Digital Smart Metering Devices

SMS configuration of metering devices

- *Import of source data from SMS-based meter*
- *Initialization of SMS-based meter in the MİSL system*
- *Import of subscriber data into the system*
- *Creating groups of messages*
- *Sending SMS by groups*
- *Creating alert messages*
- *Checking the GSM signal strength*
- *Connecting a metering device to the data channel*

SMS-BASED SMART METERS

SMS-BASED METERS

Sms vasitasiylə məlumatın göndərilməsi.

Sms vasitəsiylə məlumatın alınması.

GSM GATEWAY

Mobile Operator

SMS meter operating center

Consumer

Building 7 Building 8

Building 5 Building 6

Building 3 Building 4

Building 1 Building 2

Group of consumers

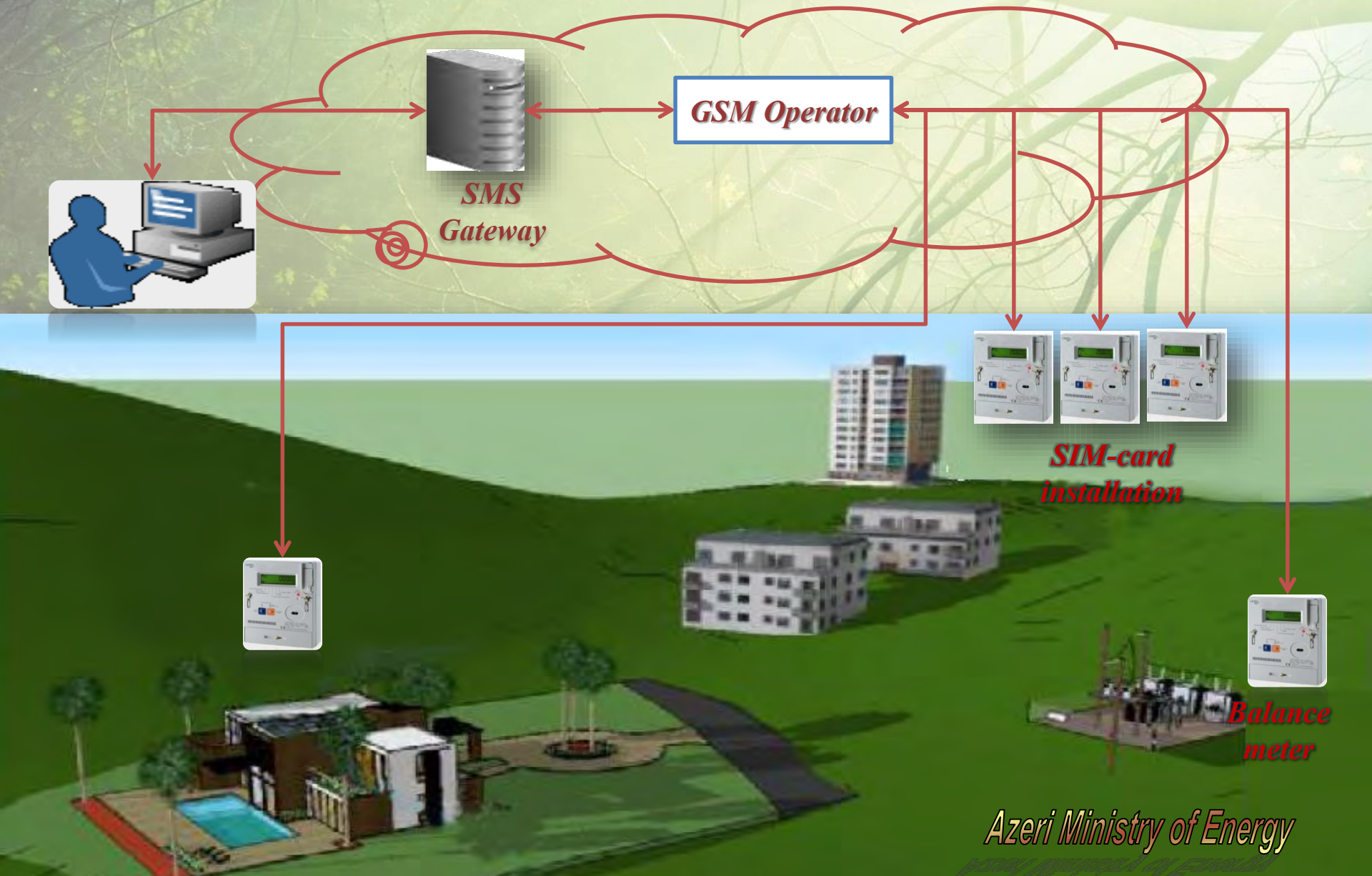
Azeri Ministry of Energy

Achieving power balance

with the SMS-based meters

Azeri Ministry of Energy

Real-time balance data update



Azeri Ministry of Energy

Note: F - feeder

F1

F2

F3

$F t = (F1+F2+F3)$

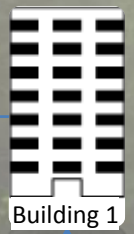
N1

Private residence 1

N2

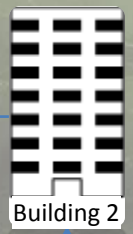
Private residence 2

N3



Building 1

B1

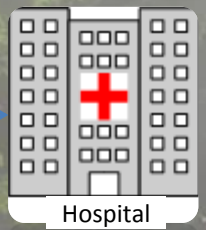


Building 2

B2

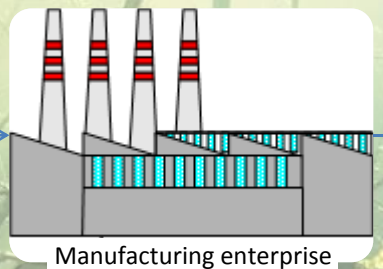
Public institution

C1



Hospital

C2



Manufacturing enterprise

Private residence 1

Y1

Private residence 2

Y2

Private residence 3

Y3

Private residence 4

Y4

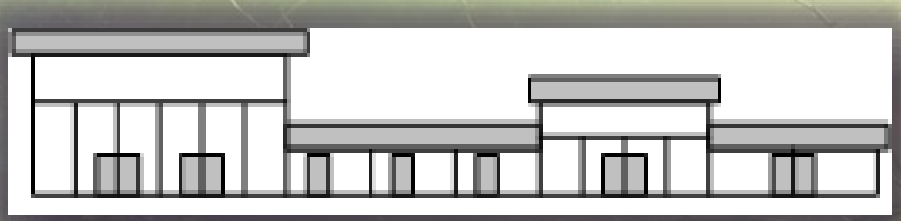
Private residence 5

Y5

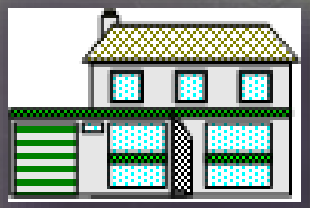
Private residence 6

Y6

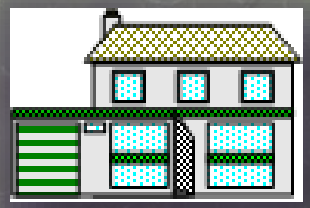
Calculation of differential consumer balance



N1



N2



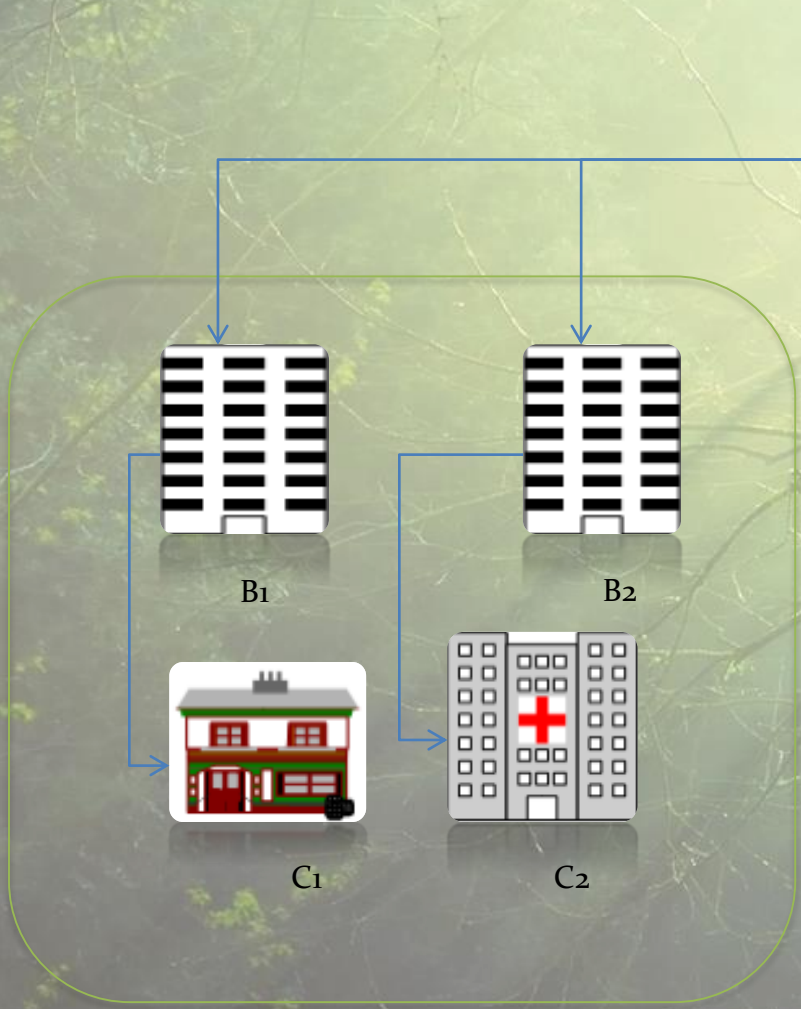
N3

F1 Power substation 0.4 kV

F1 = (N1+N2 +N3)

Azeri Ministry of Energy

Calculation of differential consumer balance



Power substation 0.4 kV

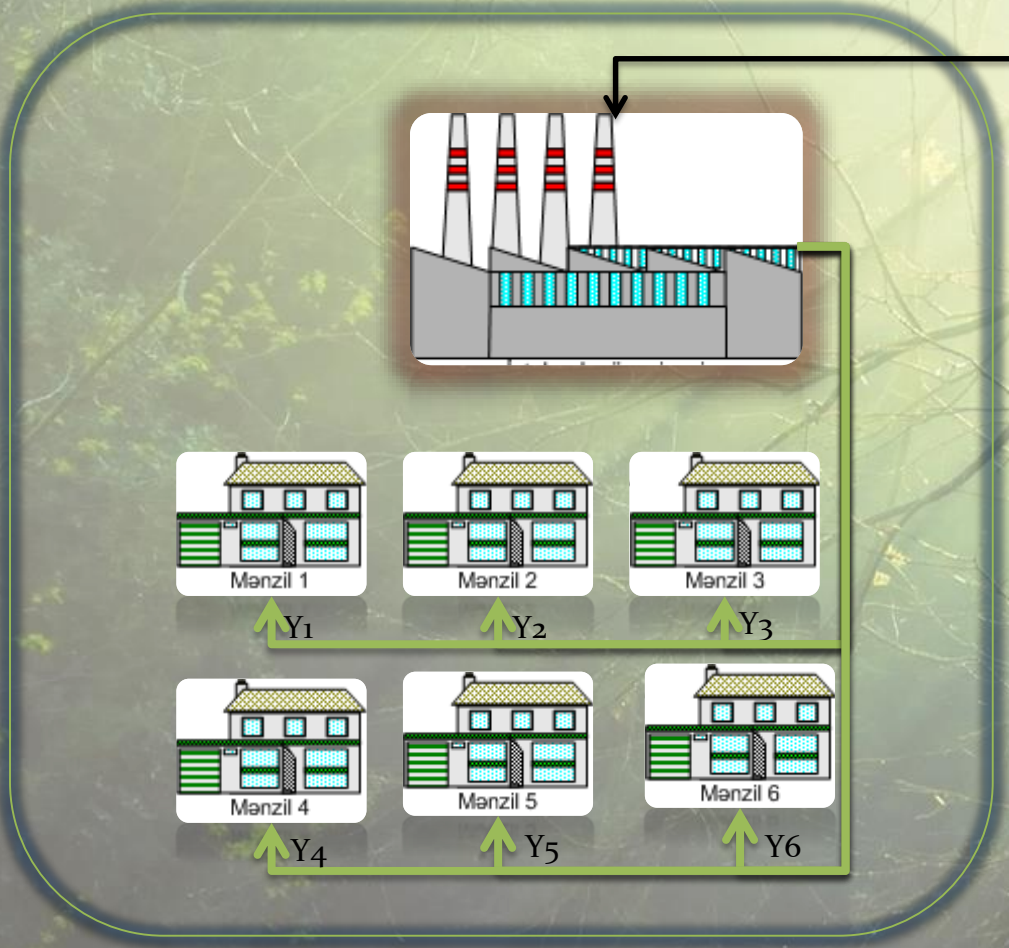
$$F2 = (B1-C1)+(B2-C2)$$

$$B1 = (m1+m2+..+m_n)$$

$$B2 = (m1+m2+..+m_n)$$

Calculation of differential consumer balance

F3



$$F3 = Z - (Y1+Y2 \ldots+Yn)$$

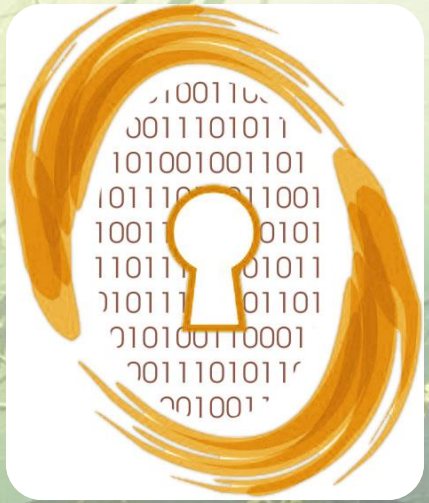
Azeri Ministry of Energy

Communication with smart meters

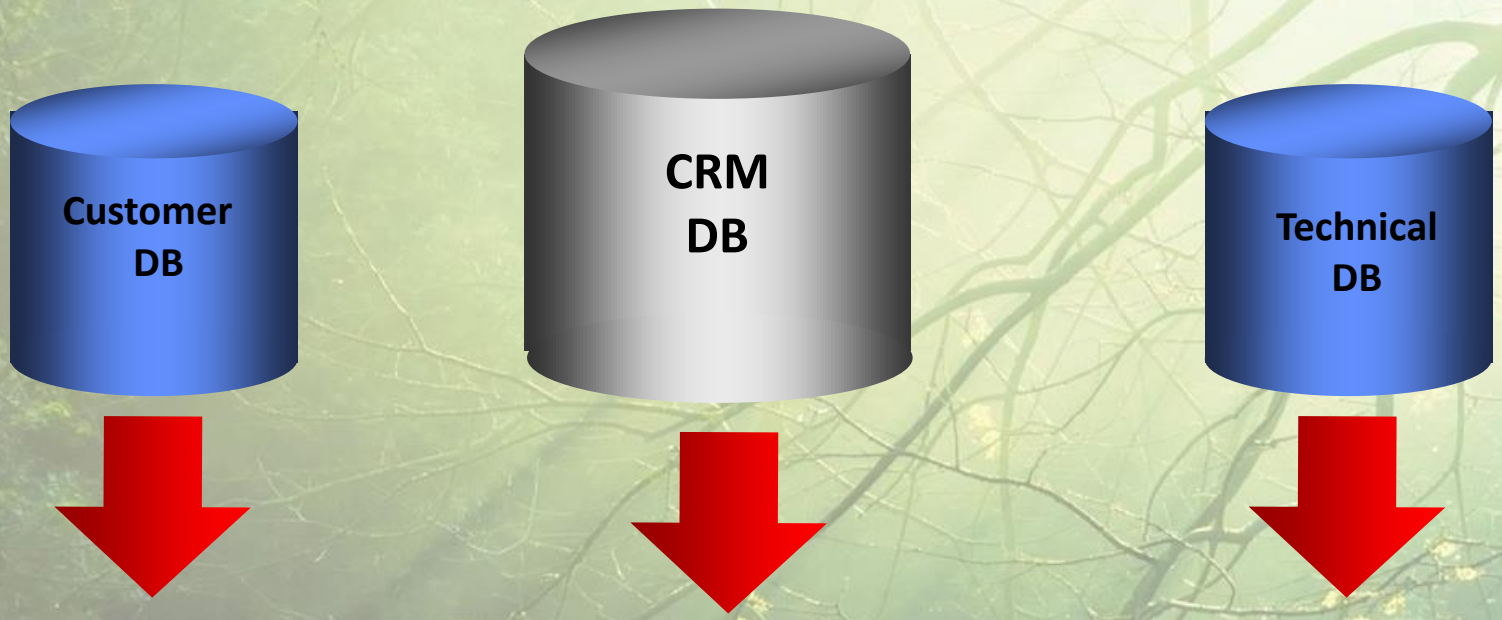
- ✓ DATA EXCHANGE WITH SMART METERS IS BASED ON 8-BIT SMS MESSAGES
- ✓ Data is delivered to smart meters by the Bull's algorithm
- ✓ 0:0 – SENDING A MESSAGE
- ✓ 0:1 – MESSAGE IS DELIVERED TO THE MOBILE OPERATOR
- ✓ 1:0 - MESSAGE IS RECEIVED BY A SMART METER
- ✓ 1:1 – DATA DELIVERED WITH A MESSAGE IS PROCESSED BY A SMART METER

Smart meter data security protection

- Data is encrypted by the hex-decimal algorithm
- Short messages (SMS) are only received on a dedicated short number
- Balance is topped up through a pre-defined number
- Each meter has individual unique (20-digit) code for prepayment

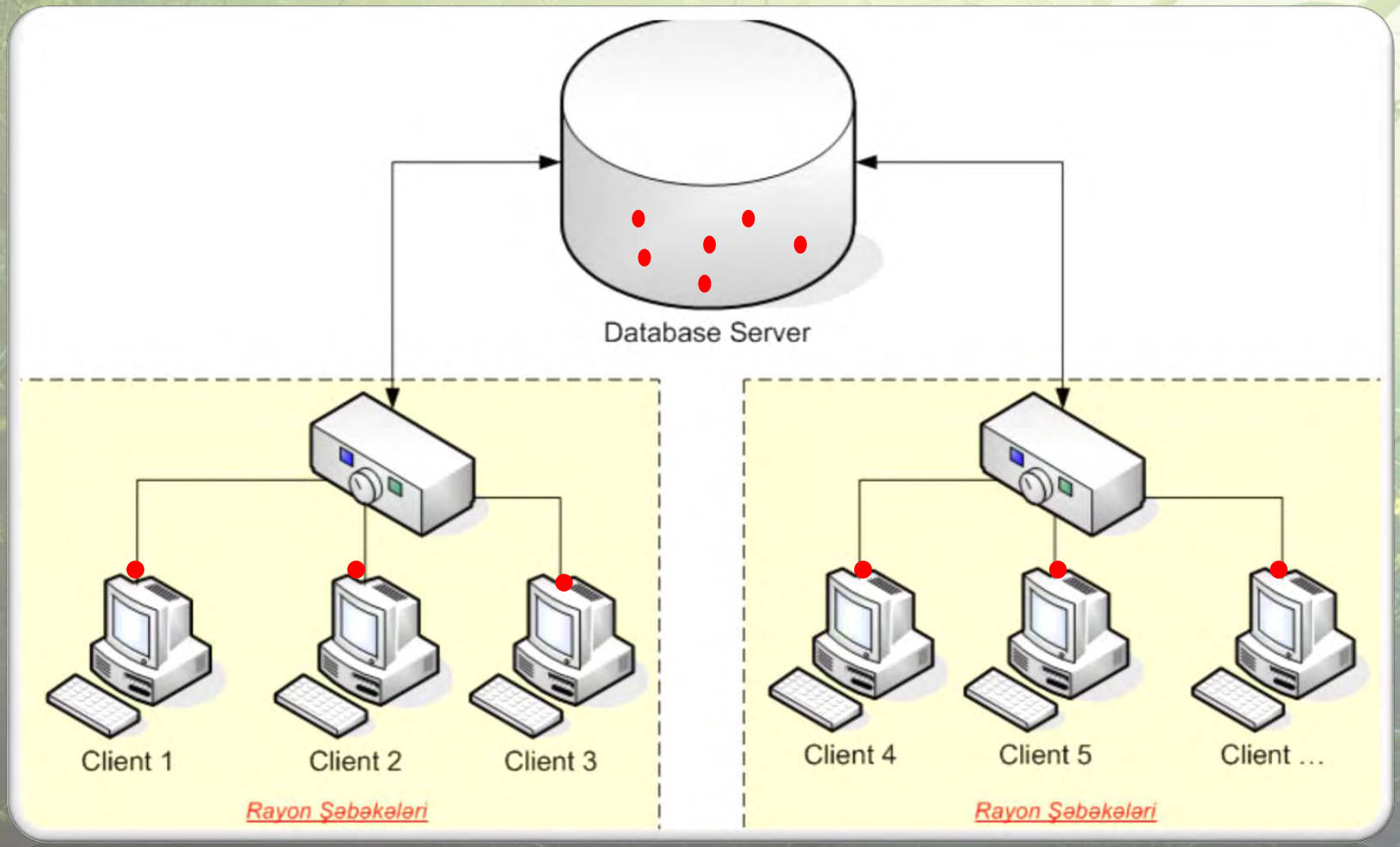


Database Structure



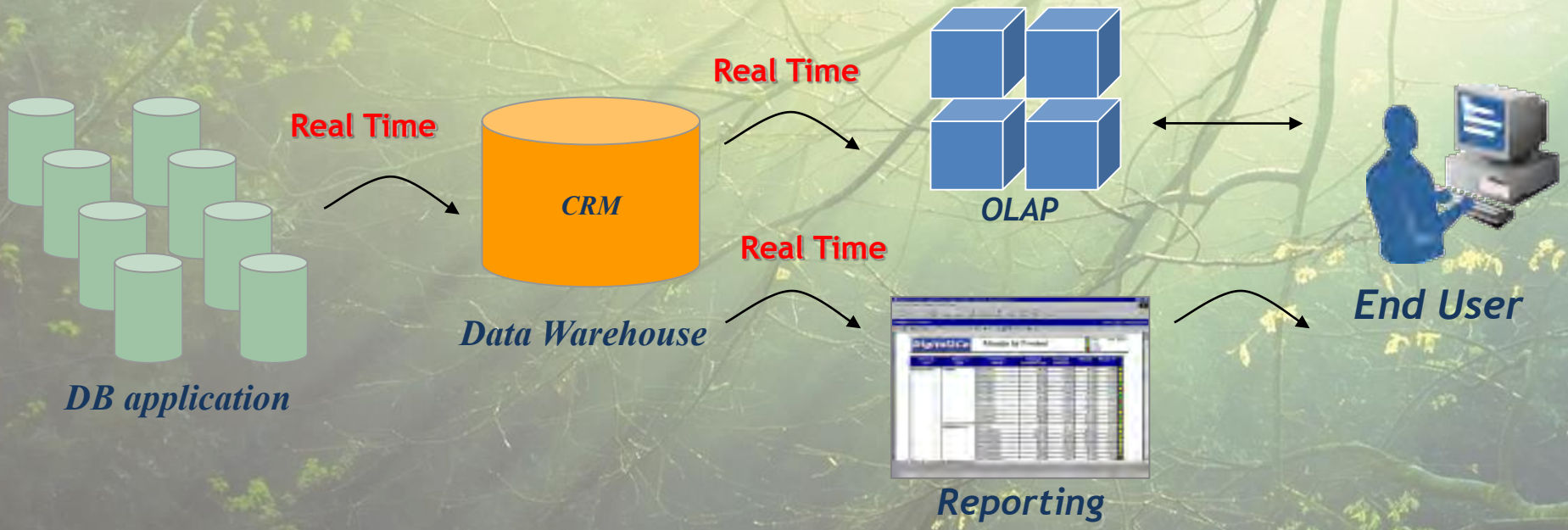
Subscriber Information Management System

Active Directory Network



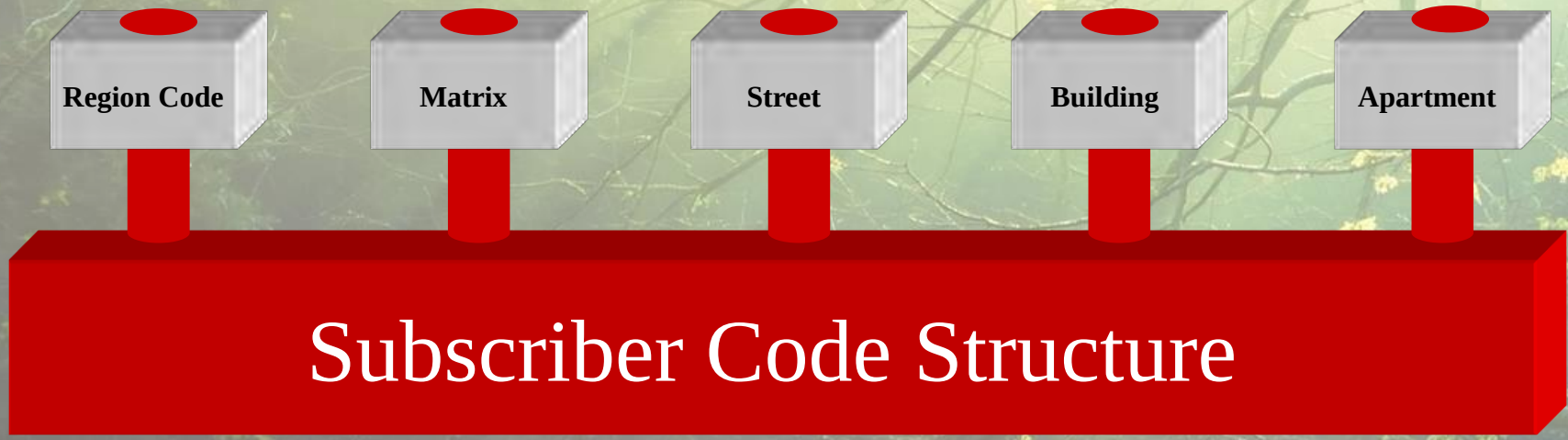
End User diagram

Information Management structure:

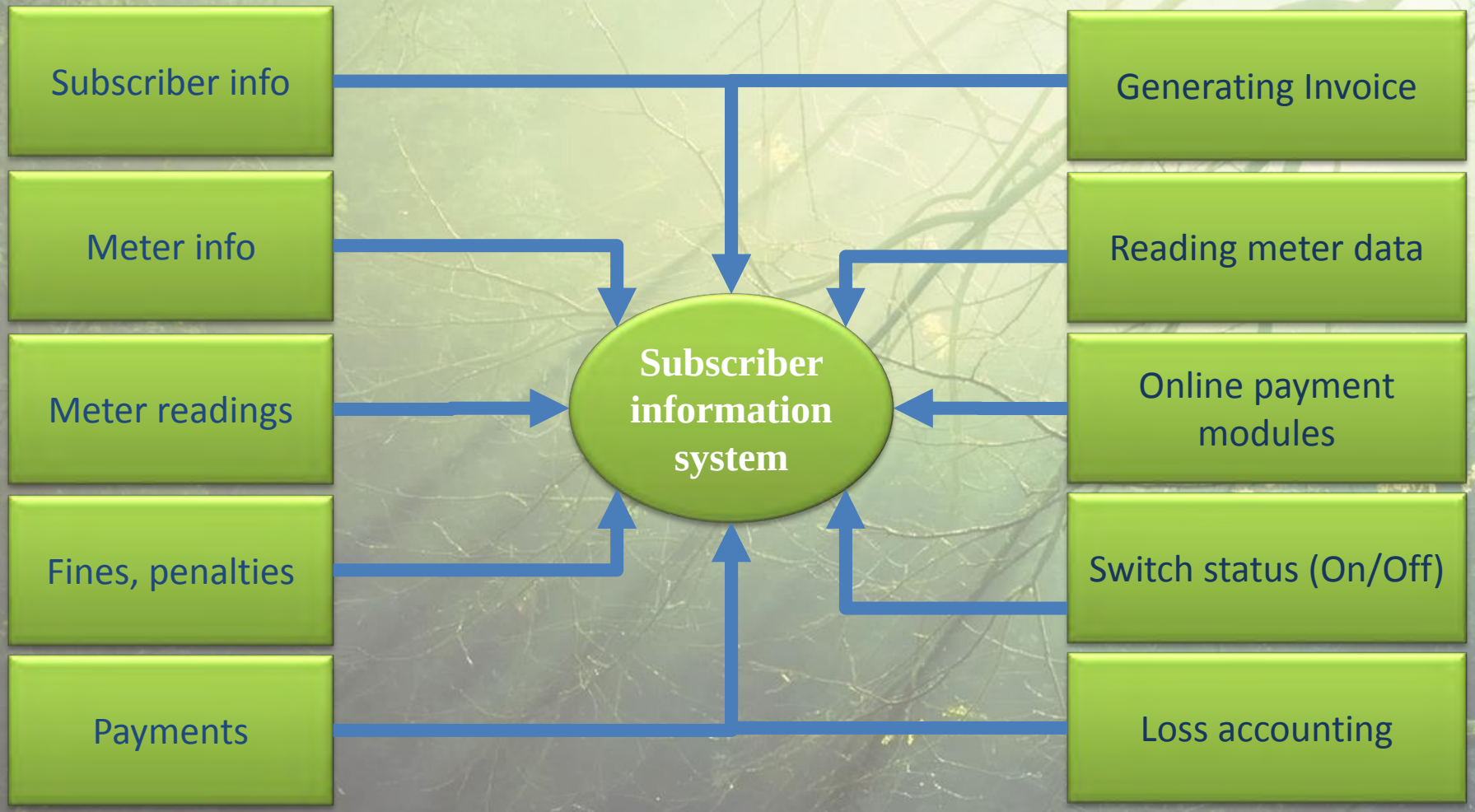


Subscriber CODE Generation

01 06 002 0026 0012



Subscriber information system



Subscriber Information Management System
SIMS Operations menu

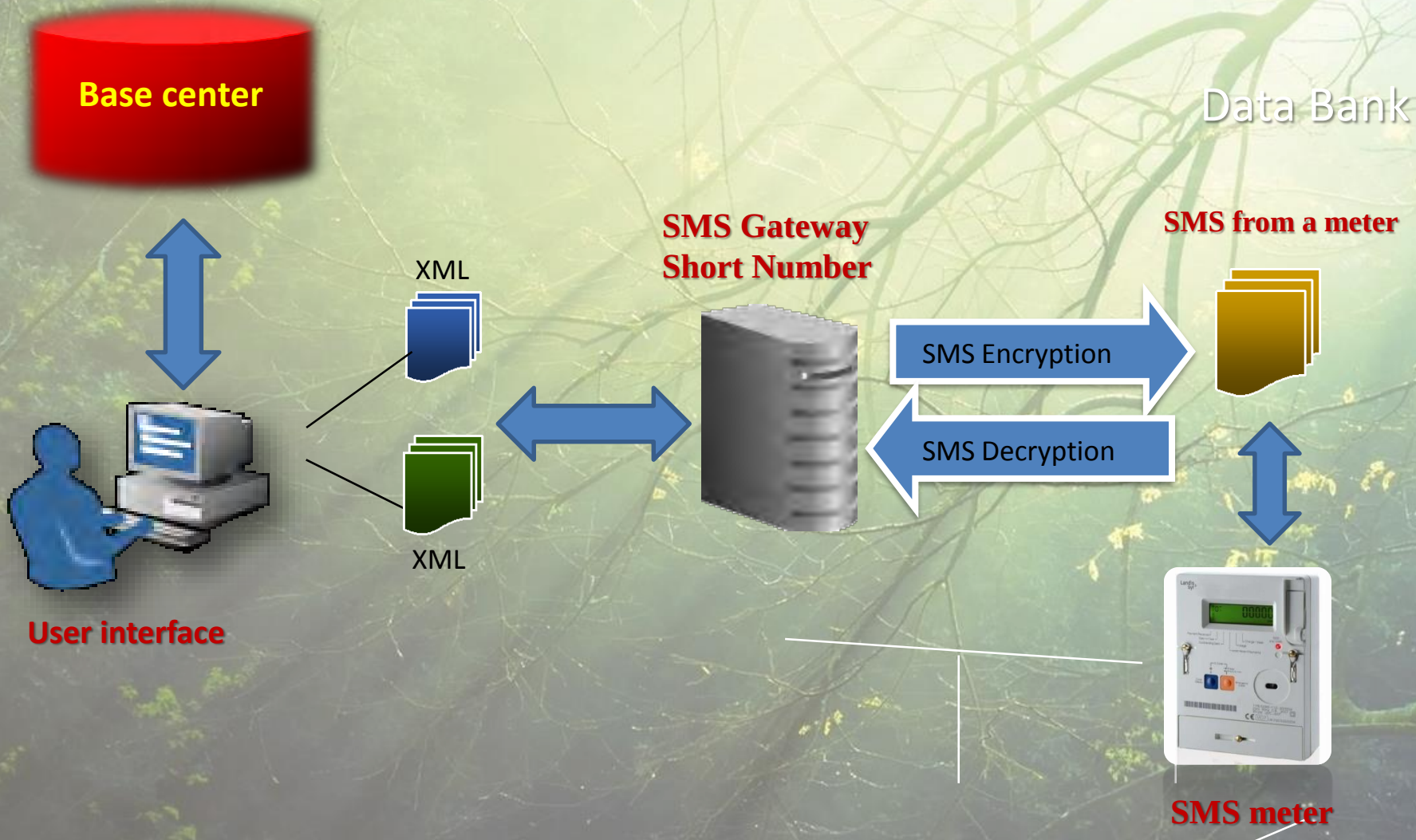
- Subscribers
- Reading
- Payment
- Invoice
- Meters
- Generation
- Losses
- Transformers
- Transactions
- Reports

Azeri Ministry of Energy

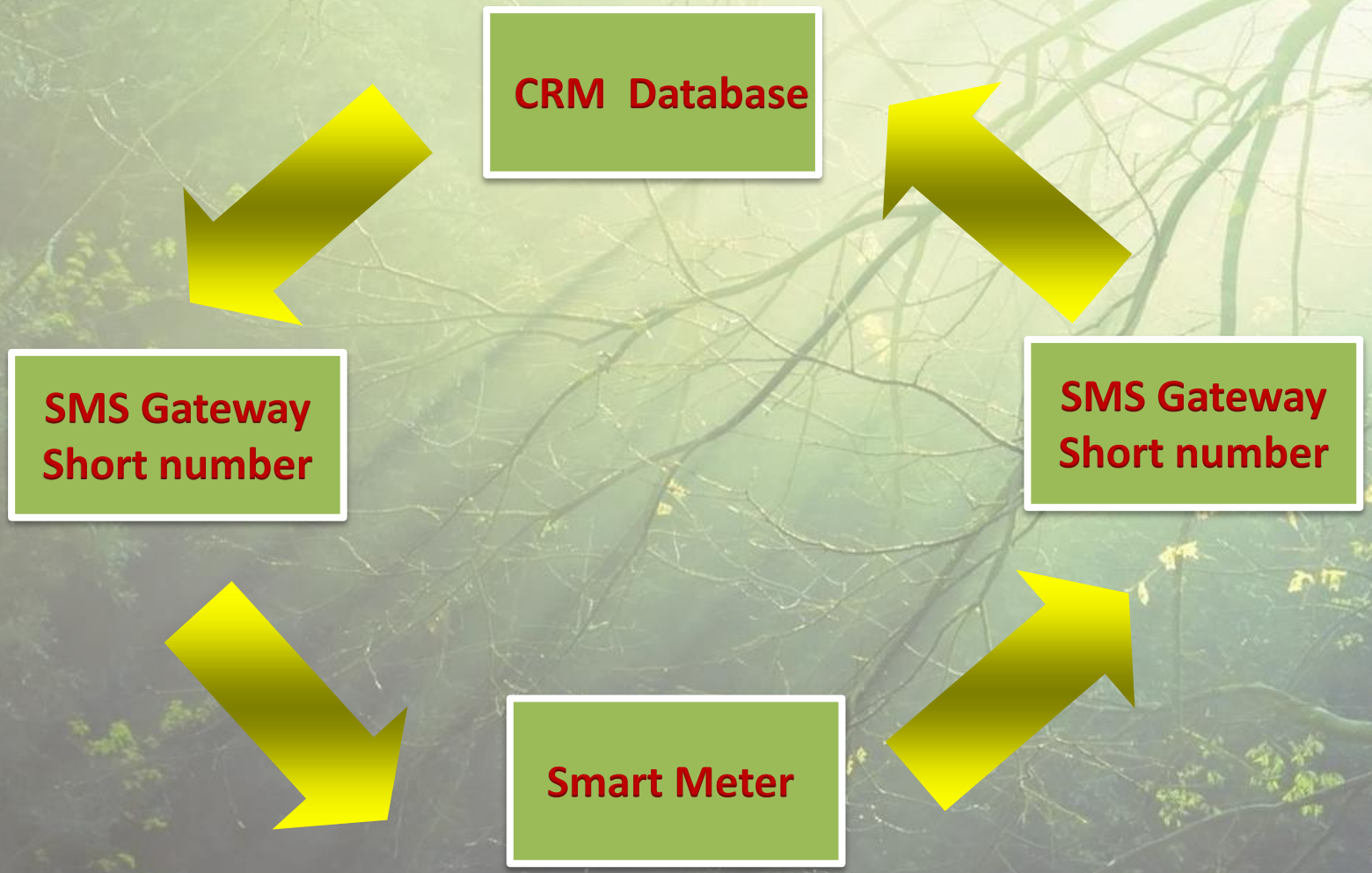
Function menu

- Meter readings
- Penalty management
- Meter management
- Payment
- Losses
- Tariff adjustments
- Agreements
- Transformation

Smart SMS-communication system structure



System Structure



SMS System Parameters

Control Center

- CRM database integration (subscribers, consumers)
- XML generation
- XML injection to the CRM

SMS messenger

- Radius Server installation
- Introduction of a short number
- Encrypting short messages
- XML delivery to the sms gateway Api
- XML reception by a meter

Smart (SMS-based) meter configurator

- Decrypting received short messages
- Explanation of an XML message
- Sending auto-SMS
- Reception of true and wrong SMS
- Control functions
- Switch operation (ON/OFF)

Remote reading of information from analog and digital meters

Optical device

RTU Modem

Dial Up connection

- Reading data manually with an optical device.
- Information from the OD is sent to the RTU via wireless connection
- Sending information via GSM modem to the CRM system
- CRM system helps ensure prompt collection of information

Azeri Ministry of Energy

Services

- Information about payment arrears provided by phone
- Information about payment arrears provided by SMS
- Information about payment arrears provided/payment made via Internet
- Interruption and restoration of power supply
- Automatic generation and sending tax returns
- Logging all program operations
- Entering subscribers into the database (rol/user)

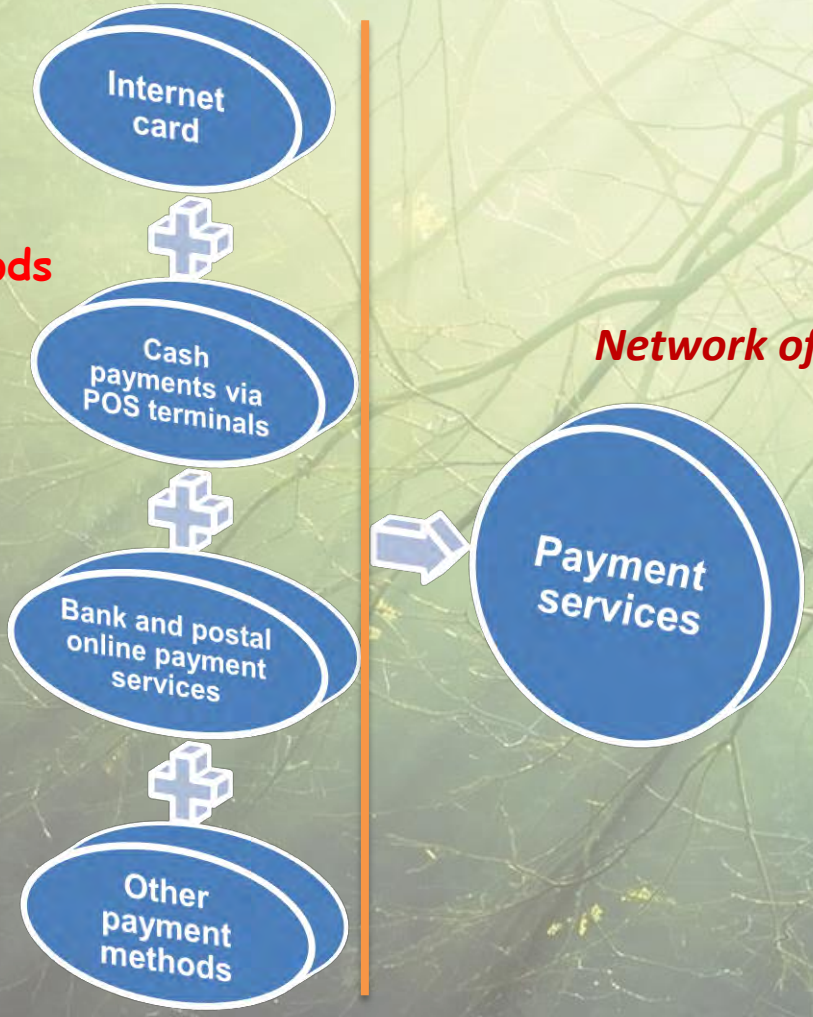
Online payment system integration

Internet resources

Electronic payment methods

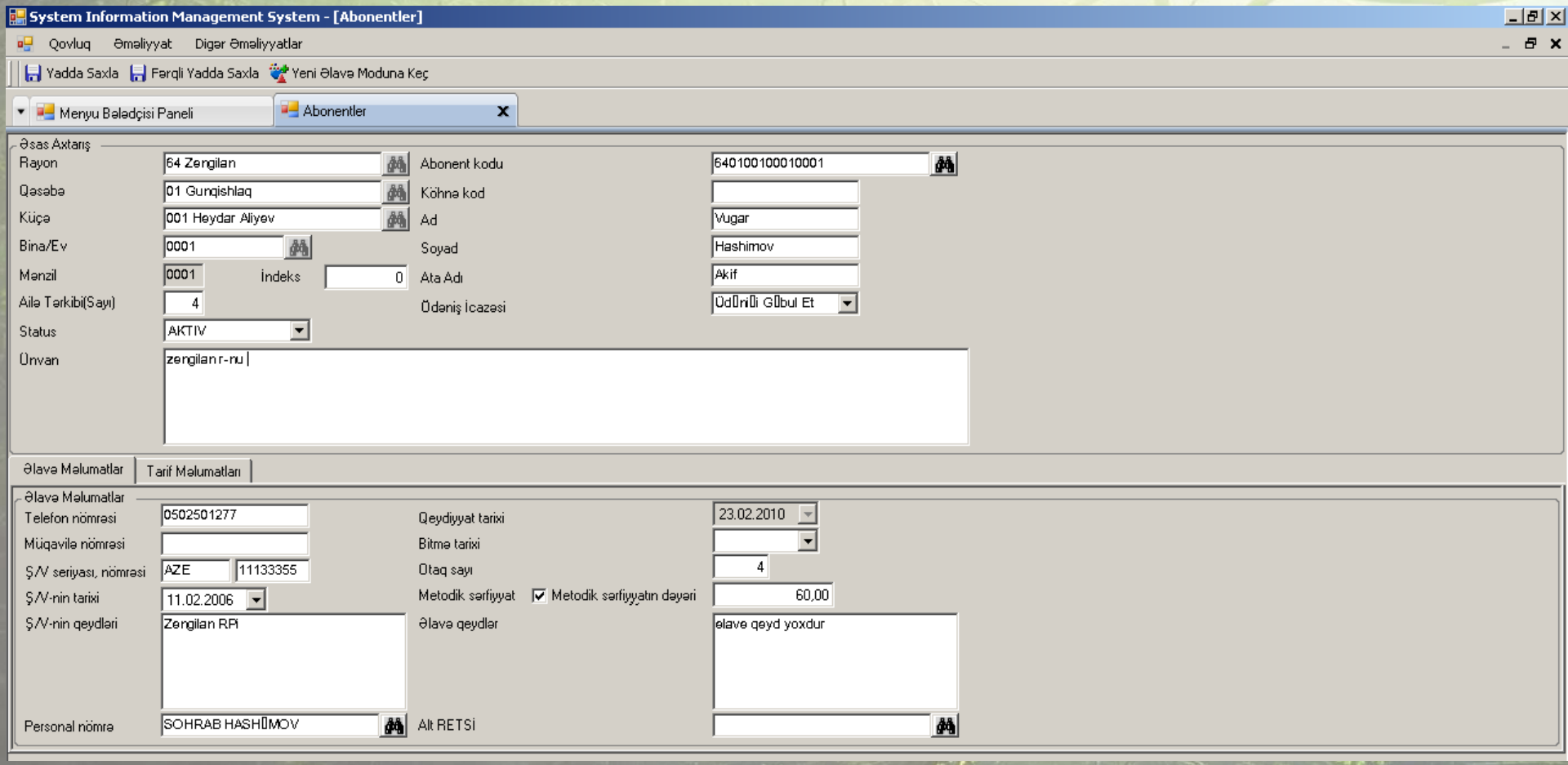
Manual payment terminals

Mobile and other payment methods



Network of payment services

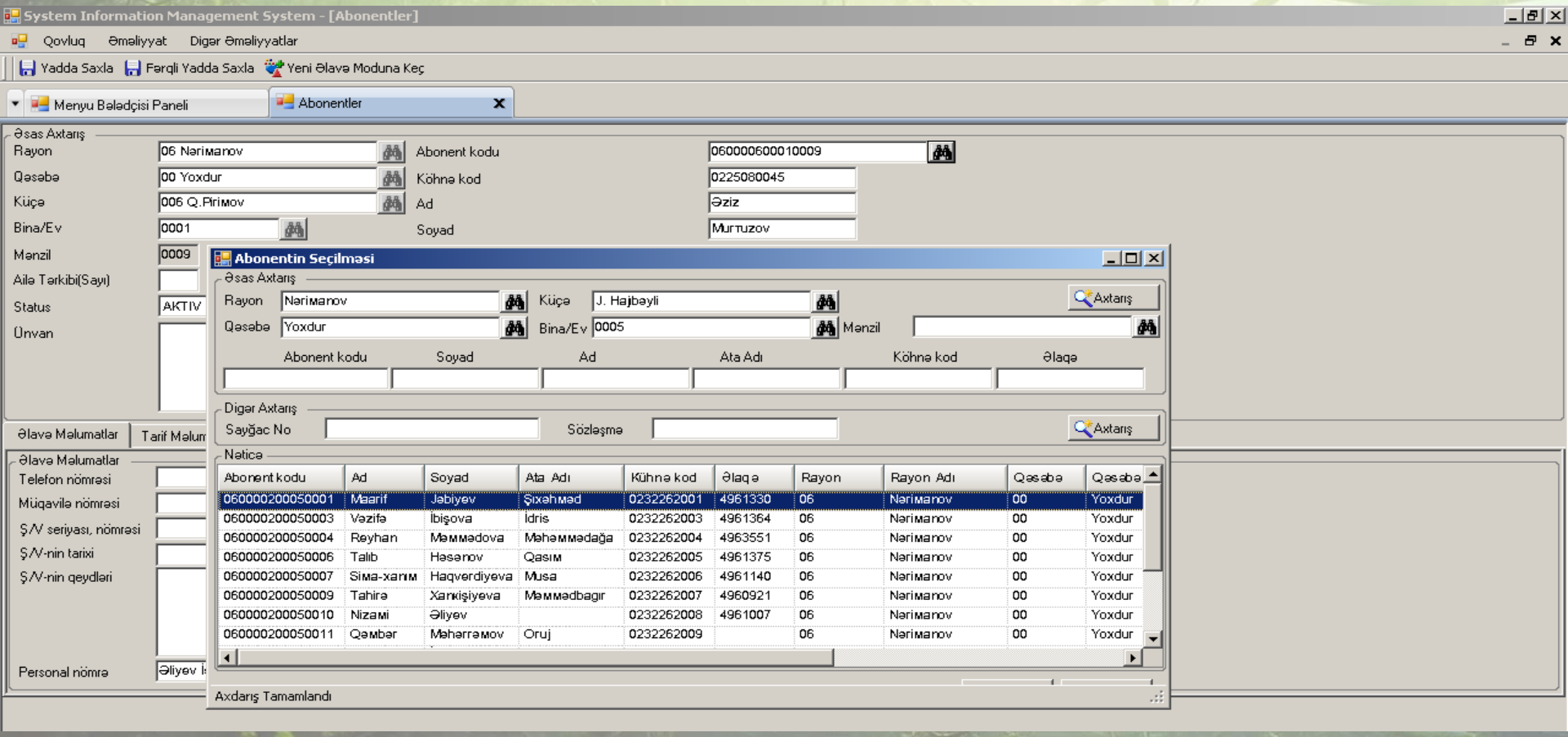
Subscriber page interface



- Database for all groups of subscribers includes complete history of events with the trend of development to the maximum

Azeri Ministry of Energy

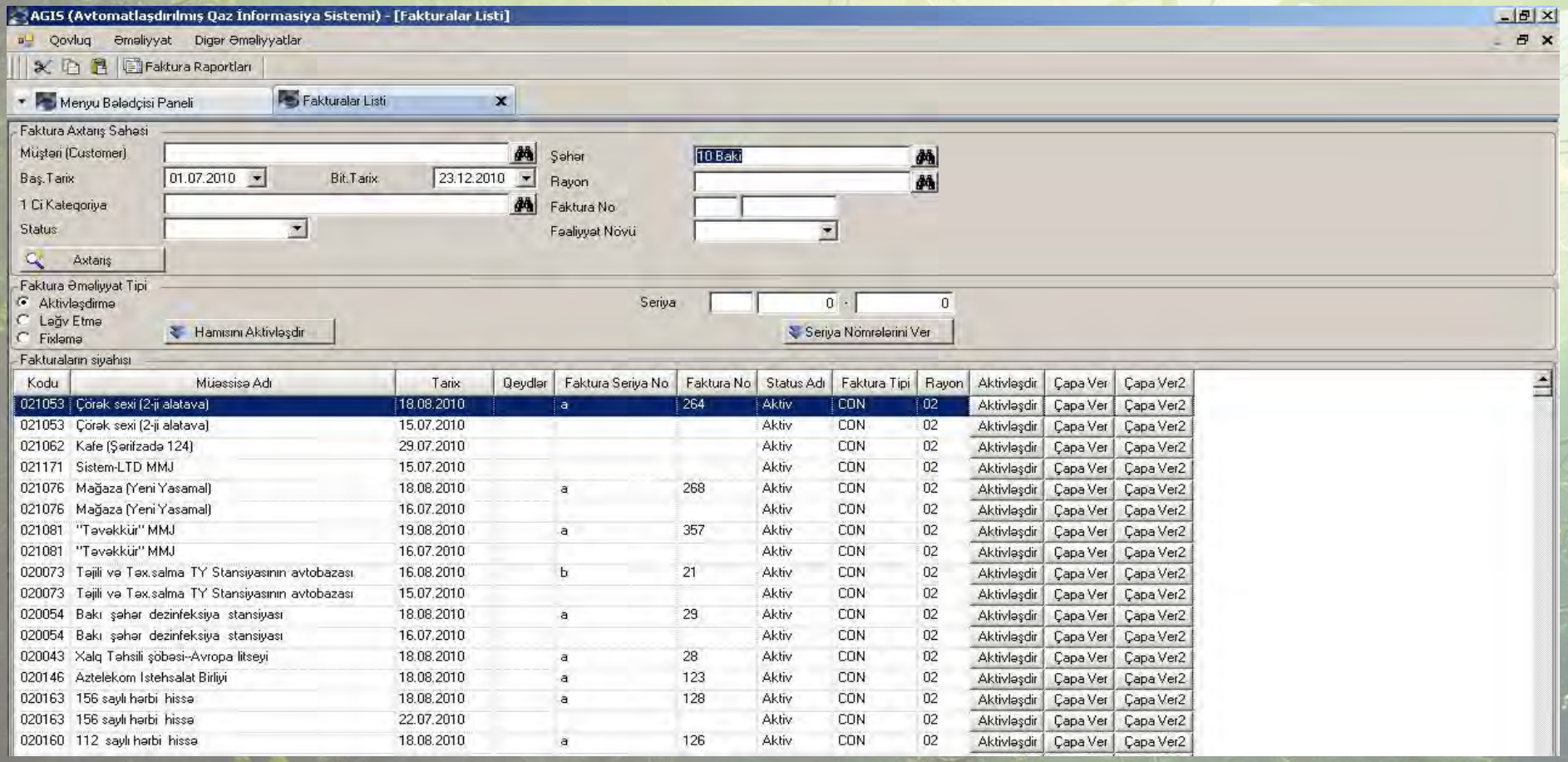
Retrieval System



- Search for the history of events by an individual subscriber code, address, meter serial number
- On-screen display and print-readiness of all customer data

Azeri Ministry of Energy

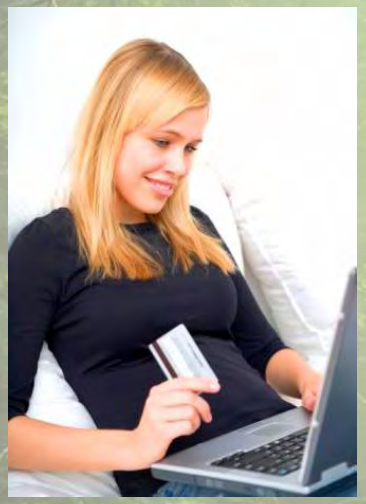
Tax invoices in the prepayment system

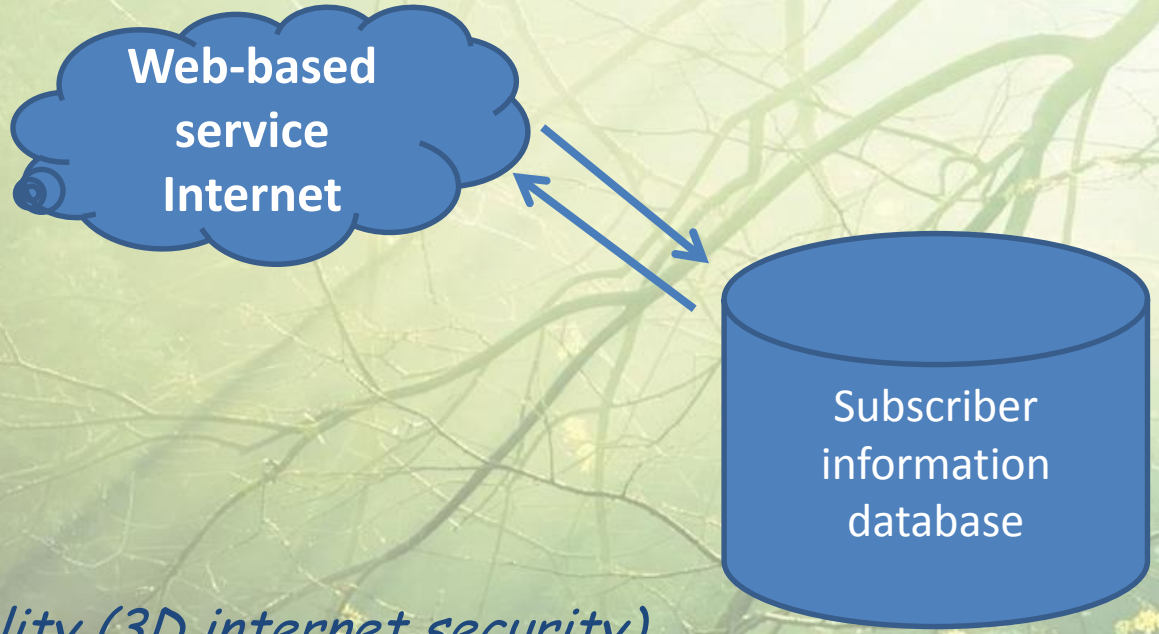


- Remote reading of data from the meter
- Automatic generation of tax invoices according to the meter readings
- Sending tax invoices by email/online – active window on the site of a power company

Azeri Ministry of Energy

On-line payment through the Internet





- *Cipher confidentiality (3D internet security)*
- *Information encryption*
- *Verification of subscriber's identity*
- *Electronic cipher generation*
- *Payment logging*
- *Electronic notification of the payment made*

New energy management technology:

«Smart Grid» «Smart Metering»

Intellectualization of distribution and transmission networks (**“Smart Grid”**)

Intellectualization of accounting for end-consumers (**“Smart Metering”**)

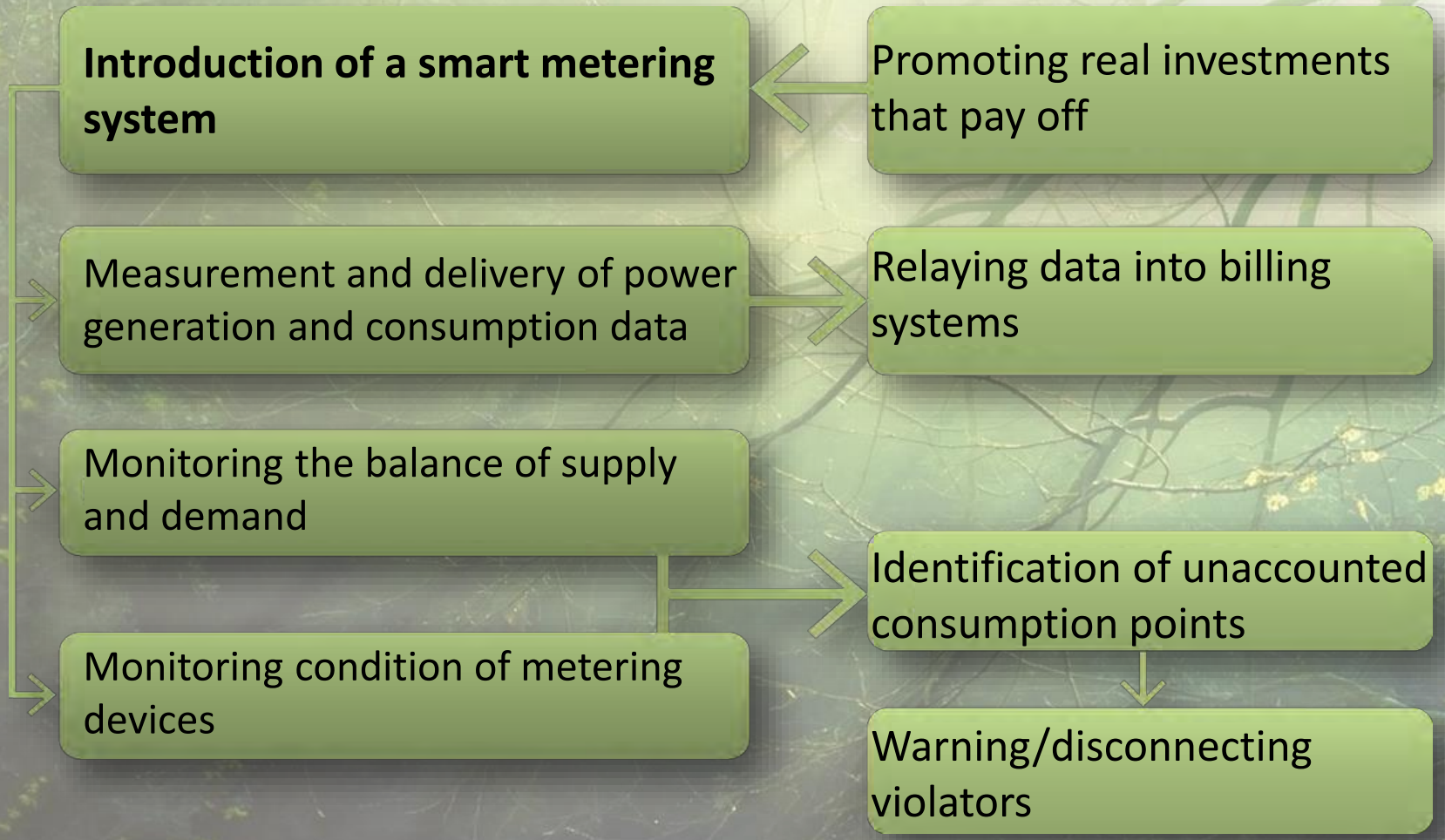
Consumption/generation management

Data, discretionary signalization

Implementation of the “Smart Grid” technology is impossible if end-consumers have no smart metering systems with the tools of control, management and timely delivery of data and alerts to the upper level

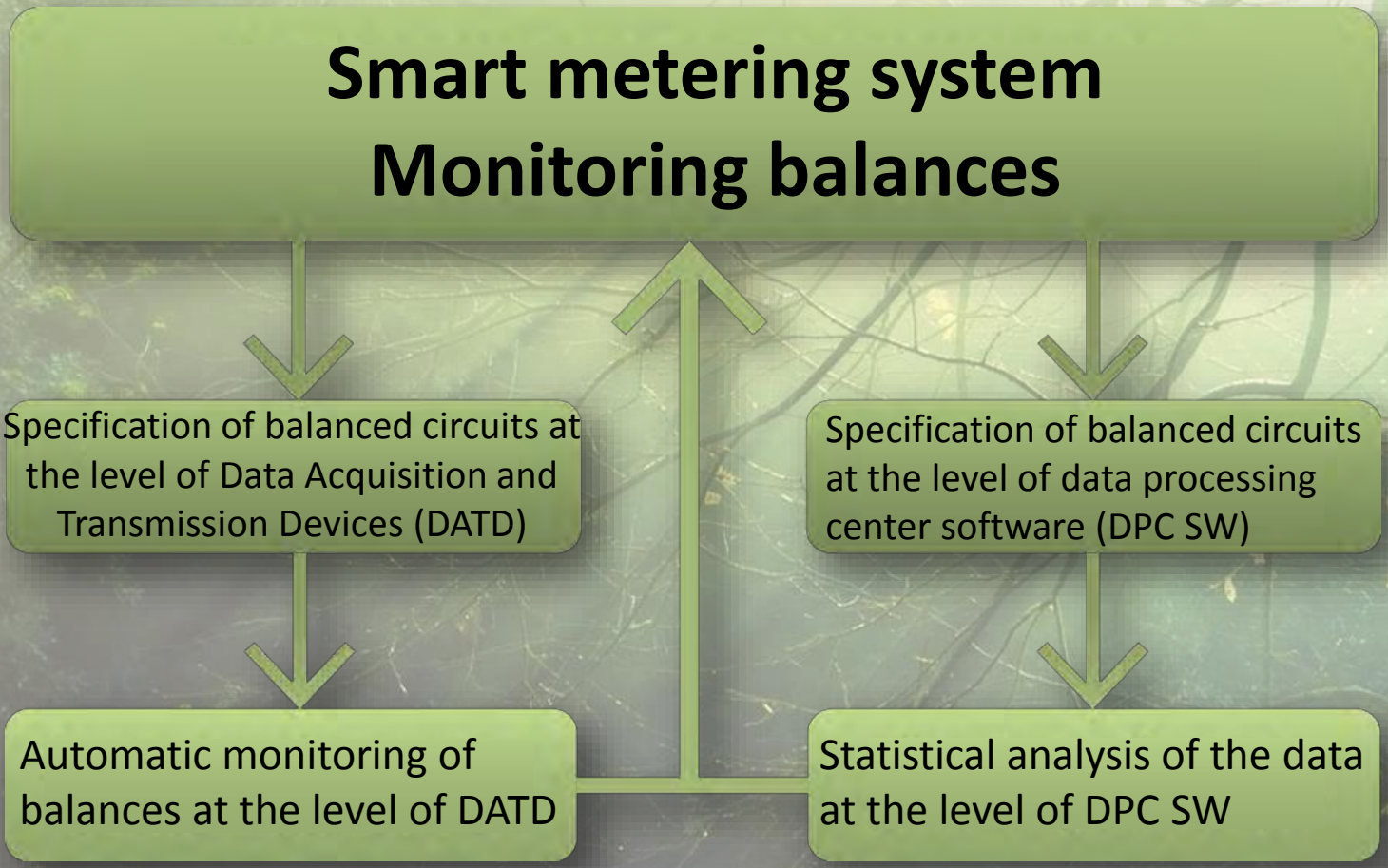
Smart Metering system for power companies

Vital objectives of power companies are to reduce energy losses and ensure collection of payments for the energy output



Smart Metering system for power companies

Automatic and semi-automatic control of the instances of exceeding a specific level of power supply/demand imbalance



Smart Metering system for power companies

Monitoring of unauthorized actions causing unaccounted consumption and, as a consequence, imbalances

Smart metering system
Identifying the causes of imbalances

Exceptional measures
to identify sources of unaccounted consumption caused by unauthorized actions of consumers

Keeping track of the actual instances of:
- tampering with the metering device or terminal compartment;
- powerful magnetic or radio interference;
- power consumption by neutral conductor;
- attempts to guess passwords;
- closing or disconnecting alarm circuits;
- low consumption for a long period of time

signalling

Smart Metering system for power companies

Immediate-action alarm (from the lower and middle levels to the upper level) of the set criteria violation instances

Smart metering system
Signalling entities

immediate-action

DATD
Excess of the coincidental demand peak
Imbalances across entities
Low collection rates
Mistiming
Power loss, failures
Meter/adder events

end-to-end

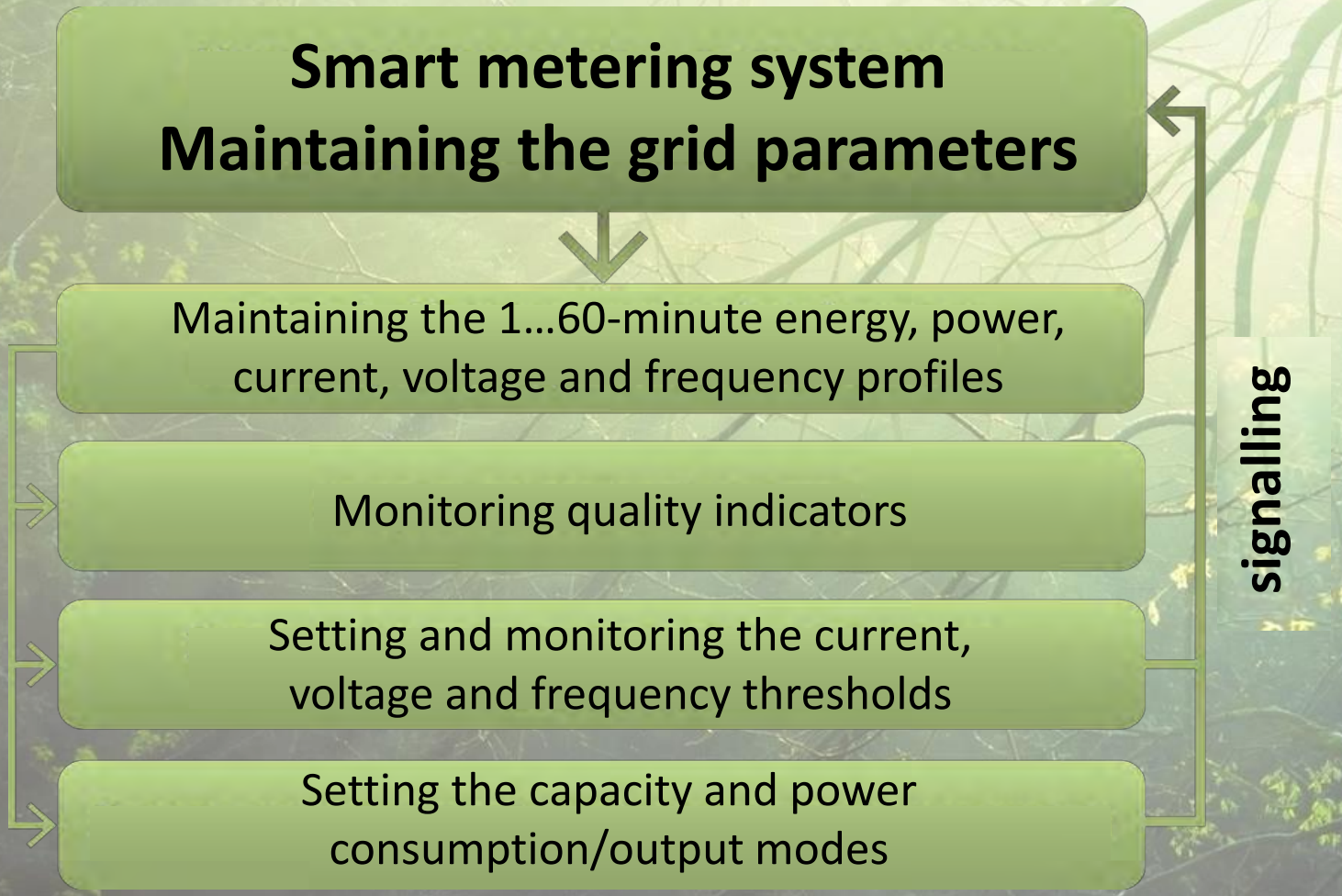
Meters and adders
Unauthorized actions
Overload, overconsumption
Deviation from grid parameters
Tampering with the meter
Violation of the connection pattern

signalling

Azeri Ministry of Energy

Smart Metering system for power companies

Continuous monitoring of the grid performance, load, consumption and generation parameters



Smart Metering system for power companies

Maintaining grid functionality by continuous monitoring of grid performance, load, consumption and generation parameters

Smart metering system Control functions

- Control of the consumption/generation modes → Timely redistribution/ restriction of consumption/ generation
- Grid condition monitoring → Emergency prevention/reversal

Smart Metering system for power companies

Effective user notification and management scheme

Smart metering system
User management

Early warning of the consumer:
- sound signal
- visual message on LCD screen
- online notification

Adverse forecast of overload and/or overconsumption

Load curtailment:
- automatically (meter level)
- by DPC SW operator

Immediate/delayed reconfiguration of the system:
Change of tariff schedules, limits, passwords, subscriber numbers, etc.

Smart Metering system for power companies

Outstanding features of the CE-Nero technology

Advantages as compared to other technologies (S-FSK, BPSK, OFDM, and others):

- high noise immunity of connection
- sensitivity of up to 40 µV (ability to operate in phases and between transformers)
- immunity to the power line impedance fluctuations
- low cost of technical implementation

Disadvantage as compared to the OFDM technology:

- Maximum achievable connection rate of 2400 bps

Smart Metering system for power companies

Outstanding features of the CE-Intro technology

Advantages as compared to other technologies (868 MHz, 2.4 GHz ZigBee):

- high noise immunity of connection by applying the data-reducing coding algorithm
- best penetration with the minimum signal strength and low antenna-feeder path requirements (especially as compared to 2.4 GHz)
- no restrictions on the use of the frequency band (as compared to 868 MHz)
- low cost of technical implementation

Disadvantage as compared to the ZigBee technology:

- Maximum achievable connection rate of 16 bps

Система «Smart Metering» для энергокомпаний

General features and advantages of the applied technical solutions

- high noise immunity of connection
- availability of a backup communication channel (for each relay level)
- rate adaptation in each communication channel depending on communication quality
- no need for initial settings or preset parameters (minimum need in special cases)
- special algorithms of dynamic signaling and direct access to metering devices
- effective support of system time
- low cost of technical implementation

THANK YOU!

Azeri Ministry of Energy