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INDUSTRIAL CONTROL
Solutions Guide

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Embedded Systems for Industrial Control in a Greener World

To meet the demands for energy efficiency for cost savings and to reduce emissions that contribute to global warming, Intel stands ready with the technologies, the product roadmaps and the vision for a greener future.

Efficiency. It's a word we use every day. At the first level, it means doing more with the same amount of resources—be those resources time, money or energy. At the next level, it is doing more with fewer resources. No industry or technology in history has had more success at increasing efficiency at all levels over all resources than the computer industry. That success has now given the world the opportunity to use that technology to improve efficiency over all areas of life: personal, industrial and public. Today Intel is poised with new technologies, new products and a new vision to enable intelligent automation for a more efficient, cleaner and above all, greener world.

And that technology is backed by huge numbers of talented programmers and engineers along with a host of sophisticated development tools that can get Intel®-based systems designed, integrated, installed and connected. These are backed by a host of OEM partners who are already offering Intel® Atom™ processor and multi-core-based COM and SBC modules with memory, I/O, BIOS and operating systems installed and verified. This selection of Intel®-based technology comes in a wide array of form factors and configurations that can readily be built into new or existing equipment to give it the embedded intelligence for energy-efficient operation in scores of application areas.

The largest amount of power used in factories is for running electric motors. Many machines consist of multiple motors of different power capacities, all of which can benefit from intelligent control.

The harsh fact is that a vast amount of the power that is produced worldwide is simply wasted, dissipated as heat, gone. At the same time the emissions from the fuels that created that waste energy are dissipated into the atmosphere as greenhouse gases, which worsen global warming. Energy waste happens at the macro level at power plants and over long-distance transmission lines as well as at the micro level in millions of individual appliances and devices. The average desktop PC wastes nearly half the power it consumes. Today's servers lose about one third. Although both desktop and laptop computers are provided with power management settings, some 90% of all desktops do not use them. Systems that still use CRT displays continue to suck up vast amounts of power. That is about to change.

Intel's revolutionary 45nm hafnium-based technology is driving Moore's Law further than ever before and at unheard-of power savings. The new process technology has already resulted in dual-core and quad-core technologies and in the new Intel Atom processor family of 32-bit x86 processors that are changing the very nature and reach of embedded control. At 1.6 GHz, today's Intel Atom processor consuming 2W, shows an almost 6x increase in performance per watt over a 1.6 GHz Centrino from 2003 running at 22W. Such a radical improvement not only consumes less power and generates less heat, it allows a finer distribution of high-end embedded computing into a vast array of devices and applications for which it was previously unthinkable. The doors have been flung wide open for innovation.

The Intel® processor family alone can meet the application demands all the way from the "big iron" down to small dedicated modules and even handheld mobile monitoring equipment. Intel® processors include an instruction set architecture that can accommodate legacy applications along with the new ones that are constantly being developed, and frequently rely on the ability to reuse software in new applications. In addition, they support features such as virtualization and Advanced Management Technology that assist in the flexibility, adaptability and manageability not only of individual machines, but also of machines cooperating in running common as well as unrelated functions in large networks.

Such power savings are great news for users of computers in general and even more so for operators of large data centers where savings can amount to tens of thousands of dollars per year. But since digital computer and communications systems consume somewhere around two percent of the world's energy, the impact on global warming, energy consumption and the generation of greenhouse gases is by itself minimal. The real challenge and the real opportunities lie in using this computing power to improve energy savings outside the information and communications industries in areas including industrial manufacturing, transportation systems, building automation for retrofit and design, power and energy management and more. Industrial activity alone is responsible for some 23 percent of the world's greenhouse gas emissions—and that is beyond the contribution of the power plants that generate the electricity used by industry, which uses nearly half the electrical power generated globally. There is much to do and now we have the means to do it.

Greening the Factory Floor

Green is not just a term for use by environmental activists. It is also the color of money. It directly affects the bottom line. What CEO would object to running his company's operations and even expanding them while using and paying for less electricity? Who would oppose making better use of engineering and human resources and improving not only the automated systems, but also the overall production process by automating operations around a common computing architecture that reached from the corporate servers to the sensors and actuators on the factory floor? And if that had the added benefit of reducing emissions in the face of government restrictions that are surely on their way, the payoff would be even greater. The two means to accomplish this are, at the process level, the automation of Product Lifecycle Management (PLM) across the entire enterprise, and at the operations level, the use of intelligent motor control for energy savings.

PLM can be thought of as both a repository for all information that affects a product as well as a communication process between actors in the product process including engineering, manufacturing and service. To that end, it also incorporates the various elements that produce and consume the product information, such as design, machine control and documentation. In order for a PLM environment to work, all these elements that have vastly differing computing requirements must interact seamlessly.

The advantages gained by PLM—reduced time-to-market, better product quality, reduced design and development costs, reduced waste, etc.—are made possible through the reuse of the data generated by all elements participating in the process. Thus, aspects of data produced by a CAD system can be reused to produce documentation, develop the code for fabricating parts and for developing options for customers to select in configuring a custom order.

Intel® Active Management Technology (Intel® AMT) can greatly aid this process by helping to identify resources present on the network that can be used for simulating the production. These could be real machines that can be connected to the trial run, or processor cores where virtual nodes can be simulated using Virtualization so as not to conflict with processes that may be running on other cores for some current operations. Intel AMT can be used to move software to selected nodes for use in the simulation and later to manage the ongoing processes by supporting software fault detection and identifying faulty peripherals. This can be done over a subnetwork that is assigned to the simulation process and will not interfere with traffic running on the active manufacturing process.

In many cases, the production design will involve the reuse of large amounts of software in different configurations. Here again, it is a great advantage to have a unified Intel® architecture over which software components and applications can be easily distributed and configured, and processor resources that can be readily scaled to meet the needs of those applications without the time lost on analysis, recompilation and reverification of code that is already proven just to move it to another architecture. Within the Intel architecture, that is never an issue and the time and cost savings are tremendous.

Across the board, multi-core, virtualization and AMT allow for constant seamless improvement while machines are still being used for productive work. For example, legacy code can run on one or two cores while enhancements are being developed on another core. Incremental improvements can be made to existing code, debugged, verified and then patched in using AMT without disturbing operations and constantly improving quality and efficiency. Reducing the requirement to assign dedicated tasks to dedicated platforms frees resources for reuse, reconfiguration and enhancement while minimizing time and costs.

Given the characteristics and scope of PLM, it becomes apparent that the computing environment needed to support such a complex and diverse process must be very powerful, yet at the same time have the ability to economically scale to the needs of the various elements. The computers that maintain the data repository are certainly not the same ones that run the automatic painting equipment. At the same time, however, it is desirable to have a common architecture that will enable the use of a compatible operating system, networking and communications software and that will support the broad range of applications that will be installed to support the various phases of the process and all aspects of factory operations. Such an environment also makes it easy to integrate and coordinate the energy-saving technologies that are transforming the factory floor including intelligent motor control, lighting control and building management of HVAC systems as well.

Only Intel offers the range of processing power and the selection of features with the flexibility, configurability and manageability to meet the needs of the modern digital factory. The x86 architecture scales from the smallest low-power Intel Atom processor to the most powerful multi-core Intel® Xeon® processor to enable a world where the machines can easily communicate and take on different tasks as the situation demands without major reconfiguration efforts.

This stability and flexibility exists not only over the range of processing engines but over time as well. The Intel architecture code base is compatible with processors available now across performance ranges, but also with processors available well into the distant future. In addition, Intel protects the investment in resources by providing long life cycle roadmaps for its embedded products and chipsets that span at least seven years.

Managing Motors

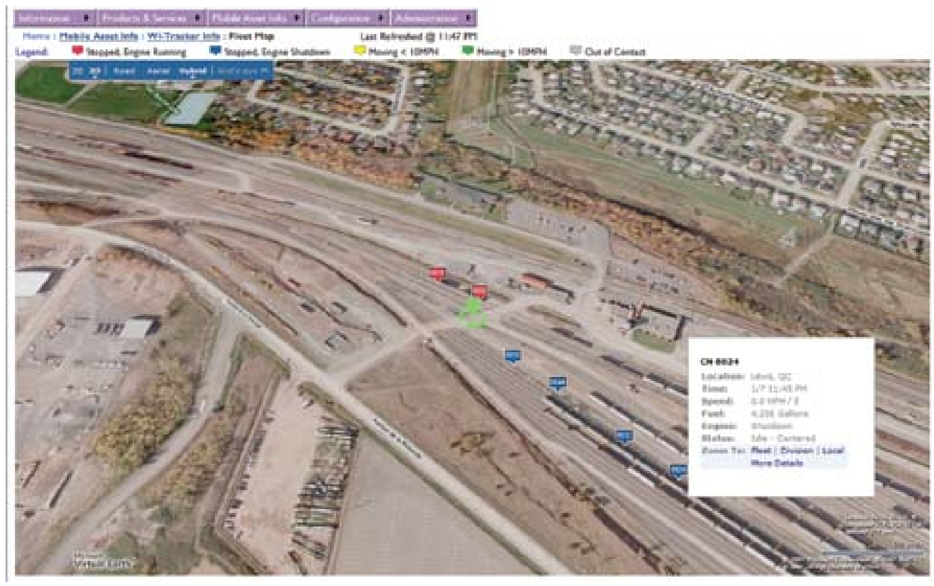
Implementing PLM in the digital factory represents a quantum leap in reusing information to manage resources for efficient operations, resulting in savings in manpower, equipment, time and energy. But for real, raw energy savings in the manufacturing environment, we need to address the use of electric motors. While industrial activity uses nearly half the power generated globally, industrial motor systems consume about 65% of the electricity used in factories, making them directly responsible for 7% of global emissions and representing a huge portion of the expenses for the manufacturing process.

Most motor systems are dumb. They simply turn on and off and run at the speed and torque they were designed for. However, applications have varying needs and while a minority may be fine with a dumb motor, most could take advantage of intelligent control to match the speed and torque of the motor to the load at any given time. There are also issues with inrush current when a motor starts up because it draws a lot of current to get going. For applications that require motors to frequently start and stop, this can amount to a huge waste of power. Dumb motors that simply churn out a constant power output are often matched to the needs of their applications by mechanical means such as gears and belts resulting in further huge wastes of power.

One approach has been the variable speed drive (VSD), a motor controller that holds a motor's velocity signal to a selected range based on a function of voltage, temperature and load changes. Two types are available, an open loop control that simply sets the speed and relies on the motor's internal regulation, and a more intelligent closed loop control that measures the motor's speed and adjusts it to the set value. Most VSDs are external boxes that attach to the motor and operate in the range of 75 to 750 watts.

Obviously, any control system that uses a feedback loop can benefit from embedded microprocessor control, and the emergence of processors like the Atom point the way to smaller controllers that can potentially be integrated into the motor itself. They also open the path for integration into even smaller motors (as well as larger ones) and the incorporation of additional intelligence for even more efficient operation.

Beyond variable speed control, there is a big push for smarter motor systems.



This railway monitoring system by Wi-Tronix allows an operator to locate any car via GPS tracking and see the car's contents, its destination, routing and also monitor the critical mechanical systems to anticipate maintenance requirements.

Traditionally, it has been easier to apply motor control to DC motors because they are simpler, and DC motors can produce full torque at zero speed. In addition, it is possible to control speed and torque independently. AC motors, however, have advantages in terms of size and the variety of motors available, lower maintenance requirements and they can run at high speed because there are no brushes. AC motor controllers that also offer torque control are beginning to appear on the market and should gain in popularity. A constant torque drive is appropriate where torque requirements are independent of speed. Applications such as fans, pumps and blowers, however, require full torque at top speed and diminishing torque with decreasing speed. A variable torque drive in such cases can significantly reduce power consumption.

This represents a growing opportunity for implementing control using embedded intelligence, which offers even more possibilities in that an intelligent motor controller can dynamically monitor the motor's load as the load changes and calculate the amount of power needed at any given time, and adjust the power accordingly. This fine-grained control not only greatly reduces the overall amount of electricity used; it also can increase the life span of a motor by reducing maintenance requirements and—not insignificantly—reducing the carbon footprint of the motor.

That same embedded computing power can also be applied to cases where a motor does not need to start up at full voltage and torque. Intelligent controls can limit the current inrush on start-up, which is often a significant spike in current, letting the motor ramp up more slowly to the desired speed and torque, and directly affecting the bottom line on the power bill. In fact some estimates find that properly sized motors (many are larger than needed because designers overcompensate) with proper intelligent control, along with improved gears, drives, bearings, lubricants, etc., could use 60% less energy.

Translating such numbers to a country like China, that means that optimization of motor systems alone in China could reduce that country's carbon emission by 200 million tons of CO2 by 2020. That in turn yields a $6 billion reduction in carbon costs and electricity savings of around $12 billion. When you integrate tiny intelligent controllers into small and large motors in the millions, the numbers that can come back are truly staggering. China also has a program of government subsidies that will pay for the difference between regular and high-efficiency motors and up to 20% of the cost of VSD installations.

Beyond this, however, integrating intelligent motor control offers even more opportunities in the context of the digital factory. Connecting such motors to the real-time Ethernet makes the data on power consumption and performance available for use within the PLM process as well as for collection in the database for independent energy auditing. In addition, operators can set up a site for central collection of real-time energy data for optimization of operations, such as scheduling processes to make use of available power or when rates are optimal, etc.

A prime candidate for such a scenario would be a Intel® Core™2 Duo processor where one core could be dedicated to the real-time tasks for the monitoring and control of speed, load and torque while the other connects to the network and communicates with the operator control panel and the PLM system.

Instrumentation Everywhere

If you can't measure it, you can't control it. In order to create a new generation of energy-efficient technologies and environmentally friendly products and systems, it is necessary to accurately acquire and analyze data about their performance and their effect on the environment both in the development phase and during actual deployment. In this sense, the activities of test and measurement are no different than they are in any other applications, but the increasing penetration of real-time embedded control into smaller and more distributed systems is putting similar pressure on the instrumentation technology used to analyze these systems.

There is now a trend to integrate measurement capability into the same module as the real-time control, taking what was once a programmable logic controller (PLC) into a programmable automation controller (PAC), which combines the features of a PC-based control system with a PLC. In one such design, the module consists of a processor and an FPGA. The FPGA is used to configure the specific I/O for the device to be controlled, which includes actuator as well as sensing interfaces. The processor runs the real-time operating systems and the control program as well as the data acquisition and the interface to the network. Thus, feedback from the device is available in real time both to the control software as well as to the operators. PACs can integrate multiple Fieldbus networks as well as Ethernet connectivity. They are small, low power and easily distributed.

With the Intel Atom processor's low power and small die size (less than 26 mm^2), the processors are being built into ever smaller devices, which although connected to the network become increasingly physically inaccessible. Here again, virtualization and AMT make it possible to upgrade software without interrupting operation, and do things like additionally upgrade the programming of an FPGA used in a PAC without taking the controller offline.

The diversity of measurements needed to characterize one phenomenon can often be quite large. For example, a factory may be measuring power consumption, internal environmental temperatures, smokestack emissions, chemical effluents and a number of other things. In another application, measuring the transfer of carbon and other materials between the Earth and the atmosphere in a tropical rain forest required gathering data from a wireless sensor network on such parameters as temperature, CO_2, humidity, 3D wind movement, heat flux, solar radiation and photosynthetic active radiation. Having to use multiple data loggers for such a task would have been daunting.

Advances are being made in the popular PXI (PCI eXtensions for Instrumentation) platform with faster CPUs, including the Intel Core 2 Duo processor T9400 running at 2.53 GHz as well as the high-speed PXI Express*, which like the PCI Express* standard will offer 8-, 16-, 32- or 64-bit transfers at up to 64 GByte/s. The combination of high-speed processors on PXI cards along with a higher-speed compatible bus is aimed at handling a huge volume of high-speed and diverse data formats in an affordable and manageable system that will allow managers and operators to deal with the extended mass of real-word data needed to optimize their activities.

Of course, the spread of embedded control also demands the widespread use of intelligent sensors, which are increasingly finding their way into wireless mesh networks, which often communicate using the ZigBee protocol. Fortunately for users of industrial automation, there are standardization efforts underway to integrate the ZigBee protocol with IP, so that such sensor networks can fit seamlessly into applications in factories, building management, transportation, environmental monitoring and power management. Sensors of this type will increase the demand for processors that not only inherently use low power, but which also can incorporate advanced power management such as sleep modes to minimize use of battery power while deployed.

Solar panels are becoming less expensive and more efficient. They will connect to the Smart Grid from many decentralized locations and both put power onto the grid as well as pull it off.

Transportation: Greener Means Safer and Less Costly

There are approximately two million US rail cars and some twenty thousand locomotives moving freight and passengers over this vast continent. They not only connect with cities, but the reliability and scheduling of rail service also directly affect the loading and unloading of ships in ports. In addition, freight is expedited by a vast fleet of over the road trucks and local delivery services. Improving the efficiency of the routing and scheduling of these vehicles has a huge impact on fuel consumption. Monitoring the mechanical condition for timely maintenance can also result in large savings as well as avoiding injuries and death in accidents. Since 9/11, mandates from the Department of Homeland Security have been issued to improve the safety and security of containers and cargo crossing US borders.

Regarding rail transport, there is a very big motivation to develop an integrated system that can track rail cars and locomotives for routing and scheduling as well as incorporate wireless sensor networks to monitor critical points on the rolling stock. Estimates are that the average train speed in the US is about nine miles per hour. Every mile-per-hour increase in average speed can result in a savings of $100 million. On the maintenance side, the numbers are equally compelling. The “average” train wreck due to derailment can cost $100 million. And derailments can be caused by a wheel bearing failure. The ability to catch something as humble as a wheel bearing before it fails can prevent catastrophe. On a less dramatic level, it can greatly reduce maintenance costs by alerting personnel to schedule service at more convenient times then when wheels start smoking on a downgrade in the Rockies. Modules to monitor such parameters must be small, low power and inexpensive yet have the power and connectivity to participate in the overall networked systems. The Intel Atom processor is a perfect fit for these applications with its computational power along with AMT for remote management of modules in small, inaccessible places.

A number of railroad companies have already extensively installed sensors in their rolling stock, but there are differences in how and how often the data is read; there is no unified data format or protocols and so it is difficult but not impossible to bring these existing sensors into an integrated system. For example, in many instances sensors were connected to event recorders, which are black boxes that often lack the ability to be read remotely or in real time. Under development are multi-level systems with wireless networks of sensors at critical points in cars and locomotives that can send data in real time to a central data base. This includes GPS tracking of each car or locomotive’s location, speed and direction to within three meters.

For those cases where existing sensors and modules must be integrated into a more comprehensive system, Intel® multi-core processors can smooth the transition. In many cases, the existing code and RTOS of the sensor could be moved to one core of a multi-core processor, and the RTOS and application code of the supervisory system run on another, needing only to transfer the data between the two. As in so many other application areas, virtualization and AMT ease the task of resource identification, simulation and software upgrade in such critical systems.

By clicking on a train ID on a large map display, a dispatcher can retrieve data on fuel levels, engine conditions and critical mechanical conditions as well as a given asset's destination for routing through switch yards, and scheduling additional freight loading and unloading at terminals along the way. Small processor-based intelligent on-board modules communicating with larger on-board systems and ultimately to large server-based databases will form the core architecture of such systems. Once again, a compatible processor architecture that can span all levels is essential for smooth integration and flexible expansion of such systems, and the Intel architecture is already there to span the whole range of such needs.

Fleet management in transportation also extends to truck and delivery systems as well, and a similar mix of maintenance, safety and scheduling efficiency issues exists here. Already trucks, delivery trucks and service vehicles such as for local phone service are being fitted with GPS tracking systems. These form the foundation for further extension of functionality for fleet management. One interesting aspect is route scheduling to optimize fuel consumption by minimizing left turns. Individually, waiting at an intersection to make a left turn seems a trivial thing. But when you've got tens of thousands of vehicles across the continent on the streets every day, the fuel consumption becomes enormous. Using such management technology and intelligent routing software to avoid making left turns can once again result in tremendous savings not only in fuel, but in the obvious harmful emissions—a win-win proposition all around.

The next generation of green vehicles will also heavily rely on embedded intelligence—not only for their internal operations, but also in terms of the infrastructure that will support them. The coming wave of pluggable hybrid electric vehicles (PHEVs) and fully electric vehicles will interact with the Smart Grid and with intelligent networks of charging stations and battery exchange facilities, all of which will be automated. When a pluggable vehicle, be it PHEV or full electric, connects to a charging station, that station must identify the vehicle by means of an RFID chip for billing purposes and transmit the data to a central location. Intelligence on board the vehicle must not only control the interaction between gasoline and electric motor and/or control the electric motor; it must also monitor available energy and be able to locate a charging station or a battery exchange station via a GPS system and alert the driver.

Work is now underway in Denmark and Israel—supported by government funds and tax incentives—to install a nationwide infrastructure for the use of all-electric vehicles. The system consists of intelligent charging stations and battery exchange stations. For vehicles with replaceable batteries, the exchange stations are a network of bays that the driver can pull into, have his car identified, and where a robot arm will replace the car's battery with a fully charged one in less time than it takes to fill a tank with liquid fuel. Such a system will have its own complement of embedded intelligence, but will also have to interact with the overall electrical power grid. More recently, projects driven by the Israeli-based Better Place company have been started in cooperation with governments in Australia, local governments in the San Francisco Bay area and the Province of Ontario in Canada.

Green Buildings: Big Savings and Better Living

Commercial and residential buildings are major conduits for venting energy into space in the process of providing shelter, warmth and comfort. In 2020, the world will emit some 11.7 billion tons of CO_2 amounting to about $340 billion because of inefficient buildings. The losses are due to leaks in window and door seals, faulty insulation and poor window design to name a few causes. But they also result from inefficient energy usage in terms of heating ventilation and air conditioning (HVAC), lighting and water heating.

In the US the Green Building Council has established a building rating system called Leadership in Energy and Environmental Designs (LEED) to rate new building construction and existing building retrofit for energy usage and environmental quality. The LEED system specifies certification criteria for site sustainability, water efficiency, energy and atmosphere, materials and resources and for indoor environmental quality. While a number of these can be addressed in the building's design and construction, an important part of the criteria concerns the building's energy systems. As in so many other green applications, optimization of energy usage in buildings requires accurate distributed sensing and control. Another part of the criteria actually evaluates the controllability of the systems used to monitor and control lighting and thermal comfort

A number of companies, such as Beckhoff, are rising to meet these challenges with building management systems (BMS) based on embedded PC technology. Touch display control panels allow building managers to monitor systems from a central terminal and set up automated control parameters for what is in reality a widely distributed system consisting of many small intelligent nodes throughout what may be a very large facility. For example, it is possible to set up multiple policies for lighting control based on the types and usage of different rooms. Sensors can detect if the rooms are occupied and when not, shut off the lighting. A combination of temperature and CO_2 sensors makes it possible to adjust the heating or cooling and optimize the airflow for maximum comfort with minimal expenditure of energy.

For optimizing ventilation, software in the BMS must be able to work with controllers for the efficient speed control of pumps and fans. Once again, we see how the importance of intelligent motor control plays a central role in the reduction of electricity consumption in so many diverse applications. A BMS must be able to deal with switching large loads in big facilities as well as having the ability to interface with legacy sensors and devices in the case of a building retrofit. Networking capabilities must span the IP network, wireless networks and the ability to interface with field buses, as we saw in the scenario of the factory. Once again, a scalable, consistent processor architecture such as the Intel architecture offers a seamless path from large to small and from legacy to today's latest design.

The sensors and controllers in a BMS must meet many of the requirements for a general SCADA system. Again, minimizing power consumption for battery-operated nodes is essential. Sending human personnel around a large facility to change batteries represents a major expense. The power management capabilities of the Intel Atom processor, for example, enable it to enter a deep sleep mode that often needs only to be awakened for very short periods to respond to some stimulus or to check its network for messages.

One example can show striking results. The city of San Francisco passed a $100 million bond measure to implement solar, energy efficiency and renewable energy resources for the city's public buildings. One building, the 65,000 square foot Moscone Convention Center, was fitted with solar panels and an intelligent building management system. The solar array accounted for savings of about 825,000 kWh per year. The other improvements, such as switching to T5 fluorescent lighting and the BMS accounted for another 4.5 million kWh per year. In conjunction with lighting, temperature and CO_2 sensors to calculate how much air to move where, the system uses intelligent motor control on the fan motors for optimal energy usage as well.

Wind generators are a source of decentralized renewable energy and are also embedded systems in their own right. Sensors and controls are needed to monitor voltage, current and rotation velocity while also reducing dynamic stress on blades, axel, rotors and gearbox.

Power Management—the Roots of Green

We now get to the source—moving from how energy is used and consumed to how it is produced and distributed. As it turns out, however, production and consumption cannot really be separated. They are interconnected and optimizing them both is required to reduce emissions and the waste of electricity. This interdependence will be particularly significant with the advent of the Smart Grid. The US Department of Energy has received the mandate to orchestrate—among the many players and stakeholders—the upgrade of the nation's power grid. The goal is to make the grid more reliable, more "visible," more efficient and more interactive to accommodate the new sources of renewable energy, such as wind, solar and geothermal, that will be coming online in the near future. DOE estimates show that a mere 5% increase in overall efficiency of the country's power distribution systems would be the equivalent of eliminating the fuel and greenhouse gas emissions of 53 million cars.

Among the attributes of the Smart Grid are that it will be more interactive in terms of two-way communication and that it will be more visible, allowing operators to easily view problems and outages and oversee usage to respond more quickly to changes in demand. One of the attributes of the Smart Grid will be the development of the Advanced Metering Infrastructure (AMI) whereby meters will measure and record usage data at a minimum in hourly intervals. This data will be available to both the utility and to customers at least once a day. Another feature that is starting to appear already is automated meter reading (AMR) where meters are networked, often using the wireless ZigBee protocol to send usage data to the utility for billing, eliminating the need for meter readers to visit customer sites each month.

The existence of the AMI will make it possible for customers to manage their usage by taking advantage of the time-of-use pricing, i.e., lower prices for off-peak usage, to set smart appliances such as dishwashers, washers and driers to operate when they receive the signals over the power line from the utility that the rates are at the pre-programmed level. Smart appliances, of course, will be equipped with microprocessor-based modules to allow them to communicate with and manage their usage of the Smart Grid.

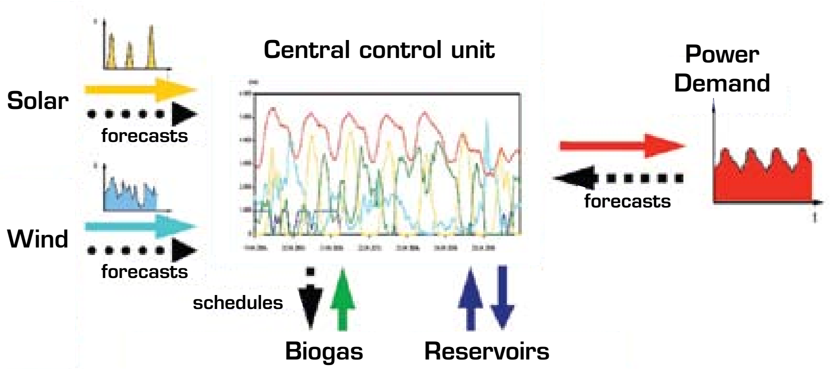
The open, two-way architecture that enables the AMI will also empower grid operators to use visualization technology for real-time load monitoring and response to shifting demands. One prototype management system, under development at Oak Ridge National Laboratory, integrates real-time sensor data, weather information and grid modeling with geographical data so that an operator can view the grid layered on top of Google

Earth from the national level on down to the street level to pinpoint problems and gain insight into operations.

As the grid becomes more intelligent and as more sources of renewable energy become available, it also becomes more decentralized. One of the major areas of power loss is transmission over long distances from power plants to substations and on to consumers. The increased use of solar arrays, wind generators and other renewable resources require that they be easily integrated into the intelligent grid. As solar panels spread among the rooftops of both residential and commercial buildings, they will be taking power off the grid when needed and pushing power back onto the grid ("running the meter backwards") when they are producing more than is being used at that location. This requires the use of intelligent grid tie inverters.

A grid tie inverter works like a normal inverter in that it chops up the DC voltage into a square wave and then smoothes it into a sine wave to produce AC voltage. The grid tie inverter does this, but also has the intelligence to match its frequency to the phase of the grid. It also adjusts its voltage to be slightly higher than that of the grid so that it can make its current flow onto the grid when needed. Grid tie inverters use an embedded computer to sense the grid's AC waveform and match it as well as to set their output voltage to work with the grid. Wind generators, like solar arrays, will also increasingly connect to the Smart Grid from decentralized locations and from locations that may not be foreseen from a long-term planning perspective. They therefore also need this match of intelligence to the grid to be able to connect cleanly. They will require the familiar intelligent control of output voltage and current and matching their AC to the phase of the grid.

Grid engineers often speak of a "system stability problem" involved with incorporating decentralized renewable resources. However, a pilot project in Germany has already shown that an intelligent grid can maintain stability while enabling decentralized wind, solar and hydropower installations to be linked in so that the fluctuations in the energy fed to the grid can be compensated for. This Combined Renewable Energy Power Plant links and controls 36 wind, solar, biomass and hydro power plants spread across Germany, and involves a central control unit that uses forecasts in terms of weather forecasts, expected output and expected load to balance with demand and that can compensate for short-term fluctuations with biogas and/or hydro power.



The German Combined Renewable Energy Power Plant project has demonstrated that by using intelligent control, renewables can function in combination, be balanced across the grid and provide a stable source of power.

The new generation of green energy will save consumers and industry enormous amounts of money and at the same time contribute to the reduction of greenhouse gases that are the major source of accelerating climate change. The keys to this new green future are intelligence, connectivity and adaptability—the hallmarks of the Intel architecture.

So many of the areas that are using technology to achieve green goals are interconnected and interdependent. The digital factory has an over-arching management technology that brings in power efficiency to significant areas like motor control. But it also involves green building management for the internal environment and efficient lighting. Electric vehicles rely on a network of smart charging stations that in turn will rely on a smart grid to monitor and balance energy demand. Transportation systems require a hierarchy of networks from the smallest sensors to large databases, as does the control of the grid. To work with the smart grid, appliances need embedded intelligence that can communicate as well. All aspects of efficient energy management depend on intelligent distributed instrumentation to provide accurate data and feedback.

For all of these areas there is an Intel architecture solution ready to use, be it at the component, OEM module or integrated system level. A range of computing power from the single-core Intel Atom processor to the multi-core Intel® Core™2 processor family, supplies the right level of intelligence for each application. Multi-core solutions can have computing power in reserve for enhanced functionality or partitioned for multiple tasks in the same application. Active Management technology allows upgrades and resource monitoring without disrupting operations. Virtualization provides for simulation and flexibility for the allocation of available computing resources to meet changing needs without major hardware and software changes.

Unseen to the casual observer will be the foundation of what makes it all work—the power of embedded computing that permeates all aspects of green technology. Intel is ready now with the architecture and the embedded virtualization and management technologies that reach from the largest server to the smallest embedded controller—a range of technology that enables the power, scaling, flexibility and the secure roadmap ahead to a more prosperous and greener world.

Wind River
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QNX Software Systems
Fastboot for Intel Architecture

The QNX IPL (Initial Program Loader) start-up approach for Intel® Architecture provides boot loader type functionality that meets the performance needs of hard real time embedded applications with greater control and in exchange eliminating the traditional BIOS expense of an Independent BIOS Vendor (IBV) from your final bill of materials. Compared to traditional x86 BIOS start up time of 20 seconds, a QNX IPL for Intel® Architecture can boot in less than one second. QNX Software Systems, bringing you a Faster Booting and Less Expensive solution.

QNX Software Systems can provide the IPL start-up kit for self-enablement or can provide services to customize an IPL specifically for your device.

www.qnx.com/solutions/industries/automation/

Embedded and Communications Alliance Associate

Wonderware
Wonderware System Platform

The Wonderware System Platform, built on Invensys ArchestrA technology, provides the key functions needed for any industrial information and automation application, including:

- Industrial-level Robustness and Stability
- Software and Device Connectivity
- Information and Data Management
- Information Delivery and Visualization
- Application Development
- System Management and Extensibility

Delivering a framework of services, and extensible with function-specific modules, the System Platform is optimized for today's powerful multi-core architectures to provide a highly-scalable architecture capable of configuration to manage from just 250 to over a million I/O points.

www.wonderware.com

ads-tec
Terminal VMT 6015

PC compatible, slim, robust and beautiful ads-tec terminals have been competing for several generations, and are designed to meet these criteria. Specifically created for tough environmental conditions of daily use in industrial environment, ads-tec terminals work on forklifts and vehicles, as well as on production lines and machines under difficult conditions.

www.ads-tec.com

Embedded and Communications Alliance Affiliate

ICONICS

GENESIS64™

The largest cost of any automation project is in engineering the application. For an average project, this can be well over 60% of the total expenditure. Taking advantage of 64-bit computing can greatly reduce this effort, resulting in enormous savings and helping your bottom line. The GENESIS64 software suite from ICONICS, designed and certified for Microsoft Windows Vista, takes advantage of true 64-bit technology from Intel, allowing for faster development of your automation solution.

GENESIS64 is people-ready and allows plant level workers and IT professionals to integrate real-time manufacturing and business information into a common, OPC-UA-compliant, Web-enabled visualization dashboard. Collaboration of plant information has never been easier. The "Next Generation for Automation" has arrived. GENESIS64 is truly "64-bit-to-the-Core".

GENESIS64 Takes Visualization and SCADA to New Levels Manufacturing, automation and IT technology is changing at an ever accelerated rate. To stay competitive, companies need to adopt 64-bit technology. GENESIS64 takes advantage of the following Microsoft Windows Vista's key features, providing fast returns from your automation project, giving you a competitive advantage.

Universal Data Connectivity using Windows Communication Foundation (WCF)
- Real-time KPI Gadgets and Windows Vista Desktop Sidebar Technology
- Enriched User Experience with Windows Presentation Foundation (WPF)
- Hardware Accelerated Graphics for 3D Imaging
- Increased Security via User Account Control (UAC) Integration
- Virtual Earth Geographical Information System (GIS) Integration
- Integrated Windows Vista Search & Organize Technology
- Windows Workflow Foundation for Secure Real-time Data Communications (WF)

www.iconics.com

Siemens AG, Industry Sector, Industry Automation

SIMATIC IPC

SIMATIC Box IPCs are particularly rugged and reliable industrial PCs in compact design for universal installation in machines, control enclosures and control cabinets. They are equipped with powerful and energy-saving Intel® Core™2 Duo processors and characterized by high performance with minimum space requirements as well as their modular design with high service friendliness, e.g. externally accessible battery compartment for fast replacement of the CMOS battery even when installed. A front portrait assembly kit and mounting bracket allow flexible and space-saving installation in control cabinets with a high level of user friendliness as all interfaces are accessible from the front. The SIMATIC Box PCs offering maximum computing power without power loss up to an ambient temperature of 55°C for reliable 24-h continuous operation and are resistant to high vibration and shock loads for application in rough industrial environments. For reduction engineering costs, Box PC 627B and 827B are equipped with identical long-term available main board basis, image compatibility and identical footprint. They offer onboard PROFIBUS/MPI or PROFINET-interface with three ports for the cost-effective connection of I/O field devices or for coupling to SIMATIC S7
Expansion slots of…
SIMATIC Box PC 627B: 2 x PCI or optional 1 x PCI and 1 x PCIe x4
SIMATIC Box PC 827B: 4 x PCI and 1 x PCIe x4 or optional 2 x PCI and 3 x PCIe x4

www.siemens.com/box-pc **www.siemens.com/ipc**