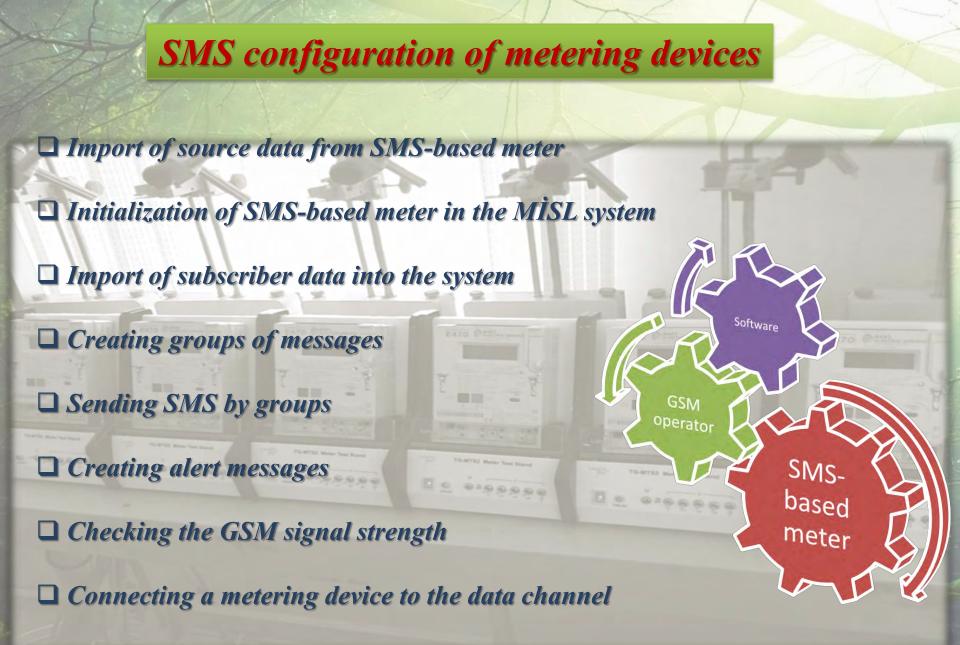
Smart Metering - Smart Grid



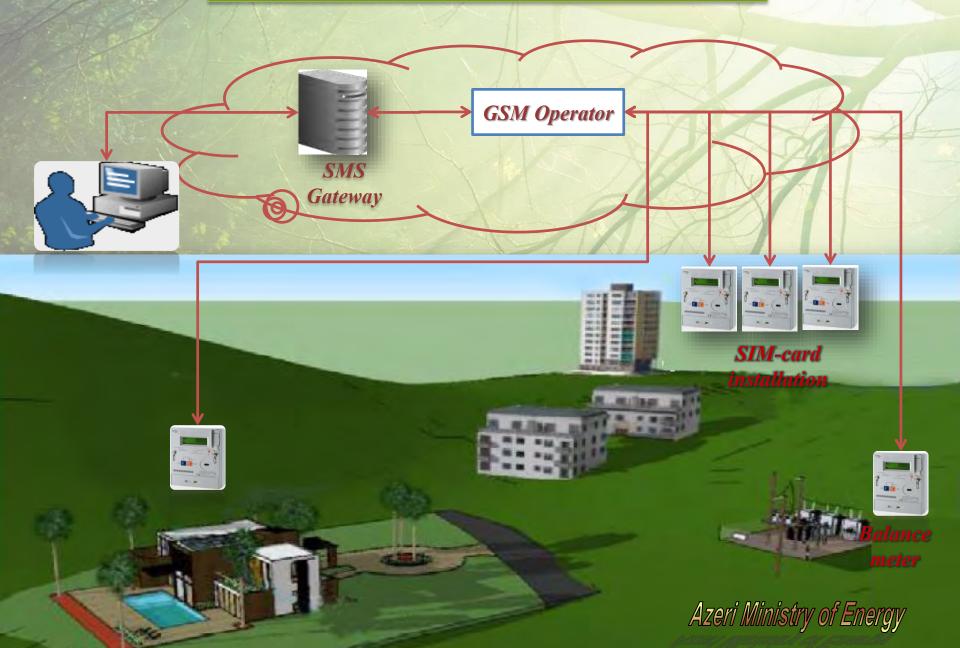


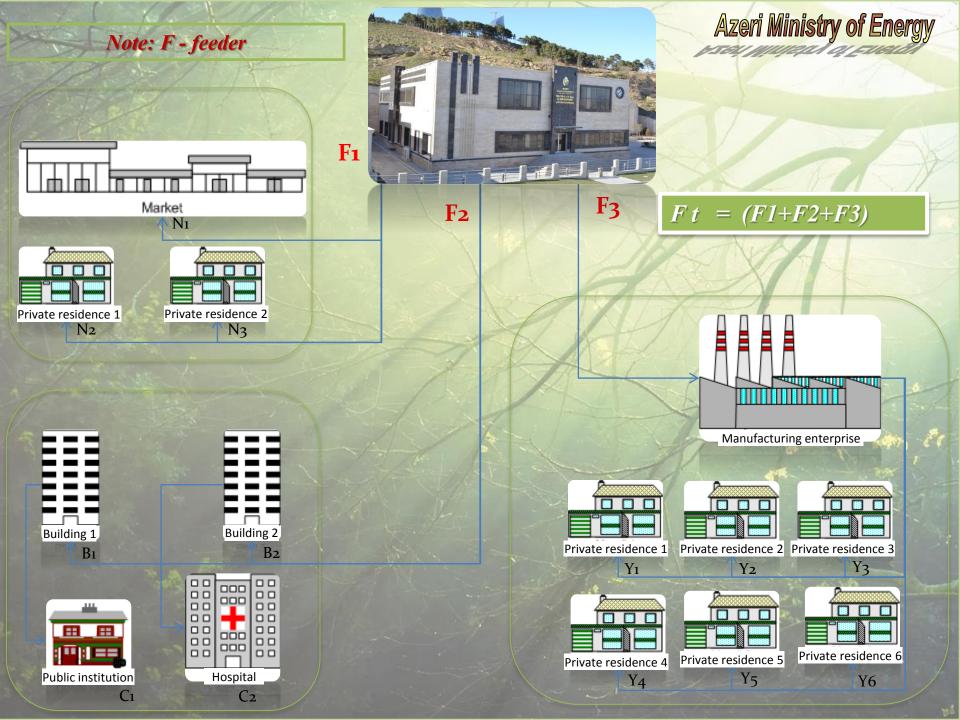
SMS-BASED SMART METERS



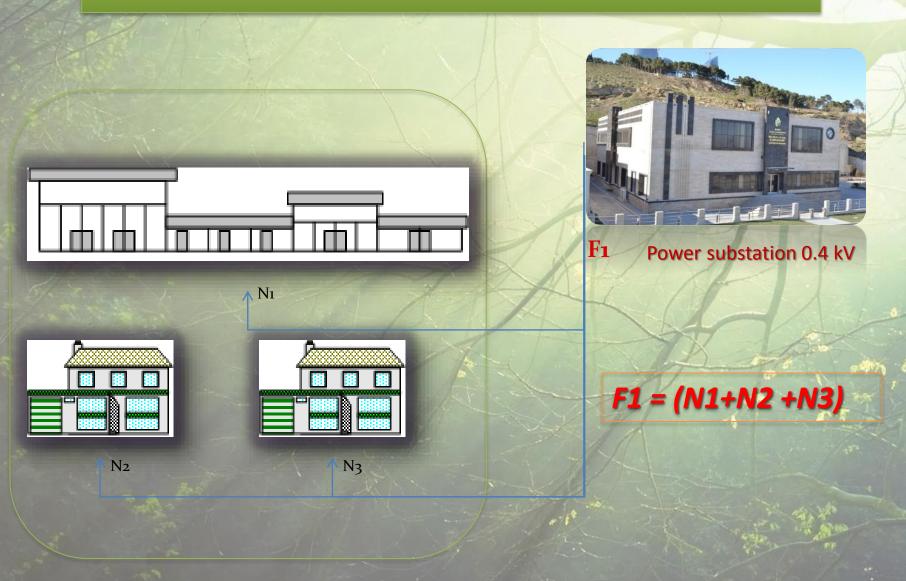


Real-time balance data update

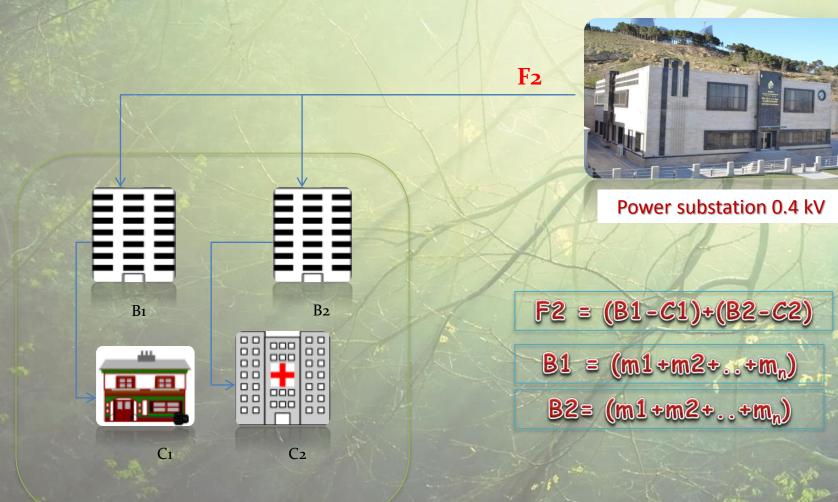




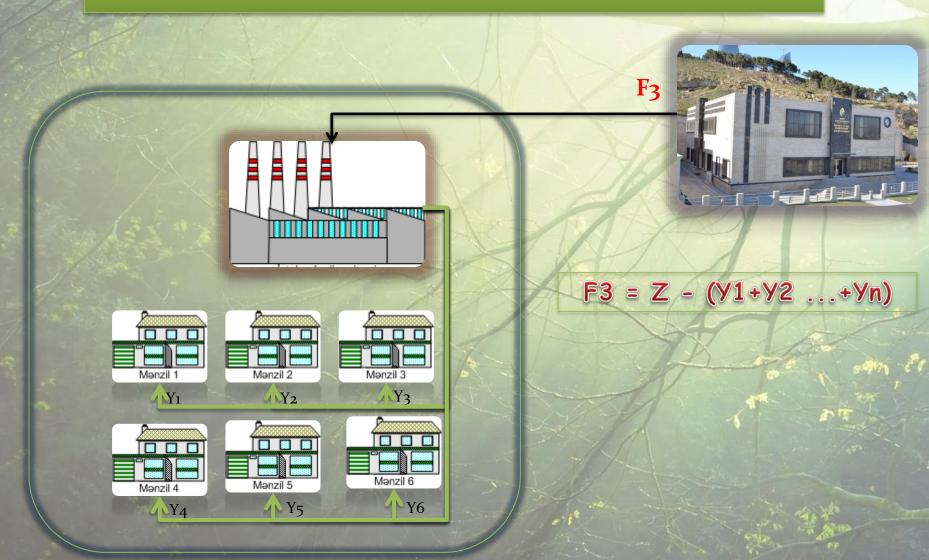
Calculation of differential consumer balance



Calculation of differential consumer balance



Calculation of differential consumer balance



Communication with smart meters

V 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

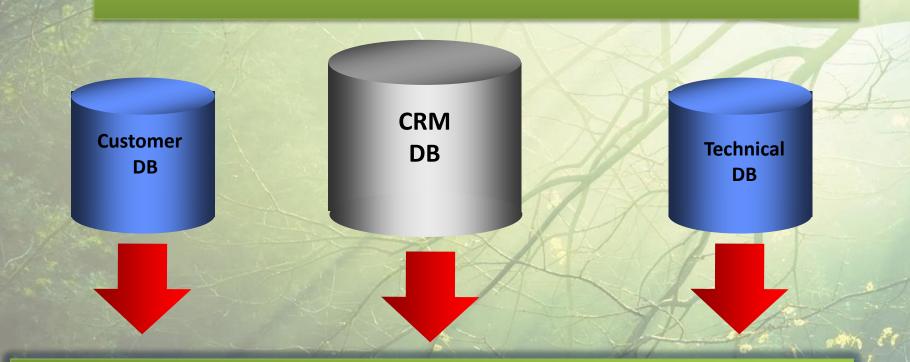
✓ 1:1 - DATA DELIVERED WITH A MESSAGE IS PROCESSED BY A SMART METER

666

Smart meter data security protection

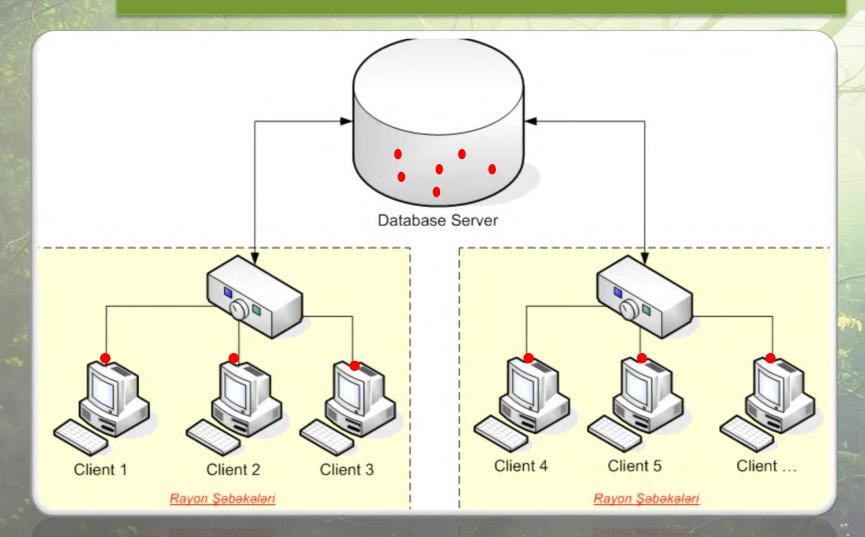
Data is encrypted by the hex-decimal algorithm
 Short messages (SMS) are only received on a dedicated short number
 Balance is topped up through a pre-defined number
 Each meter has individual unique (20-digit) code for

Database Structure

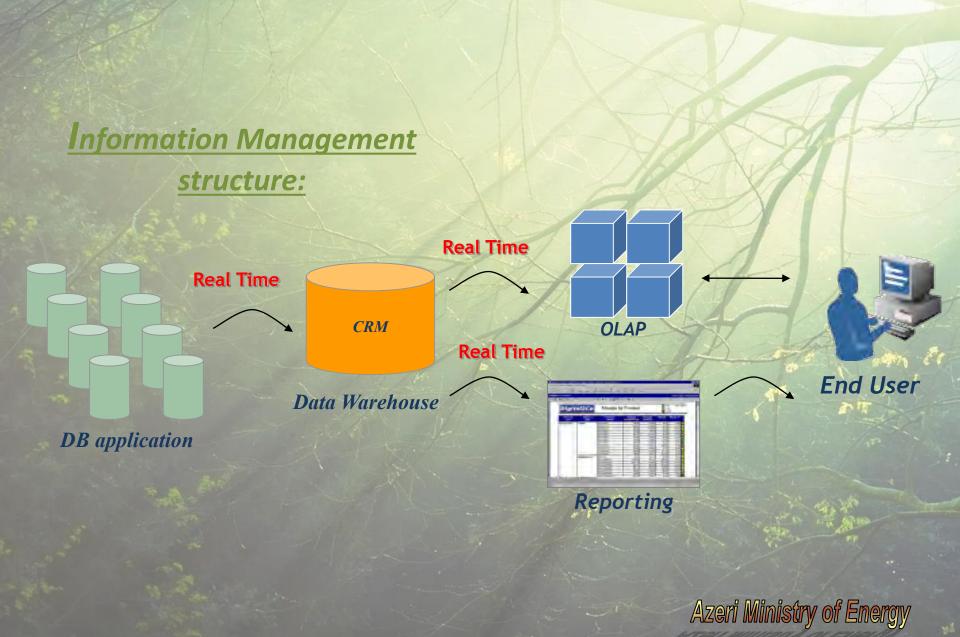


Subscriber Information Management System

Active Directory Network



End User diagram



Subscriber CODE Generation

01 06 002 0026 0012

Region Code

Matrix

Street

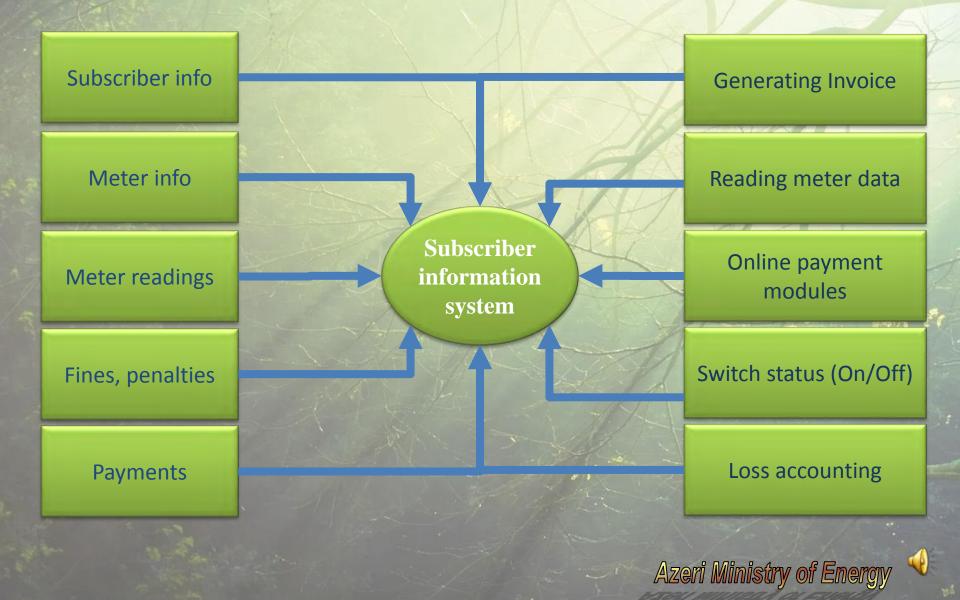
Building

Subscriber Code Structure



Apartment

Subscriber information system



Subscriber Information Management System SIMS Operations menu

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

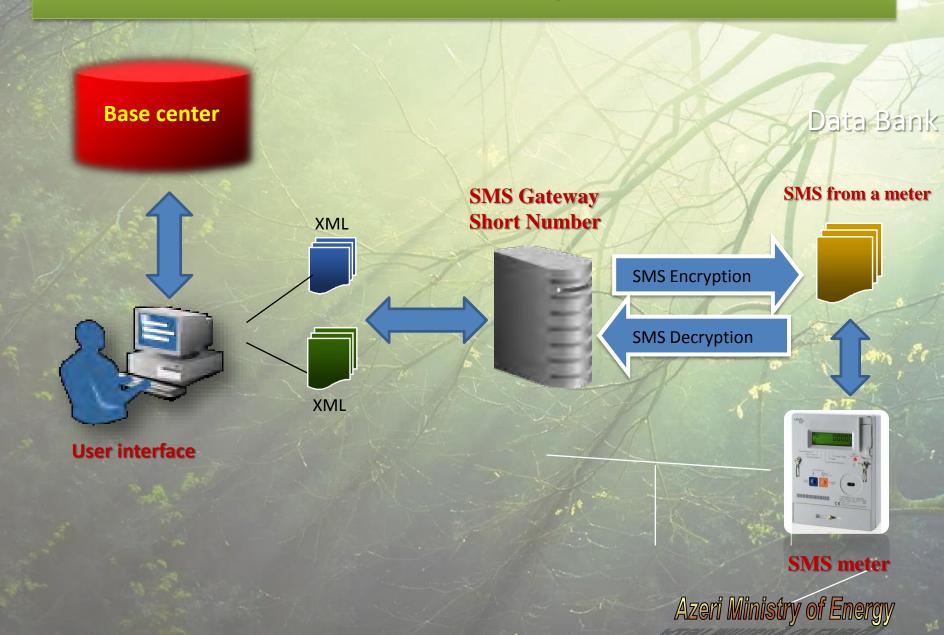


Function menu

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



Smart SMS-communication system structure



System Structure

CRM Database

SMS Gateway Short number SMS Gateway Short number

Smart Meter

SMS System Parameters

Control Center

SMS messenger

Smart (SMS-based) meter configurator

- CRM database integration (subscribers, consumers)
- XML generation
- XML injection to the CRM
- Radius Server installation
- Introduction of a short number
- Encrypting short messages
- XML delivery to the sms gateway Api
- XML reception by a meter
- 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



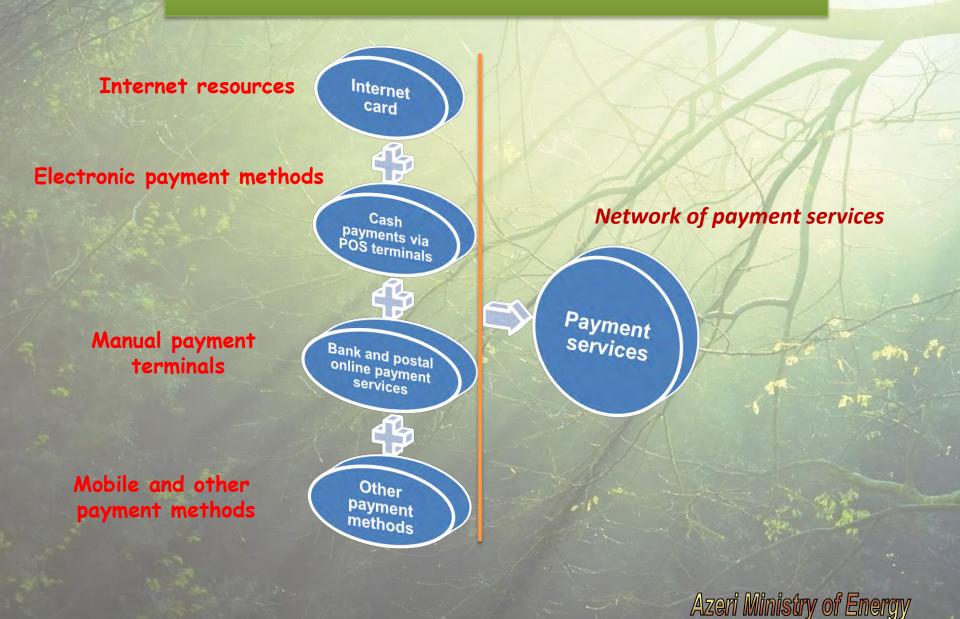
Reading data manually with an optical device.
 Information from the OD is sent to the RTU via wireless connection
 Sending information via GSM modem to the CRM system
 CRM system helps ensure prompt collection of information



- 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



Subscriber page interface

| | | Will do | I DUE DAT | and the second | | 1 | | | | | | |
|--|-------------------|---|---------------------|----------------------------|----------------------|------------|--|--|--------------|--|--|--|
| 🖶 System Informatic | on Management 9 | iystem - [Abonent | er] | | | | | | X | | | |
| 🖳 Qovluq Əməliyy | ∕at Digər Əməliyy | atlar | | | | | | | _ <i>8</i> × | | | |
| 🔚 Yadda Saxla 🗧 Fərqli Yadda Saxla 🦉 Yeni Əlavə Moduna Keç | | | | | | | | | | | | |
| 💌 🛃 Menyu Bələdçisi | Paneli | 🛁 Abonentler | x | | | | | | | | | |
| Əsas Axtarış ———— | - | | - | | | | | | | | | |
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| Qəsəbə | 01 Gunqishlaq | å | Köhnə kod | | | | | | | | | |
| Küçə | 001 Heydar Aliyev | â | Ad | | Vugar | | | | | | | |
| Bina/Ev | 0001 | <u>å</u> å | Soyad | | Hashimov | | | | | | | |
| Mənzil | 0001 in | deks (| Ata Adı | | Akif | | | | | | | |
| Ailə Tərkibi(Sayı) | 4 | | Ödəniş İcazəsi | | Üdünili Gübul Et 🛛 💌 | | | | | | | |
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| ∼Əlavə Məlumatlar — | - | | | | | | | | | | | |
| Telefon nömrəsi | 0502501277 | | Qeydiyyat tarixi | | 23.02.2010 🖃 | | | | | | | |
| Müqavilə nömrəsi | | | Bitmə tarixi | | _ | | | | | | | |
| Ş∕V seriyası, nömrəsi | AZE 11133 | 355 | Otaq sayı | | 4 | | | | | | | |
| Ş∕V-nin tarixi | 11.02.2006 💌 | | Metodik sərfiyyat 🔽 | Metodik sərfiyyatın dəyəri | 60,00 | | | | | | | |
| Ş∕V-nin qeydləri | Zengilan RPi | | Əlavə qeydlər | | elave qeyd yoxdur | | | | | | | |
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| | | In the second | | | | | | | | | | |
| Personal nömrə | SOHRAB HASHIIM | | Alt RETSI | | J | <i>#</i> 4 | | | | | | |

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

Retrieval System

| 🖶 System Informati | on Manag | jement Syste | m - [Abonentlei | 1 | | | | | | | | | <u>_ 8 ×</u> |
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| Qəsəbə | 00 Yoxd | ur | <i>8</i> 4 | Köhnə kod | | | 0225080045 | | | | | | |
| Küçə | 006 Q.P | ří MOV | <i>d</i> 46 | Ad | | | Əziz | | | | | | |
| Bina/Ev | 0001 | Murruzov | | | | | | | | | | | |
| Mənzil | 0009 | 🔜 Abonentin | - | | | | , | | | | _D× | 1 | |
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| onvan | | , | onent kodu | Soyad | Ad Ad | | Ata Adı | <u> </u> | , Köhnə kod | Əlaqə | <u>#4</u> | | |
| | | | | Suyau | | Ata Aui | | | | | | | |
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| | - | - Digər Axtarış | | | Sözləşma | | | | | | 💐 Axtarış | | |
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| Telefon nömrəsi | | Abonentkodu | | Soyad | Ata Adı | Kühnə kod | Əlaqə | Rayon | Rayon Adı | Qəsəbə | Qəsəbə 📥 | | |
| Müqavilə nömrəsi | | 06000020005 | | Jəbiyev | Şixəhməd | 0232262001 | 496133 0 | 06 | Nərimanov | 00 | Yoxdur | | |
| Ş/V seriyası, nömrəsi | | 06000020005 | | lbişova Məmmədova | İdris Məhəmmədağa | 0232262003 | 4961364 4963551 | 06 06 | Nərimanov Nərimanov | 00 | Yoxdur Yoxdur | | |
| Ş∕V-nin tarixi | | 06000020005 | | Hasanov | Qasim | 0232262004 | 4961375 | 06 | Narimanov | 00 | Yoxdur | | |
| Ş∕V-nin qeydləri | | 06000020005 | | | | 0232262006 | 4961140 | 06 | Nərimanov | 00 | Yoxdur | | |
| | | 06000020005 | 50009 Tahirə | Xankişiyeva | Məmmədbagır | 0232262007 | 4960921 | 06 | Nərimanov | 00 | Yoxdur | | |
| | | 06000020005 | 50010 Nizami | Əliyev | | 0232262008 | 4961007 | 06 | Nərimanov | 00 | Yoxdur | | |
| | | 06000020005 | 50011 Qəmbər | Məhərrəmov | Oruj | 0232262009 | | 06 | Nərimanov | 00 | Yoxdur 🖵 | | |
| | Oliversi | • | | | · | | | | | | | | |
| Personal nömrə | Əliyev İs | | | | | | | | | 1 | 1 | | |
| | | Axdarış Tamam | hlandı | | | | | | | | .:: | | |
| | | | | | | | | | | | | | |

- 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



Tax invoices

in the prepayment system

| AGIS (Avt | omatlaşdırılmış Əməliyyət Dir Raktura Ra | gər Əməliyyatlar | a Sistemi) - [F | akturalar L | isti] | | | | _ | | | | | | <u>- 명 ×</u> - 명 × | | |
|---|--|---------------------|-----------------|------------------------|---------|--|-----|----------------|--------------------------------|--|----------------------------|----------------------|------------------------|--|-----------------------|--|--|
| Menyu Baladçisi Paneli Fakturalar Listi X | | | | | | | | | | | | | | | | | |
| Faktura Axtan Müştəri (Custo Baş. Tarix 1 Ci Kateqoriy Status | omer) 01.07. va | 2010 丈 | Bit.Tarix | 23.12.2 | 010 🖌 | Şəhər Rayon Faktura No Fəaliyyət Növü | | | | | | | | | | | |
| Faktura Əməli Aktivləşdir C Ləğv Etmə C Fixləmə | rmə | amısını Aktivləşdir | 1 | | | Seriya | | - |) • va Nömrələrini | 0 Ver | | | | | | | |
| -Fakturaların si | | | 1 | | 1 | 1 | | | r. | 1 1 | | | | | | | |
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| | vəkkür" MMJ | | | 6.07.2010 | | | | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020073 Təjili və Təx.salma TY Stansiyasının avtobazası | | | | 6.08.2010 | | ь | 21 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020073 Tejili ve Tex.salma TY Stansiyasının avtobazası | | | | 5.07.2010 | | - | | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020054 Bakı şəhər dezinfeksiya stansiyası | | | | 8.08.2010 | | a | 29 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020054 Bakı şəhər dezinfeksiya stansiyası | | | 1 | 6.07.2010 | | | | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020043 Xalq Təhsili şöbəsi-Avropa litseyi | | | 1 | 8.08.2010 | | a | 28 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020146 Aztelekom Istehsalat Birliyi | | | 1 | 8.08.2010 | | a | 123 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020163 156 saylı hərbi hissə | | | | 8.08.2010 | | a | 128 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020163 156 | i saylı hərbi hissə | | 2 | 2.07.2010 | | | | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |
| 020160 112 sayli hərbi hissə 18.08.2010 | | | | | | a | 126 | Aktiv | CON | 02 | Aktivləşdir | Çapa Ver | Çapa Ver2 | | | | |

- 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

On-line payment through the Internet



Web-based service Internet

> Subscriber information database

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: «Smari Grid» «Smari Meiering»

Intellectualization of distribution and transmission networks ("Smart Grid")

anazemen

Intellectualization of accounting for endconsumers (**"Smart Metering"**)

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 Azeri Ministry of Energy

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

Introduction of a smart metering system

Promoting real investments that pay off

Measurement and delivery of power generation and consumption data

Monitoring the balance of supply and demand

Monitoring condition of metering devices

Relaying data into billing systems

Identification of unaccounted consumption points

Warning/disconnecting violators

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

Smart metering system Monitoring balances

Specification of balanced circuits at the level of Data Acquisition and Transmission Devices (DATD)

Automatic monitoring of balances at the level of DATD

Specification of balanced circuits at the level of data processing center software (DPC SW)

Statistical analysis of the data at the level of DPC SW

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

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

> Smart metering system Signalling entities

DATD

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

Meters and adders

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

immediate-action

end-to-end

signalling

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

Smart metering system Maintaining the grid parameters

Maintaining the 1...60-minute energy, power, current, voltage and frequency profiles

Monitoring quality indicators

Setting and monitoring the current, voltage and frequency thresholds

Setting the capacity and power consumption/output modes

ignalling

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

Azeri Winistry of Energy

Grid condition monitoring

Emergency prevention/reversal

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

Load curtailment:

- automatically (meter level)
- by DPC SW operator

Adverse forecast of overload and/or overconsumption

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

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

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 raterofn16 bpsrgy 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 Azeri Ministry of Energy

THANK YOU!