SMART CITY

PACIFIC CONTROLS ICT
ENABLED MANAGED SERVICES
FOR THE SMART CITY

PACIFIC CONTROLS

PACIFIC CONTROLS ICT ENABLED MANAGED SERVICES FOR THE SMART CITY

THE CONCEPT OF THE SMART CITY

As the world's population continues to migrate to cities, and the biggest cities grow to encompass tens of millions of people, managing those cities becomes increasingly challenging. City planners have devised complex strategies to manage all the services of modern life in these rapidly growing cities, which use a number of core systems composed of different types of networks related to their key functions: city services, citizens, business, transport, communication, water, and energy. The most advanced of these systems make use of smart computing. Today's smart computing operates in separate vertical sectors such as city administration, education, healthcare, transportation, and utilities. To create a Smart City, these systems must be transformed by interconnecting them to work as a system of systems that is both ubiquitous and citizen oriented.

Smart cities make key information available to the right people in real time, allowing them to use resources more efficiently, matching the supply of services to demand. Integrating systems brings other benefits, by discarding the traditional information silos and providing real-time data for variables affecting issues as diverse as pollution, congestion, energy use, emergency response and access to health care. The smooth flow of information empowers policy makers to take better decisions: it becomes easy to take account of all the relevant variables, and evaluate all options, when they are collated in a single information tool.

Creating a Smart City also enhances the 'soft infrastructure' of knowledge networks, voluntary organizations, crime-free environments, and the entertainment economy. This, in turn, helps to attract a creative and skilled workforce, which in a knowledge-intensive world is increasingly what determines a city's economic success. The data shows that business-oriented cities that create smart business parks, such as Kochi, Malta, and Dubai, demonstrate good socio-economic performance.

BY USING ICT TO CREATE SMART CITIES, INTELLIGENCE IS BEING INFUSED INTO THEIR SYSTEMS, PROCESSES AND INFRASTRUCTURE. THIS PROMISES INCREASED CONVENIENCE, AWARENESS, TRANSPARENCY, AND ACCESS TO INFORMATION TO MAKE LIFE IN THE SMART CITY SAFER, MORE COMFORTABLE, AND MORE CONVENIENT THAN THAT IN MOST CITIES TODAY.

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Smart cities must be sustainable both in environmental and social terms. This depends on taking steps to increase growth, while protecting vulnerable people and the environment. Smart City systems are designed to improve environmental sustainability: integrated management of the whole ecosystem provides numerous opportunities for optimizing performance that generate savings without compromising standards. Social sustainability can be enhanced by making education more accessible and by using tools such as online consultation to allow citizens to participate in decisions about the city's future.

In the technology underpinning a Smart City, Smart Computing is combined with Internet and M2M technology to become ubiquitous computing that connects everything, everywhere, and delivers core services to the public in a streamlined and intelligent manner. This is made possible by the rapid convergence of mobile communications, machine to machine (M2M) mobile data services, automated positioning technologies, geographic information systems (GIS), and the Internet. It is raising the possibility of a dramatic transformation in the way people perceive and experience their environment and interact with urban spaces.

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The Pacific Controls solution makes use of hardware and software elements that already exist within the city and connects them to its Galaxy™ converged Enterprise City Management Platform located in a central Global Command Control Center (GCCC). The solution brings: savings on ICT costs through the use of cloud computing, greater efficiency and sustainability through more intelligent management of resources, and increased citizen participation through managed and secure access to the city's systems. The GCCC is used by city managers to monitor and control all of the diverse systems through one central point, which allows local communities to take control of their services within a central managed framework. Real-time data about the city and its services can be accessed from any web-enabled device.

The Smart City Solution builds on Pacific Controls' proven solutions for managing airports, shopping malls, traffic systems, and the energy consumption in all the buildings of a city to create smarter solutions for the different types of city infrastructure.

PACIFIC CONTROLS' SMART CITY SOLUTION

With Pacific Controls' Smart City Solution any city can use ICT to increase productivity and competitiveness. This innovative solution provides a means to link existing systems and equipment to the Galaxy integrated cloud computing platform supported by ground- breaking intelligent Gbots™. Policy makers can make the transition to a Smart City approach in stages by developing sector-focused, cluster-based, intelligent-city strategies using Pacific Controls' technology.

SMART SOLUTIONS FOR MANAGING ENERGY, WATER, TRANSPORTATION AND EMERGENCY SERVICES AS WELL AS VERTICAL INDUSTRY SECTORS SUCH AS HEALTHCARE, RETAIL, AND HOSPITALITY ARE BROUGHT TOGETHER ON ONE PLATFORM TO CREATE A SMART CITY.

GOVERNMENT'S LARGE-SCALE IT SYSTEMS ARE PARTICULARLY WELL SUITED TO THE USE OF CLOUD COMPUTING. GOVERNMENTS HAVE BEEN SLOWER TO MAKE THE MOVE THAN THE PRIVATE SECTOR BUT ARE GAINING CONFIDENCE AND INCREASINGLY EVALUATING CLOUD COMPUTING AS A POSSIBLE SOLUTION IN MANY FIELDS. ALTHOUGH CONCERNS, ESPECIALLY AROUND PRIVACY, SECURITY, AND SOVEREIGNTY OF DATA, DO CONTINUE TO INHIBIT ADOPTION THE VALUE PROPOSITION OF MOVING TO THE CLOUD, WITH ITS PAY-AS-YOU-USE SERVICE MODEL, MASSIVE SCALABILITY, AND READY AVAILABILITY, IS TOO ATTRACTIVE FOR GOVERNMENTS TO IGNORE.

SMART CITY

COMMUNITY CLOUD COMPUTING FOR SMART CITY GOVERNMENTS

Sharing IT infrastructure across many departments a community cloud architecture can facilitate collaboration between departments to deliver a better integrated service to citizens and businesses. The many different agencies in cities that are all working to optimize their operations in limited physical space have much to gain from an integrated approach that links disparate management systems and provides close links to community services. Integrated infrastructure, which facilites collaboration between agencies, is an important step towards creating the Smart City.

Pacific Controls e-Government Community Cloud Computing service (e-GC3) offers integration management, automated problem resolution, and end-to-end security. It delivers a unique value proposition to governments and the entire community. Government agencies can use the cloud platform to deliver:

• Cost saving in ICT - by adopting Pacific Controls cloud model government sectors and departments can create a central pool of shared resources – software, applications, and infrastructure – and pay only for what they use at any time. Research by the Brookings Institute in the US found that savings obtained by government agencies from migrating applications to the cloud were typically between 25% and 50%.

• Agility - cloud services provide the capability to provision resources quickly within an overall contract framework without the need for new purchase orders to be approved.

• Access to the latest technology - with cloud services the onus of upgrading technology is on Pacific Controls. Its staff ensures access to the most up-to-date solutions.

• Simplified procurement and maintenance – the complex task of integrating and managing multiple technologies is delegated to Pacific Controls.

• Reduced need for IT staff allows the government agencies to focus on their core responsibilities.

• Universal access - the Internet enables access to resources from any web-enabled device, for both government staff and the public, in a secure and controlled manner.

Cloud architectures can help governments to reduce duplication and increase utilization of resources. This in turn helps with governments' green agenda by reducing use of resources, reducing pollution and allowing effective waste management.

A unified government infrastructure, based on cloud and SOA architectures, paves the way for inter-agency information sharing and workflow. With one click users can access any relevant data in a fraction of a second from any Internet connected device.

THIS ENABLES THE DELIVERY OF SEAMLESS SERVICES TO THE PUBLIC AND ALLOWS FOR RAPID DEPLOYMENT OF TURNKEY TEST ENVIRONMENTS TO TRIAL NEW SERVICES.

Figure 1 illustrates the role of Pacific Controls e-GC3 service for government IT services:

Pacific Controls' e-government cloud computing transforms the working model of government and federal entities. Some of the major advantages are:

- Inter-linking isolated government and federal agencies in the country - and thus providing improved manageability

- Filtration of information and data with checks on consistency and compliance – giving improved security

- Providing a robust infrastructure with multiple redundancies in systems and networks, delivering high availability

- Providing a single e-government portal for information on services and billing – delivering improved accessibility

In the community model of cloud computing cloud services are shared by several government and semi-government agencies. These services may be managed by the organizations themselves or by a third party as a private government cloud, either on government premises or off-site.
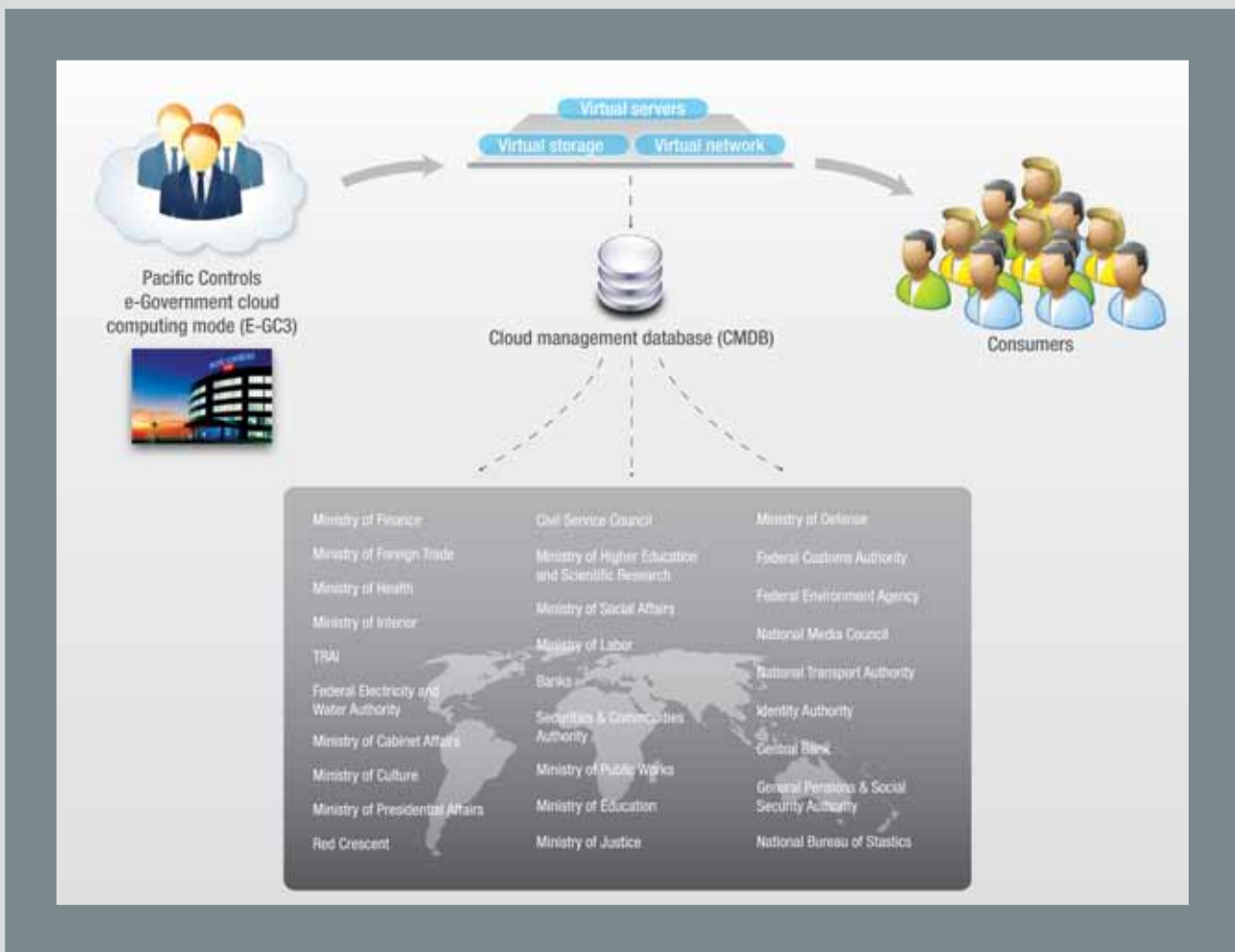

Figure 1 Pacific Controls e-government cloud platform

Pacific Controls operates multiple instances of cloud computing as a shared service on a private government cloud that is available to all government departments but no outside users. The company has all the tools and technology needed to support a large client base in its Uptime-certified Tier-3 data centers.

Cloud computing has a different risk profile from in-house infrastructure. Pacific Controls works with its clients to carry out a careful risk assessment and ensure that the highest possible security standards are enforced. Its security services include 24x7 firewall management and monitoring, immediate application of security patches, anti-virus, and intrusion protection. Access controls are under the control of the client's system administrators and the physical location of the data can be specified to meet the client's requirements.

This approach delivers seamless integration for customers, users and the government by using simple and cost-effective ICT infrastructure that is fully redundant and has high uptime. It gives all government IT departments complete visibility of, and access to, their mission-critical databases around the clock.

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BY ADOPTING PACIFIC CONTROLS E-GC3, THEY CAN REDUCE THEIR ICT
EXPENSE AND IMPROVE MANAGEABILITY, SECURITY, AND SCALABILITY.

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THE NUTS AND BOLTS
OF THE SMART CITY

Pacific Controls deploys the following hardware and software components to form the infrastructure of their Smart City solution:

• The Galaxy™ Platform that brings all the information together in the cloud so that systems can be monitored and managed from the GCCC

• Pacific Controls revolutionary Gbots™, which infuse intelligence into all the systems of the city

• Network Interface Units (NIUs) that bring the control information from diverse legacy systems onto the IP network

• Enterprise Integration Software that interconnects multiple NIUs and manages the data and its presentation.
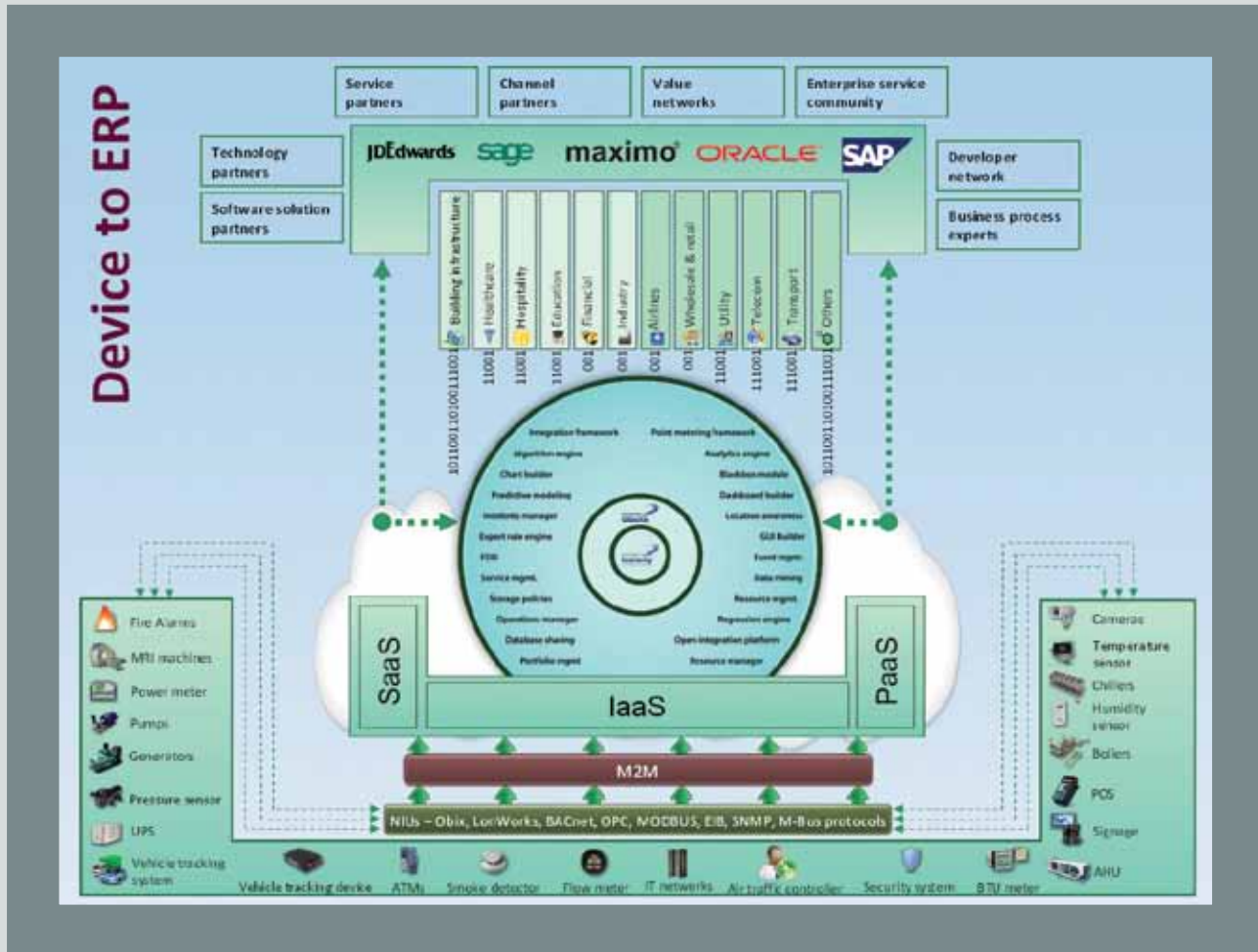
THE GALAXY™
PLATFORM OF PLATFORMS

Figure 2 Galaxy™ cloud platform interconnects a wide range of systems

Pacific Controls Galaxy™ cloud platform, the world's first Enterprise City Management Platform, delivers services for managing the whole ecosystem of a city or enterprise. Galaxy™ alone has the reach to exploit the synergies available from sharing data between multiple control platforms. It achieves this by hosting many of the control and management systems, and linking to others as shown in Figure 2. Galaxy™ can interwork with all the existing software and management information systems already in use, to deliver the benefits of an integrated Smart City approach without the cost and management headaches of the wholesale replacement of established solutions.

Pacific Controls developed Galaxy, its cloud based city management platform, to support its managed services delivery, building on expertise developed over a number of years. There was no single platform available in the market that could deliver the entire spectrum of functionality required to manage the performance of all the buildings and systems of an enterprise or city over their whole life-cycle. To meet this need, Pacific Controls developed a scalable framework capable of managing and analyzing many exabytes of data from a wide range of sources. Figure 3 summarizes the role of the Galaxy™ platform.

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The GCCC is implemented on the Galaxy™ platform and provides central supervision in real time, 24x7x365, to ensure that the city's systems are operated according to defined policies. It coordinates Gbots™ for the gathering and analysis of data and applies artificial intelligence to identify patterns in the data that can indicate potential problems or changes in the environment. When necessary, the Gbots™ adjust parameters or raise alerts as appropriate and forward them to the relevant people or systems.

Pacific Controls GCCC is already managing energy distribution and communication networks, transport terminals, healthcare facilities, universities, hotel chains, retail facilities and many other types of infrastructure to optimize operations and reduce energy consumption. In addition, Pacific Controls is already delivering managed services to lower the operating costs, energy consumption and GHG emissions of unlimited numbers of buildings. To create a Smart City, all of these services are integrated into one seamless whole.

MODULARITY IS THE KEY TO THE SCALE AND BREADTH OF THIS DEVELOPMENT. THE PLATFORM CONSISTS OF DISCRETE MODULES SUPPORTING SPECIFIC PROCESSES AND MORE CAN BE ADDED AS AND WHEN REQUIRED.

SMART CITY

Figure 3 Galaxy™ supports the GCCC as the hub of city management

It offers developers the opportunity to build and integrate applications for specific vertical sectors using the various platforms in the Galaxy™ development framework that can integrate with third-party applications and platforms.

Pacific Controls has opened the door to a world where seamless technology networking and system integration enable control over virtually any system in the world.

END USERS CAN OPERATE ON A SINGLE UNIFIED PLATFORM AND HAVE DIRECT ACCESS TO REAL-TIME DATA, WEB-BASED DATA, AND CORPORATE APPLICATIONS REGARDLESS OF LOCATION.

GBOTS™ AND
THEIR APPLICATIONS

Gbots™ are unobtrusive automated tools for customer service integrated into Pacific Controls' Galaxy™ services delivery platform. They are built using using Java, a language that is widely used in the Internet environment for machine learning and reasoning. They are created and dispatched by the GCCC as and when required, working independently within the target system, or transferring data to the central platform when more powerful analytics are required. This new technology will simplify next generation equipment maintenance and customer service, enabling early fault detection, and creating real-time predictive and self-healing systems. Figure 4 illustrates the different system levels at which Gbots™ have a role.

GBOTS™ ARE THE NEW PARADIGM IN CLOUD COMPUTING. THESE INTELLIGENT, AUTONOMOUS, AND COGNITIVE "SELF-LEARNING" REMOTE SERVICE DELIVERY AGENTS ARE DEPLOYED ACROSS NETWORKS TO OBSERVE AND ACT UPON EQUIPMENT AND SYSTEMS BEHAVIOR IN ANY LOCATION.
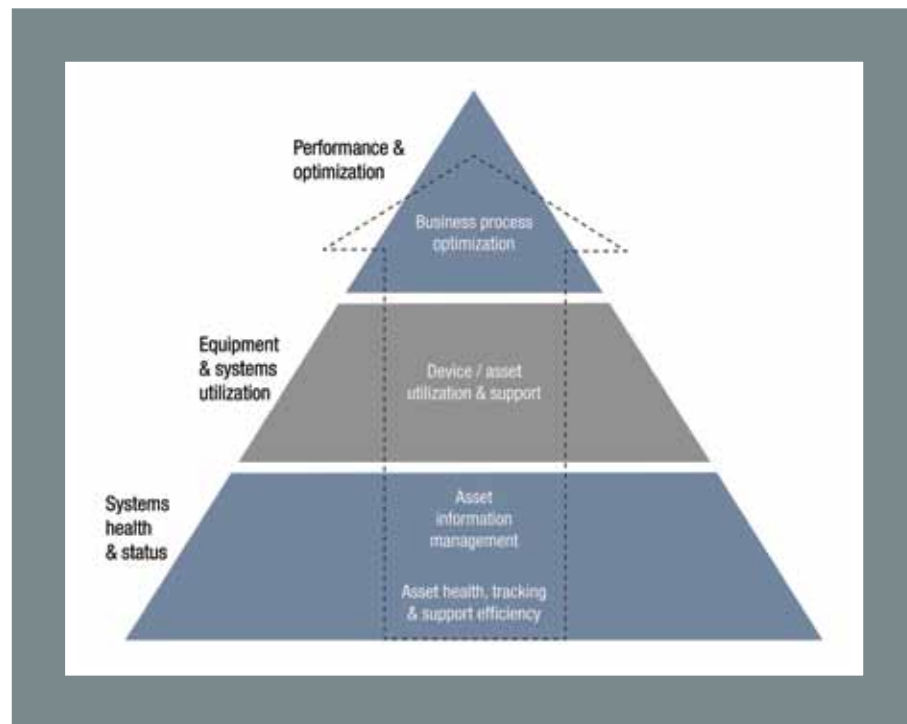
SMART CITY

Figure 4 illustrates the different system levels at which Gbots™ have a role.

GBOTS™ FIX PROBLEMS REMOTELY, OR IF THAT IS IMPOSSIBLE, DISPATCH A SERVICE TECHNICIAN TO THE RIGHT PLACE AT THE RIGHT TIME, WITH THE REQUIRED TOOLS AND EXPERTISE. THIS ALLOWS THE GCCC TO ARRANGE APPROPRIATE MAINTENANCE AND FORESTALL POTENTIAL PROBLEMS, MAKING SYSTEM FAILURES EXTREMELY RARE.

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Gbots™ are installed in devices and equipment to support Galaxy™'s managed services. They are able to:

- Sense conditions such as temperature and electrical current to enable equipment health

- Switch system parameters automatically based on customer preferences

- Feed analytical tools with system performance and behavior data to determine immediate and future actions

- Identify issues within a system by doing root-cause analysis and troubleshooting to resolve them.

Gbots™ are capable of predicting imminent component failures. Data about energy consuming equipment is downloaded frequently and analyzed immediately. Gbots™ intelligently extract knowledge and useful information from the data and diagnose problems. They can identify early signs of malfunction through supervised and unsupervised learning, including case-based reasoning and neural network techniques. The Gbots™ provide continuous feedback to the facility maintainer - or the maintenance Gbots™ if that role has been delegated to them.

City managers can achieve higher uptimes with smaller staffs and have peace of mind through knowing that the Gbots™ are monitoring their systems.

IN THE SMART CITY GBOTS™ CREATE BRIDGES BETWEEN THE INFORMATION SILOS OF THE EXISTING SMART COMPUTING SYSTEMS AS SHOWN IN FIGURE 5, THEY INTELLIGENTLY TRANSFER DATA AND INITIATE ACTIONS WITHOUT THE NEED FOR HUMAN INTERVENTION.

Figure 5 Gbots™ at the heart of a City ecosystem
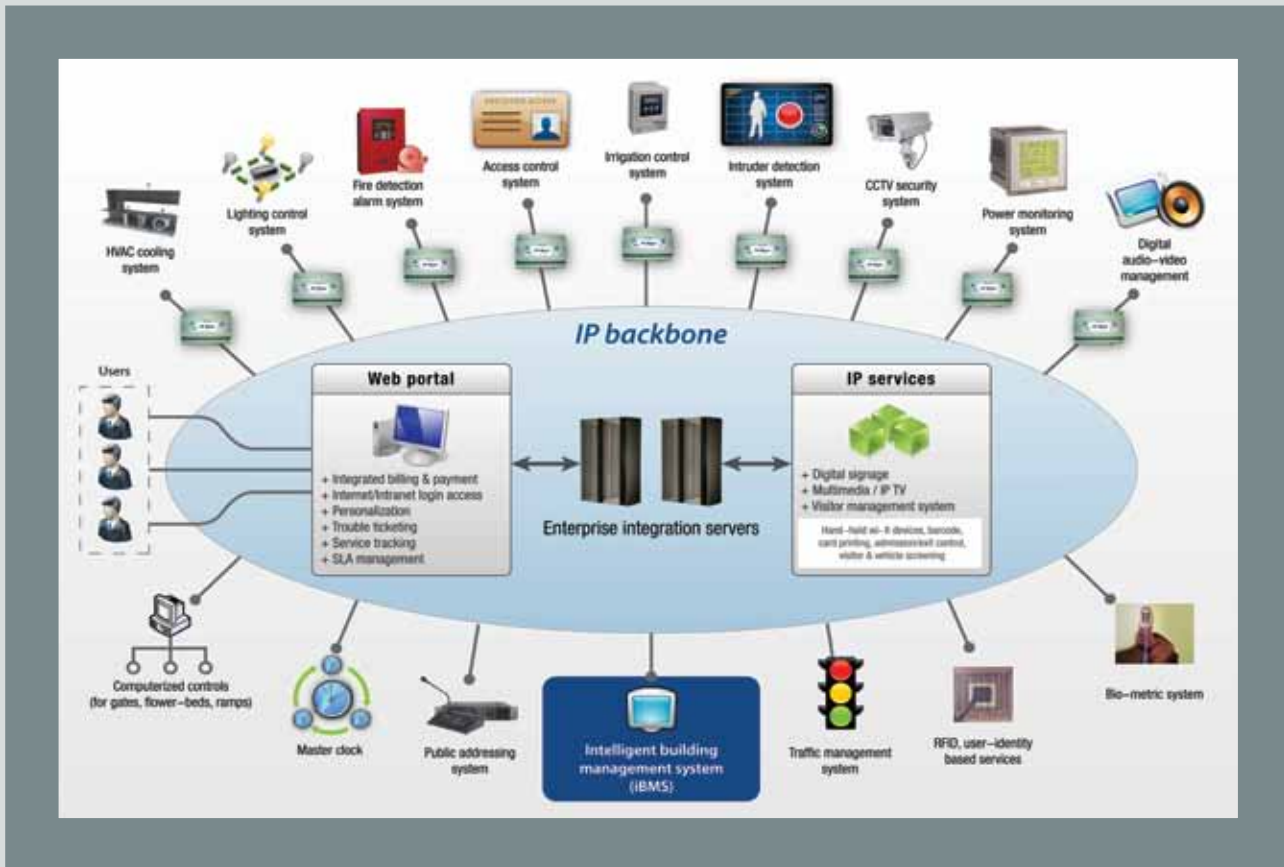
NETWORK INTERFACE UNITS (NIU)

Figure 6 Using IP to integrate the city's systems

In many cases, creating a Smart City requires the integration of existing systems with the management facilities at the GCCC as shown in Figure 6. In order to achieve this, Pacific Controls will install a Network Interface Unit (NIU) to connect the existing system to the IP network.

The NIUs are multiprotocol controllers that communicate over IP and non-IP networks simultaneously. NIUs bring data from systems that do not use IP onto the IP network, so that decisions and actions can be managed from an Internet platform. This interoperability makes it possible to use sophisticated policy scenarios, such as improved energy management in existing heating, ventilating, and air-conditioning (HVAC) systems.

To eliminate the communication problems that are often encountered between legacy and new systems, the NIU creates a unified data structure on the ICT network and normalizes data, irrespective of the type of systems connected to it.

The NIU supports all Industry standard open protocols such as Bacnet, Lonworks, Modbus, SNMP, EIB, oBix (Web services), as well as many legacy systems. It can communicate over IP and serial networks using the correct protocols to read and write data into the different systems. The NIU logs data at intervals that can range from one second up to 24 hours, or when there is a change of value or change of state. The logged data will be transferred to the GCCC periodically to make it available for enterprise applications and for archiving.

The NIU generates rule-based alarms that are routed directly to the GCCC. These alarms can be forwarded to the relevant enterprise applications, or direct to individuals using SMS or email, and reports can be printed automatically.

The NIU operates as a fully-fledged control engine and can be used to develop analytical rules for a variety of tasks such as for energy management, performance optimization or scenario creation.

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TThe NIU can integrate, monitor, manage, control and analyze:

• HVAC and cooling systems

• Lighting control systems

• Irrigation control systems

It can integrate, monitor and control:

• Access control systems

• CCTV security systems

• IP public address systems

It can integrate, monitor and analyze:

• Power monitoring systems

It can integrate and monitor:

• Intruder detection systems

• Fire detection alarm systems.

The NIU will take on the role of primary network control module and will interface to field-based Direct Digital Controllers (DDC) down the line using open protocols. These in turn communicate to field sensors and devices such as temperature sensors and valves. The NIU will also connect the Building Management System (BMS) to the Command Control Center and allow centralized control, monitoring and management of the BMS.

THE EIS IS USED WHERE MULTIPLE
NIUS ARE NETWORKED TOGETHER.
IT ALLOWS STANDARD WEB-
BROWSERS TO SHOW REAL-
TIME GRAPHS OF THE DATA AND
PROVIDES CENTRAL SERVER-LEVEL
FUNCTIONS SUCH AS:

SMART CITY

ENTERPRISE INTEGRATION SOFTWARE (EIS)

- Centralized data logging

- Data archiving

- Alarming

- Real time graphical displays

- Master scheduling

- System-wide database management

- Integration with enterprise software applications.

In addition, EIS provides a comprehensive graphical toolset for application development. The software is implemented on a high-end redundant server platform running either a MS Windows™ or Linux operating System.

The EIS acts as a client to the NIUs and as a server to other third party applications accessed via web services. The EIS allows for custom components to be added, as and when required, to connect to third party systems.

These can provide additional functionality and other types of data transfer and act as a bridge between the existing and new systems. The EIS hosts the web

portal through which users access all the diverse systems on the network including:

- Digital audio video management systems

- Digital content such as dashboards

- IP multimedia, audio-visual, and IP TV content

- A master clock

- Traffic management systems

- IP visitor management: handheld wi-fi devices, barcode, card printing, admission and exit control, visitor and vehicle screening

- Biometric systems

- Computerized control for gates, flower beds, ramps etc.

MANAGING M2M ECOSYSTEMS IN A CITY-CENTRIC SERVICES ARCHITECTURE

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Pacific Controls' Galaxy platform, working together with M2M technology, is delivering a wide range of solutions in different vertical sectors. These vertical solutions form the building blocks of an integrated Smart City in which the centralization of data on the Galaxy platform allows planners to exploit synergies between the different sector solutions. The revolutionary Gbot™ technology, deployed from the GCCC, applies artificial intelligence to create bridges between the various data structures and working practices and allow ICT to be used in new ways. The flexibility and versatility of the Galaxy™ platform in using M2M to allow disparate ICT and control systems to work together can play a valuable role in many industries and sectors within the Smart City, as illustrated in Figure 7.
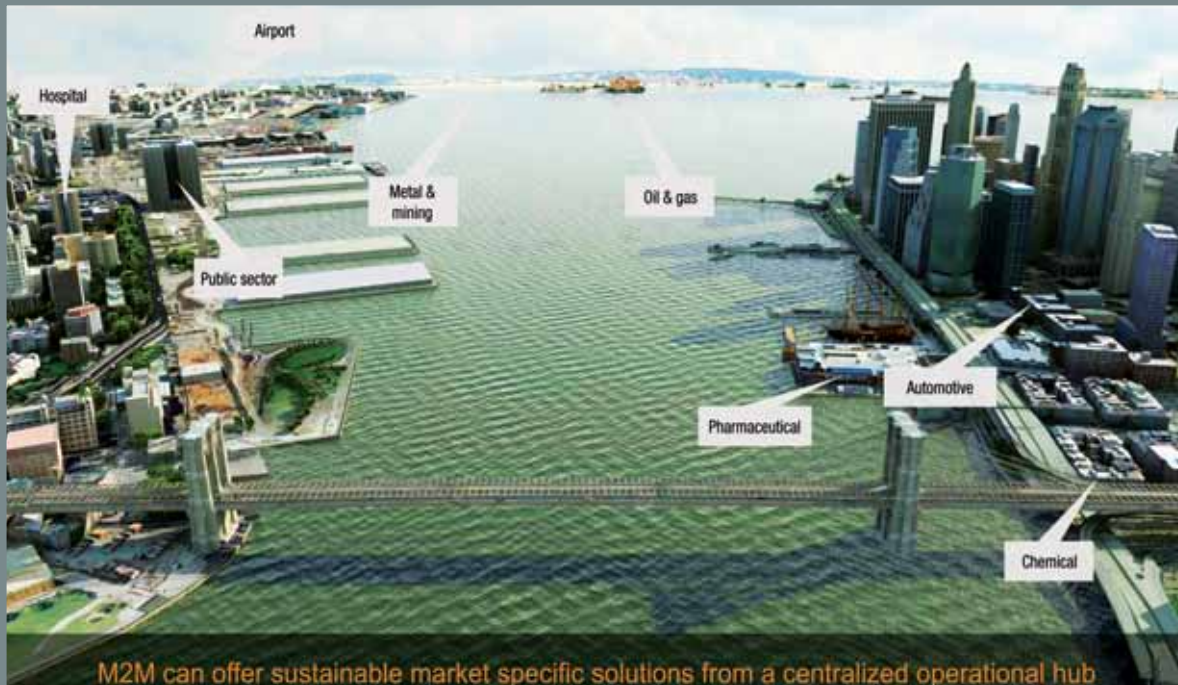
Figure 7 M2M integrates data from many industry sectors

ENERGY INFRASTRUCTURE

The Grid Management solution includes:

• Renewable, distributed energy, and microgrid management

• Smart device and sensor network asset management and integration

• Eco-asset and carbon trading transaction management
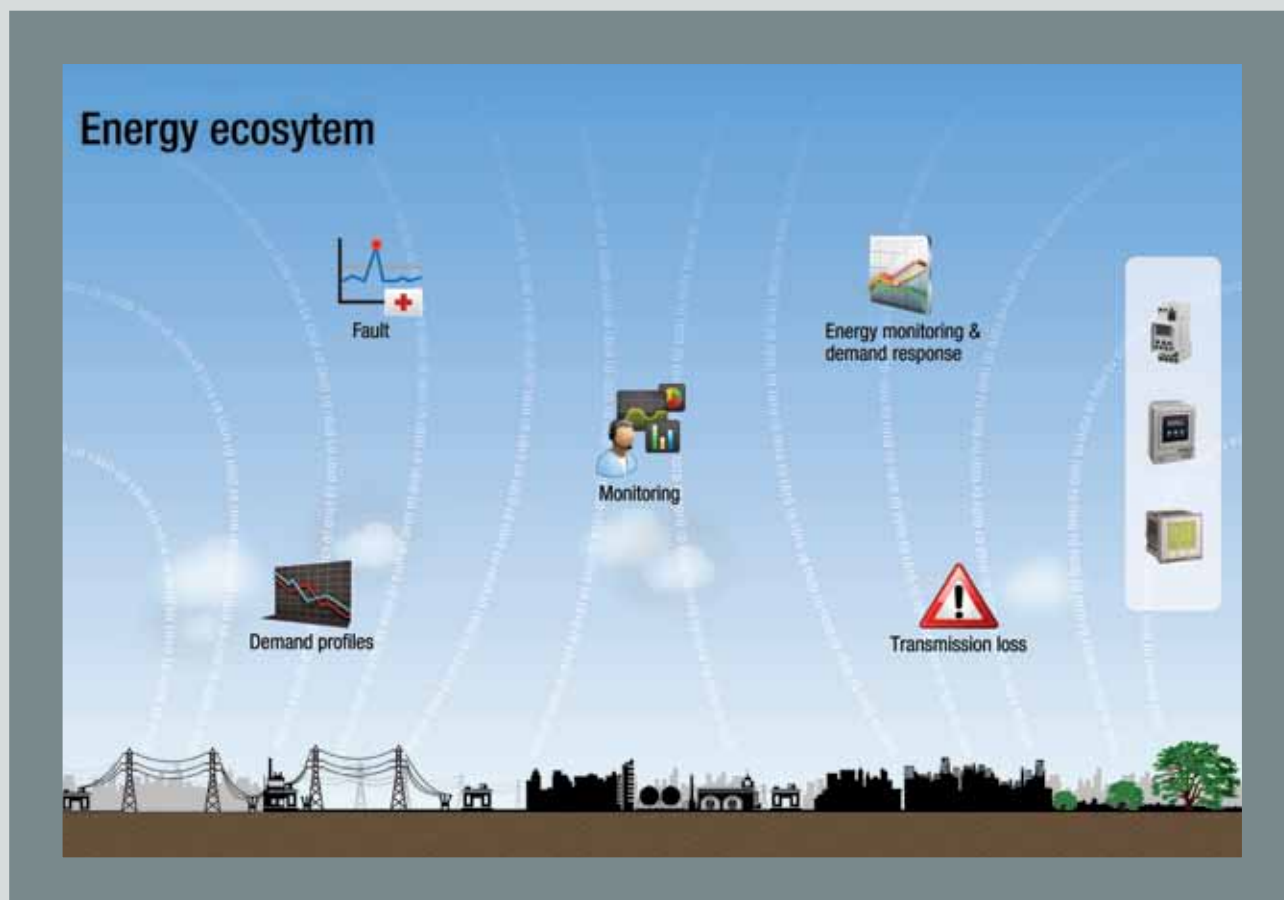
• Distribution network automation.

Figure 8 Galaxy's role in Energy Distribution

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One key problem with the current electricity distribution system is that electricity suppliers have no direct information about the demand the users are about to place on the system. Most suppliers have to maintain what is known as a 'spinning reserve' of generators that are running but not used, in order to be sure they can meet the maximum likely load at any time. Galaxy™ reduces the need for this waste and links the Smart Grid with the management systems of the Smart City to make energy needs more predictable and visible to the suppliers.

Providing both suppliers and end-users with real-time information about energy generation and use brings numerous benefits: making it possible to use dynamic pricing models; allowing consumers to be flexible in their energy use in response to pricing signals; and, finally, empowering a fully-fledged Smart Grid that underpins the development of the Smart City.

A major benefit that Smart Grids promise is allowing information to flow back through the grid control systems

so that the generating company knows what users are doing and, in some cases, may be able to take control of usage to reduce demand. This process is known as Demand Side Management and Figure 9 shows how this is achieved on the Galaxy™ platform.

As renewable energy sources, such as offshore wind turbines and photovoltaic cells, become part of mainstream distribution, it becomes even more important to maintain the flow of information and communication between producers and consumers. Galaxy™'s unique ability to inter-operate between many diverse systems is crucial where multiple energy sources are connected to local grids to meet the growing demand for energy.

Galaxy™ favors an ecosystem rather than the traditional silo-based approach for energy management. The platform uses multi-agent system technology to create an advanced software foundation designed to work in concert with Service-oriented Architectures such as web services. Gbots™ will create eco-systems of intelligent grid resources, adapt to changing run-time conditions, collaborate to solve complex problems, and flexibly accommodate new behavior through the use of plug-in architectures. These can be used for integration of communities of renewables and distributed energy resources, microgrid managment, intelligent load control and smart charging applications, including photovoltaics & storage, load control, and future assets such as plug-in hybrid electric vehicles (PHEVs). Using its Smart
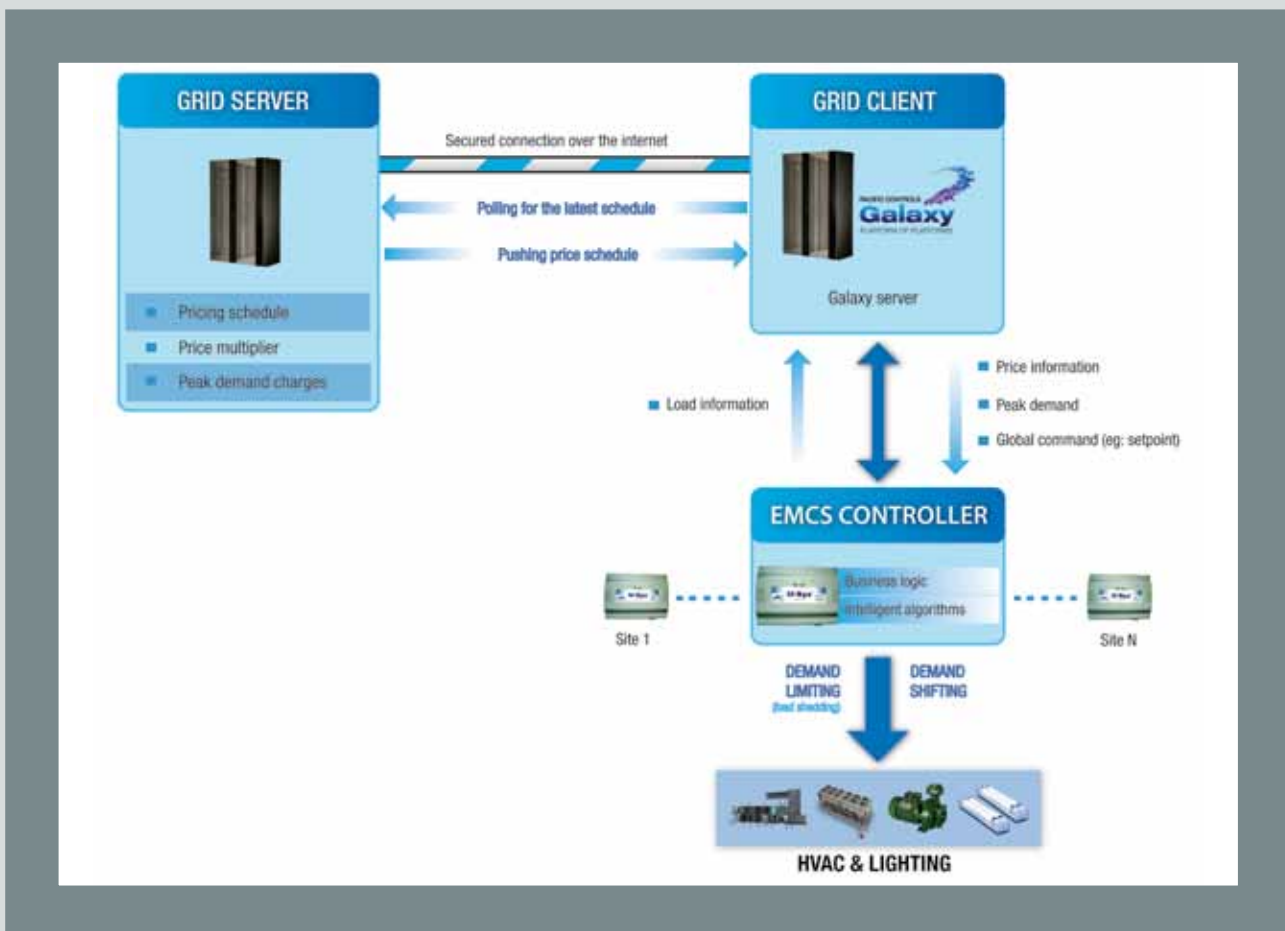

Figure 9 Galaxy™ for Demand Side Management

Grid system, Galaxy™ has the ability to connect various macro- and micro- grids and enable a flow of data between them so as to optimize performance, minimize wastage, and ensure the safety of maintenance staff.

Pacific Controls' Galaxy™ energy services can save energy now and inspire others to follow suit, in order to start a widespread movement toward conserving precious resources and developing new and innovative methods to meet current, and future, energy demands.
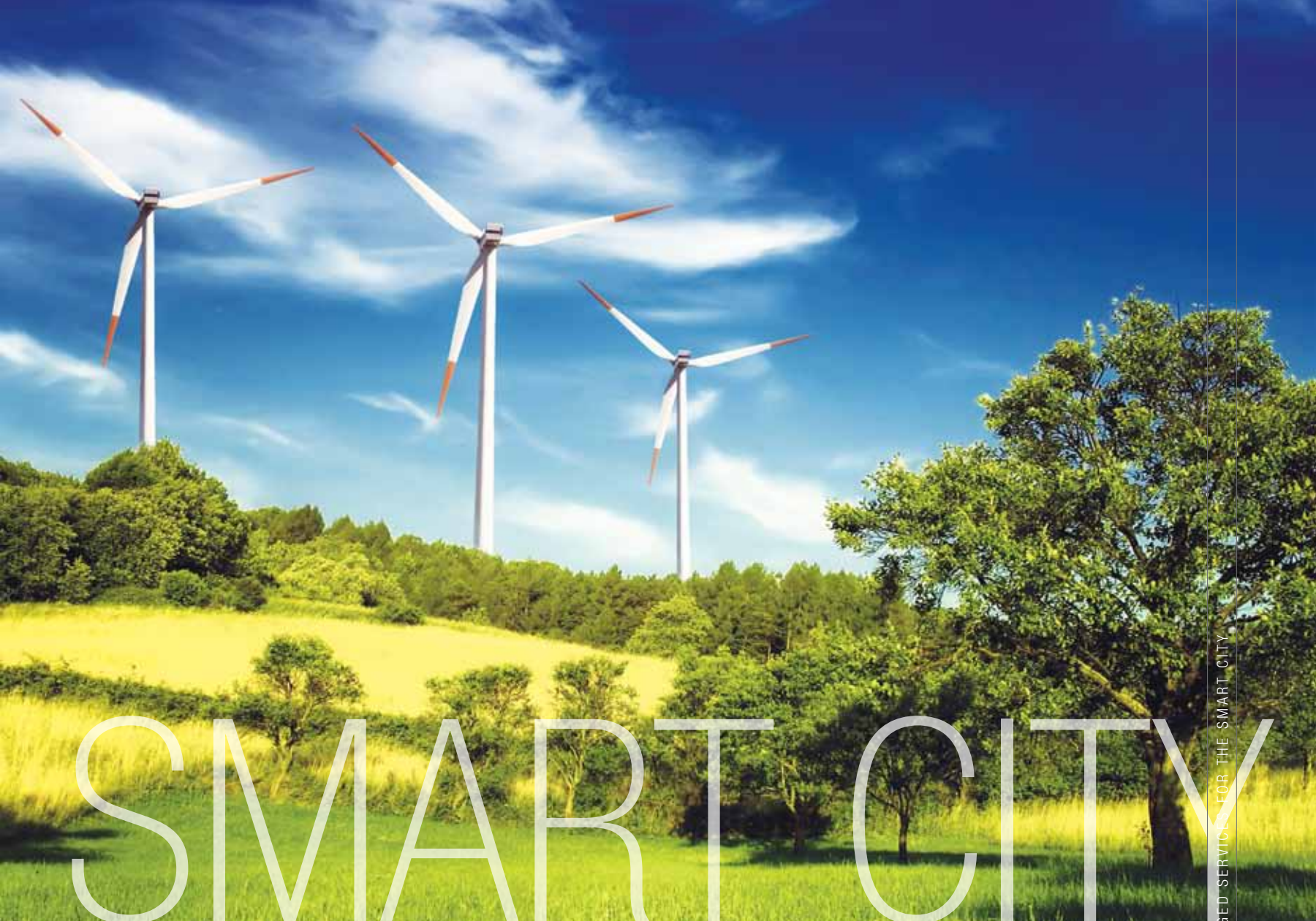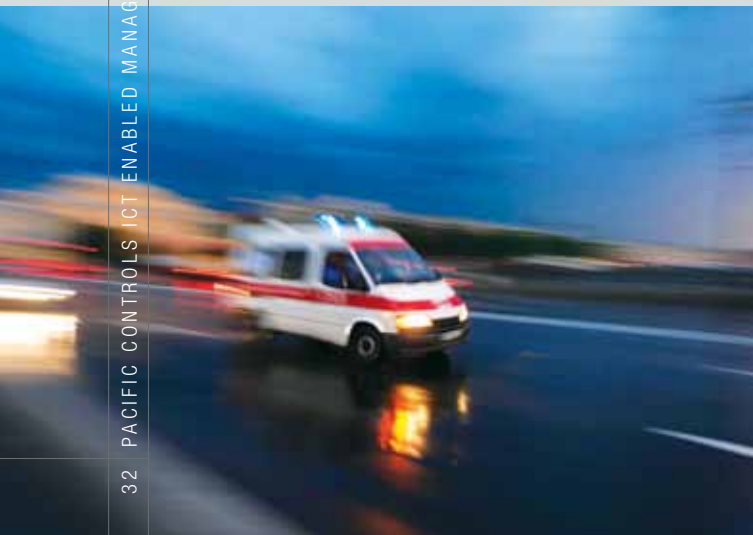
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HEALTHCARE

Healthcare is a sector where time is of the essence, and where many people are willing to pay for the best possible care and treatment, whatever their ailment. Technology in this field is advancing at an incredible rate and, thanks to the reach of new media, the public is aware of these developments. As a result, they are becoming more pro-active about ensuring that they get the best and fastest treatment available.

Healthcare providers are using ICT to streamline efficiency within a clinic or hospital but having difficulty linking these systems to bring wider benefits. Galaxy™ and Gbots™ in the Smart City add value to healthcare databases and networks by linking the systems used at doctors' surgeries, hospitals, clinics and insurance companies. Integrating the different healthcare applications, devices, and networks, whatever protocols they use, creates a unified platform for managing end-

to-end healthcare. This platform can help the healthcare system be more responsive, offering its patients and practitioners access to a wealth of resources and the best possible facilities and technology. It facilitates the move to telemedicine and the remote delivery of expertise.

In the modern world, time is also at a premium. For patients, going to see a medical professional often means taking time off, cancelling other appointments and having to adjust their busy schedules. For doctors, it often means compromising on individual patient care and having to shift and cancel appointments. Improved time management through shared diary systems on the Smart City community cloud infrastructure can alleviate these issues and facilitate effective time management for all parties.

THIS SMART INFRASTRUCTURE WILL SUPPORT THE PROVISION OF PREMIUM QUALITY, AFFORDABLE HEALTHCARE FOR EVERYONE IN THE SMART CITY.

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Timely treatment could mean the difference between taking a course of antibiotics and a three-day hospital stay; between a series of costly and painful treatments and a quick and simple procedure; and, most importantly, between life and death. It is because timely response is so important that Pacific Controls has introduced Galaxy™ -enabled healthcare management.

Galaxy™ is bringing about a revolutionary transformation in the healthcare sector by connecting systems that deliver better functionality and performance for patients, doctors and insurance providers alike. By securely sharing data in real time, the platform has the potential to completely revolutionize the healthcare industry and ensure that an exceptionally high standard of care is delivered at every stage.

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SHOULD AN ACCIDENT OCCUR, GALAXY™ CAN AUTOMATICALLY ALTER TRAFFIC SIGNALS TO ALLOW REGULAR FLOW OF TRAFFIC AND MINIMIZE CONGESTION IN THE SMART CITY. THIS IS NOT RESTRICTED TO THE ROAD TRANSPORTATION SYSTEM, BUT CAN BE APPLIED TO AIR AND WATER TRAFFIC AS WELL, MAKING IT POSSIBLE TO CREATE A SMARTER CITY WHATEVER ITS GEOGRAPHICAL CHARACTERISTICS.

TRANSPORTATION

Poorly managed transportation systems can cost a country billions of dollars. Congestion on roads costs the United States $78 billion every year due to the amount of fuel wasted and time that commuters could have better spent working. The impact on air quality has to be added to that cost. Widening roads and deploying more buses and trains could be very expensive, and completely impractical in densely packed urban spaces. As a result, governments everywhere are working on making their transport systems smarter and can obtain even more benefits if these systems are integrated into a Smart City platform.

Figure 10 Galaxy's role in Transportation

Galaxy™'s Enterprise City Management Platform offers governments a modern solution to transportation problems as shown in Figure 10. By harnessing the pervasive power of the Internet, Galaxy™ creates a platform on which all the players within a transportation system can communicate with each other in real time to optimize their operations and deliver efficiencies.

This free flow of data can save governments billions of dollars through better resource management. For instance, giving managers the ability to track the number of commuters traveling on a subway at any given minute allows them to determine peak and off-peak times more precisely. This information could allow them to deploy shorter trains on one line and transfer the free cars to another line that is carrying more passengers.

Management of vehicular traffic is a major concern in many cities. Gbots™ offer the potential to connect traffic management systems online for the more efficient regulation of traffic flow and patterns throughout the day. Galaxy™ and Gbots™ can help in the management and operation of traffic lights by enabling intelligent data sharing between traffic points.

HOSPITALITY

Smart Cities need to attract visitors as part of the drive to boost tourism and the knowledge economy. With globalization, travel continues to increase, both for business trips and holidays, and hotels are seeing growing numbers of guests coming through their doors. Nonetheless, this is a very competitive market and hotels need to differentiate themselves by offering good, fast service. Hotels and hotel chains are continuously aiming to be "bigger and better" than their competitors and hotel guests have come to expect a certain level of luxury. This means the onus is on hotels to make sure that their guests are getting the most out of their stay.

The hospitality industry is one sector where a little extra attention and special care go a long way. People want

the comforts of home away from home, and to be made to feel that they are special and valued. Successful hotels strive to make sure that every one of their guests enjoys a pleasant stay, free of any hassles, delays and misunderstandings. Galaxy™'s tailor-made hospitality makes it easy to ensure that everyone's different needs and preferences are catered to.

Galaxy™ integrates the best that ICT and M2M have to offer to provide guests with a unique and highly personalized experience. Harnessing the power of Gbots™, the software improves the efficiency and quality of hotel operations, including front desk, housekeeping, guest services and security. It enables smart, flexible hospitality by integrating guest room automation services

NOT ONLY DOES GALAXY™ INCREASE CUSTOMER SATISFACTION, IT ENSURES THAT STAFF TIME AND RESOURCES ARE USED EFFICIENTLY, FACILITATING THE SMOOTH AND SEAMLESS RUNNING OF THE HOTEL AND SAVING THOUSANDS OF DOLLARS IN THE PROCESS.

SMART CITY

(including HVAC, lighting, room safes, mini bar, door locks, computerized maintenance and guest-room management systems) using intelligent data analysis. This enables hotel owners to customize their services to each of their guests' preferences, habits and needs.

At the same time, Galaxy™ enables energy and asset data to reach the facility manager in an easily understandable and visually rich format. Energy consumption data can be used to drive energy-efficient measures in the hotel, plan maintenance schedules for the HVAC and lighting equipment and many other purposes that reduce operating costs. This is achieved by integrating separate ICT systems into a single package – one that's versatile, intelligent and adaptable.

With Galaxy™-enabled Hospitality Management, hotels can ensure that each and every one of their guests will be made to feel valued and welcome.

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Cities are composed of millions of buildings and these account for about 40% of the city's energy consumption. Government and Non-Government Organizations (NGO's) worldwide now stress the need to take steps to reduce energy use in both residential and commercial buildings. Many countries have introduced regulations that require companies to limit emissions to standardized levels and more are in the pipeline. With the increased emphasis on corporate social responsibility and new legislation on reducing carbon emissions being introduced, sustainability is becoming a priority for many businesses.

In the Smart City, ICT helps to manage indoor comfort and energy use. Pacific Controls' innovative technology and the GCCC make it simple to reduce power consumption and carbon emissions at home or in the work place. Up to now, measuring carbon footprint has been a difficult task. Pacific Controls GCCC remote Energy Monitoring Solution ensures optimal CO_2 levels and accurately maintains the building's carbon footprint within permissible limits. Galaxy™ makes it straightforward to adopt business strategies that meet the needs of the enterprise and its stakeholders while protecting, sustaining, and enhancing human and natural resources. Companies that make use of Pacific Controls' energy management services have seen considerable savings that easily pay back the capital invested within two or three years.

Among its world leading services on the Galaxy™ platform, Pacific Controls offers managed services
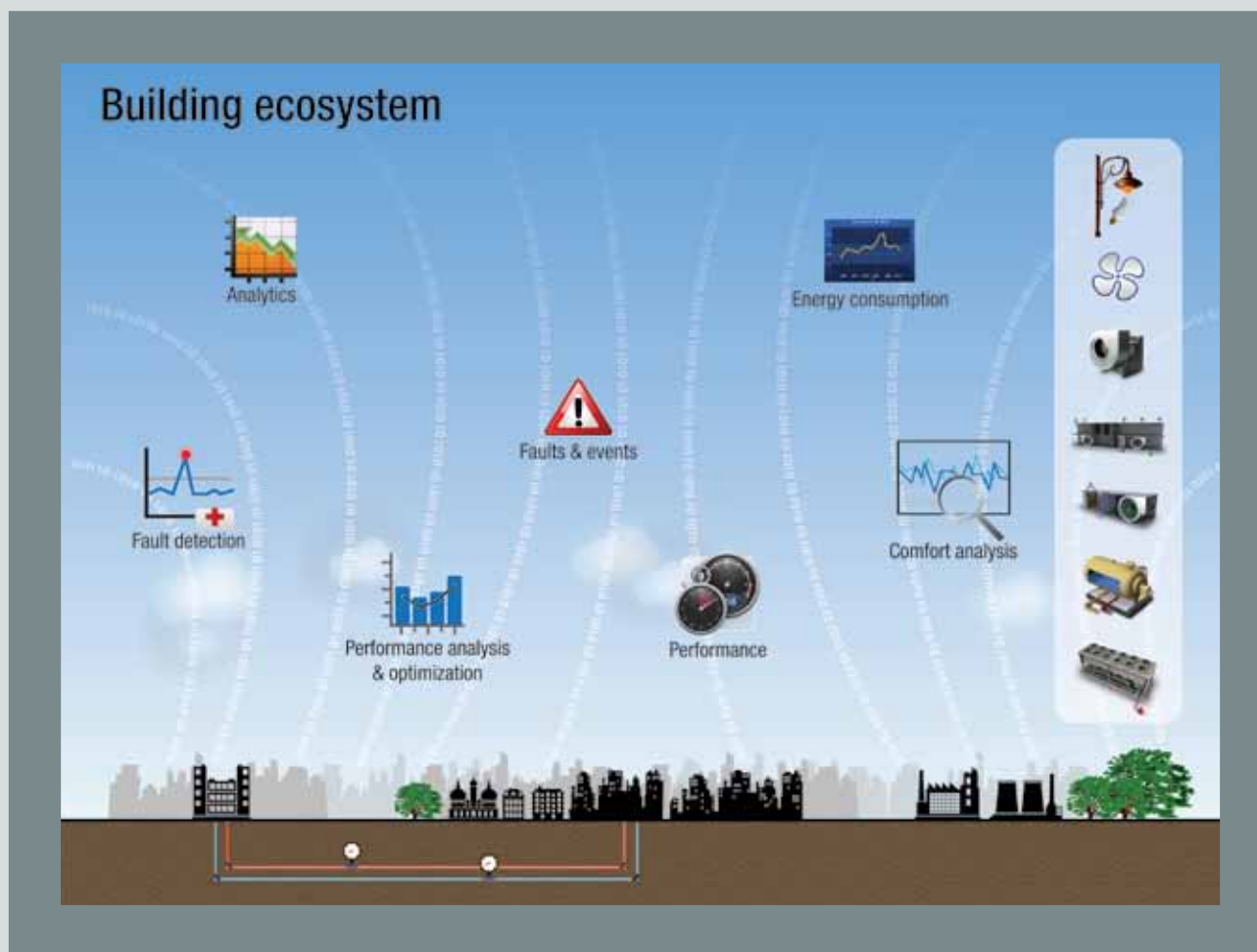
BUILDINGS

Figure 11 Galaxy's role in building management

for remote monitoring, energy management, building commissioning, and facilities management of unlimited numbers of buildings. These services are designed to lower building operating costs by remotely monitoring and controlling energy-intensive systems, such as HVAC and lighting, for optimum performance. They keep equipment working at peak efficiency by carrying out predictive maintenance, reducing both energy usage and operating expense.

These services meet the need for property owners to provide detailed accounting of their GHG emissions to comply with the growing volume of environmental legislation. They create transparent reports that provide accurate and reliable data on a building's environmental practices. Galaxy™ provides end users with the means to increase efficiency, generate cost savings, and provide energy savings as well as lower carbon footprint.

Most existing energy management software lacks the processing power to report information efficiently and has to compromise either on accuracy or frequency of measurement. Galaxy™ reduces the time taken to read meters while the GCCC automatically identifies exceptions when they occur. This means that performance reports are provided to the client swiftly and with extreme precision.

Gbots™ can be integrated with any building management system, responding to events, observing the environment, collecting and collating data as shown in Figure 11. This ability can be used for energy optimization, cost reduction, maintenance, and asset management for buildings in any part of the world, enabling decision makers in one continent to identify ways to save energy in buildings in another.

Gbots™ can be used to participate in demand side management schemes that work with the utility companies' systems in real time to reduce energy loads at peak times. Users can create energy management profiles, using the interactive energy management tools that are triggered by certain established consumption rates. As energy consumption exceeds a specific point, the system can automatically begin turning off low priority lighting, heating, and cooling zones.

An effortless way to green a space is to take control of energy consumption by finding out exactly how much is being used. Armed with software tools, building owners can measure how much electricity a device or a whole workspace uses, monitor the cost based on any rate patterns, such as peak and off-peak rates, and pinpoint billing errors as well as wasted energy. Providing information on energy usage in real time helps people understand their habits and change them to consume energy more efficiently. This makes the Smart City more sustainable as it helps building owners minimize energy costs, as well as helping utility companies reduce their need to build new capacity.

ENVIRONMENT

Figure 12 Galaxy's role in managing a water ecosystem

Monitoring the components of an environmental ecosystem, in order to manage the rate of depletion of resources, is one of the pressing issues for governments and companies and one that Smart Cities aim to address. Environmental monitoring solutions are addressing critical problems that could have far-reaching social consequences. This data is needed for the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment.

Monitoring strategies need to be designed to meet defined objectives, usually to establish the current status of a particular environment or to establish trends of change in the environment. In order to characterize and monitor the quality of the environment, Galaxy™ collects real-time data and data histories that describe processes and activities as illustrated in Figure 12.

SMART CITY

GALAXY™ STORES THE RESULTS OF THIS MONITORING AND USES GBOTS™ TO ANALYZE THE DATA AND PRESENT IT GRAPHICALLY SO THAT IT CAN BE REVIEWED, FURTHER ANALYZED STATISTICALLY, AND PUBLISHED IN ORDER TO COMPLY WITH REGULATIONS AND PROVIDE TRANSPARENT DATA ON ENVIRONMENTAL PERFORMANCE.

SMART CITY

THE SMART CITY IS MADE SAFER BY CENTRALIZED MONITORING OF SAFETY ALARMS, TO ENSURE THAT THEY ARE WORKING PROPERLY, AND BY HAVING THE ABILITY TO ALERT OCCUPANTS AND PROCESS STAKEHOLDERS ROUND THE CLOCK IF ISSUES ARISE.

EMERGENCY
& LIFE SAFETY SYSTEMS

For critical alarms, the emergency services can be mobilized faster and more efficiently by life safety management services integrated into the Smart City infrastructure.
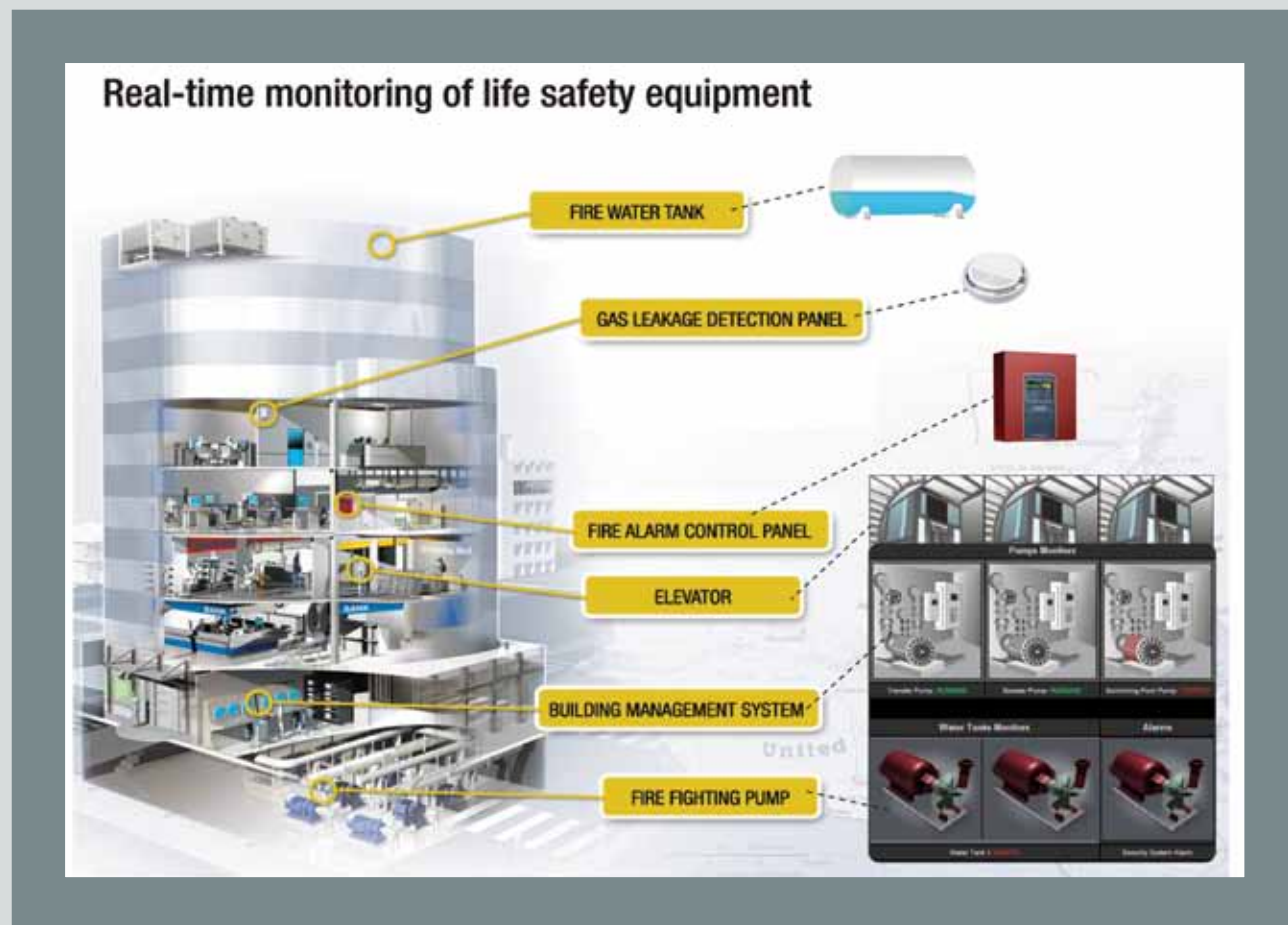

Figure 13 life and safety systems monitoring

The Galaxy™ life and safety solution continuously monitors buildings' emergency systems, including:

- Fire alarms
- Elevator alarms
- Gas leakage alarms
- Safety equipment malfunction
- Power interruption
- Low water level in reservoirs
- Fire fighting pump run alarms and malfunctions.

The status of the alarm systems, fire fighting equipment and any problems that should be addressed by routine maintenance are identified by the operations center and followed through to ensure that the necessary work is carried out in a timely manner.

SMART CITY

In non-emergency situations, site visits and remote monitoring of the life and safety systems give safety managers an opportunity to capture snags in the building systems. These are reported both to the site contacts and the local emergency services safety department for immediate action. Once a site is connected, Pacific Controls continuously ensures that any system or panel faults are cleared expeditiously. The reporting system ensures that all issues are followed up and overdue actions are identified.

In an emergency situation, Gbots™ allow the security and emergency services to be more flexible, have faster reaction times, and operate more efficiently- dispatching first responders with a single click. Galaxy™ supports more effective resource management, and ensures that equipment is deployed in the most appropriate locations. Gbots™ improve reliability by integrating telematics data from the vehicle fleet with alarm management, ensuring that all the relevant emergency services have accurate data during a crisis. Often the various security and emergency services use different communication networks, which cause problems. Gbots™ provide

a platform to provide seamless data transfer across diverse communications platforms.

For emergency response, one of the main benefits delivered by the Pacific Controls system is the immediate report that is produced by the platform for emergency response control command center, detailing the layout of the building, the location of the alarm, the escape routes and the nearest emergency vehicles. This data can be sent to the first response vehicles with a single click, helping to save precious time.

Pacific Controls' Life and Safety Service includes a vehicle tracking system that improves staff safety and vehicle security. The detailed and timely reports to senior managers improve visibility of issues and allow better strategic decision making.

Pacific Controls, together with emergency management teams, has been successful in improving the fire safety of workplaces, public and residential buildings, through the enforcement of a mandatory annual maintenance contract for buildings enrolled in the system.

BY MAKING USE OF GBOTS™' INTUITIVE RESPONSE TO ANY SECURITY BREACH OR EMERGENCY, THE RELEVANT AUTHORITIES CAN MONITOR THE SAFETY AND SECURITY LEVEL OF THE SMART CITY AND TAKE SWIFT AND EFFECTIVE ACTION.

THE RETAIL SECTOR

Retail space is an important part of the city environment and needs to appeal to citizens and visitors. Retail companies in the US spend nearly $22 billion on energy each year, the majority of which goes on lighting and cooling. Through improvements in energy performance, retailers can reduce costs, increase customer satisfaction, and enhance corporate profitability, while reducing the carbon footprint of retail stores, supermarkets, and restaurants.

The retail industry faces some unique challenges:

- Lack of meaningful information despite large volumes of data: a retail business generates an enormous amount of data from which it is difficult to extract the right information to manage operations efficiently.

- Decentralized operations: large retail businesses are usually spread over many sites, resulting in non-standard processes and lack of control of facilities.

- Pressure to innovate: retailers have to continually innovate in order to differentiate their stores and stay ahead of their competitors and thus improve margins and profits.

- The need for a reputation for integrity and corporate social responsibility: retailers need to win the trust of their customers. Reducing the business's carbon footprint increases the inherent value of the brand amongst customers.

THE SYSTEM ALSO HELPS IN PROTECTING INVENTORY BY ENSURING GOODS ARE SECURELY STORED IN APPROPRIATE CONDITIONS AND THAT COLD CHAINS ARE NOT BROKEN.

In a retail unit, Gbots™ can be used to monitor and control the energy usage patterns, cooling and heating requirements and light levels, increasing the customers comfort. The Galaxy™ platform and the Gbots™ can also be used to create a database repository of customers' buying behavior and analyze consumption patterns with respect to location, demographics, economic environment and the physical environment in the store – for example to correlate light levels with footfall or sales. The expertise created can be used by fast moving consumer goods (FMCG) companies to plan their budgets, product launches, product category expansion, packaging, labeling, and pricing, all of which are driven by patterns of customer behavior mapped by the data analysis.

PACIFIC CONTROLS'
SMART CITY EXPERTISE

Pacific Control Systems LLC is an ISO 9001:2008 company headquartered in Dubai, and has successfully implemented integrated automation solutions in the Government and Private sectors globally. The company's core strength is in offering comprehensive, innovative solutions in Intelligent Automation and Control Systems. Its success as an e-Enabled solutions provider has resulted in the company implementing total control solutions for commercial, industrial, and home infrastructure automation projects across the globe. Cities around the world can apply this expertise to create Smart Cities that are efficient, sustainable and economically successful.

Pacific Controls' domain knowledge and technology expertise is continuously being updated through collaboration with leading universities including the Technical University of Vienna and the Lawrence Berkeley National Laboratory in the US.

Pacific Controls' services have a wide range of end users including building owners, contractors, real-estate companies, Governments and Government agencies and general infrastructure owners. These key players can collaborate using the resources of Pacific Controls Command Center to:

- Optimize operations
- Reduce service costs
- Increase return of assets
- Monitor assets remotely.

Pacific Controls saw the machine-to-machine (M2M) opportunity at an early stage, and was able to leverage its potential to create impressive growth and award-winning solutions that has seen the company take a leading global role as an M2M enabler, using mobile networks to monitor and control devices in a wide range of sectors.

SMART CITY

PACIFIC CONTROLS ICT ENABLED MANAGED SERVICES FOR THE SMART CITY

Pacific Controls' strategies and services are in line with its commitment to sustainable development and energy savings built on economic progress, social development, and environmental improvement. Among its leading services Pacific Controls offers remote monitoring, energy management, building commissioning, and facilities management services to reduce GHG emissions.

Pacific Controls, in addition to its automated solutions, provides the services of Subject Matter Experts (SMEs) from diverse fields such as Energy, HVAC, and electrical systems who continuously keep a hawk's eye on systems and their performance. SMEs define how tasks are to be performed, provide technical advice to customers, and are responsible for maintaining acceptable performance levels and meeting performance objectives.

Galaxy™ brings decision makers real-time, relevant data about all the operations within a Smart City so that they can analyze, compare and implement strategies to correct issues and, in many cases, prevent problems before they occur. The ultimate beauty of Galaxy™ is that it interconnects all the vertical sectors within a Smart City's ecosystem. Transportation, healthcare, retail, education, utility management, and telecoms systems can now freely share information to improve their

practices, increase the profitability of the Smart City's companies and deliver a better quality of life for its citizens.

The core activities rally around the development of the Galaxy platform and the Gbot engine that generates Gbots to respond to real time events both within the building and on the grid. These are nascent technology solutions with no benchmarks established. Thus, Pacific Controls is pioneering the establishment of benchmarks and rules in this unique space of virtualization.

Pacific Controls is a company providing ICT enabled managed services and converged engineering solutions for buildings and infrastructure projects globally. Pacific Controls has pioneered the concept of city centric management of buildings and infrastructure for sustainability, and has established the world's first Global Command Control Center (GCCC) for energy and managed engineering services. The GCCC serves clients by enabling continuous commissioning, measurement & verification of their carbon footprint in real time. Pacific Controls delivers managed services using "Galaxy" its enterprise service delivery platform and "Gbots" its intelligent, autonomous, experienced and cognitive software robots deployed across networks to deliver diverse tasks in assets across the world.

GLOBAL ASSETS ARE CONNECTED IN REAL TIME TO THE PACIFIC CONTROLS CLOUD USING M2M HARDWARE DEVELOPED BY PACIFIC CONTROLS. THE COMPANY HAS DELIVERED SOME OF THE WORLD'S LARGEST ICT ENABLED INTEGRATION PROJECTS.

PACIFIC CONTROLS ICT ENABLED MANAGED SERVICES FOR THE SMART CITY

SMART CITY

PACIFIC CONTROLS

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