




**HEXING**

Version v1.0

# **MDC System Proposal**

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## Revision

Version	Date	Author	Remark

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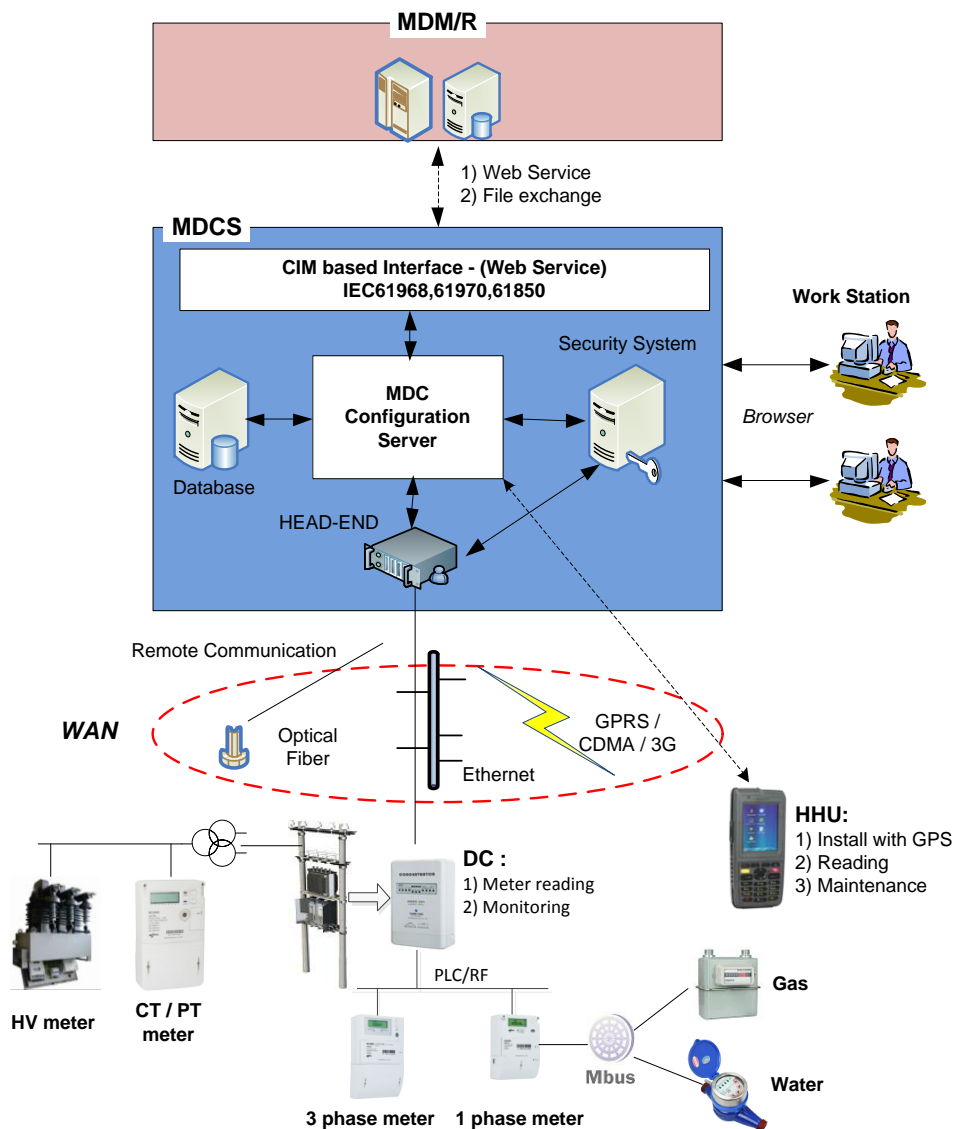
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# 1 Hexing MDC System

## 1.1 Hexing MDC Advantages

- 1) Integrated metering data collection platform which can manage HV meters, gas meter, water meter;
- 2) HEAD-END platform is well designed to support huge scale of meters;
- 3) Enhanced support for operation and maintenance;
- 4) CIM based interface

## 1.2 MDC Architecture

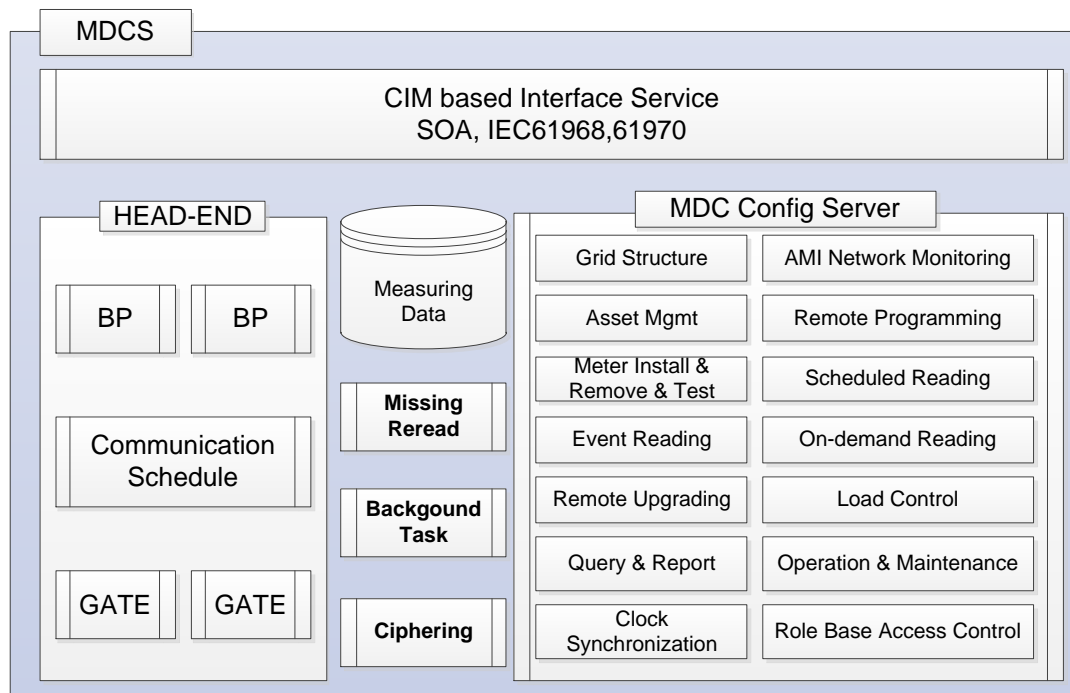


MDCS is meter-data collection system and also it can be called AMI system. MDCS consists of HEAD-END, MDC Configuration Server, communication ciphering system ( optional ), database and CIM based Interface.

MDCS uses J2EE technology and operator can access MDC configuration server by browser ( no extra client site software ).

### 1.3 MDC System Components and Modules

MDC system software has many stand-alone process and some components which are defined as the picture.



### 1.4 HEAD-END

HEAD-END of Hexing consist of three parts: Unified gate ( Gate), Communication scheduler ( FE ) and protocols handler ( BP ). Gate manages all remote communication channels and keeps communication alive or connects to meters. FE is responsible for managing relationship between meter and which gate connected. FE is right place to monitor AMI network states. BP mainly resolves different protocols and process related business.

#### 1.4.1 Communication Gate

Currently the communication gate can support following protocols:

- 1) DLMS-IP

- 2) DLMS-HDL
- 3) DLT\_645-07
- 4) ZJ-PROTOCOL
- 5) ANSI
- 6) DNP3

Physical communication channels are as follow:

- 1) GPRS
- 2) CDMA
- 3) CSD
- 4) GSM (SMS)
- 5) ETHERNET
- 6) Optical Fiber

The communication modes are:

- 1) Always-on mode.

The meter is always online and you can access it immediately. The communication performance is high, but the communication cost is also high.

- 2) Period-on + SMS wakeup.

The meter connects to MDC(Gate) at pre-defined time period. MDC can read meter data/events at specified time period. When operator wants to access the meter at off-time-period, the 'Gate' will send a SMS to wakeup meter. By this way the communication cost is cut down.

- 3) On-demand.

The meter never initiates to connect to MDC. When operator wants to access the meter at off-time-period, the 'Gate' will send a SMS to wakeup meter.

## 1.4.2 How to support huge-scale communication points

Hexing HEAD-END supports the solution of total cluster .

Gate , as Server port mode, each Gate can manage  $\leq 30000$  communication points. Each BP manages 200000 meters.

## 1.5 MDC Configuration Server

### 1.5.1 Assets Management

Function List:

- 1) Meter management, including DLMS meter, ANSI meter, HV meter...
- 2) Terminal management: GW (DC) data concentrator, ZJ DC, GW data collector...
- 3) SIM card management;
- 4) Archives import/export: Meters archive file may be excel or CSV;
- 5) Archive statistics and reports
- 6) Optional GPS information is supported.

### 1.5.2 Meter Installation

#### 1. Function List

- 1) Installation management: for installation management of concentrators and collectors, come true the connection between terminal and meter, parameter setting of measuring points, default task issuing etc.
- 2) Default task: according different equipment types and use of meters, support predefine default task, issue the task automatically when installation.
- 3) Resend failed task: support to resend the failed task.
- 4) Resend measuring point parameters: support to resend measuring point parameters when installation.
- 5) Concentrator communication test: when finish installing the



concentrator, it can test communication state in downstream.

- 6) Installation Statistics: support statistic of installation state by divided units according to the time.

## 2. Meter Installation Process

The meter installation process is the core of MDC asset management. From meter lifecycle, there is a state: be put in storage, operation, disassembly, rejection.

Main installation steps:

- 1) put the batch of meter archives in storage

In general, the factory will supply archives when making delivery. When the archives lead in MDC, meter or concentrator's states are "in storage".

- 2) Installation and Operation

For GPRS meters or concentrator, monitor the "in storage" equipments if receive communication report or not in fixed time (the cycle can be configured). If it receives the communication report, it will change the state to "Operation" automatically.

For PLC or RF meters, operators connect the meters to the concentrators according to installation manual by hand, then it enter "Operation" state.

For meters which have automatically register function, according to automatically register event, automatically set meter state to "Operation".

- 3) Disassembly

Operator set the state to "Disassembly" by hand. This meter will not be assessed in operation and maintain.

- 4) Injection

Operator set the state to "Injection". If the disassembled meter receives communication reports, MDC will produce abnormal alarm to warn to administrator to check.

### 1.5.3 Remote Parameter Programming

#### 1. Terminal Parameter Setting

Automatically make out the following parameter list according to the terminal types.

Terminal Type	Protocol Type	Explain
Concentrator/	China State Grid Protocol	

Collector	Guangzhou Protocol	
Special transformer terminal	Zhejiang Protocol	
GPRS meter	DLMS Protocol	

## 2. Batch Parameter Setting

Support batch setting terminal parameter which have the same protocol .

Terminal Type	Protocol Type	Explain
Concentrator	China State Grid Protocol	
GPRS Meter	DLMS Protocol	

## 3. Terminal Configuration Calling

Calling appointed terminal configuration parameters, different protocols different configuration parameters. The called parameters can be saved in master station.

Terminal Type	Protocol Type	Explain
Concentrator	China State Grid Protocol	
GPRS Meter	DLMS Protocol	

## 4. Meter Control Command

Meter control command: for GRPS meter or PLC meter under concentrator management, and it only fit for DLMS communication protocol.

Control command list:

- 1) Clean Event
- 2) Clean Load
- 3) Clean alarming-state register
- 4) Recover battery quantity after replacing battery
- 5) Enter test mode
- 6) Exit test mode

- 7) Close register by force
- 8) Enter active impulse mode
- 9) Enter inactive impulse mode
- 10) Accumulative calculate MD reset
- 11) Historical MD reset
- 12) Manual MD reset
- 13) Open DST function
- 14) Close DST function

## 5. **Concentrator Control Command**

Concentrator control command list

- 1) Allow communication between terminal and master station
- 2) Prohibit communication between terminal and master station
- 3) Allow terminal up-report automatically
- 4) Prohibit terminal up-report automatically
- 5) Delete all the meters of appointed ports
- 6) Hardware initialization
- 7) Data area initialization
- 8) Clear all parameter, recover factory setting
- 9) Clear all parameter(except communication parameter) and data area

## 6. **GRPS Period on-line management**

Setting and reading GPRS function

- 1) online mode: permanent online, period online, passive activation, on demand online
- 2) log on: allowed or inhibited
- 3) Check master station cell-phone number function: allowed or inhibited

- 4) Master station up-report alarming: allowed or inhibited

## 7. Concentrator period online management

Setting and reading concentrator communication work mode

- 1) online mode: permanent online, period online, passive activation
- 2) period online mode allows online period
- 3) permanent online ,period online mode repeat interval
- 4) passive activation mode repeats times

## 8. Alarm shield

The alarm up-reported by terminal are frequent incorrect or non-accident, shield this alarm in master station, to reduce communication pressure and operator's work pressure. The alarm that each terminal need to shield can be set one by one or batch.

Alarm shield function :

- 1) Calling
- 2) Open alarm shield
- 3) Clean alarm shield

### 1.5.4 Tariff Management

#### 1. Tariff definition( tariff template management)

TOU tariff: daily template, weekly template, seasonal template, holiday template.

#### 2. Tariff Issuing

- 1) Single meter tariff issuing
- 2) Single concentrator tariff issuing(for china state protocol)

Support concentrator measuring point list, can choose all the meters or several meters;

- 3) Meter tariff batch issuing
- 4) Prepaid meter tariff issuing: TOU tariff, Step tariff, single tariff.

### 1.5.5 On-Demand Reading

Function:

- 1) Real-time data calling
- 2) Alarm data calling
- 3) Batch data calling
- 4) Channel data calling
- 5) Concentrator archives calling
- 6) Meter event calling

### 1.5.6 Scheduled Meter Reading

General demand: flexible configurable meter reading template( according to different protocols, meter types, business applications) . the main template types: load , daily frozen, monthly frozen, billing date ,etc.

#### 1. Meter reading task template management

##### **Terminal task template management**

Terminal task template is fit for the equipment that initiatively up-report in fixing time. At present it is for the terminal, concentrator, collector and meter under China State Grid Protocol or Zhejiang Protocol)

##### **Master station task template management**

Master station task template is applied for the equipment that can not initiatively up-report. At present it is for the concentrator, collector and meter under DLMS protocol, ANSI protocol and Hexing Guangzhou protocol.

#### 2. Meter Reading Management

##### **Terminal Task Management**

- 1) Task Query
- 2) Setting and reading task function: task issuing, calling, stop use ,delete etc.

## **Master Station Task Management**

- 1) Task Query
- 2) Setting function: start ,stop ,delete ,etc

### **3. Terminal Default Task**

Terminal Default Task, the special meters ,concentrators automatically issue configured default task after installation.

### **4. Task Execution State**

Count the execution states of different task template issuing task. Main goal is making sure each terminal and meter can enter correct and suitable task.

### **5. Failed Task Management**

- 1) Failed Task Query
- 2) Re-put the terminal failed task

### **6. Load profile template example**

- 1) Three phase current
- 2) Three phase voltage
- 3) Three phase power
- 4) Three phase power factor and total power factor
- 5) Three power energy
- 6) Grid frequency

### **7. Daily frozen data reading template example**

- 1) Forward active total energy and four tariff
- 2) Backward active total energy and four tariff
- 3) Forward reactive total energy and four tariff
- 4) Backward reactive total energy and four tariff

## 8. **Monthly frozen data reading template example**

- 1) Forward active total energy and four tariff
- 2) Backward active total energy and four tariff
- 3) Forward reactive total energy and four tariff
- 4) Backward reactive total energy and four tariff
- 5) Forward active power MD and time of occurrence
- 6) Backward active power MD and time of occurrence

## 9. **Billing data reading template example**

- 1) Forward active total energy and four tariff
- 2) Backward active total energy and four tariff
- 3) Forward reactive total energy and four tariff
- 4) Backward reactive total energy and four tariff
- 5) Forward active power MD and time of occurrence
- 6) Backward active power MD and time of occurrence

### 1.5.7 **Meter Events Reading**

#### 1. **MDC function definition**

- 1) Read concentrator event
- 2) Read GRPS meter event
- 3) Read the event of meter under concentrator
- 4) Read and write the meter event status word(DLMS protocol)
- 5) Read and write concentrator event status word
- 6) Clean event record
- 7) Clean event mark
- 8) Periodically read meter event in background

- 9) Event analysis and filter
- 10) Event (alarm) query
- 11) Abnormity statistics

## 2. Event Category Definition

- 1) Tampering
- 2) Device
- 3) Control
- 4) Power Quality
- 5) Others

## Dealing with Abnormity

- a) Abnormity analysis

Analysis according to different area institutions, display it with biscuit diagram.

- b) Dealing with abnormity: query, then deal with abnormity list

Query condition: area institution, equipment address, abnormal status( new abnormity , miss report, have been filed, have been dispatched), start time, end time, abnormal type.

Method: display abnormal information, execute action : fill the suggestion, choose action( dispatch, miss report, filed)

## Abnormity Subscription Management

◦ Administrator distribute several terminals (GPRS meter+ concentrator) to the operator, choose the communication method and abnormal types.

## Abnormal Subscription

Operator manage the abnormity ,choose communication method(SMS/email) and abnormal types, and then choose the terminal which need to be managed.



## 1.5.8 Load Control

### 1. Overview

For electricity users, most of the time the used amount of electricity is uneven; but the Utility needs to provide enough electricity at any time according to users demand; since it is unable to store large amounts of electricity economically, the Utility must design according to the peak electricity demand so as to meet the various needs at any time. This peak condition is rare, but it causes a huge spending to power plants; and these costs will eventually be transferred to the electricity users; that is the demand electricity.

Load control can effectively reduce the peak load of power grid.

There are two main ways for load control,:

- 1) direct load control (DLC) : master station control, i.e., remote relay disconnection and reconnection;
- 2) "overload" control: master station preset the parameters, meter local control;

"overload" has the following definitions according to the needs and usage of different customers,:

- power overload: when the current active power of single phase or all phase of meter is greater than the threshold, and "duration" is more than the "delay time";
- current overload: when the current of single phase of meter at present time is greater than the threshold, and duration is more than the delay time;

In some countries, current threshold is set for single phase meters for limiting the load; since for each country or power supply company, the voltage is usually specific, it can be converted into power overload.

### 2. Relay Management (Load control mode)

Relay physical state, read-only

Relay control state, read-only

Control mode can be read and write. There are 5 kinds of control modes: mode 0, mode 1, mode 2, mode 3, mode 4:

<b>Mode type</b>	<b>Disconnect</b>	<b>Connect</b>	<b>Disconnect</b>	<b>Connect</b>
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	remotely	remotely	manually	manually
<b>Mode0</b>	-	-	-	-
<b>Mode1</b>	-	-	√	√
<b>Mode2</b>	-	√	√	-
<b>Mode3</b>	√	-	-	√
<b>Mode4</b>	√	√	-	-

### 3. Remote Control (Remote Connection and Disconnection)

#### Definition of MDC Standard Function

- 1) read the relay control state of a single meter;
- 2) remote relay connection and disconnection of a single meter
- 3) remote relay connection and disconnection of batch meters
- 4) all the relay connection and disconnection operations and settings of parameters related to relay connection and disconnection need to have password authentication of second operation, and MAC or IP binding of the operation computer

### 4. Power Control or Current Control

Power control means the master station issues the control parameters, and the meter automatically executes it when condition is met.

There are two kinds of strategies for power control: normal state control and emergency state control.

In some special period, normal state control is unable to meet the requirements of lower power grid load; at this time emergency state control needs to be started(threshold of emergency state control is smaller than that of normal state control). The users' electricity limit is then restricted by a greater extent so as to reduce the current load of power grid.

#### Definition of MDC Standard Function

- 1) load control template management

Template content: template name, application state (normal control or emergency control), templates notes, minimum duration after over the threshold (seconds),

reconnection interval (seconds), allowed automatic reconnection times, clear the time threshold for automatic reconnection times value(seconds); power control time period table(including time period and the corresponding maximum power value).

Load control day table		
hour	min	A
Period 1		
Period 2		
...		
...		
Period 24		

A specific attribute of emergency state control: emergency control ID, emergency control break time, and duration of the emergency state control (hours).

- 2) single meter: normal state control;
- 3) single meter: emergency state control;

### 1.5.9 AMI Network Monitoring

- 1) online monitoring: the terminal online condition monitoring.
- 2) terminal communication statistics: support monitoring and statistical analysis about terminal communication status, get the running status of each equipment.
- 3) dataflow statistics: support the dataflow statistics for terminal, assist in dealing with the abnormal situations like excess dataflow. etc.
- 4) management monitoring: statistics reports and list of excess dataflow communication abnormal.

## 1.5.10 Clock Synchronization

### 1. Manual Synchronization Management

Support single or batch manual synchronization for the concentrator and meter with the same protocol.

Support single or batch repeating manual synchronization for the meter under the concentrator.

### 2. Automatic Synchronization Management at Background

Support auditing and viewing of the automatic synchronization function and synchronization results for all the terminals in one Utility, thru the background task template configuration.

## 1.5.11 Remote Firmware Upgrade

- 1) **Concentrator upgrade:** supports firmware upgrade for concentrator (it supports concentrator initiates read the upgrade file via FTP, master station sends upgrade issues in the way of framing), for PLC meter under the concentrator, and PLC module of PLC meter. It is only for concentrator of China State Grid protocol.
- 2) **GPRS meter upgrade:** supports firmware upgrades for GPRS meter, and GPRS module; It is only for DLMS meters.
- 3) **Batch update:** supports batch automatic upgrade in the way of background task. The upgrade period can be configured as free time. The operation is simple, and the upgrade result is very easy to manage.
- 4) **Upgrade log query:** supports firmware update log query for concentrator, PLC meter under the concentrator, PLC module of PLC meter, and GPRS meter and its GPRS module.

## 1.5.12 Operation & Maintenance

- 1) **audit log:** supports the system to access the log about operation, communication, reading and configuration.
- 2) **abnormal management and analysis,** also support abnormal subscription

(SMS, email, bubble remind).

- 3) communication message management: support display and contents analysis of uplink and downlink and abnormal original message.
- 4) missing data rereading: support missing data re-reading function, can define data range according to types of tasks.
- 5) periodic time synchronization: support batch synchronization operation according to Utility and strategy(read-only without synchronization, and automatic synchronization).
- 6) meter reading success rate: record meter reading success rate as per Utility, day, and month.
- 7) missing data statistics: record and analyze the missing data as per Utility, day, and month.

### 1.5.13 Query & Analysis

- 1) support single or batch query of original data

Single-family query: load data, energy data (day, month, week, year), consumption data query (day, month, week, year).

Batch-family query: energy data (day, month, week, year), consumption data query (day, month, week, year).

- 2) curve display

Power curve, current curve, voltage curve, energy curve, and power factor curve .etc

### 1.5.14 System Access Management

- 1) organization management: support management of organization.
- 2) role management: the management of access control of different roles.
- 3) operator management: manage and edit the operators according to the Utility, and role control. The system improves the safety of the operator account through the login password, IP binding, and login time, etc.

- 4) homepage management: can choose to display of a different homepage when different operators log in the system.

## 1.6 MDC CIM Based Interface

MDC takes charge of meter data collection, as well as parameter reading and writing, and control command execution. The MDC data needed by the related external systems shall also make parameter reading and writing and control issuance operations through the MDC.

MDC needs to be synchronized with the asset archives and power grid structure of marketing system or ERP system.

### 1.6.1 Interface Business Requirements

Interface type	Related external systems	Technical standards	Business standards	Description
1)power grid structure	ERP,SCADA	WebService, client site	IEC61968	Import existing power grid structure information to MDCS
2)asset archives	ERP, marketing system	WebService, client site File Exchange		Import external asset to MDCS
3)parameter reading and writing	MDM, marketing system	WebService, server site	IEC61968 IEC61970	The external systems configure the meter via the MDC; Bach operation is supported
4)meter control	MDM, load management system	WebService, server site	IEC61968 IEC61970	Load control and relay connection and disconnection; Bach operation is supported
5)meter data	MDM, Billing	File Exchange; Database exchange;	Pls refer to MDM specifications	Support the load curve of every 15 minutes, every hour, every day, every month; Support daily frozen energy consumption data, monthly frozen energy consumption data, and event information.

## 1.6.2 Technical Standard

Application layer shall be based on Service Oriented Architecture (SOA) and act with interfaces and communication specification base on IEC 61970 and IEC 61968.

- IEC 61970 Common Information Model (CIM) that is collection of standard for definition of data model in Grid and input and output format like XDF, RDF and SVG is supported base on XML.
- Client and server configuration model base on TCP/IP
- Open interfaces like JDBC, OLE and ODBC
- Data transmission like IEC 60870-5 and IEC 60870-6

## 1.7 MDC Database

Currently MDC can only support Oracle 10g, 11g.


## 1.8 Missing data reread

This Process is running at background. When MDCs can not read some meters due to communication problem, missing data reread will use configurable strategy to reread.

Missing data reread supports DLMS protocol and 645 protocol ( Concentrator ).

## 1.9 Background Task Process

This process is running at background ( Without GUI). By using such process, batch operations such time-synchronization, batch(group) meters firmware update, batch ( group ) meters tariff download, batch ( group ) meters load-profile configuration download, batch ( group ) meters events reading.

 **NOTE:** Information in this document is subject to change without notice. The information is accurate at the time of printing (November, 2013) ©

*MDC System*



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