

White Paper

M2M, Device Connectivity and IP Networks - A Synergistic Relationship



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Embedded, “smart” devices pervade our environment. They are hidden behind the walls and ceilings of the buildings we live and work in and are responsible for everything from environmental control (air and water temperature, humidity, lighting levels, air quality), to security (access control, intrusion detection), to electric metering, to the equipment that produces our fast food (ovens, scales, grills), to the production lines that make the goods we buy. These devices are the brains that operate our world allowing us to focus on other things.

These devices have much intelligence and capability in their own right, but are we really using them to their full advantage? Do they tell us what they are doing, what conditions they sense, what decisions they are making, or not making? Are they aware of each other and the actions that each is taking? Do they coordinate with each other? The reality is that embedded devices, unlike the PCs and servers that support desktop applications, do not easily talk with each other. The world of embedded devices is characterized by literally hundreds of different, non-IP communications protocols. Some are considered standards, other are artifacts of substantial investments in legacy systems. And unlike the PCs on our desks, these legacy systems have useful economic lives on the order of 10-15 years, not 3-4 years. The point? – these systems will be with us for a considerable period of time; any solution that helps companies bring these together and better manage their operations must be able to embrace these devices, not require them to be replaced.

The Value of Connecting Devices

As with teams of people, the effectiveness of intelligence increases when information is shared and correlated. Metcalf’s law highlights this by positing that the value of the network increases in relation to the square of the connections. What are the implications when we are able to easily connect intelligent, but non-IP devices?

Let’s think about the devices for a moment. How can the network help them collaborate; be more effective and valuable? How can the real-time, often critical data contained in these devic-

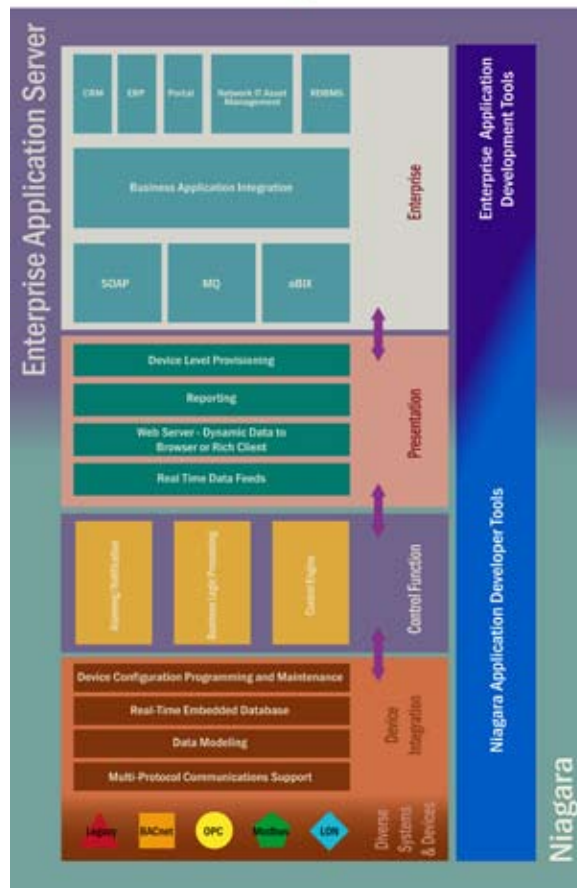
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es be shared, coordinated, and turned into useful, actionable information to help companies maximize the benefit of their technology investments and improve their business operations?

IP networks which provide connectivity to PC-based client applications, browser-based thin client views, and real time data feeds to enterprise applications are part of the solution – part of what we refer to as the “device-to-enterprise solution stack”. Equally important to achieving an end-to-end solution, however, are the other layers of the stack – the device connectivity, protocol conversion, data modeling, device management, application logic and user presentation layers. Without these, there can be no device-to-enterprise solution and no effective connection of the devices to the IP networks.

Tridium’s Niagara Framework® is a comprehensive software infrastructure designed specifically to address the challenges associated with creating Internet-enabled products and comprehensive, device-to-enterprise applications – applications that utilize IP networks to connect real time operational data to the people and systems that manage business enterprises. Niagara provides the critical device connectivity, control, data management, device management and user presentation layers of the stack – in short, it is a complete **IP-Convergence platform.**

The Device-to-Enterprise Solution Stack



Diverse Applications

Today, over 40,000 instances of Niagara are at work in over 6,000 projects worldwide covering a wide range of applications, all of which bring device data to the people and systems that need it via IP networks. Some representative examples of applications include:

Total Facilities Management Company, South Africa

TFMC provides facilities management services to telecommunications network operators in South Africa. They implemented a Niagara-based system to provide real time monitoring and control of remote sites and central stations that are the foundation of South Africa Telekom's network infrastructure. The SA Telekom project connected non-IP based systems including security, fire monitoring and suppression, battery backup, emergency generators, and temperature control systems into an integrated solution that is managed from a central network operations center in a fully web-based application. The system currently supports over 300 sites.

HVAC Concepts, Maryland

HVAC Concepts of Gaithersburg Maryland has established a hosted service bureau for owners of condominiums and apartment buildings in the Maryland/Washington D.C. area. The system, based on Niagara, provides 24/7 monitoring of all essential building systems, automated service dispatch, and customer friendly reporting, all via a web-based application.

Commonwealth of Virginia

The State of Virginia in the United States, selected a Niagara-based solution for a statewide system to monitor, analyze and report energy consumption data for state owned facilities. The system is being implemented in cooperation with the Engineering Department of Virginia Commonwealth University that had independently selected Niagara for a campus-wide system to integrate all of their diverse control and monitoring systems.

Other notable applications include 4 star hotels, hospitals, and 2 of the largest retail store chains in North America, gas station/convergence retail chains, military bases, municipal government installations and Class A commercial office buildings around the world.

Typical System Architecture and the Role of IP Network Connectivity

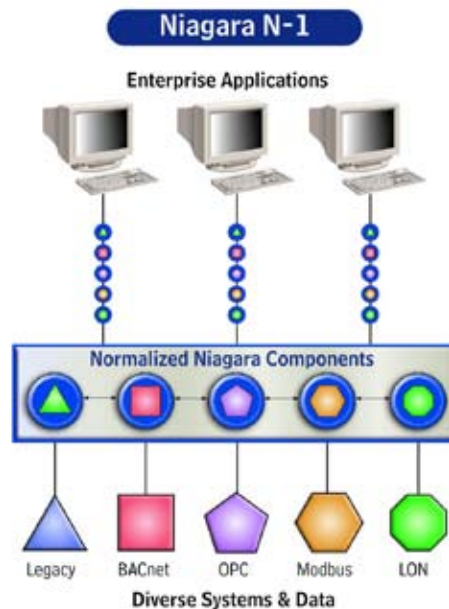
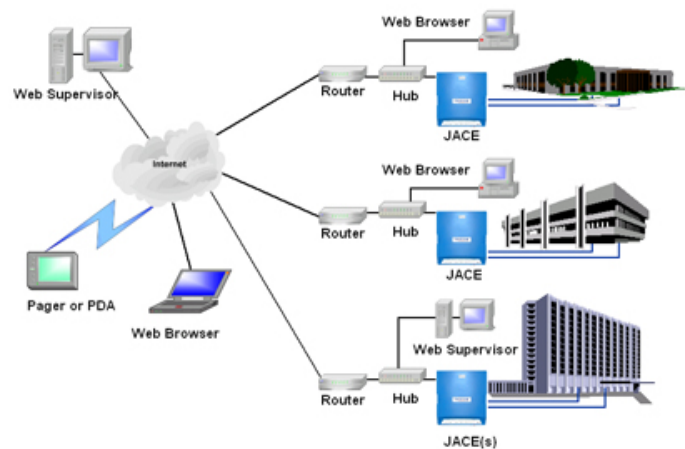
It is helpful at this point to look at how devices are integrated by the Niagara Framework, and connected to the IP network infrastructure.

Niagara software runs in an embedded device (we call it a JACE) that is placed at the edge of the IP network where it connects to the non-IP devices and equipment systems and to the IP network infrastructure.

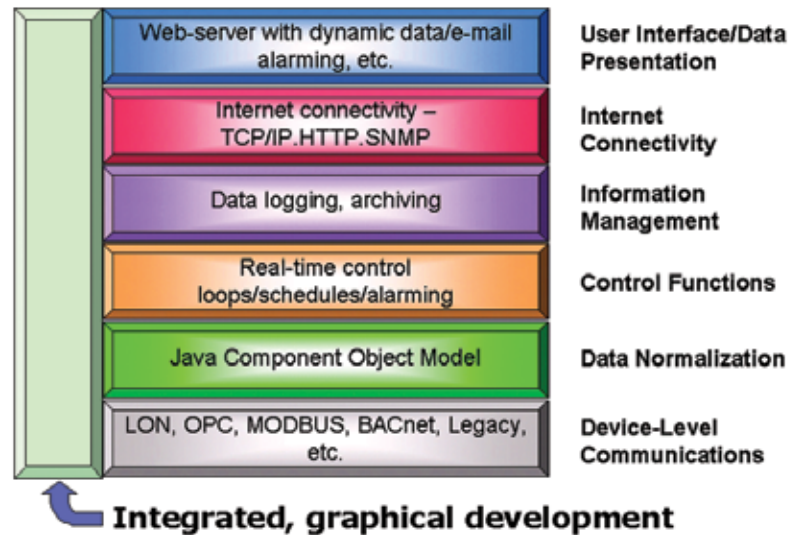
Niagara communicates with the diverse devices and transforms their data into normalized software components that form the foundation of the higher level functions and services, shown earlier in the device-to-enterprise stack diagram

Niagara includes a rich application server specifically designed to perform functions such as: control, alarming/notification, business rules processing, data logging, user presentation to a browser-based device, and data serving to other applications and systems. Niagara provides a complete IP-Convergence platform and can be run on a wide variety of hardware platforms, from small single board computers to fault tolerant server clusters.

Internet-based Deployment Architecture



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The Need to Connect to Operational Data – Expectations Driven by the Pervasive Use of the Internet and Familiarity of the Web

What's your favorite sports team? How long would it take you to check the latest score? Now how long would it take you to determine which of your 100 facilities has the highest energy cost per square foot this month? Could you even do it?

Even if you are a rabid fan you can probably agree that it's a bit illogical that we can check something like a sports score in near real time, yet have no similar ability to check the operation and status of our enterprise and the assets and equipment systems that support it. The always connected lifestyle helps drive the expectations of customers and managers for immediate access to essential data. What could be more essential than information from these assets and the processes that drive your business?

Lean manufacturing, the dramatic costs associated with equipment downtime, competitive pressures, security, regulation compliance – these business realities drive the value of having real time access to operational data, alarms, alerts and system status.

Device connectivity, M2M, IP Convergence – whichever term you prefer, is the next major wave of data flow for IP networks. Tridium's Niagara Framework is a proven enabler in driving that wave.

Niagara Is an Open Solution

One of Niagara's key benefits is that it is an open, flexible platform offered in the market by a wide range of leading companies, giving customers maximum freedom of choice, and the benefits of a competitive marketplace.

Key Elements of an Open System

There are many facets of openness: device connectivity, support for accepted standard protocols, end user access to products, the ability to integrate to legacy systems, third party development of complementary applications, public interfaces (or "APIs") to allow third party access to data, and compatibility with standard databases. Each has relative importance in a given situation. Let's review these topics focusing on simple definitions:

- **Device connectivity** – How many products of importance to my application can the system communicate with?
- **Support for accepted standard protocols** – Does the system support the "lion's share" of relevant standard communication protocols?
- **Access to products for initial purchase and system expansion** - Where can I buy these products? Where can I get them installed or serviced? How many suppliers? Is it a competitive situation?
- **Third party development of complimentary enterprise applications** – can independent developers create new products and applications that work coherently with the system?
- **Public interfaces (or "APIs") to allow third party access to data** – Are there published interfaces that makes it easy to access system data?
- **Compatibility with standard databases** – Can data from the system be easily shared with common database formats used throughout my enterprise?

Now, let's take a quick overview of the Niagara Framework focusing on these measures of open.

Device Connectivity and Support for Accepted Standard Protocols

The Niagara Framework provides support for a wide variety of protocols. It includes comprehensive support for major standards in the building market including BACnet (Ethernet and IP) and LonTalk™ (LON) as a standard feature. Other supported protocols, which are typically considered as “open” protocols include: MODBUS, SNMP (Simple Network Management Protocol), and OPC (Object Linking and Embedding for Process Control).

In addition to these open protocols; Niagara directly supports many proprietary protocols used by manufacturers of control systems and other smart devices. While Niagara does not have an interface to every device ever made (no one does), we are constantly developing new communication interfaces to meet the needs of our customers. Today we have working interfaces to well over 1000 different devices ranging across the building automation, industrial automation, M2M, telecommunications, energy and IT infrastructure markets. Further, any new device that supports any of standard protocols supported by Niagara can be integrated with ease. No additional gateways or custom software is required.

Open to the Enterprise and Availability to Independent Developers

The end user owns the data in their systems, but effective use of that data is where the real value is created. End users need the means to make the information from their systems valuable – to give them the intelligence and knowledge they need to improve the operation of their facilities. Many systems offer reporting tools to help address these needs. Tridium’s Vykon Suite offers tools for advanced data analysis and reporting. But every facility is unique and different and in many cases the standard tools offered by any one manufacturer just don’t fit the needs of the end user. This is where open access to data comes in. Third party tools are often needed to meet unique data reporting and analysis requirements.

The Niagara Framework provides a wide variety of software features to enable robust interfaces with third party software applications. Here are a few key examples:

- Standard Database Support. Niagara supports industry standard databases including: Microsoft SQL Server, Microsoft MSDE, IBM Cloudscape, DB2, and Oracle.
- Public APIs and support for JDBC (Java DataBase Connectivity). Even with the freedom to choose among a number of commercially available databases it may often be

necessary to pull data from the database to bring it into other applications. JDBC is a standard method of accessing data in databases and is supported by almost all major commercial databases. For specialized access to other data in the Niagara framework, Niagara provides public (this means open) API's which provide third party programmers a defined, officially supported method of accessing, reading and writing data.

- Sometimes specialized applications require manipulation of data beyond what the public API's offer. Servlets are a tool that allow a third party programmer to do virtually anything they need with Niagara data. In addition to the public API's, Niagara includes sample servlets to help developers quickly implement servlets that meet their unique application needs.

Access to data and integration with the Enterprise – Niagara provides the richest choice available in the market.

Open to Serve the Customer

The end use customer is where the buck stops with open systems – they choose the systems, they pay for them, they live with them. We believe that an open system gives the end user the ultimate freedom of flexibility and choice. The more open . . . the more freedom.

With Niagara, end users have exceptional choice – the manufacturer of their choice, the protocol of their choice, the local contractor of their choice, the choice to select add-on applications and devices from third party suppliers, and the choice to extend the capabilities of the system through standard software interfaces.

And once those choices are made, the user gets all of the features and benefits of Niagara: the dynamic display of real time information in a standard web browser, built-in network management tools that provide auto-discovery and automated database generation, and the ability to integrate with many proprietary legacy systems. And because Niagara is vendor and protocol neutral, you don't have to commit your future to a single protocol decision. You can specify a project around one protocol today and decide to expand another in the future.

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Perhaps most important, the range of choice comes from the names you know and trust. The companies that offer Niagara-based systems are a virtual who's who of the established players in the automation market.

Open for Partners

The best solutions come from a collaboration of the best minds. The Niagara Framework is a platform built and designed for partners. It enables companies to quickly and easily develop Internet-based products, comprehensive device-to-enterprise applications, Internet-based automation systems and IP-Convergence solutions.

Today Niagara is being successfully applied in the building automation, M2M, telecommunications and energy services industries by a wide range of partners that include OEM manufacturers, and their associated distribution channels, Value Added Resellers, and their associated distribution channels, and independent systems integrators large and small. Other companies have built applications that reside on top of, or work with, the Niagara Framework. These partners have several things in common . . . they see the need for a framework solution, and they recognize the value of "open."

An Open Technology Enabling an Open Market

When evaluated on the measures that matter, Niagara provides industry-leading openness, affording the leading array of connectivity, customer choice, and manufacturer and distribution channel flexibility. Derived from future-oriented Internet standards, Niagara provides the solution to cost effectively integrate multi-vendor, multi-protocol systems with IP networks and enterprise applications to provide true **IP Convergence**.



Technology that Powers the Brands You Trust.

Created to Solve Open.

About Tridium, Inventors of the Niagara Framework

Tridium, based in Richmond, Virginia, was founded in 1996 with a goal of creating an open interoperable framework to solve the challenges associated with device-to-enterprise applications and connecting smart, non-IP devices to the Internet. The company has an established and growing revenue base, including offices in the United Kingdom to support the European market and in Singapore for the Asia Pacific market.

Tridium's main product is the patented *Niagara Framework*® (or "*Niagara*"); a Java-based framework that provides a software infrastructure that integrates diverse systems and devices - regardless of manufacturer, communication standard or software - into a unified platform that can be easily managed in real time over the Internet using a standard web browser

In addition to Niagara, Tridium develops and markets a suite of products and applications, powered by the *Niagara Framework*, and sold under the *Vykon*® brand. This product suite is designed to meet the specific requirements of two key markets served by Tridium - building automation and energy services. *Vykon Building*®, and *Vykon Energy*® enable facilities managers, energy service companies and systems integrators to integrate proprietary and otherwise incompatible solutions into a unified enterprise solution, which permits anyone using a standard Web browser to measure, manage and control a wide variety of facilities and energy applications from any location in the world. Customers in these markets (including OEM and reseller partners) have a choice of either developing their own applications utilizing Tridium's software framework or implementing these off-the-shelf *Vykon applications*.

Tridium's goal is to make Niagara a major global framework for integrating control and monitoring systems of all types via the Internet. Tridium sees the same need to create a standardizing force in the embedded-systems market as occurred in the personal computer market.



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