 2 digits defining the registration country of this EAN/UCC Company Prefix. No indication as to where the meters are being produced or where the company is located. 73 represents Sweden.
1...7	Company Prefix: Registration # from EAN. The company prefix can either be provided by the customer or the Landis+Gyr S/A Danmark Filial Sverige can be used. The Landis+Gyr Company Prefix is: 5002874
1...6	Individual Asset Reference: Unique Number defined by supplier during manufacturing.
P	Test Digit over the code without Application Identifier (8004). L+G offers different ways for the calculation of this Test Digit, all of them standardised and approved. Modulo 10/3; Modulo 43; Modulo 11
OBIS	The OBIS code identifies the type of measurement (e.g. energy consumption high tariff)
Timestamp	Assigns date and time to each meter reading. Each meter reading data is clearly assigned to all three cross references from its generation in the meter until its storage in the database. Therefore, it is always ensured that the correct metering unit is controlled on the base of these cross-references. Each concentrator is identified by its unique manufacturer serial number.

5.8 System platform

The *advantis* central system is based on Microsoft technology and Oracle database.

5.8.1 Database

The *advantis* central system employs an Oracle database for data storage. All data such as measurement values, status and event logs etc. remain in the database until the system administrator deletes them explicitly. The initial disk capacity is defined to hold a minimum of 13 months of data in the database. The storage capacity can easily be expanded by adding additional disk space to the database server.

5.8.2 Operating system

The operating system is Windows Server 2003. Dedicated servers are used for database, data acquisition, data processing and user interface services. Standard Windows PCs can be used for operators of the system. All definiions and data are stored in an Oracle database. The system components are highly scalable regarding the number of meter nodes to be acquired (multi communication servers), distribution of data processing (processing servers), numbers of users (IIS servers) and transaction processing (database service). High availability of the overall system is achieved by configuring the different components as cluster nodes with fail over mode and/or load balancing.

5.8.3 Availability and scalability

The system can be configured with fault tolerant and highly available system hardware. Servers are clustered as hot-standby or load balancing configuration. The members of the clusters are located on two different sites for disaster tolerance. The system backups of one site are archived on the opposite site.

The database servers and the communication servers can be running in a scalable configuration which means that more servers can be added if more power is needed.

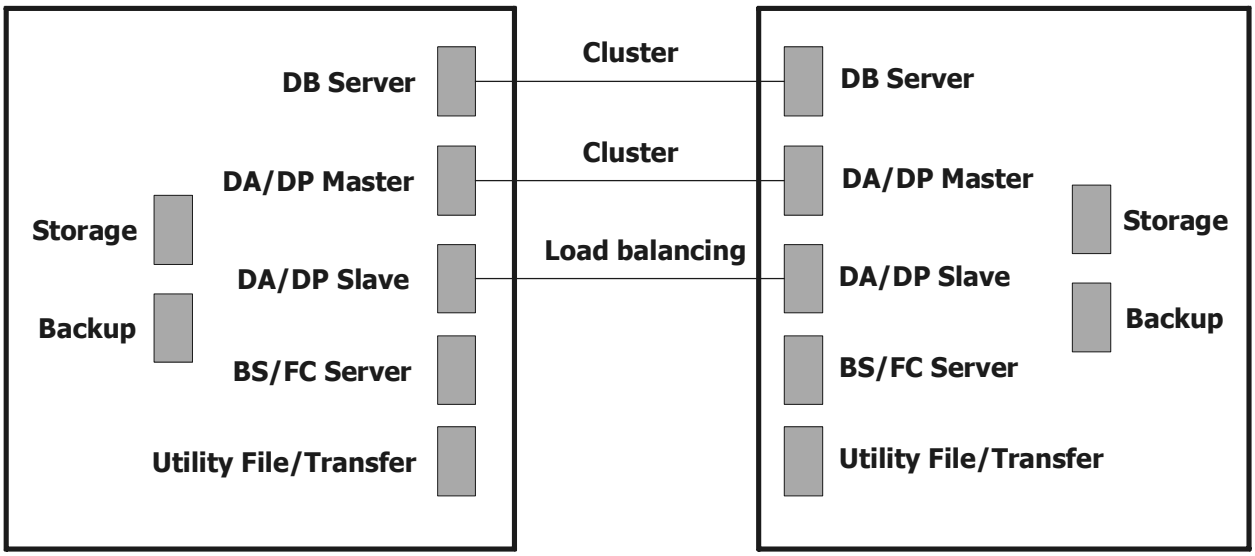

Figure 17: Platform availability