# THE INDUSTRIAL INTERNET OF THINGS

NEXT GENERATION TECHNOLOGY ENHANCING PRODUCTIVITY AND SAFETY
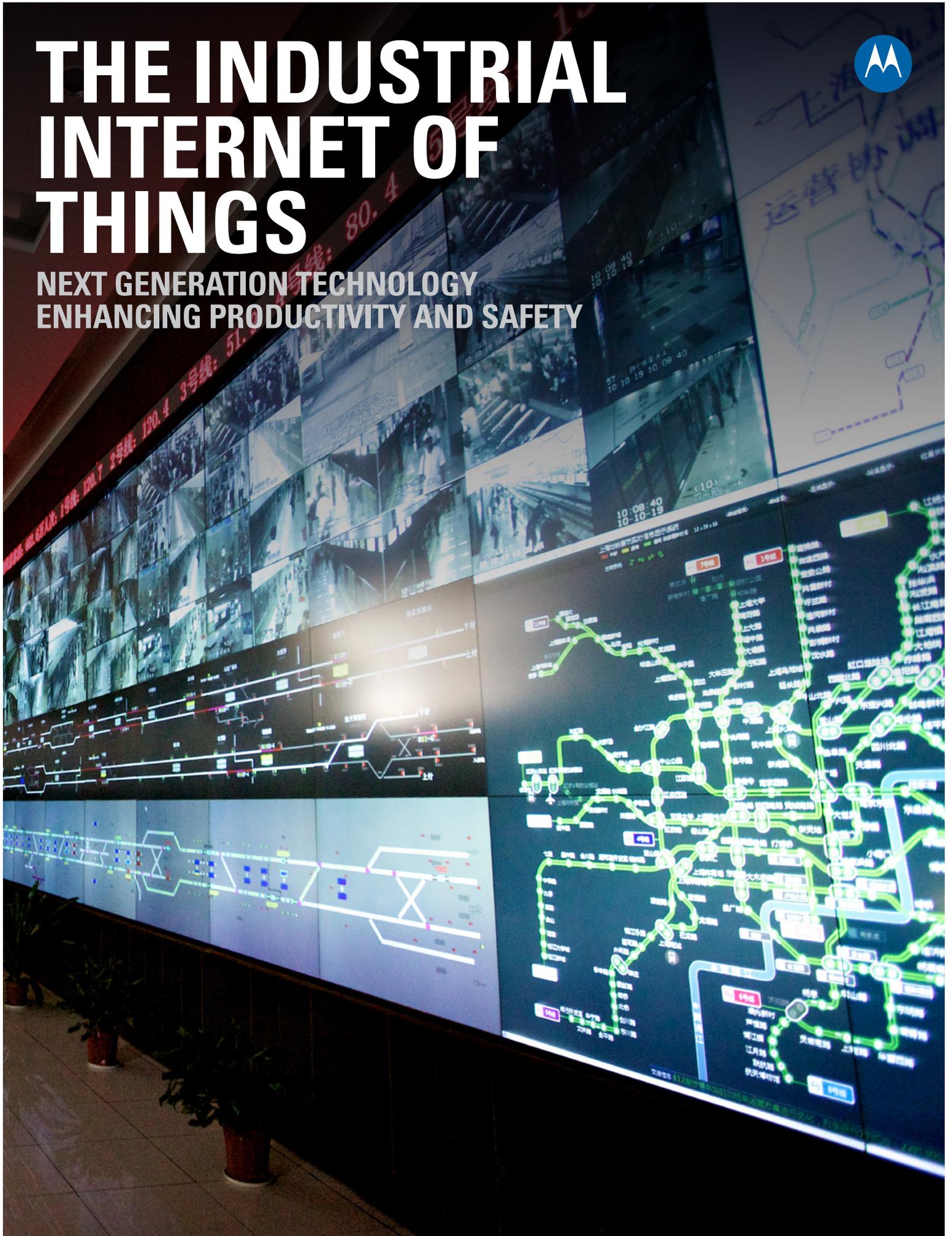
THE CONNECTED WORLD

The term Internet of Things is used to describe an environment where smart sensors, connected to objects, give those objects a 'digital voice'. It's a voice that allows them to autonomously connect and share data with one another – and the back office – over an IP connection. Anything can have sensors attached to them: people, vehicles, pipelines, infrastructure, robots, and production lines, just to name a few.

The Internet of Things in the critical infrastructure sector can improve the flow of real-time information around an organization and enable devices to be remotely managed and controlled. This ability to sense, manage, and change the status of equipment, can create new ways to work across critical infrastructure sectors. Dubbed 'Industry 4.0' for its potential to power a new industrial revolution it promises to enhance the productivity of organizations while ensuring greater safety of workers and the community.

THE INDUSTRIAL INTERNET OF THINGS

This connected web of things offers new opportunities to enhance operations across manufacturing, energy, agriculture, transportation and other critical infrastructure sectors of the economy; sectors that account for nearly two-thirds of the global gross domestic product (GDP)[1]. It can improve the way you collect, analyze and share real-time information to help your organization make better decisions. It also enables machines and equipment to realize and correct for potential failures before they become a catastrophe. And, it allows objects to operate autonomously while being monitored by personnel from remote locations. The following table includes some examples of how this connected web of devices can resolve some of the challenges facing industrial sectors:

THE CHALLENGE	HOW THE INDUSTRIAL INTERNET OF THINGS CAN HELP
By 2025, 66% of the world's population may suffer water shortages – shortages that could lead to starvation and health problems. Preventing water loss is also a major issue for utility companies – 34% of water is lost in transmission and distribution globally. As climate change reduces rainfall in some regions we must better protect this valuable resource.[2]	Sensors capable of machine-to-machine (M2M) communication in lakes and aquifers can monitor water quality and raise alarms if pollutant levels are becoming an issue. Supervisory Control and Data Acquisition (SCADA) can also provide remote control and data communication across distribution systems. This can alert to hotspots, abnormalities and leaks across your network and allow corrective measures to be taken automatically (e.g. lowering temperature, pressure or water flow) to prevent a breakdown.
We need cleaner energy and more of it: global energy consumption will rise by over 50 percent over the next thirty years. But right now, utilities in the United States alone, are faced with $200 billion in annual losses of electricity – with $85 billion due to theft.[3]	Smart electricity grids can help utility companies identify and take immediate corrective measures where power is being lost or stolen through a combination of SCADA and other operational technologies communicating across the grid. Smart meters – of which there could be close to a billion by 2020[4] – are expected to help cut global power consumption significantly. They can also help utility companies reduce fraud by shutting down supplies where properties are empty or bills are unpaid.
With the population due to increase from around 7.3 billion today to 9 billion by 2050, farm productivity needs to rise from 1.5 tons of grain per acre to 2.5 over the same timeframe.[5]	Real-time weather combined with soil condition data can turn crop irrigation from an educated guess to a science. Water management technologies, remotely monitored and efficiently automated, enable water supplies to be better used and protected.
In 2013, methane leaks from oil and gas pipelines and facilities accounted for 2.8% of all global emissions[6].	The National Transportation Safety Board recommends that operators of transmission and distribution natural gas pipelines equip their pipeline monitoring systems with tools to assist in recognizing and pinpointing leaks[7].

Across critical infrastructure sectors the Industrial Internet of Things (Industrial IoT) can change the way organizations work. For example, site monitoring can enhance the safety of personnel, maintenance teams can move from reactive to proactive work to increase the life of equipment, and the real-time stream of data can enable intelligence-led changes to be made to workflows – delivering productivity gains throughout operations.

IMPROVING PUMP FLOW

1%

IMPROVEMENT IN GLOBAL PUMP PERFORMANCE WOULD PROVIDE OVER A HALF MILLION ADDITIONAL BARRELS OF OIL PER DAY – THAT'S

19 BILLION

PER YEAR[8].

MAINTENANCE SAVINGS

CONTINUOUS MONITORING OF EQUIPMENT ENABLES MAINTENANCE TO BECOME MORE PROACTIVE TO ACHIEVE:

12% SAVINGS ON SCHEDULED REPAIRS

30% REDUCTION IN OVERALL MAINTENANCE COSTS

**70%** REDUCTION IN BREAKDOWNS[9]

SMART MANUFACTURING

82%

OF MANUFACTURERS WHO HAVE IMPLEMENTED "SMART" MANUFACTURING TECHNOLOGIES HAVE SEEN AN INCREASE IN EFFICIENCY:

49% REPORTED FEWER PRODUCT DEFECTS

45% REPORTED INCREASED CUSTOMER SATISFACTION[10]
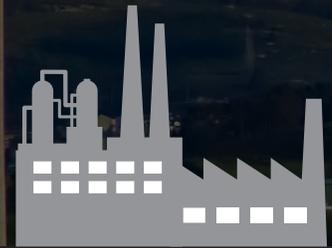
ENSURING THE SUCCESS OF THE INDUSTRIAL INTERNET OF THINGS

While the Industrial IoT creates smarter ways to work, it brings challenges, especially around security. Introducing thousands of gateways across your operations adds potential vulnerabilities. And, hackers are attracted to critical infrastructure markets – particularly the energy sector. In 2014, 32% of all cyber attacks on industrial control systems targeted energy companies according to the Department of Homeland Security[11].

In addition to security, standardization is needed to ensure that any operational technology that you add to your infrastructure can easily connect to and talk to your new or existing technology. Open standards create confidence to attract new vendors, developers and integrators and ultimately lower the costs of products. At Motorola we're working to help resolve these challenges:

SECURITY MEASURES

Having designed and built communication and intelligence solutions for military and government customers, we offer a broad range of security features – from device authentication as they connect to the network, to installing end-to-end military-grade network encryption, to using advanced firewalls and monitoring tools to sense and deny attacks. Not all your systems will need the highest levels of security but a wide range of product features and professional services are available to protect you.

STANDARDS

Motorola is committed to open standards and we are working with standards bodies, legislators and other vendors to continuously introduce and improve common protocols. We are already developing products with a common set of service layers, open interfaces and application program interfaces (APIs) to provide the greatest level of network independence and interoperability. These features allow you to easily connect our products to a variety of systems and technologies. It also creates scalable infrastructure to meet anticipated demand for an explosion in both Industrial IoT device numbers and data volumes.
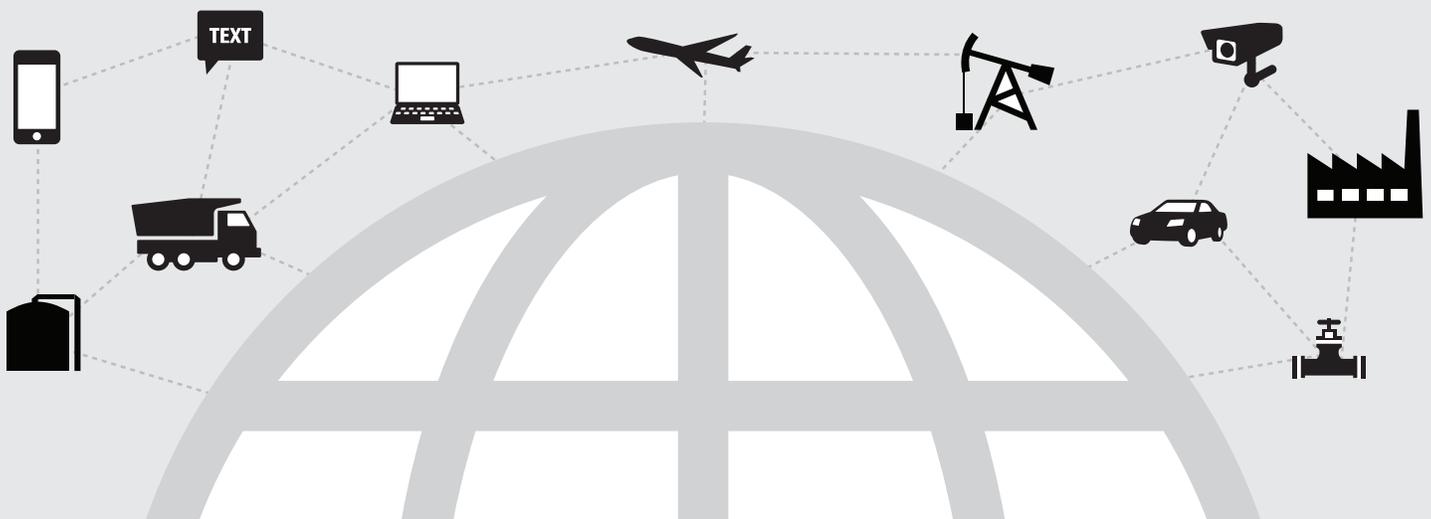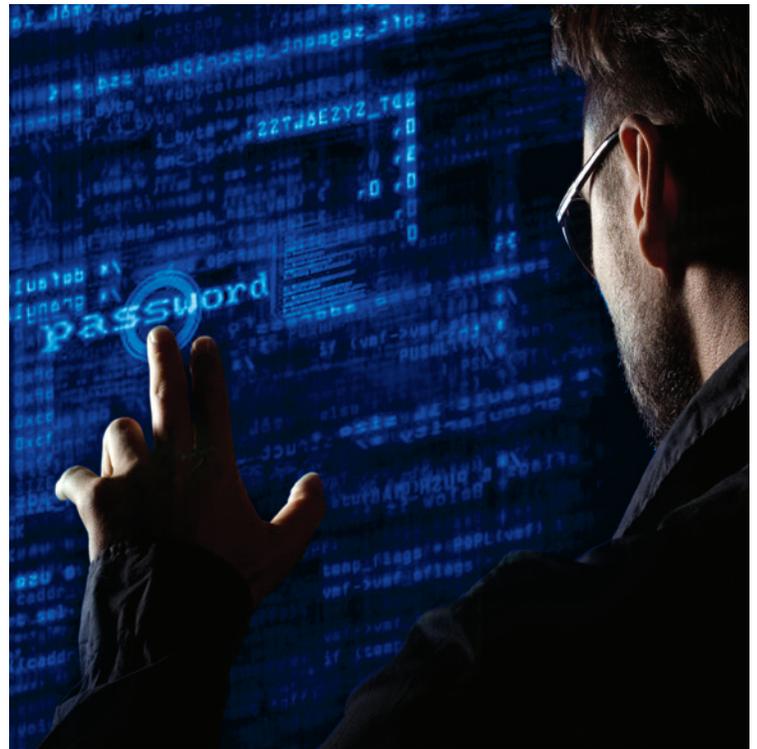
MOTOROLA'S INDUSTRIAL IoT

Our Industrial IoT solutions give your organization the power it needs to be more productive and the insight to help reduce the risk of safety incidents. This allows you to better safeguard your personnel and communities, extends the life of your assets, and creates greater efficiencies across your operations.

Comprised of four different components, our Industrial IoT portfolio provides an end-to-end solution, customizable for a variety of applications. SCADA remote terminal units (RTUs) help you operate more efficiently with powerful process automation and expansive communication capabilities seamlessly integrated across your organization. M2M modems expand your organizational view and control by enabling further operational technology connectivity and data communication. A Network of Networks integrates devices across a variety of communications systems for enhanced reliability, coverage and the ability to better leverage the networks you already have in place. And, Partner Solutions deliver the complete integration and development of intelligent control and monitoring solutions from the sensors at the edge, to the application interfaces in the control room.

SCADA REMOTE TERMINAL UNITS

SCADA RTUs are made to help you keep your teams out of harm's way, reduce downtime and optimize operational efficiencies – maximizing the safety, productivity, and profitability of your organization. Our RTUs feature versatile interconnectivity over a combination of wired and wireless networks – including our two-way radio networks – for the most encompassing and reliable process automation and monitoring of your assets and field equipment. They also support a variety of other broadband and narrowband technologies including third party analog/digital two-way radio, dial-up modem, point-to-point microwave, 3G/4G public or private, and Ethernet. And, they are standards compliant and compatible with a variety of common protocols including MODBUS and DNP3.

All of our RTUs also feature the MDLC protocol which uses advanced compression techniques to enable SCADA communications over narrowband connections unlike any other SCADA RTU. For customers who connect their RTUs over wireless broadband technologies, MDLC can reduce data usage charges by 50%, freeing up bandwidth for photo or video surveillance capabilities.

Quickly realize gains in productivity and safety with the easy integration of RTUs across your operations, the seamless distribution of data among multiple clients, RTUs and control centers, and the unparalleled flexibility to take control of your operations.

ACE1000: SCADA SIMPLIFIED

The ACE1000 is a highly flexible, easily deployed RTU that's ideal for less complex process automation and monitoring applications. Its Linux operating system and remotely-accessible, web-based management and configuration tool, minimize the specialized knowledge and time needed to deploy or expand your SCADA system for more encompassing control.

KEY BENEFITS INCLUDE:

Easy Development: Built on a Linux OS, the ACE1000 can connect to pretty much any operational technology and run easy-to-write, common language applications.

Flexible Deployment: The ACE1000 is capable of peer-to-peer and RTU-to-host communications along with advanced networking configurations. This means you don't have to purchase additional repeaters or antennas and can more freely customize your system.

Green Performance: Low-power and Sleep modes reduce power consumption – especially useful for solar-powered applications.

ACE3600: FOR OPERATIONS-CRITICAL SCADA

The ACE3600 is designed to handle large volumes of data for more complex process automation and monitoring. With robust security features, scalable capacity and a high-performance processor it can connect to, and manage, any number of programmable logic controllers (PLCs), RTUs and other operational technologies while being remotely maintained through a single front end processor gateway.

KEY BENEFITS INCLUDE:

High-Performance Control: A real-time high-performance operating system enables input and output control with support for polling and event-based reporting, peer-to-peer or RTU-to-host. Each CPU module can support simultaneous communications on up to seven ports.

Enhanced Security: The ACE3600 integrates the same security features built into our most mission-critical hardware including firewalls, access controls, intrusion detection, application control software, RTU-to-control room key encryption for end-to-end security and many more.

Large Scale Capacity: 24 different types of I/O modules are available, and each RTU has capacity for up to 110 I/O modules, giving you great flexibility to configure large or small sites compactly and cost-effectively.

MACHINE-TO-MACHINE (M2M)

Motorola's M2M modem is the simple and affordable way to easily connect to and communicate with, operational technologies across your organization and enhance your operational view and control. You can send and receive process automation commands to PLCs, monitor sensor data from a centralized control room and collect valuable information to better understand how your assets are performing.

IRM1500 INTELLIGENT RADIO MODEM: WIDESPREAD CONNECTIVITY WITH ASTRO® 25 RELIABILITY

The IRM1500 Modem enables simple, M2M connectivity – and data transmission – over your ASTRO 25 two-way radio network. Ensure greater communication reliability of valuable data, and further enhance the return on your ASTRO 25 investment, as you avoid the vulnerability and airtime subscription fees of carrier networks.

KEY BENEFITS INCLUDE:

Connection Versatility: With analog and digital ports the IRM1500 can connect to IP and non-IP, serial devices to extend your ability to monitor and communicate with your operational technologies in the field.

Purpose-Built Design: The IRM1500 is certified and tested to meet IEEE 1613 class 1 specifications for high EMI and ESD levels. For critical infrastructure markets the IRM1500 provides a secure communication option to remote devices in the harshest environments.

Easy Installation and Maintenance: A simple graphical user interface and web-based application enables easy configuration, management and troubleshooting on the IRM1500's Linux operating system.

NETWORK OF NETWORKS: EXTEND YOUR COMMUNICATION CAPABILITIES

Your Motorola digital two-way radio system, LTE broadband network or a combination of both, are cornerstone technologies in keeping your operations connected. Extend the capabilities of these operations-critical technologies to communicate data for process automation and monitoring with SCADA RTUs and M2M modems. With integration experts working alongside our partners, we can design, build and deploy systems proven to ensure that your organization is continuously connected and operating with voice and data communications.

To meet the growing need to connect your devices across different networks for a single operational view and streamlined control, we can also help you simplify the complexity of combining with other technologies. Our IP based networks make it easy to combine any number of systems, devices and apps into a unified infrastructure. This helps you get the most out of your existing technology while seamlessly integrating new devices, networks and services.

COMMUNICATIONS OFFERINGS

TWO-WAY RADIO

Reliable and dedicated IP connectivity traditionally used for voice can also be extended to communicate data across your organization for process automation and monitoring. This eliminates the need for recurring commercial network charges and minimizes expensive hard wiring, giving you a cost effective approach to maximize the productivity of your already relied upon voice system. Data on your two-way radio system maintains the same high reliability of your voice communication and is applicable for a variety of other applications as well. And, rest assured that voice and data priority ensures the most operations-critical transmissions will get through even under the harshest conditions.

BROADBAND LTE

As technology advances, networks need to offer more data capacity and transmission speeds — especially for things like streaming video. A combination of private LTE broadband and two-way radio systems can meet all of your data needs in the most practical and efficient manner. The networks can prove useful in the transmission of data for process automation and monitoring by providing redundancy or enhanced coverage across your operation for the seamless flow of data. And just as with your two-way radio communications, LTE data can be intelligently prioritized across networks to ensure critical operations are never compromised.

BROADER NETWORK COMPATIBILITY

Whatever other networks you have access to for your Industrial IoT data transmission - we can integrate with them. From Mesh and Wi-Fi networks to other communications you may have in place including Bluetooth, ZigBee, 802.11a, 802.11n, T1, Ethernet, PSTN and more.

OUR SOLUTION PARTNER ECOSYSTEM

We work with a wide-range of partners who are certified to develop, integrate and deploy Industrial IoT solutions. Our partners' offerings cover the complete system – from sensors at the edge of your operations to software applications in your control room. They are leading systems integrators and solution developers dedicated to providing you with the process automation and monitoring to make your operations more productive and safer.

AREAS OF EXPERTISE

THE SMART GRID

Electric utilities are modernizing their distribution grids to achieve greater supply reliability and to cut operating and maintenance costs. Our Industrial IoT solutions can provide computerized remote control and monitoring at medium-voltage substations and elsewhere on the grid. Using reliable wireless links, RTUs and M2M modems connected to a variety of operational technologies – PLCs, capacitor bank controllers, transducer-less AC measurement units, fault passage detection units and more – you can monitor and control activity throughout the grid.

THE DIGITAL OILFIELD

Oil and gas operations require remote control for production wellheads, long pipelines and valves located in difficult-to-access locations. The strictest safety measures are required to prevent and detect leaks and fires. That's why so many operators depend on our Industrial IoT solutions. RTUs and M2M modems can be used for the many gas installations that require flow calculations required by American Gas Association (AGA) standards. Deploy solutions along oil pipelines to perform pressure monitoring and control using Proportional-Integral-Derivative (PID) based control routines and control cathodic protection rectifiers and other industry technologies across your operations. We even offer models certified to Factory Mutual Class 1, Division 2 standards for safe operation in potentially hazardous areas.

WATER AND WASTEWATER

Industrial IoT solutions can oversee the continuous monitoring and control of water facilities, providing immediate problem detection and resolution. Well pumping can be automatically adjusted for water quality or energy costs and reservoir volumes and system pressures can be regulated to maximize the efficiency of the delivery system. Operators alerted to line breaks, equipment failures and possible unauthorized water use can react quicker and smarter to maintain the highest level of productivity. Our solutions are also routinely used to monitor and control the collection of waste water delivered to treatment facilities.

EARLY WARNING SYSTEMS

Motorola Industrial IoT solutions can be integrated with a range of siren equipment to enable many activation options. Secure and encrypted communications minimize the possibility of false alarms or intrusion and systems can support combinations of tones or pre-recorded voice messages across multiple control centers. Our partners offer robust functionality such as siren activation in selected groups, backup control, silent test, download of pre-recorded public warning messages, and redundancy.

FACILITIES / INFRASTRUCTURE

Our Industrial IoT solutions are highly versatile and can be used for applications that you may not have thought of. Examples include: monitoring door opening/closing across public safety entities (e.g. fire station alerting and automation) and industrial/commercial facilities; remote disaster recovery and response for critical network appliances; and control and management of municipal infrastructure such as highway lights, street lights, highway fast lane direction, and more. Our solutions have even been deployed to automate aircraft arresting systems.

WHY MOTOROLA SOLUTIONS?

Utilities, government agencies, and private enterprises count on our deep expertise and proven track record in SCADA to better protect their people and local communities, optimize processes, and enable people to work in more efficient and productive ways. Our systems are proven to offer no compromise performance – delivering the robust, secure, and continuous monitoring, automation and data communications that you need to effectively run your operations. We are now taking a lead role in working for the creation of the Industrial Internet of Things that will enable this technology to fully deliver on its potential to create better ways to work and spark a new industrial revolution.

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To begin enhancing your organization's productivity and increasing safety with our Industrial IoT solutions, visit **motorolasolutions.com/industrialiot.**

MOTOROLA SOLUTIONS