

Ambient Computing and the Internet of Things

—by Andy Daecher and Tom Galizia, principals, Deloitte Consulting LLP

Ambient computing refers to an ecosystem of Internet-connected “things” that can intelligently respond in real time to business needs. With it, enterprises can move the Internet of Things beyond the novelty and start creating real business value.



The Internet of Things (IoT) is pulling alongside cloud and big data as another seismic IT shift that awaits simple, compelling scenarios to reveal its business potential.

Yet many companies exploring IoT have focused their attention to date largely on the physical “things” themselves, including the sensors, machines, and other devices that act as signals and actuators. These are important, of course, but real innovation comes from interconnecting these devices to do something differently and of value—seeing, understanding, and reacting to the world around them on their own or alongside their human counterparts.

Enter “ambient computing,” in which an ecosystem of things responds in real time to what’s actually happening in the business environment, rather than relying on static, predefined workflows, control scripts, and operating procedures. Ambient computing requires:

- Integrating information flows between varying types of devices from a wide range of global manufacturers with proprietary data and technologies;
- Performing analytics, and managing the physical objects and low-level events to detect signals and predict impact;
- Orchestrating those signals and objects to fulfill complex events or end-to-end business processes; and
- Securing and monitoring the entire system of devices, connectivity, and information exchange.

The current focus on the “things” side of the equation is natural. Advances in sensors, computing, and connectivity now allow us to embed intelligence into almost any object: jet

engines, thermostats, ingestible pills, blast furnaces, electricity grids, and self-driving freight trucks, to name a few.

The revolution is already well underway: An estimated 11 billion sensors are currently deployed on production lines and in power grids, vehicles, containers, offices, and homes. But many aren't connected to a network, much less the Internet.¹ Putting these sensors to work is the challenge, as is deciding which of the 1.5 trillion objects in the world should be connected and for what purpose.² The goal should not be the Internet of Everything; it should be the network of *some* things, deliberately chosen and purposely deployed. Opportunities abound across industries and geographies: connected cities and communities, manufacturing, retail, health care, insurance, and oil and gas.

Look Beyond the Thing

Deliberate choice and purpose should underpin ambient computing efforts. Analytics—specifically turning data into signals and signals into insight—is a big part of that.

Consider a transportation industry example. Embedding sensors and controls in 24,000 locomotives and 365,000 freight cars across 140,000 miles of track supporting U.S. Class I railroads only creates the backdrop for improvement. Companies such as General Electric (GE) are going a step further, creating predictive models and tools for trains and stockyards that optimize trip velocity by accounting for weight, speed, fuel burn, terrain, and train traffic. The gains include faster-rolling trains, pre-emptive maintenance cycles, and the ability to expedite the staging and loading of cargo.³

Such interconnectivity underscores the need for cooperation and communication among a wide range of devices, vendors, and players. Many compelling scenarios spill across departmental boundaries or require cooperation with external parties; blurry boundaries can fragment sponsorship, diffuse investment commitments, and constrain ambitions.

Where to Start

The opportunities presented by ambient computing are evident to many already. In a recent survey, nearly 75 percent of executives said IoT initiatives were underway in their enterprises,⁴ and Gartner predicts that, “by 2020, the installed base of IoT devices will exceed 26 billion units worldwide; therefore, few organizations will escape the need to make products intelligent and the need to interface smart objects with corporate systems.” Other predictions measure economic impact at \$7.1 trillion by 2020,⁵ \$15 trillion in the next 20 years,⁶ and \$14 trillion by 2022.⁷

But moving from abstract potential to tangible investment is one of the biggest hurdles stalling progress. Here are some lessons from early adopters:

Beware fragmentation. Compelling ambient computing use cases will likely cross organizational boundaries. For example, retail “store of the future” initiatives may cross store management, merchandising, warehouse, distribution center, online commerce, and marketing department responsibilities. Such collaboration will require political and financial buy-in across decision-making authorities.

Stay on target. Starting with a concrete business outcome will help define scope and guide which “things” should be considered and what level of intelligence, automation, and brokering will be required. Avoid “shiny object syndrome,” which can be dangerously tempting given how exciting and disruptive the underlying technology can seem.

User first. Even if the solution is largely automated, usability should guide vision, design, implementation, and ongoing maintenance plans. Companies may use personas and journey maps to guide the end-to-end experience, highlighting how the embedded device will take action, or how a human counterpart will participate within the layers of automation.

Eyes wide open. Connecting unconnected things will likely lead to increased costs, business process challenges, and technical hurdles. Be thoughtful about funding the effort and how adoption and coverage will grow. Will individual organizations have to shoulder the burden, or can it be shared within or across industries and ecosystems? Additionally, can some of the investment be passed on to consumers?

Network. With the emphasis on the objects, don’t lose sight of the importance of connectivity, especially for items outside of established facilities. [Forrester Research highlights](#) “a plethora of network technologies and protocols that define radio transmissions including cellular, Wi-Fi, Bluetooth LE, ZigBee, and Z-Wave.” Planning should also include [IPv6 adoption](#).

Stand by for standards. IoT standards for interoperability, communication, and security will continue to evolve, with a mix of governmental bodies, industry players, and vendors solving some of the challenges inherent in such a heterogeneous landscape. Having preliminary standards is important, but organizations shouldn’t hold off on investing until all standards are finalized and approved. Press forward and help shape the standards that affect your business.

Enterprise enablement. Many organizations are still wrestling with how to secure, manage, deploy, and monitor smart phones and tablets. That challenge is exponentially exacerbated by ambient computing. Consider launching complementary efforts to provision, deploy policies for, monitor, maintain, and remediate an ever-changing roster of device types and growing mix of underlying platforms and operating systems.

In many cases, ambient computing will be a sophisticated enabler of amplified intelligence in which applications or visualizations empower humans to act differently. The machine age may be upon us, but automation only sets the stage. Real change will come from combining data with relevant sensors, things, and people in order to perform work differently and rewire the rules of competition.