

White Paper

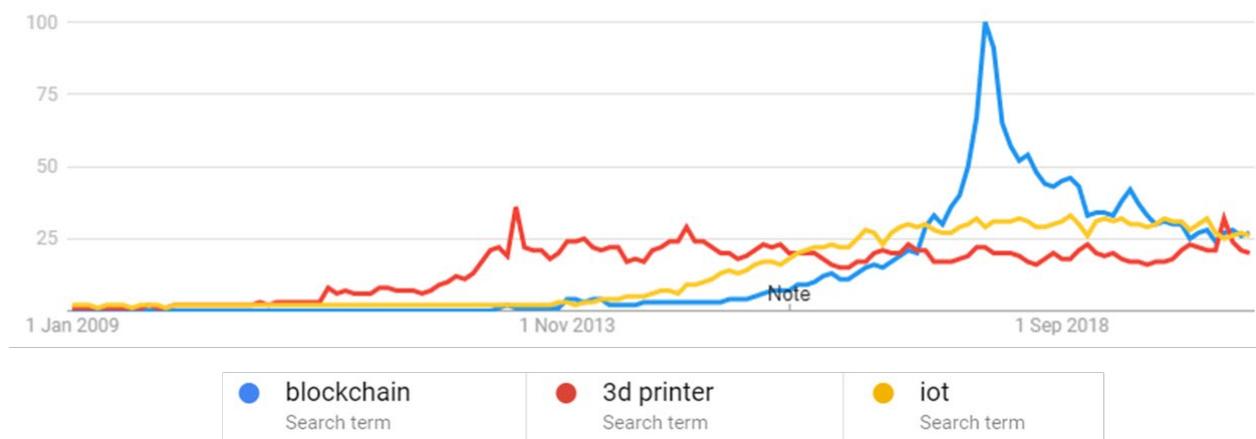


INTERNET OF THINGS for idloTs

In this paper, we give an overview of the Internet of Things (“IoT”) to the uninitiated. Leveraging our three years of work advising Claranova (CLA FP, market cap = €260m), a French digital pure play and leading IoT platform solution provider, we describe what it is and is not, who the players are as well as the trends and opportunities. We also argue that there is ESG in IoT.

Over the last few years, IoT has been much talked about among journalists, venture capitalists and technology enthusiasts. It is another buzz term such as “blockchain”, and “3D printing” that is promising to have a major impact on our lives and provide tremendous investor returns. Yet most of it within the realm of the private sector with the exception of CLA FP.

Google trends: popularity of search terms



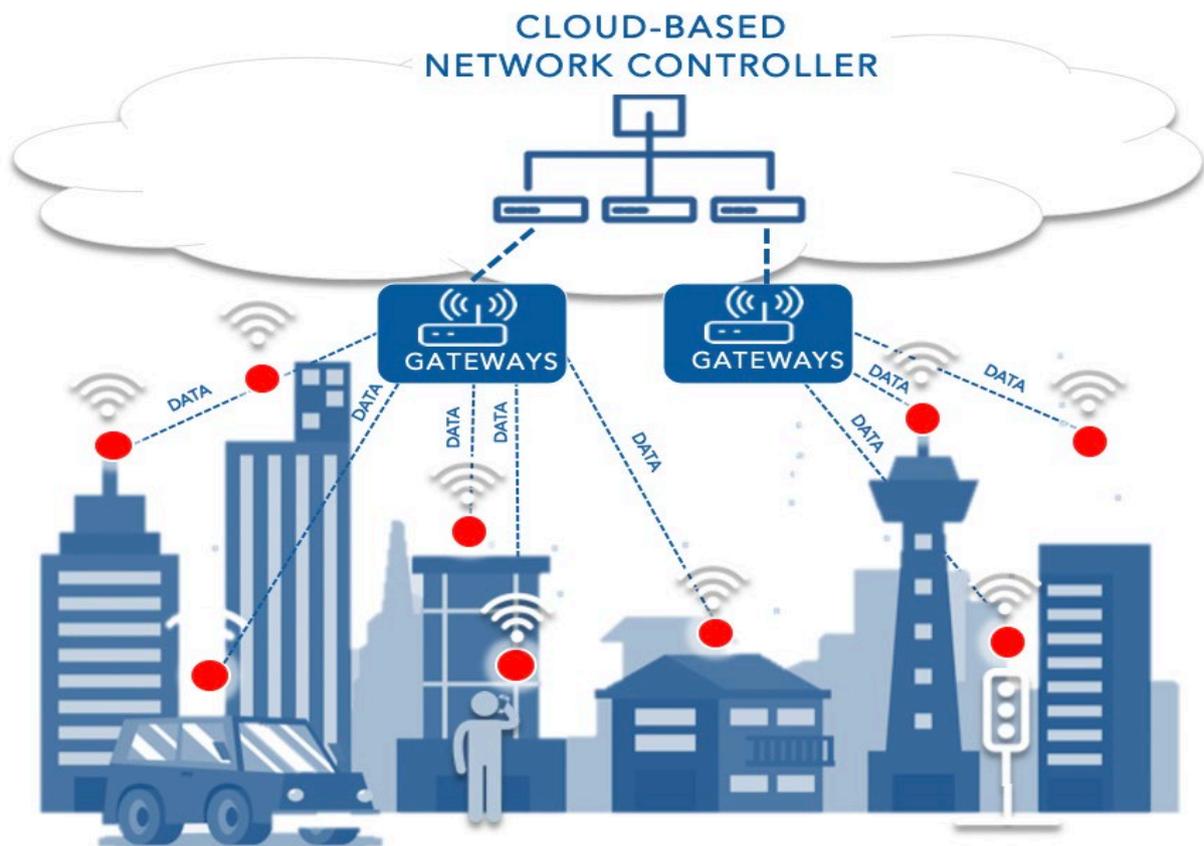
Source: Inbound Capital

However, unlike blockchain which is still controversial and 3D printing which is still a long way from mass adoption, IoT devices already have many very useful applications and are proliferating exponentially in homes, factories and the great outdoors. Furthermore, IoT will tick the ESG (Environmental, Social and Corporate) boxes, which are an increasingly important investment criteria for investors.

* What is IoT?

Old school definition

IoT encompasses everything connected to the internet that does not require human interaction. These devices can be mechanical or digital machines that monitor and/or interact with their environment. They have unique identifiers and are able to receive or transfer data over the internet. In most cases they comprise of a minimum of three main elements: sensor, processor, and communicator. Examples of IoT devices include CCTV IP (Internet Protocol) cameras, smart thermostats, vending machines, and self-driving vehicles. Internet connected devices that require human interaction or control are not considered IoT; such items include desktop computers, laptops, phones, TVs and game consoles.



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Old school definition

IoT technology is evolving at an accelerating pace, and what will be considered IoT in a few years' time will seem unrecognisable by today's preconceptions. According to Claranova, the definition of IoT will be devices that have three main features: wireless, autonomous and extremely low cost.



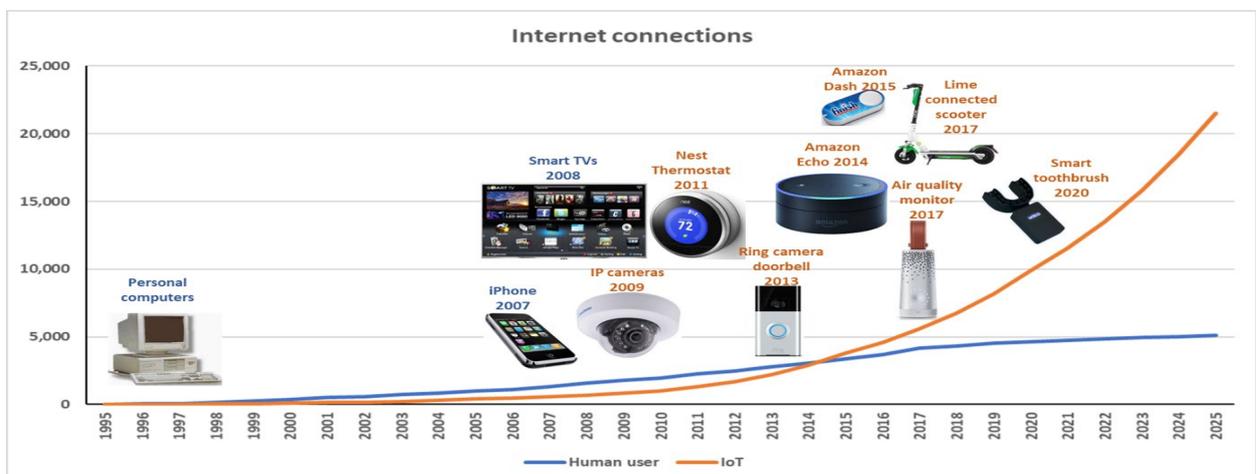
Source: Claranova, Inbound Capital

If you think Alexa is IoT, think again!

The moment when industry is capable of manufacturing products with these three features will be an inflection point and we will see the number of IoT devices truly explode as cost will no longer be a barrier, tethering will no longer be a restraint and the usefulness of autonomy will be a driver. From that moment on, IoT will be all-pervasive and everywhere, and our lives will be significantly changed.

History

The first IoT device is thought to be a Coca-Cola (KO US, market cap = \$202Bn) vending machine at Carnegie Mellon University which was modified in 1982 by computer science students so that it could report inventory levels and temperatures thus helping the students avoid wasted trips to the machine when empty. The machine was connected to Arpanet, a precursor to the internet, and data on the machine's contents could be accessed from the 300 computers worldwide connected to Arpanet at the time – whether anyone on the other side of the planet ever checked the machine's stock level is unknown. It should be pointed out that ATMs were also “online” as early as 1974, but these used proprietary protocols.

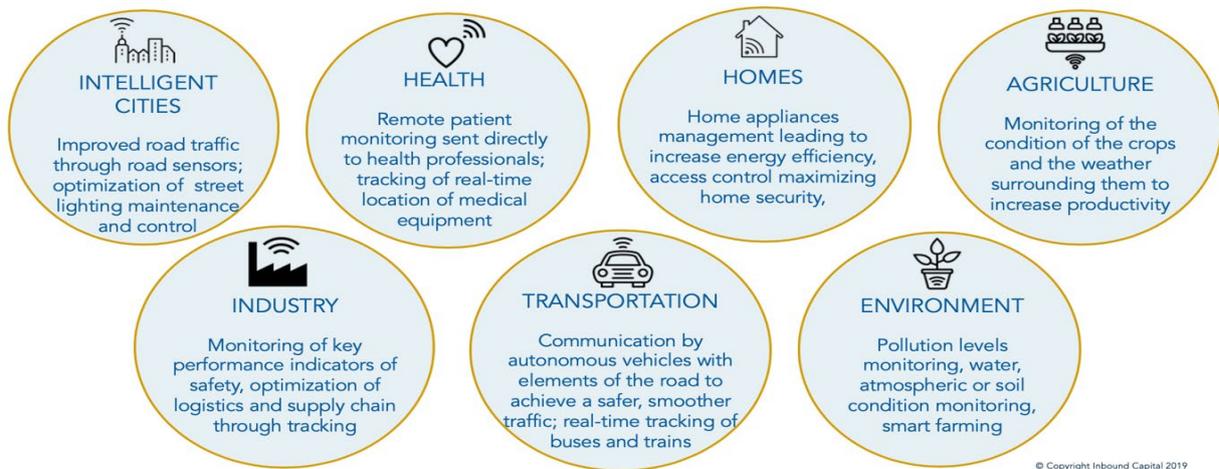


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Over the last forty years, the number of IoT devices has grown exponentially. Until about 2012 the majority of internet connected devices were personal computers followed by mobile phones. The global number of non-IoT internet connected devices is fairly easy to track as it is closely correlated to the number of people. Whereas, the number of IoT devices is much harder to estimate due to the profusion of many different types of device. As a result, estimates on number of IoT devices vary greatly depending on the source (Gartner, Cisco, McKinsey etc), but the growth rate is generally estimated to be circa 25% to 30% per annum. The chart above depicts a growth chart based on an average of various sources.

* Applications

Most people will have come across domestic IoT devices such as a smart thermostat or smart speakers, but IoT devices are proliferating in all sectors of industry and government such as manufacturing, agriculture, mining, hospitality etc – interestingly all with substantial ESG benefits:

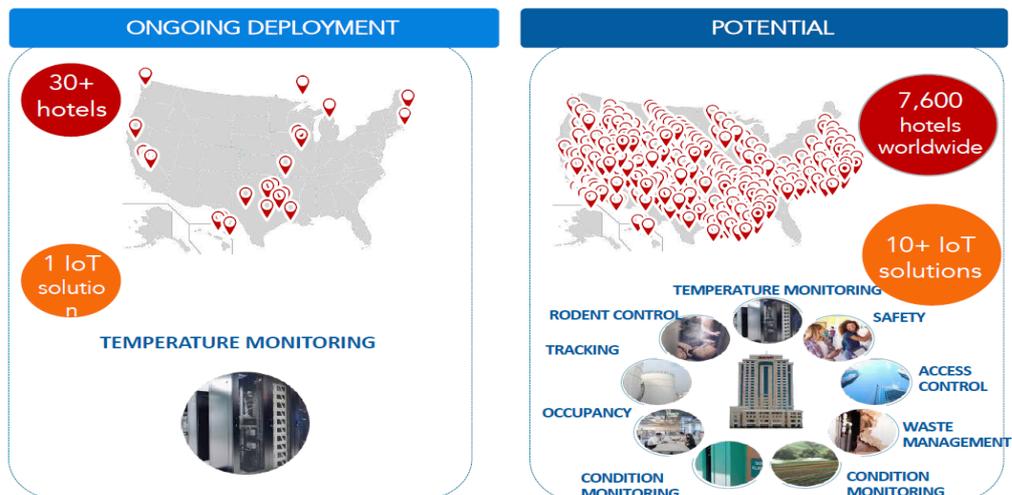


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The Marriott (MAR US, market cap = \$31Bn) hotel chain is an example of a corporate using IoT such as provided by Claranova. The group has consistently wanted to improve customer satisfaction, reduce costs and contribute to its ongoing sustainability efforts and goals with the introduction of smart rooms. For example, guests will be able to instruct the virtual assistant to book a wakeup call, request housekeeping services, set shower to an exact temperature. Behind the scenes, IoT technology will help track room occupancy, waste, rodent control and much more.

THE MARRIOTT BUSINESS CASE



Source: Claranova

* Market Forecasts

IoT devices are projected to number over 20 billion by 2025 (Cisco forecasts 80 billion). Here are some growth examples:

- Smart speakers, such as Amazon Echo and Google Home, have so far sold 200 million units. By 2025, they are forecast to have an installed base of 400 million worldwide and be present in 75% of US households.
- Global shipments of IP cameras are growing at an annual rate of 14% and sales will exceed 100 million units by 2025 reaching an installed base of 1.2 billion.
- Smart doorbell sales are growing at 46% per year.
- The Installed base of smart electricity meters is projected to grow from 600 million today to over 1 billion by 2025.
- The IoT sensor market is forecast to grow at between 24% and 33% per year (depending on the source) for the next 5 years.

* What are the benefits?

There is ESG in IoT

IoT will bring many benefits to consumers and commerce, several ticking ESG boxes.

		Reduced waste	For example, using IoT to optimise temperature control can minimise food waste in production, transport, and storage.
		Efficient use of energy	E.g. continuous condition monitoring of electricity distribution equipment and wiring using sensors can prevent overloads and help maintain balanced loads on the electricity grid.
		Rapid decision making	autonomous devices can make instant decisions based on live data feeds
		Increased labour productivity	IoT is leading to a new industrial revolution which allows increased automation and therefore increased productivity of the labour force.
		Improvement in quality of life	Most domestic devices are tailored to improve quality of life such as lighting, temperature, and security
		Fewer accidents	It is well known that self-driving vehicles such as the Tesla have a myriad of sensors that reduce accidents, but IoT sensors also help reduce industrial accidents in the workplace.
		Improved decision making	Increase in the availability of technical and business data leads to informed decision-making based on insight, knowledge and forecasting.

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* What are the issues?

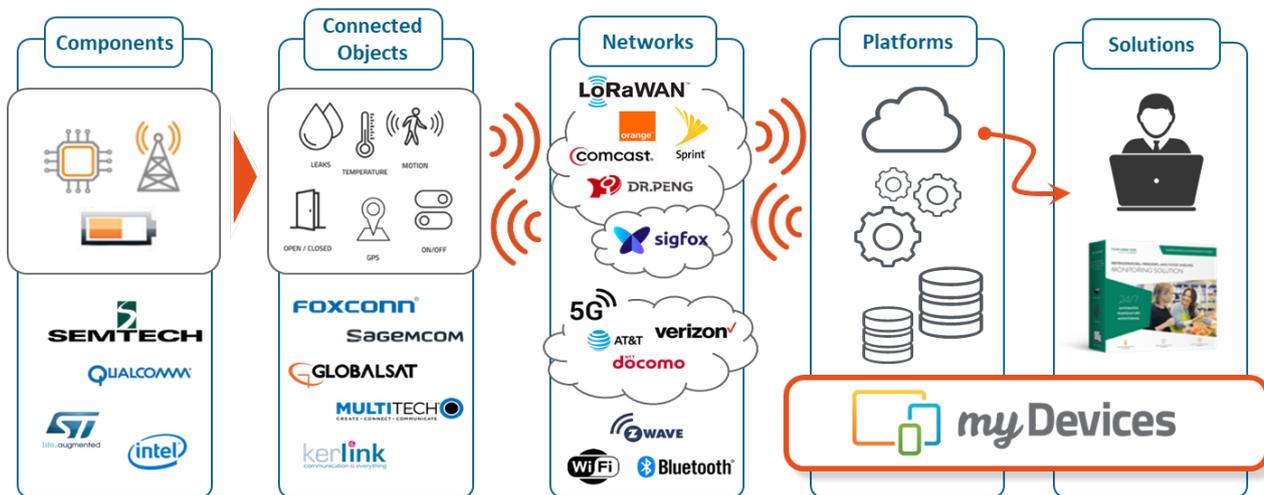
Privacy

There are risks associated with the IoT, for example a person hacking into your home to check whether it is empty or not. The impact of having insecure devices running on the workplace network is even more concerning. Often, they present vulnerabilities for hackers to be able to break into, infiltrating the network and stealing private and commercial information. IoT botnets, created using a network of out-of-date CCTV cameras took large websites and services offline in 2016 - a Chinese firm later recalled 4.3 million unsecured connected cameras. It is clear that protecting IoT applications is going to turn into a key issue for users over time, creating growth opportunities for software companies such as Verimatrix (VMX FP) which provide shielding products and security solutions for IoT applications.

Standards

There exists a wide array of IoT standards - Postscapes identified nearly 90 different IoT standards across eight categories that have been developed by more than 26 organisations and alliances. The standards need to cover many technologies which have been developed for heterogeneous applications for different types of devices and different types of connectivity to address many different markets. As a result, we have clusters of devices on specific verticals for each operating system.

Connecting different devices from different manufacturers is a significant challenge. So far, the easiest problem has been solved: how to get data from A to B, but the industry is still not fully ready to provide relevant solutions that are “Plug and Play” or in the case of many IoT solutions: as Claranova’s CEO put it at a Morgan Stanley Expert Call: *Plug and Forget*. For instance, Claranova’s has a Java type approach, its “myDevices” open architecture platform can link and interact with 450 different devices from 175 different manufacturers.



Source: Claranova

Power consumption

Most individual IoT devices consume very little energy compared to say a microwave oven or a vacuum cleaner, however, the fact that they are usually always on, combined with the sheer volume of devices (perhaps 80 billion by 2025) will create a very huge load on the electricity grids. 80 billion 3-watt devices (equivalent to the power consumption of an Amazon Echo on standby) would require 60 nuclear power plants!

Data overload

A connected car for example (one in five vehicles now have some sort of wireless network connection), produces around 20GB of data. A huge amount of this data is stemmed from built-in apps such as Spotify, weather programmes, Sat Nav and traffic warnings - and that is before your car is connected and serving as a WiFi hotspot for its passengers. While most of this data is not all strictly IoT, new IoT applications also need to be considered in the context of this burgeoning incremental new data traffic.

Bandwidth overload

The growth of IoT will put increasing pressure on available bandwidth. Businesses will start to see an enormous amount of traffic coming from a wider selection of connected devices and ill-prepared networks could be constricted further as the need to be connected ramps up. With this avalanche of data generated from connected devices sending data back and forth simultaneously, networks will struggle to cope, and developers will need to find solutions to constrain data volumes and distribute data intelligently.

Networks

There are a number of networks that are compatible or available for IoT, however, to become a fully mass-market solution, IoT would significantly benefit from a more ubiquitous data network coverage. 5G should have a major positive impact when it is fully ready though it is likely to be running alongside other competitive technologies.

Trends

Autonomy

IoT devices are increasingly more intelligent doing more than just sensing and recording data. There is a shift towards more autonomous control and reacting to events in the device's environment. An example of this is a self-driving vehicle. Autonomy will be driven by two other trends: low energy and wireless connectivity.

Wireless connectivity

Wired connectivity will not be feasible due to the sheer quantity of devices that will be installed. Wireless connectivity is therefore the default solution. New wireless standards will emerge, especially low power protocols. There will be an increase in bandwidth demand which will lead to government licensing of additional spectrum.

Low Energy

IoT devices will need to run 24/7/365 in remote locations where access to the electricity grid is not an option. They will therefore need to run off battery power for several months even years without recharging. This will be possible by keeping power consumption to a minimum. For example, Semtech (SMTC market cap = \$4.0Bn), a Californian semi-conductor company has developed dedicated data protocol and chips that use minimal energy for transmission.

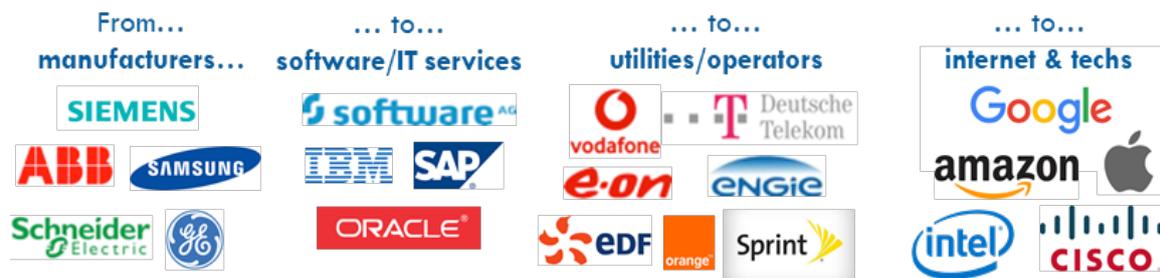
Low cost

Many IoT devices of the future will be extremely low cost – this will make them widespread in places and for functions that are currently beyond the public's imagination: embedded in clothing, in machines, disposable objects, packaged food or transport items etc.

* Investment opportunities

Solving any of the problems listed above will be a good business opportunity. However, there are two areas that will certainly flourish: IoT digital security and IoT platforms that connect to multiple devices from different manufacturers.

While there are few viable pure IoT stand-alone companies, many large corporations are impacted by IoT across all sectors and are busy developing IoT products as well as searching for acquisition targets. Arguably this provides scarcity value to a listed player like Claranova with its myDevices IoT business.



* Publicly traded companies involved in IoT

While there are no pure-play IoT listed companies, several stocks in Europe and the US have marginal exposure to the IoT sector. Some assets managers have also created ETF funds that seek to invest in companies which stand to potentially benefit from the broader adoption of IoT, such as the Global X Internet of Things ETF (SNSR) managed by Mirae Asset.

NAME	TICKER	Mkt Cap
ADVANTECH CO LTD	2395 TT	\$262bn
SAP AG	SAP GR	€198bn
XIAOMI CORP-CLASS B	1810 HK	\$66bn
DEXCOM INC	DXCM US	\$40bn
STMICROELECTRONICS	STM FP	€26.9bn
SKYWORKS SOLUTIONS	SWKS US	\$23.4bn
GARMIN LTD	GRMN US	\$19.8bn
PTC	PTC US	\$10.3bn
TEAMVIEWER	TMV GR	€9.1bn
ADT INC	ADT US	\$8.5bn
SENSATA TECH.	ST US	\$6.6bn
AMS AG	AMS SW	€4.3bn
SILICON LABORATORIES	SLAB US	\$4.5bn
SEMTECH	SMTX US	\$3.9bn
SOFTWARE AG	SOW GR	€3.1bn
SIERRA WIRELESS	SWIR US	\$0.5bn

* Recent IoT related Acquisitions

Date	Target	Acquirer	Activity	Amount
Jul-20	Electric Imp	Twilio (TWLO mkt cap = \$36.7Bn)	Secure connection of IoT devices with their data centres and third-party services.	
May-20	Moovit	Intel (INTC mkt cap = \$207Bn)	Mobility as a service	\$900m
Jan-20	Armis Security	Insight Partners	Agentless IoT security solution	\$1B
Nov-19	Fitbit	Google (GOOG mkt cap = \$1074Bn)	Wearable fitness device	\$2.1B
Nov-18	Cylance inc	Blackberry (BB mkt cap = \$2.6Bn)	Anti-virus software for IoT	\$1.4B
Sep-18	Relayr	Munich Re (MUV mkt cap = €33Bn)	linking Internet connected sensors and edge devices to platform controls	\$300m
Sep-18	Propeller Health	ResMed (RMD mkt cap = \$26Bn)	Sensors, mobile apps, analytics, and services to support respiratory health management	\$225m
Jul-18	Fibaro	Nice S.p.a.	Management of integrated automation systems	\$73m
Mar-18	Xyvelly	Google (GOOG mkt cap = \$1074Bn)	Platform for connected devices	\$50m
Feb-18	Ring	Amazon (AMZ mkt cap = 1644B)	Smart doorbells	\$1.3B
Jun-17	Smartlabs, Inc	Rob Lilleness	Smart lighting	\$7.3m
Apr-17	Automatic	SiriusXM (SIRI mkt cap = \$25Bn)	Connected car dongle	\$100m
Sep-16	Avnet inc	Tech Data (TDT)	IoT consulting	\$2.5B
Apr-16	PCB Piezotronics	MTS Systems Corp (MTSC mkt cap = \$475m)	Sensors and systems for machinery health monitoring	\$580m
Apr-16	Whistle	Mars Petcare	GPS Pet Tracker	\$119m
Feb-16	Jasper	Cisco (CSCO mkt cap = \$177Bn)	Cloud-based software platform for IoT	\$1.4B

Source: Claranova

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Inbound Capital has been acting as outsourced IR for Claranova (CLA FP, €260m) since 2017 and for Verimatrix (VMX FP, €220m market cap) since 2020.

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