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Global Insight

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Technology-Semiconductors

The Internet of Things is now

The key building blocks are in place for the Internet of Things – the next evolutionary step in personal computing – to take off. The opportunity is huge with the number of units potentially reaching tens of billions. Similar to the mobile internet wave, hardware stocks could be first to benefit.

The Internet of Things is the next wave of computing. If IoT follows a similar development pattern to previous computing waves, units could reach tens of billions at maturity. At this stage, it looks more complementary than disruptive to the mobile internet wave.

Why is IoT likely to happen now? The key building blocks are in place: These include: 1) the wide availability of smartphones, which can be used as remotes or hubs for IoT; 2) inexpensive and low power processors based on ARM; 3) wireless connectivity and Bluetooth Smart in particular at a low price point for a 2-year battery life from a coin battery cell; 4) IPV6; and 5) big-data / analytics.

Who are the potential beneficiaries? The IoT provides a tailwind to the chip industry after a period of strong innovation (smartphone and tablets) albeit with lots of units at low ASPs. We highlight potential early winners in the **microcontrollers, sensors** and **wireless** space. The range of applications is very large and could impact a vast number of industries. As a result, margins for chip vendors could be better than for mobile internet with a less concentrated customer base.

We also touch on big data / analytics, which could really turbo-charge the IoT. While for most companies we cover revenue contribution from IoT is tiny or non-existent at this stage, **Splunk**, the largest software company focused on this area, trades on 21x EV/sales, which highlights the potential for significant upside risks from those exposed to the Internet of Things.

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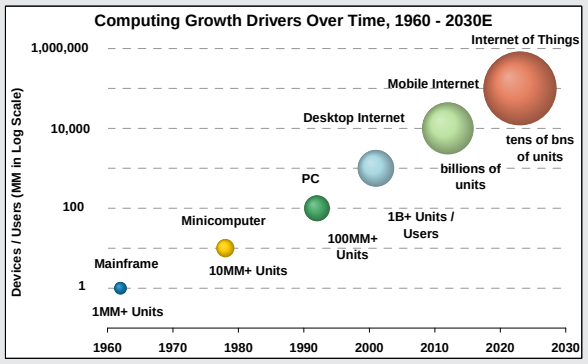
The Internet of Things: the opportunity is potentially huge



Source: Company Data, Thomson Reuters, Morgan Stanley Research

We will organize an Internet of Things panel at our European TMT Conference in Barcelona on November 20th, 2013.

What is the Internet of Things?

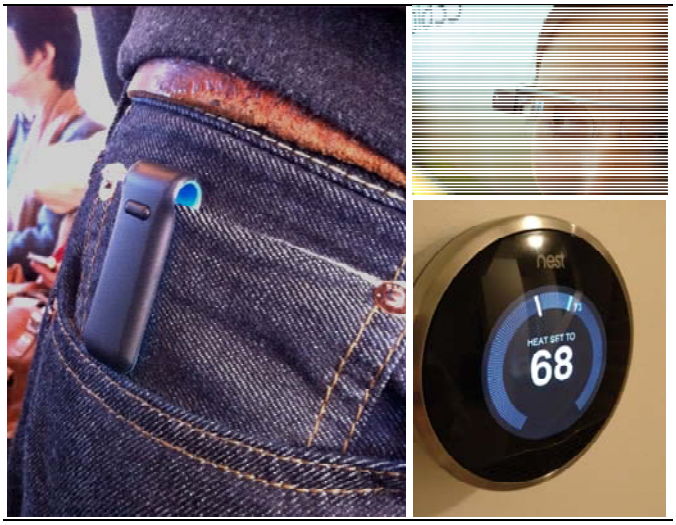
There are many ways to define the Internet of things:

The Internet of Things is an army of tens of billions of tiny robots making our lives easier. While this may seem a simplistic definition, in our view it summarizes very well the aim of the Internet of Things. It is like an army of small semiconductor based robots, all connected and able to take decisions on their own or based on higher level decision making.

Exhibit 1

The Internet of Things is now

Fitbit Ultra, Google Glass, Nest Diamond Thermostat

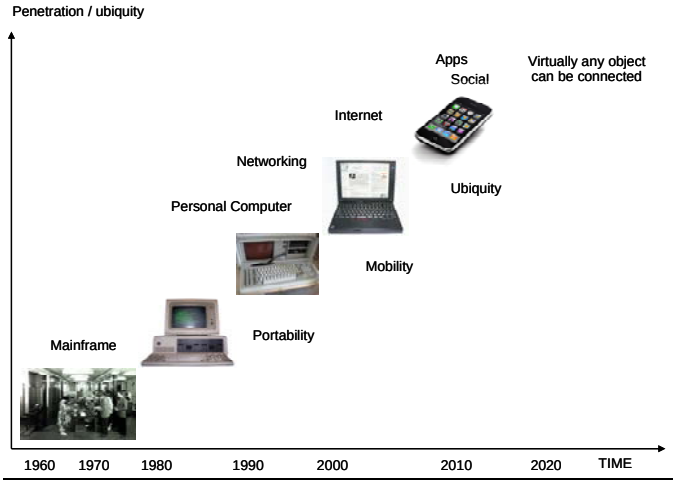


Source: Wikimedia Commons

The Internet of Things is the next generation of personal computing, whereby objects interact, potentially independently, with each other and with their environment. This is more of an historical definition, as it positions the Internet of Things as the next evolutionary step for personal computing.

Exhibit 2

Internet of Things is the next step in Personal Computing's evolution

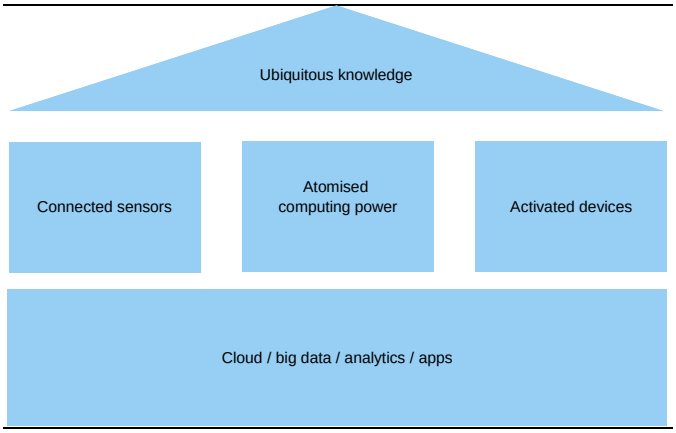


Source: Morgan Stanley Research

The Internet of Things is the combination of sensors, actuators, distributed computing power, wireless communication on the hardware side and applications and big data/analytics on the software side. This is more of a functional definition, but it shows that there are many prerequisites for the Internet of Things to exist.

Exhibit 3

Functional definition for the Internet of Things



Source: Morgan Stanley Research

A 15 year old concept, which started with RFID (radio-frequency identification)

In 1997, Kevin Ashton, an assistant brand manager at Procter & Gamble, became interested in RFID tags to help manage its supply chain. He then moved to the Massachusetts Institute of Technology (MIT) where he helped to start a RFID research consortium, now called the Auto-ID Labs. He is now working at Belkin and he is behind the WeMo home automation system.

"If we had computers that knew everything there was to know about things – using data they gathered without any help from us – we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so." – Kevin Ashton in a presentation to Procter & Gamble in 1999

The industry view

"We are entering a new era of computing technology that many are calling the Internet of Things. Machine to machine, machine to infrastructure, machine to environment, the Internet of Everything, the Internet of Intelligent Things, intelligent systems – call it what you want, but it's happening and its potential is huge" – **ARM and Freescale** white paper about 'what the Internet of Things needs to become a reality'

"the Internet of Everything creates $14.4trillion in value at stake – the combination of increased revenues and lower costs that is created or will migrate among companies and industries from 2013 to 2022. […] Currently, 99.4% of physical objects that may one day be part of the Internet of Everything are still unconnected" – **Cisco** white paper by Joseph Bradley published in 2013

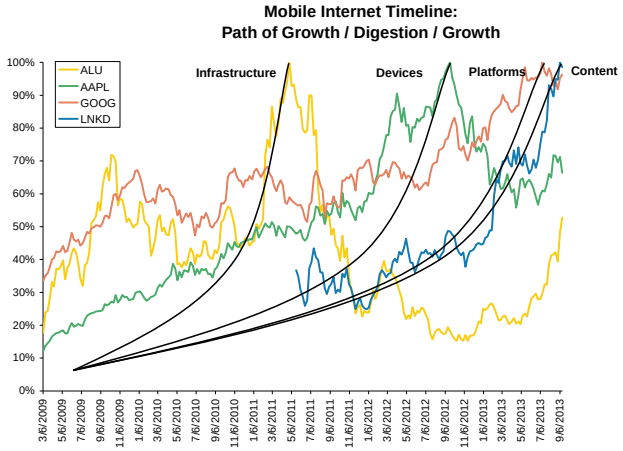
"The Next Big Thing is actually a Trillion Small Things. Networked microcontrollers with sensors and actuators are about to be embedded in any tangible object or place, ready to observe and control the real world. Imagine tiny web servers in all embedded devices, ready to connect to the Internet and provide their observations and services to a new set of Web applications. Ericsson has a vision of 50 billion connected devices by 2020. Included in this vision is the Networked Society where all aspects of people's lives, the operations of enterprises and society in general are impacted by the proliferation of communications. The Internet of Things will be a major cornerstone of an emerging networked society." – **Ericsson,** Ericsson Labs
https://labs.ericsson.com/research-topics/internet-of-things

Hardware stocks likely to be the first beneficiaries

In the mobile internet wave, hardware stocks' prices were the first to move (see Exhibit 4), and we believe the hardware stocks will likely also be the first beneficiaries of the Internet of Things. Therefore, in this report we concentrate on the potential impact of the Internet of Things to semiconductor companies.

Revenues are small today for most companies and it is difficult to find pure players, but as we have seen with smartphones, the potential for growth is large – iPhone grew from 6% of Apple revenue in 2007 to 52% in 2012.

Exhibit 4
Mobile Internet Timelime – Internet of Things could be the next growth driver



Source: Company Data, Thomson Reuters, Morgan Stanley Research

Why now and not in ten years?

Some key building blocks of the Internet of Things have only been made available recently.

4-5bn connected hubs by 2016 – The emergence of smartphones and tablets and their proliferation in most pockets by 2016 is a key enabler of the Internet of Things. Smartphones can run apps to interact with the Internet of Things and connect wirelessly with it. Smartphones and tablets work as hubs for the things to connect to the cloud.

Support from major operating systems: According the Bluetooth Special Interest Group, Apple was the first major OS to support Bluetooth Smart in early 2012 by supporting natively more than 15 Bluetooth Smart profiles. OS X, Windows 8 and Android Jelly Bean also support Bluetooth Smart.

Atomised processing power – Things need a 'brain' to become robots and the emergence of ARM based microcontrollers at a low cost, which consume very little power, enable any object to interact with its environment.

Wireless connectivity – This is not a new concept, but we believe that a unified wireless standard (Bluetooth Smart) able to communicate with any smartphone and at a low price will enable the proliferation of the Internet of Things. Bluetooth Smart also allows long battery life (two years) from a coin battery cell.

Sensors – The miniaturization of sensors and MEMs/cameras in particular, through the emergence of smartphones, leads to price points low enough to integrate sensors into anything.

ipV6 – A vast improvement over ipV4 providing a larger number of unique addresses, based on 128 bits addresses. ipV4 provides 4bn unique addresses while ipV6 provides 8x10^28 addresses, so more than enough for the foreseeable future.

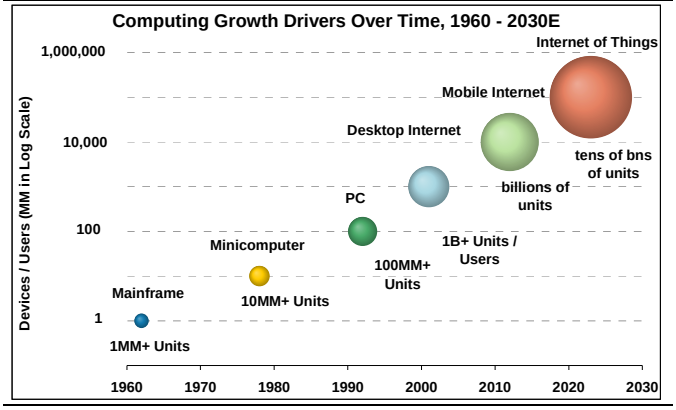
Analytics / big data – Analytics in our view, is really what could turbo-charge the Internet of Things, by analyzing patterns and taking decisions without human intervention. (See Cisco analysis page 5.)

What is the addressable market?

It's going to be big – unit wise

Should the Internet of Things follow the path of previous computing waves, units could reach tens of billions. We have updated the graph of computing growth drivers published a few years back in *The Mobile Internet Report* by Katy Huberty and the Morgan Stanley Tech team (December 16, 2009).

Exhibit 5
Unit wise, the potential is huge



Source: Company Data, Morgan Stanley Research

According to Cisco, the addressable market is 1.5 trillion things. At the individual level, there are 200 connectable things per person in the world today. Of all of these, Cisco estimates that **10bn things are connected today or 0.66% penetration.** However, we note that most of those 10bn things are smartphones, tablets, laptops and PCs.

This represents a growth rate of 40% CAGR compared to 2000. Cisco estimates that only 200 million things were connected in 2000. Extrapolating the same growth rate up until 2020, this could mean that 75 billion things could be connected by then. This compares with Ericsson's prediction that 50 billion things will be connected to 6 billion people by 2020.

Cisco's analysis shows that most of the potential value at stake (66% or $9.5trn) comes from transformation based on industry-specific use cases such as smart grid and smart buildings. The other 34% is produced by cross-industry use cases such as future of work (telecommuting) and travel avoidance. In terms of geography, most of the value at stake is in the US ($4.6trn) and Europe ($4.3trn) according to Cisco. In terms of sector, no surprise that Cisco has found that most of the value at stake will occur in manufacturing industries (27%), retail (11%), IT (9%) and Finance / Insurance (9%). Cisco expects smart factories, smart grid and smart buildings to play a prominent role. (Source: Cisco IBSG 2013)

General Electric has made a similar study showing that Industrial Internet (so part of the Internet of Things) could impact $70trn of global GDP. GE shows the impact of 1% fuel savings in the aviation sector amounting to $30bn over 15 years, 1% fuel savings for all gas turbines amounting to $66bn, 1% reduction in healthcare system inefficiencies amounting to to $63bn, 1% reduction in rail system inefficiencies amounting to $27bn and 1% reduction in oil & gas capex amounting to $90bn.

Not everyone will have a smartphone, but we estimate that globally there will be an installed base of 4.5 billion smartphones from 2016. 75 billion connected things would imply an attachment rate of 17 things per smartphone (50 billion, 11 things per smartphone).

From the Internet of MY Things to the Internet of ANY Thing – there are 1 billion electricity meters in the world, more than 1 billion homes, 200 million ship and sea containers … the potential is huge.

What does the industry say? Intel forecasts that the Internet of Things will represent a 3.8 billion device opportunity by 2015 (including mobile computing i.e. tablets, smartphones…) and ABI research forecasts that number will reach 30 billion by 2020.

Internet of Things – chips allow things to become aware

The combination of sensors, microcontrollers and wireless communication allow things to become aware of their environment.

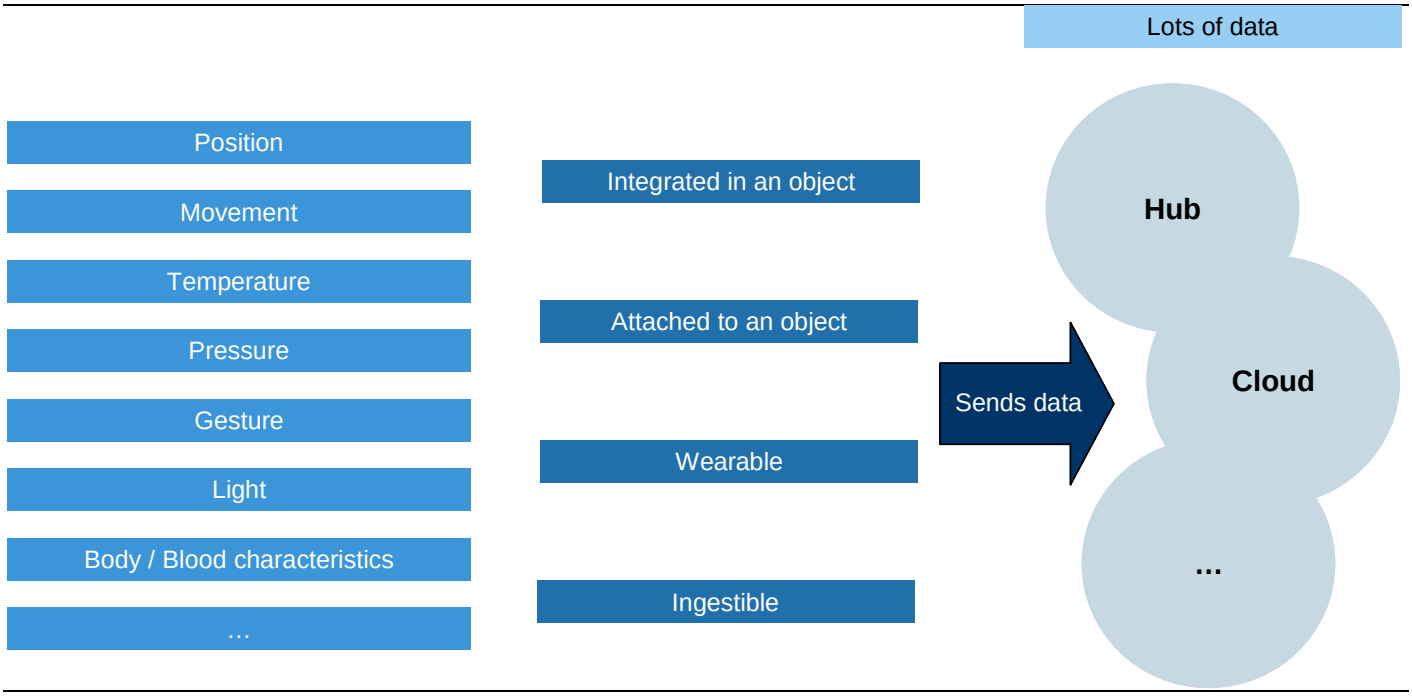
- Semiconductor based MEMS allow measurement of movements, pressure, altitude, blood pressure.
- GPS chips allow measurement of position.
- Semiconductor based sensors allow measurement of temperature, light.
- Semiconductor based cameras allow measurement of gesture.

Continued miniaturization and price reduction allow those sensors to be integrated in or attached to nearly any object. They can also be worn on the human body or even be ingestible.

Wireless communication allows the data to be transmitted to a local hub (smartphone, tablet, wifi-router) or directly to the cloud.

Exhibit 6

The combination of sensors, microcontrollers and wireless communication is the first building block of the Internet of Things

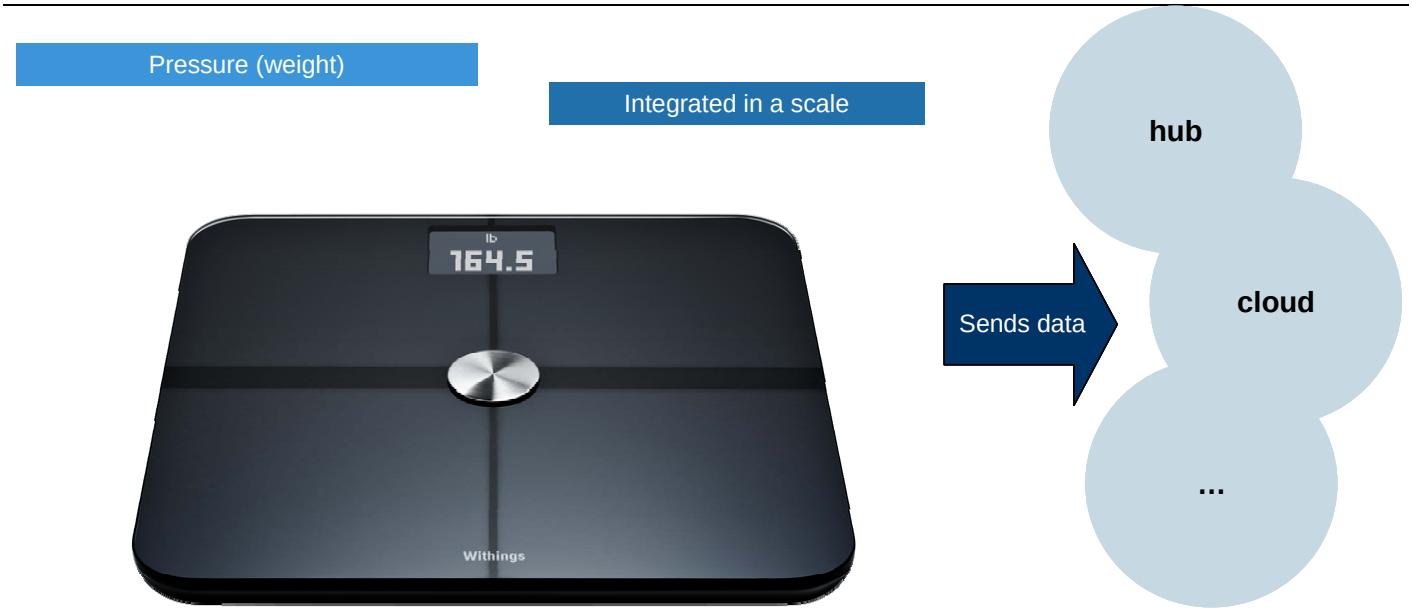


Source: Morgan Stanley Research

Exhibit 7
The Internet of Things is now – to help golfers improve their swing

Source: Company Data, Morgan Stanley Research

Exhibit 8
The Internet of Things is now – to stay fit

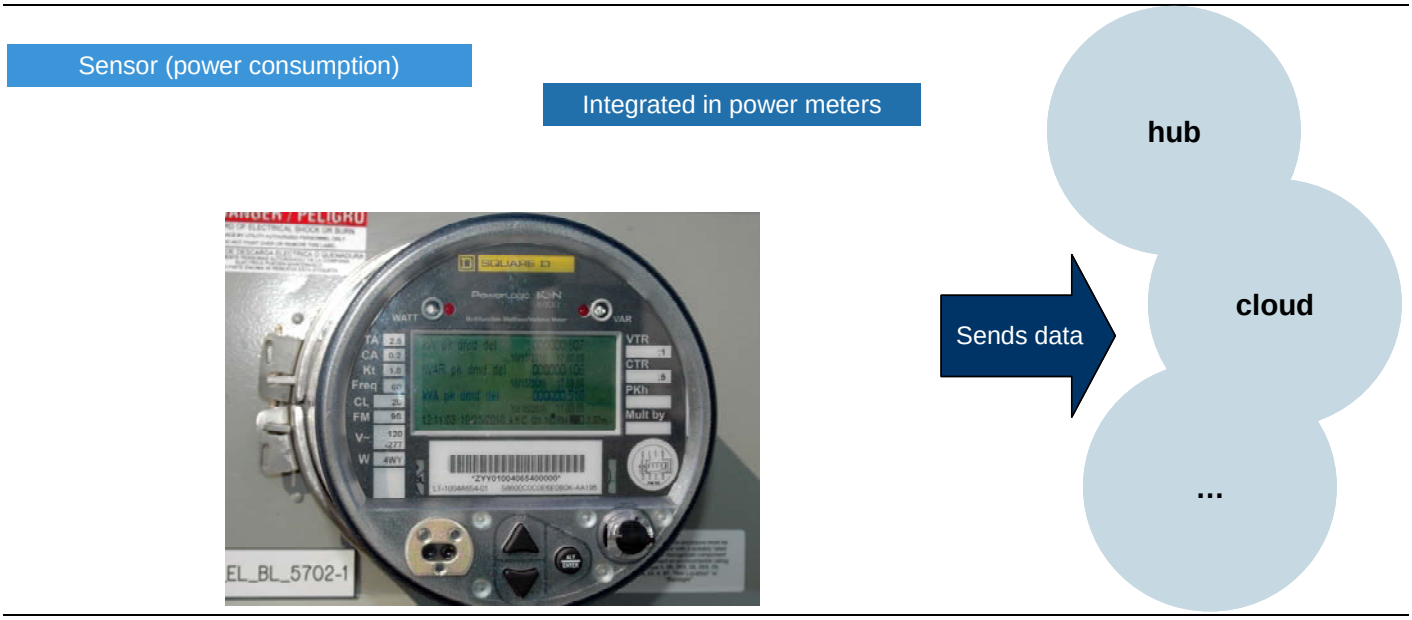


Source: Wikimedia Commons, Morgan Stanley Research

Exhibit 9
The Internet of Things is now – to track containers

Source: Wikimedia Commons, Morgan Stanley Research

Exhibit 10
The Internet of Things is now – in power meters to improve power efficiency



Source: Wikimedia Commons, Morgan Stanley Research

Huge market in units, infinite possibilities, but what about its semiconductor $$$ content?

While the opportunity is likely to be huge in unit terms and span many different markets, as always in semiconductors, we expect pervasion to be driven by price declines.

Today's landmark market – fitness and lifestyle

We believe that the semiconductor content today in a connected sensor like a fitness band is less than $5. It typically includes a MEMs 3-axis sensor and potentially a pressure sensor for $1-3, an ARM based microcontroller for $1 and a Bluetooth Smart chip for $1.

Other potential landmark markets – proximity sensors

We have seen consumer interest in proximity sensors from companies like Tile (Bluetooth tags, which used in conjunction with an app allow you to locate items) or shipping in the box with smartphones. This is usually based on a wireless chip only, so cheap enough to be disposable.

Low volume, high ASP, high margins for wireless chip makers today. Today, we believe this is a very attractive market for semiconductor companies as there are lots of small companies working on these types of products and their purchasing power is much lower than that of smartphone OEMs. However, because of the high fragmentation in the end-markets and the relatively high retail price, volumes are likely to be limited.

IHS Research forecasts that the fitness monitor market will reach 44 million units in 2013

Higher volume, lower ASP and potential integration of components tomorrow. In our view, the microcontroller is the component that is more likely to be integrated without compromising flexibility:

- either in the Bluetooth chip by reusing the on-board processor or by adding a bigger microprocessor core in the chip (not necessarily ARM as discussed with Bluetooth SMART vendors).
- or in the MEMS – with the emergence of MEMS made in foundries, there is no limit to digital integration within the MEMS chip.

Microcontrollers perform an array of functions and are commonly used in a wide range of markets including automotive, industrial, consumer, compute, and communications. With the introduction of the IPv6 protocol, almost every device can be assigned an IP address giving them the ability to communicate with each other. These connected processors and microcontrollers perform one or more of the following functions: sense, measure, control, and communicate – both ways. Furthermore, adding connectivity capabilities enables easy access to these devices.

Ultimately, we wonder whether full integration could ever occur. However, there are not many companies with both Bluetooth and MEMs capabilities (Texas Instruments, STMicroelectronics). Also, there are some conflicting manufacturing constraints as Bluetooth chips are manufactured on small nodes (28nm) and MEMS on bigger nodes (130nm). Hence, the market might continue to be a two-chip solution in the mid-term until volumes really take off.

Customer concentration not the driver for price decline. Today, there are lots of different products and lots of small companies working on fitness/lifestyle products. In recent months, smartphone rivals Apple, Samsung and Google have all been rumoured to be working on 'smart watches' (source: Financial Times, August 13). Should one company launch a highly successful product and concentrate market share, we would view this as a negative for chip suppliers in this market.

However, as described in the 'What is the addressable market' section on page 5, the overall Internet of Things is likely to be huge and thus we doubt there will be any vendor with a dominant market share overall.

But commoditization is a prerequisite to reach volumes above a billion

In our view, to drive adoption in the billions of units, the market will need to commoditize – potentially around the wireless chip with an integrated microcontroller / small microprocessor. In the past, Bluetooth chips prices declined to less than 50c for high volume mobile phone applications (volumes in the hundreds of millions) compared to Bluetooth Smart today at or above $1.

Assuming the same price elasticity as ARM chips, a good proxy for wireless chips, we believe that prices of chips would halve at about 1.7 billion units.

Exhibit 11
Units vs ASP in Bluetooth smart market

Units (m)	45	70	100	200	600	800	1150
ASP ($)	1.20	1.15	1.13	1.06	0.84	0.74	0.60
Revenue ($)	54	80	113	212	502	594	692

Source: Morgan Stanley Research estimates

The Internet of Things could provide some tailwind to the microcontroller makers (providing there is not much integration in the wireless chips)

We believe that the IoT could provide tailwind for an otherwise slow-growing microcontroller market. The RF (radio frequency) and connectivity features central to the IoT should further propel growth in the 32-bit space. That said, 8- and 16-bit MCUs (microcontroller units), which make up over 60% of the market, could also see some benefit at a time when they are vulnerable and losing share to 32-bit MCUs.

This is a market where 8-bit MCUs could still flourish, despite the performance advantages of 16- and 32-bit MCUs. The 8-bit MCUs are smaller, cheaper, and can meet the demands of many designers. In addition, the low power consumption of 8-bit offers an advantage over higher bit MCUs.

ARM has introduced the Cortex M0 and M0+ 32 bits processors to compete in this space at price points as low as 8 and 16 bits.

Semiconductor content could increase as the Internet of Things grows

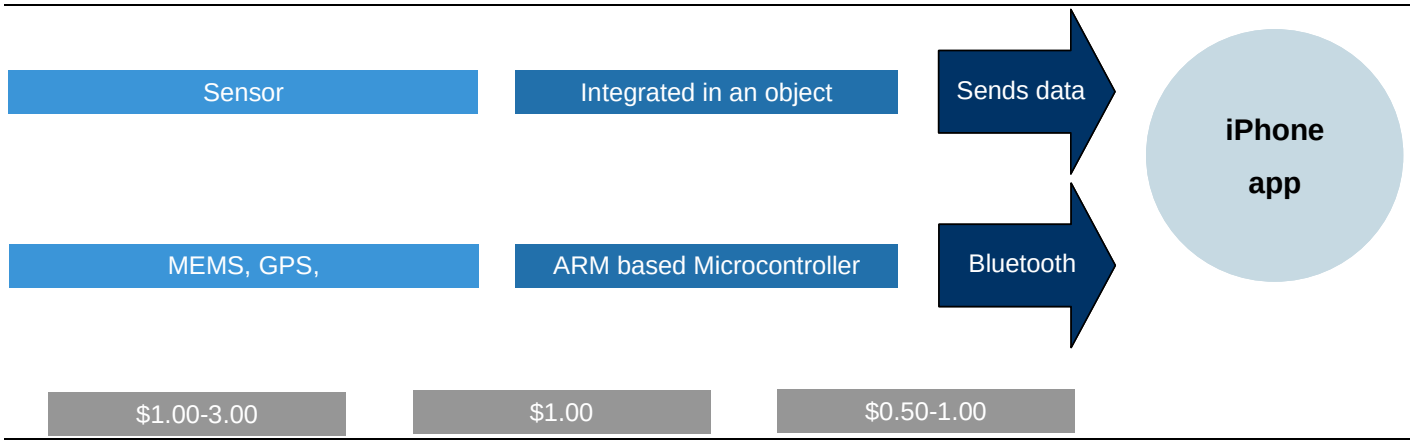
At the moment, the Internet of Things is dominated by the Internet of My Things, where a sensor sends data to a smartphone, data is stored and analysed in the cloud and sent back to the user. If the Internet of Things really takes off, then there could be more semiconductor content but it depends on more interaction with Analytics/Big Data.

Exhibit 12
More intelligence could lead to more semiconductor content

	low	medium	high
node level	dumb sensor	simple decision making helped by context	'robot' - takes autonomous decisions based on context
hub level	transmits data to the cloud	user interacts with nodes	hub controls nodes independently
cloud level	collects and store data	analysis of data sent to user	cloud controls nodes based on analytics of all kind of data available

Source: Morgan Stanley Research

Exhibit 13
Typical cost of material of a connected sensor today for a lifestyle product



Source: Morgan Stanley Research

Exhibit 14
Potential semiconductor content in the Internet of Things value chain

	processor content	communication chip	other semi content	pervasion into	unit potential	growth drivers
node level	none, mcuanything	bt smart, zigbee, whitespace..	sensors (mems, camera), gps	any object	nascent but tens of billion	potential pervasion into anything
hub level	micro controller, microprocessor, microserver			smartphone, tablet, glass, router, car, plane	installed base of several billions	pervasion into more pockets, cars, homes, factories….
cloud level	microserver, server		ethernet	server rack, micro server	installed base of tens of millions	more data, more analytics

Source: Company Data, Morgan Stanley Research

We believe Bluetooth Smart is the wireless standard of choice for the Internet of Things, especially for personal applications

Bluetooth SMART was introduced as Wibree by Nokia in 2006. Nokia already had the vision that any object could be connected to a smartphone. Unfortunately for Nokia, the concept of smartphone and apps was taken a new and higher level by Apple and Google. Wibree was merged into the Bluetooth standard in 2010 and has been known as Bluetooth SMART since 2011. Bluetooth SMART is a smaller, simpler and cheaper chip than a full Bluetooth chip and it can be as small as 6 sq mm on a 28nm process. It can run on a small battery for a year or two.

Other wireless connectivity standards are as power efficient, like ANT for instance. ANT has been used for PC mice and keyboards – however, they require a dongle to be installed on a PC.

The beauty of Bluetooth SMART is 1) the compatibility with any smartphone / tablet from the start and 2) lower cost / lower power than WiFi.

We believe the market for Bluetooth Smart is $40-50m in 2013, with ASPs of around $1.20

Companies involved in Bluetooth Smart are CSR, Dialog Semiconductor, Nordic Semiconductor, Texas Instruments.

Exhibit 15
Bluetooth Smart – competitive landscape

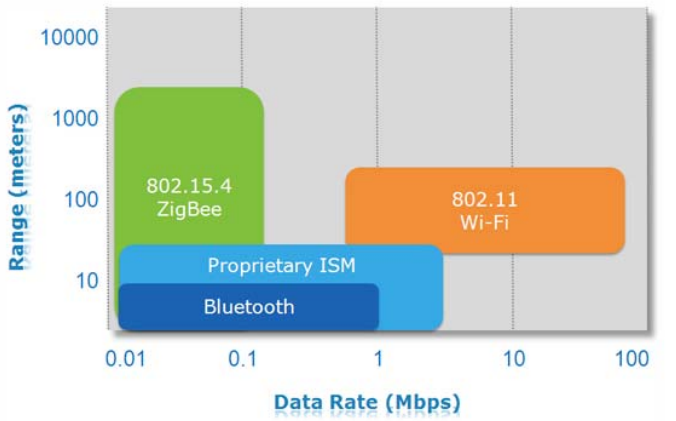
	CSR	Dialog	Nordic	STMicroelectronics	Texas Instruments
Streng-ths	Historical leader in the Bluetooth market	6mm2 chip at 55nm	Market leader in wireless chips for keyboards and mice	Potential combo chip with MEMS and MCU	Strong marketing push
	Potential synergies with apps processors SOCs	ARM Cortex M0 processor on-board	Strong marketing push	Good early market share in fitness	Strong support to start-ups
	Next generation product has an ARM processor		ARM Cortex M0 processor on-board		Potential synergies with apps processors SOCs (OMAP)
					Biggest promoter of Zigbee
Weak-esses	Marketing push late on TXN	unproven in the market yet	legacy revenues (proprietary 2.4GHz, ANT) at risk	Only introduced a single chip in August 2013	8051 microprocessors not as scaleable as ARM Cortex M0
	Current generation chip on 85nm	not approved by Bluetooth SIG yet	No SOC synergy		Recent track record in Bluetooth and Wireless
	Proprietary 16 bits microcontroller	Protocol Stack licensed from 3rd party	180nm chip		180nm chip

Source: Company Data, Morgan Stanley Research

For industrial applications or machine to machine, several wireless standards might coexist

For industrial applications or machine to machine, several wireless standards might coexist. Zigbee, Bluetooth, and WiFi are the widely used wireless connectivity protocols, and the choice of one relative to another depends on the data transfer rate and communication distance. Exhibit 16 graphically illustrates the sweet spots for each of these technologies. The proprietary ISM band is part of the radio spectrum that does not require a license as long as one complies with the rules, which are set regionally.

Exhibit 16
Units vs ASP in Bluetooth smart market



Source: Atmel

Most IoT applications involve small amounts of data, and **Zigbee** presents a cost-effective method to transfer data. The Zigbee mesh network also allows numerous devices (as much as 65,000 nodes) to be connected together whereas Bluetooth and WiFi face some limitations as to the number of nodes (8 for Bluetooth and 32 for WiFi). Zigbee is potentially interesting for industrial applications because of its potential mesh / tree topology as it enables a higher range (300m better for a factory). Zigbee is also self-organising and thus very easy to deploy. Main company involved here is Texas Instruments (as well as Silicon Labs).

WiFi can be integrated with ZigBee to extend connectivity to the internet and is considered best for industrial control and automation given its easy deployment in WiFi covered areas.

3G/4G datacards are expensive and require a subscription, but might be needed in some high data rate applications. We also wonder what could be the incentive for wireless operators to manage a high number of subscribers generating a low amount of data. We believe that 3G/4G datacards could be used to transfer a larger amount of data after aggregating data from several "things". Public listed companies involved here are Ericsson and Gemalto in Europe.

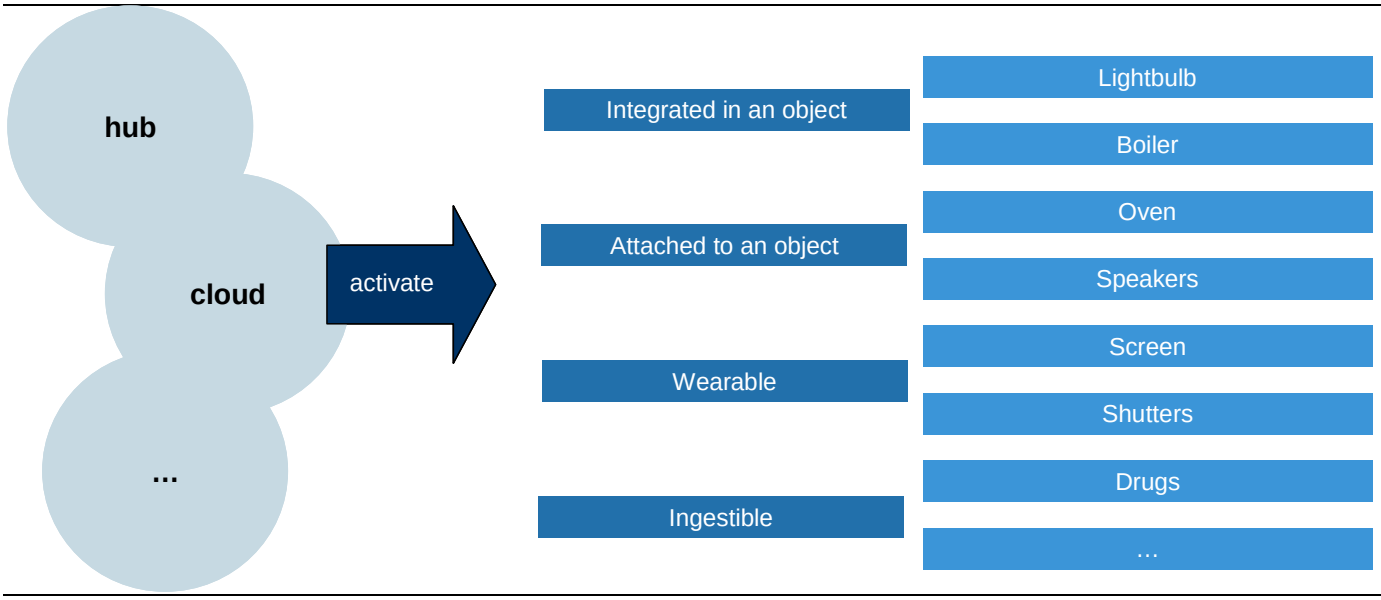
Use of radio **whitespace** – for long-range / low bit-rate communications, some companies are exploring the use of spectrum left over between TV channels.

- French private company SigFox is promoting the **Ultra Narrow Band** standard, with Silicon Labs, Simtec, Intel and STMicroelectronics as chip partners. SigFox has now become a Special Network Operator in France and can cover a whole country with only 1500 antennas, potentially handling 1.5 billion things.
- UK based NEUL (cloud in Gaelic) promotes **Weightless** with ARM, Freescale, CSR and Vodafone. The objective is to have a 10km range, 10-year battery life for less than $2 module cost. NEUL plans to license the implementation of Weightless on silicon so that it can be integrated with any other chip (with MEMS, GPS, any other sensor and microcontrollers). Integration and price decline is key to lower system cost and allow strong unit growth in the Internet of Things.

Internet of Things – when the Internet activates any thing

While we have seen lots of innovation in terms of connected sensors so far (lifestyle objects such as Fitbits, Withings, Tile etc.) we have seen less innovation around activated devices. In our view, large appliance OEMs are generally averse to new technologies (not everyone is Apple), they tend to overprice technology ($20k Internet Refrigerator by LG in 2000) and the replacement cycle of appliances is usually very long (when did you last buy a hoover? What is a hoover?).

Exhibit 16
The Internet takes control of Things



Source: Company Data, Morgan Stanley Research

Exhibit 17
Taking control of lighting – £180 retail price, needs a Zigbee dongle

Source: Company Data, Morgan Stanley Research

Cloud + Big Data/Analytics – The upper brain behind the Internet of Things

The atomization of processing power allows things to become aware of their environment and to be activated remotely. Apps running on smartphones allow the visualization of data and the activation of things remotely. However, apps today work in 'silos' collecting 'lots of data' without really knowing what to do with it.

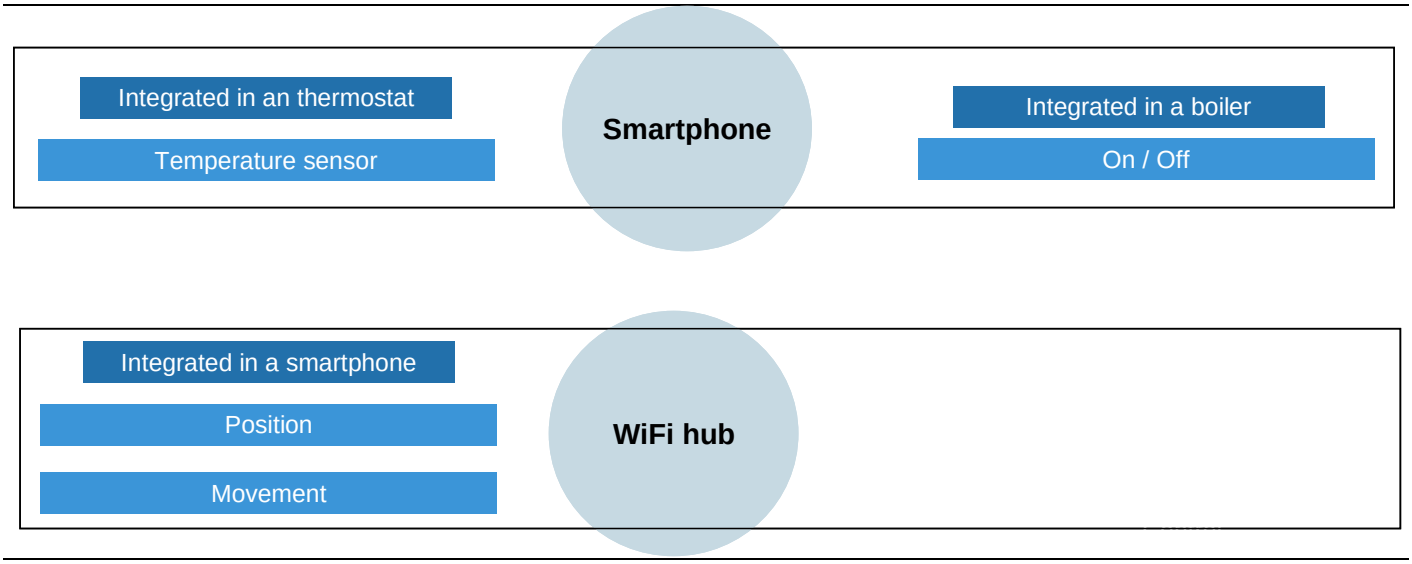
We view the Internet of Things as a key enabler of Big Data, as it collects vasts amount of information from the real world.

For example, if the cloud were aware that I was coming back home, as I got closer my positioning and movement tracked on my smartphone would communicate with software to switch on the boiler to increase the temperature to 20 degrees by the time I arrive home, and switch on the lights as I enter.

Taking the idea forward, let's assume that all the smart meters in a country were connected to utility companies. Utility companies could predict in advance any consumption peak and start gas turbines in time to optimize the cost of production.

Exhibit 18

Applications running the Internet of Things in silos today



Source: Company Data, Morgan Stanley Research

Cisco forecasts that proper use of the Internet of Things with big data/analytics could increase asset utilization, increase employee productivity, eliminate waste in supply chain and logistics, improve customer experience and reduce time to market across all industries to the tune of $14.4 trillion over the next decade.

European companies' exposure to the Internet of Things

ARM has been talking about the Internet of Things for a long time and we believe that investors have a positive stance regarding ARM in this market. If the Internet of Things really takes off to tens of billions then the impact would be meaningful.

For instance, ARM cores can be found in 3G/4G baseband for machine-to-machine communications today. However, we believe that as the Internet of Things takes off, the bulk of wireless communications will be achieved through other standards (either short range or long range). ARM believes that the proliferation of open standards will be accelerated through the ARM mbed project, which is an industry collaboration to deliver open source hardware and software for the rapid development of connected devices. As part of this, ARM on August 27 acquired the middleware company Sensinode Oy, a software company developing open standards. In particular, ARM believes the 6LoWPAN standard developed by Sensinode is an important one as it allows IPv6 to be sent over very low power and slow data rate networks. ARM management believes the combination of ARM's architecture and Sensinode's software technology will be a compelling solution for IoT developers.

We believe the bulk of revenues from the Internet of Things will come from microprocessors. Today ARM has 18% of the microprocessor market and we expect its market share to continue increasing.

In a blue sky scenario of 1 billion chips for IoT in 2016, with 50% market share for Cortex M0 and 1% royalty rate per chip, IoT would represent $33m royalties or less than 2% of royalties revenues vs our ARM blue sky scenario.

There is also a wild card for ARM in the form of micro-servers. If IoT really takes off then every home and factory would require more processing power running in the background. As a result, low cost, low power servers could be a solution.

Therefore, we conclude that the leverage of ARM to the Internet of Things is not as high as thought in the market.

CSR specialises in connectivity chips and is historically a market leader in Bluetooth technologies. CSR is exposed to the Internet of Things as it supplies Bluetooth Smart chips, which are used in Internet of Things devices, connecting these devices to a user's smartphone or tablet. It currently operates in the consumer space (termed the Internet of My Things), focusing on Fitness Life-style products, proximity tag products (could be used for Apple's iBeacon) and connected / streaming audio products (Beats headphones), with the majority of units sold in 2013 driven by a design win in the Nike Fuelband. While CSR is one of the companies in Europe with the most exposure to potential opportunities from the Internet of Things, looking at 2016, the size of the market, ASP of the Bluetooth Smart chip and CSR's market share remain uncertain at this stage.

Dialog currently has Bluetooth SMART connectivity chip solutions, with its Bluetooth SMART SoC released earlier this year. Dialog gained access to the connectivity business through its acquisition of SiTel Semiconductor in February 2011, adding short-range wireless connectivity to Dialog's portfolio, and connectivity is currently 12% of total group revenues in 2012. With its Bluetooth SMART SoC, the company is targeting similar markets to CSR, namely app-enabled smartphone accessories – wireless computer peripherals and Fitness Life-style products. The company claims its SmartBond chip has the lowest energy consumption in the market currently. The Bluetooth Smart product is currently only available for customers to sample and production is expected in Q4 2013. The chip is expected to be qualified by the Bluetooth SIG in Q4 as well.

Ericsson sells a Machine-to-Machine platform to operators to handle communication management, subscription management and OSS/BSS. It allows automation of the business processes between the operator and companies involved in Machine to Machine. In this platform, Ericsson supports not only existing wireless networks (2G/3G/LTE), but short-range connectivity standards like Bluetooth Smart or Zigbee.

Ericsson's long-term exposure to the Internet of Things is highly dependant on the role that wireless operators will play in the Internet of Things. We believe that wireless operators could be aggregators of data traffic in some instances, but it is not clear whether they will play a major role overall.

In January 2012, Ericsson signed a deal to connect the entire vessel fleet of the world's largest shipping company, Maersk Line, using the company's capabilities to enable machine-to-machine communication.

Gemalto's Machine-to-Machine business, acquired from Siemens in 2010 under the Cinterion name, provides connectivity in a number of applications including smart metering, tracking & tracing, vehicle telematics, health, security, remote maintenance and monitoring, industrial computing and

routers and gateways. These are all applications where there is a value to providing a unique identifier to an object, and in monitoring how that object performs. The value might be insurance in the case of tracking shipping containers, preventing factory downtime through remote monitoring and planned preventative maintenance, or ensuring the integrity of service subscriptions managed through routers/gateways. M2M mobiles can also provide more conventional connectivity, and recent deals include Audi in 2013 to provide 4G connectivity for Audi's in-car, LTE-connected infotainment systems.

STMicroelectronics, like Invensense, has a card to play in the fitness / lifestyle market with MEMs sensors. Most of the volume for MEMs is related to smartphones and tablets. With the fitness / lifestyle accessory market representing 40-50 million units this year, this will represent a nice tailwind for the MEMs market.

STMicroelectronics has also exposure to the smart-meter market and a proprietary short-range communication offering (Spirit1). It is also working on an integrated module – embedded flash, MEMs, microcontroller, and full Bluetooth LE, for fitness applications.

STM also benefits from selling ARM based microcontrollers and RF amplifiers for Bluetooth (Nike Fuel). With more integration going forward, the RF amplifier and ARM based microcontroller will likely be integrated in the Bluetooth chip so we are not sure how long STM's position is sustainable here.

Exhibit 19

European exposure to the Internet of Things*

Company name	Products	2013 % of revenues*	Potential for growth
ARM	MCUs, Baseband modems for IoT	<5%	++
CSR	Bluetooth smart	<5%	+++
Dialog Semiconductor	Bluetooth smart	0%	++
Ericsson	Machine to Machine	<1%	+
Gemalto	Machine to Machine	10%	+
Nordic Semiconductors	Bluetooth smart	20%	++++
STMicroelectronics	MEMS, MCUs for IoT	<5%	++

Source: Company Data, Morgan Stanley Research, * Things exclude mobile computing

American companies' exposure to the Internet of Things

Splunk is an enterprise tool used to index and make sense of unstructured log data, which is generated through sensors or devices. Customers can use Splunk to analyze unstructured data, whether it is collecting data from medical devices to monitoring customer activity. Splunk's use cases have traditionally centered around traditional IT operations, security and app management. However, customers are increasingly using Splunk for a wider variety of use cases related to web analytics and business intelligence.

Splunk is the largest software company focused on the Internet of Things and it trades on 21x EV/sales highlighting the potential for significant upside risks for the Internet of Things.

Almost every US semiconductor company has its eyes set on Internet of Things as a key driver for growth. However, for many, revenues from IoT remain very small compared to the rest of their segments. The functionalities of many potential IoT devices are well defined, and the challenge remains in incorporating connectivity and addressing power consumption requirements. In particular, we focus on companies in the microcontroller space, as MCUs tend to be ideal candidates for IoT devices.

Microcontrollers and IoT

Microcontrollers perform an array of functions and are commonly used in a wide range of markets including automotive, industrial, consumer, compute, and communications. With the introduction of the IPv6 protocol, almost every device can be assigned an IP address giving them the ability to communicate with each other. These connected processors and microcontrollers perform one or more of the following functions: sense, measure, control, and communicate – both ways. Furthermore, adding connectivity capabilities enables easy access to these devices.

Today, most of these devices use wired connectivity to communicate. RF and wireless methods provide additional options to transmit data between these devices. However, connectivity also demands more resources such as additional memory and power.

With connectivity, one could cut back on data memory; however, power consumption is a key issue for many of these devices. As a result, we see continued demand for 8- and 16-bit MCUs. At the same time, 32-bit processors such as those from ARM focus on optimizing their power requirements. In the following section, we address some of the initiatives taken by leading MCU vendors to capitalize on growth opportunities in IoT.

We think the growth opportunity in IoT adds to an already compelling investment case in ATML

IoT should provide a tailwind for an otherwise slow-growing MCU market. At this early stage of development, however, it is difficult to determine how much the IoT is contributing to growth and MCU companies are not breaking it out. As a result, we are initially looking at this market as something that can supplement our existing framework of evaluating MCU stocks. Bottom line, we expect Atmel to leverage the combination of its low power AVR architecture and ARM-based products, in addition to low power WiFi capabilities added through the Ozmo acquisition, to gain additional market share.

We are buyers of ATML due to above-average growth and also because it offers the strongest operating leverage across our analog and MCU universe; the IoT adds yet another positive element to the story.

Freescale was one of the first MCU vendors to use ARM's Cortex M0+ processor. The newly introduced Kinetis KL02 product at a footprint of 1.9 x 2.0 mm could be used in applications where space is limited. The company has committed to offer 110 ARM MCUs by the end of 2013 targeting IoT applications.

NXP Semiconductor also licenses the ARM Cortex M0+ processor core in its JN5168 product. This wireless microcontroller targets the IoT segment for applications such as smart lighting, home automation to building automation and wireless sensor networks.

Atmel. In December 2012, Atmel announced the acquisition of Ozmo Inc., a provider of low-power Wi-Fi Personal Area Networks, in order to accelerate entry into the IoT segment. With Ozmo, Atmel gains access to a low power, low latency connectivity solution (802-11 a/b/g). Atmel also has software stacks to address Zigbee, mostly utilized in industrial applications. In addition, the company has licensed Sensinode's connectivity solutions to develop IPv6-based embedded wireless products.

Microchip has been active in adding connectivity to its portfolio through tuck-in acquisitions. Standard Microsystems, acquired in 2012, brings smart connectivity solutions for embedded markets. Roving Networks, also acquired in 2012, added low power embedded WiFi and Bluetooth solutions. ZeroG Wireless, which specializes in embedded WiFi for MCUs, was acquired in 2010.

Texas Instruments. For TI, the focus is on embedded OMAP and connectivity strategy in the aftermath of the wireless exit. We think it has a nice opportunity with WiFi and Bluetooth, although its OMAP capabilities may be overkill for the functions best suited in IoT. In addition to offering discrete WiFi and Bluetooth products, TI offers integrated low power connectivity solutions that combine WiFi and Bluetooth technology. The company has developed complete ultra low power systems that bring together MCUs, sensors, wireless connectivity, as well as energy storage and harvesting.

Linear Technology. In December 2011, Linear Technology acquired Dust Networks, a leading provider of wireless sensor networking solutions that leverages low power radio and software technology. Linear now has two lines of SmartMesh products based on Dust Networks – a cost-effective solution for dynamically changing RF environments and another for some of the harshest industrial environments.

Broadcom. In addition to MCU vendors, existing connectivity leaders such as Broadcom, Qualcomm, and Intel are also developing low power connectivity solutions. For example, Broadcom has developed SoCs for embedded devices using 8- and 16-bit MCUs. The company also rolled out a new suite of low power, wireless connectivity solutions for embedded devices to target the wearables market – a market, which according to Juniper research could reach more than $1.5bn in revenues by 2014. In terms of units, Juniper research estimates the market at 15mn devices in 2013 rising to 70mn by 2017.

Qualcomm, on the other hand offers a complete suite of "Internet of Everything" solutions for the automotive, consumer, industrial automation, and smart energy segments. The company has also developed a platform specifically for developing applications for a variety of embedded-to-enterprise communications markets leveraging

its expertise in multiband cellular coverage as well as WLAN connectivity.

Intel. At its recent developer forum, Intel unveiled "Quark", its new CPU family targeting the Internet of Things and the Wearables markets. The chip based on the x86 core, is one-fifth the size and one-tenth the power consumption of Atom, and is built on a 32nm process, fully designed to be integrated into a system on chip. Quark provides a standard fabric to which one could attach their IP to, and can be customized for specific sensors, algorithms, and accelerators. The Quark will compete against ARM's Cortex-M series and will likely be available early next year.
Intel needs to develop its capabilities to compete in this market, as implementing SOCs with customers IP integrated with Quark on the Intel manufacturing process is an entirely new sales process. There will be some switching costs from customers. Intel has similarly announced SOC efforts around Atom with TSMC, but has not announced customers. Further, while there is a significant amount of x86 code that could take advantage of Quark, which is less of an advantage in the embedded space.

Power source

Many of these IoT devices stay in sleep mode much longer than in active mode, and process much less data, that the approach to tailoring power consumption is different from other typical applications. Peripherals and software are just as important as the core, and the ability to process data efficiently, to wake up and go to sleep fast, etc. could mean substantial power savings.

In addition to designing devices to consumer low power, several companies (including startups) are involved in attacking the power issue from the source standpoint. Energy harvesting technologies such as thermoelectric, piezoelectric, electromagnetic, as well as thin film batteries and supercapacitors are currently in development to tackle the power issue. For example, ST Microelectronics has teamed up with Micropelt, which supplies a thermoelectric energy harvesting solution that generates sufficient power to drive a wireless sensor node and charge a rechargeable battery.

There is a growing trend towards the use of wireless sensor networks, and they would be useful in applications like process automation, condition monitoring, and smart buildings. As energy harvesting becomes more widely used, free electrical energy can be extracted from many other sources where thermoelectric power is not readily available, such as vibration, light, and RF energy.

One of the common themes among all MCU vendors is that they pair their existing MCU product with appropriate peripherals and a compelling low-power connectivity solution. By adding the connectivity piece, MCU vendors can differentiate their product and increase the ASPs of their products.

Asian companies involved in the Internet of Things

Samsung Electronics' overall IoT related contribution to Samsung revenues and profits is insignificant at less than 1%. A more meaningful upside could come from Samsung mobile devices (currently makes up for 65% of total profits), which could benefit from IoT as the technology develops and results is higher demand for smarter devices running applications that eventually make useful autonomous decisions for the user. The company acquired CSR (fabless company) to expand its mobile connectivity business last year. Through CSR, Samsung will expand its wireless connectivity offering such as WiFi, Bluetooth, and GPS. Samsung is looking to provide a total wireless solution using CSR's technology and Samsung's Exynos application processor. Samsung also acquired NanoRadio for its low power WiFi solution. In the near term, Samsung is targeting to launch a total solution for mobile device from AP to wireless connectivity. For microcontrollers, Samsung is mainly focused on 8-bit MCU development and recently sold its 4- and 8-bit microcontroller business to power IC vendor Ixys Corp in July this year. Samsung will continue to make the products under an expanded foundry agreement with Ixys.

Samsung Electro-Mechanics. SEMCO is the main supplier of components to Samsung Electronics and has several wireless connectivity solutions such as tuner (terrestrial, cable, satellite), WLAN module, Bluetooth and Zigbee IC. All wireless connectivity products total less than 15% of revenues, but the market is expanding rapidly and the company is gaining share in these markets.

Others. Partron manufactures advanced sensor products for mobile and automobile applications, which make up 3% of revenues and likely to surpass 10% by 2015. LG Innotek is a supplier of components (camera modules, LED) to LG and manufactures sensors for automobiles in collaboration with Hyundai Motor Group on its smart cars.

Similar to US semiconductor companies, we also see many of the Taiwanese foundry, back-end, and fabless companies with ambitions on IoT. However, revenue contribution today is likely nothing or at best low single digits as a percentage of the total.

While exact winners are hard to place today, we believe there are some winning characteristics that should be apparent: 1) Connectivity is key. In the move from PCs to smartphones, the world became more connected. In moving to IoT, it seems clear that connectivity will be a key focus again. This could mean sensors of all types, and it could mean wireless connectivity solutions such as Bluetooth or WiFi. 2) Power consumption is also key. Laptop computers generally run for a few hours, smartphones are expected to last at least a day, and wearable devices ideally need to last for multiple days. 3) Cost. As pointed out earlier in the report, semiconductor content in most IoT devices costs single digits in US$ today, which means driving costs lower is key. This does not necessarily mean cheap, but for example the ability to integrate multiple functions on a device likely becomes even more important.

AAC and GoerTek. AAC and GoerTek are leading acoustic component (speaker, receiver, microphone) suppliers based in China. Their client base is well-diversified and includes internationla handset OEMs such as Apple and Samsung. AAC focuses only on miniature dynamic components while GoerTek also supplies earpods. Following their clients' expansion into other end applications, AAC and GoerTek are both working on wearable projects (mainly on supplying acoustic components) and may benefit from the trend once it takes off. Both have close to no contribution from wearable products thus far.

Fabless

MediaTek. We see MediaTek as a key play on the wireless connectivity solutions. Through its own R&D efforts and the Ralink acquisition, MediaTek has strong product offerings in GPS, Bluetooth, WiFi, and cellular. In addition, while it is not always the technology leader, it has done well historically in price sensitive segments and its ability to integrate and cost down is usually one of the best worldwide. As an example, we note that MediaTek was one of the first to commercialize a four-in-one combo chip that integrated GPS functionality on a single piece of silicon, thus lowering costs significantly.

Richtek is the largest fabless analog IC company in Asia. The company has built up a team in 2012 designing MEMS sensors for consumer electronics. TSMC's support in the MEMS foundry process is one of key factors that Richtek can design a competitive MEMS product in Asia. We expect MEMS sensor to start to contribute Richtek's revenue in 2H14.

Faraday could be an indirect beneficiary of IoT, given its favourable customer exposure. First, Faraday provides chip design services to the communication chip vendors for China smart electricity grids. The chips are used to connect smart meters to grids. Besides, Faraday's 10% investee, NeuroSky, designs brainwave sensors and cardinal gram sensors for wearable devices. We expect Faraday to generate both design service revenue and investment gain from Neurosky starting from 1H14. We estimate IoT related revenue could contribute 10%-15% of Faraday's 2014 total sales.

Foundries

What IoT means to the foundries is less clear to us. Many of the MEMS devices today are made in IDMs such as STMicro. Unlike traditional semiconductors where the fabless companies focus on the design and foundries focus on the manufacturing process, since MEMS is inherently a mechanical device, the manufacturing process is much more central as a differentiating feature and thus IDMs have been less willing to outsource. This has perhaps started to change: foundries such as TSMC have worked to standardize manufacturing processes, and there are at least a few successful fabless MEMS companies such as InvenSense.

As cost and integration are key drivers for IoT, a key question is what it does to Moore's Law. On the one hand, accelerating the move to smaller nodes has historically been the key method to drive costs lower, on the other hand, we could argue that additional analog/mixed-signal functionality plus the escalating costs of advanced nodes could mean the move to advanced geometries slow down, especially as cost becomes a bigger concern.

TSMC today is the leader in specialty foundries technologies, just like it is at the leading edge. For example, TSMC is the leader for backside illuminated CMOS image sensors, and TSMC is also the foundry partner for InvenSense. Having said that, we would estimate that total IoT likely accounts for less than 1% of TSMC's total revenues today.

Murata Mfg. Murata's broad line-up includes infrared sensors, ultrasonic sensors, shock sensors, rotary sensors, rotary position sensors, and angular rate sensors. With the acquisition of Finnish company VTI completed in January 2012, it gained a line-up of MEMS sensors. We estimate around 50% of its communications module segment is made up of WLAN modules, with the bulk of the remainder being front-end modules. Wireless devices use coaxial antenna connectors, and Murata has a large share of the market for coaxial connectors for smartphones.

Alps Electric. Alps' products include HDD atmospheric pressure sensors and magnetic sensors. We estimate annual sales of sensors (part of the components business) are on the

order of Y15bn. Wireless products include digital tuners and network modules but only account for around 5% of total sales.

Hirose Electric. Wireless devices use coaxial antenna connectors, and Hirose has a large share of the market for coaxial connectors for smartphones.

TDK's main sensor product is NTC thermistors. We estimate annual sales are around Y15bn. WiFi module sales are on the rise but still not a major profit contributor.

Taiyo Yuden. Sensor sales remain limited. Wireless products include Bluetooth modules and wireless LAN modules.

Mitsumi Electric. Main products include tuners and WiFi modules. Sales of automotive antennas are expanding of late.

JAE's products include accelerometers for combat aircraft, sensor packages for oil drilling equipment, and resolvers (rotary position sensors) for EV/HEVs. The aerospace business, to which these products belong, accounts for around 10% of total sales (based on F3/13 actual).

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Morgan Stanley is currently acting as financial advisor to Google Inc. ("Google") with respect to its proposed stock dividend, as announced on April 12, 2012. Certain aspects of the proposal are subject to approval by Google's shareholders. Google has agreed to pay fees to Morgan Stanley for its financial advice. Please refer to the notes at the end of the report.

Morgan Stanley is acting as financial advisor and providing financing services to Verizon Communications Inc. ("Verizon") in relation to their definitive agreement with Vodafone Group Plc. ("Vodafone") to acquire Vodafone's U.S. group with the principal asset of 45 percent of Verizon Wireless, as announced on September 2, 2013.

The proposed transaction is subject to the consent of Verizon and Vodafone shareholders, required federal regulatory approvals and other customary closing conditions. This report and the information provided herein is not intended to (i) provide voting advice, (ii) serve as an endorsement of the proposed transaction, or (iii) result in the procurement, withholding or revocation of a proxy or any other action by a security holder.

Verizon has agreed to pay fees to Morgan Stanley for its services, including transaction fees and financing fees that are subject to the consummation of the proposed transaction. Please refer to the notes at the end of the report

Exhibit 20

Summary exposure of covered companies

	Microcontrollers	Sensors	Wireless connectivity	Software
ARM	X		X	X
CSR	X		X	
Dialog	X		X	
Infineon		X		
STMicroelectronics	X	X	X	X
Nordic	X		X	
Gemalto			X	X
Ericsson			X	
ASE		X		
MediaTek			X	
UMC			X	
TSMC		X	X	
Faraday		X		
Winbond	X			
Realtek			X	
Microchip Technology	X	X	X	
Atmel	X	X	X	
Freescale	X	X	X	
NXP Semiconductor	X	X	X	
Analog Devices	X	X	X	
Linear Technology		X	X	
Fairchild Semiconductor		X	X	
Avago Technologies		X	X	
Maxim Integrated	X	X	X	
ON Semiconductor	X	X		
Texas Instruments	X	X	X	
Broadcom	X	X	X	
Invensense		X		
Qualcomm	X	X	X	
Intel	X	X	X	
Splunk				X
Teradata				X
Apple		X		
Murata		X	X	
Alps		X	X	
Hirose Electric			X	
TDK		X	X	
Taiyo Yuden		X	X	
Mitsumi Electric			X	
JAE			X	

Source: Company Data, Morgan Stanley Research

Exhibit 21

Bluetooth Smart ready products (hubs)

Manufacturer	Product Name	Type of Product
Apple	iPad (Mini, 3rd & 4th gen)	Tablet
Apple	iPhone (5 and 4S)	Phone
Apple	iPod touch	Portable Media Player
Apple	MacBook Air	Laptop
Apple	MacBook Pro	Laptop
Apple	Mac mini	Computer
Apple	Apple TV	Smart TV console
BlackBerry	Q10	Phone
BlackBerry	Z10	Phone
ConnectBlue AB	OLS425 / OLS426	Module
ConnectBlue AB	OLP425	Module
DISH	Hopper	DVR
DISH	Hopper with Sling	DVR
Fujitsu	Arrows	Tablet
Fujitsu	Lifebook Series	Laptop Tablet
Fujitsu	Stylistic Series	Laptop Tablet
Microsoft	Surface	Tablet
Motorola	Droid RAZR	Phone
NEC	LaVie Series	Laptop
NEC	VersaPro Series	Laptop
Samsung	All-In-One PC 700A3D	Laptop
Samsung	ATIV Smart PC	Laptop
Samsung	Galaxy S III	Phone
Sony	VAIO S Series	Laptop

Source: Bluetooth SIG

Exhibit 22

Bluetooth Products

Type of Product	Manufacturer	Product Name	Type of Product	Manufacturer	Product Name	Type of Product	Manufacturer	Product Name
6.5	Joybien Technologies	GS201t	Heart rate monitor	BiiFit	HRM01	Proximity sensor	Ace Sensor Inc.	Pally Smart Key Finder
Blood glucose monitor	Panasonic	GT-1830	Heart rate monitor	Blue Leza	BLSFHR01	Proximity sensor	Albers Inc.	Item Finder/APP controller
Blood pressure monitor	HoMedics	BPW-360BT	Heart rate monitor	Dayton	HRM	Proximity sensor	Buffalo	Bluetooth Proximity Tag
Blood pressure monitor	IDT Technology Limited	BPU329	Heart rate monitor	EB Brands	Sportline SYNC 3015	Proximity sensor	Deltron Technology	iFound Key
Blood pressure monitor	Samico	SA-B58	Heart rate monitor	Echowell	BH20	Proximity sensor	Denso Corporation	KFDNX
Blood pressure monitor	Truly Healthcare	Arm Blood Pressure Monitor	Heart rate monitor	Geonaute	Geonaute	Proximity sensor	Find My Car Smarter	Find My Car Smarter system
Blood pressure monitor	Vitagoods	BP Monitor	Heart rate monitor	Gpulse	BLE-HRM-100	Proximity sensor	Hippih	HipKey
Body scale	iHealth Lab	Hs4	Heart rate monitor	IDT Technology Limited	SZ999	Proximity sensor	Joybien Technologies	CM101t
Body scale	Newgen Medicals	NC-5666	Heart rate monitor	Latitude Limited	MapMyRun 3015	Proximity sensor	Joybien Technologies	KF101t / KF101n
Body Scale	Samico	SA-B89	Heart rate monitor	Latitude Limited	Runtastic TD00290	Proximity sensor	Maytel	Smart Nudge
Body Scale	Transtek	VS-3200-W	Heart rate monitor	Mobile Minds	Pebble	Proximity sensor	Pebble Smart Keeper	PK-01
Body scale	WiTscale	Model S1	Heart rate monitor	Mobility Holdings, Ltd	BioLogic	Proximity sensor	Qualcomm	FYX Beacon
Breathalyzer	BAC Track	BT-M5	Heart rate monitor	National Electronics	Bluetooth 4.0 Chest Strap	Proximity sensor	Vencer	VK-2000 Bluetooth Proximity Tag
Broadcaster	Joybien Technologies	SD101t	Heart rate monitor	Pafers Tech Co., Ltd.	HR-KIT	Remote control	Huawei	MediaQ
Ceiling Fan Remote	Satellite Electronics	Fan Light	Heart rate monitor	Pear Sports	Pear Mobile	Remote control	Huawei	RC310
Cycling sensor	Echowell	BTR20	Heart rate monitor	Polar	H7	Remote control	LG	Onekey
Cycling sensor	Meso International GmbH	BikeLogger	Heart rate monitor	Runtastic	App	Remote power supply	Joybien Technologies	ES101t
Cycling sensor	Wahoo	Blue SC	Heart rate monitor	Salutron	HRM Chest Strap	Smart posture sensor	Lumoback	LUMOback
Dimmer lamp	Joybien Technologies	LL101t	Heart rate monitor	Scosche	BLCS	Smart watch	Casio	G-Shock GB-6900
DSLR camera remote timer	Semilink Inc.	Satechi SD-100	Heart rate monitor	Sports Beat, Inc.	BodyFit	Smart watch	Citizen	W760
Finger pulse oximeter	Nonin Medical Inc.	3230	Heart rate monitor	Wahoo	Blue HR	Smart watch	IDT Technology Limited	RA900 / SE900
Fitness GPS watch	TomTom	8RS00	Heart rate monitor	Weartech	Gow Trainer	Spinning bike	Icon Fitness	Pro-Form Spinner Bike
Fitness tracker	Fitbit, Inc.	Fitbit One	Heart rate sensor	Techsport Ltd.	SHR-01	Stride sensor	Polar	Y8
Fitness tracker	Fitbit, Inc.	Zip	Laser measure	Leica Geosystems AG	Disto™ D510	Stylus	Adonit Corp.	Jot Touch
Fitness Tracker	GeoPalz	iBitz	LED outdoor light	Evluma	Area Max	Stylus	Ten One Design	Pogo Connect
Fitness tracker	Motorola	MOTOACTV	Medical monitor	Newgen Medicals	NC-4924-675	Tire pressure sensor	Joybien Technologies	TP101t
Fitness tracker	Withings	Smart Body Analyzer WS-50	Mobile phone accessory	CCA Electronic Factory	RT-1201A	Toy car	Joybien Technologies	TC101t / TC101n
Fitness tracking system	Under Armour	Armour39	Mobile phone accessory	Logitec Corp.	BLE Tag LBT-VRU01	Toy helicopter	Joybien Technologies	TH101t
Fitness watch	Salutron	C Series	Module	ConnectBlue AB	OBS421	Treadmill	Fitcrew	RUN 4.1
Game controller	Zagg	Caliber Advantage	Mouse	Elecom Co., Ltd	M-BT11BB	Treadmill	Icon Fitness	Boston Marathon Treadmill
Gaming appccessory	Joybien Technologies	DC101t	Mouse	Mad Catz, Inc.	R.A.T.M	Treadmill remote	Icon Fitness	Speed Ring
GPS hiking watch	Garmin	Fenix	Mouse	Mad Catz, Inc.	M.O.U.S.9	USB dongle	Bluegiga Technologies	D112
Heart rate monitor	60beat	60beat BLUE	Notification device	SmartLight	L8 SmartLight	Wearable tech	Nike	Hyperdunk+,
Heart rate monitor	Alatech Technology	CS010, CS009	Pet activity tracker	Whistle	Whistle	Wearable tech	Nike	LunarTR1+, Lunar Hyperworkout+
Heart rate monitor	Alutech Int'l Ltd.	W183	Power consumption sensor	FBSC	F-PLUG	Weight scale	Ace Sensor Inc.	Pally Smart Health Scale
Heart rate monitor	BeetsBlu	BBHRM1	Proximity Device	Cardiofitness GbR	Brustgurt	Wireless glucose monitoring system	iHealth Lab	GB5L
Heart rate monitor	Beurer GmbH	PM250						

Source: Bluetooth SIG

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Global Stock Ratings Distribution

(as of August 31, 2013)

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	Coverage Universe		Investment Banking Clients (IBC)		
Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category
Overweight/Buy	**978**	**34%**	**400**	**38%**	**41%**
Equal-weight/Hold	**1280**	**44%**	**491**	**46%**	**38%**
Not-Rated/Hold	**114**	**4%**	**28**	**3%**	**25%**
Underweight/Sell	**510**	**18%**	**137**	**13%**	**27%**
Total	**2,882**		**1056**		

Data include common stock and ADRs currently assigned ratings. An investor's decision to buy or sell a stock should depend on individual circumstances (such as the investor's existing holdings) and other considerations. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months.

Analyst Stock Ratings

Overweight (O). The stock's total return is expected to exceed the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Equal-weight (E). The stock's total return is expected to be in line with the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Not-Rated (NR). Currently the analyst does not have adequate conviction about the stock's total return relative to the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Underweight (U). The stock's total return is expected to be below the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Unless otherwise specified, the time frame for price targets included in Morgan Stanley Research is 12 to 18 months.

Analyst Industry Views
Attractive (A): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be attractive vs. the relevant broad market benchmark, as indicated below.
In-Line (I): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be in line with the relevant broad market benchmark, as indicated below.
Cautious (C): The analyst views the performance of his or her industry coverage universe over the next 12-18 months with caution vs. the relevant broad market benchmark, as indicated below.
Benchmarks for each region are as follows: North America - S&P 500; Latin America - relevant MSCI country index or MSCI Latin America Index; Europe - MSCI Europe; Japan - TOPIX; Asia - relevant MSCI country index.
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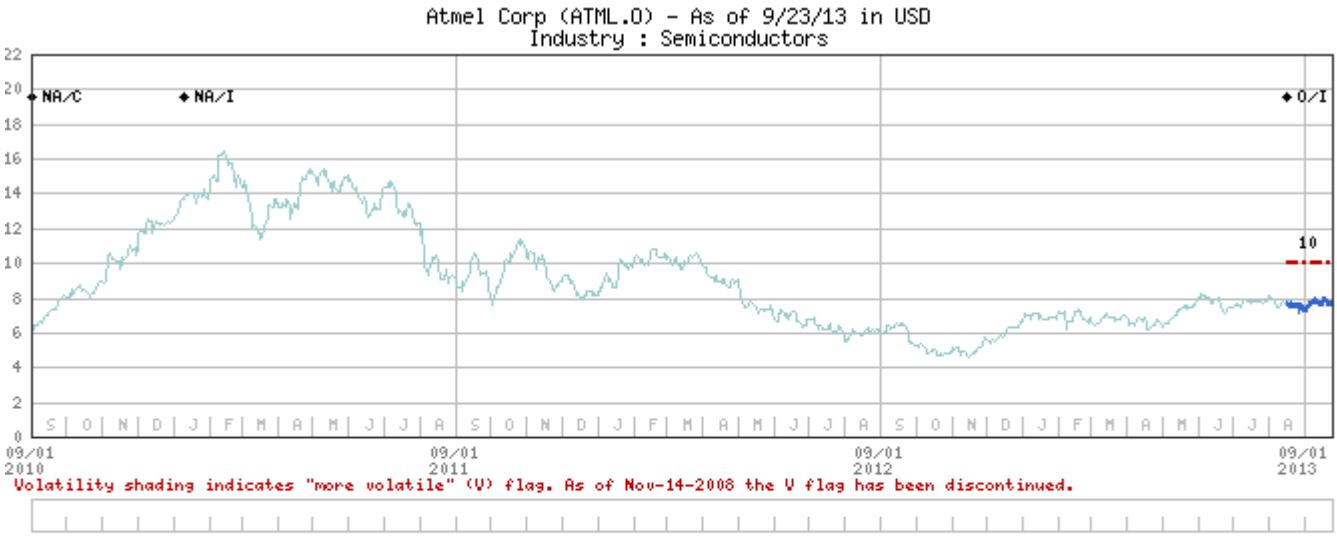
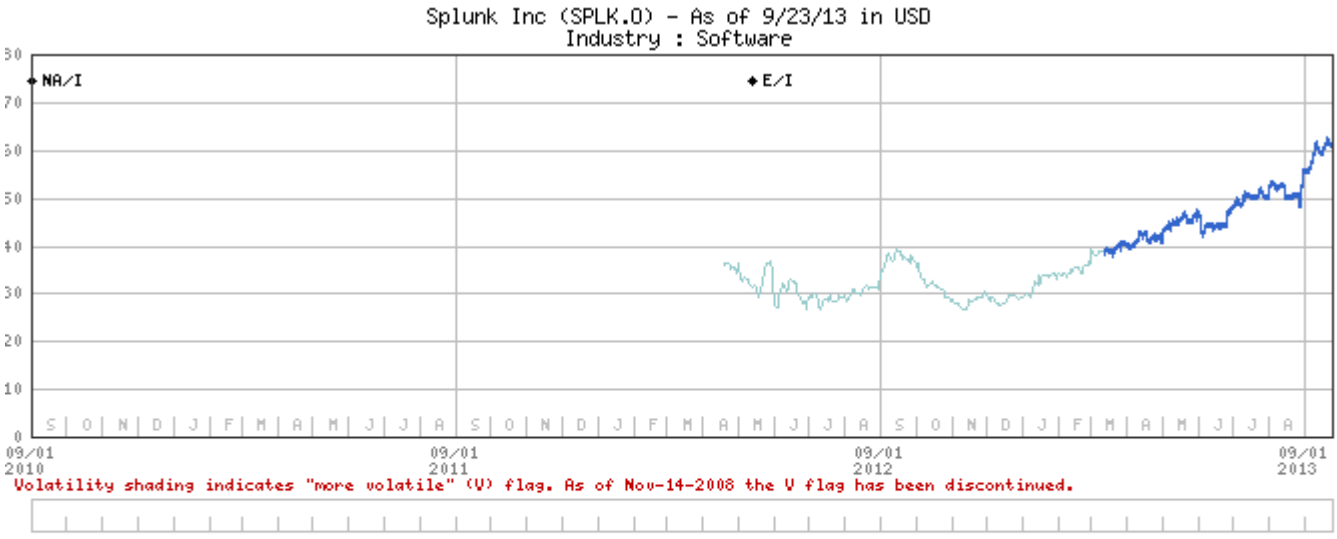
Stock Price, Price Target and Rating History (See Rating Definitions)



Stock Rating History: 9/1/10 : NA/C; 1/10/11 : NA/I; 8/16/13 : O/I
Price Target History: 8/16/13 : 10

Source: Morgan Stanley Research Date Format : MM/DD/YY Price Target No Price Target Assigned (NA)
Stock Price (Not Covered by Current Analyst) Stock Price (Covered by Current Analyst)
Stock and Industry Ratings (abbreviations below) appear as ◆ Stock Rating/Industry View
Stock Ratings: Overweight (O) Equal-weight (E) Underweight (U) Not-Rated (NR) More Volatile (V) No Rating Available (NA)
Industry View: Attractive (A) In-line (I) Cautious (C) No Rating (NR)



Stock Rating History: 9/1/10 : NA/I; 5/14/12 : E/I

Price Target History: 5/14/12 : NA

Source: Morgan Stanley Research Date Format : MM/DD/YY Price Target No Price Target Assigned (NA)
Stock Price (Not Covered by Current Analyst) Stock Price (Covered by Current Analyst)
Stock and Industry Ratings (abbreviations below) appear as ◆ Stock Rating/Industry View
Stock Ratings: Overweight (O) Equal-weight (E) Underweight (U) Not-Rated (NR) More Volatile (V) No Rating Available (NA)
Industry View: Attractive (A) In-line (I) Cautious (C) No Rating (NR)

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