Star Beat

Software Architecture

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Summary

The aim of this document is to describe the architecture for the Enel Link. For all the terms in brackets [], please refer to Project Glossary.

Distribution List

Document target list

Name	Company

This artifact is available on Confuence:

- Project: IN - Product StarBeat

Document modifications

The following modifications refer to the old document versions.

Changes Description	Reference
First version	1

References

List of the documents

[1] [Krutchen 1995] Philippe Krutchen, Architectural Blueprints - The “4+1” View Model of Software Architecture, IEEE SW 12-1995

[2] 1250_AD5GL_AMMSoftwareArchitecture.docx

Table of Contents

1. Introduction

This Software Architecture document give information about the Product Functionalities available and the architectural solution used in the Star Beat System. It will also provide an overall overview of the systems that are involved in the business processes described.

1.1. Audience

The audience of this document is Enel Global Digital Solution ,and, interested partners and suppliers.

2. Main Functional and Architectural Overview

In following paragraphs will be explained the Star Beat Product features, functions and software architecture.

The Star Beat Product features and functions are explained using the following points of view:

1. The **Features and Functionalities** View. Section that contains a brief description of the available features.
2. The **Use-Case** View, that contains use cases ,and, encompasses scenarios architecturally significant.

The StarBeat Product Technical Architecture documentation is represented by a number of different views, which in their essence are extract illustrating the "architecturally significant" elements. The StarBeat Technical Architecture documentation is composed by:

1. **The Logical View**, which contains the most important design classes and their organization into packages and subsystems, and the organization of these packages and subsystems into layers
2. The **Implementation/ Deployment View**, which contains
   - an overview of the implementation model and its organization in terms of modules into packages and layers. The allocation of packages and classes (from the Logical View) to the packages and modules of the Implementation View is also described.
   - the description of the various physical nodes for the most typical platform configurations, and the allocation of tasks (from the Process View) to the physical nodes. This view need only be used if the system is distributed. It is a subset of the deployment model.

2.1. StarBeat Sub-System Model

Star Beat System is composed of the following main three subsystems:

- **StarGroove**
- **StarPulse**
- **StarSync**

The functionalities of these three main subsystems are described below.
The logical view of the interactions is resumed here:

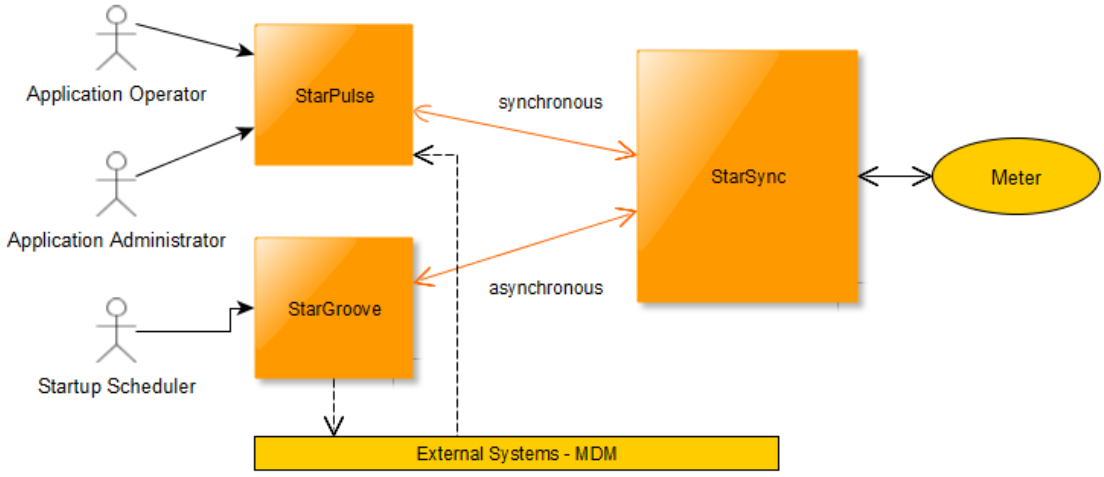


Figure 1: Main Sub-Systems view

These three subsystems uses:

- service modules (like Configurator, Profiler) by which it is possible:
  - to establish authorizations and roles on their functionality
  - to configure the parameters of the systems, appropriately
- persistence modules (see StarPulse, StarGroove, StarSync) to interact with DB

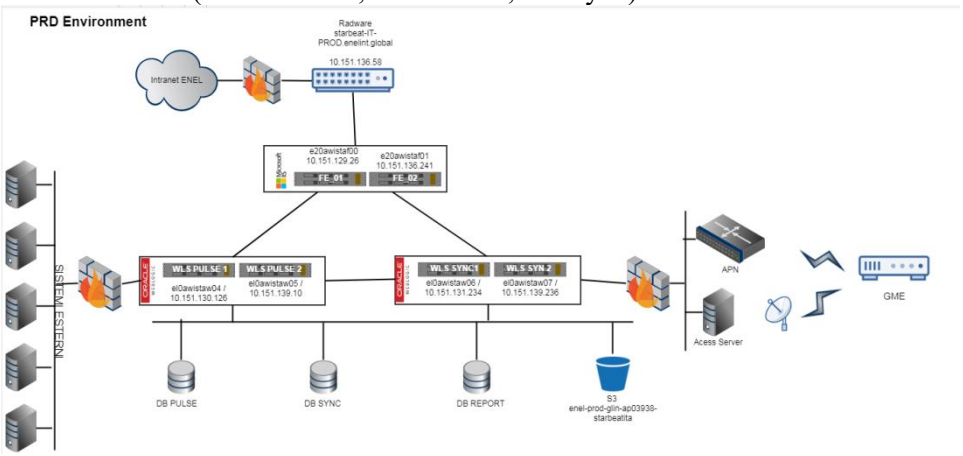


Figure 2: Infrastructure view

In StarBeat there are other modules for example the Reporting Module, allows the user to filter, view and export the Star Beat data (master data, readings execution, etc.) . All these modules are represented and described in the **Technical Architectural View (document/section).**

2.1.1. StarPulse

StarPulse subsystem provides all user interfaces ,and, services that enable a back office operator to handle the inventory of meter, and, create manually scheduling Tasks.
It provides administrative interface for enabling an application administrator to change the system parameters. StarPulse contains services that allow external systems of meter management to upload the inventories. ***Basically it's a subsystem of presentation interfaces and services.***

2.1.2. StarGroove

StarGroove subsystem provides all processes for creating automatically GME meter management tasks, and for dispatching these tasks to StarSync subsystem. It's responsible for processing the responses returned from StarSync and to communicate them to external systems. ***Basically it's a subsystem responsible for automatic creation of scheduled Tasks and for processing the returned response massively.***

2.1.3. StarSync

The StarSync Subsystem takes charge of the activities for meter management created and dispatched by StarGroove or of the spot requests activated by a back office operator in StarPulse (or via Remote system request). It uses appropriate driver to submit these request activities to meters and acquire responses.
Basically it's a subsystem responsible for the communication with the meters for performing the activities submitted by StarGroove and StarPulse.

2.1.4. Report

The Reporting module allows the user to filter and view the acquired readings (eventual errors and warning), the historical master data, and the telereading communication data; this module is described in the **Technical Architectural View (document/section).**

3. Advantages

Advantages

- ✓ Horizontal scalable and High Availability solution
- ✓ Product configuration modularized and customizable
- ✓ Avoid system modules coupling
- ✓ Self-consistent
- ✓ Provide expandability
- ✓ Testable
- ✓ Enel architecture compliant

3.1. Horizontal Scalability and High Availability solution

Star Beat System provides a load balancing and an high available system, in order to satisfy a strict horizontal scalability constraint; in according to the system architecture design.

3.2. Product configuration modularized and customizable

The installation and customized configuration of the product, can be made in according to the system architecture design ,and, the country that uses it (E.g. Protocols, Measurers, and, territorial organization) StarBeat System Is a modularized system in which each component has its own specific responsibilities.

3.3. Avoid tight coupling

The StarBeat System architecture solution avoid tight coupling among its components.

3.4. Self-consistent

StarBeat System is a self-consistent application, that depends only on its own features with no logic implemented inside other systems. When StarBeat System rely on information stored inside an external system, it access it using well-defined APIs compliant to widely adopted open standards.

3.5. Provide expandability

It is possible to add new features to StarBeat System without affecting the current implementation.
The underlying constraint in use is to minimize the use of custom code, to rely on well-known, de-facto standard frameworks, and to exploit middleware services.

3.6. Testable

StarBeat System is a distributed system with strong integration requirements, is designed ,and, developed from start having testability in mind. The "Software testability" means automatic testability first of all, so StarBeat come with a comprehensive suite of unit tests and supports automatic integration testing. Integration tests is implemented so that they can be executed without the need to deploy the application modules to shorten the development cycle. The Documentation (e.g. Catalogue) provided supports to the tests ,and, the interfaces are comply to established open standards supported by common software testing tools.

3.7. Adhere to Enel architecture guidelines

The StarBeat System is compliant with the standards and guidelines issued by Enel Governance.

4. Features and Functionalities View

The StarBeat System is a Point to Point Advanced Metering Management System for GME Meter , with global scope (Italy, Spain, Brazil, Peru, Colombia, Chile, Romania, etc.), for this purpose the system is scalable and customized for the different country on which the system will be installed.

4.1. Product Features, and, Functionalities list

Product features	Functionalities
Authentication and authorization (through Secure Beat system)	Single Sign-on compliant
	Integration with LDAP
	Authentication from external Enel domain
	Definition of physical user/operators, and, also application/virtual user
	User Profile association to specific territorial organizations, with different levels of authorization
Generic product functions	Web access
	Multilanguage
	Time Zone management
	Synchronization with an external clock source
	Administration console - Product parameters configuration
	KPI - Dashboard
	Reports dynamic and customizable
	Data Export
	External systems integration
	Log and trace management
	Internet Protocol version 6 (IPv6)
	High availability and scalable architecture
	Data storage for a parameterized number of month
	Self diagnostic functions and alarms management
Meter Local Reading management	Local meter acquisition within Mobile smartphone (Android)
	Local meter synchronization within Mobile smartphone (Android)
	Data transfer from Mobile Smartphone to SB server
Inventory (Technical master data management)	GUI for Equipment master data creation, modification and visualization.
	Password management
	Territorial hierarchy management
	Groups management
	External System Interfaces for master data update
Call and connection management	Connection technologies supported: GSM, GPRS, PSTN, RTC, SAT, etc.
	Multi protocol capability: IEC , DLMS , REE …
	Main and back up communication technologies management
	Multi provider and call routing management with GSM cost optimization
	Multidrop meter management (one modem with more than one meter installed)

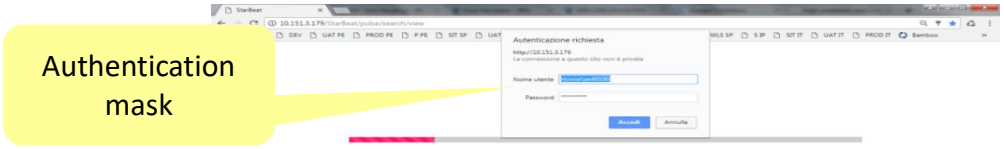
	Multi communication protocols management (Main Second)
	Calls priority management
	Retries and errors/warnings management
	Tracking of history of connection/communication attempts - Report
Scheduling management	Automatic predefined scheduling configuration
	Frequency acquisition configuration
	Call Scheduling management and configuration
	Massive or single scheduled Activates management
	Raw Data Normalization
Telemanagement functions	Workorder management from external system
	Configuration of Workorder operations
	Workorder execution (acquisition and retry)
	History of workorders and GUI view
	Backend Configuration of workorder/operations
Tele reading functions	Activities type customizable.
	Reading execution and meter data acquisition customizable
	Communication and call setting
	Data acquisition inconsistencies check
	Meter remote setting: Eg. Clock, etc.
	Meter remote data acquisition: Billing/Actual registers, Instantaneous values and diagnostics data
	Acquired data standardization and normalization
	Acquired data visualization
	Acquired data exporting to external system
Online functions	On line activities, via GUI of inventoried or not inventoried meters
	Online GUI visualization of the: activities status/results, and, acquired data (Raw and normalized)
	On line activities, via External System request, of inventoried meters
	Online communication to external system of the: activities status/results, and, acquired data (Raw and normalized)
	Online meter clock setting
	Online activities execution using custom communication setting
	Online activities in order to recover periods of Load Curves stored in the meter

4.2. Authentication and authorization

The system is able to manage authentications ,and, authorizations in cooperation with the Secure Beat system, so the authentication/permissions functionalities that Star Beat manages are closely to what is defined in Secure Beat system. The macro functionalities managed are as follows:

1. Single Sign-on compliant
2. Integration with Enel LDAP
3. Authentication from external Enel domain
4. Definition of physical user/operators, and, also application/virtual user (E.g. Digitaly)
5. User Profile association to specific territorial organizations, with different levels of authorization (Create, View, Edit)

The Authentication can be executed from external Enel domain with enelint.username and password



Catalogue link: FU - Checking Authorization

4.2.1. User definition and profile association

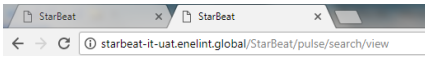
This feature is present in collaboration with the Secure Beat system

4.3. General Product functions

Below is a brief description of the general functions

4.3.1. Web access

Web access is via the enelint.global domain, so it can do via VPN.



Catalogue link: FU - Checking Authorization

4.3.2. Multilanguage

In each product installation, this function allows:

- to load all the available languages.
- to each user in any StarBeat UIs to change the default language.

Star Beat is developed and configured in English, as it is the reference language. The default language is a specific installation setting, so the default language depends from the configuration of the installation. The languages currently available are: English - Italian - Spanish - Chilean - Romanian.

Catalogue link: FU - MultiLanguage

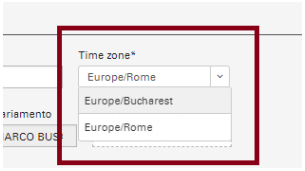
4.3.3. Time Zone management

This function allows StarBeat to utilize different time zones, in order to manage meters physically installed in different location (compared to the telemetering / telemanagement server system) take into account the time zone in which the meters are physically installed, in order to execute the activity. So:

- in one system installation, can been inventoried equipments placed in different time zones
- the telemetering process manages the meters taking into account the time zones in which they are physically installed.

The Time Zone is a variable present in the:

- schedule process;
- reading and normalization operations, in addition to the clock synchronization operation;



Catalogue link: FU - Time Zone management

4.3.4. Synchronization with an external clock source

The clocks of the systems present in the various StarBeat installations are synchronized in the Country respectively directly from Amazon.

4.3.5. Administration console - Product parameters configuration

The Admin Console is used by the product administrators to view ,and, edit the parameters of groove and Sync components, in each specific product installation.
This feature also includes functions that provide information reserved for administrators, or, profiled controls that can be performed on the meters, as well as the level of reporting (if error or warning). E.g.:

- In the SYNC Properties Console the operator can configure the Providers, and at each installed meter it is possible to associate the Provider with whom it will be contacted.
- In the SYNC Properties Console it is possible to configure the communication timeout.
- Etc.

Catalogue link: FU - Admin Console

4.3.6. KPI - Dashboard

StarBeat provides dashboards that aggregate the starbeat data in the reporting section.
The dashboards are navigable in detail and allow the operator to filter the exposed information. The KPI Dashboard shows the below three main sections, and, gives access to sub-pages of details:

- the Telereading Panel section
- the Communication Panel section.
- the Mater Data Updating Panel section

Catalogue link: FU - KPI Dashboard

4.3.7. Reports dynamic and customizable

Star beat system give reports in order to aggregate and analyze data. The reporting sections are customizable ,and, made dynamic thanks to the various filters provided.

The product reports are listed below, and, each report gives access to the respective detailed sub-pages:

1. **Equipment Report** - shows the equipments historical data.
2. **Communication Report** - shows the synthesis of call executed for day, and, to get access to the Error details Report by day and communication channel
3. **Telereading** - contains summary information of the Telereadings volumes , divided by month, and, then by day (in the detail UI) .
4. **Call Tracing Report** - the synthesis of call make to executed an activity.
5. **Warning Details** - the warnings occurred in the activities execution.
6. **Error Details** - the errors occurred in the activities execution.

Catalogue link:

- FU - Equipment Report
- FU - Communication Report
- FU - Telereading
- FU - Call Tracing Report
- FU - Warning Details
- FU - Error Details

4.3.8. Data Export

SBS provides various features to export the data stored in it, both at the report level and in the most interesting features.

4.3.8.1. Report – Export data

SBS in **reporting** features provides, through the set filters in the GUI, the possibility to **export** (in **Excel, Csv, Pdf**) the extracted data.

Catalogue link:

- AD - Report Export - PDF/CSV/EXCEL
-

4.3.8.2. View Readings – Export Row-Normalized data

SBS in the View Readings feature provides, through the set filters in the GUI, the possibility to export (in Excel, Csv) the extracted data.

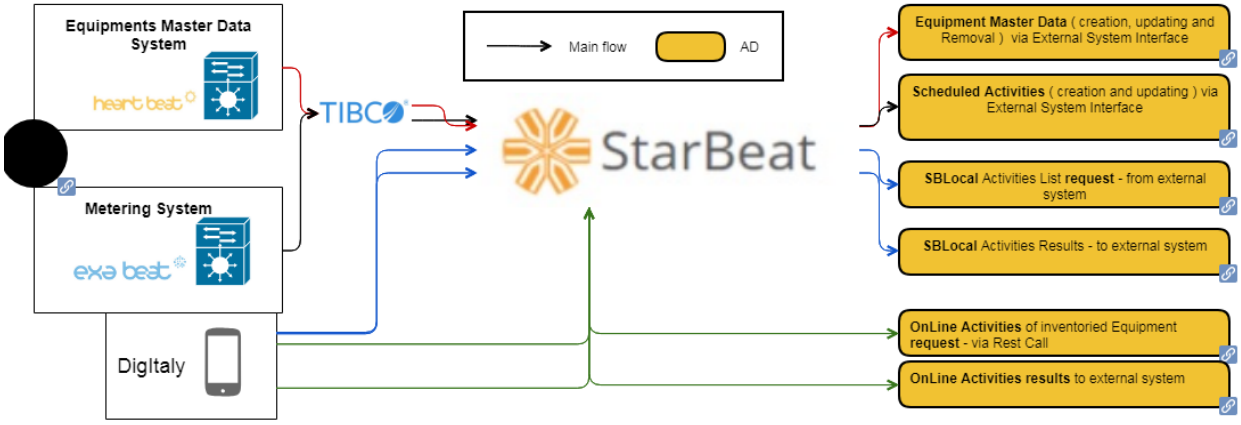
Catalogue link:

- AD - Table Data Export

4.3.9. External systems integration

StarBeat can be integrated with the following external systems:

- the centralized master data system (E.g. Heart Beat)
- the measurement master data system (Exa Beat)
- work planning systems ,or, Mobile component (Diana / Work Beat)



Catalogue link:

- FU - Equipment
- FU – Scheduled Activities
- FU - StarBeat Local

4.3.10. Log and trace management

Logging into the StarBeat system is done using log4j framework, database-level tracing.
Tracing into the StarBeat system is done using database-level (tables) tracing.
Logging and tracing are configurable, this functionality is used, for example, to keep track of the commands sent to the meters, of the activities performed by operators or external systems on the various entities, of the errors that occurred in the various processes.

Catalogue link:

- FU - Logging
- FU - Tracing

4.3.11. Internet Protocol version 6 (IPv6)

Star Beat can manage and inventory the "IPv6" attribute, but communication with meters with IPv6 technology has not yet been tested.

Catalogue link:

- EO - Equipment Master Data - SI

4.3.12. High availability and scalable architecture

StarBeat allows to have a scalable architecture.
See paragraph 3.1.

4.3.13. Data storage for a parameterized number of month

The number of months in which the data must be kept in StarBeat are to be defined in each installation.

4.3.14. Self diagnostic functions and alarms management

In the system there are automatisms (probes and queries on db, and automatic sending of mail) to monitor the progress of the system, in addition to the dashboards already available.

4.4. Meter Local readings management

The StarBeatLocal functionality expands the StarBeat system with the on-site meters measurement tasks, and, data processing currently performed by the EnelLocalAndroid applications.

Catalogue link:

FU - StarBeat Local

FU - SBLocal Activities List - from external system

FU - SBLocal Activities Result - from external system

4.4.1. Local meter acquisition within Mobile smartphone (Android)

This functionality recovers the list of SBLocal readings taken on the selected meter in the specified date range. If the date (Period) is not present, the current day will be selected.

4.4.2. Local meter synchronization within Mobile smartphone (Android)

This functionality called by the external system retrieves the Starbeat Local file normalization status ,and, the SB_Local readings results specified in the message request. The external system (Android) can call this functionality in polling.

4.4.3. Data transfer from Mobile Smartphone to SB server

The functionality is available via Back End utility; in this functionality the system give the opportunity to take .zip files from a default directory, decrypts them and normalizes them, and then publishes the results to the measurements system (Es. ExaBerat);

4.5. Inventory (Technical master data management)

The Inventory features allows users to:

- Create, edit and View the technical meters master data
- Password management: allow users administrators to view equipment's passwords
- Territorial hierarchy management: users can only be enabled to manage the meters installed in the territories to which they have been enabled.

4.5.1. GUI for Equipment Master Data Management

The Inventory features allows the GUI users to execute the below operation in the technical meters master data: Create, Edit (also remove) , View .

Catalogue link:

- FU - Equipment
  - FU - Equipment - Installation
  - FU - Equipment - Edit
  - FU - Equipment - View

4.5.2. Password management

StarBeat via user interface only provides system administrators with the ability to view the write password, read password, administrative password, etc. in plain text. This feature is provided with the Secure Beat system

Catalogue link:

- FU - Passwords management

4.5.3. Territorial hierarchy management

This function allows StarBeat to manage the installed equipment in different territorial organizations, in order to allow the authorized users to access to the data for which they have been enabled.
Territories are hierarchically organized in a 5-level geographic structure, will be mandatory utilize the first 3 levels.

Catalogue link:

- FU - Territorial management

4.5.4. Groups management

This function allows StarBeat to manage (to aggregate) installed equipments in different groups, in order to allow the authorized users to associate the desired equipment group to specific 'default scheduled activities'. On the defined meter groups, the system will be able to do specific activities, which can be carried out with a given priority.

Catalogue link:

- FU - Groups management

4.5.5. External System Interfaces for master data update

This functionalities are used in the interaction with the equipment master entity data via external systems, these functionalities allows:

- the installation/creation of a new equipment in the equipment master data entity ,and, automatically assigns a 'default scheduled activities' based on the schedule template;
- the editing/updating of already inventoried equipments, ,and, automatically assigns the right 'scheduled activities' ;
- the removal of inventoried equipments, and, of related 'scheduled activities' ;

Catalogue link:

- This 'FU - Equipment Master Data' has the following other sub-functions:
  - FU - Equipment - Create
  - FU - Equipment - Remove
  - FU - Equipment – Update

4.6. Call and connection management

The calls management process applies to call with the following origins:

- Automatic scheduled activities requests.
- Manual scheduled activities requests: Requests released manually on a group of measure points.
- Online requests.
- Problem Manager requests

The connection management process and the below information will be explained in the ''Technical Architectural View'' document/section:

- the calls prioritization
- the calls grouping (by phone number /multidrop)
- the calls routing
- the communication with the measure equipments and equipment data acquisition, 'INCOHERENCE OF PARAMETERS' checks and verifications
- the retries/delays policy.
- Call trace
- Publishing of the acquired data to external systems

The calls/concessions configuration refer to the administrative console paragraph, documentation ''Technical Architectural View'' document/section, everything else can be found in the product catalog.

4.6.1. Connection technologies supported

StarBeat manages GSM, GPRS, PSTN, RTC, SAT, etc. connections.

4.6.2. Multi protocol capability

StarBeat manages the communication through the protocols: IEC - DLMS – REE.

4.6.3. Main and back up communication technologies management

StarBeat manages:

- communications with dual-technology meters, thus allowing communication with the meter with a main and a secondary communication way
- a main channel and a secondary (backup) channel on which to route calls by telephone number.

4.6.4. Multi provider and call routing management with GSM cost optimization

StarBeat manages the optimization of calls and their routing, in order to reduce GSM costs.

4.6.5. Multidrop meter management

StarBeat provides the ability to install meters in multidrop chain (connected to the same modem), in order to be able to communicate even with a single call.

4.6.6. Multi communication protocols management

StarBeat handles communication with multiple protocols and multiple communication technologies simultaneously

4.6.7. Calls priority management

StarBeat manages the possibility of defining different priorities to the type of calls made, based on who is doing the activity request, the type of meter and the type of activity required.

4.6.8. Retries and errors management

4.6.8.1. Retries

StarBeat manages the possibility to parameterize the connection attempts both for the primary communication channel and for the secondary communication channel; it can also parameterize retries to perform a certain type of activity.

4.6.8.2. Errors/warning

StarBeat manages the possibility of reporting or not: errors, warnings generated by profiled controls.
For the profiled checks configuration, see the administrative console.
For the report of the errors and warnings generated by the calls, see the Reporting paragraph.

4.6.9. Tracking of history of connection attempts

StarBeat keeps a history of connection attempts in the **Communication/Call tracing** report, see the Reporting paragraph.

4.7. Scheduling management

The function via:

- **user interface** allows the operator to search for equipments, in order to select one equipment in the obtained result list. The operator on the results list can select an equipment in order:
  - to **view**
    - the **Manual Scheduled Activities** on it, so also the Massive Scheduled Activities (schedules that are open on equipments lot);
    - **Default Scheduled Activities** on it;
  - to edit the Manual Scheduled Activities on it, but the system does not allow to edit the Massive Scheduled Activities (schedules that are open on equipments lot);
  - to create a new manual scheduled activities:
    - using one of the configured schedule templates available, in order to create manual scheduled activities from template;
    - creating a custom manual scheduled activities;
- The function via system interface allows the external system:
  - to update Manual and Default Scheduled Activities.
  - to create ,or, to update Manual Scheduled Activities (but not the schedules that are open on equipments lot)
  -

Catalogue link:

- This 'FU - Scheduled Activities' has the following other sub-functions:
  - FU - Scheduled Activities - Create
  - FU - Scheduled Activities - Create and Maintain
  - FU - Scheduled Activities - Update
  - FU - Scheduled Activities - View

The Essential step in the schedules process is the Schedules creation, for this purpose the system uses the FU - Schedule Process - Definition .
The Definition module is responsible of the persistence of the schedules master data ,and, responsible for their queuing toward scheduler module. The system uses various components in order to perform the planed telereading activities; so the system uses the Scheduler, the Executor, the Dispatcher and the Response Handler, all the activities of the process are tracked by the Logging Manager. Below the details:

- The **scheduler** module is responsible of the meter aggregation into job, tasks evaluation, persistence and enque toward executor module. (for details see FU - Schedule Process - Scheduler)
- The **Executor** is responsible for any validation of message and eventually for completing the attributes of activities: for example if a Load Profile reading of two days is required but the last reading is older than two days, the Number Of days attribute will be increased for reading the missing days. If the message is expired, the executor has “to close” the activity.
  If the message is valid, the Executor uses the Dispatcher for choosing the queue and the appropriate STAR_SYNC responsible for the processing of the activity message, according technology and operator.
- The **Dispatcher** is meant to be a group of functionalities that allow to:
  1. Choose the primary/secondary communication mode
  2. Get the connection info (accordingly to the previous point)
  3. Dynamically create messageSenders through the messageSenderBuilder
  4. Get the messageSender: once that both communication mode (point 1), telecommunication provider and comm method (GSM, GPRS, point 2) have been defined, the messageSender will be chosen from the dispatcherEngine and returned to the caller

  These functionalities are grouped into the sb-groove-dp module and shared by Scheduler and Response Handler.
- The **Response Handler** is responsible for the processing of the readings returned by StarSync system. If the reading returned by StarSync is successful, Response Handler will:
  1. Execute supported checks on the input data (see Profiled Checks)
  2. Transcode the manufacturer obis to standard obis.
  3. Normalize and standardize the readings.
  4. Save the normalized readings and sends the results (through a queue) to the external systems. ***Notes***: *If the response is not successful and the number of retries doesn’t exceed the maximum number, Response Handler will dispatch the activities again, using the queue returned by the same dispatching algorithm used by Executor and will save the error response code*.

4.7.1. Automatic predefined scheduling configuration

To each meter installed in StarBeat are associated 'Default Scheduled Activities' that are performed automatically

4.7.2. Frequency acquisition configuration

StarBeat allows you to manage and configure the frequency of acquisition of planned activities through appropriate parameters

4.7.3. Call Scheduling management and configuration

SatarBeat allows to manage and configure through appropriate administrative parameters the scheduled activities

4.7.4. Massive or single scheduled Activates management

4.7.4.1. Massive

StarBeat allows to create the same scheduled activities on multiple meters

Catalogue link:
This FU - Massive Schedules has the following other sub-functions:

5. FU - Massive Schedules - Create
6. FU - Massive Schedules - View
7. FU - Massive Schedules - Edit
8. FU - Massive Schedules - Import From File

4.7.4.2. Single

StarBeat allows to create the scheduled activities on single meters via GUI, and, via External System interface.

Catalogue link:

- This 'FU - Scheduled Activities' has the following other sub-functions:
  - FU - Scheduled Activities - Create
  - FU - Scheduled Activities - Create and Maintain
  - FU - Scheduled Activities - Update
  - FU - Scheduled Activities – View

4.7.5. Raw data Normalization - *Response Handler*

The StarBeat system performs a pre data normalization of the data read on the meters, in order to send it to the measurement system.

The System utilizes the EO - Internal constants to normalize the raw data taken (from remote/local reading) on the meter, so the system after taken the raw data it applies the Internal constants to normalize them in the defined UM, E.g. Kwh ,and, communicate the measures at the measurement data system.

The system converts the OBIS read by the various meter families into international standard OBIS coding (XSD/XML - OBIS - MeterReadingsResult) .

The system normalizes the measurements tele-read with the internal constants set by family, **except** in cases where the equipment is inventoried with specific own inventoried constants (in EO - Equipment Master Data) and with specific operation rules of they application (for details see EO - Internal constants)

Catalogue link:

- This FU – Normalization has the following other sub-functions:
  - FU - Dirty Response
  - FU - Starbeat - Response Dispatcher
  - FU - Starbeat - Handling the chain of components for processing the responses
  - FU - Starbeat - Handling of Response Error
  - FU - Starbeat - Handling of Response Retries
  - FU - Profiling Engine Proxy
  - FU - StarBeat - Configuration Reading Normalization
  - FU - StarBeat - Diagnostic Registers Normalization
  - FU - StarBeat - Logbook Normalization
  - FU - StarBeat - Register Reading Normalization

4.8. Telemanagement functions

Through this macro functionality the system:

- gives the opportunity, from external system, to require work orders execution ; For details see:
  - FU - Work Order - Create.
- executes the possible work order requested, and refuses the no feasible one; providing a response (in the specific queue) with the results to the external system that has requested the work order ; For details see:
  - FU - Work Order - Validation
  - FU - Work Order - Execution
  - FU - Work Order - Response (Ack).
- gives the opportunity to view the results of work order requested via UI ; For details see:
  - FU - Work Order – View
- publishes in the specific queue the work order result in xml messages ; For details see:
  - FU Work Order – Result
  - FU - Work Order

Catalogue link:
For details see FU - Work Order.

4.8.1. Workorder management from externa system

StarBeat allows to perform workordes required by external systems.
The StarBeat user can view the WO results via GUI .

4.8.2. Configuration of WorkOrder operations

StarBeat allows to configure via the BackEnd utility the operations, and the sequence, that the various workordes can perform. In the administrative console there are a series of parameters that allows to parameterize some operations, and their execution logic.

4.8.3. Workorder execution (acquisition and retry)

StarBeat allows to configure via the BackEnd utility the execution logic, that the various workordes can perform. In the administrative console there are a series of parameters that allows to parameterize some retry, and, their execution logic.

4.8.4. History of workorders and GUI view

StarBeat maintains, in the database, the history of the workordes performed, which communicates to external systems at the time of execution ending.
Via GUI the starbeat operator can view the history of the workordes performed on a meter.

4.9. Tele reading functions

Tele reading functions allow to execute remote activities , efficient collection of measures ,and, data recorded in the measure equipment, given the appropriate configurations and protocols for each equipment and country.
The system performs, for each type of Meter / protocol, only the possible activities.
Each activity can have its **priority** and **can be retried a defined number of times.**

4.9.1. Activities type customizable

The StarBeat acquires the load curves, and, the: billing, instantaneous, diagnostic registers from the meter, in addition to the Instantaneous values and the diagnostics data. StarBeat allows also the remote operators to perform even massive tasks of synchronizing meter clocks with that of the server

STAR BEAT may execute the following types of task :

description	priority	retry
Historical Registers Reading	1	5
Register Reading	1	5
Load Curves Hourly	1	5
Load Curves Quarter quarter Hourly	1	5
Load Curves Quarter quarter Ten Minutes Freq	1	5
Clock Synchronization	1	5
Diagnostic Register Reading	1	5
Instrumentation Profile Reading Hourly	1	5
Instrumentation Profile Reading Quarter Hourly	1	5
Instrumentation Profile Reading Ten Minutes Freq	1	5
Register Reset	1	1
Instantaneous Register Reading (IEC Protocol)	1	5
Instantaneous Register Reading	1	5
Configuration reading	1	5
Logbook Reading	1	5
Get ATR Summary Current	1	5
Get ATR Summary Total	1	5
First Load Curve Absolute	1	5
Second Load Curve Absolute	1	5
Daily Summary Absolute	1	5
First Load Curve Incremental	1	5
Second Load Curve Incremental	1	5
Daily Summary Incremental	1	5
Set Change Date Time	1	5
Get Events	1	5
Get Meter structural data	1	5
Get Current Date Time	1	5
Get RM Parameters	1	5
Get Holidays	1	5
Get Contract Powers	1	5
Get Official Time Change	1	5
Get Instantaneous Magnitudes	1	5
Get Monthly Closure	1	5
Get Seasons Table	1	5
Get Special Days Table	1	5
Get RM Data	1	5
Get Current Rate Periods	1	5
Get Latency Activation Date	1	5
Get Electronic Signature Absolute Readings	1	5
Get Electronic Signatures Energy Increments	1	5
Get Voltage Failure	1	5
Get Automatic Time Switch IV	1	5
Get Nominal Value Tension	1	5
Get High Tension Set point	1	5
Get Low Tension Set point	1	5
Get Separation Threshold Between Low Tension And Lack Of Tension	1	5
Get Minimum Duration Lack Tension	1	5
Get Minimum Duration Tension Out Of Limits	1	5
Get Incidence In Tension Out Of Limits Closed	1	5
Get Incidence In Lack Tension Closed	1	5
Get Incidence In Tension Out Of Limits Course	1	5
Get Incidence In Lack Tension Course	1	5
Read Meter Manufacturer	1	5
Get Load Curve Period	1	5
Set Holidays	1	5

Set Billing Period Closure	1	5
Set Contact Powers	1	5
Set Official Time Change	1	5
Set Monthly Closure	1	5
Set Seasons Table	1	5
Set RM Data	1	5
Set Special Days Table	1	5
Get Current Rate Periods	1	5
Set Latency Activation Date	1	5
Set Load Curve Period	1	5
Set Automatic Time Switch IV	1	5
Set Nominal Value Tension	1	5
Set High Tension Set point	1	5
Set Low Tension Set point	1	5
Set Separation Threshold Between Low Tension And Lack Of Tension	1	5
Set Minimum Duration Lack Tension	1	5
Set Minimum Duration Tension Out Of Limits	1	5
Delete Contract	1	5

Catalogue link:

- EO - Activity Type

4.9.2. Reading execution and meter data acquisition customizable

In StarBeat System the data execution and acquisition are configurable.

The activities that StarBeat executes may have the following origins:

- **Online** request:
  - SB via GUI allow to generate spot call requests on demand for a particular inventoried meter
  - SB via GUI allow to generate spot call requests on demand for a particular **NOT** inventoried meter
  - SB via external system request allow to generate spot call requests on demand for a particular inventoried meter
- **Automatic** request:
  - SB has a process that automatically generate activities for each measure point to collect its information according to the schedule plan defined in the inventory.
- **Manual** request:
  - SB via GUI allow a **user** , with the appropriate profile, make specific scheduled requests on specific meter.
  - SB via external interface allow to an **External System** , with the appropriate profile, to make manual scheduled requests on specific meter.
  - SB via GUI allow a user , with the appropriate profile, to make **Massive scheduled requests** on a group of meter.
- **PM** request:
  - ToBeIntegrated

StarBeat keeps track of the activities carried out, and of their results

All **tele-readings requests** along with the date and time of their generation, regardless of its origin, are **saved in the system**.

The order to perform the remote activities is determined by their 'priority levels' , that will be established depending on:

- the origin of the request
- the activity type
- the request type (manual, system, online, Etc.)
- the meter type (the group) ;

The 'priority levels' can be customized, so the SB System allowing to define up the priority levels of specific meter, or, activity type, etc.

Catalogue link:

- FU - Scheduled Activities
- FU - Massive Activities
- FU - Schedule Process
  - FU - Schedule Process - Definition
  - FU - Schedule Process - Scheduler
  - FU - Schedule Process - Executor
  - FU - Schedule Process – Dispatcher
    - FU - Starbeat - Response Dispatcher
    - FU - Starbeat - Handling of Response Error
    - FU - Starbeat - Handling of Response Retries
- FU - Online Activities
  - FU - Online Activities - On Inventoried Equipment
  - FU - Online Activities - On Not Inventoried Equipment
  - FU - Online Activities Results via External System
  - FU - Online Activities via External System - On Inventoried Equipment
- FU – StarSync
  - FU - DLMS protocol request processing
  - FU - Handling of communications with meters on Mobile networks (GSM\PSTN, GPRS)
  - FU - Handling of Expired Tasks
  - FU - Handling of physical connections the meters
  - FU - IEC protocol request processing
  - FU - ION protocol request processing
  - FU - REE protocol request processing
  - FU - StarSync activation for processing a synchronous or an asynchronous request
  - FU - StarSync Protocol Processing of a StarBeatLocal Request
  - FU - StarSync Protocol Processing selection for a standard StarBeat Job Request
  - FU - Tracing of Sync Events
- FU – Normalization
  - FU - StarBeat - Configuration Reading Normalization
  - FU - StarBeat - Diagnostic Registers Normalization
  - FU - StarBeat - Logbook Normalization
  - FU - StarBeat - Register Reading Normalization
  - FU - Starbeat - Handling the chain of components for processing the responses
- FU - XML Publication
    - FU - StarBeat - XML Generation for external systems

4.9.3. Communication and call setting

StarBeat allows to set communication and call parameters

4.9.4. Data acquisition inconsistencies check

StarBeat performs profiled checks on the acquired data in order to detect any inconsistencies or discrepancies between purchase data and inventoried or expected data

4.9.5. Acquired data standardization

StarBeat standardize / normalize the acquired data

4.9.6. Acquired data visualization an exporting to external system

StarBeat allows to view the acquired data through the functionality: FU - View Readings.
The system can also export the acquired data after receiving a request from an external system:
XSD/XML - MeterReadingsResult

4.10. Online functions

This functionality is available via the graphical user interface, and, via external system interface.

This functionality the system give the opportunity to search inventoried meters, in order to execute online activities with them; and, in case the meter has not yet been inventoried will be also possible to do Online Activities on it, by entering the request data.
E.g. In StarBeat, through this feature:
- can be set the meter clock online;
- it is possible to set up custom communication setting in order to execute the activities;
- it is possible to recover the desired periods of Load Curves stored in the meter.

- is possible the online visualization of the call status, of the results, and of the acquired data (raw and normalized).

The system, **with the GUI functionality**, provides access to:
- details of the steps that the system performed by carrying out an OLA
- details of the results generated by the execution of OLA
- details of the equipment that has been selected (only in the case of OLA on equipment inventoried)

The system, with the OLA **via External Interface request**, allows the remote system to execute online activities on inventoried equipment. So, the system provides access to:
- details of the results generated by OLA execution requested form external system
- details of the result generated by StarBeat Local reading

N.B.: the **activities** that can be done are those listed in the 4.9 and 3.9 telereading paragraphs.

Catalogue link:
- FU - Online Activities
  - FU - Online Activities - On Inventoried Equipment
  - FU - Online Activities - On **Not** Inventoried Equipment
  - FU - Online Activities Results via External System
  - FU - Online Activities via External System - On Inventoried Equipment

5. Use Case/Activities View

This section describes the main use cases of the software architecture: these use cases document the main requisites of Star Beat System.
The documentation focus on those cases that represent central aspects of architecture, with particular emphasis to synchronous and asynchronous functionalities.

Catalogue link:

- Activity - STAR BEAT

5.1. Supported use case types

Here are described the most relevant use cases in influencing the architecture or the functionalities of the Star Beat System.
Some of these use case types are extended by ,or, included in other use case types. Moreover, use case types can have different levels of abstraction: some may refer to business processes, other can be very technical and low level.

For more details see the AD section in the product catalog.

5.1.1. Graphical User Interface ‘’use cases/activities”

Below some uses cases.

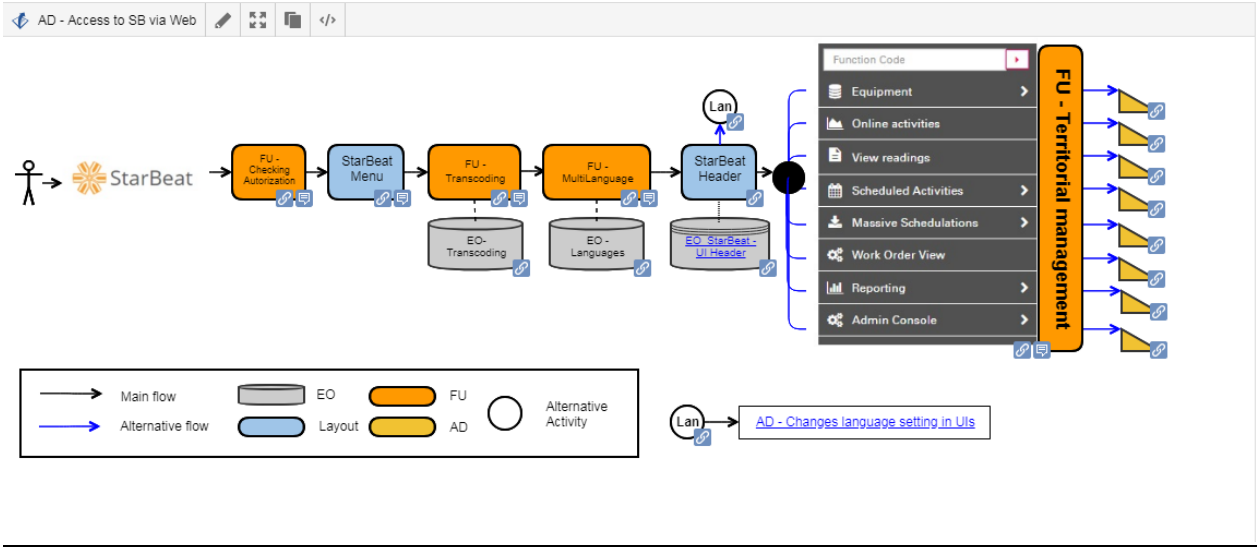
5.1.1.1. GUI users - Roles/Profiles – Authentication/Authorization

- **Manage users and Roles/Profiles**:

The SB application can manage the user Roles/Profiles in collaboration with Secure Beat System.
After adding a new Star Beat user in Secure Beat, it’s possible to associate a profile to it.
According to this profile, the user will be authorized to certain functionalities (activities)

- **Perform authentication and authorization**:

The system is able to authenticate users and filter functions available to the user based on his role/Profile; authentication can be internal or integrated with external identity providers.
Systems refuses the access to a no authorized user, notifying the lack of grant.



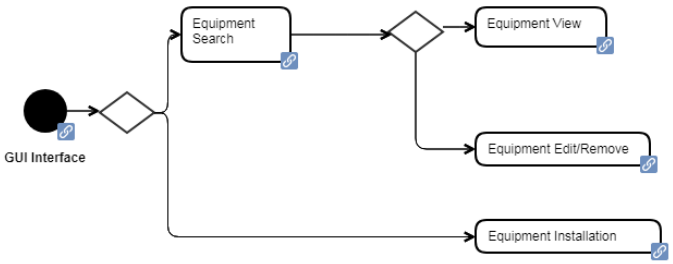
Catalogue link:

- AD - Access to the System via the web

5.1.1.2. Inventory (Equipment master data) management

The system provides a set of:

- **Graphical user interfaces** that allow an application operator to perform CRUD operations on Meter Inventory: insert/update/view of a Meter providing information on its communication module and SIM.
- External system interface that allows to perform insert/update/removal operation in the Equipment Mater data StarBeat Entity.



- **Manage Meter Inventory data:**

The operator can establish the communication parameter types that the system has to perform for each device, the system via GUI propose the default ones.
Moreover, the user can define the meter belonging to a group, so the parameters of mandatory scheduled readings in each equipment profile.
System has to notify if an error occurs during the operation and rollbacks all partial changes on inventory.

Catalogue link:

- AD - EMD - via User Interface

- **Equipment master data creation (installation)**

The system provides a user interface in order to insert master data equipment in the application data base.
In case of complete equipment installation, that is Meter installation, the system will creates a mandatory reading scheduling;

Catalogue link:

- AD_EMD installation via user interface
  - AD - EMD installation in commercial offline status
  - AD - EMD installation in technical offline status
  - AD - EMD installation - Internal constants setting
  - AD - EMD installation without communication module

- **Search equipment**

The system give the opportunity to search in the Equipment Master Data; this means that it will be possible to search meter, and, therefore, the communication module connected to them.
For Search Equipment the system will use a standard component, this component is used by viewing functionality, by the editing functionality, and also, by in the removal/disabling functionality.

Catalogue link:

- AD - Search Equipment/s for

- **View Equipment Master Data**

The system gives the opportunity to view Equipments master data details stored in the application data base. The Application Operator can query the inventories of one or more entities in the system (devices data, device management Scheduling data) and returning the results.

Catalogue link:
- AD_EMD view

- **Edit/Remove Equipment Master Data**

The system gives the opportunity to edit Equipment master data details stored in the application data base.

The system gives also the opportunity to
1) Remove Meter
2) Remove Communication module
3) Disable default scheduled Activities
4) Set 'Commercial off line' Status, or additional internal constant

Catalogue link:
- AD_EMD edit via user interface
  - AD - Edit the Equipment Master Data details
  - AD - EMD edit in order to change the [commercial offline] flag
  - AD - EMD edit in order to change the [Telereading inhibition] flag
  - AD - EMD edit in order to change the equipment [Profile] or the [Group], so the Scheduled Activities
  - AD - EMD edit in order to enter the 'Communication Module' after the installation
  - AD - EMD edit in order to remove the selected equipment
  - AD - EMD edit in order to remove the 'Communication Module'
  - AD - EMD Edit - Internal constants setting

- **Create a spot schedules (manual Scheduled Activities) on a meter ,or, a group of meters**:

The system provides a set of user interfaces that allow an application operator to define Manual scheduled Activities on one ,or, a set of meters.
A Manual scheduled Activities is a scheduling that is valid on a limited time interval: has a start date and an end date and is used to perform occasional readings on one or on a group of meters.
The operator can establish the types ,and, the parameters of manual scheduled activities that the system has to perform for each device.
System has to notify if an error occurs during the operation and rollbacks all partial changes on inventory.

Catalogue link:
- AD - Scheduled Activities - Create and Maintain via User Interface
  - AD - Scheduled Activities - View via User Interface

- **Tele management function:**

The system provides the user interface in order to view ,and, verify a remote work order execution to the meter.

Catalogue link:
- AD - Work Order

- **Perform on-line activities (Online Meter Readings/Synchronizations)**:

An application operator can perform activities (readings or synchronization) on a specific meter and acquire the results in real time. The can be inventoried or not. An appropriate Web interface enables the user to choose the type of operation on the meter and shows the intermediate steps during the task. The

user interface shows the results in case of acquisition success or the type of the communication/acquisition error.

Catalogue link:

- AD - Online Activities
  - AD_Online Activities - Inventoried equipment
  - AD_Online Activities - Not Inventoried equipment
  - AD - Online Activities - Display the detail results
  - AD - Online Activities - Display the executed or still running activities
  - AD - Online Activities - Display the execution steps
  - AD - Online Activities - Export the acquired data
  - AD - Online Activities - Reached the maximum number of executable Online Activities

- **Set System Property:**

Administrators can set and change system properties using appropriate user interface.
This settings concerns:
- the StarSync Module (for tuning the number of retries, retries delay, Provider association, etc.),
- the StarPulse module (changing language settings, layout parameters, etc.).

Catalogue link:

- AD - Admin console

- **Create Reports**

The system provides a User Interface in order to access to a set of report that provide the capability to define dynamic queries and export data.

Catalogue link:

- AD - Reporting
  - AD - Equipment Report
  - AD - Communication Report
  - AD - Telereading
  - AD - Call Tracing Report
  - AD - Warning Details
  - AD - Error Details

- **Check the state of application using administration console**

The system provides a general dashboards with information on the main functions and indicators, graphics and contextual information, alerts, etc.

Catalogue link:

- AD - KPI Dashboard

5.1.2. System use cases

- **Create automatically meter management activities**:

The system can create, using an appropriate scheduler, multiple meter activities, then starting the execution of every created activity and send them to the meter using the subsystem responsible for sending commands to meter remotely (StarSync).
The scheduler creates these tasks periodically according the settings of scheduling (established during the definition in inventory of the meter) or with Spot Scheduling User Interface.

Catalogue link:

AD - Schedule Process
AD - Schedule Process - Definition
AD - Schedule Process - Creation, Execution and Response Handling
AD - Response Dispatcher
AD - Response Handler
AD - Scheduler

- **Group activities for meter belonging to the same multidrop chain**:

The system is able to group the activities related to meters belonging to the same multidrop chain (meter connected to the same phone number).
It dispatches these activities as a unique group in order to perform them in the same communication session.

- **Dispatches activities to the proper subsystem responsible for sending command in order to execute them on meters:**

The system can dispatch the generated activities to StarSync in order to perform them using the first communication type (for example GPRS) and switching to the second communication type if the number of retries exceeds the maximum for the first type.
Moreover, the more convenient mobile operator will be used during the communication.
In the case of exceeding maximum number of retries for all communication types, the activity will be closed with an error.

  - **GPRS Communication**

  The system responsible for remote communication with the meters (StarSync) calls the appropriate method of drivers for performing the request
  (Basically it open a socket on the IP of the meter)
  If an error occurs during the reading, the system must return an appropriate error code
  - **GSM (PSTN…) Communication**

  The system responsible for remote communication with the meters (StarSync) calls the appropriate method of Drivers for performing the request
  (Basically it opens socket on the access server on a specified port according the chosen mobile operator).
  If an error occurs during the reading, the system must return an appropriate error code

- **Process activities returned from meters:**

The system has to process the results returned by the meters.
If the activity is acquired successfully the system verifies the identity of the meter, performs checks for verifying if all obis were read/write or if there are holes in the samples of load profile readings.
Moreover, the system has to associate the manufacturer obis on standard Obis in order to standardize the acquired data.
If the number of retries exceeds the maximum, the system has to save a KO response with an appropriate code error. For the next scheduled activity on the meter, the system has to considerer the KO previous response for calculating the attributes of the activity.

- **Taking charge of the asynchronous activities generated automatically and dispatched massively**

The system responsible for remote communication with the meters (StarSync) is able to take charge of the activities in a multithread mode and at the same time open more session of communications towards the meters. If an error occurs, the activity must return in the queue of activities and must be retried until the number of retries exceeds a maximum.

Catalogue link:

- AD - StarSync

- **Taking charge of a on line reading activity that was requested from the user using the proper web interface**

The system responsible for remote communication with the meters (StarSync) is able to take charge of the requested activities and returns the result to the user in real-time.
If an error occurs during the reading, the system must return an appropriate error code

- **Perform the activities of meter belonging to the same multidrop chain using the same communication session**

The system responsible for remote communication with the meters (StarSync) is able to perform the activities related to meters belonging to the same multidrop chain in a unique communication session.

Performing meter The system responsible for remote communication with the meters (StarSync) is able to:

- Perform Register Readings
- Perform Load Profile Readings at specified frequency
- Perform meter work order to program the meter
- Perform synchronization on Meters.

For performing these activities, StarSync maps the high level commands in appropriate request to Driver.
If an error occurs during the reading, the system must return an appropriate error code.
The acquired data and the result of the activity will be stored in the application data base.

- **Log and trace management**

All the application and communication log are stored in an appropriate data store.
Each specific log can be enabled or disabled by the administration setting console.

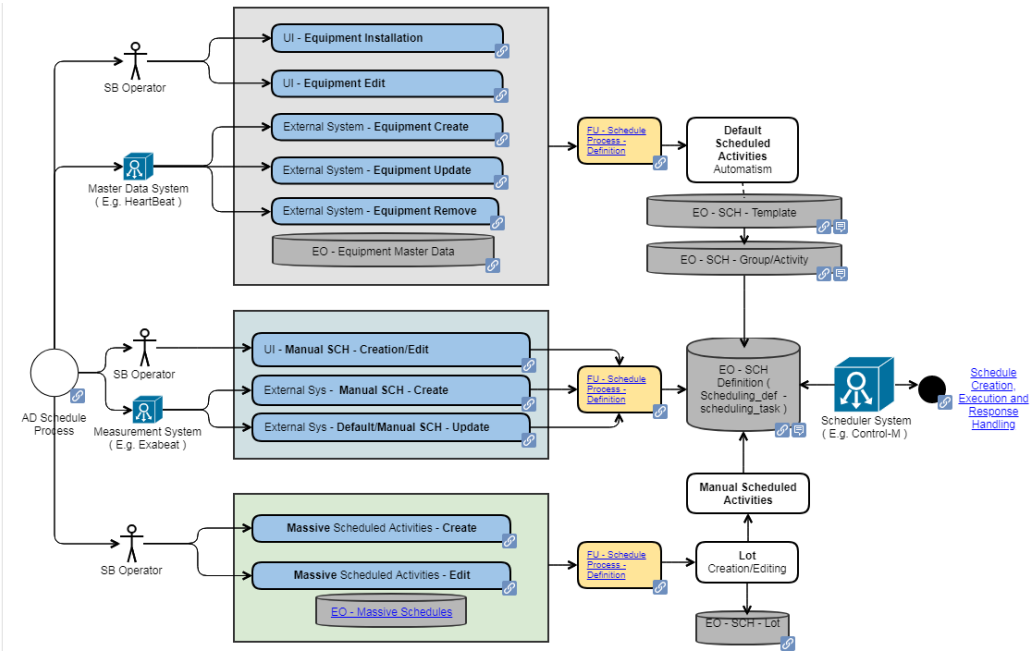
Catalogue link:

- AD – Tracing
- FU - Logging

5.1.3. External System Integration use cases

- **Enter on-demand device management task**:

This include entering a request for one or multiple on-demand device management tasks validating the request coming from the external system, creating the task, starting the task execution, then sending the *submission results* to the external system.



- **Send meter management task execution results**:

This consists in sending to the external system the *execution results* of a manually started, automatically started, on-demand or periodic device management task.

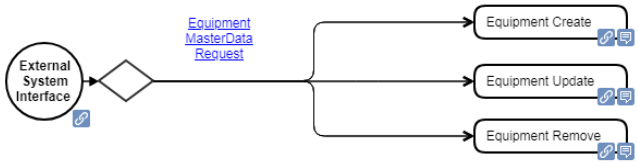
Catalogue link:

- AD - XML Publication
  - AD - XML Publication - Meter Readings Result

- **Enter inventory data**:

The system provides a set of:

- Graphical user interfaces that allow an application operator to perform CRUD operations on Meter Inventory: insert/update/view of a Meter providing information on its communication module and SIM.
- **External system interface** that allows to perform insert/update/removal operation in the Equipment Mater data StarBeat Entity.



This consists in entering a request for creation or updating the inventory of entities in the system (meter master data, communication module master data scheduling, etc.) and returning create/update *execution results* to the external system.

5.1.4. The Business Use Cases Scenarios

5.1.4.1. Send asynchronous activities to meters

This scenario describes the remote activities to automatically acquire readings from the meter.

In this case the scenario is activated when there are defined scheduling for meter and activities are generated using them. These activities are asynchronously sent to meter.

In the StarGroove system, the activities are generated and sent to StarSync according
1) the most economical operator
2) the technology protocol associated to meter in inventory.

StarSync uses meter driver to send raw commands on meters.
On the acquired readings, there is a check to verify errors on mandatory registers readings (if so, the result of the reading will be KO).
The scenario is described in the figure below.

5.1.4.2. Send asynchronous activities to meters

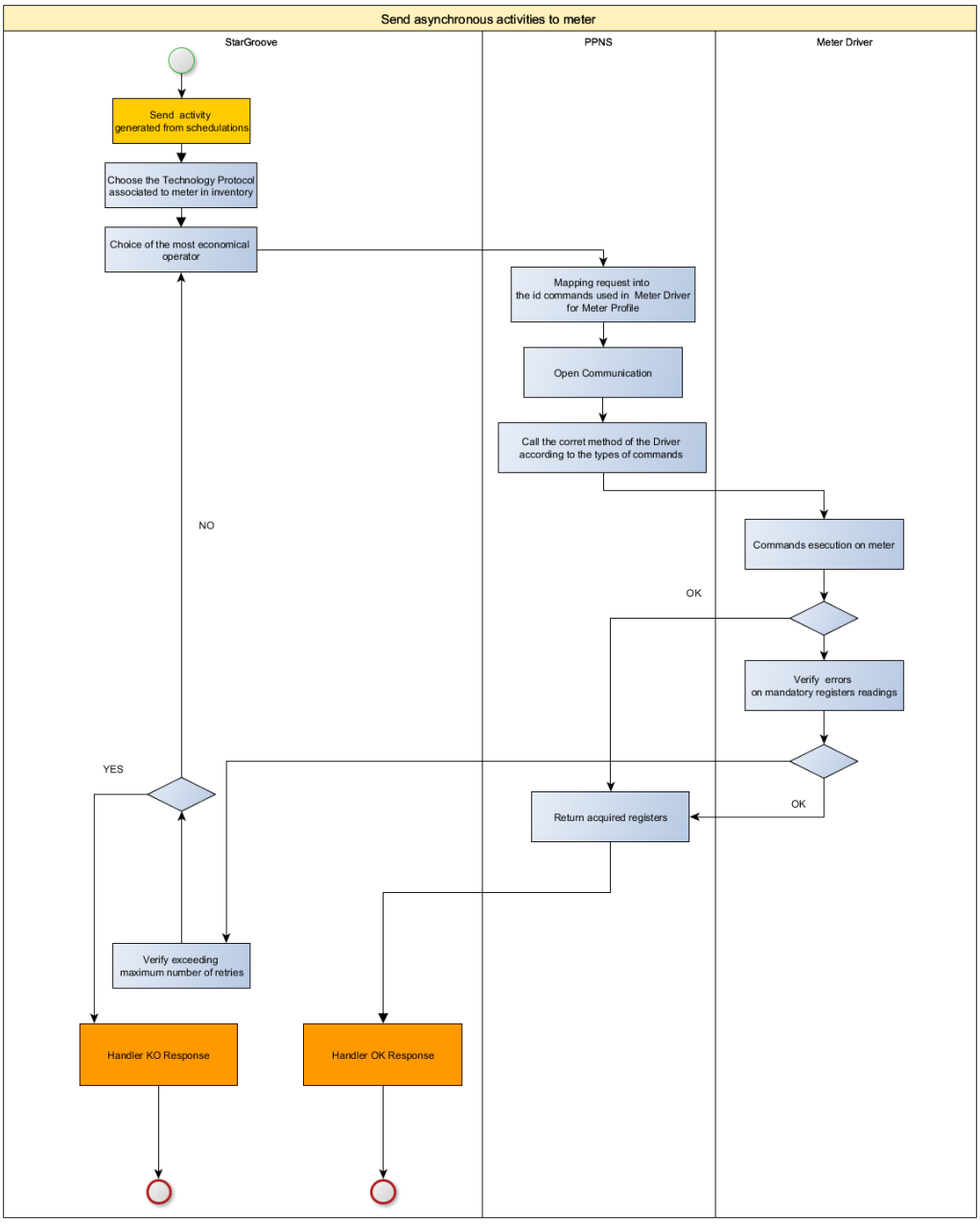


Figure 3: Send asynchronous Activities to Meter – Activity diagram

5.1.4.3. Send asynchronous activities to meters of the same multidrop chain

This scenario describes the processing of activities related to a group of meters belonging to the same multidrop chain.

If the are scheduling related to meters belonging to the same multidrop group, they have to be processed by StarSync inside a unique process/Thread.

The Scheduler has to group the activities in this way:
In the body of the message there will be the activities associated to the group of meters.

The message will be identified by a meter of the group, the master meter.

The StarGroove System sends this "group" message to StarSync.
When the Message Driven Bean takes charge of it, the process has to cycle on all the meters, sends the commands and acquire responses.
These responses and their result code (OK/KO) will be returned to StarGroove.
The responses with OK result will be saved in database, while the activities of other meters with KO responses (not exceeding the maximum number of retries) will be part of a new "group" message to send to StarSync.
When the "master" meter will be processed, another meter of the group will became the new master.
There isn't any particular logic in choosing a meter as master.
It's sufficient to choose the first meter of the group, not yet processed.
The scenario is described in the figure below:

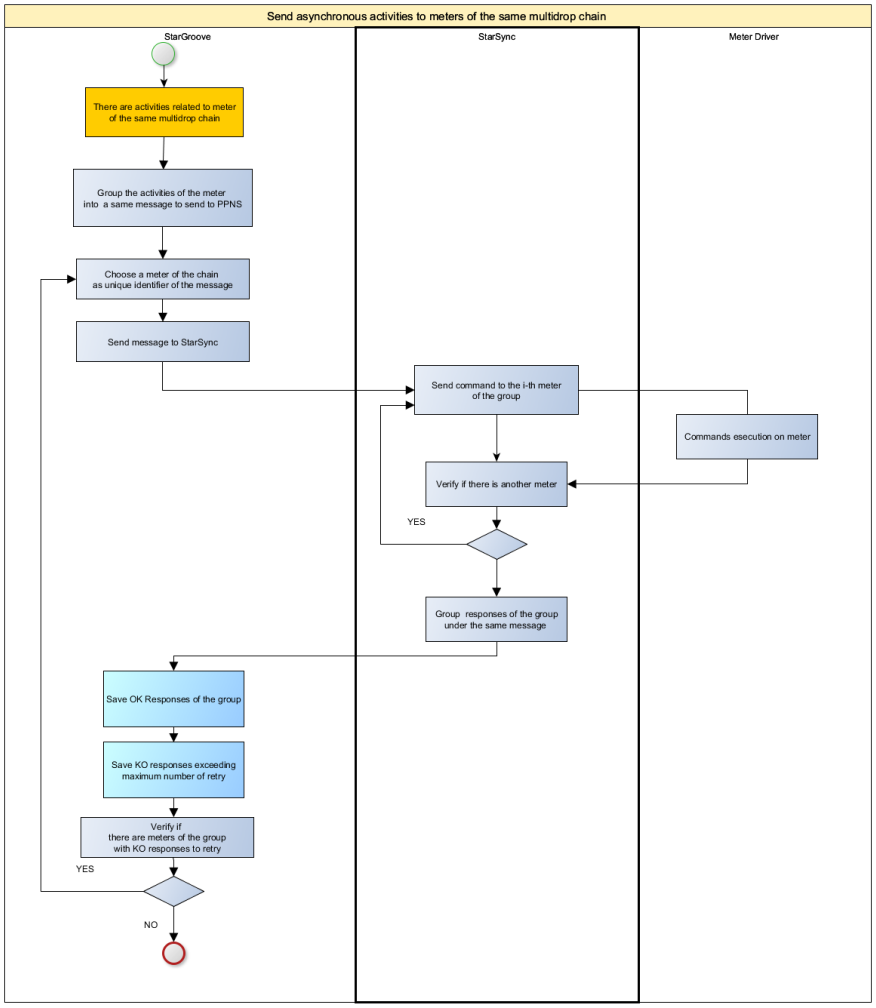


Figure 4: Send asynchronous activities to meters of the same multidrop chain – Activity diagram

5.1.4.4. Request of an administrative Spot Reading scenario

This scenario describes the request of an administrative Spot Reading.

In this case the scenario is activated in StarPulse system when an operator activates a spot reading on meter using the corresponding Web interface.
The activities in StarSync and Meter Driver are basically the same of the previous scenario.

In contrast with the previous case, this is a synchronous activity.
Furthermore it's possible to read a meter, present in inventory or a new meter.
In the case of meter present in inventory:

- the technology associated with meter in Inventory should be considered.

In the case of a new meter:

- the technology chosen in a combo-box should be considered.

The scenario is described in the figure below.

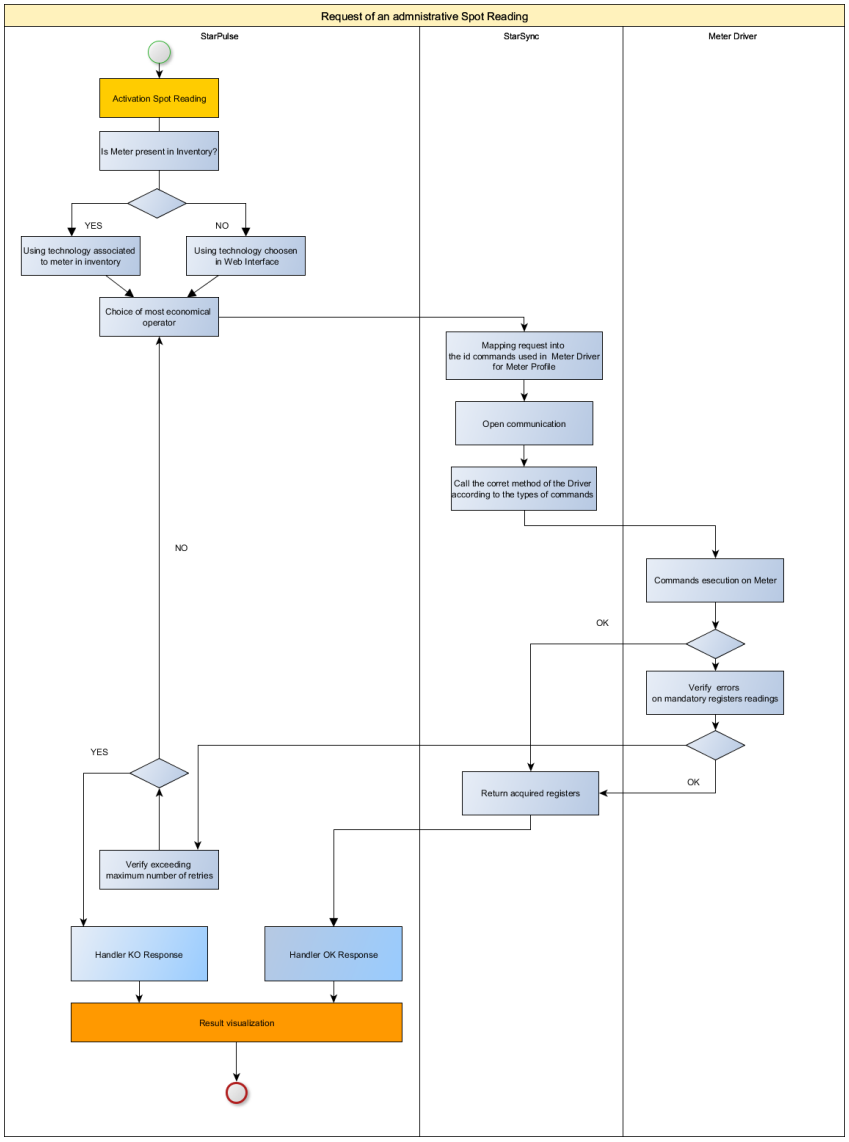


Figure 5: Request of an administrative spot reading on Meter – Activity diagram

5.2. Actors, Use Case Model and Supplementary Specification

Actors, Use Cases and Supplementary Specifications are listed below.

5.2.1. Actors, Use Case Model of StarGroove System

1. **StarGroove Actors:**
   - Time: is responsible for activate meter scheduling
2. **StarGroove Use cases:**
   - **Scheduler Use Cases**
     - Activate scheduling
       - Check scheduling to activate
       - Submit Activities for execution
       - Generate activities to execute
         - Generate Meter activities
         - Generate Modem activities
         - Group activities into the same multidrop chain, identifying the “master” Meter
         - Save activities
       - Submit Activities for execution
       - Scheduling of the next activation
   - **Executor Use Cases**
     - Activity Execution
       - Check the validity of the activity
         - Close KO/not valid activity
       - Calculate/complete all the attributes of the activity
       - Call Dispatcher Algorithm
       - Dispatch the activity to StarSync
   - **Dispatcher Use Cases**
     - Determine to which StarSync/Queue send the activities.
       - Select communication protocol.: the first time, the main communication in the inventory is chosen.
       - Select more convenient operator for type of communication protocol.
       - Verify exceeding maximum number for type of communication protocol.
         - Verify exceeding maximum number of retries for all types of communication protocol
       - Return the queue to which dispatch the activity.
3. **Handler acquired responses Use Cases**
   - Processing the acquired responses from StarSync
     - Acquiring StarSync responses from JMS queue
     - Process OK Response
       - Association Request-Response
       - Association Manufacturer Obis with Standard Obis
       - Verify inconsistency between received data with inventory data
       - Save Responses
     - Process KO Response:
       - Check expiration date for activity message
       - Call dispatcher algorithm
         - If no dispatcher is returned (retries exceeds maximum for all technologies) then activity will be closed
         - If dispatcher returns a queue, the Response Handler dispatches the activity.
4. **Logging Manager**
   - Trace operations during scheduling activation, and when the generated activities is submitted to StarSync

Here are described the most significant Use Cases of StarPulse BACH system.

5.2.1.1. Generate Activities Use Case

5.2.1.1.1. Brief Description

This use case belongs to the StarGroove system, Scheduler Subsystem.

When there is a scheduled task to activate on a meter, the scheduler has to generate an activity having the attributes related to the type of commands to send.
For example, if there is a daily scheduled task of Load Profile Reading on the meter, an activity with:

- Command Type= <identifier of Load Profile Reading Type>
- Number of Days=1

will be generated.
The attributes of activity will be completed by Executor.

5.2.1.2. Group activities into the same multidrop chain Use Case

5.2.1.2.1. Brief Description

This use case belongs to the StarGroove system, Scheduler Subsystem

When an activity is generated for a meter, the system has to verify if there are other activities related to meters of the same multidrop chain.
The system must to treat all the meters belonging to the same chain ***using a unique thread process***.
For this reason, the scheduler has to generate a unique message: in the body of the message , there will be a group of attributes of the activities related to the meters of the group.
The message will be identified in the header by the identifier of a "master" meter.

5.2.1.3. Save Activities Use Case

5.2.1.3.1. Brief Description

This use case belongs to the StarGroove system, Scheduler Subsystem

When the activities are generated, these activities must to be saved in the Activities Persistence Entity.
There will be an association between the identifier of scheduled task and the identifier of the generated activities.
In a such way, it will be possible to monitor the state of scheduled tasks.

5.2.1.4. Calculate/complete all the attributes of the activity Use Case

5.2.1.4.1. Brief Description

This use case belongs to the StarGroove system, Executor Subsystem

The executor has to check if an attribute of the requested activity is compatible with the last acquired reading.
For example if the last acquired reading is older than the number of days required in activity, the missing days will have to be read and the number of days attribute will be increased.

5.2.1.5. Select Communication Protocol Use Case

5.2.1.5.1. Brief Description

This use case belongs to the StarGroove system, Dispatcher Subsystem.

The Dispatcher is a component that is responsible for selecting the protocol, using the protocol associated to the meter in the inventory.
The Dispatcher returns the queue to Executor/Response Handler for routing the activity to the appropriate StarSync module that handles this technology.
(see: Logical View: Interaction between StarGroove and StarSync)

5.2.1.6. Select more convenient operator Use Case

5.2.1.6.1. Brief Description

This use case belongs to the StarGroove system, Dispatcher Subsystem

The Dispatcher has to choose the most economical operator according to criteria like “Time of Use”.
In the same way of the *Select Communication Protocol Use Case*, the Dispatcher has to return the queue to the logic StarSync module that handles this operator.
So in general, the following criterion is valid:

- GPRS (in general the main communication technology associated to the Meter in the inventory) has the priority overs GSM.
- Established the protocol, the more economical operator has to be chosen.

In the following figure the relationships between Use Cases are shown.

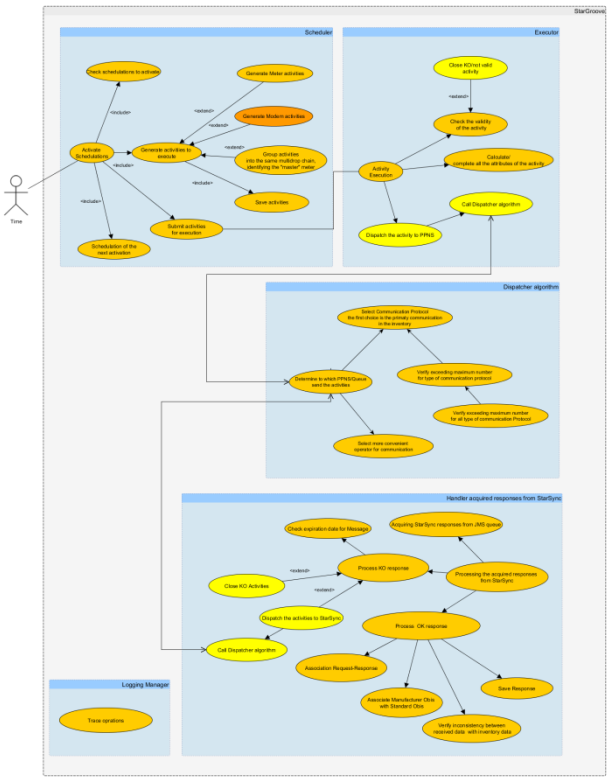


Figure 6: StarPulse BATH Use Cases

5.2.2. Actors, Use Case Model of StarSync System

- **StarSync Actors:**
  - Administrative Spot Request from StarPulse
  - Scheduled Activities from Dispatcher of StarGroove.
  - StarSync Administrator: is responsible for setting StarSync parameters.

- **StarSync Use cases:**

  - **Handler StarSync Command Use Cases**
    - Send asynchronous commands for a scheduled activity to Meter
    - Send synchronous commands for an administrative activity to Meter
    - Send commands to meter
      - Check free communications
      - Send commands to meters belonging to the same multidrop chain
      - Select the correct driver according to the type of meter
      - Mapping activity request into the request identifiers used in Meter Driver
      - Add the serial meter reading command to the other commands for verifying Meter identity
      - Open communication for GPRS Protocol
      - Select Access Server according to Operator
      - Open communication to Access Server with authentication for GSM Protocol.
      - Setting TimeZone Parameters for Synchronization
      - Call the correct method of the Driver according to the types of command in the activity
      - Close communication. .
      - Acquiring the response from Meter Driver.
        - Put the response into the output Queue
        - Return response using ejb for administrative request

  - **Application Console Use Cases**
    - Modify and reloading application Property
    - Display application parameters.

  - **Logging Manager**
    - Trace operations during sending commands to Meter

5.2.2.1. Send asynchronous commands for a scheduled activity to Meter UC

5.2.2.1.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem.

StarSync can receive synchronous requests from StarPulse.
A StarPulse Operator can require a spot administrative reading on a meter and wait for the response using a Web Interface. This scenario is described in *Request of an administrative Spot Reading scenario.*

5.2.2.2. Send asynchronous commands for a scheduled activity

5.2.2.3. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem

StarSync receives asynchronous requests from StarGroove
These are the massive activities generated from scheduler and dispatched from Dispatcher Component of StarGroove to the appropriate StarSync.

5.2.2.4. Check free communications

5.2.2.4.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem

When a Message Driven Bean takes in charge an activity, it has to check if there are free resources to serve the request. If there are no resources, the activity will be put back in the queue for a retry.

5.2.2.5. Select Access Server according to Operator Use Case

5.2.2.5.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem

When GSM protocol is used, it's needed to open a socket on a particular ip and port of an Access Server.
A unique couple <IP, PORT> is associated with every operator.

(For GPRS, the choice of Access Server it should be transparent.
In this case it's needed to open a socket on a particular IP that uniquely identifies the meter inside the APN).

5.2.2.6. Setting TimeZone Parameter for Synchronization Use Case

5.2.2.6.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem
.
According to the location of the meter, an appropriate Timezone will be set on Initialization Parameters of the DLMS Driver used by StarSync. The use of appropriate TimeZone is needed because of the different countries on which the Star Beat System will be deployed. Furthermore for the same country (example Spain) it's possible to have two TimeZones.

5.2.2.7. Mapping activity request into the request identifiers used in Meter Driver Use Case

5.2.2.7.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem

Every activity by StarGroove (request of Load Profile reading, request of registers reading or synchronization) has to be mapped into the identifiers of requests that the Driver uses inside
The Driver uses a configuration file with associations of this type:

```
<Request id_request="3" description=" Billing Profile Reading ">
        <MeterData class_id="7" obis_code="0.0.98.1.0.255" obis_attribute="2" description="Billing Data"   />
</Request>
```

5.2.2.8. Put the response into the output Queue Use Case

5.2.2.8.1. Brief Description

This use case belongs to the StarSync system, Handler StarSync Subsystem

StarSync has to be send the acquired responses from Driver to StarPulse/StarGroove.
In the case of Spot Reading, the response is returned using the called remote interface (ejb) .
In the case of Asynchronous activities, the responses is put on a logical queue towards StarGroove.
It will be the Response Handler and the Dispatcher in StarGroove that are responsible for saving the OK/KO results or retries KO readings that not exceed the maximum number.

The relationship between the use cases is shown in the following figure.

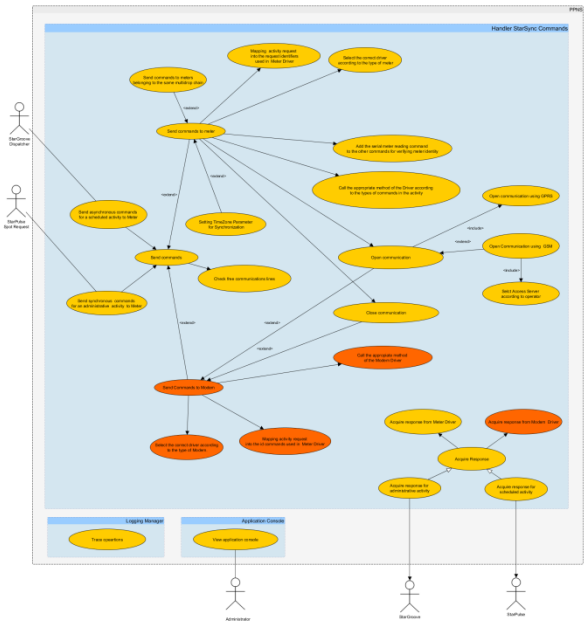


Figure 7: StarSync Use Cases

NB: The orange colored use cases are related to a future managing of modem devices (TBD).

5.2.3. Actors, Use Case Model of StarPulse System

- **StarPulse Actor Use cases**
  - StarPulse Operator: is responsible for managing devices inventory, defining schedulings and requesting administrative spot readings to GME.
  - External Systems: can send data to load on devices inventory, or send data for defining spot scheduling.
- **StarPulse Use cases**
  - **Scheduling Inventory Use Cases**
    - Define scheduling
      - Define mandatory automatic scheduling
      - Define spot scheduling from Operator
      - Define scheduling from external system.
    - View scheduling
  - **Devices Inventory Use Cases**
    - Manage Meter Inventory
      - Define Meter Group
      - Define mandatory scheduling for Meter.
    - Manage Modem/Sim Inventory (TBD)
    - View Inventory
  - **Spot Reading on Meter Use Cases**
    - Require an administrative spot reading on Meter

In figure, the main StarPulse Use Cases and their relationships are shown:

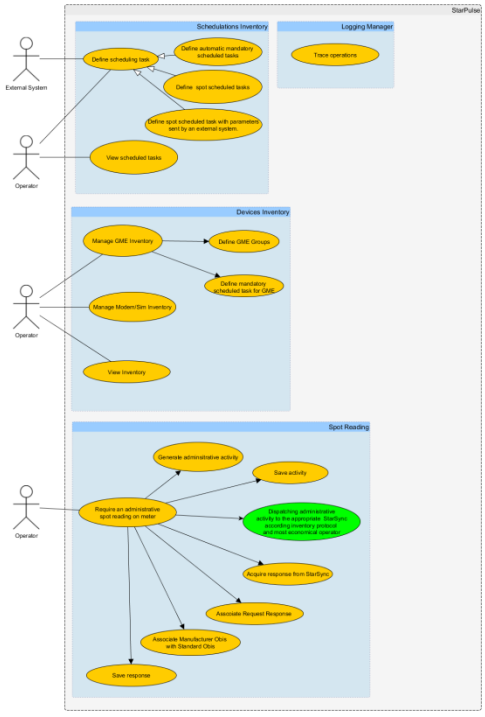


Figure 8: StarPulse Use Cases

5.2.3.1. Define Scheduled Tasks Use Case

5.2.3.1.1. Brief Description

This use case belongs to the StarPulse system, Scheduled tasks inventory subsystem.

The aim of this use case is to allow the actor to define (insert/delete/modify) scheduled tasks.
The scheduled task inventory subsystem shows that the definition can be related

- to a mandatory scheduled task,
- to a scheduled task defined by an operator using the Web Interface.
- to an external systems.

5.2.3.2. Manage Meter Inventory Use Case

5.2.3.2.1. Brief Description

This use case belongs to the StarPulse system, Device Inventory subsystem.

The aim of this use case is to allow the actor to insert/delete/modify the devices.
Similarly to meters, it's possible to manage the inventory of Sims and Modems.

5.2.3.3. Dispatching the administrative activity to the appropriate StarSync UC

5.2.3.3.1. Brief Description

This use case belongs to the StarPulse system, Spot Reading.

As in StarGroove System, StarPulse uses a Dispatcher algorithm with the same functionality of calculating the appropriate queue/StarSync in order to route the activities. In contrast with the asynchronous component,
the interaction between StarSync and StarPulse is implemented using a synchronous interface (a stateless ejb)
The algorithm for choosing the operator and technology is the always the same:

- Protocol:
  It's used the protocol associated with the meter (for meter present in the inventory).
  For meter not present in inventory, it will be used the protocol chosen in a combo box of the Web Interface by the user.
- Operator: it will be used the most economical operator.

5.2.4. Actors, Use Case Model of Driver System

- **Driver Actor Use cases**
  - StarSync: is responsible for calling the appropriate method of modem/meter driver in order to read the desired types of registers.

- **Driver Meter Use cases**
  - Call appropriate method of Meter Driver for R/W Registers
    - Mapping driver request identifier into manufacture obis
    - Security and multilevel password management
    - Definition of the actions for errors on the readings of the various obis.
    - Return obis readings as list of objects <obis,value,capture time>
    - Return Load Profile as list of objects <Timestamp,value>
    - Mapping error codes into categories

In figure, the main Driver Use Cases and their relationships are shown:

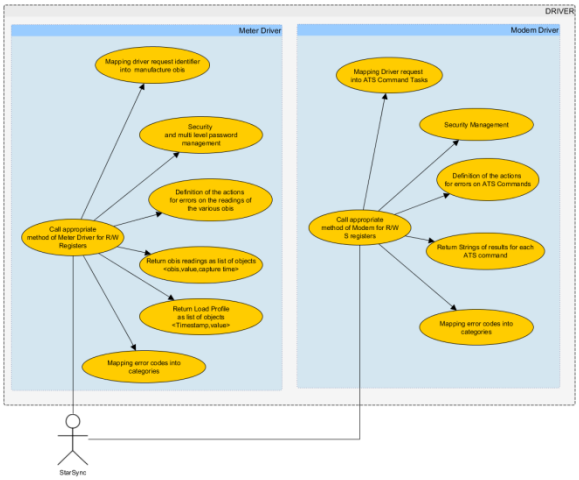


Figure 9: Driver Use Cases

5.2.5. Actors, Use Case Model of Report

- **Report Actor Use cases**
  - StarPulse Operator
- **Report Use cases**
  - **Reports StarPulse/StarPulse_Batch Use Cases**
    - Contain and display information about the acquired readings, state of scheduled tasks.
  - **Report StarSync Use Cases**
    - Contain and display information about connection states
    - Contain and display information about retries
  - **Report CNS Use Cases**
    - Contain and display information about mobile data exchange

6. Definitions, Acronyms, and Abbreviations

All terms, acronyms and abbreviation are contained in the Project Glossary and here below.

Abbreviations - Acronyms	Definition
AMM	Automated Meter Management
AMM Suite	Global AMM Solution including multiple systems
AMMS	Automated Meter Management System
ASDU	Data Unit Application Services
ATR	Third Party Network Access
BO	Back Office
CPD	Data center
CUPS	Universal Supply Point Code
DB	Data Base - Base Dati
DH	Hourly discrimination
EI	External Interface - Interfacce Esterne al Sistema
EMD	Equipment Master Data - Dati Anagrafici Attrezzature
EXABEAT	Measure system
FE	Front End
GME	Electronical Measuramente Device - Gruppo di Misura Elettronico
GUI	Graphical User Interface - Interfaccia Grafica Utente
Heart Beat	Master Data System
Job	Group of tasks related to the same communication session (multidrop chain). A job can also contain tasks related to a single meter.
Meter	Measure Point
Multidrop	The multidrop feature, in when more than one meter that aim to the same node and are bounds in a chain to be read and in the same communication session.
N.A.	Does not apply
OLA	Online Activity/Activities
POD	Point of delivery
PS	System Parameter - Parametri di Sistema
RPT	Report
SB	Star Beat
SBS	Star Beat System
SBS	Star Beat System - Smart Metering System for the acquisition of measurement data from devices connected to the high & medium voltage grid
SCH	Scheduler - Modulo Star Beat che si occuppa di pianificare le attività da eseguire sugli Equipment
SI	System Interface - Interfaccia di Sistema
Task	Single operation (e.g. Load Profile Reading) to execute.
TOUs	Territorial Organizational Units
UI	User Interface - Interfaccia Utente
UOT	Territorial Organizational Unit
WO	Work Order - Ordine di lavoro (Richiesta di esecuzione attività su GME)
WORK BEAT	Work Order System
XSD	Scheme XML definition

Figure and Table Indexes

Tables

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