ELECTRONIC SOLUTIONS **TREND REPORT**

Home Technology — From Connected to Proactive

How manufacturers can successfully position themselves for what comes next

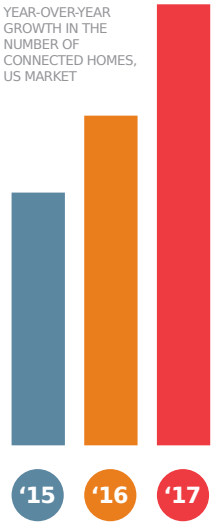
molex

The idea of "home" has greatly evolved over the millennia. Over the last decades, technology has transformed homes into "hubs of functionality" — centers of entertainment, environmental management, work, fitness, security and more.

Molex believes looking at home technology in an evolutionary context is valuable — if not essential — to manufacturers developing the solutions that will further transform tomorrow's homes. The better we are able to see where we were and where we are, the better we may be able to see where we will be. This is of great importance to manufacturers of home products and systems, for they must place bets now to retain a competitive edge down the road.

Molex sees the Connected Home as the current phase in the ongoing evolution of home technology. While some may view the Connected Home as the future, we believe that it is already reality, as the hurdles to achieving connectivity have largely been met. While Connected Home adoption continues to expand, we are looking ahead to the next phase, developing the technology that will guide the transition to homes that grow more proactive and automated than we can currently imagine.

Presently, Connected Home adoption varies widely throughout the world, both in market penetration and use cases. The United States and Canada make up the largest market, growing by 31% per year, but the majority of usage is for home security systems, or detecting fire or water leaks. Europeans are adopting connected home technology in growing numbers, with an overwhelming focus on reducing energy costs through monitoring and adapting applications. Healthcare applications are also popular for an aging European population. Asia is currently the fastest growing market, driven not only by a large, innovative telecom industry, but also by the need to save energy in a region where an inadequate infrastructure can lead to energy shortages.[1]



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[1] McKinsey & Company. "There's No Place Like [A Connected] Home." http://www.mckinsey.com/spContent/connected_homes/index.html

Gartner predicts there will be 20.8 billion Internet of Things-enabled devices by 2020,[2] while Strategy Analytics anticipates that Americans will spend up to $48 billion on these devices by 2020.[3] Globally, the Internet of Things market is estimated at $1.7 trillion.[4]

In the United States, one in four internet users already owns a smart home device (most often a security system or home automation device), with adoption strongest among men with a household income greater than $100,000.[5]

To a greater or lesser degree, the Connected Home has arrived. But how did it get here and where is it going?

1 in 4 internet users already owns a smart home device

Looking at home technology in an evolutionary context is valuable — if not essential.

The Enabled Home

By the end of the 20th century, most homes contained items once considered extravagant luxuries, from refrigerators to multiple television sets to programmable thermostats. Manufacturers with expertise in miniaturization and digitization were leading the way, developing technology that grew richer in features while taking up less space and costing less.

While the home's occupants benefited from greater safety, comfort and convenience, they still had to deal with two significant (by today's standards, anyway) constraints. The first was that these products needed to be activated by people in order for them to respond. For example, when a person turned on an appliance, opened a garage door, set a thermostat or armed a security system, their physical action was required before the electronics could react.

[2] PWC Consumer Intelligence Series. "Smart Home, Seamless Life." January 2017.

[3] IOT-NOW. "Connected Home Trends Around the World." August 4, 2016. https://www.iot-now.com/2016/08/04/50638-connected-home-trends-around-the-world/

[4] PWC

[5] PWC

Second, enabled products were not connected. Manufacturers who created them typically enhanced the discrete functionality of the products themselves, but without integrating those products with anything else in the home or environment. While some products might have used sensor technology (e.g., for motion detection), the products themselves were not interoperable — one product could not react to a sensor in another product.

The Connected Home

As sensors and interconnects have become more pervasive, and cloud technology more robust, homes evolved into today's Connected Home. Devices and appliances can now connect with each other and the cloud through greater interoperability. Additionally, human actuation is becoming less necessary. Devices such as the Amazon Echo with the Alexa Voice Service, the Google Home smart speaker and Apple's HomePod with Siri make the home an increasingly connected, interoperable environment. Occupants can now prompt more actions through voice commands rather than physically pressing a button, and devices are more programmable to act at certain times or conditions without human intervention. Security, cost savings, social engagement, and health and wellness are more easily integrated into the daily routine, rather than another to-do or afterthought.

Still, interoperability of devices remains a "work in progress." Competing technology ecosystems that place myriad products under central control now vie for prominence in the marketplace, and monitoring and control of different devices not made to work with these platforms can be clunky if not impossible. The Connected Home is the present, but the future will demand more seamless interoperability.

The Proactive Home

The next evolution is speculative, but its seeds have already taken root. Leveraging growing artificial intelligence, machine learning, natural language processing and visual recognition, the home itself will acquire the ability to sense — to "watch," "listen," "smell" and "feel." At the heart of this ability will be sensors that can detect movement, temperature, occupancy, etc.

By 2025, approximately 80 billion devices will be connected to the internet.[6] Gartner projects that by 2022, a typical home could contain more than 500 smart devices.[7] Using artificial intelligence that combines data from across these devices, the house will learn, and take "responsibility" for functions such as switching on lights at certain times of day, setting temperature based on the weather, suggesting music and creating grocery lists.

"I think that the individual may not know what's happening, these cognitive systems will ooze into our lives,"says John Cohn, IBM Fellow for the Internet of Things.[8]

For all intents and purposes, the home will become a proactive partner in its occupants' daily existence. It will predict what it is that they need or desire, and act — based on current or changing conditions — even at times before they themselves may realize their own inclination.

THREE-PHASE EVOLUTION OF HOME TECHNOLOGY

	ENABLED HOME	CONNECTED HOME	PROACTIVE HOME
			
Enabling Technologies:	Digitization, miniaturization	Ubiquitous sensors and interconnects, cloud-based services	AI/machine learning, natural language and visual recognition
Supplier Value Creation:	Enhanced discrete product functionality	Increased density of interaction via connections	Data mining and learning algorithms
Dweller Benefits:	Safety, comfort, convenience	Security, health and wellness, convenience, cost savings, sustainability, social engagement	Freedom, self-fulfillment
Communication:	One-way, person-to-device	Two-way, person-to-device, some device-to-device	Two-way, person-to-device, device-to-device, automated responses

For example, the Proactive Home might "observe" that traffic is heavy on a particular day, and "decide" to wake an occupant (let's call her "Jane") 30 minutes earlier than usual to compensate for it. The smart mattress she is sleeping on will track her sleep pattern so the home will "know" that a gentle wake up alarm will do the trick that morning.

[6] ABI Research. "The Future of Sensors in the Smart Home." April 2017. https://www.abiresearch.com/market-research/product/1018560-the-future-of-sensors-in-the-smart-home/

[7] Gartner. "Gartner Says a Typical Family Home Could Contain More Than 500 Smart Devices by 2022." September 2014. http://www.gartner.com/newsroom/id/2839717

[8] IBM. "One Day, You'll Remember When Your House Didn't Know You So Well." https://www.ibm.com/internet-of-things/iot-zones/iot-buildings/cognitive-systems-in-buildings/

As Jane gets up, the shower will already be at her preferred temperature (the home will recognize different people living in it due to their size or other visual characteristics) and the coffee she likes will be brewing.

As she gets ready, a smart mirror may offer advice on everything from wardrobe choice to makeup, together with news and an update on that day's traffic situation.

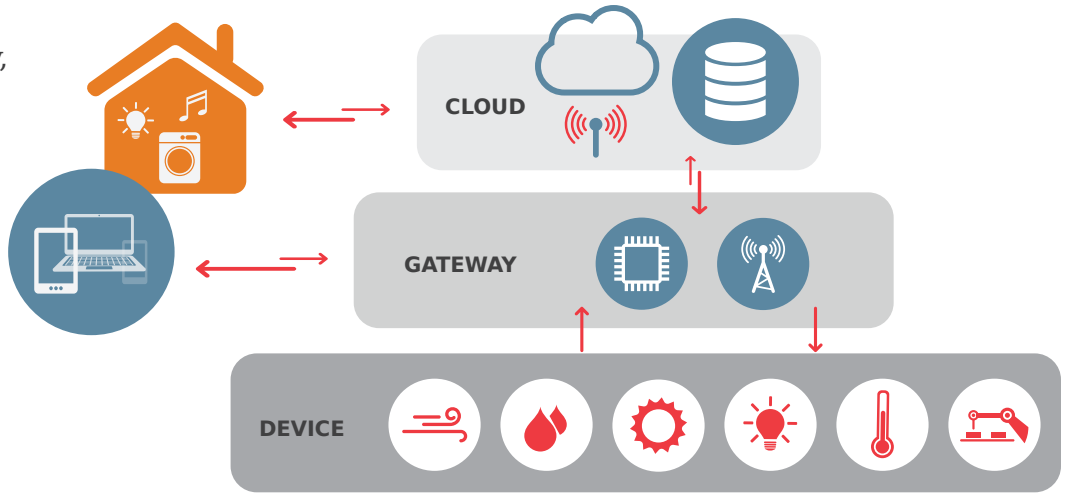
This example shows how, in the span of a few minutes, the home performed a complicated analysis of data drawn from the cloud and local sensors, compared it with learned knowledge and preferences, and made a series of intelligent, proactive decisions that saved the home's occupant time and energy (and likely reduced her stress level).

Making tomorrow's Proactive Home a reality

Molex believes this coming Proactive Home will improve the quality of life for millions of people around the world. By eliminating repetitive tasks or routine chores, life is made easier, but it is the "anticipatory" aspect of this next technology wave that shows the most promise. As with autonomous driving, "autonomous living" will usher in a new age of personal productivity at home. With extra time on their hands, people will enjoy greater opportunities for self-fulfillment. Manufacturers truly able to connect smart devices across platforms and their users are poised to capture and lead new markets — and make their products indispensable to modern life.

There are still a number of challenges to iron out in transforming the Connected Home into the Proactive Home. Power consumption, connectivity and interoperability are just a few. But as these hurdles are overcome, new ones will replace them as the home technology evolution progresses.

Since each consumer's routines and preferences vary, Proactive Home solutions will need to be greatly adaptable, while keeping a positive user experience at their core. One-size-fits-all solutions will not impress tomorrow's consumers, who will expect their homes to flawlessly anticipate their needs with a minimal learning curve.



Product developers must also determine how to reconcile homes with multiple occupants, each with distinct preferences and habits.

Critical to the success of the Connected Home (and the manufacturers who enable it) is the ability to translate harvested data into product value. The many overlapping data streams in a home will be powerful predictors for all kinds of behavior, and will present new opportunities across home technology ecosystems.

No one company can overcome these challenges; instead, collaboration along the entire home technology value chain will be required. Rather than thinking in terms of individual devices, suppliers for the Proactive Home will strive for complete solutions that combine devices, applications, services and processes to harvest and intelligently use all the available data. To truly be "smart," these solutions must articulate and address consumer needs and wants. Leading manufacturers will leverage insights from across the entire supply chain, acquiring and transferring knowledge fluidly from their own component and sub-system suppliers to and from the broader technology ecosystem of which they are a part.

Strategically Choosing the Right Solutions Developer

There are suppliers who focus on one segment within the ecosystem only, but there are also an increasing number of companies that are getting involved in the entire ecosystem. The latter will be better positioned to act as strategic resources in the coming Proactive Home.

Molex, for example, has been traditionally an interconnect company and, as a result, mostly focused on the device layer *(see sidebar)*. But today, we are transforming ourselves into a solutions provider. We are continuously acquiring new technologies, ranging from sensor, software and firmware developments. Additionally, we are collaborating with our own sister companies within Koch Industries to explore bringing ancillary technologies to the home.

Just how smart can the home get?

The answer is "very." Artificial intelligence and machine learning capability will see to that. IBM's Watson is at the forefront of this new era, with capabilities that already mirror some of the key cognitive elements of human thinking. These include:

Understanding
Finding answers and insights locked away in volumes of data — not simply following programmed instructions.

Reasoning
Personalized recommendations — even based on recognition of an occupant's personality or tone.

Learning
Cognitive systems continue to learn and get better at the things they do, without human intervention.

Interacting
Natural language processing skills mean that cognitive systems can engage with humans on human terms.

For example, Molex has joined the EnOcean Alliance with the goal of incorporating EnOcean energy harvesting technology within the Molex Transcend Network Connected Lighting system.

This low-voltage lighting system powers and controls LED fixtures to enable lighting that adapts to mood, tasks, ambient lighting and more. The system not only creates a personalized experience that supports higher productivity, it also enables digital ceiling and smart building networks to converge over IP. The applications feed sensor data to a central host, enabling the measurement of real-time energy consumption, air quality, temperature and more for increased operational efficiency.

Molex also offers the Soligie line of flexible printed electronic solutions, providing a thin, flexible, robust and economical alternative to rigid printed circuit boards (PCBs) or copper flex circuits. The Soligie line enables the use of flexible sensors in a host of applications for the smart home, including remote medical diagnostics.

As mentioned, connectivity and power consumption are critical requirements for connected home devices. Molex Laser Direct Structuring (LDS) technology uses a laser beam to create the required antenna pattern on the surface of complex 3D parts, enabling customers to achieve a higher level of product integration with fewer components at a lower cost.

Wireless charging will also be a feature of the Proactive Home. Molex is now offering both standard and custom wireless power coils with NuCurrent technology for plug-free device charging at the PowerLife standard.

The integrated wireless power coils feature a thin design and a high-power transfer efficiency (Q-factor).

Molex continues to acquire new technologies, which we can leverage as the Connected Home evolves to the Proactive Home — an important part of the larger Internet of Things innovation that will revolutionize our lives.

Molex is already adding value along a number of far-reaching applications. These include:

The Molex team of Connected Home experts is focused on the design, development and distribution of innovative product solutions that touch virtually every walk of life. Our portfolio is among the world's most extensive, with over 100,000 reliable products used across many industries. From capacitive switches and LED displays to antennas and USB connectors, an extensive Molex portfolio supports a wide range of modern home applications.

Application:
Security and surveillance

Products and devices with Molex content:
Smoke detectors; person recognition sensors; burglar sensors; security cameras; door locks; door bells

OEMs need to leverage solution providers that not only understand the Connected Home, but where it's going.

Today's Connected Home manufacturers need to predict where technological change is heading in order to steer design in the right direction. That means they need to work with a solutions provider that not only delivers the products and solutions to help them win consumer acceptance in a crowded field, but one that understands the possibilities of underlying technologies to transform what their products can become.

Since the early days of "electronics" as we know them, Molex has been inspiring and embracing disruption. We know that the Connected Home — the Proactive Home — is a stepping stone to even bigger things as we embark on the next technological revolution. By combining data with interoperability and groundbreaking technology that's already proven reliable, Molex is part of the Internet of Things revolution, helping change society for the better.

Applications where technology is right at home

Molex is a trusted supplier to major consumer electronics, appliance and device OEMs. We are also focused on "disruptive" companies that are emerging across the market and innovating across technology categories.

Foundational Components of Connected Home Technology

Molex's participation in technology for the Connected Home, as well as the evolutions that will follow it, are dependent on several core capabilities. These include precision stamping, plating, molding and assembly. From these capabilities, almost any type of electronic product can arise — completely custom, semi-custom or off-the-shelf.

Application:
Home automation

Products and devices with Molex content:
Connected outlets; indoor and outdoor lighting; smart assistant hubs

Application:
Smart appliances

Products and devices with Molex content:
Smart mirror; smart faucet; smart refrigerator; smart coffee maker

Application:
Home streaming entertainment

Products and devices with Molex content:
Coffee table computer; home streaming device

Currently, our portfolio is among the world's most extensive, with over 100,000 products used across many industries — and it is growing all the time. For the Connected Home, critical Molex content includes:

Antenna

Molex designs, develops and manufactures custom antennas and antenna assemblies for wireless applications. We can support a wide range of communication technologies, including cellular, UMTS, Wi-Fi, WIMAX, Bluetooth, GPS and others.

Sensors

Measuring temperature, motion, force, flow and more are all part of the Connected Home landscape. Molex sensors, including ambient light sensors, proximity sensors and microphones, can meet your device sensor needs. Our exclusive Soligie Printed Electronic Sensor Systems utilize a uniquely integrated design and manufacturing process to produce printed sensor systems that can incorporate a wide variety of components on printed electronic substrates.

Flex assemblies

Molex has one of the industry's broadest lines of printed and flexible hybrid electronics that can fit into smaller spaces while bending to allow for movement. Thanks to a breakthrough new technique we developed, we can now accurately screen silver directly on polyester. In some applications, this Silver Flex option can save significant costs compared to copper.

Switches

Molex capacitive and metal touch switches deliver exceptional performance with superior tactile response and design flexibility.

Application:
Energy and utilities

Products and devices with Molex content:
Weather station; water sensor; smart thermostat; smart meter (water, gas, electric)

Interconnects and assemblies

When you work with Molex, you get access to one of the world's broadest lines of electrical interconnects. In the Connected Home space, this content includes FFC/FPC connectors, HDMI connectors and cable assemblies, USB (Type C) and micro USB products, fine pitch SMT board-to-board connectors, wire-to-wire and wire-to-board connector systems, high-density connector systems, micro SD/combo memory card connectors and SIM and SIM/SD combo connectors to name a few.

Our value goes well beyond products. We can help you work through design issues and mechanical rigors — all while intelligently balancing cost, performance, weight and other requirements. Our deep experience with a vast array of production and manufacturing methods enables us to combine creative design and smart engineering to deliver effective mechanical solutions. In fact, Molex customers often tell us our highest value lies in the earliest stages of the product development process — when design optimization is most important. ■

Your Toughest Challenges
Simply Solved ›

Molex has the current capabilities — and the potential to add new ones as a leader in electronics technology and as part of Koch Industries — to be your solution provider on the road to the connected home. For more information on how Molex can help you design electronics for the connected home, visit **molex.com**.

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