

Intelligent Enterprise Platform— Connecting Devices to the Enterprise



A Frost & Sullivan White Paper
in Partnership with Tridium, Inc.

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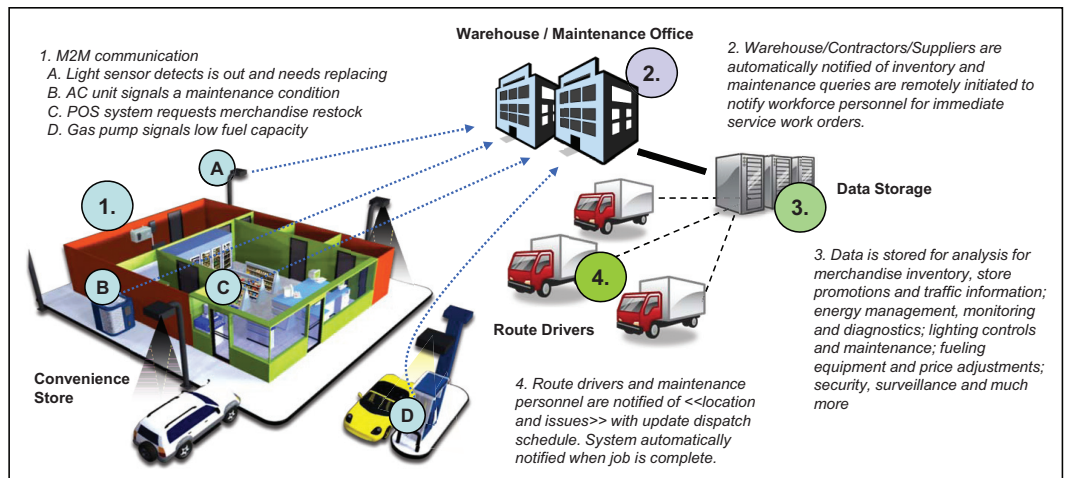
CONNECTING DEVICES TO CREATE BUSINESS VALUE

The future of pervasive device communication is envisioned to be so powerful that everyday devices will be able to identify each other's presence and role, and interact in a manner that benefits our way of life. Such communication-rich environments will lead to embedded computation abilities, where information can be collected by devices and sensors, and processed to generate an intelligent response and coordinated actions. This white paper focuses on the benefits of integrating devices with enterprise and business processes and the importance of having holistic visibility over operational data.

This pervasive communication phenomenon is founded around M2M communication. M2M stands for machine-to-machine, machine-to-mobile, and mobile-to-machine interconnection to enable a mobilized workforce. The goal is to allow users to access information and receive alerts regarding critical situations and then control and manipulate variables on dispersed machine assets via a computer or personal digital assistant (PDA) device. Leading the market in innovative M2M solutions, Tridium's extensible integration and connectivity platforms support the rapid and wide-range development of M2M communication.

A simple example of M2M communication implementation is shown in Figure 1, which demonstrates how a convenience store's POS system and other equipment sensors can automatically transmit a work order message to a local warehouse and contractors. Dispatch systems are automatically updated, and work orders are remotely initiated. The M2M communication network enables dispatch systems, or even the route drivers and maintenance personnel, to remotely access a convenience store's inventory for additional merchandise supply information and equipment maintenance needs. The result is fewer trips, better services and improved inventory management. The benefits include savings from maintenance, energy and operations; reduced equipment downtime; better customer service; and informed usage patterns with customer traffic statistics to facilitate improved sales and higher profits.

Figure 1—Example of M2M communication implementation



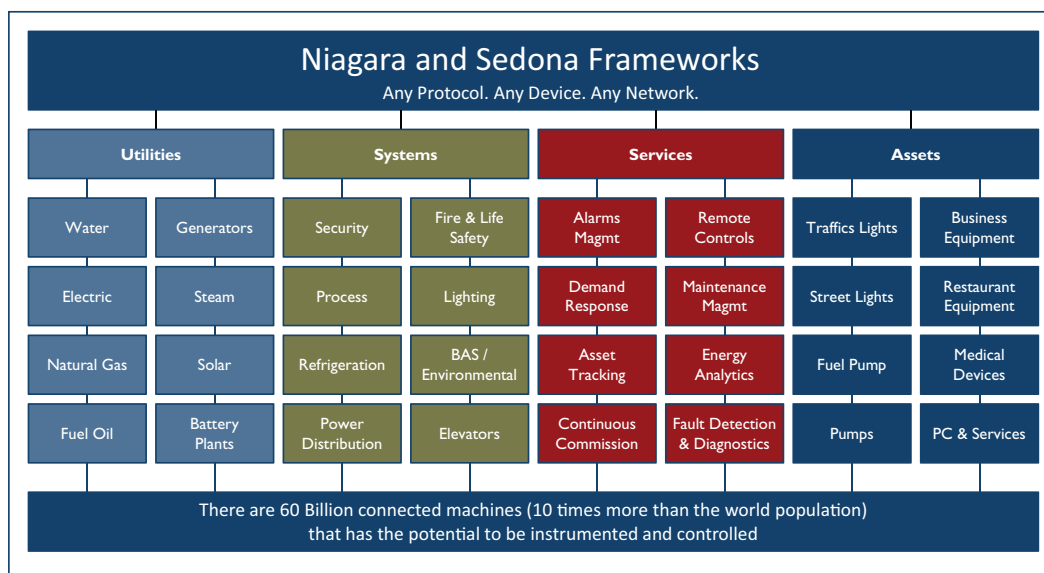
Source: Frost & Sullivan

Sensing and controlling our environment is a significant phenomenon that has gained attention in the past few years for a wide range of applications. Key market segments demanding device-to-enterprise solutions include building automation, energy and asset management, security, industrial automation, healthcare, location and tracking, mass transit, environmental control, and more. Modern buildings, for example, are increasingly being fitted with sophisticated sensors and networks for better resource utilization, control and surveillance.

Connecting Devices, Protocols and Networks

Tridium’s open-architecture Niagara and Sedona Frameworks provide a complete platform for developing, integrating, connecting, and managing pervasive device applications, helping businesses connect people with operational data from remote locations. Figure 2 shows some of the areas where the Niagara and Sedona Frameworks are being successfully applied.

Figure 2—Convergence of assets to single-point enterprise architecture



Source: Tridium and Frost & Sullivan

Frost & Sullivan estimates that from the almost 7 billion world population, more than half—4 billion and counting—have mobile handsets. While those are indeed large numbers, they pale in comparison to the 60 billion devices that could be connected within the next 10 years—and those include only the more intelligent devices. Device-to-enterprise applications can provide many benefits in a variety of customer applications. Some of the main benefits that can be expected from a converged enterprise platform include:

- Real-time monitoring and reporting capabilities
- Energy, maintenance, and operational cost-savings
- Future-proof integration platform
- Increased asset value, optimum equipment performance and life of assets
- Improved comfort and productivity

Device-to-enterprise solutions enable a centralized architecture to provide complete information management capabilities and direct access to all systems and information sources. Building owners, facility managers, C-level officials and strategic product developers have the ability to fully maximize the diversity of Tridium's IP-based enterprise technologies to create and enhance products that bring business value.

Of all the elements involved in the realization of this pervasive communication vision to enable anytime remote access, wired or wireless sensors play a vital role. Sensors are equivalent to a human body's ability to hear, see, and smell. The essence of a smart energy infrastructure is made up of millions of smart, connected devices such as sensors. Buildings, in general, could be outfitted with tens of thousands of small sensors, some Web-enabled, and tied into a central computer for information gathering and control. Enterprise applications are exploiting the existing IT infrastructure to integrate these sensors, devices and systems, enabling remote access, management and distributed control.

IP-Based Device-to-Enterprise Evolution

Advances in networking technologies and the Internet have opened the door to a vast network-enabled world. As the number of devices, applications and services based on IP technologies is growing, it is imperative to have sufficient IP addresses to cater to the same. The next generation of IP technology, called IPv6, was designed in such a way that there is an IP address available for virtually every grain of sand on earth. The Sedona Framework, combined with Niagara, can distribute decision-making control and connectivity to such devices residing at the very edge of the network and everything in-between, and aggregate the data to the network level for real-time, remote management and control.

OVERVIEW OF TRIDIUM'S ENTERPRISE SOLUTION

The Niagara and Sedona Frameworks

Tridium introduced its technology through the Niagara Framework® in 1996, which was designed to integrate diverse formats regardless of manufacturer or communication protocol. Tridium's Niagara Framework is an Internet-based software infrastructure that enables end-users to communicate between M2M devices and to an enterprise for simpler and more efficient flow of data and operation. For customers this means operating on one unified platform, easy data access through the Internet, real-time information sharing, and simplified interoperability and integration between building infrastructures to improve efficiency and maximize cost-savings. After the Niagara, Tridium introduced the Sedona Framework™, an open-source framework that provides a complete platform for developing, integrating, connecting, and managing pervasive device applications.

Tridium's Niagara and Sedona Frameworks capitalize on energy savings and cost-effectiveness, while offering a tailored package solution with unique features that yield measurable returns. Tridium provides customers with the technology to operate on a single, unified platform and the tools to easily integrate data and improve efficiency and cost-savings. The technology enables integrators, original equipment manufacturers (OEMs) and reseller partners to offer an open and interoperable approach for automation and control solutions.

Reaping the Multi-fold Benefits of a Converged Enterprise Platform

Real-Time Monitoring and Reporting Capabilities

The Niagara Framework provides data reporting in adherence to current IT standards that enable an invaluable and actionable reporting mechanism for timely and accurate decision-making. Data on HVAC, lighting, parking lots, electricity, security, access control and many other building devices and systems were, until recently, completely isolated. These devices and systems can now be aggregated to one central monitoring station with remote real-time capabilities, easy data access through the Internet and, ultimately, simplified interoperability and integration between building infrastructures for better performance and lower operational costs. This holistic monitoring and reporting allows building managers to proactively monitor building components and provides immediate assistance with routine and condition-based problems.

Energy, Maintenance, and Operational Cost-Savings

Energy efficiency is a priority for building managers but can be complex, expensive, and have long payback periods on return on investment (ROI). The Niagara solution addresses these concerns by significantly enhancing energy efficiency, thereby controlling cost and reducing energy consumption easily and quickly.

While there have been several factors driving customers' desire for integrated building systems, the two foremost economic drivers include energy and operational cost-savings. By monitoring and measuring energy-intensive systems, such as HVAC and lighting, they can be controlled for optimum performance and predictive maintenance needs, reducing energy usage and operating expense. In some instances, the technology from Tridium can pay for itself in as short as six months based on those two factors alone.

Lower Lifetime Operating Costs—Improve Building's Asset Value

Aside from managing energy and operating costs, concerns around life cycle benefits, management of resources, and legislative requirements are increasingly important for today's industry stakeholders. Through monitoring, measurement and verification of assets, operation and processes can be measured for optimum performance and predictive maintenance needs, reducing both energy usage and operating expense. The reduction in operating costs enhances the value of assets and resources. Realtors and corporations can benefit from lower insurance premiums and save on administrative costs through better leasing renewal rates, reduced churn and maximizing tenant lifetime value.

Improved Comfort and Productivity

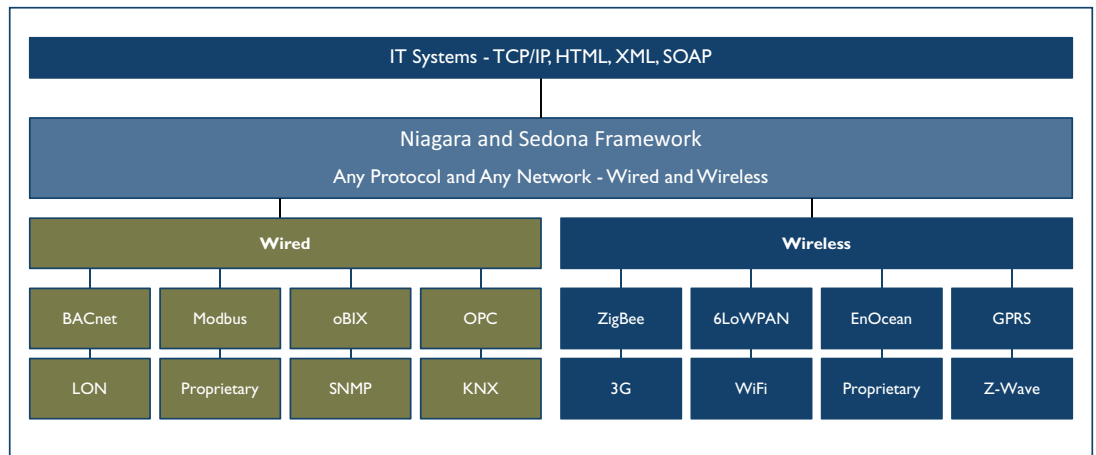
Productivity costs, due to the high size of staffing expenses relative to energy costs, can produce significant administrative savings and ROI. Effective building control and management technologies will improve the building environment and functionality for occupants, and enhance comfort and productivity gains. This, in turn, will significantly shorten the ROI period on capital investments, especially in owner-occupied buildings.

Future-Proof Integration Platform

The key requirement in a future-proof platform is standardization of the system, where the underlying technologies can seamlessly speak to one another regardless of protocol and type of network—wired or wireless. It must meet the needs of the present without compromising the needs of future generations of technology innovation. For example, the transition of stand-alone, legacy network HVAC&R, lighting, or security to a TCP/IP-based network

Tridium’s enterprise platforms facilitate this convergence of IT enterprise with building systems and other business assets. This converged communication solution complies with a building’s original design and is future-adaptable to anticipate and respond to new technologies, process changes, and smooth system evolution. The Niagara Framework uses the IT infrastructure to add scalability and extensibility. This open-framework architecture enables building owners and facility managers to embrace the diversity found in buildings and provide a near future-proof integration infrastructure.

Figure 3—Niagara and Sedona Frameworks for wired and wireless networks



Source: Tridium and Frost & Sullivan

IT-Based Integration with Third-Party Devices and Programs

Tridium is a strong advocate of open and interoperable systems, supporting IT-friendly solutions for system management. Using an IP network makes it easier for third-party developers and manufacturers to bring out products compatible with any IP-based control system. Some programming might be necessary at the management end, but overall the use of an open platform such as the IP network significantly enhances the compatibility between various control products.

Tridium’s product line is designed around the standard IT/IP infrastructure, with its Niagara enterprise framework serving as the foundation. The frameworks offer added flexibility, scalability and portability to incorporate unique features from other innovative technologies. Tridium’s open technology is being adopted by integrators, OEMs and reseller

partners to either implement the product as is or build upon the existing platform. This allows integrators to have more flexibility in targeting and addressing specific end-user requirements and, in some areas, meet more stringent government regulations, building codes, and/or energy efficiency demands.

Business Process Management Implementation and Improvement

Tridium realizes the need to streamline the efficiency process and remove ad hoc applications, helping clients first understand the ecosystem of a facility and then the necessary changes needed to address inefficiency. Using an IP network offers flexibility in adding and removing devices from the network without affecting the functioning of the other devices attached to the network. Apart from providing the flexibility of adding innumerable devices to the IP control system, it also provides the flexibility of mixing different topology, such as systems with control panels, systems with sub and master control panels, or systems using only an IP-enabled intelligent reader.

The use of extensible markup language (XML) and application programming interface (API) has resulted in a lower cost option for getting disparate systems to communicate with one another. These programming languages and APIs have helped in automating various functions of various control systems, which previously were manned by personnel sitting in front of consoles and banks of monitors. Present-day systems can be run from a single PC connected to a local or remote centralized server, with the administrators only providing a cursory attention to the proceedings. Tridium software can display all the access points, display alarms, disable and enable doors, and provide the condition of the access point from anywhere on the network. As the IP network includes the Internet, along with LANs and WANs, the remote management of an IP-based control system can be achieved from anywhere in the world if proper authorization is provided to the management software.

MARKET OPPORTUNITIES—CONNECTING DEVICES TO THE ENTERPRISE

Building Automation Systems

Building automation systems (BAS) have been around for more than a decade and mostly ruled by proprietary protocols, controllers, and sensors creating data “islands” identified in specific pockets of the building automation systems. The adoption of open building automation protocols has given a new dimension to standards-based building automation systems. Tridium’s enterprise platform enables convergence of the IT enterprise with building automation systems and the underlining mechanical systems.

Building automation systems can contain a lot of data—from electricity meters, gas and water meters, alarms, access control, security, HVAC control, boilers, and refrigeration units—flowing in real-time. Building owners/proprietors now have a common platform through which they can access specific controllers/sensors, and monitor and control the same using Web-based technologies.

In general, a building automation system benefits from seamless interactions across the following devices and systems:

- HVAC&R controls
- Lighting controls
- Elevator controls
- Parking area controls
- Fire and smoke detectors
- Gas detectors
- Access controls
- Digital signage systems

IP-based enterprise platforms for building automation are set to unify the many services and applications that were once isolated and make them controllable from a single monitoring center.

HVAC&R Controls

The automation of HVAC systems includes the regulation of temperature, humidity, and power and control of air flow. Having control over these parameters leads to an effective resource utilization scenario, thus saving power and, eventually, capital expenditure (CAPEX) and operational expenditure (OPEX). In an HVAC scenario, the OPEX is greater than the CAPEX, and an automated system reduces the former to a considerable extent. An IP-based HVAC automation system further enhances the flexibility of remote monitoring and control, enabling interoperability among various protocols and devices.

Lighting Controls

Lighting sensors, such as motion and temperature-based sensors, can be embedded in individual lighting fixtures using unique IP addresses. Using virtually connected sensors in lighting systems can feed information about occupancy status to other building systems and further enhance the functionality of the building automation systems. Daylight sensing dimmers and automatic blinds systems are two emerging technologies in this segment. The former can automatically dim the interior lights depending on the amount of daylight.

Elevator Controls

IP-based elevator automation systems enable effective monitoring, control, and optimization of various aspects in an elevator, such as usage, performance and access. With the advancement in technologies such as radio frequency identification (RFID), varying degrees of access can be provided to visitors, staff, residents, and the like. Additionally, wireless Web-based streaming applications can be installed in elevators to feature important news and emergency evacuation instructions from a central control room.

Parking Area Controls

Effective control over parking areas includes lighting, billing, access control, security, and integration with HVAC. Used in conjunction with the elevator control systems, it further

improves monitoring and control of occupants. Parking management software enables complete control and real-time information access, over the Web, by integrating the entire parking system.

Fire and Smoke Detectors

The fire and smoke detection industry is highly driven by fire and building codes, which have been maintained in a conservative manner, as they deal with issues of safety. All buildings require some level of fire/smoke detection. An IP-based fire alarm system efficiently handles the situation in a more dynamic manner than the typical, isolated fire alarm systems. IP-based fire alarms, when networked into the mainstream IP network infrastructure, facilitate coordination among the security personnel in case of fire. Web-based control systems can pinpoint the exact location of the fire and direct first responders to that particular spot immediately. Additionally, the sprinkler system could be activated with increased force over the affected area and at a lesser vigor over areas not affected.

Gas and Biohazard Detectors

Gas and biohazardous leaks, such as anthrax, put lives and property at stake. Conventional gas and biohazard leakage detection systems comprise of sensors, controllers and a monitoring center, where the data from the sensors are collected and transmitted by the controller over serial communication links. The data gathered by this system stays isolated and cannot be controlled from a remote location without IP-based infrastructure. Using a platform to connect sensors to management systems can activate a timely mass notification and evacuation process, and isolate the contaminated area through the interaction of systems and alarms from a centralized command center.

Access Controls

Large complexes and multi-storey buildings comprise of a large number of access points (entry/exit) that need monitoring, and sometimes restrictions, for security purposes. Technology advancements in magnetic access cards, RFIDs, and biometrics are increasingly being deployed in buildings to improve security measures. Security personnel and facilities operators can centrally manage and monitor various access points, coupled with real-time updates and changes.

An existing IP network in the building could be an effective backbone for centralized security management and control by providing user-level and/or floor-level access. The movement of people and assets can be monitored via video surveillance over the same IP network. The growth trend in the surveillance market away from analog CCTV toward network-based IP video surveillance is well-recognized. An example of Tridium's enterprise dashboard displaying a real-time view of a building's integrated security camera and access control is shown in Figure 4 below.

Figure 4—Niagara dashboard from a computer desktop



Source: Tridium, Inc.

Digital Signage Systems

Modern advertisement techniques woo consumers with customized, locale-specific ads to create a greater impact, attention, and momentum for the product/service being displayed. The prices of liquid crystal displays (LCD) and plasma displays have plummeted, and shopping malls are increasingly adopting them for delivery of announcements, messages, and, of course, advertisements. IP-based digital signage facilitates remote message control in real-time and is also highly advantageous in emergency situations to help direct mass evacuation efforts.

Renewables and Smart Grid Integration

With electricity demand growing faster than supply, there is a clear opportunity for “intelligence” to be integrated into the energy management chain to improve efficiency. Opportunities are emerging along the entire network from point of generation to point of consumption. The concept of an IP-based enterprise brings an opportunity to marry energy management with digital communication technology. The enterprise can employ many tightly integrated mechanical and electrical systems, as well as micro-renewables, with the ability to respond in real-time to demand response programs and, in some cases, emergency backup power generators.

The adoption of demand response programs and the integration of renewable energy as part of converged enterprise applications are expected to be a phenomenon over the coming decades. The future trend is not only for buildings to become smart through the use of integrated building control systems, but also for whole cities to attain a new level of inter-connectivity. The future trend is for buildings to become an extension of the smart grid deployment by enabling continuous two-way communication capabilities. The key growth enablers include open architecture, connectivity of devices, networks of ubiquitous sensors, and integrated analytical software tools that together will enable a seamless real-time information infrastructure.

Assets (Pervasive Devices/M2M)

M2M solutions have been implemented in a variety of industries and environments to monitor and manage widely dispersed machine assets on a global scale across a wide portfolio. M2M solutions have the inherent capability of providing problem diagnosis from a remote location and removing the hassle of on-site visits. They provide the additional functionality of generating automatic alerts to maintenance personnel via local alarms, pager, e-mail, or mobile phones when power failures, lighting failures, equipment breakdowns, or other events occur. These are some of the versatile advantages provided by M2M solutions.

Depending on the environment in which the solution is being implemented, as well as the business needs driving the solution, machines being managed can communicate wirelessly, via a phone line or an Ethernet network connection. The M2M devices that can be managed and controlled can range from sensors, exit signs, medical equipment, copiers, fuel pumps, etc., and connect at the enterprise level. From an end-user perspective, having visibility over devices and operational data is extremely valuable as it provides high levels of transparency and visibility over assets and operations.

Street Lights

A good example of pervasive M2M play is the use of embedded street lights with the Sedona platform, making each street light part of the enterprise network to enable officials to manage and control those remotely. From a business perspective, instead of having multiple personnel driving around in trucks and climbing dozens of street lamps a day, city officials can now improve the efficiency process with one single user managing and maintaining the operation of thousands of street lights remotely on a computer.

Wireless Technology

The growing support and acceptance of wireless technologies has augmented the application of wireless sensors in areas such as building monitoring, lighting, fire and life safety, and many more. Newly developed standards such as ZigBee, 6LowPan, Z-Wave and others provide flexibility and ease of deployment of wireless systems, as they address the unique needs of remote monitoring and control, and sensory network applications. Wireless IP networks are beneficial in many ways, such as reducing the cost of cables and minimizing the cost of installation. Wireless technologies allow for mobility and flexibility, and various data from building automation systems can be delivered to smart phones, personal digital assistants (PDAs), iPads, PCs or notebooks.

Wireless deployments in buildings are expected to become more commonplace with further evolution of the technology, along with wider acceptance and endorsement from the customers. Tridium's technology supports both wired and wireless technologies. Wireless networks are expected to further expand automation systems to reach new levels of operational efficiencies.

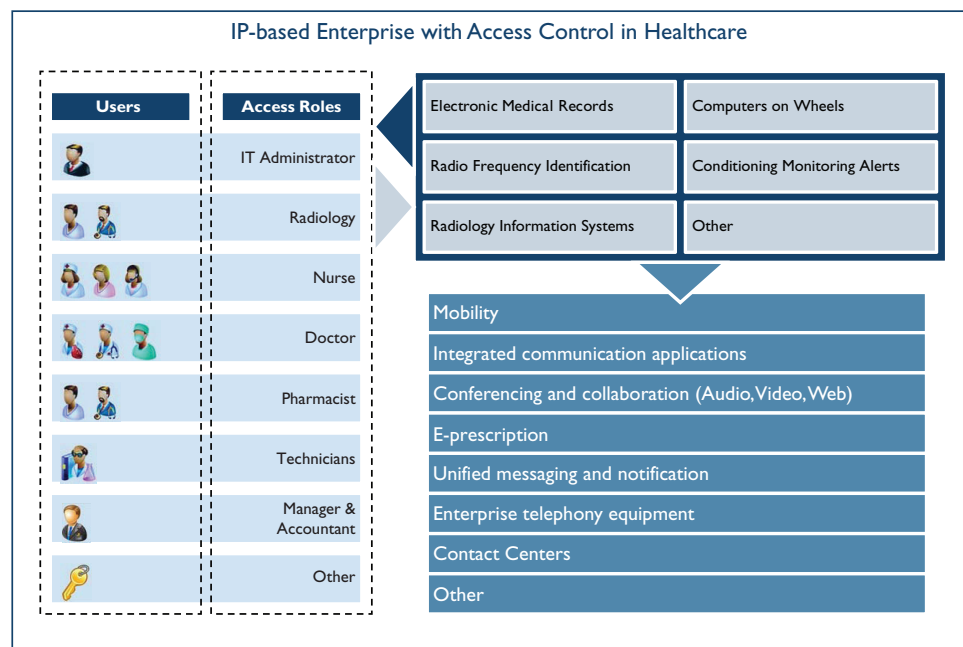
Medical Devices

Healthcare is an information-intensive sector, driven primarily by people and knowledge and the need to respond quickly and efficiently in an environment where downtime is not acceptable. Organizations increasingly demand faster and enhanced communications that will improve collaboration among highly dispersed caregivers, accelerate and simplify decision-making processes, and complement clinical decision support systems, ultimately enhancing patient care.

Healthcare organizations want real-time, reliable and accurate diagnostic results provided by devices that can be monitored remotely whether the patient is in a hospital or at home. These factors indicate that sensors are becoming increasingly important in medical applications. Cost-effectiveness is improved with the increased use of integrated delivery systems through standard interfaces that can easily communicate with other third-party sensor systems. In addition to these features, an IP-based enterprise portal enables care professionals to view data sets of multiple patients simultaneously, via a dedicated server.

Figure 5 depicts how a large hospital with complete digital systems would have various databases such as patient records, laboratory information systems (LIS), radiology information systems (RIS), picture archiving and communication systems (PACS), billing and administrative database, and the IT database. IP-based enterprise solutions can allow devices to operate on a common platform combined with security systems to control access and monitor information usage. The access to these databases can be either given on a user-to-user basis or it could be assigned to different roles within the hospital. The different roles can include the doctor, nurse, radiologist, pharmacist, laboratory technician, accountant, manager, and IT administrator.

Figure 5—Schematic of an IP-based enterprise with access control in healthcare



Source: Frost & Sullivan

Cloud Enterprise Applications—A Major Game Changer

The cloud can help companies meet the growing challenges associated with the increasing number of smart, connected devices and services in the market. Data collected from systems, meters, and sensors are transferred to the IP network and sent over the Internet to central servers. These servers run very complex algorithms and are equipped with very high-processing power. In order to make the analysis more sensitive, data from other installations are also utilized. As data is sent through the Internet, the result of the analysis is a Web service and can be utilized effectively by the building management system, energy management system, or maintenance management system. One feature of this IP-based system is that it is possible to integrate the data and automatically generate work orders and send notification via SMS, phone call, RSS or an e-mail to a PDA, mobile phone, laptop, and the like.

As the entire system is IP-based, it offers automated analysis as a service and the customers would pay on a monthly basis to use this service. Advanced analytical tools such as automated demand response, automated commissioning, energy management, automated fault detection and diagnostics are some of the future applications expected to be available for download on the cloud. Using the cloud allows companies to use best-of-breed technology at lower cost levels. This kind of a business model allows one to choose to use or not to use the service, depending on the requirement. This is analogous to the latest cable TV systems that allow users to switch to the Internet with the flip of the remote, download and watch movies, and pay for them.

CONCLUDING REMARKS

Connecting Devices to New Frontiers

With the flexibility and power of Niagara and Sedona Frameworks, Tridium continues to expand on its vision of interoperability and M2M play to new frontiers. The need, technology, and timing are ripe for the rapid deployment of device-to-enterprise solutions. Global infrastructure is deteriorating, and governments and businesses are under increasing pressure to update and upgrade the physical systems that people and businesses rely on every day. Scores of targeted applications are being constructed from this device-to-enterprise module to quickly and cheaply implement new M2M applications. This presents an opportunity to implement new technologies and applications that will save money, save energy, reduce risk, and improve the quality of life for millions of businesses worldwide. Due to its unique technology and business model, Tridium has broken cost barriers to access data from diverse systems and devices. This timely concept provides powerful solutions and sound technology that builds bridges between systems and devices to accomplish true M2M plug and play for myriad applications.

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