

1. MESMET XT System Architecture

1.1. Global Overview

The System for automatic data collection from remote electricity meters MESMET XT is made of four units:

1. MESMET XT CENTRAL – central part of the system through which the entire system is managed, its configuration is maintained and reading data is managed.
2. MESMET XT COLLECT – part of the system dedicated to direct communication with the meters and/or automatic reading of electricity meters
3. MESMET XT REPORT – part of the system dedicated to creating and displaying report on the data read, to the widest set of users
4. MESMET XT WEB – part of the system through which the authorized users via public network (Internet) access the reports created on their data

The core of the system are MESMET XT CENTRAL and one or more MESMET XT COLLECT configurations. MESMET XT REPORT and MESMET XT WEB are optional parts of the system, primarily dedicated to utilization of the data collected in the procedures of automatic readings.

The system is realized on Microsoft operative system, Windows Server 2008 platform, .NET Framework 3.5 and SQL 2008 Server. WPF and Infragistics controls for WPF are used for implementation of applications. WWW is used for communication between applications and the base. Applicative part of the system is made of windows and web services, whose interconnection and communication with database are protected by use of asymmetric cryptography elements. Safety mechanisms are very important part of this system and they are applied to all system layers – from the client access points, through application service layer to database. Pairs of asymmetric keys on smart cards are used as the basic client authentication mechanism; pairs of asymmetric keys are also used as elements of service identity in inter service communication, as well as in communication with database. Digital signatures are applied in database at all important places, as elements of integrity protection and nonrepudiation, i.e. hybrid encryption for protection of confidentiality of the most sensitive data. Internal Windows applications are installed explicitly on the selected client stations. Authentication for these applications is made by use of smart cards, meaning that all workstations must have standard smart card readers.

Authentication of external users, those using MESMET Web Access application is also made by use of smart cards.

Targeted client platform for both user types is Windows XP SP2 and later.

Figure 1 shows global presentation of system architecture.

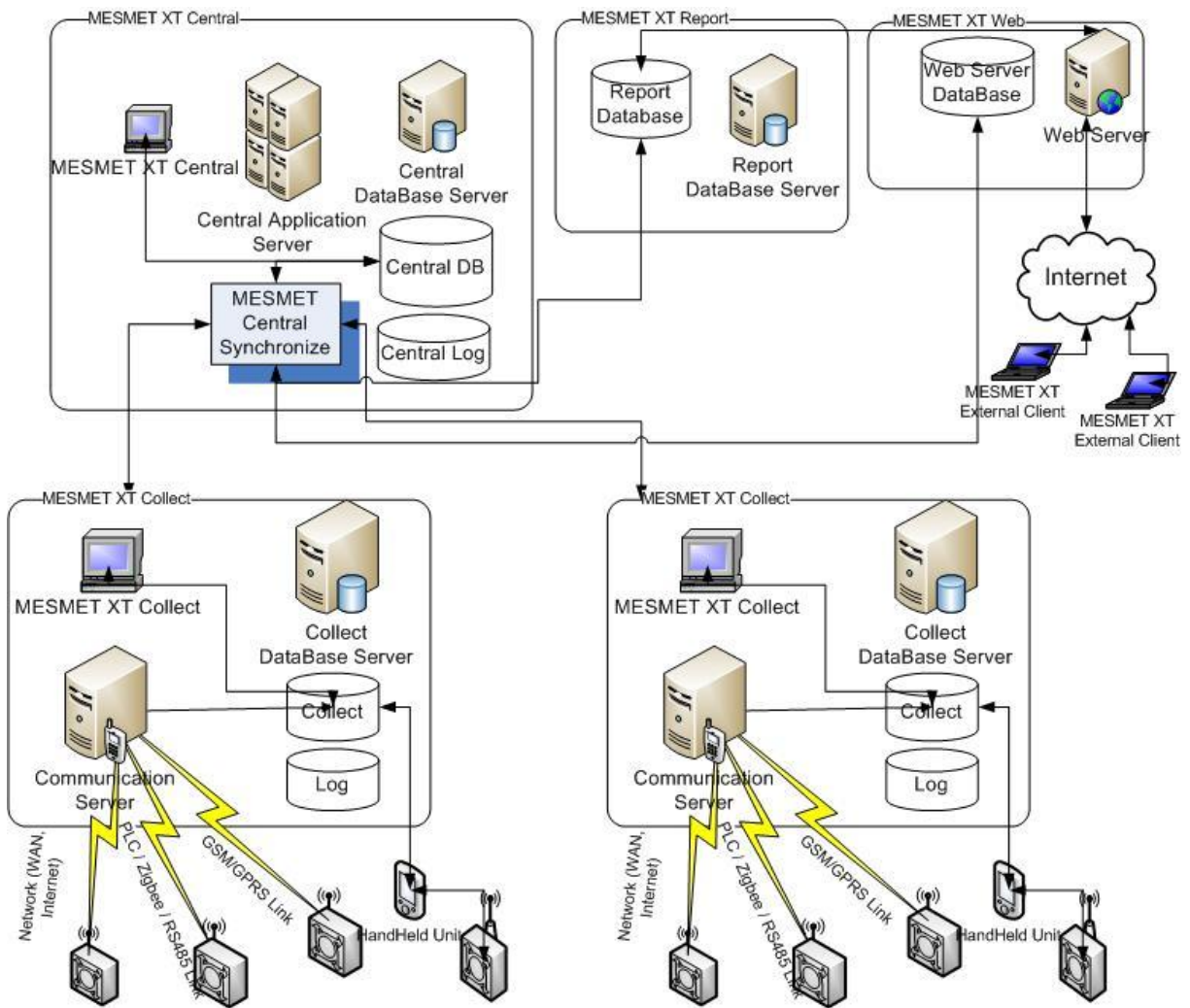


Figure 1: Global presentation of system architecture

One MESMET XT COLLECT unit, by use of capacity of its communication server, collects data directly from the meter or through concentrator. Basic validation of this data is performed, and then this data is synchronized with MESMET XT CENTRAL part.

1.2. Architecture of MESMET XT Central

MESMET XT CENTRAL system is realized as modular and scalable solution which is capable to support data processing for more than 500,000 electricity meters. The key roles of this part of the system are:

1. Data processing and Reporting
2. Monitoring and Event management in the system.

Thus through client application MESMET XT Central it is possible to define tasks of validation, calculation and substitution of read data, as well as data export tasks in the formats suitable for use in other systems. Also, through client application MESMET XT Central it is possible to administrate access rights to system functionalities for all other system users.

The system has service parts which, according to the parameters defined through the application MESMET XT Central, perform data management tasks (Data Validation and Processing), along with the replication tasks with remote system parts (Replication services). Logging of all operations in the system is made through the service MESMET XT Logging.

Figure 2 shows MESMET XT CENTRAL architecture.

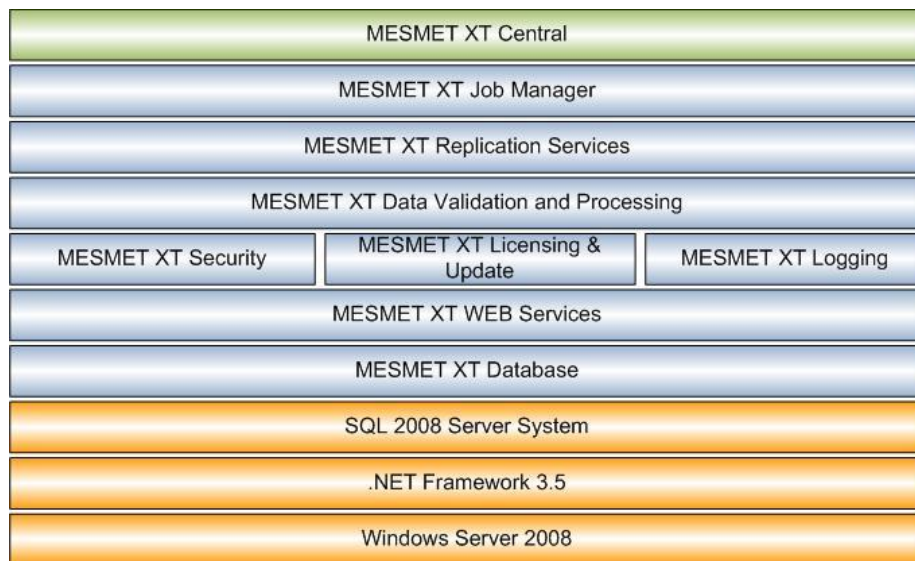


Figure 2: MESMET XT CENTRAL architecture

1.2.1. MESMET XT Logging

All activities of the system are recorded in the database established specially for this purpose. The activities include: operator's actions, service's actions, direct data changes and events scheduled in database. Depending on configured level

of detail, the data on performance of these actions and their results is entered into MESMET XT Log and MESMET XT Central Log base.

1.2.2. MESMET data validating and processing

System capabilities for validation and processing are validating, editing and running of calculations on data. Validation implies definition of the rules according to which validation will be performed automatically or manually.

Automatic validation is performed at two levels:

- Basic validation in which read values are compared to their predefined boundary values
- Advanced validation in which read values are compared to previously read values of the same type.

Appearance of any irregularities in the data is signalized to the user and possibility of manual validation of data is provided.

In calculations it is possible to define complex calculation by use of simple operators and to apply such calculation according to the schedule automatically or manually to user defined set of data. Some of the basic calculations are calculation of energies from the read profile of loading for the period, summing of energies of a group of consumers, calculation of maximum and minimum for the period, multiplication by the constant.

The System has its own protection mechanisms based on asymmetric cryptographic systems and the sub-system for automatic update of versions and licence control.

1.3. Architecture of MESMET XT Collect

MESMET XT COLLECT system is realized as specialized software – hardware assembly intended for direct support to communication with the meters. Capacity of this part of the system depends of user needs. In the basic version it includes one database server and one communication server. Depending on the available server hardware and organizational and structural distribution, to one database server of the MESMET XT COLLECT system it is possible to connect over 30 communication servers, or at various locations – nearer to users to install separate database servers to which smaller number of communication servers is connected. The key roles of this part of the system are:

1. Reading of data from the meters at customer or at transformer substation and sending commands towards meters,
2. Monitoring of reading,
3. Monitoring and remote parameterization of communication equipment and the meters themselves

Through client application MESMET XT Collect it is possible to administrate data on consumers in the system and their metering points, automatic data reading, add and administrate all parameters of the meter and communication modules in the system, issue On Demand commands and view read data and reading statistics, substitute data with other values, whereby both original and new values are stored in the database. Through this application it is possible to perform remote parameterization (tariff profile, clock setting, disconnecting a group of consumers, etc...). The application contains also the overviews of the read event logs which are suitable for perceiving any irregularities on distribution grid or operation of the meters themselves.

The systems of protection, logging, update of versions and licensing are identical to the infrastructure applied to MESMET XT CENTRAL.

Figure 3 shows MESMET XT COLLECT architecture.

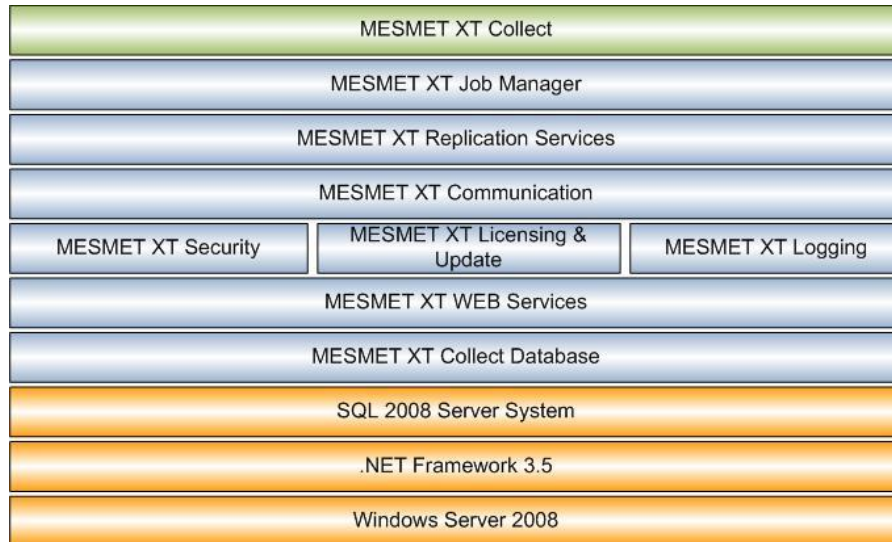


Figure 3: MESMET XT COLLECT architecture

1.3.1. MESMET Comm Services

Data collection communication system includes windows services which communicate with remote meters directly or through concentrators. Currently for direct communication with meters the standard DLMS/COSEM is supported, while the standard defined by concentrator manufacturer is used for communication with concentrators.

A part of the communication system is envisaged as a modular sub-system, thus it can be upgraded with modules which communicate with meters and concentrators under other standards as well. This enables management of equipment of various manufacturers via different communication channels (Zigbee, PLC, GSM, GPRS, Internet ...).

According to schedules which are downloaded from the MesmetXT Central system, or based on commands initiated by user, the service starts specified operations over the meters. By use of one or more communication servers on which it is possible to install 32 GSM/GPRS modems, the service reads groups of meters at the same time, thus enabling efficient reading of great number of meters (with one communication server reading of 30,000 meters twice during a day is possible). The service creates the context within which connection with the metering device is initiated, required reading or operation is performed, and after that the data read or operation result is recorded into database. The basic data validation is performed during recording of the read data. The data, with adequate statuses (Substitution, Invalid, Valid...), is sent to MESMET XT Central.

The service is realized in Windows Service technology and it operates independently from other client applications and it can be monitored by ServiceControlManager.

1.4. Architecture of MESMET XT Report

The system MESMET XT Report is realized on SQL 2008 Reporting services. The key roles of this part of the system are:

1. Creation of reports on the data collected in the central part,
2. Modification and adjustment of reports to users' needs,
3. Publication management and creation of reports according to specified schedule.

Through application MESMET XT Central and through Web portal the user can modify and adjust already defined reports to his own needs, subscribe to the defined reports. The sub-system MESMET XT Report automatically, according to schedules, generates and sends reports to all subscribed users.

The systems of protection, logging, version update and licensing are identical to the infrastructure applied to MESMET XT CENTRAL.

Figure 4 shows MESMET XT REPORT architecture.

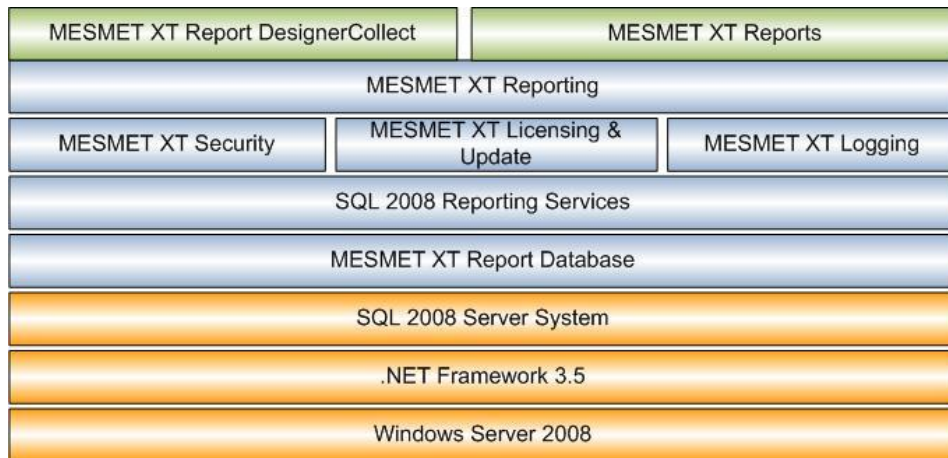


Figure 4: MESMET XT REPORT architecture

1.5. Architecture of MESMET XT Web

The system MESMET XT Web is realized on Microsoft IIS 7.0 platform. The key roles of this system are:

1. Web application for access of remote authorised users to data,
2. Modification and adjustment of reports to users' needs
3. Monitoring of meters performing metering at metering points for which the user is authorised.

The systems of protection, logging, version update and licensing are identical to the infrastructure applied to MESMET XT CENTRAL.

Figure 5 shows MESMET XT WEB architecture.

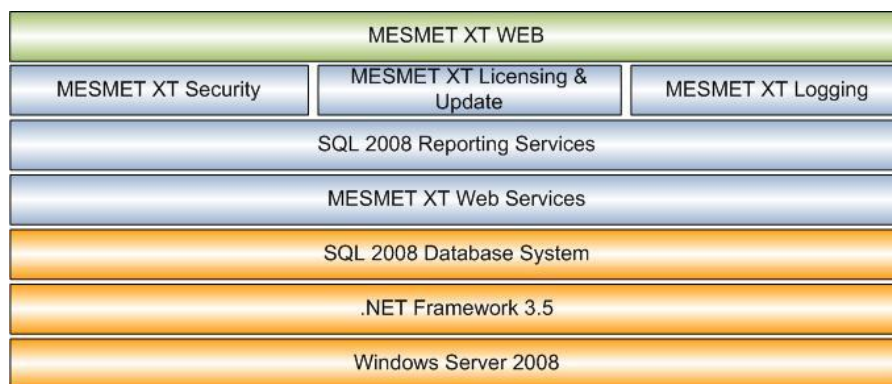


Figure 5: MESMET XT REPORT architecture

2. Description of System Elements

2.1. MESMET XT Central

In the basic package MESMET XT Central application provides:

- Administration of topology of MESMET XT system represented by Collect units,
- Administration of users and application groups and their rights,
- Administration of meter types whose use is supported by the system, DLMS communication parameters, status related to parameterization, etc.,
- General administration through which the following is defined:
 - o accounting period,
 - o physical metering values,
 - o data view format,
 - o time zones,
 - o tariff table and profiles,
 - o value identifiers by use of which objects on various meter types are uniformly identified
- Definition of schedule for all automatic system activities. It is possible to define the schedules on daily, weekly or monthly level for activities such as:
 - o Creation of collected data backup
 - o Data replication (import or export) towards other systems
- Definition of sequential task flow composed of several tasks with parameters mapping. Thus, for example, it is possible to define the task "Read-Validate-Export" which will be executed according to the defined schedule.
- Overview of activity logs and performed tasks
- Synchronization monitoring and management with collect centres

In the basic package through MESMET XT Central Windows services the following is provided:

- Automatic synchronization of data with Collect bases
- Automatic synchronization of Reporting basis
- Automatic synchronization of data with Web base

As additional options of MESMET XT Central application the following may also be obtained:

- Administration of virtual metering points which enables better analysis of collected data and definition of wide calculation spectrum with data
- Configuration of calculation parameters on the data related to virtual metering points (SUM, MAX, MIN, SUB ...) and performance of calculations automatically, according to schedules.
- Configuration of parameters for the tasks of validation and data substitution, automatic execution of these tasks according to schedule and allocation of adequate status to such data.

2.2. MESMET XT Collect

In the basic package MESMET XT Collect application provides:

- Administration of user rights and application groups taken over from the central system to the specific functions of Collect unit.
- Administration of consumer profiles, consumer categorization and connection with metering points,
- Administration of metering points, set of metering points for which metering is performed, administration of metering point profiles, connection with reading schedules,
- Definition of schedule for all automatic system activities. It is possible to define the schedules on daily, weekly or monthly level for activities such as:
 - o Operations on meters (reading or parameterization). It is possible to read load profile, grid quality, events on metering point and all other values supported by the meter under DLMS standard, as well as setting up of operation of remote disconnection of individual or all phases for a group of consumers,
 - o Creation of collected data backup
- Administration of meters and connection to metering points, meter configuration recording, meter activation with connection to metering point, support to meter lifetime processes (replacement, failure, deregistration).
- Administration of individual communication network elements (GSM/GPRS modem, PLC modem, Zigbee modem, Concentrator)
- Administration of communication network and communication service. Total configuration of communication path to individual meters is enabled (Communication Server – GPRS – Zigbee – Meter or Communication Server – GPRS – Concentrator – PLC – RS-485 – Meter, etc.)

- Administration of parameters of basic data validation read on meters and manual data substitution
- Support to meter maintenance process, reading and overview of event log, meter safety switches, clock adjustment, setting power limit, tariff profiles and other configuration data on the meter that are supported through DLMS standard.
- Issuance of On Demand commands for reading and writing, at the level of metering points.
- Overview of reading task table and possibility of repetition of unsuccessful commands and tasks
- Permanent insight into efficiency in communication with meters in form of various statistics
- Overview of reports on efficiency of connecting and disconnecting of consumers, clock synchronization or setting of configuration parameters on group of meters
- Overview of activity logs, communication, synchronisation with the central part
- Basic reporting on reading results.

Through windows services:

- Automatic meter reading

As additional options of MESMET XT Collect application the following may also be obtained:

- Meter parameterization module which includes creation of meter profile parameterization, and meter parameterization tools
- Module for communication module parameterization with tools for communication module parameterization and creation of module parameterization profiles
- Module for direct communication with meter
- Module for examination of read data
- PocketPC module which includes administration of PocketPC operator, administration of PocketPC device, administration of PocketPC application and communication with PocketPC device in the processes of application installation and data exchange.

2.3. MESMET XT Report

In the basic package MESMET XT Report application provides:

- Administration of right to reports
- Report overview
- Adjustment of reports to users' needs
- Definition of reporting-related tasks: automatic subscription to reports, periods of synchronization with central base

2.4. MESMET XT Web

In the basic package MESMET XT Web application provides:

- Administration of right to web access
- Synchronization of web base with reporting base
- Acceptance of new subscriptions to reports by users
- Display of reports related to data and readings