Power System & Environment Monitoring (PSEM) Solution

Henry Huang (ENP China)
E-Mail: huangren@emersonnetwork.com.cn
Mobile: 86-13923728821
Index

1. Architecture of PSEM
2. Site solution
3. Communication
4. Capacity
5. Management function
6. Application of PSEM
7. Roadmap
Practical Problems

- **MSC/BSC**
  
  2% of sites have a severe disaster each year
  
  40% of disasters take 12 hours or longer time to be found out from sign to occur.
  
  60% of them can be identified and recovered within 24 hours.

- **BTS**
  
  65% of downtime or failures is caused by power facility problem.
  
  85% of failure take 12 hours or longer time to be found out, almost via subscriber complaint, or routine inspection by maintenance team.
  
  80% of them take more than 24 hours to identify and recover on site.

Source: InformationWeek Research Business Continuity Survey
What We Can Do

- Monitor the operation status in real-time
- Response the emergency quickly
- Prevent disaster proactively
- Manage maintenance work-flow efficiently
- Integrate and unify various alarm systems
- Simplify statistics, plan and report
- Optimized design for telecommunication infrastructure
- Reduce operation cost
PSEM Architecture

2-Layers for initial phase

State Center
SC/SS

State Center
SC

Regional Center
SS

SU
SM
SM

3-Layers for network expansion & operation

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SU
SM
SM

SC: Supervision Center – Network Management and Operation Center
SS: Supervision station – Routine Maintenance Center
SU: Supervision Unit – MSC / Transmission / BTS sites
SM: Supervision Module
PSEM Architecture

PSEM

LAN

Core Switch Center

Upper OMS

E1 / IP / GPRS / CDMA / SMS / ADSL / 3G

Power Systems

Environmental Systems

Rectifier
Generator
HVAC
Leak Detection

Battery Plant
UPS
Water
Smoke

Power Systems

Environmental Systems

Rectifier
Generator
HVAC
Leak Detection

Battery Plant
UPS
Water
Smoke

USB Camera

BTS Nodes
Index

1. Architecture of PSEM
2. Site solution
3. Communication
4. Capacity
5. Management function
6. Application of PSEM
7. Roadmap
Telecom Application

Non-Intelligent

- AC Distributor
- Door Switch
- Water leakage
- Temp. & humidity
- Smoking
- Battery
- Transducer

Intelligent

- GEN Sets
- ATS
- UPS
- DC Power
- HVAC
- Video Monitoring

RS232 / 422 / 485
**Site Controller – IDU**

IDU: Integrated Data Unit processes all data from intelligent equipments and sensors.
Optional Module for IDU-HOST

**IDU-BAT module**: Each battery monitoring module for 24/48 cells of battery. Can support 2V/6V/12V battery voltage signal.

**IDU-COM module**: Each com module provides another 4 serial ports for intelligent equipment.

**IDU-BRG module**: Transmission function module for E1 transmission. Must be configured when using E1.

1. Only 2 optional modules can be configured in 1 IDU simultaneously.
2. Only 1 BAT module or COM module can be configured when using E1 for using 1 BRG module.
Monitoring of Intelligent Equipment

IDU-Host has 4 serial ports, which is used to connect intelligent equipment into the system.
**Intelligent Equipment Supported**

- **DC power:**
  - Emerson (including legacy products from Ericsson, Huawei, Nortel, Marconi), Eltek, Delta(Ascom), PowerOne, Benning, Switchtec, Saft, Argus...

- **UPS:**
  - ABB(APC), Liebert, Delta, Exide, MGE, Chloride...

- **Air conditioner:**
  - Liebert (Hiross), RC, Atlas, AirFlow, Isovell, UN, DaiKin, Denco, Stulz, AireDale, Emicon...

- **Generators:**
  - Caterpillar, Cummins, Wilson, Simpson, Galaxy, Detroit, Auto...

- **others:**

*PSEM is able to monitor over 800 types of intelligent devices in addition to Emerson equipment.*

**Note:** The protocol of 3rd part equipments shall be provided by Operator.
Monitoring of Non-Intelligent Equipment

IDU-BAT module: Battery monitoring module for 2 groups (48-cell volt, 2-current, 2-total volt.). Can be extended to 2 IDU-BAT modules for 4 groups in each IDU.

IDU-IO channel: 16-channel AI, DI 4-channel DO

Battery

Environment sensors

IDU

E1/IP

Distribution

HVAC

Others
Generator set

<table>
<thead>
<tr>
<th>Vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Caterpillar</td>
</tr>
<tr>
<td>2 Stamp Ford</td>
</tr>
<tr>
<td>3 Deutz Genepack</td>
</tr>
</tbody>
</table>

Intelligent Generator

Non-Intelligent Generator

To Host

Sensor

VT

Power meter

V.A.f.P.kWh

VT

CT

Oil Pressure

Water temperature

RS-232/422/485

To Host

VT

Battery

Diesel

Vendor

1 Caterpillar

2 Stamp Ford

3 Deutz Genepack

EMERSON

Network Power
Mode 1: Throw-in type Sensor

Mode 2: Screw Thread Mounted Sensor

Real oil position

Measured oil position

$H_{\text{Real oil position}} = H_{\text{Measured oil position}} - \Delta H$
**Rectifier**

**Intelligent Rectifier**
- Interface card
- IDU
- To Host

**Non-Intelligent Rectifier**
- Interface card
- IDU
- To Host

**Vendor**
1. Emerson
2. Ericson
3. Siemens
4. Power One
5. Saft - Nife
6. Benning
7. SPS-2180
8. Alcatel
9. Harrif
**PAC**

Intelligent PAC

Non-Intelligent PAC

<table>
<thead>
<tr>
<th>Vendor</th>
<th>1 Liebert</th>
<th>2 RC</th>
<th>3 Hirros</th>
</tr>
</thead>
</table>

RS-232/422/485 Interface card

To Host

Temperature

Humidity sensor

To Host

IP

EMERSON
Network Power
**BTS solution**

To server in SC.

IP, GSM, GPRS, CDMA, ADSL, E1, SMS.

- **Power**: 20~60V DC
- **1 Console Port**
- **1 Ethernet Port**
- **USB Video**
- **LAN**
- **4-channel DO**
- **16-channel AI, DI**
- **Door access**
- **4 232/422/485 Serial Ports for intelligent device monitoring**
- **ACDB**: 3 phase voltage/current transducer
- **Environment sensors**
- **Diesel level**
- **Battery total voltage**
- **DC power**
- **Air conditioner**
**IDU Family**

**IDU-Host**
- 16-channel DI/AI inputs
- 4 relay outputs
- 4 serial ports, maximum 8 with an IDU-COM
- Monitoring 1 or 2 battery strings with an IDU-BAT
- Ethernet communication
- 2 extended slots all kinds of functional card
- 1 USB port
- I2C interface for low cost temperature & humidity sensor connecting

**IPLU1202**
- 6 General IO
- 1 Battery String Total Voltage
- 1 DO
- 1 I2C Temperature and Humidity Sensor Interface
- 2 Intelligent Serial Ports
- Ethernet Communication
- E1 Communication
- 1 USB Video
Index

1. Architecture of PSEM
2. Site solution
3. Communication
4. Capacity
5. Management function
6. Application of PSEM
7. Roadmap
Communication --- from BTS to SC via IP Network

IP Network

LAN

Server

Console

SC

SU

BTS NO.1

IDU

BTS NO.2

IDU

BTS NO.5000

IDU
Communication --- via Wireless

GPRS/CDMA/3G/SMS

SC

SU

BTS

IDU

NO.1

NO.2

NO.5000

Console

LAN

Server

GGSN/SMS center
Communication 1 --- via GPRS
Communication 2 --- via GPRS

- Console
- Server
- LAN
- GPRS modem
- Host
- GPRS network
- BTS
- IDU
- NO.1
- NO.2
- NO.5000

EMERSON
Network Power
1. Architecture of PSEM
2. Site solution
3. Communication
4. Management function
5. Application of PSEM
6. Roadmap
Capacity of PSEM Using IDU

- One server is able to monitor total about 5000 BTS
- One IDU is able to monitor about 12 types of device.
- PSEM can be expanded by to add number of servers to n * 5000 BTS.
Functions of Software

Monitoring & Control
- Self-diagnosis
- Managing work-orders
- Work hand/take over
- Remote monitoring
- Remote control
- Authority mgmt
- Equipment mgmt

Function of Monitoring System
- Weekly, monthly and yearly report
- Statistic function
- Report
- Management
Functions of PSEM software

Electronic site map and free navigation
Simply and exactly remote on-line configuration, monitoring and trouble ticketing

Real time monitor all sites and equipments simultaneously
Advanced battery management

- **Battery capacity**
- **Battery backup time calculation**
- **Battery charge / discharge test**
- **Lag-behind battery checking**
- **Battery cable anti-theft**

Outage power allocation such as intelligent distribution of Gen-sets when input power outage happens
Facility trouble shooting expert system

3rd party maintenance compliance management

PSEM can smoothly connect to 3rd party work flow trouble ticketing system
Functions of PSEM

Preventive/predictive maintenance by data statistics and analysis
Equipment life cycle and asset management
Efficient tools for backup power system / network optimization
Functions of PSEM

Economic video system for theft control and personnel compliance management

Both USB camera and IP camera are available

Current CCTV integration by using original camera
Functions of PSEM

Self-diagnosis help to ensure the stability of system
Functions of PSEM----Energy management

- Fuel mgmt.
- Mains KW mgmt.
- Air Con. KW mgmt.
- DC KW mgmt.

Diesel Fuel level sensor

AC energy meter

DC Fan Temperature

Air conditioner (switch running)

DC energy meter Rectifier (Branch current)

PSEM
Diesel consumption management

Diesel Consumption:

\[ \Delta V = (h_1 - h_2) \times S \]

<table>
<thead>
<tr>
<th>running times</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>\ldots</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel (liter)</td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>\ldots</td>
<td>Ln</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>site</th>
<th>month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>\ldots</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTS1</td>
<td></td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>\ldots</td>
<td>Ln</td>
</tr>
<tr>
<td>BTS2</td>
<td></td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>\ldots</td>
<td>Ln</td>
</tr>
<tr>
<td>BTS3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>\ldots</td>
<td></td>
</tr>
</tbody>
</table>
**Air conditioner management**

Flexible field logic control strategies

Efficient energy cost cut-off solutions

Optimize set-point to control air conditioners to reduce energy cost for AC by 15% per site per year

<table>
<thead>
<tr>
<th>Temp</th>
<th>AC 1</th>
<th>AC 2</th>
<th>DC Fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains failure</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Over 35°C</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>28°C - 35°C</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>23-28°C</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Switch running</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>running Based on °C</td>
<td>28 °C</td>
<td>23 °C</td>
<td>0</td>
</tr>
<tr>
<td>Below 23 °C</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Mains/DC bill management

- BTS site management
- Payment management
- Statistics
- Pre-alarm (arrear, rent at term, abnormal electricity expense)
- System management
- User management
1. Architecture of PSEM
2. Site solution
3. Communication
4. Management function
5. Application of PSEM
6. Roadmap
Power management (Telstra in Australia)

Diagram:
- Diesel
- Generator
- Rectifier
- BTS
- Solar system
- Battery
- IDU
- GPRS

Table:

<table>
<thead>
<tr>
<th>DCV</th>
<th>Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-&gt;48V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&lt;48V</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>54-&gt;48V</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>&lt;48V</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

- Diesel lower alarm
- Time
- Duration

Legend:
- 54V
- 48V
- DCV
Power management (PT Win in Indonesia)

<table>
<thead>
<tr>
<th>Normal</th>
<th>Mains failure/Phase trip</th>
<th>Trigger Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Generator</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Door open expired</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Temperature over 35 °C</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Fuel tank empty</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Arrester failure</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AC outdoor unit removed</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

- AC mains
- Generator
- Battery
- Rectifier
- BTS
- IDU
- Outdoor unit of AC
- Access keyboard
- Ground cutting
- Dry contact

AC Voltage

- Diesel lower alarm

Time

Mains failure
Example---Indosat (Indonesia)
Case Study – CMCC (Jiangsu)

Location: East of China
Area: 102,600 km²
Population: 75,495,000
GDP(2006): USD 282 billion (3rd)
Per capita: USD 3,775 (5th)
Growth rate of GDP: 15.4%
Capital: Nanjing
Prefecture-level: 13 divisions
Mobile penetration: 51%
Case Study – CMCC (Jiangsu)

Company Overview:
1. BTS number: Over 14,712.
2. Subscriber: Over 30 million.
3. Revenue(2006): USD 2.5 billion
4. Market share: 80%

Monitoring Overview:
1. One Supervision Center
2. 13 regional Supervision Station
3. BTS sites monitored: 14,000+.
4. Monitoring penetration: 98%

<table>
<thead>
<tr>
<th>City / Region</th>
<th>BTS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suzhou</td>
<td>2352</td>
</tr>
<tr>
<td>Nanjing</td>
<td>2023</td>
</tr>
<tr>
<td>Nantong</td>
<td>1122</td>
</tr>
<tr>
<td>Yancheng</td>
<td>1128</td>
</tr>
<tr>
<td>Xuzhou</td>
<td>1135</td>
</tr>
<tr>
<td>Yanzhou</td>
<td>752</td>
</tr>
<tr>
<td>Taizhou</td>
<td>719</td>
</tr>
<tr>
<td>Huai’an</td>
<td>683</td>
</tr>
<tr>
<td>Zhengjiang</td>
<td>674</td>
</tr>
<tr>
<td>Changzhou</td>
<td>1023</td>
</tr>
<tr>
<td>Lianyungang</td>
<td>803</td>
</tr>
<tr>
<td>Suqian</td>
<td>796</td>
</tr>
<tr>
<td>Wuxi</td>
<td>1502</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14712</strong></td>
</tr>
</tbody>
</table>

Over 11,000 sites built by Emerson.
Monitoring Network Topology

- 1 Provincial Supervision Center
- 13 Regional Supervision Stations

- Data Server
- IP Network
- IP / E1
- BTS IDU
- 14000 BTS

- Enviro.
- Equip.
- Video
Monitoring for Base Station (BTS)

- The highest position of BTS monitored is on Everest.
  (Altitude 6500 meter)
Business application

Gen-sets Intelligent Distribution System (GIDS)

- Power cut
- Real time data
- Real time voltage
- Get the information of power cut
- Leave for
- Start off Gen sets
- SMS
- Maintenance staff
- Adjustment
- Distribution Solution
- Distribution SMS
- Start of Gen sets
- Shutdown Gen set
- Adjust Distribution Solution
- Proofread time
- Distribution Solution
- Distribution time
- SMS center
Shares in China Telecom marketing

China Telecom
- Emerson 52%
- A 14%
- B 6%
- C 5%
- D 5%
- Other 18%

China Mobile
- Emerson 49%
- Other 26%
- A 9%
- B 6%
- C 5%
- D 5%

China Unicom
- Emerson 65%
- A 12%
- B 9%
- C 6%
- Other 8%

- Total 872 suits of monitoring system of PSEM be used for 109572 sites monitored until May, 2007.
Thank you