

Use of a switching platform in the Kumir-Resurs complex for the organization of commercial and technological metering in the pipeline energy system

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Abstract. This work is aimed at creating a domestic switching IT platform that organizes commercial and technological data exchange with intelligent metering devices within the Kumir-Resource complex. To facilitate efficient control and management of the modern pipe line and electric grid infrastructure an IoT (Internet of Things) platform can be built to organize communication with a multi-million audience of end consumers using smart metering devices. Implementation of such a platform will allow centralized collection, monitoring, management, analysis and visualization of all pipeline system data.

By combining data through the Internet of things (IoT), organizations gain transparency and control over resources. The IoT leads to transparent and streamlined operations, increased productivity, reduced risk and the development of new business models. However, integration of various IoT systems that have different communication protocols is a major challenge for the industrial manufacturers. Scientific and Technical Center "KUMIR", (STC KUMIR) platform provides interaction between any terminal devices and IoT applications in a single domain based on the Kumir-NET protocol, while application developers can abstract from data transfer technologies and focus on describing the application logic, while equipment developers focus on hardware specifications. The IMS Kumir-Resource platform facilitates high-speed data communication between IoT components using Kumir-NET protocol and is unique on the Russian Federation market.

STC Kumir studied IoT communication technologies of the world IoT infrastructure companies: Itron, Siemens, Honeywell, Landis + Gyr, Kisters AG, Cuculus, Zonos. In the initial review, the closest comparable can be the MindSphere platform from Siemens, which combines all the various physical and IT infrastructure of an enterprise under a single communication domain. While expanding its market share, Siemens MindSphere utilizes external hardware and software developers in its own standard communication protocol by providing development tools and application store within the MindSphere platform, while keeping MindSphere a proprietary platform owned by Siemens.

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Table 1. Comparison of the capabilities of Kumir-Resource with foreign analogues.

| 1. Information-measuring system | | | |
|--|--|---|--|
| | Kumir-Resurs | Cuculus | Siemens |
| Product | Information-measuring system "Kumir-Resource" | ZONOS software platform. Smart metering systems: - advanced metering device management (AMM); - measurement data management system (MDM); | EnergyIP software information and measurement platform as part of MindSphere |
| Number of supported metering devices, mln. | 50 | - | 75 |
| Metering point cost per year | 50 RUB. | - | 0,75 € (60 RUB.) |
| Ultra-fast communication core | In developing | Supported | Supported |
| Multi-resource (gas, water, heat, electricity) | Supported | Supported | Supported |
| Multiuser / Multidisciplinary functionality | Supported | Supported | Supported |
| Compliance with the separation of roles in the market | Supported | Supported | Supported |
| Extended roles and access rights management, data encryption | Supported | Supported | Supported |
| Supports third party metering devices and standard interface protocols (DLMS, SML, IEC 62056-21, ANSI 12.22 MBUS, wMBus) | Supported | Supported | Supported |
| Integration (support) of third-party top-level applications (ERP, CRM, EDM, etc. | API (For any systems) | Supported (For proprietary systems) | Supported (For proprietary systems) |
| Analysis of the quality of supplied resources and thermal conditions of buildings | Supported | Partly | Partly |
| Remote control of mixing unit controllers and shutdowns | Supported | Partly | Partly |
| Possibility of operational control of the electrical network | In developing | Supported | Supported |
| 2. Additional opportunities for the development of the system as a communication platform | | | |
| | Information-measuring system "Kumir-Resource" | ZONOS | Siemens MindSphere |
| Smart home system (Energy Management): home energy management, remote control, home security, alarms and other applications. | In developing | Supported | No support |

| | | | |
|--|---------------|------------|------------|
| Third party software development tools | In respect of | No support | Supported |
| App Store | In respect of | No support | Supported |
| "Smart Housing and Utilities" as part of the "Smart City" program | In developing | No support | No support |
| Control and management of lighting networks | In developing | No support | No support |
| Meteorological and environmental control of water bodies and territories | In respect of | No support | No support |
| Dispatching of utility companies | In developing | No support | No support |
| Dispatching engineering networks of commercial enterprises, educational institutions, and public buildings | In developing | No support | No support |

The considered foreign systems are proprietary, in contrast to the proposed system of STC KUMIR.

The STC KUMIR platform is not proprietary and compatible with IEC 62056 Protocol, supporting stable connectivity scaled at millions of units of measuring sensors/devices.

Thus, the STC KUMIR meets several major business requirements:

- High-speed communication core required to process several million transactions.
- Organization of simultaneous and parallel data exchange, which will allow organizing the operation of several systems, for example, room flooding systems, alarm systems, pressure and leakage systems in pipelines will use one common line and data transmission equipment.
- Creation of the necessary development tools and simple software API libraries to adapt to work with any client's top-level application.
- The proposed proprietary intelligent platform organizing the lower and middle layers of the network is not proprietary and must be freely compatible with the IEC 62056 protocol.
- Hybrid implementation, (i.e. using a radio channel and a CAN bus) is necessary for successful work in difficult urban conditions, where installation based on purely radio channel solutions (such as LoRaWan, Sigfox, Strizh / Vaviot) is costly and does not give a guaranteed result of error-free data exchange. The architecture of the KUMIR-NET switching platform is shown in Figure 1.

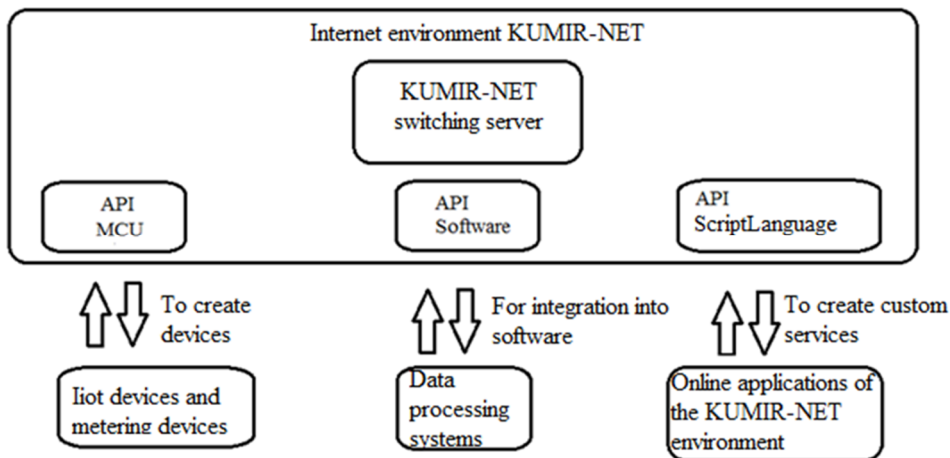


Fig. 1. Architecture of the KUMIR-NET switching platform

There are three main ways of interaction between the switching platform:

- Software interface for working with microcontrollers
- Module for interaction with device software
- Software library of scripting languages for online applications

Implementation of the STC KUMIR technology will reduce cost of creating and managing large networks of IoT equipment, data transfer, collection and processing. The technology also includes configuration options of building hybrid networks: based on generally accepted Internet technologies, local field networks of bus topology with random access, as well as based on wireless LPWAN and PAN networks.

LLC STC KUMIR also offers metered data transmission directly to third party billing systems via open source API, where clients can program data transmission and interoperability logic.

IMS "Kumir-Resource" is developed on the basis of the open Linux OS PostgreSQL database. Currently IMS "Kumir-Resource" (software and hardware implementation) allows you to work with all types of measured resources (more than 80 integrated metering devices). The platform is based on our patented and patented innovative method of transmitting data over open IP networks, when telemetry devices are located in the segment of local private addresses (patent No. 2382520) and its implementation in creating the Kumir-NET protocol, which allows to reduce transaction costs during switching and transmission data.

The latest version of the server software in bench tests shows switching speeds of about 2 million transactions per second at 2.4Gbit / s flow rates. This should be enough to process readings from 50 million metering devices with an interval of 15 minutes.

An IT platform based on KUMIR-NET protocol can facilitate simultaneous metered data transfer from several million-meter devices in a single hydro network in addition to:

- control and management of intelligent metering devices,
- equipment condition monitoring,
- prescriptive maintenance forecast,
- systems management,
- management of data and cloud resources of accurate digital models of systems,

The main problem of modern IoT technologies is that, due to the presence of an IoT interface, the price of a device rises several times, for example, electricity meters with a wired RS-485 interface, which measure not only electricity consumption, but also quality parameters (voltage, current, frequency, power factor etc.) cost in Russia 2500-3500 rubles. depending on the manufacturer, and with the IoT interface (GPRS, NB-IoT, Ethernet) - 5500-6500 rubles. Dispatching systems existing on the market, for example Danfoss Comfort Contour, are quite expensive (5-7 thousand euros for a telecommunication node) and are often proprietary solutions designed to work with a single line of equipment.

Therefore, the NTC KUMIR has its own necessary equipment for building networks and the possibility of organizing the simultaneous and parallel operation of several monitoring systems, for example, the simultaneous operation of a flooding system, an ALARM alarm system, a pressure and leakage system in pipelines, while using one common line and exchange equipment data.

The use of this method of data exchange will reduce the number of peripheral devices and reduce the cost of re-equipping the accounting systems of network organizations to a new industrial level or organize data transmission with existing metering devices.

The development of our own metering devices and auxiliary systems is designed without reference to a specific manufacturer of components and, if necessary, allows you to change the manufacturer of components in the shortest possible time without losing the functionality of the devices.

The system includes:

- switches (KUMIR-K23 / K24),
- GPRS modems (KUMIR-M32),

• radio channel transceivers and impulse counters operating at a frequency of 868 MHz, allowing for bi-directional communication with metering devices (Radio module RM81). The Kumir-Resource platform can become the basis for organizing the management of medium / low voltage engineering systems in a distributed area. With its help, it is possible to organize monitoring and control of remote pumping stations, boiler houses and other technological equipment of the pipeline complex.

In conclusion, I would like to note a few main theses of the proposed platform:

1. An innovative approach to data processing that meets the requirements of scalability and performance for intelligent platforms allows you to reduce transaction costs, which will increase the number of final metering devices up to several million pieces.
2. The use of the Kumir-NET protocol to exchange data with IoT technological devices that have low requirements for end devices will lead to low cost, which will allow creating a budget switching platform, including for organizations with their own billing system. Creation of transport layers for the protocol over the CAN field bus and over the IEEE 802.15.4 standard radio channel will create the most common and cheapest way of radio channel data transmission.
3. Organization of the lower-level interface, allows you to receive readings from metering devices and transmit commands to meters and gateways, to ensure that network organizations independently and in their own user applications process the received data.
4. Organization of the high-level interface, will allow connecting user applications to the switching platform, which enables organizations that do not have their own user applications to process data through the IIS "Kumir-Resource".
5. The combination of low-cost means of collecting and transmitting information based on the developments of LLC STC "Idol" and a distributed system for processing and storing information can give a good multiplier effect, which will allow you to develop this business direction. ID "Idol-Resource" is a multi-resource system that allows you to work with any accounting devices with open protocols or counting output. This makes it possible to connect almost any metering device on the market or already installed at the customer's enterprise to the monitoring system.

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