AMI Head-End System

Automated system of control and accounting of electricity

What is Advanced Metering Infrastructure Head-End System

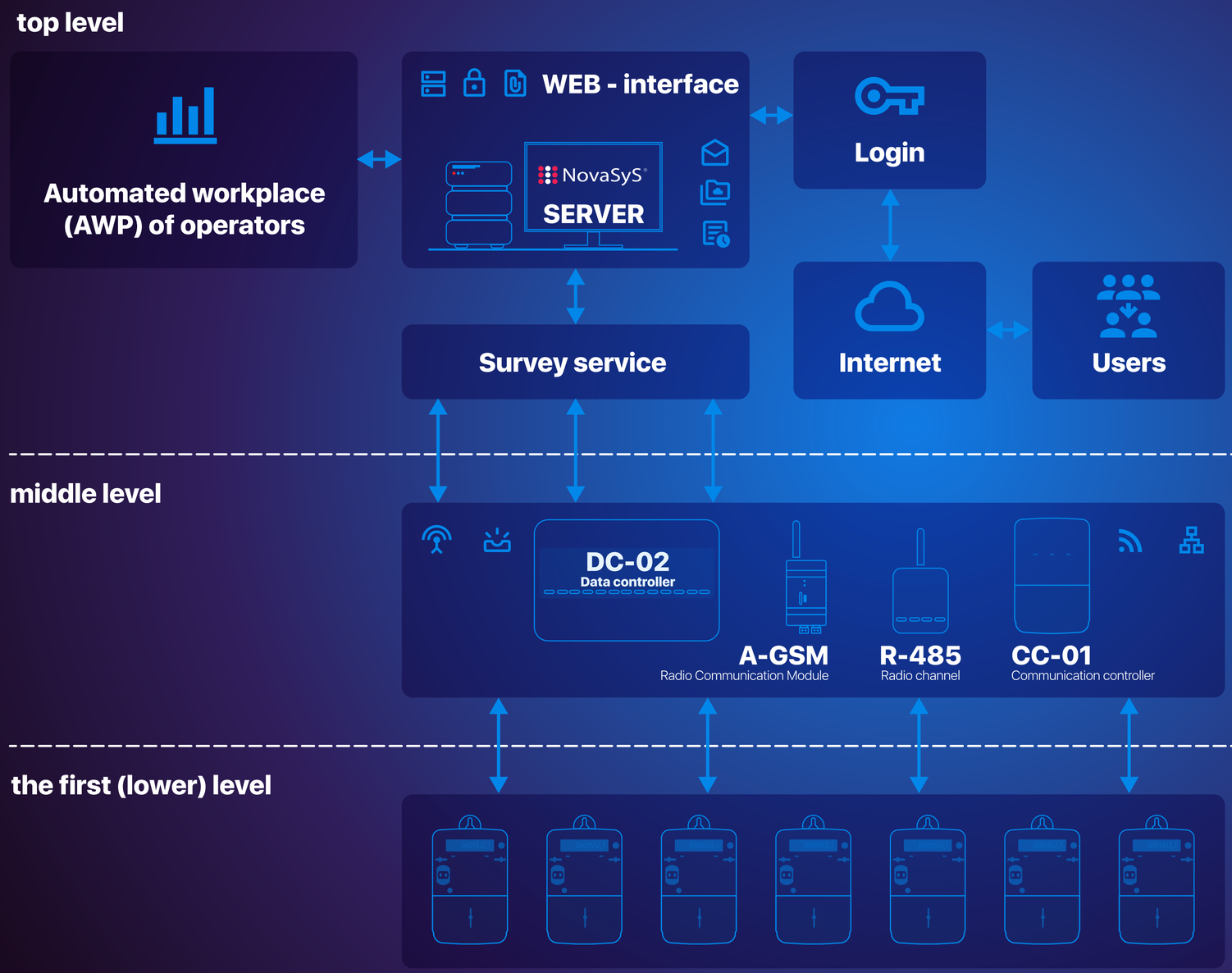
AMI Head-End System is an automated system of control and accounting of electric energy. As stated in the Rules for the Use of Electricity (PKEE), AMI HES is a set of integrated into a single functional metrologically-certified system of local equipment for data collection and processing of metering devices, information transmission channels and devices for receiving, processing, displaying and recording information.

That is, AMI HES allows you to remotely collect information from electricity meters and transmit it to the server where the databases are stored. This can be done through different communication channels (depending on the functionality of the meters, their available interfaces) and with the involvement of auxiliary communication equipment.

The AMI HES system allows to carry out the following main tasks:

- Collection of information from meters and its processing for commercial calculations between suppliers and consumers
- Continuous control of the condition of facilities (monitoring of the condition of meters for correct operation, absence of emergency situations, as well as monitoring of the premises of metering units in order to detect unauthorized access, flooding, etc.)
- Control of energy balances
- Detection of losses
- Accuracy and timeliness of resource accounting

System architecture



Usually AMI HES has a three-tier architecture:

- the first (lower) level - meters
- medium - channels and means of data transmission
- top - communication servers, applications and databases, user workstations and specialized software

Benefits AMI HES NIK

The NIK software package provides an opportunity:

- Connection of various metering devices, the total number of which can be more than 2 million pieces.
- Database accumulation
- Synchronization of databases located on different servers
- Remote access to metering devices
- Creating customized reports
- Exchange of information between the database and other systems
- Data transmission by different communication channels (dedicated wired lines, switched communication channels, radio communication, GSM communication, bank communication, Ethernet)
- Connection of network components, operating systems
- Construction of a dispatcher control system

AMI HES: data transfer methods

Among the methods of data transmission in AMI HES systems are the most common:

- **PLC** (signal transmission through power supply lines)
- **RF** (signal transmission via radio channel)
- **RS-485** (signal transmission through a dedicated twisted pair of wires)
- **GSM-communication**

Each of them has its advantages and disadvantages.

Below we will consider each method in more detail.

PLC

A system that provides signal transmission over power lines

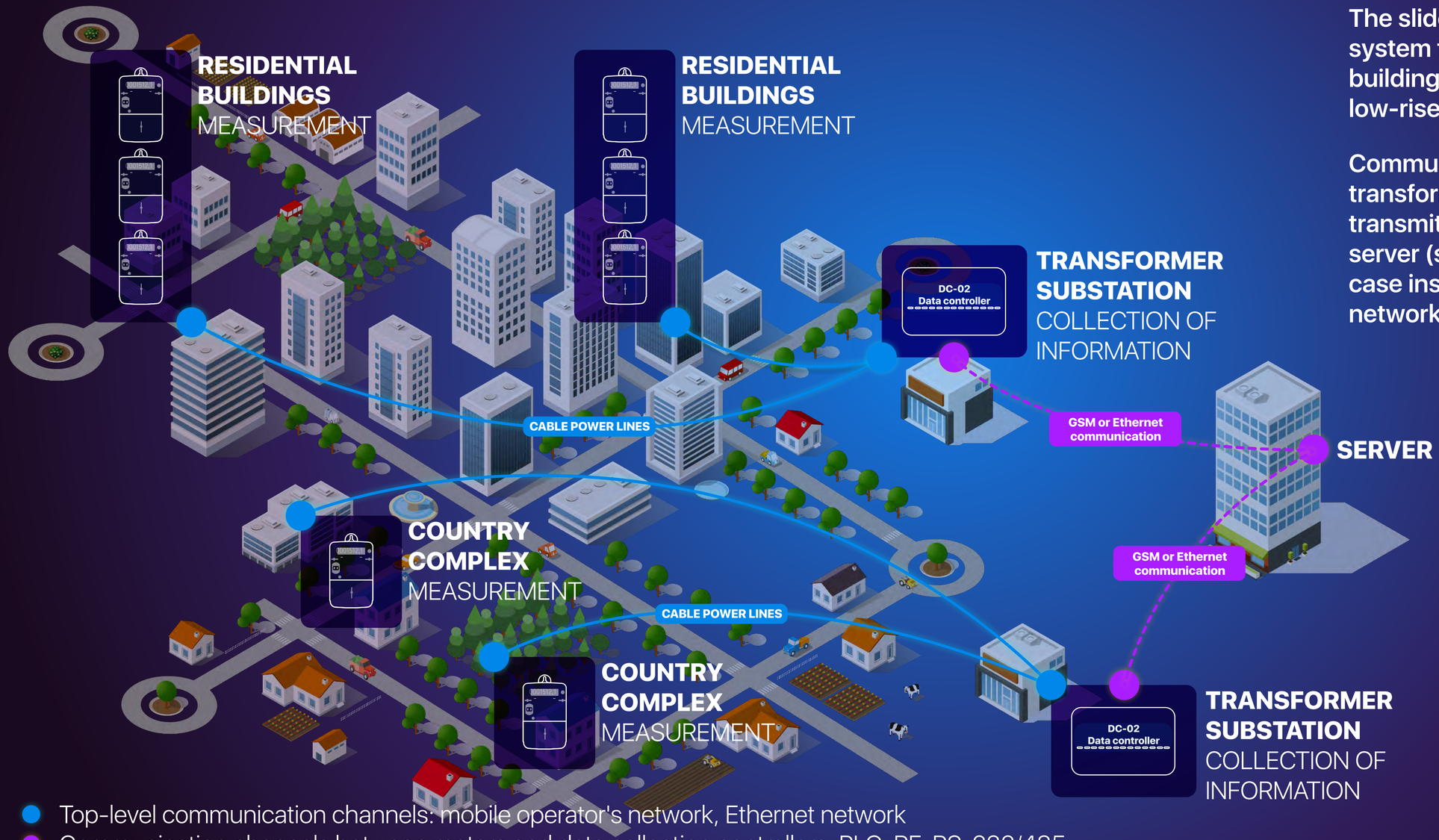
Advantages:

- Ability to create networks with a large number of consumers
- No need to lay additional cables. This allows, for example, to easily transfer an old house to a new system
- There is no need for direct visibility of metering objects
- The most reliable system

Disadvantages:

- High requirements for the condition of power lines (in particular, they work poorly in areas with overhead power lines). In case of poor condition of electrical grids, it is necessary to install additional equipment
- High cost of meters with PLC interface compared to, for example, meters with RS-485 interface, as well as additional costs for data transmission by power supply lines
- Installation of the system requires direct intervention in the power system and disconnection for some time (approximately 5-15 minutes) of electricity supply to consumers.

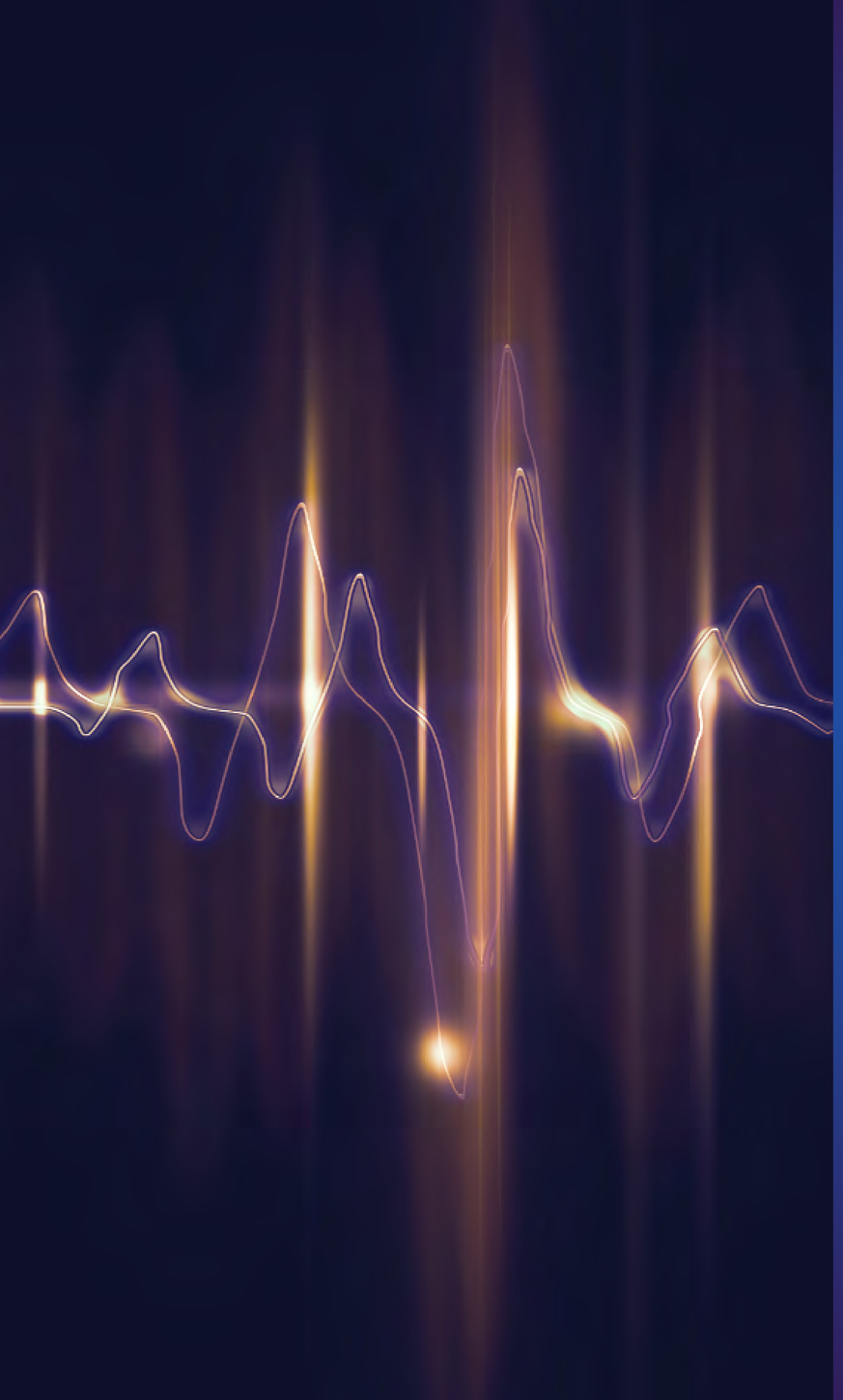
Example of system architecture PLC



The slide shows an example of a PLC system for a residential area with high-rise buildings and for the private sector with low-rise buildings.

Communication controllers installed at transformer substations are used to transmit the signal from the meters to the server (since AMI HES equipment is in this case installed directly in the power supply network).

- Top-level communication channels: mobile operator's network, Ethernet network
- Communication channels between meters and data collection controllers: PLC, RF, RS-232/485



Systems RF (ZigBee, radio communication)

A system that provides signal transmission over a radio channel

Advantages:

- No wires
- They do not require special requirements for power lines, because they do not use them
- Do not require additional equipment at substations (for example, KS), it is enough to install, for example, the AGSM module - much cheaper device
- Quick installation, without interfering with the power supply system

Disadvantages:

- The need for direct visibility between the "participants" of the network
- If there is no direct visibility - it is necessary to install additional equipment (channel extenders, repeaters, etc.), which increases the cost of the network
- System instability in the long run due to circumstances independent of the system itself (for example, a tree has grown between the elements of the network or a fence has been installed)

Example of system architecture RF (ZigBee, radio communication)

An example of an RF system for a residential area with high-rise buildings and for the private sector with low-rise buildings.

Different combinations of devices can be used to transmit the signal from the meters to the server - for example, AGSM module and access point, communication controller and access point. Connection to a transformer substation in such a network is not required, communication equipment can be installed at any available facilities, where it is more appropriate for optimal signal transmission.

In the territory of a residential area with high-rise buildings for one of the houses we have direct visibility between meters and communication equipment, and near another house a tree creates obstacles for signal transmission, so the roof has an additional radio extension.

- Top-level communication channels: mobile operator's network, Ethernet network
- Communication channels between meters and data collection controllers: PLC, RF, RS-232/485

Systems RS-485

A system that transmits a signal through a dedicated twisted pair of wires

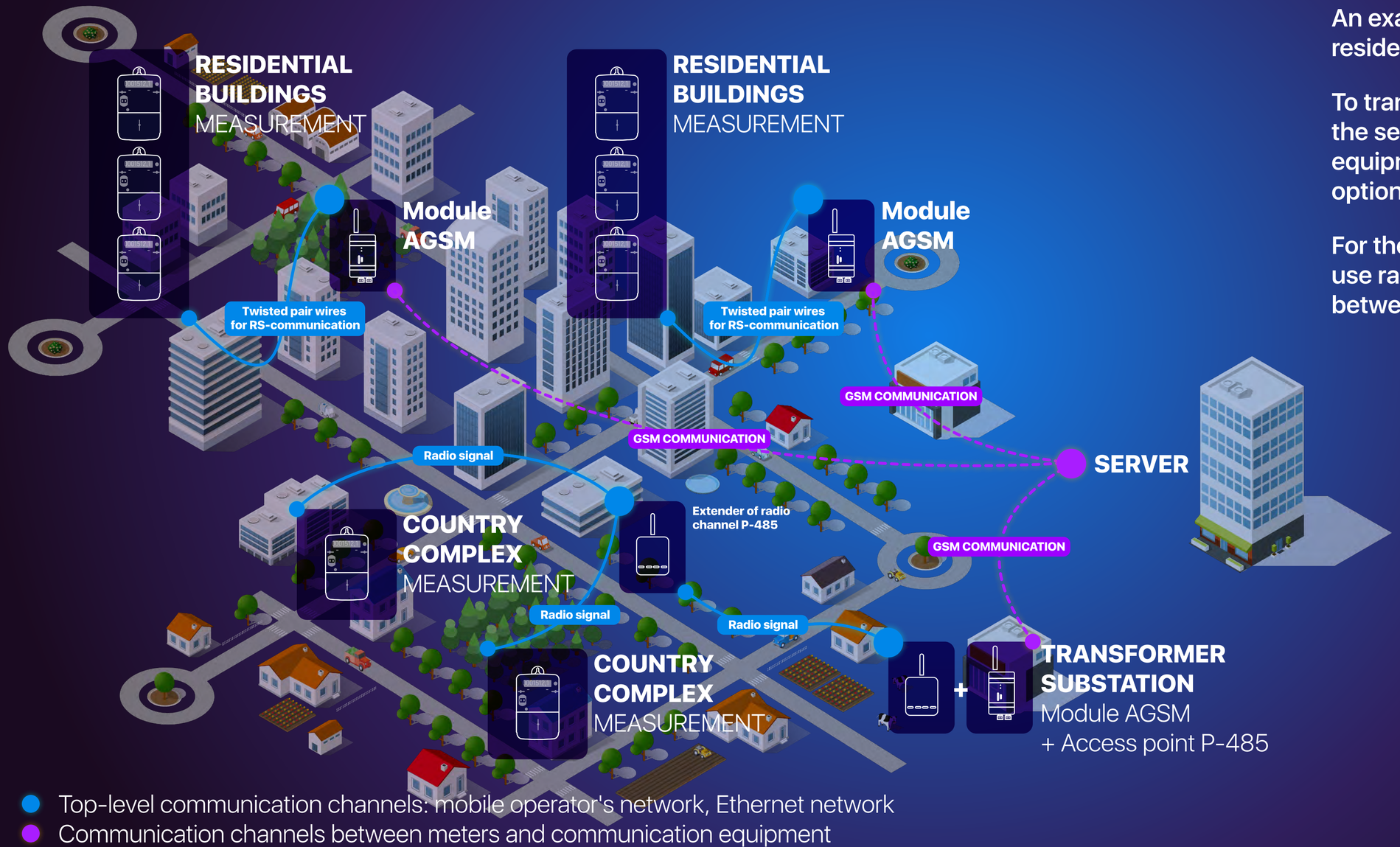
Advantages:

- Low cost of devices with RS-485 interface (compared to PLC or ZigBee)
- Relative ease of installation, does not require intervention in the power supply system
- No special requirements are required for power lines or visibility of objects, as communication is provided through a separately mounted twisted pair of wires

Disadvantages:

- Small maximum length of lines - about 300-500 m
- Limited number of devices (consumers) in the network (available options 32/64/128)
- Due to the first drawback, it is not possible to install a communication controller at the substation, it must be installed directly on each house
- The wires that provide the connection are easy to break

Example of system architecture RS-485



An example of the RS-485 system for a residential area with high-rise buildings.

To transmit the signal from the meters to the server, additional communication equipment is installed, the least expensive option is to use the AGSM module.

For the nearby private sector, it is better to use radio communication, as the distance between the meters is much larger.

- Top-level communication channels: mobile operator's network, Ethernet network
- Communication channels between meters and communication equipment

Systems with GSM-communication

Meters with a built-in GSM module are used to transfer data to the server

Advantages:

- No need to install additional communication equipment or wired communication to transfer information from the meter to the server
- They do not depend on the distance of objects, the quality of power supply networks, the presence of physical interference between the meter and the data collection server

Disadvantages:

- High cost of meters with built-in GSM-module
- The need to install sim-cards with a static IP address in each device, additional payment for mobile communications, maintaining the relevance of the validity of each card, complications if necessary to change the mobile operator
- The installation of electricity meters with a GSM module may be appropriate, for example, for remote villages with a small number of consumers, where it is difficult to reach the controllers-representatives of the energy supplier to take meter readings

Example of system architecture with GSM-communication

An example of a system using GSM communication for a remote village with a small number of consumers.

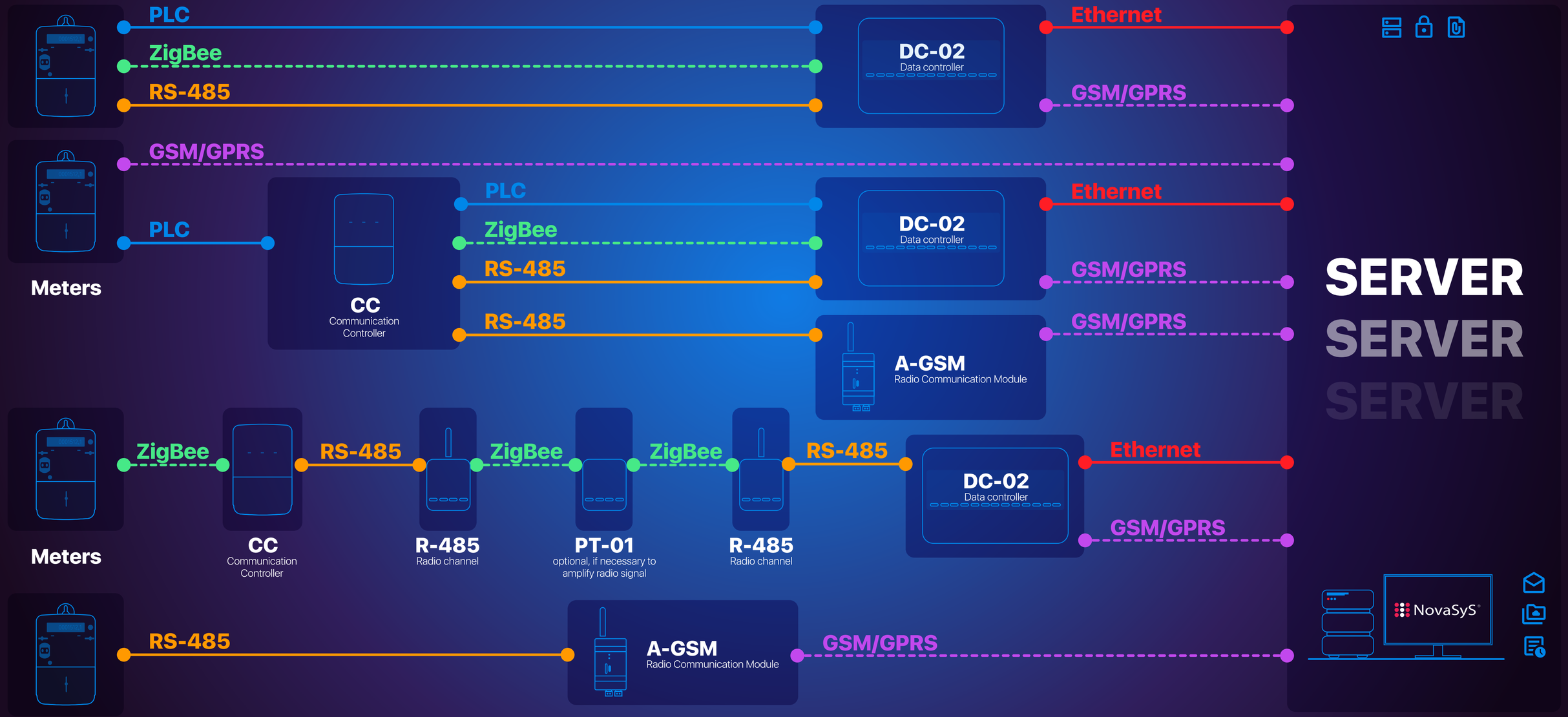
Meters with a built-in GSM module receive readings directly to the server via the network of the mobile operator.

Hybrid systems

These examples of data transmission schemes reflect the most common options used in energy industry, so to speak, in "pure" form. However, combinations of different types of data transmission are possible, so-called "hybrid" systems - such as PLC and RF, or RF and RS-485, or all of the above types of communication simultaneously. After all, in practice, the design and implementation of the AMI HES system takes into account the most optimal implementation options, depending on the existing infrastructure, the remoteness of the objects from which to collect information, the presence of interference, the state of power grids and more.

For a more complete understanding of the variety of data transmission methods and equipment applications in automated power control and metering systems, see the diagram below.

AMI HES: examples of using devices in the system



Thanks for attention!

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