IQRF®

Reliable by definition

IQRF® General Guide

IN MESH WE TRUST

IQRF® wireless mesh technology, standard and ecosystem

IQRF® is a complete **technology**, **standard** and **ecosystem** including hardware (transceivers, gateways, repeaters, complete electronic devices, accessories, development tools), software, protocols, support, commissioning tools and services.

Since 2004, MICRORISC and IQRF Tech have developed IQRF®, a reliable, low-power, bidirectional, wireless mesh communication technology. With its IQMESH® protocol, IQRF® enables extremely **robust** and sophisticated **mesh** topology. Thousands of wireless systems worldwide are the proof of that.

After two decades on the market, the IQRF® gets **standardized**, allowing everyone to use and implement all technical achievements and reliable protocols protected by dozens of patents under one royalty-free license.

IoT with IQRF® works great thanks to its reliability in the field of smart lighting, heating, sensors, automation, and smart sanitary.

www.iqrf.org

IQRF® features

More than 20 years of continuous research and development for and with customers crystalized in state-of-art communication technology featuring:

- ▪ industrial reliability
  - o thanks to the IQMESH® protocol, more network nodes mean higher reliability
  - o it is deterministic and reliable even in difficult environments
  - o it delivers robustness and industrial reliability to the wireless IoT
  - o with 250+ repeating nodes in one network cooperating in a mesh topology you can cover huge facilities, industrial halls, and streets and reliably deliver the message despite bad RF conditions
- ▪ simple integration
  - o modular architecture, lightweight yet efficient DPA protocol, hardware and software development tools, plenty of guides, examples, and tutorials along with excellent technical support make development easy
- ▪ ultimate security
  - o the complex approach from device association to a network to automatically encrypted communication is based on security standards
  - o the security services layer is responsible for ensuring the following security objectives: frame integrity, networking frame authenticity, footer and payload confidentiality, replay protection
- ▪ interoperability and huge ecosystem
  - o the interoperability of devices from different manufacturers is based on IQRF Interoperability standards
  - o products certified on IQRF interoperability (application and communication levels) are listed in the IQRF Alliance marketplace at a website and can be easily used in complex IoT projects
- ▪ IQRF True Low Power® consumption
  - o low wireless consumption pushes battery limits to the new boundaries defined only by the battery's self-life
  - o a smart combination of different power consumption modes, from transmit mode to deep-sleep mode, makes it possible to achieve really low total power consumption
  - o for example, a sensor transmitting data every minute can run for more than 20 years on a single AA battery, twice the actual battery life
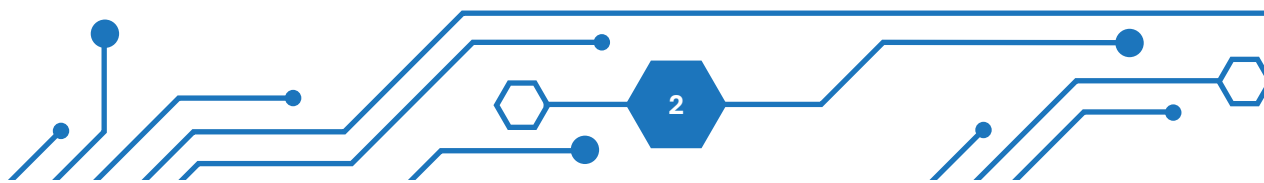
IQRF Alliance

IQRF Alliance is an open international IoT community including design houses, manufacturers, cloud providers, telco operators, system integrators, research, and innovation centres, technical high schools and universities with the mission to deliver #1 wireless IoT devices and solutions based on the IQRF® technology. Companies that manufacture products for the IQRF ecosystem or offer related software and services join together in the IQRF Alliance.

Certified interoperable IQRF® products on the Marketplace

Develop your IQRF® product and promote it on the IQRF marketplace at the IQRF Alliance website and use the huge support of our marketing and R&D team.

IQRF Alliance tests products for **interoperability** at the **application** level, which enables their integration into complex IoT systems. Detailed description of IQRF Standard for sensors and other devices is to be found in the section [IQRF Interoperability](). When a product manufacturer follows the prescription for IQRF standard on the application level, then from the point of view of integrators it does not matter if they communicate with sensors from one manufacturer or another, because they communicate uniformly and get predictable, uniformly structured responses.

The IQRF Interoperability certification procedure is available on the IQRF Alliance website. It includes getting HWPID (Hardware Profile ID) for the certified product, inspecting required documents and the product, checking its compliance with the IQRF Interoperability standard, fixing possible issues, and finally, product listing in the IQRF Repository and marketplace.

When manufacturers use certified IQRF® transceivers in their products, the development process is significantly simplified. They just need to follow guidelines for IQRF Interoperability certification on the application level published on the IQRF Alliance website.

If manufacturers decide to integrate IQRF® directly into their product or develop their own IQRF® transceivers, they need to follow IQRF Communication Standard Specification, which is defined by IQRF Standards Association.
Members of the IQRF Alliance get the IQRF Communication Standard Specification with significantly favored conditions.

Member discounts on products of other alliance members

IQRF Alliance members have the opportunity to expand their sales channels with a www.iqrf.shop. Members of the IQRF Alliance can purchase from other members at preferential terms.

## Promotion, trade fairs and community events

IQRF Alliance participates on exhibitions and events where members can promote their products and solutions.
Co-participation at events brings members a high value of marketing effectivity.

IQRF Alliance organizes community meetings, and seminars at universities, and promote members' products and solutions.

Members' products and solutions are listed on the IQRF Alliance website, social networks, and newsletters.

For promotion, we also use various appropriate online servers where we publish articles and advertisements related to IQRF Alliance members' products and solutions.
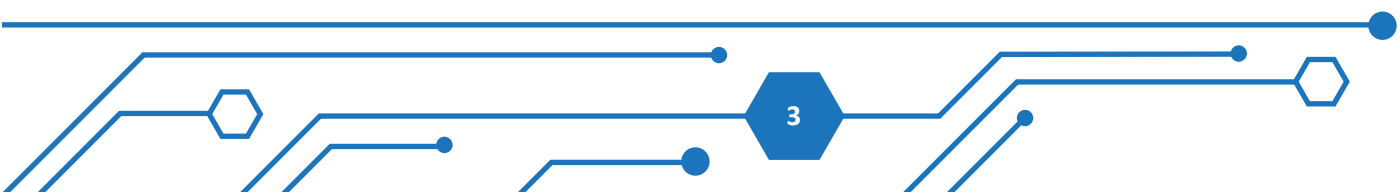
Programs for start-ups and institutions

Start-up companies working on a product directly related to the IQRF ecosystem can benefit from a two-year free of charge IQRF Alliance membership. IQRF Start-ups get all the excellent technical support, are linked to other Alliance members, are promoted through Alliance web site and social media and get a chance to demonstrate their products and solutions on common events.

IQRF Smart School is a program for academic institutions – especially technical high schools and universities. This program enables students to easily catch the fast-moving train of the Internet of Things and M2M wireless communication.

www.iqrfalliance.org

IQRF Standards Association

IQRF Standards Association is a non-profit organization founded by IQRF Tech, MICRORISC, and IQRF Alliance. It is responsible for the IQRF Communication Standard Specification, **royalty-free** licensing of the open **IQRF Communication Standard**, and the **IQRF MAC**'s management.
The IQRF Communication Standard specifies principles of communication in the IQRF wireless mesh network and enables electronic devices to communicate reliably and securely.
The content of the IQRF Communication Standard Specification may not be used to implement IQRF technology without a signed valid royalty-free license. IQRF technology is protected by dozens of patents in one patent pool, which are part of a royalty-free license agreement. The existence of this patent pool protects manufacturers from illegally created third-party IQRF-like products without a license which are not interoperable with others.

Manufacturers can implement the IQRF Communication Standard in their devices under a single royalty-free license. IQRF Standards Association certifies **interoperability** at the basic **communication** level. It is a basic part of the IQRF interoperability certification.
Manufacturers can implement IQRF® technology directly into the electronics of their products or can manufacture their own IQRF® transceivers.
Membering the IQRF Alliance brings the members benefits of priority information, software, and testing tools including a batch of IQRF MAC addresses for development and significantly favored conditions for certification and all related procedures.

standard.iqrf.org

Huge IP and ecosystem since 2004
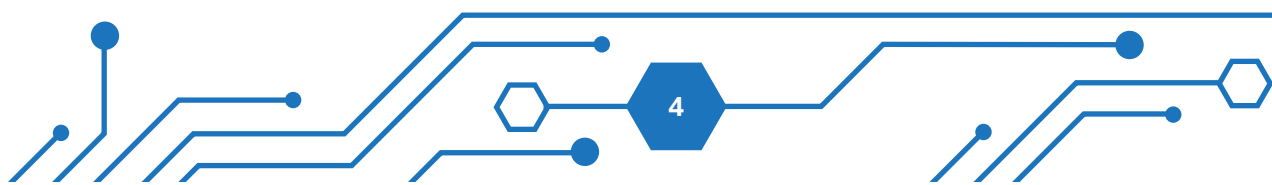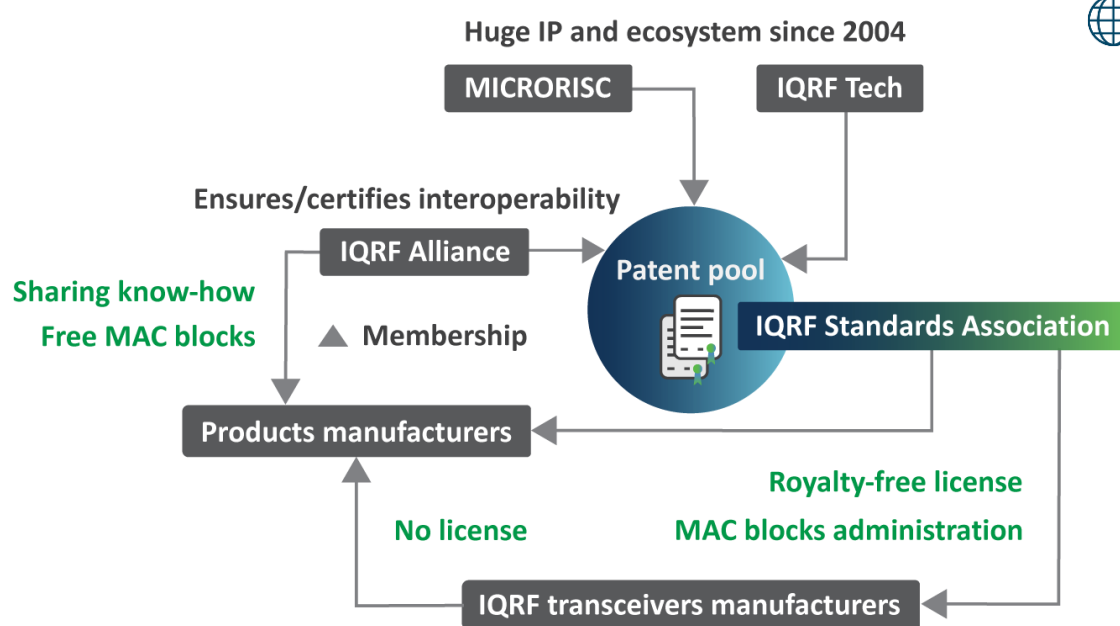
Three ways how to benefit from IQRF®

Time-effective way for system integrators with using ready hardware and software

Build your IoT solution using standardized IQRF® products from the IQRF® ecosystem. Select from a wide portfolio of sensors, actuators, lighting controllers, and more. Use various ready-made development tools, software solutions, clouds, commissioning tools, and other services.

Any device
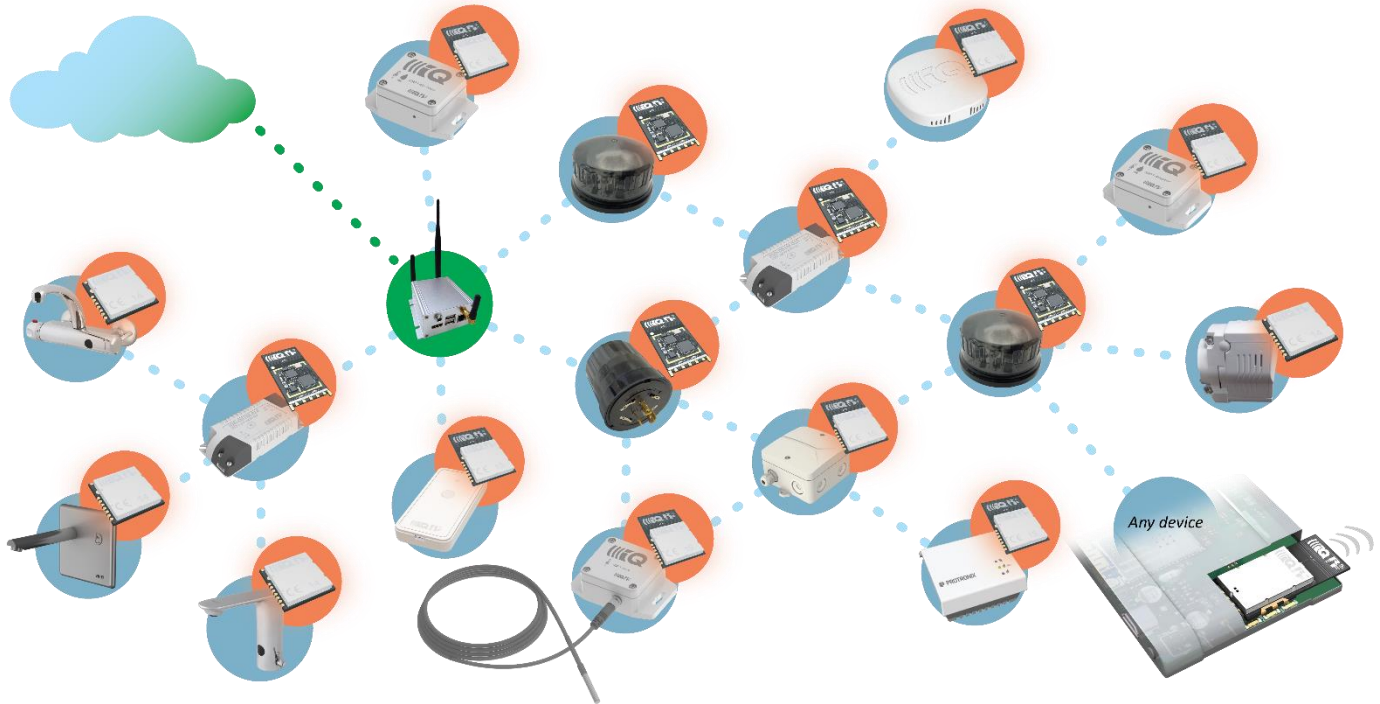
www.iqrfalliance.org

Proven and time-effective way for device manufacturers with using certified IQRF transceivers

Integrate certified, ready-to-use and fine-tuned IQRF wireless transceivers into your electronic devices to enable wireless control and monitoring within a short timeframe and at a competitive cost. New series of IQRF transceivers are upgradeable to features of the IQRF Open Standard.

Any device

eshop.iqrf.org
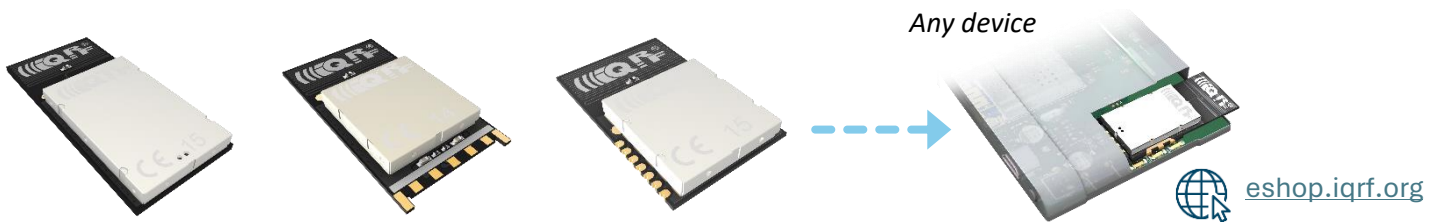
Mass-production way for large device manufacturers implementing the IQRF Open Standard

Maximize the efficiency of technology benefits and maintain control over mass production while reducing expenses. Utilize IQRF® technology following the specified guidelines and create new products for the IQRF® ecosystem or manufacture your IQRF® transceivers and offer them to manufacturers of IoT devices. Implement all features and protocols of the IQRF® technology under one royalty-free license.

standard.iqrf.org
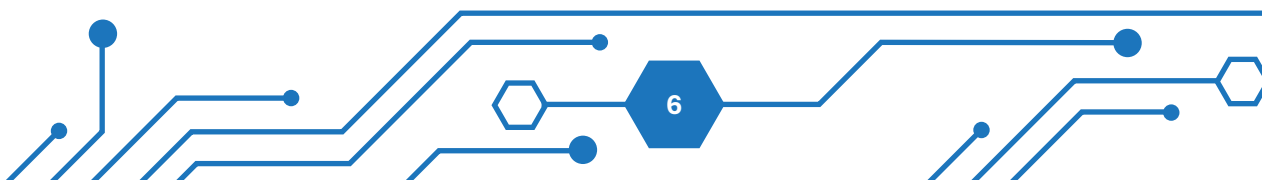
IQRF® best-fit verticals

Smart lighting

IQRF® technology fits perfectly in indoor lighting, emergency lighting and street lighting. You can communicate with lights bi-directionally, monitor and control them. You can have more than 200 lights in one network. You can have more networks on different RF channels if needed. You don't have to pay for expensive data cables. Just connect the IQRF lighting bridge or the controller into LED lights and communicate with them.
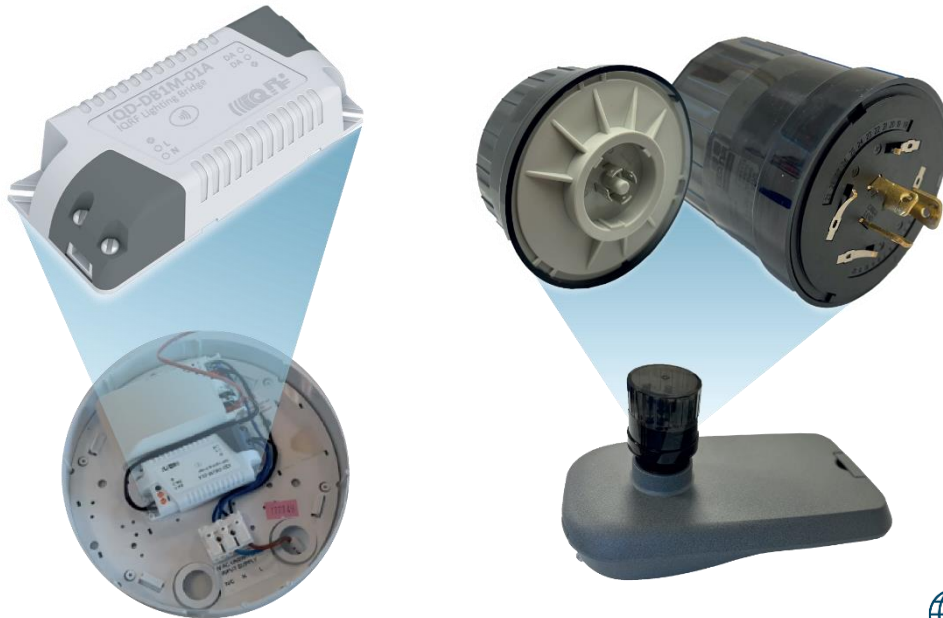
With wirelessly controllable LED luminaires, you can save up to around 80 % of electricity, compared to more energy-intensive light bulbs without control. The control unit in the luminaire is part of the IQRF® wireless mesh network, which is locally autonomous and can thus operate locally without any problems, without the use of cloud services. A command for switching on, off, changing the light intensity, etc. is sent to the control unit in a light from the central management application installed on the local IoT gateway or in a cloud if requested or directly from the switch on the wall.
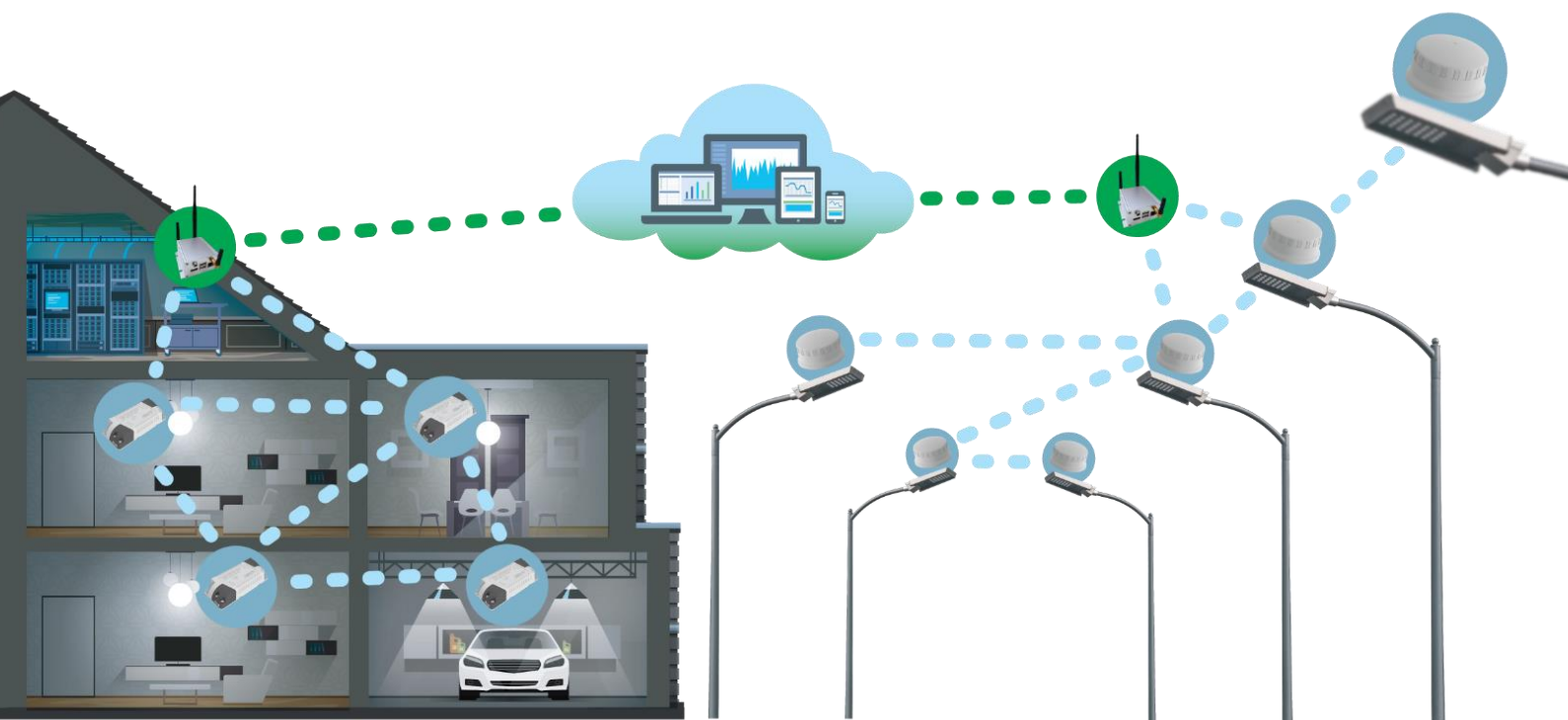
You can wirelessly monitor the status of the light and its parameters. In addition, the light network can also serve as a backbone network for other devices, such as air-quality sensors.

Upgrade your current lighting system with the IQRF® smart lighting solution. Simply plug the IQRF Lighting Bridge into your indoor LED light fixture or connect IQRF controllers with Zhaga or NEMA connectors to street lamps. Deploy a reliable wireless network easily with ready commissioning tools. Run your local or cloud control application and control your smart lighting system.

In the IQRF Alliance, we cooperate on complex solutions. If you need just hardware, you can order it directly from the manufacturer. If you need commissioning tools or control applications, you can use services from other members of the IQRF Alliance. IQRF Alliance members can deliver the whole solution for smart lighting projects.

Smart heating

Smart heating expert companies supply complex solutions in the field of heating and ventilation of industrial and administrative buildings, schools, hotels, sports halls, cultural centres, industrial halls etc.

They regulate heat sources using indoor environment sensors and remotely controlled active elements. These are smart thermostatic heads installed on radiators in rooms or remotely controlled infrared heaters in industrial halls or floor convectors. Thanks to reliable wireless communication in the IQRF network, there is no need to install expensive data cabling to control the elements. It significantly reduces investment costs and shortens the installation time.

Using algorithms proven by practice, progressive thermal management and the usage of artificial intelligence, they can manage any heat sources. Intelligent control systems guarantee maximum energy savings and short return on investment.
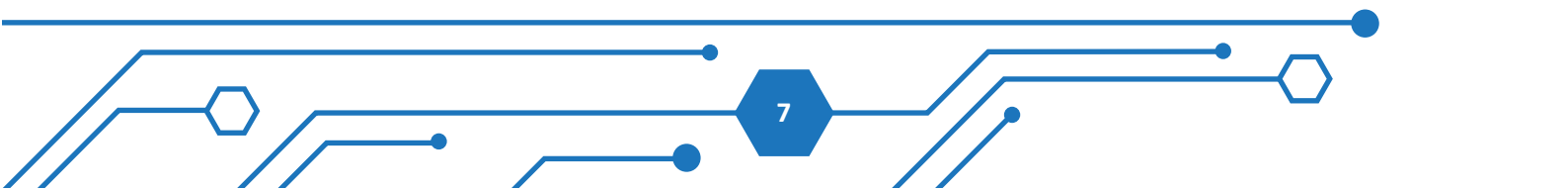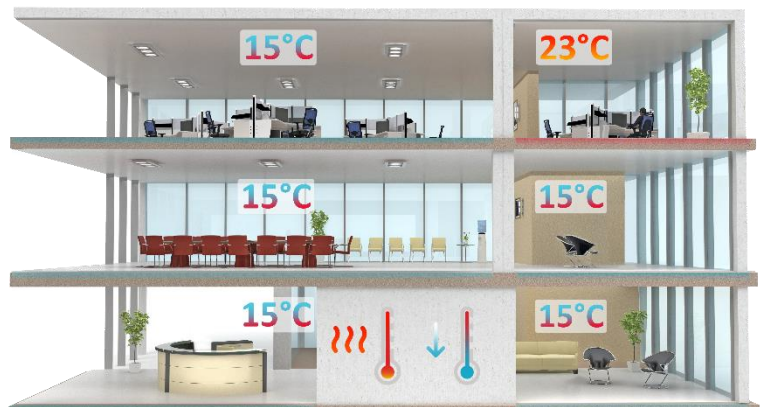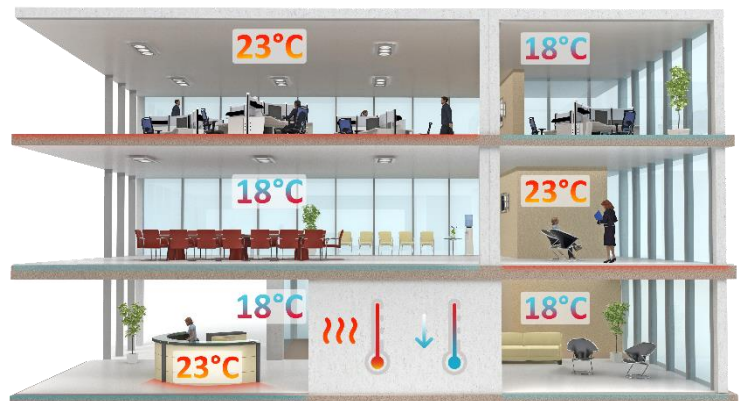
Energy is supplied at the place, time, and required quantity. A smart heating system replaces inefficient heating of the entire space with heating of a specific zone. Automation and intelligent management supported by artificial intelligence contribute to cost reduction and environmental sustainability.

Smart sanitary

Smart sanitary technology is an example of using sensors and active elements in one network and using automation processes. Sensors can detect the number of flushes, the frequency of use of the faucet, the use of soap, and the amount of water used.

Active elements can remotely control water taps and carry out hygienic flushing if necessary.

The advantages are health when dangerous bacteria are prevented from multiplying in the pipes of unused equipment, and, of course, financial, because thanks to information on the use of social equipment, cleaning can be optimized, hygiene needs replenished, or it can be determined whether water is not flowing unnecessarily.

It also has legislative advantages, as the building operator has evidence of how often hygienic flushing takes place, which is especially important in hospitals where there are people with weaker immunity. For example, Legionella bacteria can cause serious lung disease in weakened individuals that can lead to death.

With wireless IQRF technology, a large number of devices used in toilets and public showers can be remotely monitored and controlled. Thanks to the supported mesh topology, control messages reach even hard-to-reach places in the building from the point of view of RF signal propagation.
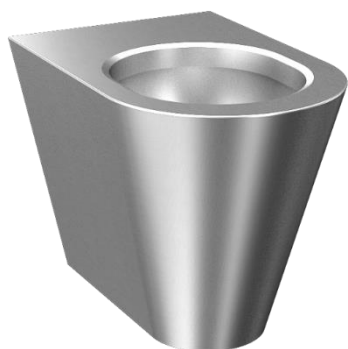
Sensors and automation

It is beneficial to monitor the air condition in buildings. The result is healthier, happier and more productive residents and workers. The sensors can measure quantities such as temperature, relative humidity, carbon dioxide, volatile organic compounds, nitrogen oxides, and also hazardous gases such as carbon monoxide or radon.

Temperature and humidity monitoring is essential for food and medicine warehouses and electronics manufacturing. An example is the IQAROS system from MICRORISC, which thanks to wireless transmission can be used in any part of the building. This gives you a 3D overview of the temperature and humidity in different parts of the building. The temperature can be different under the roof, near windows and doors, and in places facing the sun it tends to be higher.

The IQAROS system can also be used in farm buildings for wireless temperature monitoring in stored hay, straw, grain, and other crops. A temperature sensor equipped with a stainless-steel rod is inserted into the stored goods, and if the temperature inside the material rises, it can mean that there are putrid processes inside, for example, due to unremoved moisture or the presence of pests. This can lead to spoilage of raw materials or even fires. The damage that can be prevented by early detection can be significant.

Sensors provide monitoring, but if you use that information to remediate the environment, the effect of that automation is what is one of the goals of the Internet of Things.

The action may consist of modifying the environment with ventilation or air conditioning, cleaning the air, or triggering an alarm.

Automation processes affect all areas of smart buildings, cities, and industry. They touch on fields of air-quality monitoring and control, adapted lighting in buildings and streets, and heating optimization in buildings, etc.
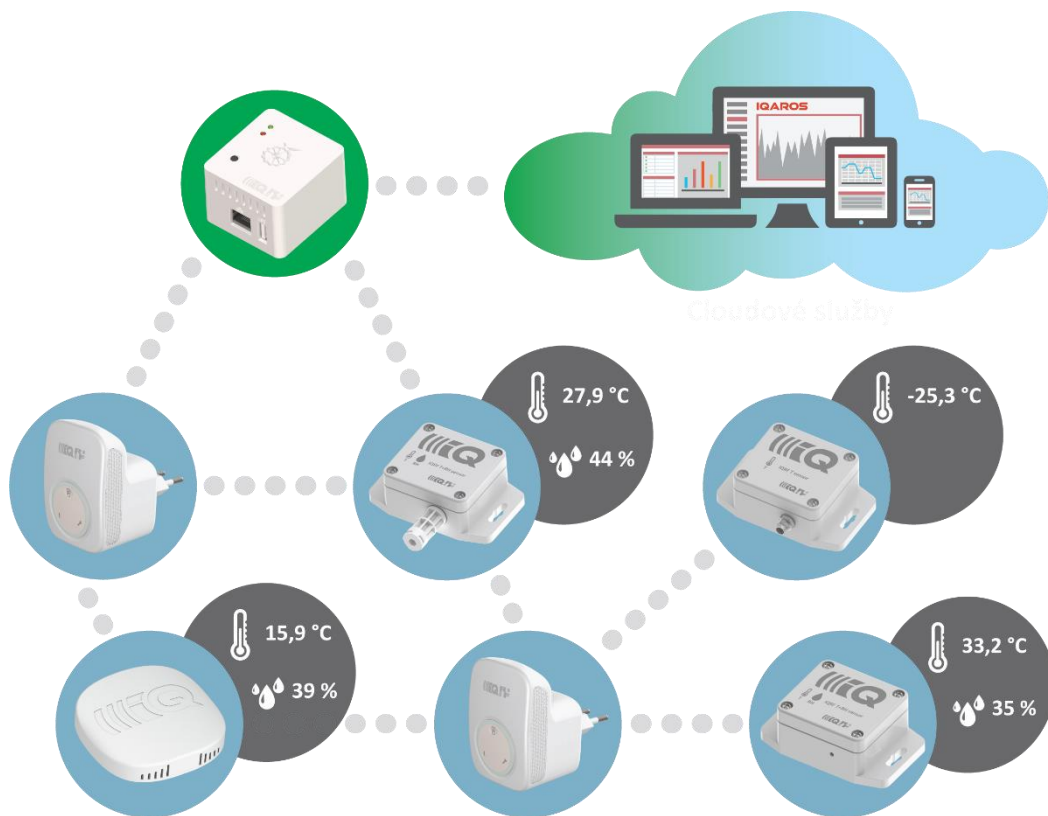
Case studies with IQRF®

Smart lighting in a cinema and a sports hall

The DATmoLUX company provided an efficient lighting system in Cinema Máj in Uherský Brod with simple control software supporting scenes, sections, and time schedules. They also provided a lighting solution for the sports hall in Podolí (Brno).

As a result, the customer return on investment with lower lighting power consumption is very fast, lighting control is 100% reliable and easy to use.

Wireless control of lighting in a JULI Motorenwerk industrial hall

The complete control solution of LED lights uses a robust and reliable IQRF wireless mesh network. There are touch screens for simple manual control, and a backend user interface that enables to set up sections, schedule, intensity, and other parameters and to monitor consumption, worked hours, alarms, etc.

As a result, the customer saves 70 % on costs with lower lighting power consumption, lighting control is 100% reliable and easy to use, and installation didn't affect production at all.

Safe bike paths in Kadaň

More than 80 dimmable public lighting fixtures are installed close to the cycle paths in the area of a park. Motion sensors detect the movement of cyclists or pedestrians and the relevant section of the cycle path is then illuminated in full. When there is nobody for 5 minutes, the lighting intensity is reduced to an economic 10% level. For safety reasons, the lights remain on at this level. Vegetation and insects do not suffer from the excessive light intensity.

Street lighting network as an ideal backbone for IoT devices

IQRF® technology is widely used in street lighting in Europe, but also, for example, in Israel. IQRF® wireless controllers use standard Zhaga or NEMA connectors. 100-200 lights in a network are controlled from an IoT gateway located in a switchboard. Gateway as a central communication element of a network can be connected to remote services placed, for example, on the cloud.

Radek Pechman company, one of our lighting partners, installs a street lighting solution mainly in the Czech Republic and Slovakia. A lighting network is a backbone for IoT devices, such air-quality sensors or parking systems.

Wireless emergency lighting system

For emergency lighting, it is mandatory to regularly check the condition of the backup battery. The luminaires are equipped with a wireless IQRF® bridge, through which the central application communicates with luminaires. Control commands are used to obtain the status of the lamp or its battery or for its identification. System deployment is easy with using automatic network construction. The management application enables to locate the lights in the building and display their location and status in the map.
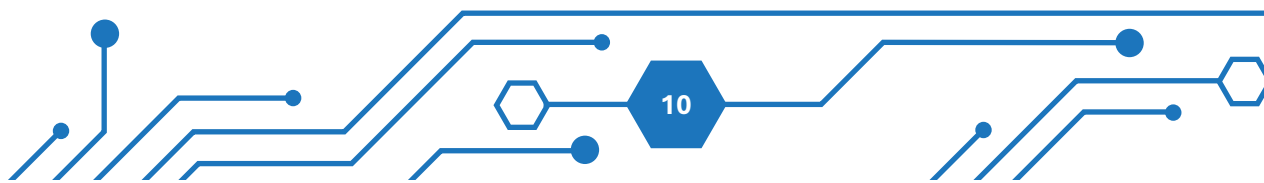
Controlled heating with air quality regulation at the Bratislava primary school

The Austyn International company designed the system at the Bratislava primary school on Kalinčiaková Street, enabling precise heating regulation of individual rooms based on the school schedule.

The intelligent solution allows a significant reduction in heat costs. Each radiator is fitted with a thermostatic head that controls it individually and wirelessly communicates with the central control unit. The batteries in heads last up to 5 heating seasons.

Temperature, humidity, and CO_2 sensors are installed in classrooms. When detecting worsened conditions, the system automatically exchanges air using a recuperation unit. Window opening sensors are installed on the windows to prevent unnecessary heating.

Heating optimization in hotel Patria, Slovakia

Original thermostatic heads in more than 120 rooms on 9 floors were replaced with electronic thermostatic heads using the IQRF® wireless technology. No cabling or other building modifications were necessary.

IoT gateways are placed in technical rooms on each floor to create independent radio networks for individual floors. The control software is connected to the existing hotel booking system. Control of heating regulation is fully automated. It optimizes the temperature in rooms based on information about arrival or departure acquired from booking system. Thermostatic heads are equipped with protective covers to prevent from being handled by unauthorized persons.

Heating and ventilation control in industrial halls

Inefficient heating of the entire hall was replaced by heating of individual zones as needed. Heating and ventilation/recuperation units are controlled wirelessly in the IQRF® network.

The regulation reacts to outdoor changes and heats zones in advance according to the scheduler. The opening status of windows and doors is monitored, and air quality is adjusted if degraded values of quantities such as CO_2, VOC, temperature, humidity, and dust are measured. The control system allows the user to detect the presence of another non-system heat source in the hall or room.

Heat regulation at SMZ – magnesite plant in Jelšava

The central heat source was replaced by local hot water boilers. A radiant system was installed in the production halls. Achieved savings are more than 70%, ROI less than 2.6 years.
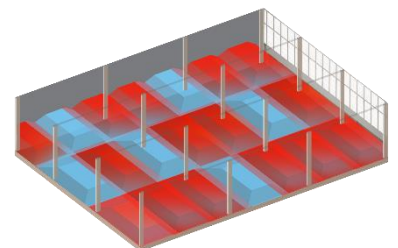
Clean bubble ventilated system at Embraco Spišská Nová Ves

The ventilation system was installed in the hall, using the clean "bubble" principle. The performance of ventilation in ventilated zones is controlled individually based on local measurements of air pollution with dust and volatile organic substances.

Heat regulation at Austrotherm Bratislava

Before implementation, there was a central hot water heating system with regulation on the heat source. After implementation, heat source management, regulation of hot air heating of the production hall, and regulation of heating of the administrative building took place. The principles of economical thermal management and intelligent heating were applied.

Defrosting of coal wagons in Slovak powerplant

Austyn International installed modern and economical system for brown coal wagons defrosting in Nováky power plant in Slovakia.

The defrosting system consists of 450 infrared heaters with 3.6 kW output, 108 heaters with 1.2 kW output, and an automatic RS AGS system, which controls defrosting based on input data wirelessly in the IQRF® network.

### Air-quality monitoring at a Prague school

Because of the concentration problems of students and the possible bad air in schools, Protronix, and its partners decided to make a long-term 4-month analysis at Smichovska secondary technical school in Prague. The CO_2, temperature, and relative humidity values were monitored. They were continuously analyzed and finally followed by recommendations for ventilation. As a result, it was found that minimum recommended values of relative air humidity had not been reached for most of the school time, and maximum allowed CO_2 values had been exceeded for almost half of the time.
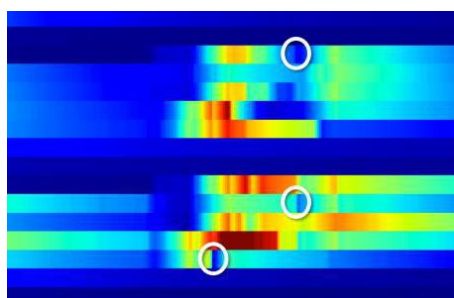
Temperature and RH measurement with the IQAROS in the swimming pool Říčany

The pool managers wanted to continuously monitor the temperature of the indoor air and water. Wireless temperature and humidity sensors of the IQAROS monitoring system from MICRORISC were installed in the main pool, restaurant, and rest area. Temperature sensors with a sensor in the cable were installed in the swimming and kid's pool.

Even though the pool environment has strong reinforced concrete walls and ceilings, and there is higher humidity, the wireless signal of the IQRF® network works without problems.
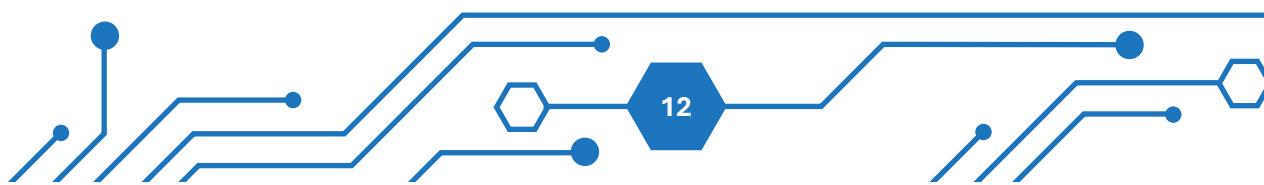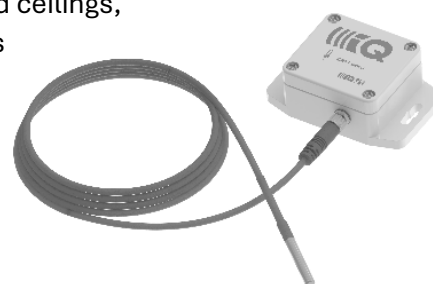
Air-quality monitoring in offices and warehouses at HQ MICRORISC

It is required to monitor the temperature and humidity during storage and production. There are warehouses on the ground floor of the two-story building. A suitable stable temperature of 22-23 °C is maintained here. There is also an operative's office, production room, and meeting rooms, on the next floor there are other offices and production rooms.

For the monitoring of air parameters, many sensors were deployed here, while the entire building is covered by the IQRF® signal using only one repeater which confirms the great RF properties of the IQRF® wireless technology.

The IQAROS wireless system fits for monitoring temperature and humidity in warehouses, offices, archives, hospitals, pharmacies, or stores. In regular reports, it is summarized whether there have been any fluctuations outside the limits. It is documented for possible inspections. In case of deviation from limits, an immediate alert is sent by e-mail.

Falling stones monitoring at Málkov, Zbraslav, and Mokré Lazce

A large number of rock formations in the Czech Republic and abroad directly threaten to damage objects or traffic along the roads located beneath these formations. For this reason, many such rock formations are stabilized using protective fences or dynamic barriers.

There was installed a sensor network on restraint system, which measures the change in the status and then wirelessly transmit measured data to the control center. This significantly reduces the cost of visual inspections and a dispatcher is immediately notified of changes in the status of all security features where monitoring systems are installed.

Systems were deployed at locations Málkov, Zbraslav, and Mokré Lazce in the Czech Republic under real operating conditions. The acquired data were archived in a database and visualized. The main advantage of designed sensors is their capability to send alarm states using asynchronous packets when specified limit values of measured quantities are exceeded. This can aid in minimizing potential damage to property and hazards to human health.

Smart sanitary monitoring at Cracow University of Technology

SANELA spol. s r. o. implemented a smart sanitary project at the Faculty of Electrical and Computer Engineering Cracow University of Technology. They installed central monitoring of soap dispensers that monitor the level of soap in the container, as well as toilet and urinal flushers that monitor water consumption.
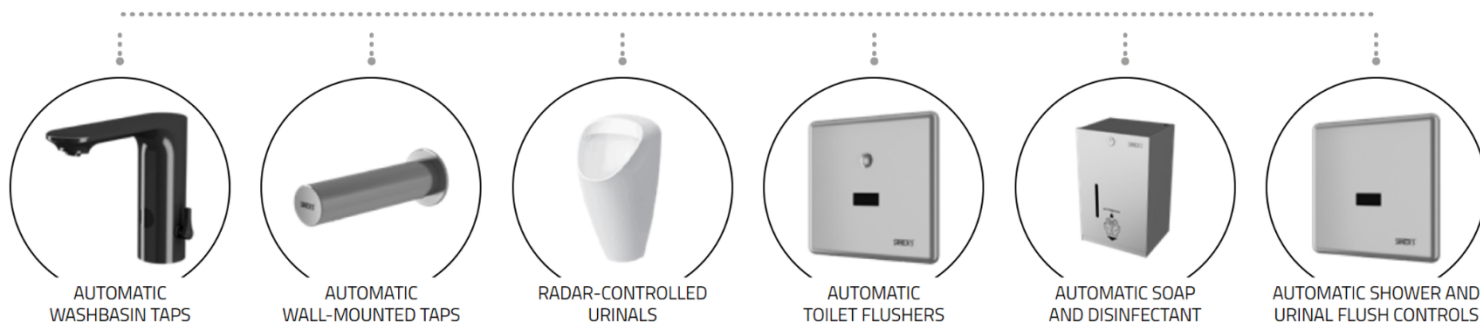

The system allows:

- ✓ monitoring and control of water consumption
- ✓ monitoring the number of uses of devices
- ✓ monitoring the level of refills
- ✓ setting parameters of electronic fittings
- ✓ carrying out hygienic flushing
- ✓ real-time display of the device status
- ✓ automatic sending of notifications (e-mail, sms)
- ✓ print/export of logs

Benefits:

- ✓ Modernisation of the facilities
  By applying the system, the building is modernized and its utility value is increased.
- ✓ Personnel efficiency
  Due to accurate information on the number of times each facility is used, staff efficiency is higher.
- ✓ Financial savings
  The system helps to reduce the need for water and the energy used to heat it.
- ✓ Legionella prevention
  Setting up hygienic flushing at proper time intervals prevents the spread of Legionella bacteria.
- ✓ Detailed statistics
  The evaluation of data allows the optimization of the operation of the sanitary equipment in the building.

| AUTOMATIC WASHBASIN TAPS | AUTOMATIC WALL-MOUNTED TAPS | RADAR-CONTROLLED URINALS | AUTOMATIC TOILET FLUSHERS | AUTOMATIC SOAP AND DISINFECTANT | AUTOMATIC SHOWER AND URINAL FLUSH CONTROLS |

![IQRF logo]

Reliable by definition

IQRF Technology
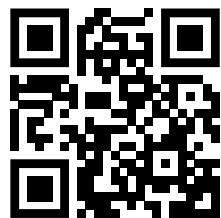
🌐 www.iqrf.org

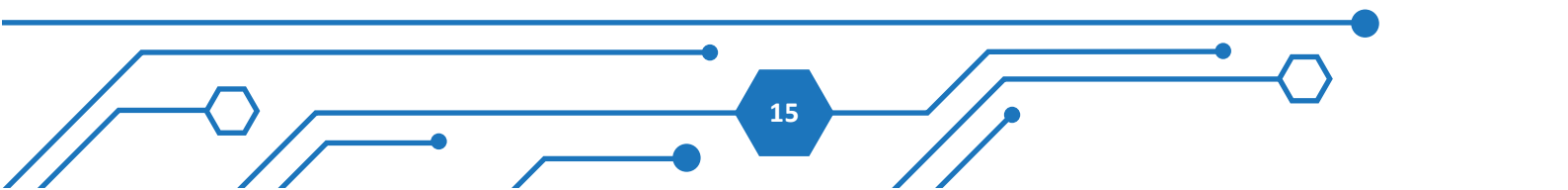IQRF Alliance

🌐 www.iqrfalliance.org

IQRF Open Standard

🌐 standard.iqrf.org

IQRF E-shop

🌐 eshop.iqrf.org

SINCE 2004