

CASE STUDY : Grid Metering for Monitoring & Energy Accounting System

CLIENT : An ISO Certified Power Transmission Company in India

LOCATION : India

INTRODUCTION

The client is a State Government run Power Transmission Company operating more than 1, 00,000 ckt km in India. The client required an Automated Meter Reading (AMR) system that will feed data to the Monitoring and Energy Accounting (MEA) System for each Open Access (OA) customers connected to the grid. The total number of Availability Based Tariff (ABT) metering points were close to 300 locations and the stakeholders included generation companies, the transmission utility, distribution circles, captive power plants, independent power producers, distributed power generation operators (for DG sets, mini-hydel) as well as EHT consumers in the state.

Kalkitech solution involved customized AMR Client/Server, Data Concentration Units (DCUs) and MIS reports as part of the MEA system. Final energy accounting reports on various requirements like Unscheduled Interchange (UI), Auxiliary consumption, Reactive Energy Consumption, Scheduled Bilateral Exchanges, Inter regional, Inter and Intra state transmission losses were delivered by Kalkitech.

CLIENT REQUIREMENTS

The client required the following main solutions as part of their MEA:

- Meter Data collection from remote meters
- Meter Data import from xml files
- Schedule Data from xls, txt files
- Creation of Master Data base
- Data Validation, Estimation and Editing
- Configuration of various meter parameters like Meter Configuration, Virtual Meter Configuration, UI rate
- GUI development for graphical display of ABT meter data's like Data trending, charts
- Predefined reports generation
- Report Generation Tool
- Exporting report to user defined format like PDF, xls
- Open access calculation
- Tariff calculation – EC, CC realization based on Availability, UI charges, REC, Incentive calculation based on PLF, TSC
- Security/ Authentication at various levels.

KALKITECH SOLUTIONS

AMR Communication Architecture

The remote meters were communicated over GSM network using GSM/GPRS modem. The meter end modem was connected to the meter with the help of an Optical cable. The server end modem was connected to Industrial PC which acted as the DCU. The DCU was in the same network of MEA server-client network. The Industrial PC was connected to the server end modem through its COM port. The application in the Industrial PC invoked the meter specific proprietary APIs. This API initiated the server end modem to dial the meter end modem. The dialling number for the modem was configurable and the same configured number was used by the API to call the meter end modem. The meter end modem was set to auto-answer mode.

The meter end modem was connected to the meter through the optical cable and it sent data fetch request and collected the data from the meter whenever the data collection command was received from the server end modem. For this the server end modem and meter end modem were connected. All this dialling and data collection from meter were handled by the meter proprietary APIs as per the MIOS regulations.

The meter end modem was physically connected to meter using Optical Cable. The server end modem was physically connected to the Industrial PC using RS232 communication cable. The server end modem and the meter end modem were connected over wireless GSM network at the time of data collection.

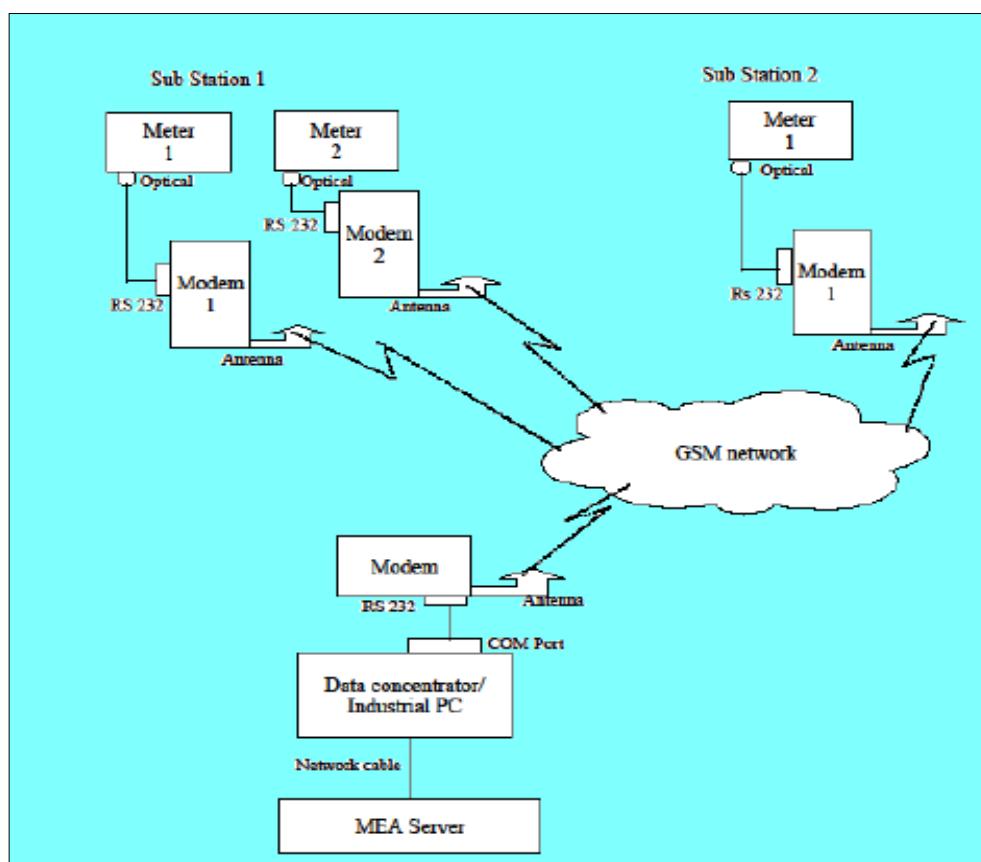


Figure 1: AMR Communication Architecture

AMR Software Architecture

With reference to the software architecture, the Application Programming Interface (API) was meter proprietary and was invoked by the AMR server on request from the AMR client. The AMR server was a continuous running service and on demand/ request from the AMR client, it responded. The AMR server configured the meter details as given through the AMR client. AMR server further invoked the API for meter communication by giving the configuration of the meter and collected the data from API. The data received through the API was stored in Data Concentrator as XML file. This data was then driven to data base using the Data Driver. The data in the DB was then converted into OPC format using the OPC server. The AMR data present in DB and the OPC format were viewed through AMR GUI. MIS reporting was done with the data present in the DB.

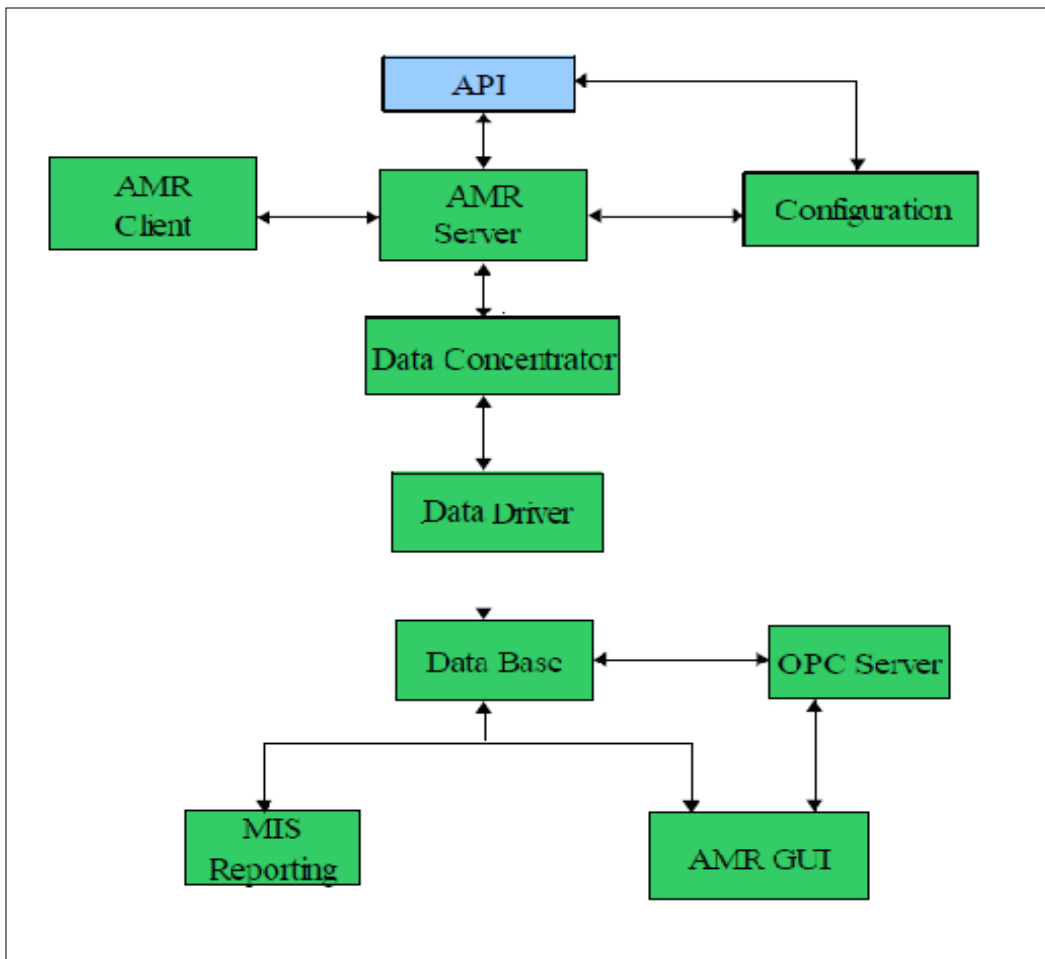


Figure 2: AMR Software Architecture

AMR Modules

The custom modules developed for delivering the AMR Solution with the MIS are listed below:

1. AMR Server
2. AMR Client
3. Configuration
4. Data Concentrator

5. Data Driver
6. OPC Server
7. AMR GUI
8. MIS Reporting

1. AMR Server

The AMR server was a continuous running service which invoked the API for meter communication as configured for automatic reading. The functionality that was present in the AMR server was:

- Invoked the Meter API for communication followed by its API for conversion
- If configured for particular time of data fetch of all meter, it started collecting the data of all the meter at that time (configured) of each day
- Collected the instantaneous data of all meter in routine
- Collected the data of particular meter's particular parameter on demand
- Configured the Configuration module as given from AMR client
- Fetched details from Configuration module as demanded from the AMR client
- Server gave priority of process execution
- The priority was highest for on demand, then followed by daily data and then for routine instantaneous parameter fetch. When the instantaneous data fetch was in process and the time for daily data fetch arrived then, the daily data fetch started and after this process was over the instantaneous data fetch, resumed from where it was paused.
- When the daily data fetch or instantaneous data fetch was in process and the on-demand data request came from the AMR client then the daily data fetch or instantaneous data fetch paused and the on-demand data fetch was done. Once this on-demand data fetch was over the respective data fetch which was paused was resumed from that particular meter where it was paused.
- Identified the meters configured for consumer name or ID that was received from client for on-demand data fetch and collected the data for all those identified meters.

2. AMR Client

The AMR client was used for configuring the meters and data fetch intervals and for on-demand data fetch. The functionality present in the AMR client was:

1. Configuring Modem details
2. Configuring Data fetch time
3. Send on-demand data fetch request to server with selection of Consumer Name or ID and parameters Which was Instantaneous, Energy Data, Events, Load Profile or All?

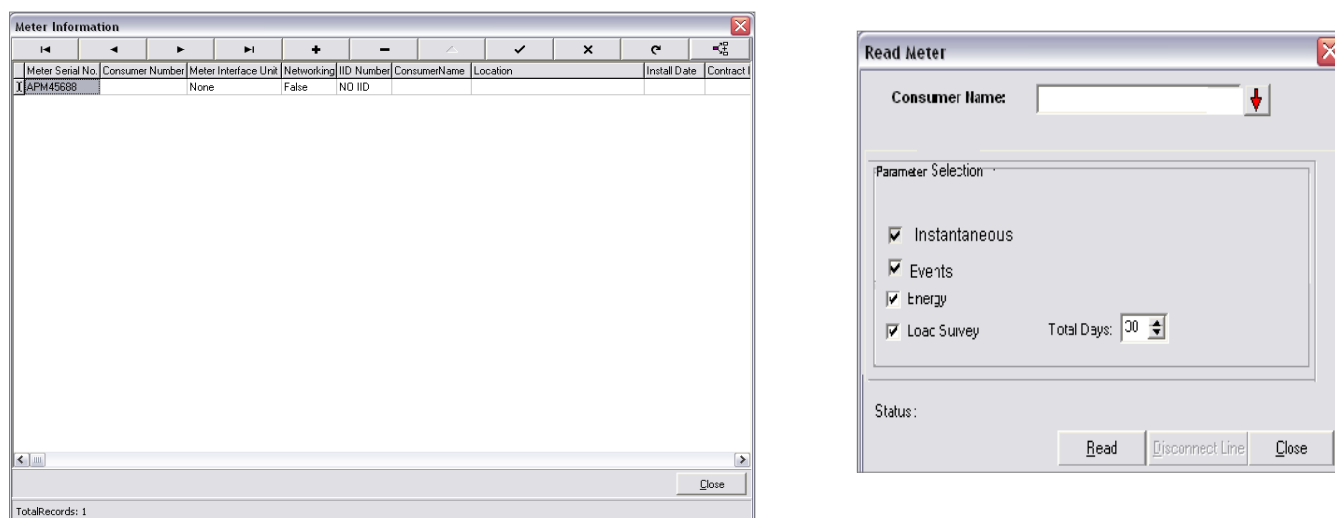


Figure 3: AMR GUI

3. Configuration

The configuration details configured for a particular meter was stored with meter Serial Number as its file name. The configuration file was then saved as *.xml file format.

4. Data Concentrator / Industrial PC

The files generated by the API were stored in particular location. The file that generated was *.xml file. These files then were used for driving the data present in the file to the Data base. The files that were processed were stored in different location. All these files were present in the data concentrator for future reference.

5. Data Driver

The data driver was for driving the data in the xml file to the data base. The driver was running continuously. The following functionalities were present in the Data driver.

1. Runned continuously.
2. Identified automatically, once the *.xml file was generated.
3. Processed the file and populated the data present in the file to database.
4. Moved the processed files to different location.
5. Had settings for configuring data file path and data base.

6. OPC Server

The OPC server fetched the data from the data base and converted the data to the OPC format. This OPC data was then fetched by any OPC client that was connected to it. The data that were converted to OPC data as tags are mentioned below:

Voltage:

R-Phase Voltage Instantaneous in V,
Y-Phase Voltage Instantaneous in V
B-Phase Voltage Instantaneous in V

Current:

R-Phase Current Instantaneous in A
Y-Phase Current Instantaneous in A
B-Phase Current Instantaneous in A

Power:

System Active Power Instantaneous in kW

System Reactive Power Instantaneous in kVAR
System Apparent Power Instantaneous in kVA

Power Factor:

R-Phase PF Instantaneous
Y-Phase PF Instantaneous
B-Phase PF Instantaneous

Frequency:

Frequency Instantaneous in Hz

7. AMR GUI

The AMR GUI was developed to display the data fetched from the meter. The data displayed were fetched from the database or from the OPC server and included Instantaneous, Energy data, Events and the Load Profile Data.

8. MIS Reporting

The MIS reports were developed to show the different data in daily, weekly, monthly and yearly wise. The reporting used the data from the data base.

Monitoring & Energy Accounting Solution

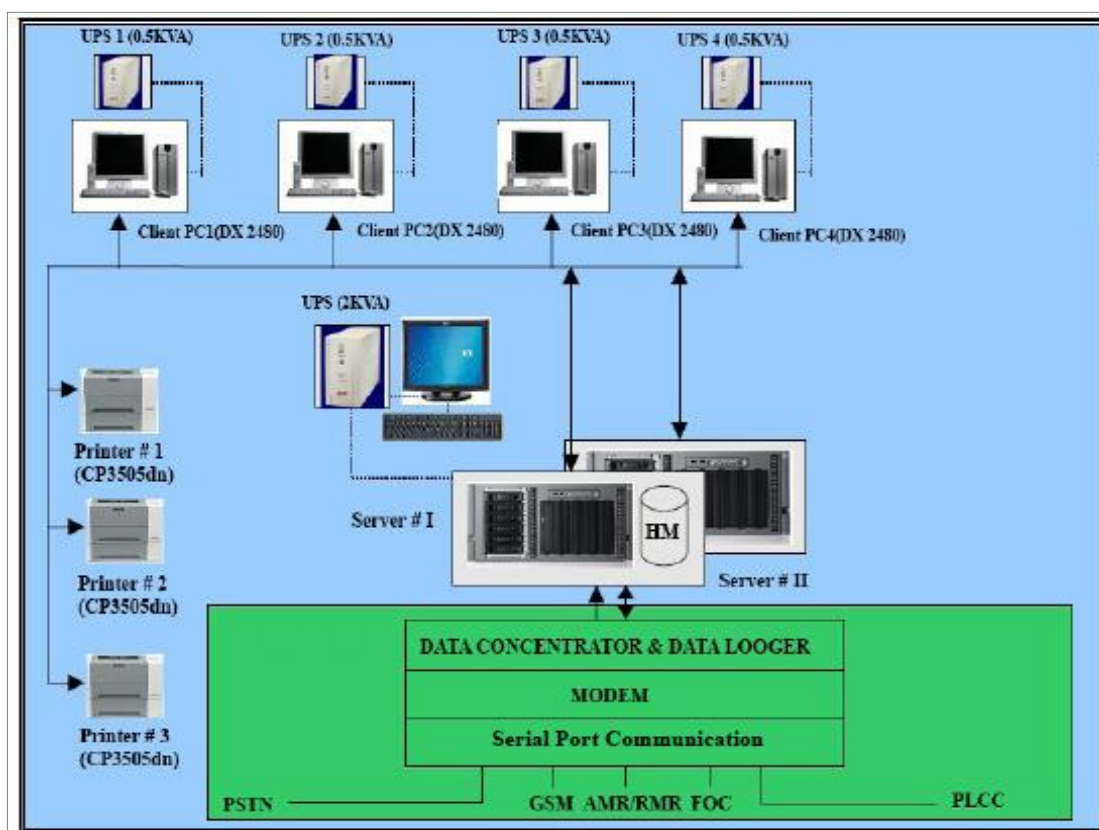


Figure 4: MEA Architecture

The Hardware (Servers and Desktop PC's) arrangement at the client for MEA solution was as given in the figure above. Hardware had dual redundant servers running in hot-standby configuration. These servers were configured and designed for a high availability requirement. The two servers were connected with the printers and the client's desktop PCs.

The data to be imported for the system included:

1. Actual interchange (ABT compliant energy meter data) from substations across the State obtained from the AMR system.
2. Declared Capacity from Generating Stations
3. Entitlement of ISGS stations from Regional Load Dispatch Centre (RLDC)
4. OA Schedule from RLDC
5. Frequency Data from RLDC
6. Time bound losses from RLDC

The Actual Interchange Data (Meter Data) and the Meter Manufacturer's proprietary software for converting .MRD files to .xml files were made available to MEA system by the State Transmission Company and State Load Dispatch Centre (SLDC). The Special Energy Meter (ABT) Data Driver read the xml files and uploaded the data to the database. All other Data were in the format of ASCII/ XLS. The system had configuration provision for defining the ASCII/ XLS file templates so that future changes or additions in the file templates don't affect the system. The user authenticated the template IDs for which processing was done. The mode of communication was through GSM/GPRS Modem (for Instantaneous, Load Profile data and mid night data) and e-mail (for declared capacity, entitlement, interstate OA schedule) and the attached ASCII/XLS file was stored in Preprocess folder. The path of the predefined folders was configurable by the user. In the e-mail mode, the MS Outlook was configured to do the function. The e-mail addresses from which the data arrived was configurable by the user.

When network communication failed, the SLDC received the information through Fax or Phone. In this case, the user entered the data manually in the predefined template (with an authenticated template ID) and saved the file in the same Preprocess folder. The Data import engine got the file from Preprocess folder, read the information from these files and validated. The data in files which were validated true were uploaded into the database and the files moved to the processed folder.

The files which were validated false were moved into Invalid folder. There was a log of these events and a pop-up message appeared to that effect. The user then requested the sender of the file to resend the information after correction or he/she corrected the file and placed in the Pre process folder for the Data Import engine to process the same. The data was stored in the Data Base and by default; the data was stored for 18 months as prescribed by CERC regulations. All incoming Actual Interchange data were validated before processing the data for calculations. The Data Validation, Estimation and Editing (VEE) were as per corresponding and viable items of Industry standards/ rules.

Report Generation

The Report Generation Module generated web based reports corresponding to the query parameters (like Date, Period, Virtual Meter ID, Meter ID, Entity ID) passed by the user. The module provided export option in PDF, XLS, CSV and txt formats. The predefined reports that were made available are classified as below:

Daily Reports

1. Unscheduled Interchange (UI) Report based on different entities.
2. Declared Capacity Report
3. Dispatch Schedule Report
4. Active Energy Export/Import Report based on different entities

Weekly Reports

1. Unscheduled Interchange (UI) Report based on different entities.
2. Deviation (Actual from Schedule) Report based on different entities.
3. Reactive Energy Account

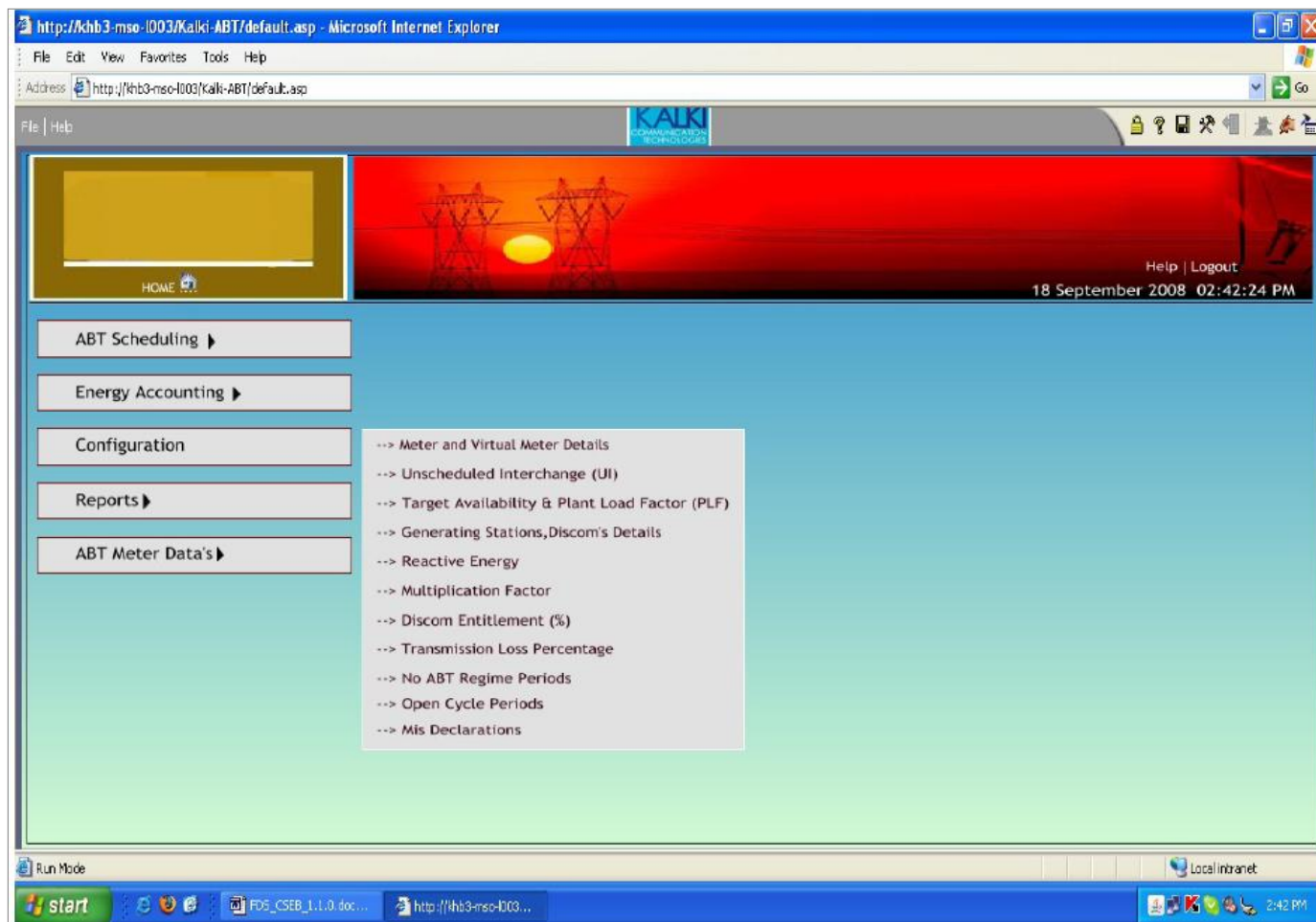


Figure 5: ABT Screen

Monthly Reports

1. Capacity index report for Intra-state generating stations and IPPs (Monthly and Cumulative).
2. Plant Load factor report (Monthly and cumulative).
3. Availability report (Monthly and cumulative)
4. Total scheduled energy import report.
5. Total scheduled energy export report.
6. User defined Inter regional, Inter and Intra state transmission losses report.
7. Maximum demand report of DISCOMs
8. Mis-Declaration by intra state generating stations and IPPs.

9. Scheduled bilateral exchanges report (With in state, Outside the state, Shared projects, other DISCOMs).

Diagnostic Reports

1. Comparison of main meter and check meter readings report
2. Comparison of frequency of RLDC vs frequency measured by ABT meter report.

MIS Reports

1. Load survey Report
2. Entity wise Detailed Energy report
3. Consumption report

Graphs

1. Load Survey Graph – entity wise
2. Frequency pattern graph- meter wise
3. Schedule Interchange Vs Actual Interchange – entity wise
4. Availability pattern Graph – entity wise
5. CI pattern Graph – entity wise
6. PLF pattern Graph – entity wise

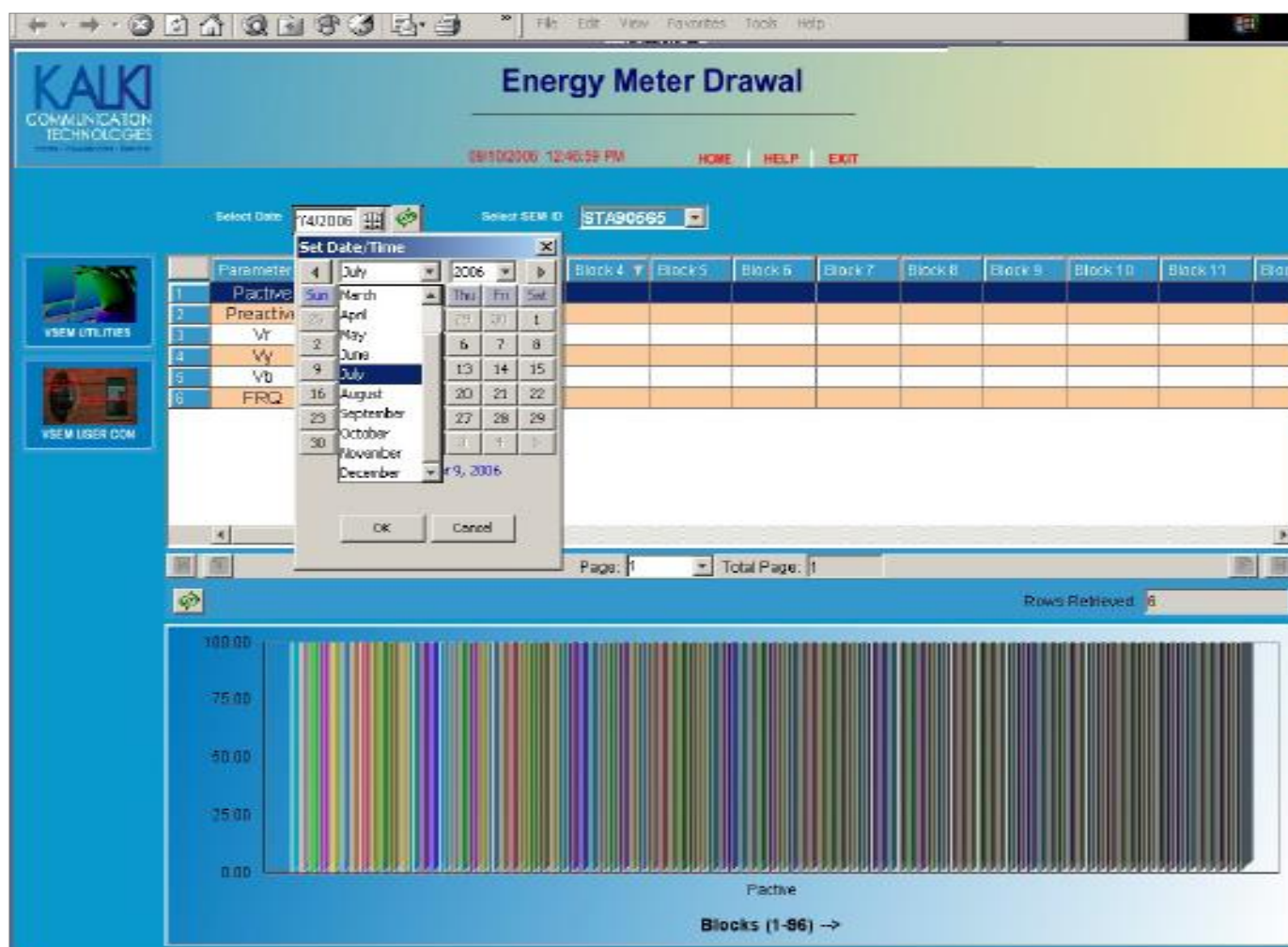


Figure 6: EA screen

CONCLUSION

Automated Meter Reading system acted as front end for the MEA System. The data acquired from the ABT meters was pushed by a modem through the GSM/GPRS network. The modem at the server end received it and sent it through a data concentration unit to the MEA network. This data as well as the information received from the SLDCs helped the client to do energy accounting efficiently. Daily, weekly and monthly diagnostic reports on various parameters like Plant Load Factor Report, Availability Report, Total Scheduled and Energy Import/Export Report.

READ MORE

- **Kalkitech Grid Metering Solution:**
http://www.kalkitech.com/offerings/solutions-td-grid_metering
- **Kalkitech ABT Solutions:**
http://www.kalkitech.com/offerings/eltrix-generation_management/