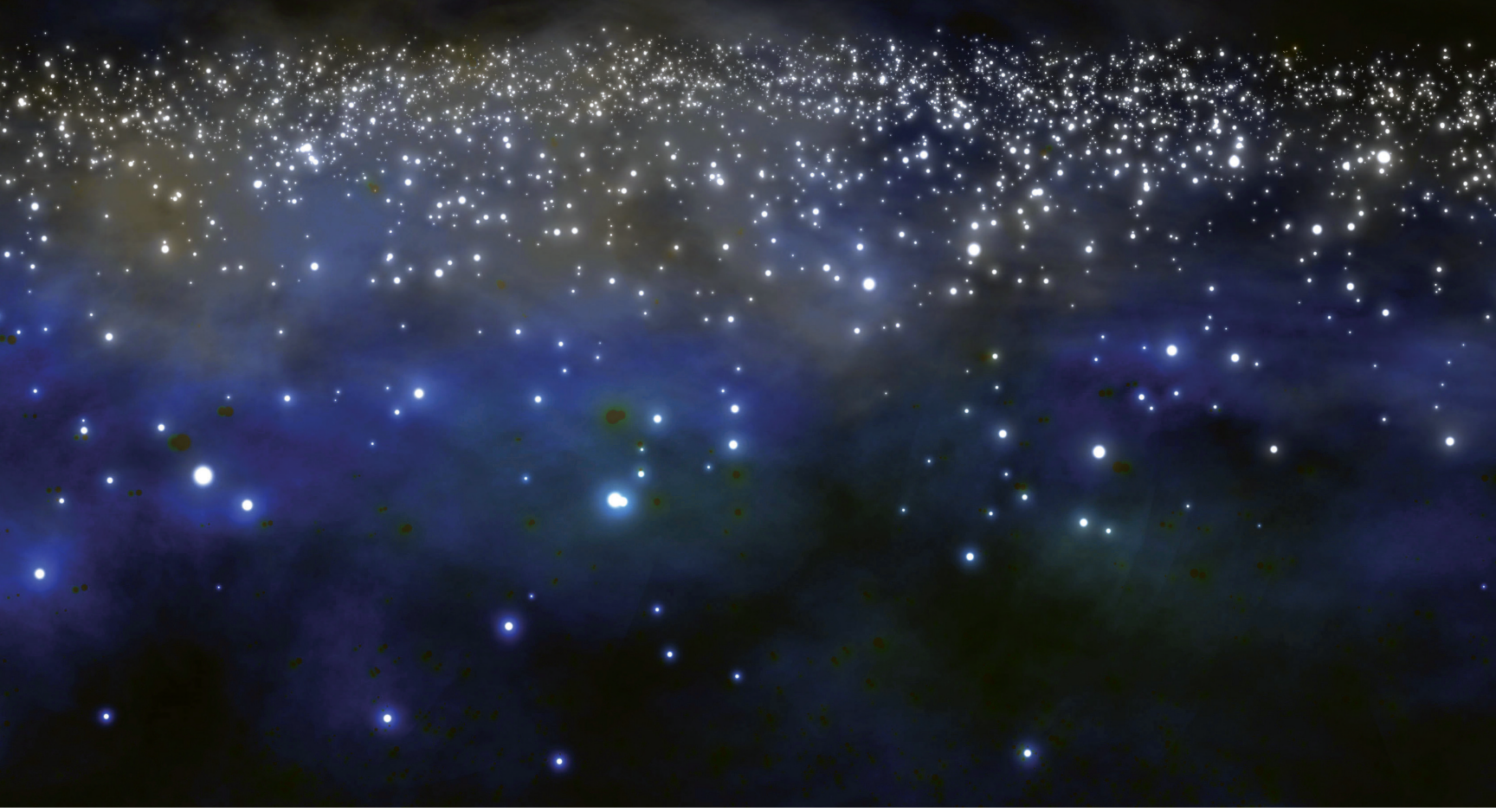


Device democracy

Saving the future of the Internet of Things

IBM Institute for Business Value

Executive Report

Electronics Industry

Transforming businesses as the Internet of Things expands

As a global electronics company, we understand the issues facing the high-tech industry and the continuous transformation required to thrive. Across the industry, companies are turning their attention from smartphones and tablets to a new generation of connected devices that will transform not just the Electronics industry, but many others. The IBM Global Electronics practice uniquely combines IBM and partner services, hardware, software and research into integrated solutions that can help you deliver innovation, create differentiated customer experiences and optimize your global operations.

Why is the IoT in peril?

More than a billion intelligent, connected devices already comprise today's "Internet of Things (IoT)." The expected proliferation of hundreds of billions more places us at the threshold of a transformation sweeping across the electronics industry and many others. Yet, the dream of a smart, safe and efficient future is threatened by subscription fees, ubiquitous advertising and intrusive surveillance. For the IoT to survive the end of trust and successfully scale from billions to hundreds of billions of devices, executives need to rethink the technology strategy, business models and design principles at its foundation.

This first report of our study shows that a low-cost, private-by-design "democracy of devices" will emerge that will enable new digital economies and create new value, while offering consumers and enterprises fundamentally better products and user experiences.

Executive summary

When the first mainframes were sold, even IBM did not imagine a global market larger than a few thousand devices. Mainframes were the province of the largest governments and enterprises, used to execute complex managerial and operational tasks. Thanks to technological progress that has been both relentless and predictable, mainframes were supplemented first by minicomputers, then microcomputers, personal computers, and most recently, smartphones and tablets. Next up: smart devices.

Each time the cost of computing power has declined by an order of magnitude, it has, in turn, kicked off a rise in unit volume – also by an order of magnitude. Even though volume increases have been so large with each revolution, the time required to achieve that growth has decreased.[1]

This next revolution, a network of billions of intelligent devices known as the "Internet of Things (IoT)," will, in some ways, be predictable and similar to past expansions of the computing world. In other aspects, however, it represents an entirely new approach. Computing is already widespread in many devices from kitchens to cars, but it is a particular kind of computing that is cheap and scalable, yet inherently limited: application-specific, embedded computing.

What is new, and what will power the IoT, is the shift from special purpose computing – often the minimum necessary for device control – to general purpose computing. Thanks to Moore's Law, it is now cheaper and easier to make a device with a powerful general purpose computer than create a customized embedded device. Very soon, devices from doorknobs to light bulbs will carry as much compute power and connectivity as the first smartphones.

To guide executives in making strategic IoT investments, and to better understand the connected future and its impact across industries, we conducted the 2014 IBM Internet of Things Study. Our study was performed in conjunction with top IBM researchers and comprised of three research components: technology strategy; business and economic

In the emerging device-driven democracy, power in the IoT will shift from the center to the edge.

As devices compete and trade in real-time, they will create liquid markets out of the physical world.

In the IoT of hundreds of billions of devices, connectivity and intelligence will be a means to better products and experiences, not an end.

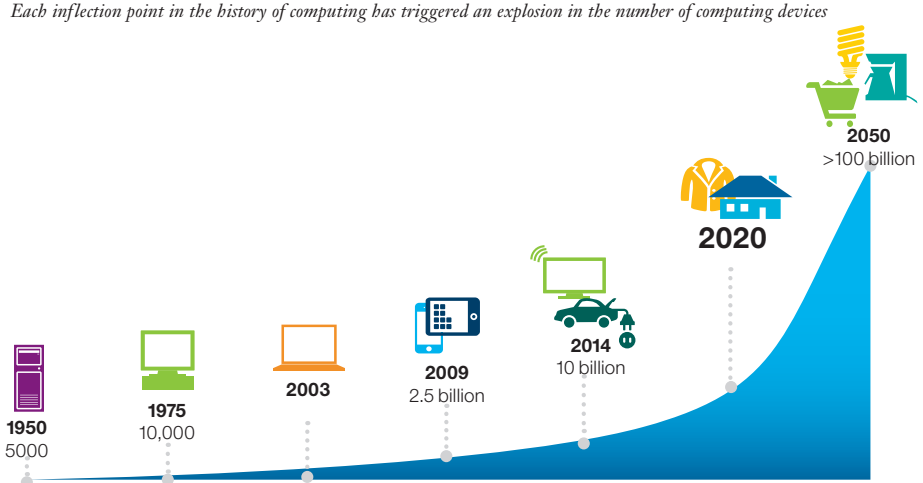
insights; and product and user experience design. The findings from the initial phase are explored in this report. Additional analysis and publication of our research findings will continue in the next phase (see methodology details on page 21).

The confluence of many technology revolutions

The rise of inexpensive general purpose computing has been accompanied by the availability of inexpensive sensors and actuators that today are cheap enough to embed in a device even if they are not used. Tremendous advances in cloud computing enable storage and analytics of the vast amounts of data generated by these sensors. Fueled by ubiquitous connectivity and the availability of billions of IP addresses with IPv6, the number of connected devices is forecasted to surpass 25 billion in 2020, up from 2.5 billion in 2009 and 10 billion today (see Figure 1).[2]

Figure 1

Each inflection point in the history of computing has triggered an explosion in the number of computing devices



Looking forward, an increase in open web-service application program interfaces (APIs) will allow devices to connect and work smoothly as part of complex, multi-vendor networks. 3D printing and digital manufacturing will enable manufacturers to build and deploy devices in small batches, quickly pioneering new products and solutions.

The result: a proliferation of hundreds of billions of devices that will be no more expensive than their dumb counterparts, yet able to operate and act as part of complex, integrated systems. As with prior revolutions, this one will usher in another order-of-magnitude reduction in cost, as smartphones and tablets that range from US$200 to US$600 are supplemented by smart devices, such as doorknobs and light bulbs, that cost as little as US$20.

Opportunities for the global economy

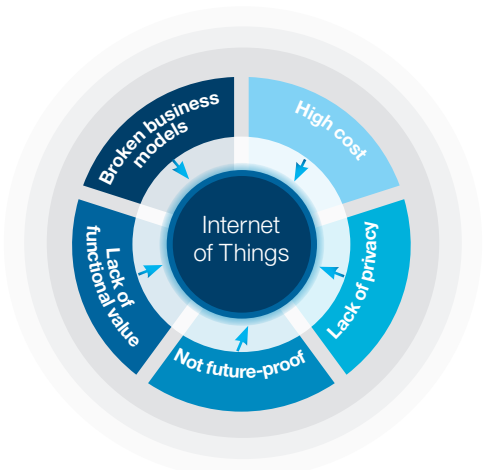
Though the IBM mainframe (once System/360, now System z) recently celebrated its 50th anniversary, the impact of the computer industry on the global economy has been relatively recent and surprisingly limited. Nobel Prize-winning economist Robert Solow remarked in 1987 that even as PC sales surged into the millions, he could see the impact of computers "everywhere but in the productivity statistics."[3]

In 1987, computers of all kinds were selling around 15 to 20 million annually.[4] It was not until after the year 2000 that economists were able to show a statistically significant impact of computers on industrial productivity.[5] By that time, computer sales were routinely exceeding 300 million annually.6 Since then, we have gone from 300 to 400 million PCs to nearly a billion smartphones.[7]

As we go from a billion smartphones toward hundreds of billions of smart devices, the scale of opportunity from the IoT becomes visible. After over 50 years of gradually growing penetration, the majority of the global economy is still considered to be in industries that are not "IT-intensive." Many of these – like agriculture, transportation and logistics – have not historically fit well with personal computers that require desks and offices. The IoT will change all that.

Figure 2

Why today's Internet of billions of Things won't scale to the Internet of hundreds of billions of Things



Why the IoT already needs a reboot

So far, the first wave of the IoT has focused on very high-value applications. There have been visible successes in continuous monitoring of jet engines, automated smart meters and remote healthcare management. But demand has been slow to take off in many areas: only 30 percent of heavy industrial equipment is networked and only 10 percent of smart TVs are used for Internet viewing.8 Perhaps the slowest area of adoption is home automation, where consumers have failed to embrace devices from smart toothbrushes to refrigerators.

Market expectations and valuations, however, have been enormous – as much as 10 to 20 times revenue, even though revenues have been relatively small, particularly in the consumer space.9 This is largely a result of the cost and complexity of most IoT solutions, as well as enterprises and entrepreneurs treating the IoT as if it were just another computing platform, and applying the same set of business models: services, ecosystems, applications and analytics. Unless executives make big strategic changes, they are set to be disappointed as they seek to scale today's IoT solutions to support tomorrow's hundreds of billions of things (see Figure 2).

Challenge one: The cost of connectivity

Even as revenues fail to meet expectations, costs are prohibitively high. Many existing IoT solutions are expensive because of the high infrastructure and maintenance costs associated with centralized clouds and large server farms, in addition to the service costs of middlemen.

There is also a mismatch in supplier and customer expectations. Historically, costs and revenues in the IT industry have been nicely aligned. Though mainframes lasted for many years, they were sold with enterprise support agreements. PCs and smartphones have not

historically been sold with such profitable support plans; but with their shorter product life cycles, that has not been a huge problem. With the IoT, it is unlikely that there will be enough margin for companies to cover several years of support and maintenance.

The cost of supporting and serving billions of smart devices will be substantial – even something as simple as maintaining centralized servers that distribute regular software updates.

Challenge two: The Internet after trust

The Internet was originally built on trust. In the post-Snowden era, it is evident that trust in the Internet is over. The notion of IoT solutions built as centralized systems with trusted partners is now something of a fantasy. Most solutions today provide the ability for centralized authorities, whether governments, manufacturers or service providers to gain unauthorized access to and control devices by collecting and analyzing user data.

In a network of the scale of the IoT, trust can be very hard to engineer and expensive, if not impossible, to guarantee. For widespread adoption of the ever-expanding IoT, however, privacy and anonymity must be integrated into its design by giving users control of their own privacy.

Current security models based on closed source approaches (often described as “security through obscurity”) are obsolete and must be replaced by a newer approach – security through transparency. For this, a shift to open source is required. And while open source systems may still be vulnerable to accidents and exploitable weaknesses, they are less susceptible to government and other targeted intrusion, for which home automation, connected cars and the plethora of other connected devices present plenty of opportunities.

Challenge three: Not future-proof

While many companies are quick to enter the market for smart, connected devices, they have yet to discover that it is very hard to exit. While consumers replace smartphones and PCs every 18 to 36 months, the expectation is for door locks, LED bulbs and other basic pieces of infrastructure to last for years, even decades, without needing replacement.

An average car, for example, stays on the road for 10 years, the average U.S. home is 39 years old and the expected lifecycles of road, rail and air transport systems is over 50 years.10 A door lock with a security bug would be a catastrophe for a warehousing company and the reputation of the manufacturer. In the IoT world, the cost of software updates and fixes in products long obsolete and discontinued will weigh on the balance sheets of corporations for decades, often even beyond manufacturer obsolescence.

Challenge four: A lack of functional value

Many IoT solutions today suffer from a lack of meaningful value creation. The value proposition of many connected devices has been that they are connected – but simply enabling connectivity does not make a device smarter or better. Connectivity and intelligence are a means to a better product and experience, not an end.

It is wishful thinking for manufacturers that some features they value, such as warranty tracking, are worth the extra cost and complexity from a user's perspective. A smart, connected toaster is of no value unless it produces better toast. The few successes in the market have kept the value proposition compelling and simple. They improve the core functionality and user experience, and do not require subscriptions or apps.

Challenge five: Broken business models

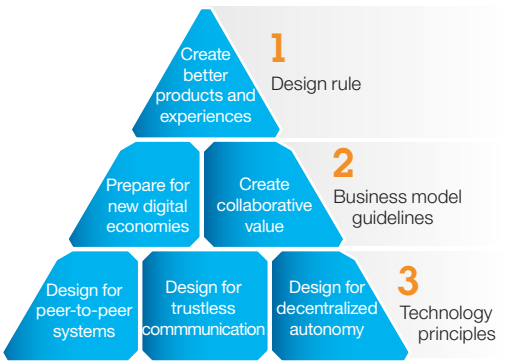
Most IoT business models also hinge on the use of analytics to sell user data or targeted advertising. These expectations are also unrealistic. Both advertising and marketing data are affected by the unique quality of markets in information: the marginal cost of additional capacity (advertising) or incremental supply (user data) is zero. So wherever there is competition, market-clearing prices trend toward zero, with the real revenue opportunity going to aggregators and integrators. A further impediment to extracting value from user data is that while consumers may be open to sharing data, enterprises are not.

Another problem is overly optimistic forecasts about revenue from apps. Products like toasters and door locks worked without apps and service contracts before the digital era. Unlike PCs or smartphones, they are not substantially interactive, which makes such revenue expectations unrealistic.

Finally, many smart device manufacturers have improbable expectations of ecosystem opportunities. While it makes interesting conversation for a smart TV to speak to the toaster, such solutions get cumbersome quickly and nobody has emerged successful in controlling and monetizing the entire IoT ecosystem.

So while technology propels the IoT forward, the lack of compelling and sustainably profitable business models is, at the same time, holding it back. If the business models of the future don't follow the current business of hardware and software platforms, what will they resemble?

Figure 3. *The pyramid of digital success: Build a strong technology foundation, guided by new business models and design for better experiences*



Saving the future of the IoT

As the number of connected devices grows from billions to hundreds of billions, and as governments and corporations race to take control of devices and data, we need to save the IoT. This "rescue" will require business and technology leaders to fundamentally rethink technology strategy by building solutions for radically lower cost, privacy and autonomy. Business models that guide these solutions must embrace highly efficient digital economies and create collaborative value, all while creating improved products and user experiences (see Figure 3).

Democratizing the digital world

The foundation of modern computing is the very humble work of transaction processing. From phone calls to electricity metering, to airline reservations, each is a transaction to be processed. As passengers make reservations, pay for tickets, board planes and receive frequent flyer miles, every step along the way a transaction is processed, recorded and stored.

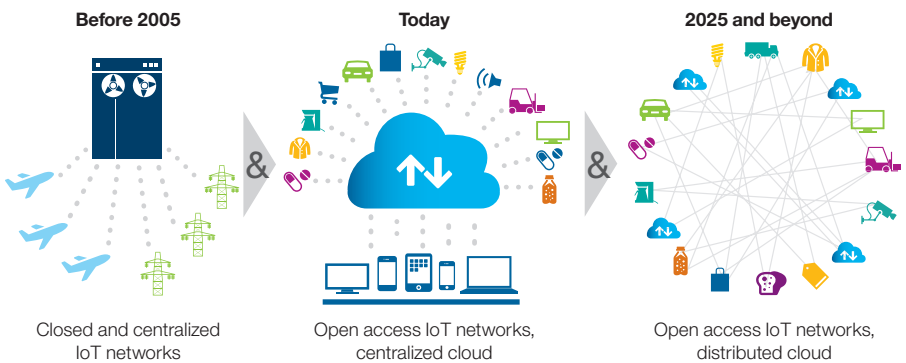
Transaction processing isn't just for "old-school" workloads, either. Every digital interaction like a message or tweet, is a transaction as well. In today's web-based world, the scale and volume of transactions have exploded. The New York Stock Exchange handles 5 million trades a day.[11] In contrast, over 5 billion social media transactions are processed every single day.[12] Now, along comes the IoT, further exploding the scale and volume of transactions to be processed.

Indeed, transaction processing could not have scaled to its current level without distributed computing. Distributed computing has existed for some time now, as have peer-to-peer systems. But as recent significant advances in peer-to-peer computing meet Moore's Law, it will soon be possible to harness the compute power, terabytes of storage and bandwidth that will be on billions of devices, in millions of locations and sitting idle most of the time for transaction processing.

Adopting peer-to-peer computing to process the hundreds of billions of IoT transactions can significantly reduce costs associated with installing and maintaining large centralized data centers. It's time for the cloud to move from the data center to your doorknob (see Figure 4).

Successful decentralization of the IoT, however, will lie not just in being peer-to-peer, but also in being trustless: an environment in which there is no need for participants to be trusted and no centralized, single point of failure.

Figure 4. *To be safe, scalable and efficient, Internet of Things networks must be re-architected to gradually shift from managing billions of devices to hundreds of billions of devices*



"The future is already here – it's just not very evenly distributed."

William Gibson, Author[13]

In the absence of a centralized server brokering messages, supporting file storage and transfers, and arbitrating roles and permissions, any decentralized IoT solution should support three foundational types of transactions:

- Trustless peer-to-peer messaging
- Secure distributed data sharing
- A robust and scalable form of device coordination.

Peer-to-peer messaging protocols are not new, but emerging trustless peer-to-peer messaging systems promise to provide a "lightweight" mechanism for highly encrypted, private-by-design communication among devices on the IoT.[14] Our vision is that in the near future, these trustless peer-to-peer protocols evolve into transport protocols more suited for the IoT than TCP/IP. Additionally, secure distributed file-sharing protocols have the potential to replace cloud-based file storage and transfers, enabling secure software and firmware updates, and direct file sharing among peer devices.

The greatest challenge, however, is not in simply building a decentralized IoT, but one that can scale universally while maintaining private, secure and trustless transactions. In other words, the IoT represents a case of billions of players, not all of which can be trusted – some even malicious – with a need for some form of validation and consensus. And for this, the "blockchain" offers a very elegant solution.

Why blockchains work for the IoT

A technology breakthrough that has fundamentally changed our notions of centralized authority, the blockchain is a universal digital ledger that functions at the heart of decentralized financial systems such as Bitcoin, and increasingly, many other decentralized systems.

The blockchain holds a record of every transaction made by every participant. Cryptography is used to verify transactions and keep information on the blockchain private. Many participants verify each transaction, providing highly redundant verification and are rewarded for the computational work required. By confirming transactions using decentralized consensus, the blockchain eliminates the need for trust.

While the blockchain may carry regulatory and economic risk as a long-term store of value (as in the case of Bitcoin), it can be quite revolutionary as a transaction processing tool.[15]

In our vision of a decentralized IoT, the blockchain is the framework facilitating transaction processing and coordination among interacting devices. Each manages its own roles and behavior, resulting in an "Internet of Decentralized, Autonomous Things" – and thus the democratization of the digital world (see Figure 5).

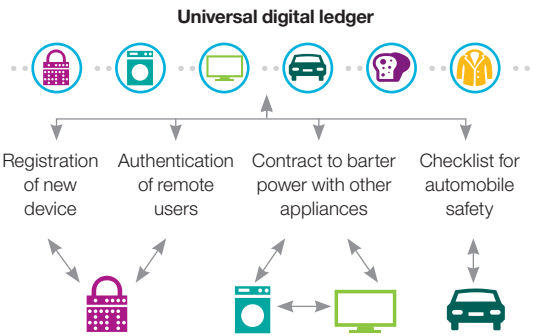
The role of users

In this democracy of hundreds of billions, users bind with devices using secure identification and authentication. Users dynamically create and maintain rules of engagement with other devices. These rules provide a powerful mechanism to define relationships between and permissions for devices based on user-defined proximity: physical, social or temporal.

Rules could also be defined by 51 percent consensus, as in the case of devices agreeing on the safety of peer downloadable software updates or banning a misbehaving participant. User creation and execution of digital checklists based on a pre-defined set of rules aims to help ensure that the autonomously functioning devices do not fail.

Figure 5

The blockchain functions as a universal digital ledger facilitating various types of IoT transactions between devices



The role of devices

Devices, on the other hand, are empowered to autonomously execute digital contracts such as agreements, payments and barters with peer devices by searching for their own software updates, verifying trustworthiness with peers, and paying for and exchanging resources and services. This allows them to function as self-maintaining, self-servicing devices.

The power to autonomously trade with other devices opens up whole new business model opportunities: each device in the network can function as a self-contained business, sharing capabilities and resources such as compute cycles, bandwidth and power at very low transaction costs with other devices. Besides the creation of new businesses that tap the unused capacity of billions of devices, the blockchain also facilitates new markets for service and consumables associated with those devices.

The role of manufacturers

For device manufacturers and service providers too, a blockchain-based IoT is attractive. It allows them to transfer maintenance ownership and responsibility to a community of self-maintaining devices, making the IoT future-proof and saving infrastructure costs on a massive scale, both during the life of a device and long past its obsolescence.

In this model, users control their own privacy and rather than being controlled by a centralized authority, devices are the master. The role of the cloud changes from a controller to that of a peer service provider. In this new and flat democracy, power in the network shifts from the center to the edge. Devices and the cloud become equal citizens.

Such a device-driven democracy is clearly very compelling for all participants in the IoT ecosystem. But perhaps its greatest value is at the macro level, not only in creating a scalable and efficient IoT, but in creating new marketplaces and shaping new business models.

Liquifying the physical world

Before the IoT, there was simply the Internet. The Internet of People (as we may come to know it) has already had an enormous impact on the economy. Its biggest impact, by far, has been in the creation and transformation of markets for digital content such as music, news, maps and other information.

The IoT will enable a similar set of transformations, making the physical world as liquid, personalized and efficient as the digital one. Based on historical case studies of digital disruption, we see five compelling vectors of disruption emerging. They will shift the IoT from technical curiosity to compelling business strategy (see Figure 6).

Unlocking excess capacity of physical assets

In transforming the market for digital content, the Internet enabled three key elements of commerce: search, usage and payment. Search became instant and comprehensive. From music to encyclopedia articles, usage and payment can similarly take place immediately and entirely online. Some of the transformation that has taken place is a result of the unique economics of digital content. With a zero marginal cost of reproduction, market clearing prices for competitive digital markets have reached zero.

The IoT creates the ability to digitize, sell and deliver physical assets as easily as with virtual goods today. Using everything from Bluetooth beacons to Wi-Fi-connected door locks, physical assets stuck in an analog era will become digital services. In a device driven democracy, conference rooms, hotel rooms, cars and warehouse bays can themselves report capacity, utilization and availability in real-time. By taking raw capacity and making it easy to be utilized commercially, the IoT can remove barriers to fractionalization of industries that would otherwise be impossible. Assets that were simply too complex to monitor and manage will present business opportunities in the new digital economy.

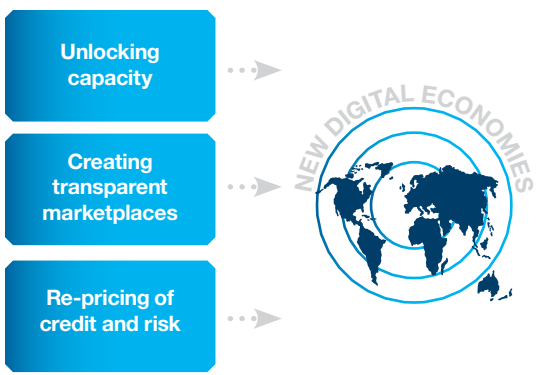
Figure 6

Five vectors of disruption: How the IoT will increase our leverage of physical assets

Vectors of disruption	Liquification of the physical world
Unlock excess capacity of physical assets	Instantly search, use and pay for available physical assets
Create liquid, transparent marketplaces	Real-time matching of supply and demand for physical goods and services
Enable radical re-pricing of credit and risk	Digitally manage risk and assess credit, virtually repossess and reduce moral hazard
Improve operational efficiency	Allow unsupervised usage of systems and devices, reduce transaction and marketing costs
Digitally integrate value chains	Enable business partners to optimize in real-time, crowdsource and collaborate

Figure 7

By transforming physical assets and services to behave like the virtual world, the IoT will create new digital economies



Creating liquid, transparent marketplaces

By identifying and matching supply and demand for physical assets and services in real-time, the IoT will create new marketplaces. These complex, real-time digital marketplaces will build upon the foundation established by mobile devices and social networks to expand the reach of this transformation very quickly. They will enable new peer-to-peer economic models and foster sharing economies.[16] Devices will be able to compete in real-time, be reviewed and recommended by consensus, and trade on their own, resulting in highly efficient digital marketplaces.

There is no better historical example of what happens when a continuous flow of capacity and services meets a powerful set of digital tools to match supply and demand than the role of Sabre in the airline industry. Uber and Airbnb are the Sabres of today, leading the creation of liquid markets for physical assets such as cars, homes, office cubicles, urban storage, parking spots and appliances that would not be possible without the IoT.

Radical re-pricing of credit and risk

Another big revolution will be in the creation of personalized risk and credit profiles. The provision of credit and management of risk today is a crude business, as crude as advertising was in the era of newspapers and television. Credit bureaus and tax records in mature western markets sparked a revolution in the availability of consumer credit, but they cover (crudely) only a tiny portion of the world's population. Unsecured credit lines in mature markets like the U.S. are often 8 to 10 times the cost of high quality credit, with remarkably little variation among customers, a testament to how poorly risk pricing is understood even in those markets.

Instrumentation and digitization enabled by mobile phones and the IoT promise a revolution in pricing risk and credit. Combining device instrumentation with mobile money, GPS logs and social networks, it will be possible for companies to build much more accurate pictures of real risk, and simultaneously reduce moral hazard and the cost of repossession.

The expansion of consumer credit at reasonable prices had an enormous impact on the prosperity of consumers, and the spread of modern appliances and other conveniences into homes. Together, the unlocking of physical assets, creation of new markets and more accurate assessment of credit and risk will open the doors to new digital economies inconceivable before the IoT (see Figure 7).

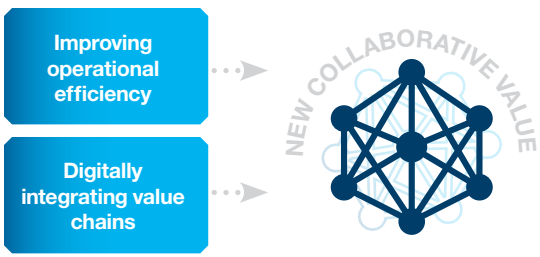
Finally, there are whole sectors of the economy where information technology is yet to make any significant impact. In these sectors, not only is there the possibility to unlock assets, create new markets and better price risk, but the opportunity is highest to improve efficiency and create entirely new solutions and value (see Figure 8). By definition, it is hard to forecast entirely new kinds of value, but a good place to start will be those industries that, to date, have felt little impact from digitization.

Improving operational efficiency

Today, the sector of the economy with the lowest IT intensity is farming, where IT accounts for just 1 percent of all capital spending. Here, the potential impact of the IoT is enormous. Farming is capital- and technology-intensive, but it is not yet information-intensive. Advanced harvesting technology, genetically modified seeds, pesticide combinations, and global storage and distribution show how complex modern agriculture has become, even without applying IT to that mix.

Figure 8

By reducing transaction and marketing costs, and enabling partnerships for innovation, the IoT will create new collaborative value



Instrumenting and digitizing every step in the agriculture process could yield substantial returns from close collaboration among farmers, biotechnology companies, farm equipment manufacturers and capital providers. The array of IoT technologies that can and will be deployed to make agriculture more productive includes drones to monitor large areas cheaply, instrumentation for optimized planting and harvesting based on soil and weather conditions, and field sensors for detailed monitoring.

Digitally integrating value chains

One of the most beneficial ways the IoT will be used is through its ability to integrate value chains. Using digital technology to integrate value chains has been one of the biggest drivers of industrial networking technology so far.

Thanks to real-time data feeds, airlines can schedule maintenance and arrange spare parts to fix defects long before a plane lands. The result: aircraft spend more time in the air earning money and less time on the ground waiting for maintenance and repairs. These kinds of high-value services exist today in very limited and closed ecosystems. The IoT will enable consumers and businesses to operate precisely this kind of value-creating integration across enterprises and systems at a tiny fraction of the cost of integration in the past. Crowdsourcing and other open collaboration platforms will further accelerate the creation of shared growth and innovation.

When it comes to enabling virtual vertical integration, there remain relatively few examples of big industrial successes. Indeed, consortia on the Industrial Internet are just starting the lengthy process of setting standards. Even as businesses argue over standards, consumers are racing ahead. Already, there are thousands of system-to-system and system-to-device integration “recipes” across services and products – slowly being adopted by large enterprises, but more rapidly by consumers and small businesses that will lead the way.

In the end, the IoT is expected to make the physical world every bit as easy to search, utilize and engage with as the virtual world. We describe this emerging transformation as the liquification of the physical world. Just as large financial marketplaces create liquidity in securities, currencies and cash, the IoT can liquify whole industries, squeezing greater productivity and profitability out of them than anyone ever imagined possible.

"Good design is good business."

Thomas Watson, Jr., Former IBM Chairman and CEO

Design thinking: Making it better

As the IoT liquifies the physical world, it will transform many products and experiences by embedding connectivity and intelligence in practically everything around us. To most users of these devices though, networking and remote usage are only secondary features. Consumers care most about the primary functional value and user experience.

Tomorrow's smart devices should create value by applying connectivity and intelligence to improve the core value proposition of the device: smart cooktops that automatically turn the heat down when a pot boils over; smart toasters that can tell the difference between golden brown and burnt; smart washers that can call for maintenance before the product breaks, mix the exact quantity of detergent needed and use the optimal temperature of water. Consumers will embrace such solutions because they provide better cooking, less mess, cleaner clothes, increased safety or greater fitness, not because they are part of complex networks or ecosystems.

First-person technology: What can your device do for you?

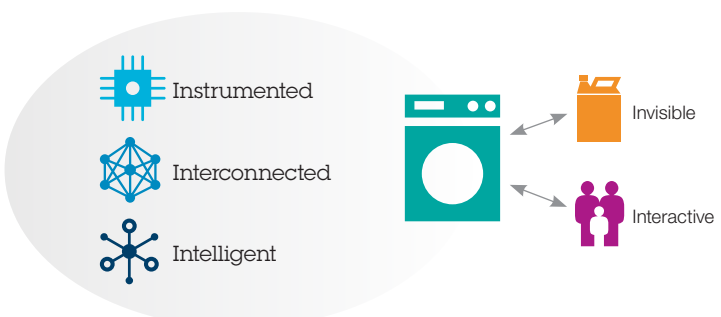
Furthermore, in the new democracy of devices where users are in control, devices in the network should be enabled to act in the best interest of the user, rather than third parties such as manufacturers, governments or service providers. While architecting the IoT to be decentralized and autonomous is a step in that direction, design habits also need to evolve to focus on the value of a connected device to its user. Putting the user first, and designing for user-centric experiences and value will be critical to adoption of the IoT.

As more and more devices around us become connected and intelligent, many physical products as we know them will be transformed into digital experiences. Many machine-human interactions will be replaced by machine-machine interactions, and new machine-human interactions will emerge. A large majority of machine-machine communication will become invisible while machine-human communication will become highly interactive (see Figure 9).

As this process unfolds, conventional design thinking will expand. Simple, transparent digital interfaces will need to seamlessly replace existing physical interactions. And as our dependence on smart devices increases, it will be essential that these devices are designed not to fail. Whether for consumers or enterprises, the most successful IoT solutions must be powerful in their value propositions, simplicity and reliability.

Figure 9

A majority of device communication will be transparent to users, and user interactions will become simple and easy to use



How ready are you for the IoT?

Companies across all industries must grasp the scale of transformation that will occur over the next decade with the IoT and prepare for its impact. These questions can help to identify useful steps executives can take toward that goal:

- What are the forecasted infrastructure and maintenance costs to your business to support the IoT?
- How secure are your IoT solutions today? Do they protect the privacy of users, whether consumers or enterprises?
- Can your business models survive the longevity of the IoT? Are they built on continuing revenue expectations from selling data, analytics, software updates and apps?
- What role can your business play in the new digital economies that will form as a result of the IoT?
- What opportunities exist for your company to improve efficiency and collaborate across the value chain to create shared innovation and growth?
- Are your smart products and solutions designed to fundamentally improve their core value propositions in a simple and reliable manner?

Methodology: 2014 IBM Internet of Things Study

Our study was comprised of three research components to address the multiple challenges of a scalable, secure and efficient IoT. We used a “clean sheet approach” and collaborated with top researchers in IBM to rethink the technology, business models and design concepts that will shape the connected future.

- Technology strategy: We developed a revolutionary reference architecture for a low-cost, private-by-design IoT and built concept prototypes to demonstrate feasibility. The next phase will focus on developing a next-generation platform and partnering externally to create functional product prototypes.
- Business and economic insights: Our research included a case study approach to understand historical industry disruptions from digitization to identify the key vectors of disruption from the IoT. In the next study phase, we are partnering with an economic research firm to build an industry model to quantitatively establish susceptibility of various industries to these vectors.
- Product and user experience design: We collaborated with expert user experience and industrial designers to conceptualize the transformation of physical products into meaningful digital experiences. In the next phase, we are crowdsourcing ideas related to these principles to build a set of prototypes that demonstrate greater functional value from the IoT.

By merging these three streams of research, we offer a tangible vision of the connected future and findings that can guide executives in making strategic IoT decisions and investments.

The right partner for a changing world
At IBM, we collaborate with our clients, bringing together business insight, advanced research and technology to give them a distinct advantage in today's rapidly changing environment.

IBM Institute for Business Value
IBM Global Business Services, through the IBM Institute for Business Value, develops fact-based strategic insights for senior executives around critical public and private sector issues. This executive report is based on an in-depth study by the Institute's research team. It is part of an ongoing commitment by IBM Global Business Services to provide analysis and viewpoints that help companies realize business value.

For more information
To learn more about this IBM Institute for Business Value study, please contact us at iibv@us.ibm.com. Follow @IBMIBV on Twitter, and for a full catalog of our research or to subscribe to our monthly newsletter, visit: ibm.com/iibv

Access IBM Institute for Business Value executive reports on your phone or tablet by downloading the free "IBM IBV" app for iOS or Android from your app store.

Winners and losers: A recipe for digital success

At a macroeconomic level, we are all winners in the IoT future, even though different industries will experience a mix of different effects. Overall growth is likely, but profit pools will not be preserved, nor will the distribution of benefits be even. However, winners in the IoT economy will share some common characteristics, as will losers.

Winners will:

- Enable decentralized peer-to-peer systems that allow for very low cost, privacy and long term sustainability in exchange for less direct control of data
- Prepare for highly efficient, real-time digital marketplaces built on physical assets and services with new measures of credit and risk
- Design for meaningful user experiences, rather than try to build large ecosystems or complex network solutions.

Losers will:

- Continue to invest in and support high-cost infrastructure, and be unmindful of security and privacy that can lead to decades of balance sheet overhead
- Fight for control of ecosystems and data, even when they have no measure of what its value will be
- Attempt to build ecosystems but lose sight of the value created, probably slowing adoption and limiting the usage of their solutions.

About the authors

Veena Pureswaran has spent more than 10 years in the Electronics industry and has held leadership positions in product development, strategy and management. She is currently the Global Electronics Industry Leader at the IBM Institute for Business Value, responsible for developing thought leadership for the industry. She can be reached at vpures@us.ibm.com.

Paul Brody has spent more than 15 years in the Electronics industry doing extensive consulting work across supply chain, operations and business strategy. He was formerly Vice President and North America Leader for the IBM Mobile and Internet of Things practice, and a founding member of the IBM Industry Academy.

Contributors

John Cohn, IBM Fellow, IBM Corporate Strategy

Peter Finn, Client Architect, IBM Sales and Distribution

Sumabala Nair, Strategy and Analytics Architect, IBM Global Business Services

Sanjay Panikkar, Global SME for Electronics, IBM Global Business Services

References

1 Reimer, Jeremy. Total Share: Personal Computer Market Share 1975-2010. December 7, 2012. http://jeremyreimer.com/m-item.lsp?i=137. Accessed on August 29, 2014.

2 Gartner press release. “Gartner Says the Internet of Things Installed Base Will Grow to 26 Billion Units By 2020.” December 12, 2013. http://www.gartner.com/newsroom/id/2636073. Accessed on August 29, 2014.

3 Triplett, Jack E. “The Solow productivity paradox: what do computers do to productivity?” Brookings Institution. April 1999. The Canadian Journal of Economics. http://www.jstor.org/discover/10.2307/136425?uid=3739776&uid=2129&uid=2&uid=70&uid=4&uid=3739256&sid=21104098246301. Accessed on August 29, 2014.

4 Reimer, Jeremy. Total Share: Personal Computer Market Share 1975-2010. December 7, 2012. http://jeremyreimer.com/m-item.lsp?i=137. Accessed on August 29, 2014.

5 Jorgenson, Dale W., Harvard University; Mun Ho, Resources for the Future; and Jon Samuels, Johns Hopkins University. “INFORMATION TECHNOLOGY AND U.S. PRODUCTIVITY GROWTH: Evidence from a Prototype Industry Production Account.” November 19, 2010. http://scholar.harvard.edu/files/jorgenson/files/02_jorgenson_ho_samuels19nov20101_2.pdf Accessed on August 29, 2014.

6 Reimer, Jeremy. Total Share: Personal Computer Market Share 1975-2010. December 7, 2012. http://jeremyreimer.com/m-item.lsp?i=137. Accessed on August 29, 2014.

7 Ibid.

8 Institute for Business Value analysis.

9 Winkler, Rolfe. “What Google gains from Nest Labs: Data Automation at Heart of $3.2 Billion Deal.” Wall Street Journal. January 14, 2014. http://online.wsj.com/news/articles/SB10001424052702303819704579321043556056678. Accessed on August 29, 2014.

10 Institute for Business Value analysis.

11 NYSE Transactions, Statistics and Data Library. https://www.nyse.com/data/transactions-statistics-data-library. Accessed on August 29, 2014.

12 The count: Social media counts. Personalizemedia. http://www.personalizemedia.com/the-count/. Accessed on August 29, 2014.

13 Gibson, William. "Fresh Air." NPR. August 31, 1993. http://www.notable-quotes.com/g/gibson_william.html Accessed on August 29, 2014.

14 Maymounkov, Petar and David Mazières. "Kademlia: A Peer-to-peer Information System Based on the XOR Metric." New York University. http://pdos.csail.mit.edu/~petar/papers/maymounkov-kademlia-lncs.pdf. Accessed on August 29, 2014.

15 "A Next-Generation Smart Contract and Decentralized Application Platform." GitHub: ethereum/wiki. https://github.com/ethereum/wiki/wiki/%5BEnglish%5D-White-Paper. Accessed on August 29, 2014.

16 "Peer to peer rental: The rise of the sharing economy." The Economist. March 9, 2013. http://www.economist.com/news/leaders/21573104-internet-everything-hire-rise-sharing-economy. Accessed on August 29, 2014.

17 Gartner perspective: IT Spending 2010. http://www.financialexecutives.org/eweb/upload/FEI/Gartner.pdf. Accessed on August 29, 2014.

18 Searls, Doc. "Why we need first person technologies on the Net." March 19, 2014. http://blogs.law.harvard.edu/vrm/2014/03/19/why-we-need-first-person-technologies-on-the-net/. Accessed on August 29, 2014.

Route 100, Somers, NY 10589

Produced in the United States of America, July 2015

GBE03620-USEN-04