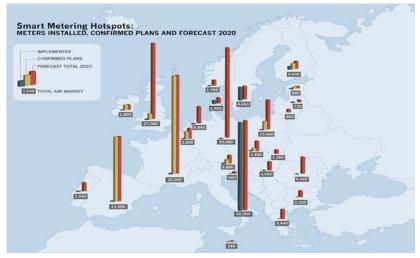# THE RIGHT CHOICE
Analytical Internet System for metering gas, electricity, water and heat "BALANCE"
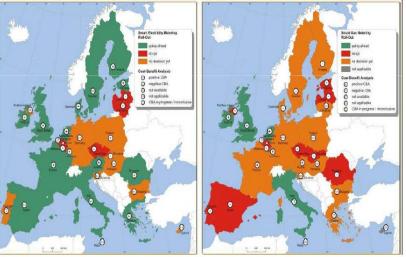
"Strategy 20-20-20" and the BALANCE system

Smart Metering Hotspots:
METERS INSTALLED, CONFIRMED PLANS AND FORECAST 2020

Cost Benefit Analysis for Comprehensive Use of Smart Metering

Quelle: Europäische Kommission

According to the **EU Strategy 20-20-20**, by 2020, the level of greenhouse gas emissions should be reduced by 20%, the share of energy from renewable sources should increase to 20%, and the total energy consumption should be reduced by 20%.

The installation of the BALANCE accounting system allows itself to be paid back only by identifying and preventing natural gas emissions. And the feedback with the consumer, in the form of consumption profiles and an energy efficiency indicator "the ratio of the temperature in the house to the energy consumption", allows you to optimize and reduce gas consumption by up to 20%. Also, the consumer can compare his consumption in relation to similar households.

In Germany, the 32 millionth market of accounting systems, at the same time, if Sweden and Italy installed accounting systems in 2006 and 2011, respectively, then in Germany everything is just beginning! As said, "that which is not taken into account cannot be saved."

What is interesting BALANCE

We use **ALREADY INSTALLED COUNTERS** with pulse output = cost reduction

ANALYTICS DETECTS LEAKS and REDUCES LOSSES by 80 - 90% = cost reduction

GUARANTEE 100% data delivery from metering devices = balance calculation

COMPLETE ACCOUNTING of electricity, water, heat and gas = cost optimization up to 40%

Consumption Management = timely payment for energy

Support for progressive tariffs on consumption value = social rate

Full, timely and reliable accounting of energy consumption

Identifies loss sites, as well as theft facts = allows you to exclude them

Support for multi-tariff metering = lower costs for night consumption

Monitor hourly consumption profiles and theft

Daily and hourly balances at home, street, district, city, region level

Data hierarchy for metering devices as well as balanced groups

Recommendations for reducing technical losses in distribution networks

Cost reduction: multi-channel metering of up to 6 devices per radio module

Cost reduction: multi-tariff metering on devices with pulse output

Data reliability control: open circuit, short circuit, external magnetic field

REALLY: self-installation by residents of the BALANCE system = Plug @ Play

Advanced High Level = objects on the map and accident filters

WEB access, personal account, including mobile application at Android

Subscription to warnings about maximum and forecast consumption on a mobile application
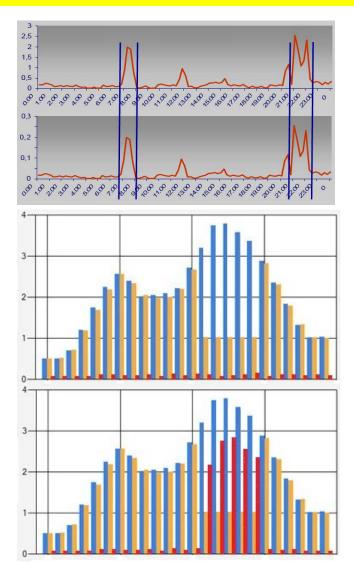
Not all metering systems are the same

First-generation systems "manual collection" - dozens of manufacturers, low cost, high deployment speed. Disadvantages - manual collection, maximum proximity to the object, access to the building and data acquisition by floors are required. Lack of consumption profiles, balances and efficiency. (**WMBus** with terminal).

Second-generation systems "intermediate routers" Itron (Actaris), Elster (Coronis), Arad ... automatic data collection to the system server. Disadvantages - intermediate routers installed on each staircase and requiring external power from the AC network. This increases the cost of equipment, complicates the deployment of the system, requires protection from vandalism. Such systems are ineffective for buildings with a low density of metering points. (**WMBus, Emeris, ZigBee** standards).

Third generation systems Business model of a "mobile operator" with a monthly fee **GSM, SIGFOX, LoRa**. Technology - a star - a much better range, but you need to have coverage; server software is not provided; 2-3 attempts per day to transfer data, if the packet did not pass, there will be no data, which means there is no balance; a request is possible when the device contacts; data transmission path from the device - according to the number of available base stations; the upper level you need to write your own.

Fourth generation systems BALANCE. Speed of deployment, low cost, lack of design work, lack of intermediate routers, installation of metering points in a few minutes, suitability for multi-storey buildings and for rural areas - manual collection. **Dmesh =** multilevel network technology + multiple attempts to transfer data + many data transfer routes from the end device. Hourly and daily monitoring of the consumption of balanced groups, remote consumption management, real-time data request, advanced analytics for loss detection and theft localization, data reliability control + functionality focused on gas, heat, water, energy accounting.

Imbalance and Loss Detection Analytics

"BALANCE" uses statistical loss detection algorithms for both home and distribution networks.

Faulty counter: at the top is the unbalance profile, at the bottom is the consumption of one of the subscribers. We **reveal the maximum coincidence of the imbalance profile and the consumption profiles of subscribers**. Attention: the scale of the imbalance and consumption scale is different!

Analytics allows you to accurately indicate the specific faulty equipment, cases of interference with the operation of the equipment and identify unauthorized connections.
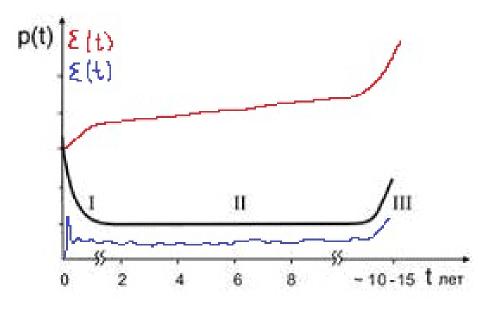
The following two figures show **another way to identify losses** based on an analysis of data on real consumption and estimated forecasts of expected consumption. (**Blue is the forecast**, **yellow is the consumption**, **red is the imbalance**).

The change in the subscriber consumption profile relative to the forecast values is analyzed. In the first case, **a change in profile did not lead to an increase in the imbalance, which remained unchanged.** In the second case, **a change in the subscriber's consumption profiles relative to the forecast values led to an increase in imbalance, and this is either the effect of a magnet or a faulty meter.**

Checking metering devices every hour

With an established accounting system, BALANCE - the concept of "verification interval" acquires a new meaning. Removal, verification and replacement of equipment is carried out in the case when losses from the operation of faulty equipment become equal to the costs of its verification and replacement. An imbalance analysis is performed every month, every day and every hour. If the imbalance is normal, metering devices can be operated for 15 and 25 years without verification, if it is outside the norm, urgent measures are taken, and the expiration of the "verification interval" is not expected.

In addition, the analyzer of the BALANCE accounting system indicates a specific device that requires verification, including a common house meter, which means that you can carry out selective verification, obtaining significant savings in money and time.

The red color shows the loss of metering devices without a metering system, the black one shows the typical distribution of the failure rate of metering devices, the purple shows the loss with the installed BALANCE system and common metering devices.

Zone I - failure of unreliable elements, manufacturing defects, manifestation of assembly defects, interference with the operation of metering devices during the installation of metering devices, unauthorized connections;

Zone II - losses during operation: braking by a magnet, wear of the mechanical parts of meters, ingress of dirt and dust, interference with the operation of metering devices;
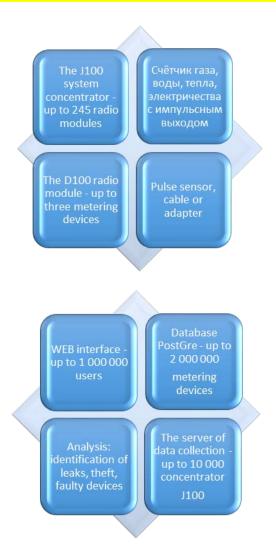
Zone III - failure of products as a result of aging, increased losses due to wear of mechanical elements, exit from the accuracy class.

Return on Investment: Pirmasens, Deutschland

We calculate the return on investment by including in the monthly fee payment for equipment in the amount of 1.99 Euro per month. We see that BALANCE pays off about two years, which is three times faster than EMERIS. Prices are subject to change, please check with your local representative. Also, the costs of installing the system, its operation and other overhead costs are not included. A more detailed layout can be obtained from regional representatives.

System cost ELSTER-EMERIS/DJV-COM-BALANCE		EMERIS	EMERIS	BALANCE	BALANCE
Equipment (prices in euros without VAT)	Qty	Price(euro)	Price Sum.	Price(euro)	Price Sum.
Magnetic sensor INZ-61 / MDT-2	10 000	22,50	225 000	5,06	50 600
Radio module TRC600p 2Z / D100-FC	10 000	83,60	836 000	31,24	312 400
Repeater TRC601	2 386	83,60	199 470	0,00	0
Hub Wavegate 310 GPRS TRC602w	7	1 234,00	8 638	0,00	0
Application software	1	12 500,00	12 500	0,00	0
EMERIS Server Software -?	1			0,00	0
EMERIS Server -?	1			2000,00	2 000
Repeater D100FC-E (according to statistics 4%)	400	0,00	0	62,65	25 060
Hub J100UC (statistically 1 on 80 D100FC)	125	0,00	0	140,38	17 548
Total (EURO)			1 281 608		407 608
Total with VAT (EURO)			1 537 929		489 129
Payback calculation using Pirmasens as an example (10,000 subscribers with a monthly subscription of 1.99 Euro)					
SYSTEM: ELSTER-EMERIS / DJV-COM-BALANCE			EMERIS		BALANCE
Monthly service charge of 10,000 subscribers			19 900		19 900
Amount of investments (EURO)			1 537 929		489 129
Payback period (months)			77,28		24,57
Payback period (years)			6,44		2,05

The structure of the metering system BALANCE

The J100 system concentrator - up to 245 radio modules

Счётчик газа, воды, тепла, электричества с импульсным выходом

The D100 radio module - up to three metering devices

Pulse sensor, cable or adapter

WEB interface - up to 1 000 000 users

Database PostGre - up to 2 000 000 metering devices

Analysis: identification of leaks, theft, faulty devices

The server of data collection - up to 10 000 concentrator J100

Communication level

Each metering point must be equipped with a metering device with a pulse output, a D100 radio module and, if necessary, a pulse sensor.

Server Software

Free database (PostGre) and free server software for LINUX, xBSD.

User-friendly interface for both the administrator and operators and managers.

Remote installation of server software on your computer.

The ability to use the server of the system supplier with a small number of users.

The program allows you to generate reports on energy consumption, disconnect subscribers and track alarm messages.

Analytics gives a forecast of consumption and warns of leaks.

For work, only Internet access is required.

DMesh - data network structure

(M) Radio module: **up to six** metering devices with pulse output

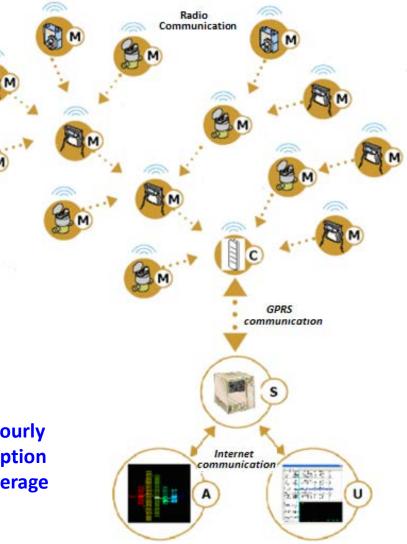**Accounting** electricity, water, gas, heat

DMesh, 433MHz, **up to 30 relay levels**

(C) Concentrator - **up to 480 metering devices per logical network** and supporting up to **eight logical networks**

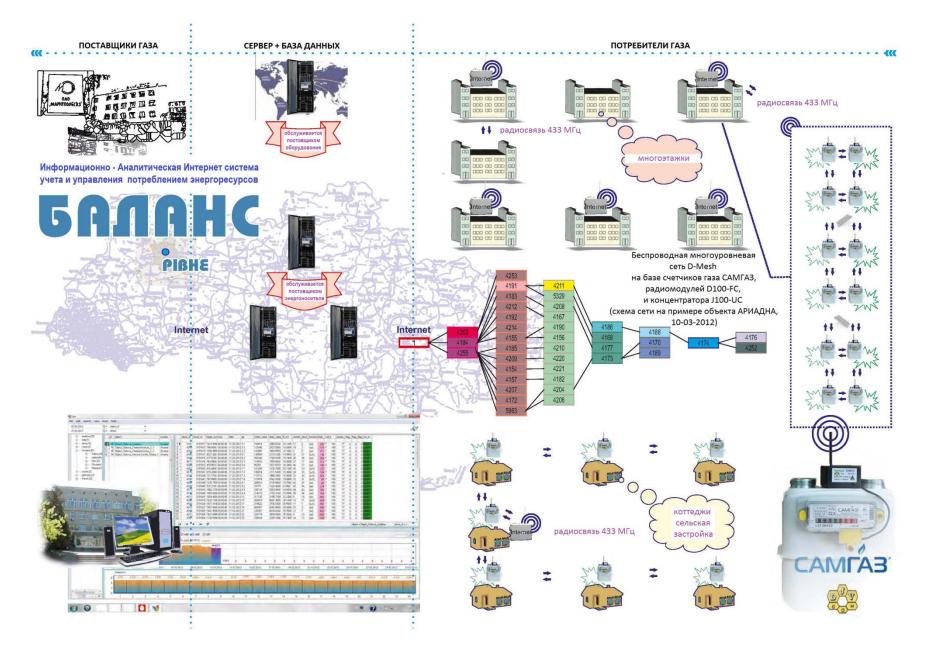**(S)** Database: **up to 2,000,000 metering devices per server**

(A) Web Admin - **network, consumption and access control**

(U) Web User/Operator - **current readings, hourly consumption profiles, leak notification, consumption forecast, comparison with estimated and average consumption by object**
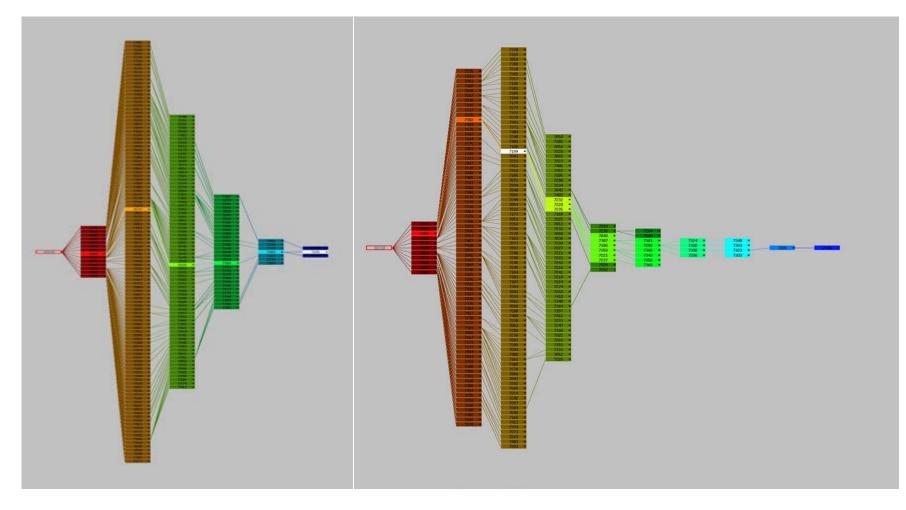
Radio Communication

GPRS communication

Internet communication

DMesh Technology Description

- **D-Mesh** operates in the frequency range **433.12 - 434.72** MHz, **which does not require licensing;**

- **433 MHz has 6 dB less attenuation** than 868 MHz and 12 dB less than 2400 MHz. **In distance it is 2 and 4 times more.**

- **Radio modules work like routers; No additional routers** with high consumption are required;

- **The coverage area of the DMesh network through relaying** can reach **up to 2 km** (in the rural zone) and **up to 10 km** (for multi-story buildings).

- Advanced network **monitoring features;**

- Equipment with **ultra-low consumption,** battery powered **with a life of 6 years;**

- The ability **to remotely enable / disable** consumption **in case of no payment or danger;**

- Remote **secondary consumption control** during peak hours of consumption

- It is a competitive product with **affordable prices.** You can calculate the costs with an accuracy of **5% -10%** for a city, region, country.

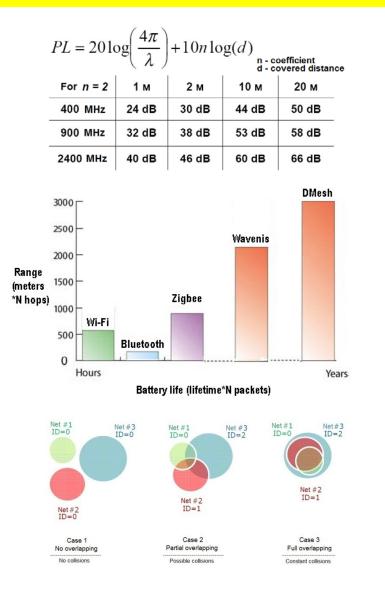- **The payback period for installing the BALANCE accounting system is only by identifying losses within 2-5 years;**

Auto build DMesh network

Koshevogo St. 18 (Leninogorsk, Tatarstan)
on January 20 and 21, 2014

PLC, ZigBee or Dmesh

$$PL = 20\log\left(\frac{4\pi}{\lambda}\right) + 10n\log(d)$$

n - coefficient
d - covered distance

For $n = 2$	1 м	2 м	10 м	20 м
400 MHz	24 dB	30 dB	44 dB	50 dB
900 MHz	32 dB	38 dB	53 dB	58 dB
2400 MHz	40 dB	46 dB	60 dB	66 dB

Range (meters *N hops) — Battery life (lifetime*N packets)

Wi-Fi, Bluetooth, Zigbee, Wavenis, DMesh — Hours ... Years

Case 1 — No overlapping — No collisions (Net #1 ID=0, Net #3 ID=0, Net #2 ID=0)

Case 2 — Partial overlapping — Possible collisions (Net #1 ID=0, Net #3 ID=2, Net #2 ID=1)

Case 3 — Full overlapping — Constant collisions (Net #1 ID=0, Net #3 ID=2, Net #2 ID=1)

Optimum attenuation and transmission rate, performed for 433 MHz. **For multi-storey buildings, Dmesh technology provides 100% data transfer.**

A study in England for 2.4 GHz ZigBee technology showed that **only 70% of data** is transmitted without additional equipment.

If we compare the battery life from the number of packets relayed by the radio module, Dmesh technology is optimal. **Any radio module in the network can relay up to 700 data packets per day, with a battery life of 5 to 6 years.**

Scalability. During the mass installation of the accounting system, or the installation by different organizations, **when the networks overlap, a number of technologies do not work**. **Dmesh is designed to work reliably with network overlap.**

Compatibility. **A number of PLC and radio technologies do not work** in the presence of interference from alternative technology devices. **Dmesh is designed to work in parallel with various technologies of accounting systems.**

LPWAN: The Great CLOSING

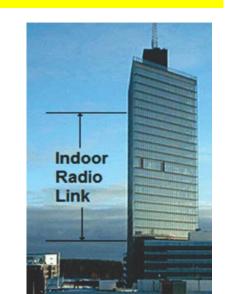*Long Range Tests at High Altitudes (from Texas Instrument)*
Test Setup: antenna Positioning: H1 = 1000 m, 91 m for *114 km outdoor with no lost data packets*
- CC1120 CC1190 at 868 MHz, 32 MHz TCXO, LRM, Tx=27 dBm and kit antennas
- GFSK, Rx BW:12.5 kHz for freq. compensation and 7.8 kHz for packet reception
- Location: Table Mountain, Cape Town, South Africa
- LNA = 0x03, ext. data filter on, Symbol Rate =0,6 ksps, Freq. Deviation = 1,5[kHz], FB2PLL =[yes]
- *Link Budget* = Tx=27 + antenna Tx=2.1 + antenna Rx=2.1 − (Rx=-126.5) = *158 dB*

High Rise Building Range Test (from Texas Instrument)
Test Setup: Tx unit placed **at floor 26** in the stairway
- CC1120 at 470 MHz, 32 MHz TCXO, LRM, Tx=14 dBm and kit antennas
- GFSK, Rx BW:12.5 kHz for freq. compensation and 7.8 kHz for packet reception
- Data could be received **12 to 16 floors below** the Tx unit. 26 -16 = **10 floors*3=30 meters indoor**
- LNA = 0x03, ext. data filter on, Symbol Rate =0,6 ksps, Freq. Deviation = 1,5[kHz], FB2PLL =[yes]
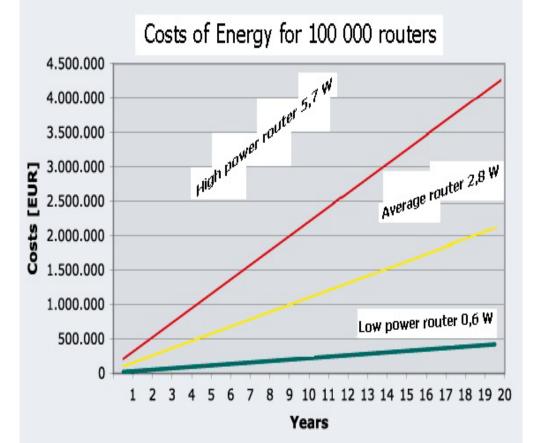- *Link Budget* = Tx=14 + antenna Tx=2.1 + antenna Rx=2.1 − (Rx=-125) = *143 dB*

Indoor Radio Link

Firm	Protocol	Budget	Freq.	1	2	3	4	5	6	7	8	9	Retransmit Fading dB	10	11	12	13	14	15	16	17	18	Retransmit Fading dB	19	20
				Atten. per floor (12 cm concrete)										Atten. per floor (12 cm concrete)										etc.	
DJV-COM	Dmesh	114 dB	434MHz	-12	-12	-12	-12	-12	-12	-12	-12	-12	atten -108	-12	-12	-12	-12	-12	-12	-12	-12	-12	atten -108	-12	-12
STRIJ	NB-FI	164 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Semtech	LoRa	150 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Sigfox	UNB	155 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Ingenu	RPMA	162 dB	2400MHz	-19	-19	-19	-19	-19	-19	-19	-19	-19	atten -171	-19	-19	-19	-19	-19	-19	-19	-19	-19	atten -342	-19	-19

This table is simply showing how the resulting effective link budget and penetration capabilities differ effecting the signal behavior in the multistory building. You can see, that attenuation per one floor is differ for different frequencies 434MHz – 12dB, 868MHz – 15dB and 2400MHz – 19dB for the concrete wall 12 cm.

You can see, if transmitter set at ground floor, data could be received for Ingenu (RPMA) only up to 9 floor, for the Semtech (LoRa) – up to 10 floor, for Sigfox (UNB) up to 11 floor, for WAVIoT (STRIJ – NB-FI) up to 12 floor and for the DJV-COM (DMesh) – first level up to 9 floor, but DMesh is the multi-level retransmission technology with up to 30 level of retransmission, so second level will be up to 18 floor, the third level will be up to 27 floor and etc.. Theoretically DMesh technology can retransmit data up to 9 floor x 30 levels = 270 floor.

Data transmission and control equipment

Costs of Energy for 100 000 routers

Costs [EUR]

4.500.000
4.000.000
3.500.000
3.000.000
2.500.000
2.000.000
1.500.000
1.000.000
500.000
0

High power router 5,7 W

Average router 2,8 W

Low power router 0,6 W

Years: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Radio module J100UC
Concentrator / Router - **one** per subnet, support up to 8 logical / time subnets, **consumption 0.6 Watt,** 220 / 240 AC Volt **(or version with a solar battery);**

D100FC radio module
with a maximum of **240 pieces per subnet**; powered by lithium battery "A" ER18505M 3500 mA / h, supporting **up to 6 metering devices** (cable up to 10 meters);

Impulse sensor - for each gas / water meter or cable for the electricity meter, **up to the maximum of 480 meters per subnet**;

Lithium battery
"ER18505M" 3500 mA / hour - 1 piece for each D100FC radio module;

Consumption management adapters - on request; **Shut-off valves or load control relays** on request too.

Data transmission and control equipment

Radio module

D100FC

D100FC-E

Concentrator

J100UC

J100UC-M
MANUAL COLLECTION

Additionally

AD220/50
Adapter

AD12/1000
Adapter

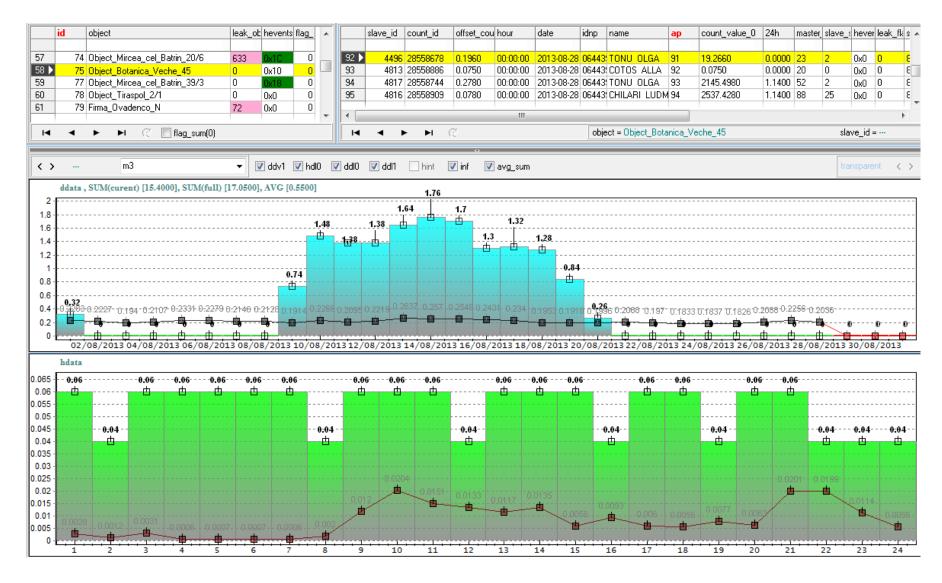**"A" ER18505M**
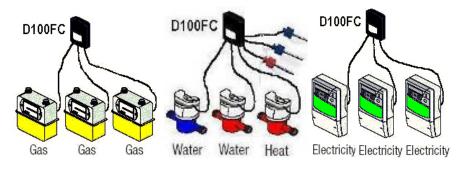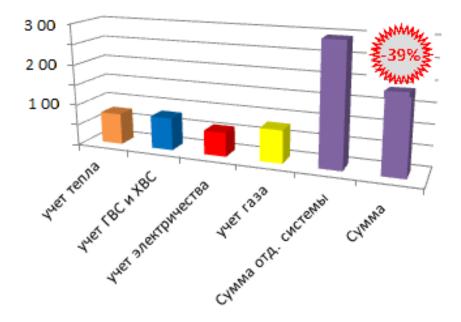
MDT-02
gas sensor

SD-25
water sensor

Turnkey Accounting System

Do you want to get a service or buy equipment? When buying a system in parts, the cost of it can exceed any of your expectations, and whether it will work as a result is a separate issue.

BALANCE supports a comprehensive energy metering: Gas, Electricity, Water and Heat, and when purchasing individual metering systems for each of the energy resources, you will have to return to this issue many times and if you have enough money, you will eventually become the happy owner of three or four separate accounting systems.

The universal BALANCE system allows for complex accounting to save both on equipment and maintenance, **while the savings can be up to 30 - 40%.** Access to accounting data will also be unified from your personal account.

Manufacturability system BALANCE

ALTERNATIVE ACCOUNTING SYSTEM	BALANCE ACCOUNTING SYSTEM
Difficult to design - ambiguity	The project is very simple, often not required
Too many different equipment	Radio modules and devices with pulse output
Optional Equipment Required	No additional equipment required
Difficult to install	Installation 2 guys/140 metering points/day
Difficult to set up	Simple or factory set up
Hard to get started	Start-up - no setup required: Plug @ Play
Hard to use	At the level of computer use
Paid Software	Software is included in the price of equipment
Purchase server	Use the DJV-COM server
Too expensive	Two to three times cheaper alternatives
Low reliability	Higher wired system reliability
Sophisticated Interface	Intuitive, customizable interface
Lack of access via WEB	WEB access for operator and client
Need programmers to operate	No programmers needed
Poor product support	Escort 24/24, 7 days a week
Delays with updates	Updates in one place - in the database
Paid Updates	Included in the cost of equipment
System Parts Warranty	Guaranteed results - all from one source
No access from mobile devices	Access also from mobile devices

User Consumption Profiles

Consumption profiles

https://djv-com.net/web/public/pv/auth/login

As for example, enter 23835 and 8110061.

Schedule of daily consumption "Month / Day / Hour"

polyline - the average consumption of the object, shows current consumption since start of month and consumption forecast at the end of the month.

Schedule of monthly consumption "Year/Month/Day"

polyline - last year's consumption.

In the calendar, you can select the one you are interested in date and see the counter

Consumption coefficient indicator:

the ratio of your consumption to the average.

Temperature coefficient indicator:

the ratio of your temperature to the average at home

Energy Efficiency Indicator:

ratio of your energy efficiency to average

The ability to display several metering devices on one chart, this handy if you have for example four water meters.

In the configuration for each of the counters you can choose the display color.

BALANCE mobile for Android

BALANCE mobile is a simple and effective solution for intelligent data reading of energy resources in your home. The mobile app has the same functionality as the BALANCE web app but is targeted and optimized for mobile devices. If you have the remote BALANCE system from DJV-COM. you can use **BALANCE mobile** to access your electricity, gas, water and heat consumption data:

* View daily and hourly consumption profiles.

* Viewing consumption at the beginning of the month compared to average consumption and end-of-month forecast.

* Events notification. You define the desired daily intake and, if consumption exceeds, the app will notify you.
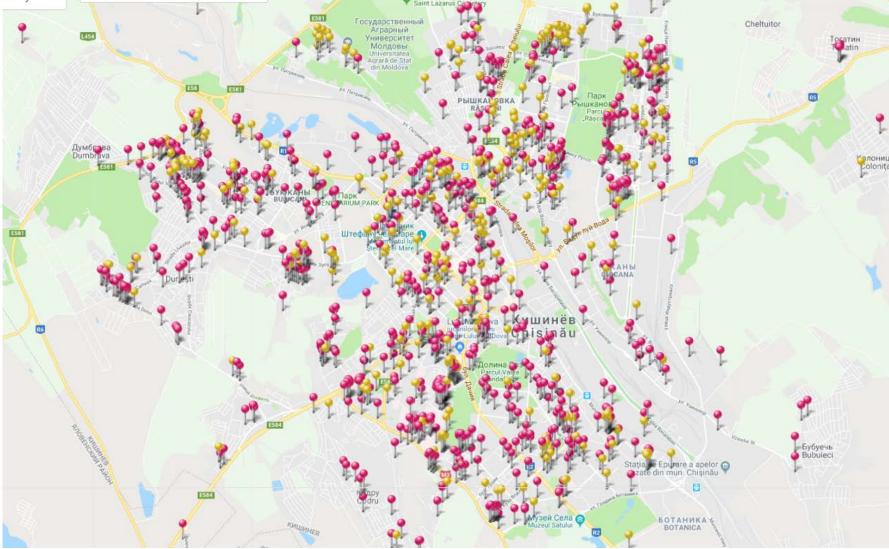
* Monitoring temperature and energy efficiency.

* The possibility of adding or removing gas, water, heat and electricity meters to control all the resources in your home / apartment.

Download app: **DOWNLOAD APLICATION.**

For support, contact us at   **mobile@djv-com.net**.

Geography of the BALANCE system projects

The geography of projects can be viewed at https://djv-com.net/web/public/map/main/index

Regarding the acquisition equipment of BALANCE system and Partnership, contact:

Germany and Western Europe, "GEMORO GmbH", e-mail: gemoro.gmbh@gmail.com, Tel: +49 176 68088019;

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Poland, "Metrix", www.apator.com, e-mail: Janina.Wieczorek@apator.com, Tel: + 48 58 53 09 340, fax: +48 58 53 09 204;

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Russia, St. Petersburg, «ZENNER-Центр», www.zenner-center.ru, e-mail: anton@zenner.spb.ru, т/ф +7 (812) 579-60-00;

Russia, St. Petersburg, "Лиом плюс", www.liomplus.ru e-mail: info@liomplus.ru, т/ф 7(812) 677-0349, 7(812) 677-0350;

Russia, Samara,"Самара ЭСКО", http://www.samaraesco.ru, e-mail: 2001@samaraesco.ru, т/ф +7 (846) 9735041;

Ukraine, LLC, "САМГАЗ", www.samgas.com.ua, e-mail: korolkov@samgas.com.ua т/ф +(380) 362 622543, +(380) 362 622519.

Thank you for your attention