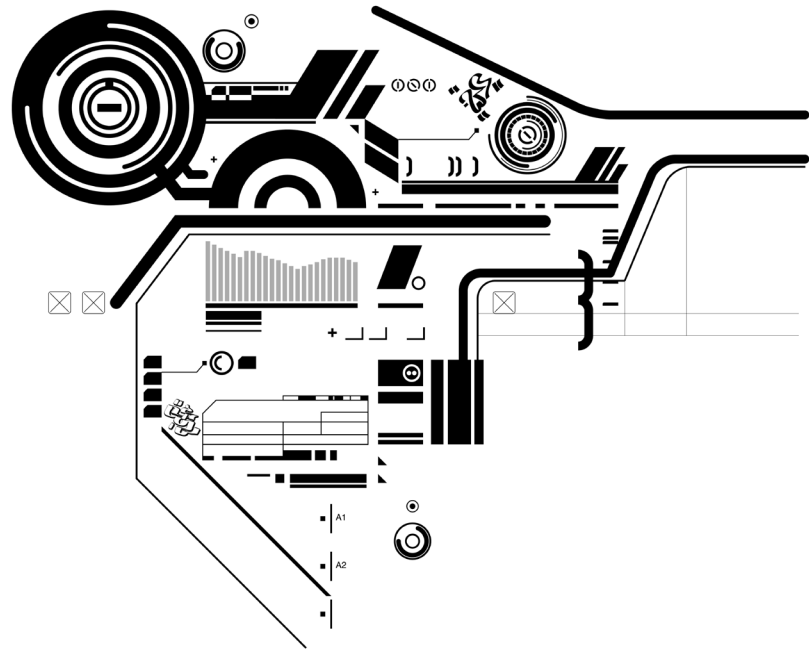


white paper

Eurotech Re-Invents Embedded Connected Computing for M2M 2.0



The convergence of smart connected devices and cloud computing is unleashing an age of anytime, anywhere connectivity that is fostering entirely new modes of customer interaction and service delivery. However, to realize the full potential of this opportunity, customers will need new tools and technologies. Eurotech's Everyware Cloud platform simplifies device and data management by providing an innovative platform that integrates distributed devices with business enterprise applications providing users and developers a path for building open, scalable M2M applications and smart services.

Many “product-driven” businesses are now discovering the concept of connectivity and the growth-creating services enabled by a connected product business model. The opportunities driven by this trend are enormous and everywhere. However, the existing tools that support the development of smart products are not providing the full measure of value they could. The next chapter in the Smart Connected Device market will be driven by new tools that will help product OEMs, third party services providers and enterprise users realize more value by providing a unified solution framework that strips out unnecessary complexity and costs and, ultimately, leverages intelligence in devices, networks and cloud-based services.

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Introduction: Convergence Drives New Value

Machine-To-Machine (M2M) communications and cloud computing are combining to create new modes of asset intelligence, collaboration and decision making. This convergence is informing significant new capabilities in which inputs—from machines, people, sensors, video streams, maps, newsfeeds, and more—is digitized and placed onto networks. These inputs are integrated into systems that connect people, processes, and knowledge to enable collective awareness, efficiencies and better decision making.

We have now entered the age when everyday objects will communicate with, and control, other objects over a global data network—24/7/365. That network is the Internet. The objects are everything from consumer appliances to the elevator you've been waiting for. It's not "the future," it's now—this year, next year—and thus it is vitally important that business leaders understand this phenomenon, its effects on their business, and what they should do right now to position themselves for opportunities that are literally just around the corner:

- » Manufacturing equipment, elevators and escalators, appliances and vehicles that know exactly when and why they will fail, and then alert you or your service

organization before the failure occurs—or even, in some cases, fix themselves.

- » Buildings and facilities with "digital nervous systems" that ensure occupant comfort and safety, and even enhance productivity.
- » Retailers and distributors who know exactly where every piece of inventory is at any moment, and under what conditions it arrived.
- » Industrial customers who save a fortune on energy by being able to see, in real time, exactly how they're using it.
- » OEMs that are not "disintermediated" at the point of sale, but stay connected to end-customers via a steady stream of status/usage/performance data.
- » Healthcare facilities where accurate, up-to-the-minute patient information is always available because every piece of equipment, from digital thermometers to life-support machines, is networked and associated with a patient ID.

And on, and on, and on. Science fiction? Not anymore.

This story is about the intersection of embedded software tools, intelligent device networking and cloud computing services which together have the potential to create a new "superset"

Smart systems connect things, people, processes, and knowledge to enable collective awareness, efficiencies and better decision making

Internet of Things: How Many and Where Are The Things?

Smart connected devices are a global and economic phenomenon of unprecedented scale. Consider the following:

Today the number of connected devices on the planet is approaching the number of people - almost 7 billion.

Depending on your definition of a sensor, there are already more sensors on earth than people.

In the long run, the potential number of smart connected devices could increase to a scale that is two orders of magnitude larger than the population with traditional IT and telephony devices becoming a very small portion of the connected world.

Smart devices will enable new services such as status monitoring, usage tracking, consumable replenishment, automated repair, and new modes of entertainment whose value together could reach beyond \$500 billion in value-added revenues by 2015.

of value in the marketplace. Each of these technologies inherently have standalone value: embedded tools enable smarter more feature-rich products, device connectivity fosters information sharing and awareness and cloud computing offers significantly easier to use and lower cost data management.

What is important about this next wave of M2M and Smart Systems is the combined impact of these technologies. While there is standalone value in each of the innovations, it is the combination of all three technologies that will allow computing technologies to inform real-world physical systems.

This white paper is about a new software platform and tools offering from Eurotech which we believe has the potential to significantly change how solutions for smart connected devices are designed, deployed and managed.

If It's So Obvious, Why Hasn't Anyone Done It?

Some things that look easy turn out to be hard. That's part of the strange saga of M2M and the Internet of Things and its perpetual attempts to get itself off the ground. But some things that should be kept simple are allowed to get unnecessarily complex, and that's the other part of the M2M story. The business and technology development history of the critical elements that comprise

smart connected systems - embedded software, device connectivity and now cloud computing - have all evolved in separate cultures and silos. That's not a good thing when defining and deploying real-world technology to deliver smart connected systems innovation. M2M is a story of "piece-meal" technologies cobbled together from disparate supply-side vendor segments that have, for the most part, never really spoken, communicated or learned from each other.

Their histories are informed by mostly myopic behavior, characteristically:

- » **Embedded Software Tool Players:** Software increasingly dominates the engineering process in consumer and industrial products as small as smart phones, as commonplace as washing machines and automobiles, and as large as farming equipment and airplanes. The primary challenge the embedded software tools players have is being overly focused on developing cheaper, easier to use software to make products smart. What they have not focused on is thinking about how these products will eventually be used in a networked context.
- » **Network Service Providers:** Today's discussions of M2M systems focus almost exclusively on communications -- the "pipe" -- and very little on the information value. Focusing on the commu-

nication element alone as ‘first-order’ business value steals the limelight and potentially eclipses the real revolution -- utilizing both embedded software tools and connectivity to liberate information from sensors and intelligent devices to leverage collective awareness and intelligence.

- » IT Equipment Players: From an IT perspective, today’s corporate IT function is a direct descendent of the company mainframe, and works on the same “batched computing” model—an archival model, yielding a historian’s perspective. Information about events is collected, stored, queried, analyzed, and reported upon. But all after the fact. That’s a very different thing from feeding the real-time inputs of billions of tiny “state machines” into systems that continually compare machine-state to sets of rules and then do something on that basis. For many years now, connected devices and IT systems have been two very strange bedfellows, but with the advent of low cost, easier to deploy IT services via cloud computing, all this is about to change.

This is where the new values of Eurotech’s Everyware Cloud platform really come into focus, integration of the key system elements required to build a complete end-to-end connected device solution. Eurotech has recognized that the intersection of these three technologies creates a differentiated business model by

cleverly combining their potential. All three technologies need to be interwoven and mutually supportive, and increasingly, we believe success only goes to the player that effectively utilizes the combined potential.

IT Meets The Real World

Since the beginning of computing there have essentially been three generations of technology and architecture: mainframe computing, personal computing, and cloud computing. Each generation of technology has had significant impacts on productivity and efficiencies: mainframes standardized transactions; personal computing placed processing power into the hands of professionals; and now, cloud-based systems enabling drastically lower cost IT services and applications. But all of these technologies have evolved in relative isolation from real-time, real-world devices and systems.

Because these IT innovations are now impacting all of us in every day life through the use of smartphones and new managed services from players like Apple, developers working on machine-based applications and smart systems are waking up to new possibilities, including:

- » M2M developers are beginning to recognize the requirement for a unified family of software and tools to develop smart connected devices and systems - today’s diverse software offerings and

Eurotech has recognized that the intersection of these three technologies creates an opportunity for a differentiated business model by cleverly combining their potential

The more that gets
connected, the
greater the reliance
on software

fragmented supplier community will not meet their needs.

- » The rapidly rising requirement for their products to be interoperable with a growing array of applications and systems over open networks.
- » The need for new development protocols to address the growing complexity of new devices and networked systems.
- » The maturation of cloud computing technologies and the related lower cost of integrating classical IT capabilities with real-time devices and systems.

We expect the rate of innovation in smart systems development is poised, finally, to rapidly increase.

Can Technology Save Us From Technology?

Our society is at the cusp of a “perfect storm” of network connectivity. This phenomenon is not just about the dichotomy between people communicating with people or machines communicating with machines: it also includes people communicating with machines (e.g. a networked ATM), and machines communicating with people (e.g. automated stock ticker alerts on your smartphone).

The concept of network effects states that the value of a network grows exponentially with the number of nodes connected to it. Along with the value, however, so too grows the complex-

ity of the software integrated into devices and the reliance on people and organizations developing and supporting these systems as all these smart devices jump onto networks.

With the rapid growth of wireless networks – from cellular to Wi-Fi to sensor networks – connecting devices to the Internet has never been easier. Many new classes of devices are becoming network enabled. The types of devices being connected today extend far beyond the laptops and cell phones we have become so accustomed to. Today, virtually all products that use electricity - from toys and coffee makers to cars and medical diagnostic machines - possess inherent data processing capability and the potential to be networked.

The fact that a rapidly expanding range of devices have the capability to automatically transmit information about status, performance and usage and can interact with people and other devices anywhere in real time points to the increasing complexity of these devices. For example, software for the average mobile phone contains over 10 million lines of code. Over the last five years, software in automobiles has grown from an average of 35 million lines of code to over 100 million. The astronomical growth of features and functions within and among connected devices pushes the bounds of what designers of software for products ever had in mind.

Some basic design principles must be put in place to guide the develop-

ment of smart connected devices and systems. It demands that we design not only devices and networks but also data and information management systems in ways not well addressed by current technologies. The reader may ask, don't we already have a vast number of software products to address these challenges? Don't we have real-time embedded software, monitoring platforms and system development tools? And don't we have cloud services to support the integration of all these devices? And aren't these technologies working together today quite handsomely?

Almost everyone in the M2M supplier arena will answer with a resounding "Yes!"

But consider this analogy from Buckminster Fuller: Suppose you are traveling on an ocean liner that suddenly begins to sink. If you rip the lid off the grand piano in the ballroom, throw it overboard, and jump on it, the floating piano lid may well save your life. But if, under normal circumstances, you set about to design the best possible life preserver, are you going to come up with the lid of a grand piano?

The growing scale of interactions between feature-rich devices and the antiquated tools available today to develop them are like that piano lid. In a period of great change and tumult, it worked—in the sense that it kept us afloat. But that does not make it the best possible design, or qualify it to be something that we should plan to live with forever.

The tools we are working with today to make products "smart" were not designed to handle the scope of new capabilities, the diversity of devices and the massive volume of data-points generated from device interactions. These challenges are diluting the ability of engineering organizations to efficiently and effectively manage development. The fragmented nature of software offerings available today and the growing complexity of M2M applications make it extremely difficult to build an end-to-end M2M application.

What Eurotech has recognized is the need for a development approach and an M2M integration platform that can leverage embedded development tools, connectivity and device data management in a unified manner...that's not too complex for product OEMs to utilize.

Customers expect evolving software tools to be functional, ubiquitous, and easy-to-use. Within this construct, however, the first two expectations run counter to the third. In order to achieve all three, a new approach is required -- a unified development platform for smart connected devices.

Eurotech's Everyware offering is a software platform that quickly connects devices in order to build and manage end-to-end M2M applications. Their development represents a true shift in thinking about how devices and IT systems will be integrated and how they will interact. Key

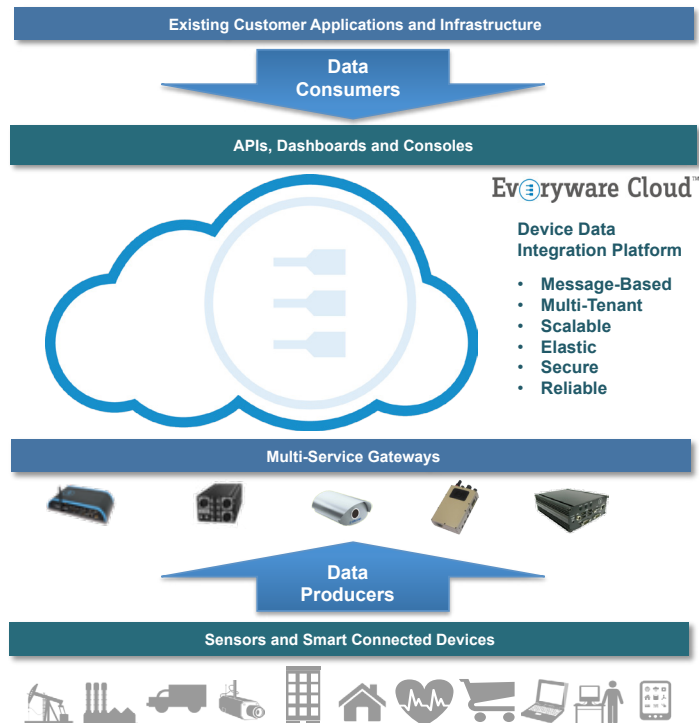
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The tools we are using to make products “smart” today were not designed to handle the complexity they are being required to support

elements they have addressed with Everyware include:

- » Open protocol: Everyware is built on MQTT, an open standard TCP/IP-based transport technology - no more monolithic proprietary solutions;
- » Optimized for machine communications: the protocol is light weight and designed specifically for machine-to-machine communications;
- » “data consumers” allowing developers to freely design and build multiple parallel relations between any device and any application with no dependencies and no limitations;
- » Real-time data management: The platform is designed for real time data aggregation, management and actions - the continuous comparison of device data to various parameters in real-time

Figure 1: Device Data Integration Platform & Building Blocks



- » Decoupling devices and applications: Eurotech’s architecture decouples the relationship between “data producers” and no matter what type of device data - transactional or time series - Everyware is designed on a schema-less, distributed, architecture where data is

managed in a fault tolerant and elastically scalable manner;

- » Real-time and historical analytics: Sophisticated statistical rules can be applied to streaming device data to trigger business decisions in real-time as well as the capabilities to design complex off-line analytics using the long term queryable data.

We are reaching a critical juncture in market development where developers will soon be crying out for a completely new approach - one where the invested effort in developing capabilities and applications can be utilized again and again across an ever broader spectrum of devices and connectivity and integration schemes.

When telephones first came into existence, all calls were routed through switchboards and had to be connected by a live operator. It was long ago forecast that if telephone traffic continued to grow in this way, soon everybody in the world would have to be a switchboard operator. Of course that has not happened, because automation was built into the systems to handle common tasks like connecting calls.

We are quickly approaching analogous circumstances with the proliferation of smart connected devices. Each new device requires too much customization and maintenance just to perform the

basic tasks. We must develop software and methods to automate development, facilitate re-use, and easily connect and integrate device data or risk constraining the growth of this market.

Eurotech has designed a software platform and development tools that work together seamlessly, securely and safely across diverse devices and supports interoperability over long application deployment cycles.

Next Gen Platforms Drive Analytics & Application Values

For all its sophistication, many of today's M2M systems are a direct descendent of the traditional cellular telephony model where the focus is more on connectivity than on enabling data analytics and intelligence.

If the growing number of devices that can be connected are connected in a way that allows them to interact effortlessly and interoperate seamlessly, they begin to give rise to complex, system-wide intelligence. This opens up endless potential for data discovery and analytics.

However, most of today's approaches to data discovery and data intelligence have two failings: they can't provide an integrated view of diverse data types (structured, unstructured or real time) and, users are typically limited to only those questions and queries known in advance.

Given the immature state of today's real-world systems, most people have

Everyware Cloud Platform Values:

Eurotech's new platform provides a robust scope of scope of capabilities, including:

Decoupling sensors and applications: flexible M2M platform that grants, at the same time, a complete separation between devices and applications while allowing to build many-to-many relations at the business level to enable new Internet of Things services

Device connectivity: bandwidth optimized, open, data agnostic transport protocol for efficient network usage

Flexible data management: data in any format, even encrypted, can be stored and accessed quickly in a schemaless database

Long-term queryable data: data can be stored and queried later at any time for up to 36 months

Real-time data management: device data can be pushed and statistically analyzed in real-time

Data accessing and querying: standard REST APIs for easy application development and data application integration

The ability to detect patterns in data is where the true value lies in smart systems because it allows not only patterns but a whole higher order of intelligence to emerge

trouble grasping the power and importance these capabilities enable. The ability to detect patterns in data is where the true value lies in smart systems because it allows not only patterns but a whole higher order of intelligence to emerge from large collections of ordinary data.

Eurotech has organized a novel combination of tools and technologies that work together in unprecedented ways to solve more complex and diverse business problems than previous generations of device networking technology and enterprise application tools.

Their platform automatically stores device data in a schema-less, distributed database which is fault tolerant and scalable. This platform stores data in any format and enables access to real time data, in its native form, for use by the final application.

This approach enables business decisions to be triggered based on mathematical and statistical real-time rules applied to device data streams, and includes capabilities for data stream filtering, continuous queries, aggregation and correlation between devices and event pattern recognition to ensure rapid reaction to business-critical scenarios.

Ultimately, this will allow developers and organizations to address the key challenge of optimizing the value of their balance sheets, allowing them to move beyond financial assets and liabilities to their physical assets and

liabilities (like electric grids, hospitals or factories) and then to their intangible assets and liabilities (like a skilled workforce or brand). The task of optimizing these assets and liabilities is where real and sustaining value can be found.

Platform Innovation Sets The Stage For New Services Value

Once a device becomes networked and is integrated into enterprise-focused cloud services, it will also serve the larger business purpose of being a key driver for the vertical customization of services in general. For example, “asset management” is an important service that incorporates a number of different variables and systems (diagnostics for equipment health monitoring, location services for maintenance and spare parts planning, etc.). Application service providers need to organize the devices and system capabilities they offer configured for the environment in which they operate—factory, office, hospital, and elsewhere. A product inventory program will have a much different configuration in a factory than it will in an office building. More than ever before, the drivers, needs, and environmental conditions will determine the way technology is implemented. Ultimately, all devices and services, like asset management, will be highly configurable to match the needs of a particular vertical, or even of a particular end-user.

We have historically referred to these foundation/platform functions as

“Systems Applications.” By this we mean a set of state-based application functions that are horizontal in nature and often characterized in a general sense as “middleware” that are not seen by the end user (we do not like the term middleware as it risks generalizing capabilities that are unique to smart systems applications).

In its most basic and practical form, our concept of “systems applications” is what Eurotech has created. These foundation platform functions are, in fact, very horizontal in nature. In its most basic and practical form, Eurotech’s platform, software tools and cloud services will enable significant re-use of developed applications across diverse environments -- how devices are modeled, how data is secured, how data is transported and, ultimately, how data is utilized in applications will evolve to be very repeatable.

Enterprise customers will be able to manage their portfolio of wirelessly connected devices either through pre-configured web portals or existing back office systems. Application Programming Interfaces (APIs) will enable straight forward device applications matched to unique client needs.

The integration of traditional enterprise IT capabilities with real-time device data management will allow applications to be adapted to business scenarios, with specific components pushed down to intelligent devices where they can execute a

specified action. For example, alerting a maintenance technician on their smartphone to a potential equipment failure, notifying a doctor on a tablet device about the drug allergies of a patient they are about to examine, or directing the thermostat in an individual office to raise the temperature by turning down the air conditioning by three degrees.

The intersection of next generation smart connected device development tools, new IT “cloud” services and network infrastructure creates new values across the business spectrum. Service and application delivery platforms will increasingly drive value creation in M2M markets - applications are a critical element as companies move to connect and manage products.

Eurotech Drives New Model

Though their business models are intermingling today, all of the major categories of suppliers - “traditional” embedded tools players, the device connectivity players and the IT systems players - have historically operated within well-established assumptions about product scope and business models. No one would characterize any of the existing players of being business model innovators or disruptive in nature.

We believe this market environment offered an open invitation to Eurotech to disrupt the status quo. Eurotech’s offering is clear evidence of their intention to do so.

About Harbor Research:

Founded in 1984, Harbor Research Inc. has more than twenty five years experience in providing strategic consulting and research services that enable our clients to understand and capitalize on emergent and disruptive opportunities driven by information and communications technology. The firm has established a unique competence in developing business models and strategy for the convergence of pervasive computing, global networking and smart systems.