FUNCTIONAL REQUIREMENTS

for

COMMON METER READING INSTRUMENT
(Compatible for Indian Companion Specification)

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Foreword

The CMRI is a portable battery operated instrument applicable for viewing, downloading, and uploading meter data to BCS. In the context of electricity metering applications, it is also referred as MRI or HHU.

CMRI have been in use for more than a decade in the Indian power sector. The present CMRI's has a hardware/ software that runs different communication protocols as provided by various manufacturers to download data from the meters of respective manufacturers, all of which are generally supplied with their own data exchange formats or protocols.

Now for Indian power sector "IEC62056 Electricity metering – Data exchange for meter reading, tariff and load control" is adopted for implementation in meters as the open protocol for meter data exchange. This series of IEC standards are supported by the Indian Companion Specification as IS 15959. When the meters complying to ICS are deployed and become part of an AMR network the meter data would be read by the HOST system. Under certain circumstances if any of the meters was not readable the data of those meters shall be possible to download in to a CMRI and uploaded to the HOST/BCS.

Hence, new CMRI is to be designed to meet the requirements of IS 15959. These new CMRI shall also support security features as per the ICS.

This Functional Requirements for Common Meter Reading Instrument (CMRI) is prepared by the committee comprising of members from CEA, CPRI, System Integrators, CMRI manufactures, Meter manufactures and utilities.

FUNCTIONAL REQUIREMENTS FOR CMRI
(Compatible for Indian Companion Specification)

1. Scope

This Functional Requirement specification outlines the minimum requirements of the software for CMRI which would be used for transfer of data between ICS compatible meters and BCS.

This document proposes a single portable unit suitable to be carried in hand from one meter installation to the next in-order to download / upload data from / to meters supplied by various meter manufacturers. The CMRI shall have adequate data security and fraud prevention measures. CMRI shall take in to consideration the security features as detailed in ICS.

The CMRI based on this specification shall download the ICS meter data and upload the same to a BCS. It shall also upload the programmable parameters from BCS to the ICS meter.

2. Mode of Operations

The CMRI shall support two modes of operation listed in Table 1:

Table 1

SI.No.	CMRI Modes	Description
1	CLIENT_MODE	• CMRI shall read and display selectively or all the instantaneous values, Energy values and demand values, etc., that are specified in ICS. • CMRI shall download data from the various meters. • CMRI shall also upload programmable parameters for desired meters
2	SERVER_MODE	• CMRI shall upload to BCS all the downloaded data from various meters.

2.1 CLIENT_MODE

In CLINET_MODE, the CMRI shall support the following two modes:

2.1.1 VIEW_MODE

In VIEW_MODE, the CMRI shall read and display the parameters, belonging to the respective category of the meter. The OBIS code, Interface Class and attributes for each of the parameters shall be as per corresponding tables in the ICS. The selection of a parameter for view shall be provided to user.

2.1.2 DOWNLOAD_MODE

In DOWNLOAD_MODE:

[a] CMRI shall download all parameters from each of the ICS meters connected with and stored in its memory. The ICS specifies three categories of meters with different usage. The data required to be provided by each of the category are defined in IS 15959. The CMRI shall download the data listed under each category in Table 2.

Table 2

Sl. No.	Parameter classification	CATEGORY		
		(A)	(B)	(C)
1.	Instantaneous Profile	✓	✓	✓
2.	Block Load profile	✓	✓	✓
3.	Daily Load Profile	NA	✓	NA
4.	Billing profile	NA	NA	✓
5.	Scaler profile	✓	✓	✓
6.	Event Log	✓	✓	✓
7.	Name plate details	✓	✓	✓
8.	Programmable parameters	✓	✓	✓

NA : Not Applicable

Note:
- All data at serial numbers 1 to 8 are required to be downloaded from each meter.
- Scaler profile for each of the corresponding data profiles is required to be downloaded.
- The IS 15959 shall be referred for list of parameters in each of the profile, OBIS code, Interface Class and attributes.
- Each of the indicated profile as whole shall be downloaded.
- Selective download of a parameter is required to be supported in view mode.

[b] Also, in this mode the CMRI shall upload the programmable parameters for corresponding selected meters. The identity of selected meter, parameters to be programmed are to be obtained from BCS as part of CMRI preparation by BCS.

The downloading of data from meter and uploading of programmable parameters if any for selected meter based on BCS requirement shall be automatic without need for operator intervention. However, indication of successful downloading and uploading of data shall be provided on the CMRI facia.

2.2 SERVER_MODE

In SERVER_MODE:

[a] CMRI server shall upload to BCS, upon request meter wise, all the downloaded data from various meters.
[b] CMRI server shall clear the meter data only upon receipt of command from BCS.
[c] CMRI server shall receive the parameters to be programmed from BCS. These parameters shall be structured as described in the following sections, for the CMRI Client to upload to various meters in the field.

The technical requirements both the modes are given under section 3.

3. Technical Requirements

The CMRI shall adopt the connectivity scheme shown in Fig. 1 and carry out the functional requirements for both the modes described in section 2.
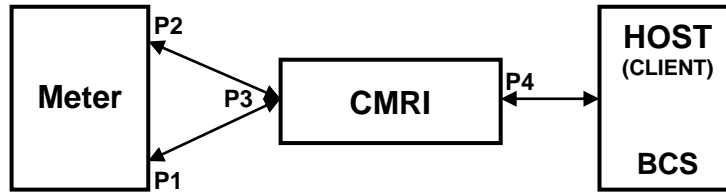
3.1 CMRI Connectivity Scheme

Fig. 1 Connectivity scheme between server (meter) and host (BCS)

The meter block in Fig. 1 may be a ICS meter. In the case of ICS meter P1 is hard ware port and P2 is optical port. The CMRI shall connect and read data from any of these ports.

The CMRI shall support a minimum of TWO ports for data communication, as given in Table 3:

Table 3

Port	Port type	Description
P3	RS232 or RS485	For local access of SERVER (METER) through HW port (P1) or Optical Port (P2). Support for default baud rate of 9600.
P4	RS232 or RS485	For communicating with (Host) BCS. Support for default baud rate of 115200.
	Ethernet (Optional)	For communicating with (Host) BCS. Data Rate = 10/100/1000 mbps.

Note: For P4 in lieu of RS232 or RS485 latest version of USB with serial communication capability or Ethernet may be offered for the buyer to choose.

3.2 CMRI Architecture for ICS compatible meters

The proposed architecture for the CMRI with which the two modes of functioning shall be implemented is shown in Fig 2.
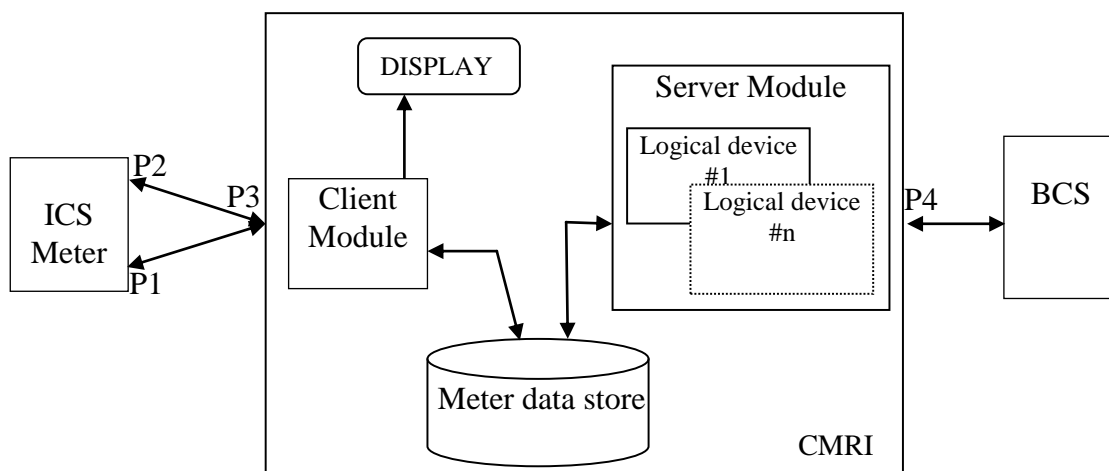

Fig.2. CMRI DLMS Server and Client architectural diagram

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3.3 CMRI Client Module

The CMRI upon power ON shall invoke a self test automatically and await choice of client modes. This Client module shall support both VIEW_MODE and DOWNLOAD_ MODE operations. The VIEW_MODE and DOWNLOAD_ MODE shall be switch/ soft (menu) selectable.

- Association – CMRI DLMS Client shall establish Application Association with meter in MR mode as defined in IS 15959. The OBIS code for US association is 0.0.40.0.2.255 with Interface Class – 15. The passwords and secret keys shall be provided by BCS as part of preparation.

- Addressing – One byte HDLC mode for direct local access.

- Referencing mechanism – LN only

3.3.1 In the VIEW_MODE, CMRI shall read and display the parameters, belonging to the respective category of the meter. The OBIS code, Interface Class and attributes for each of the parameters shall be as per corresponding tables in the ICS. The CMRI shall prompt the name of parameter through a menu or scrolling display for the reader to select the desired parameter for viewing. The CMRI shall remain in this mode until it is manually changed over to other modes.

3.3.2 In the DOWNLOAD_ MODE, CMRI shall download all parameters as per Table 2. The downloading of parameters shall begin automatically when DOWNLOAD _MODE is chosen using the selector switch/ Soft menu. The start of down load, start time, parameters currently downloaded, end time, volume of data shall be displayed on the CMRI.

The data of each of the meter shall be formed as a separate logical device inside the CMRI. This logical device is referred as Virtual Meter Device (VMD). The VMD shall include the data classification for the respective category of meters as mentioned in the ICS.

3.3.3 The CMRI Client shall also carry out programming of designated ICS meter (server) as and when required. The parameters meant for programming are as listed in the ICS. The writing shall be done through US association with HLS.

The BCS as described in section 4 shall prepare CMRI for carrying out programming of the ICS meter at field.

3.4 CMRI Server Module

The architecture of CMRI SERVER module is shown in Fig. 3 which comprises of a Management Logical Device (MLD) and many VMDs.
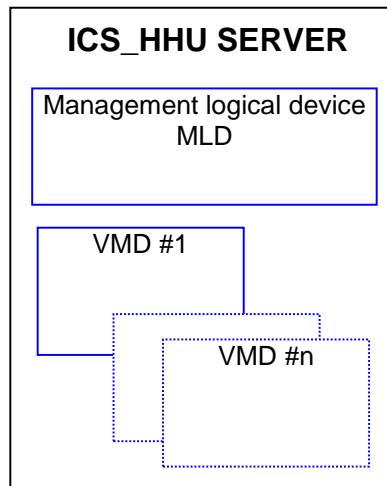
Fig. 3 CMRI SERVER Architecture

This module shall discharge the functional requirements of CMRI_SERVER_MODE. The CMRI shall be connected with the BCS through Port P4. The uploading of all the downloaded field meter data shall begin under the control of BCS. The MLD shall have SAP assignment object storing details of all VMDs.

Once the uploading begins the CMRI shall display start time the ICS meter identifier, completion of one VMD data, end time and volume of data uploaded. The BCS shall connect to CMRI associate with one VMD download all data and then disassociate with that. BCS shall repeat this sequence for all VMDs in the CMRI.

3.4.1 Management Logical Device – MLD

This is the mandatory logical device in CMRI (DLMS) SERVER module with Server SAP '1'. MLD shall contain the mandatory objects and other objects required for programming. SAP assignment list in MLD shall store the mapping information of VMDs viz SAP and VMD name. The VMD name shall be the meter serial number.

Mandatory objects

Mandatory objects in management logical devices are given in below Table-4.

Table 4

Object	OBIS code	Interface Class	Description
PC Association	0.0.40.0.1.255	15	Public Client Association object
MR Association	0.0.40.0.2.255	15	Meter Reader Client Association object
US Association	0.0.40.0.3.255	15	Utility Setting Association object
SAP assignment	0.0.41.0.0.255	17	SAP assignment list will store a list of SAP assignment entries. Each entry will have the mapping information of VMD SAP and VMD name (meter serial number).
Clock	0.0.1.0.0.255	8	CMRI's real time clock
HDLC Setup	0.0.22.0.0.255	23	Stores HDLC channel setup information

NOTE:

1. MLD and VMD shall always support accessing via current association object 0.0.40.0.0.255

2. All three association objects (PC Association object, MR Association object and US Association object) need not be visible always in management logical device for all clients – it depends on current association.

3. In addition to mandatory objects, MLD shall also contain the following objects in MR and US association.

   i. Meter Programming masks object.
   ii. Meter passwords table object.
   iii. Clock object for category A, B and C meters.
   iv. Demand integration period for category A, B and C meters.
   v. Load profile capture period for category A, B and C meters.
   vi. Single action schedule object for category A, B and C meters.
   vii. Activity calendar object for category A, B and C meters.

These objects shall be READ ONLY in MR and READ WRITE in US associations.

3.4.2 Passwords

CMRI Passwords

CMRI server shall support Low Level Security (MR association) and High Level Security (US association). The LLS secret and HLS key shall be handled using appropriate association objects in a way similar to that of ICS.

Meter Passwords

The Passwords (LLS secret/ HLS Key) corresponding to each shall be stored in Meter passwords table object in MLD. This object is modelled as Utility table (IC=26) and the "buffer" attribute shall be of the format shown in Table 5.

Table 5

SAP	Meter serial number	LLS Secret	HLS Key

Note:

    Meter Passwords List ::= Array PasswordsList_definition
    PaswordsList ::= structure
    {
        SAP – long unsigned
        MeterSerialNumber – octet string
        LLS Secret – octet string
        HLS Key – octet string
    }

- SAP - unique integer value in the range 16 – 16383
- Meter serial number – character string of length not exceeding 16 characters
- LLS Secret – LLS secret of the meter. Data type shall be Octet string.
- HLS Key – HLS Key of the meter. Data type shall be octet string and 16 characters in length.

The number of rows in this table will be dynamic depending on the number of electrical meter logical device (VMD).

BCS can optionally write SAP = 0 which is a wildcard indicating global LLS secret/HLS key which is applicable for all meters.

3.4.3 Programming

MLD shall have an instance of meter's programmable objects viz Real Time Clock – Date and Time, Demand Integration Period, Profile Capture Period, Single-action Schedule for Billing Dates, Activity Calendar for Time Zones which can be written from BCS. BCS shall set "Meter programming masks" appropriately to indicate which all objects to be actually programmed into the meter when CMRI connects to the meter.

Meter programming masks

Meter programming masks table is modelled as utility table(IC 26) and BCS can use this to select the objects to be actually programmed into meter when CMRI connects to meter. The "buffer" attribute shall be of the format shown in Table 6.

Table 6

Mask number	Mask enable	Applicable meters list

Note

- Mask number – an integer of range 1-255. Meaning of each mask will be detailed in Meter programming masks list in Table 7.

- Mask enable – Boolean (0 – False, 1 – True) indicating if the mask is enabled or not(whether the parameter is to be written or not).

- Applicable meters list is a list of structure {SAP, Meter logical device name} indicating the list of meters to which parameter specified in "Mask number" need to be programmed (provided the "mask enable" is TRUE). SAP = 0 in Applicable meters list is a wildcard to indicate the parameter shall be programmed to all meters.

Meter programming masks list

Table 7

Mask number	Meaning
1	Activity calendar passive season profile(category A meter)
2	Activity calendar passive week profile(category A meter)
3	Activity calendar passive day profile(category A meter)
4	Activity calendar activate passive calendar method(category A meter)
5	Activity calendar activate passive calendar dateTime(category A meter)
6	Single action schedule execution times(category A meter)
7	Clock time (category A meter)
8	Demand integration period(category A meter)
9	Load profile capture period(category A meter)
10	Activity calendar passive season profile(category B meter)

11	Activity calendar passive week profile(category B meter)
12	Activity calendar passive day profile(category B meter)
13	Activity calendar activate passive calendar method(category B meter)
14	Activity calendar activate passive calendar dateTime(category B meter)
15	Single action schedule execution times(category B meter)
16	Clock time (category B meter)
17	Demand integration period(category B meter)
18	Load profile capture period(category B meter)
19	Activity calendar passive season profile(category C meter)
20	Activity calendar passive week profile(category C meter)
21	Activity calendar passive day profile(category C meter)
22	Activity calendar activate passive calendar method(category C meter)
23	Activity calendar activate passive calendar dateTime(category C meter)
24	Load profile capture period(category C meter)
25	Single action schedule execution times(category C meter)
26	Clock time (category C meter)
27	Demand integration period(category C meter)

Note:

Meter programming mask ::= Array MeterProgrammingMask_definition
MeterProgrammingMask_definition ::= structure
{
    MaskNumber – unsigned
    MaskEnable – boolean
    ApplicableMetersList :: = Array Meter_definition
}

Meter_definition ::= structure
{
    SAP – long unsigned
    MeterSerialNumber – octet string
}

- Mask number – an integer of range 1-255. Meaning of each mask will be detailed in Meter programming masks list in Table 6.

- Mask enable – Boolean (0 – False, 1 – True) indicating if the mask is enabled or not(whether the parameter is to be written or not).

- Applicable meters list is a list of structure {SAP, Meter logical device name} indicating the list of meters to which parameter specified in "Mask number" need to be programmed (provided the "mask enable" is TRUE). SAP = 0 in Applicable meters list is a wildcard to indicate that the parameter shall be written to all meters.

3.4.4 Virtual Meter Device – VMD

The VMD is the logical representation of the all the parameter collected from a field meter. Each meter data is modelled as a VMD in CMRI Server. The number and mapping information regarding VMD will be stored in the SAP assignment list of MLD. VMD shall contain the mandatory objects and objects downloaded from meter. All objects (except mandatory objects) previously downloaded will be deleted from electrical meter logical device before starting a new download from meter.

Mandatory objects

Mandatory objects in an VMD are shown in Table 8.

Table 8

Object	OBIS code	Interface Class	Description
PC Association	0.0.40.0.1.255	15	Public Client Association object
MR Association	0.0.40.0.2.255	15	Meter Reader Client Association object
US Association	0.0.40.0.3.255	15	Utility Setting Association object
Logical device name	0.0.42.0.0.255	1	Logical device name shall be the serial number of the meter. Logical device name will be an octet string of length not exceeding 16 characters.

NOTE:

1. CMRI Server logical devices (MLD and VMD) shall always support accessing via current association object 0.0.40.0.0.255

2. All three association objects (PC Association object, MR Association object and US Association object) need not be visible always in electrical meter logical device for all clients – it depends on current association.

Association properties

The association requirements for both management logical device and electrical meter logical device shall be as mentioned in Table 9.

Table 9

Feature	Public Client	CMRI-R	CMRI-RW
Client address	16	32	48
Application context	LN without ciphering	LN without ciphering	LN without ciphering
Authentication mechanism	No Security	Low Level Security	High Level Security
Services required in conformance block	GET, GET WITH BLOCK TRANSFER,	GET, GET WITH BLOCK TRANSFER	GET, GET WITH BLOCK TRANSFER, SELECTIVE ACCESS, SET, SET WITH BLOCK TRANSFER, ACTION

NOTE:
  Above association properties are applicable for both management logical device and electrical meter logical device.

4. PREPARATION OF CMRI

CMRI preparation refers to the various steps involved in configuring CMRI for proper functioning as a CMRI_CLIENT and CMRI_SERVER. This involves configuring logical devices, creating meter reading groups, setting passwords and transferring programming data.

4.1 SAP Assignment list preparation

SAP assignment list object in the management logical device holds the mapping information of all logical devices (management logical device and electrical meter logical device). SAP assignment consists of a list of SAP assignment entries and each entry will have the server SAP and corresponding logical device name. SAP '1' is reserved for management logical device. Electrical meter logical device SAP shall be a unique integer value in the range 16 – 16383. Logical device name is a character string of length not exceeding 16 characters and it shall be the serial number of meter which the logical device represents. SAP assignment entry shall be created before downloading data from a meter. SAP assignment entries can be created by either of the two methods

1. Writing from BCS – BCS can write directly into the SAP assignment list.

2. Run time configuration – CMRI can read the meter serial number and create a new SAP assignment entry if there is no logical device already created for the meter.

Regarding Passwords please refer Section 3.4.2 and for Programming please refere Section 3.4.3.

5. Testability

The proposed modes of operation shall be verifiable by appropriate testing tools Server Simulator.

CPRI shall prepare a separate Test plan for CMRI designed as per this document.

6. Suggested CMRI Design requirements for selected components

The table below lists a few components with their requirements. This is a guideline. A suitable HW specification for the envisaged functional support shall be separately specified by the buyer.

Sl. No.	Name of component	Requirements
1.	Memory	The hardware shall have sufficient memory for loading the Operating System/ Application softwares/ And for downloading and storing of at least 1000 meters of data at any time and for programing as per the requirement of ICS for 1000 meters.
4.	Communication support	Shall be as per Fig-1 and Table 3
5.	Communication protocol	a) To be designed to IS 15959 based on DLMS/COSEM b) The compatibility with the existing and future upgrades in protocol is required.
6.	Application Software	The CMRI shall support softwares meeting the functional requirements mentioned in section 3, for ICS compatible meters.
7.	Input / Output (I/O) Ports	As defined in CMRI Connectivity Scheme – Fig 1. Suitable plug for the ports shall be provided for protection of ports.
9.	Key board/ Key pad	Industry standard to facilitate envisaged modes of operation.
10.	Construction	Suitable for outdoor field operation.

GLOSSARY

BCS	Base Computer System
CEA	Central Electricity Authority
CMRI	Common Meter Reading Instrument
COSEM	COmpanion Specification for Energy Metering
CPRI	Central Power Research Institute
DLMS	Device Language Message Specification
HDLC	High Level Data Link Control
HHU	Hand Held Unit
HLS	High Level Security
HW	Hard Ware
ICS	Indian Companion Specification (IS 15959; 2011)
IEC	International Electrotechnical Commission
IS	Indian Standard
LLS	Low Level Security
LN	Logical Name / Long Name Referencing
MLD	Management Logical Device
MR	Meter Reader
MRI	Meter Reading Instrument
NA	Not Applicable
OBIS	OBject Identification System
PC	Public Client
SAP	Service Access Point
US	Utility Setting
VMD	Virtual Meter Device