IHS Markit

8 in 2018: The top transformative technologies to watch this year

Technology industries have both enabled and benefited from digitization for the better part of the last 50 years. While the idea of digitization is not new, what we are now seeing is a new wave of transformative technologies with the potential to significantly impact the world around us.

IHS Markit has identified the following eight transformative technologies to pay attention to in 2018:

- Artificial Intelligence
- IoT
- Cloud
- Connectivity
- Blockchain
- Machine Vision
- Ubiquitous Video
- Robots & Drones

Understanding the opportunities and impacts of transformative technologies today means being able to see how the pace at which they are developing has accelerated. While AI, IoT, Machine Vision, Robotics, and the Cloud are not really new technologies, they are coming together in new and powerful ways and fundamentally changing businesses, fueling innovation, disrupting industries, and creating both threats and opportunities for all. An open, ecosystem-led approach to developing and implementing these technologies can help bridge the historical, structural silos between different vertical industries.

Evolution of transformative technologies: market and technology capabilities continuously drive innovation

Transformative technologies enable shifts in how enterprises function and how individuals live everyday life. As technologies become smarter and more sophisticated, and as markets evolve, transformation can begin in new industries. The rate at which we see these technologies take hold has grown rapidly in recent years.

1970s
IP Protocol Development

Email brought instant communication to business processes

1980s
Cable television

24-hour news cycle changed consumption of content

1990s
Lithium-ion batteries

Portable electronics revolutionized availability of technology

2000s
Increased bandwidth and apps marketplace

- Content streaming business models emerged
- Content changes for mobile consumption
- App marketplace service business models

2010s
Lithium-ion batteries and long-range connectivity

- Electric vehicle penetration changes market demand for oil
- 'Things' become available to more markets

Artificial Intelligence

Artificial Intelligence (AI) refers to the body of science, algorithms, and machines able to perform some version of learning and independent problem solving, relying on sufficiently advanced software and hardware components. Within the AI field of study are other sub-branches of computer science, including Machine Learning, Neural Networks, and Deep Learning, among others.

Trend: The speed of development and increased optimization in artificial intelligence (AI) has led to increased adoption in several industries—including smartphones, healthcare, and automotive. At present, AI is being implemented in two ways: device and cloud based. Both approaches have advantages and disadvantages. Cloud AI has more computing power to analyze data as it utilizes deep learning algorithms, but there are potential issues around privacy, latency, and stability. A stronger on-device AI can help offset those dangers to some degree; for instance, smartphone users who deploy the built-in AI of their phones are able to store data locally and thus safeguard their privacy.

Q: How is AI driving competitiveness today?

A: IHS Markit believes that AI has matured to the point where it is starting to be used as a competitive differentiator, particularly in the smartphone and automotive industries.

In the smartphone market, Apple and Huawei are two players actively deploying AI solutions. In September 2017, Huawei launched the world's first smartphone system on chip (SoC) containing dedicated AI computing hardware—the SoC Kirin 970. Later that same month, Apple unveiled the iPhone X, whose A11 Bionic chip also features integrated AI capability and is credited with powering the phone's new Face ID feature. Apple says the A11's neural engine performs up to 600 billion operations per second to help speed AI tasks. For its part, Huawei says the Kirin 970 holds a dedicated neural processing unit (NPU) inside, which can perform the same AI computing tasks faster and with far less power than that of the Apple A11. In a benchmark test of image recognition, 2,000 images per minute were processed by the Kirin 970, which IHS Markit believes will be the new platform for Huawei's forthcoming Mate 10 smartphone. On smartphones, the on-device AI functions can run properly without a network connection, even though high-power consumption is an issue given the phone's enhanced computing power.

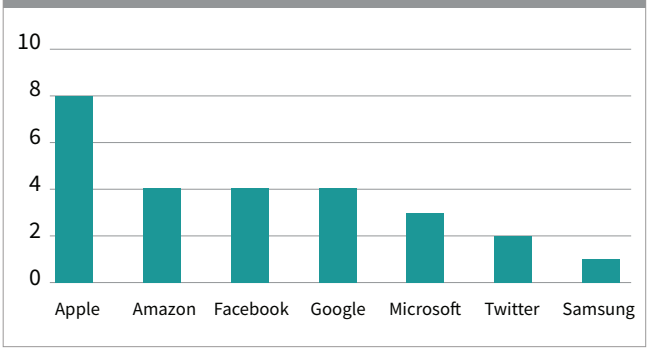
Of course, Apple and Huawei are not the only mobile ecosystem players looking at on-device AI. Google also has an AI initiative. Google has been developing MobileNets, which leverages open-source neural-network models for more efficient on-device computer vision. MobileNets can help a device detect objects and recognize faces.

That is not to say that the entire mobile ecosystem is focused on on-device AI solutions. The Chinese internet giants, meanwhile, remain focused on Cloud-based solutions with an API approach. These solutions include computer vision, speech recognition, and natural language processing. Ahead of Tencent and Baidu, Alibaba is expected to introduce mobile APIs based on its internet operating system, YunOS (now China's second-largest smartphone operating system). With these mobile APIs, developers will be able to introduce more AI-powered apps, as well as advanced experiential concepts like augmented reality (AR), further bolstering the appeal and power of on-device AI functions in smartphones.

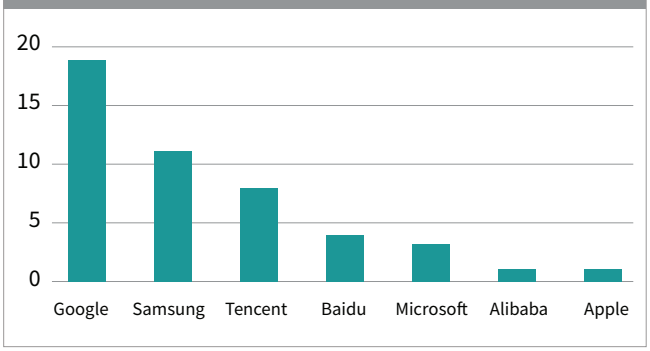
While the smartphone market is aggressively pursuing a range of AI solutions, the automotive industry has also been evaluating when and how to implement AI. While part of the focus has been on enhancing today's increasingly sophisticated infotainment and advanced driver assistance systems (ADAS) solutions, the longer-term need is expected to come from the advent of both semi-autonomous and fully autonomous vehicles. The attach rate of AI-based systems in new vehicles was 8 percent in 2015, and the vast majority were focused on speech recognition. However, that number is forecast to rise to 109 percent in 2025, as there will be multiple AI systems of various types installed in many cars.

The hardware required to embed AI and deep learning in safety-critical and high-performance automotive applications at mass-production volume is not currently available due to the high cost and the sheer size of the computers needed to perform these advanced tasks. Nevertheless, elements of AI are already available in vehicles today. For infotainment systems, most of the speech recognition technologies currently rely on algorithms based on neural networks running in the cloud. The 2015 BMW 7 Series was the first car to use a hybrid approach, offering embedded hardware able to perform voice recognition in the absence of wireless connectivity. In ADAS applications, Tesla claims to implement neural network functionality, based on the MobilEye EYEQ3 processor, in its autonomous driving control unit.

Selected companies: AI centric M&A deals



Selected companies: AI funding deals



Internet of Things

The Internet of Things (IoT) is a conceptual framework for enabling connectivity and embedded intelligence in devices. IHS Markit has identified four stages of IoT adoption and implementation: 1) Connect—embedding connectivity and processing capabilities into devices; 2) Collect—adding sensors and storage that enables devices to gather data on their surrounding environment; 3) Compute—processing and analyzing large amounts of data generated by IoT devices; and 4) Create—monetizing the IoT or creating unique solutions through access to transformational data.

Trend: The global installed base of IoT devices will rise from 27 billion in 2017 to 73 billion in 2025, IHS Markit forecasts show. Accelerating IoT growth in 2018 and movement through this four-stage IoT evolution will be the confluence of enhanced connectivity options with edge computing and cloud analytics. These four stages describe both the evolution of horizontal enabling technologies, such as IoT platforms spanning device management to data brokering, and the development of technologies and business approaches in specific vertical markets, such as enabling industrial manufacturers to achieve "mass customization' capabilities. Delving into vertical-specific factors in the development of the IoT market is critical for understanding the full complexity of the Connect to Create journey.

Enhancements in IoT connectivity, such as low-power wireless access (LPWA) and 5G, will drive this growth. Moreover, technologies adjacent to the IoT will become increasingly sophisticated: Robots and drones will enable data to be collected in new environments; machine video and ubiquitous video will empower new types of visual analytics; and artificial intelligence (AI), the Cloud, and virtualization will help develop critical insights sourced from data at the so-called "edge" of computing networks. Applying AI techniques to data will drive monetization in the form of cost savings, greater efficiencies, and a transition from product- to service-centric business models.

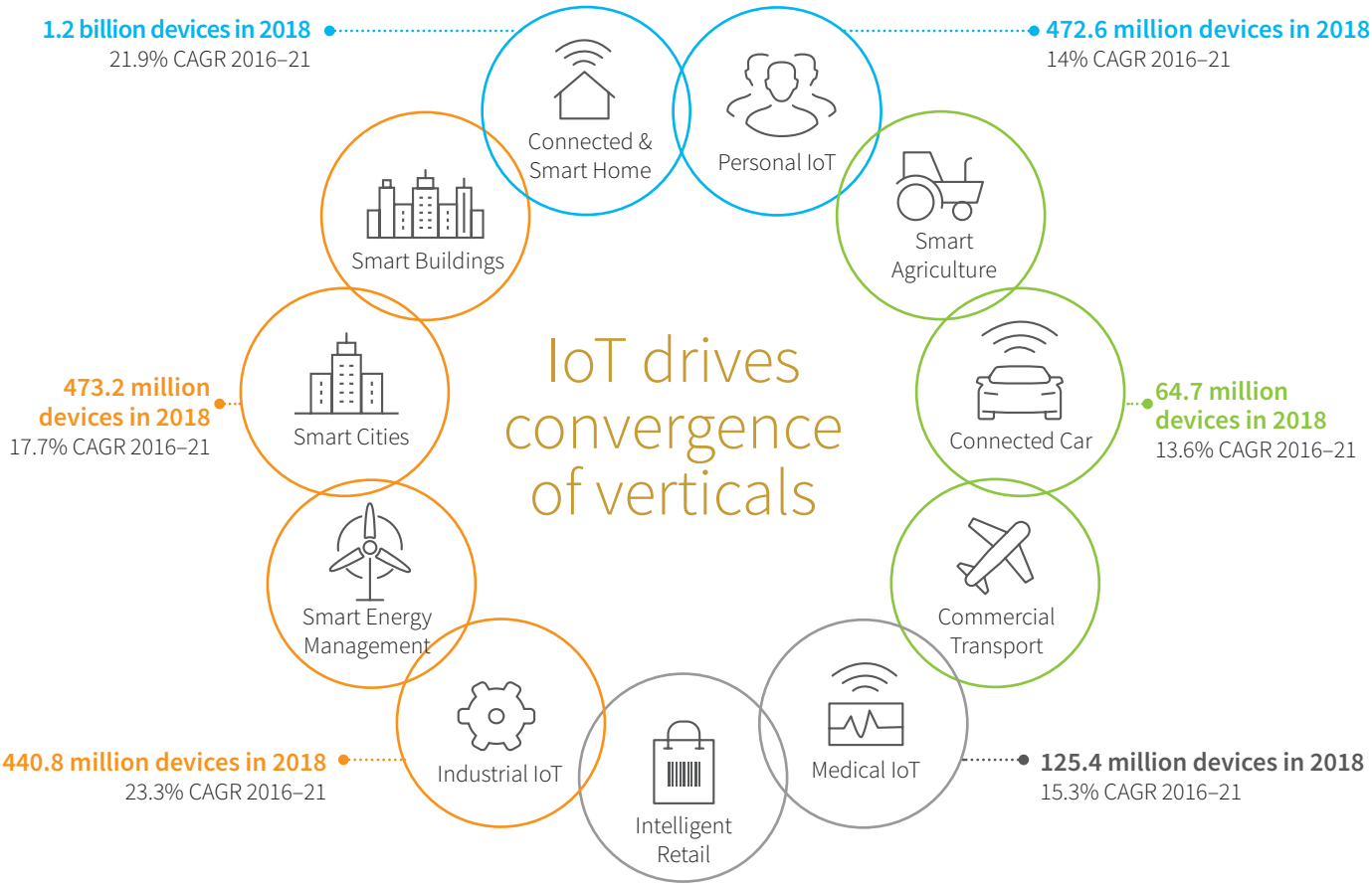
Q: It seems that "next year" is always when IoT growth supposedly will accelerate. Will IoT convergence with other transformative technologies really create new opportunities in 2018?

A: Yes. Energy production, building automation, and cold chain within the transportation and logistics sector will be the first to benefit from enhanced connectivity and smarter computing and analytics at the edge.

- **Value of IoT platforms pivots towards analytics:** The future of the IoT lies in the value of the insights that can be generated from Big Data. IoT platforms enable enterprises to provision and manage IoT devices, create applications, and visualize data. But it's a crowded market: More than 200 IoT platforms are available at present, with cloud-based data visualization included as a standard feature of such platforms. To differentiate in the fragmented platform space, IoT platform providers will need to incorporate highly sophisticated analytical tools, based on extensive R&D and specialized developer skills. Both in-house development and partnerships will play a role in driving analytical power.

- **IoT device growth accelerates shift to computing at the edge:** From cars to oil rigs to robots, many of the 40 billion IoT devices added between 2018 and 2025 will be at the edge. Increasingly, these geographically dispersed devices will need to interact with—and respond to—changes in the physical world in near-real time. This means that instead of sensor data being transmitted to and processed by a centralized cloud, data are processed locally and as closely as possible to the device. The shift in approach will not only drive increased investment in local infrastructure, such as IoT gateways, but also efforts to integrate AI at the edge.

- **Data exchange brokerages (DEBs) to fuel vertical growth:** IoT data has existed traditionally in vertical silos. Moving forward, additional growth opportunities will be uncovered by breaking apart these silos to identify relationships between events as well as among events across discrete domains. For instance, in the smart city environment, the meshing of data collected from highway and toll devices, environmental sensors, and even sensors on the bottom of dust carts could be used to identify the relationship of traffic flow, road quality, and pollution levels. Breaking up these silos and sharing access to devices and their data streams with partners alongside third-party developers will require water-tight entitlement, as well as timely and secure discovery. For this reason, IHS Markit expects DEB functionality to play an increasingly important role in the IoT platform space from 2018 and beyond.



Cloud & Virtualization

Cloud computing is an information technology (IT) paradigm that enables providers to offer widespread access to shared pools of configurable resources—such as computer networks, servers, storage, applications, and services—which can be quickly and dynamically provisioned involving little to no management effort, often over the internet. Resources provided as a cloud service can be public (shared) or private (not shared), and is usually billed based upon consumption.

Trend: Cloud services will pave the way for technologically immature companies to utilize machine learning (ML) and artificial intelligence (AI), radically transforming their usage and understanding of data.

Q: How will innovation in cloud services impact the market and cloud ecosystem?

A: Cloud solution providers (CSPs) are continually looking for ways to innovate by integrating machine learning and artificial intelligence techniques into their services. These techniques give providers a clear way toward differentiation by building teams of highly-skilled experts that most enterprises cannot duplicate.

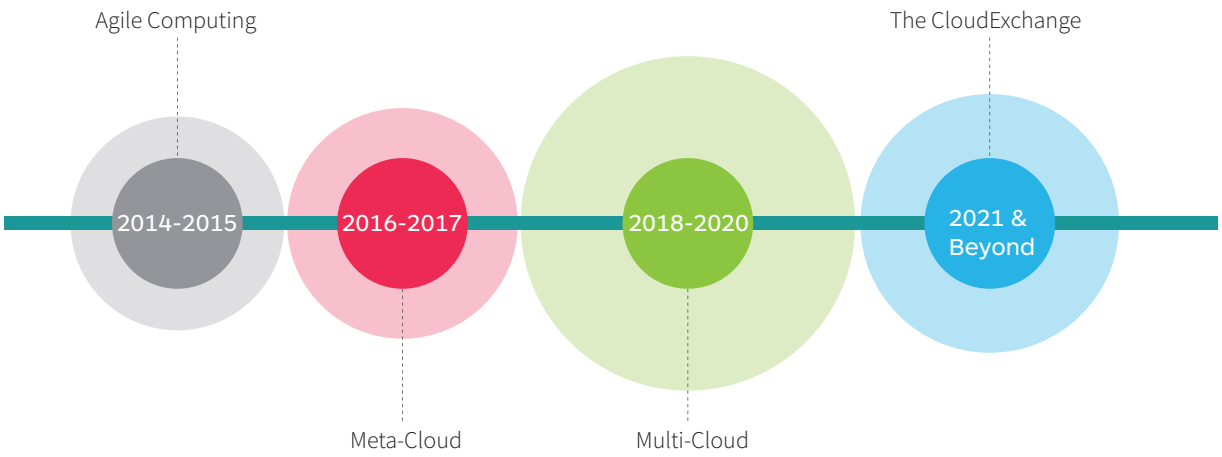
Silicon vendors have taken serious note of the rapidly rising importance of ML and AI, and thus have positioned themselves favorably to capitalize on the need for advanced infrastructure. In the first half of 2017, several chip manufacturers announced AI-related products, including a deep learning unit (DLU) microprocessor from Fujitsu and the Loihi self-learning neuromorphic chip from Intel. On the software side, Tensor2Tensor (T2T), Google's open-source library for training deep-learning models in TensorFlow, is now available.

Overall, the competitive landscape has changed as off-premises cloud service providers establish strong relationships with key technology vendors possessing large enterprise customer bases. Vendors have decided to partner rather than compete with CSPs, realizing they cannot duplicate the scale, operational efficiency, and speed of software innovation. This explains the announced plans by IBM and VMware to further their partnership by enabling enterprises to extend the VMware environment to the public cloud.

The same motivation holds for Pivotal and VMware partnering with Google: The trio collectively expanded their partnership to enable Pivotal Container Service (PCS), which allows enterprises and service providers to use the Kubernetes system for containerized applications on VMware vSphere and the Google Cloud Platform.

Meanwhile, Microsoft and open-source solutions provider Red Hat have broadened their alliance by announcing new initiatives to enable the adoption of containers by enterprises.

Off-premises cloud services market roadmap



Connectivity

Connectivity refers to the ability to link and communicate with other people, devices, computer systems, software, or the internet. This includes both wired and wireless technologies utilizing point-to-point, broadcast, and mesh topologies, among others.

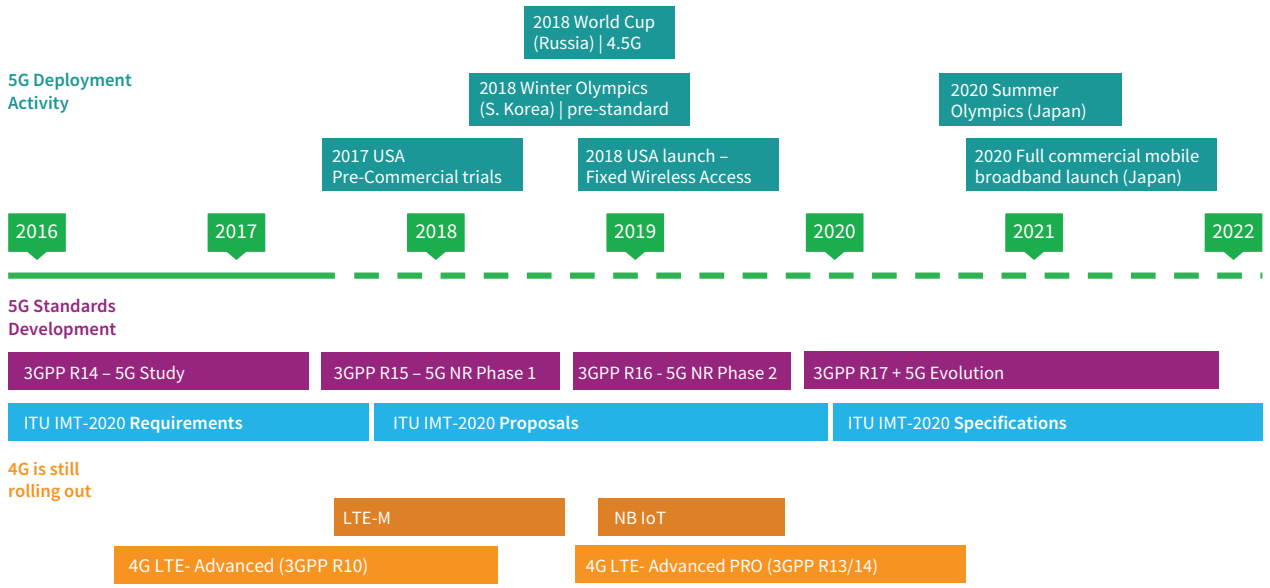
Trend: While much of the Connectivity story in 2016 focused on LTE, and 2017 centered on low-power wireless access networks (LPWAN), the conversation in 2018 seems fixed on 5G as the first commercial deployments emerge. However, the path to full 5G adoption and deployment is complicated, with new opportunities and challenges alike in store for mobile network operators, infrastructure providers, device manufacturers, and end-users. 5G—the next generation of cellular technology after LTE—represents a dramatic expansion of traditional cellular technology use-cases beyond mobile voice and broadband, to include a multitude of IoT and mission-critical applications.

Q: Will the current pace of 5G development provide opportunities for other forms of connectivity?

A: 5G will help expand the scope of practical IoT connectivity use-cases—from battery-powered, low-data-rate sensors deployed in challenging environments, such as inside buildings or in underground locations, to mission-critical, ultra-low-latency machines in applications like closed-loop factory automation. While 5G is on its way to becoming an important standard in connectivity, other connectivity forms are—and will be—available. These include low-power wireless access (LPWA), private LTE, device-to-device (D2D)/mesh networking topologies, mobile broadband, fiber, and satellite.

- **LPWA:** Most near-term development work for 5G will focus on enhancing data rates to multigigabit speeds and on reducing latency to approximately 1 millisecond or less. Those initiatives will apply to the 5G global standard known as New Radio (NR), which will deliver new levels of capability and efficiency while also meeting a broad range of requirements on deployment, spectrum, services, and devices. 5G deployments will continue to leverage current LTE-based LPWA technology well into the next decade, as LTE-M and NB-IoT—technologies specially designed for the IoT—already provide excellent costs, battery life, and in-building penetration profiles for traditional sensor-based IoT applications. More than 80 million LTE-M and NB-IoT connections will be in place by 2020, IHS Markit projects.
- **Private LTE:** Enabling the use of robust, 3GPP-standard communications technology for private LTE deployment is extremely beneficial for industrial customers, such as oil and gas companies, which possess facilities outside the range of traditional public network cellular footprints. Private LTE is yet another networking concept that will be leveraged in the near term and then incorporated over the longer term into 5G NR. By 2020, IHS Markit estimates there will be approximately 362,000 mission-critical devices on private LTE networks.
- **D2D and mesh networking:** These topologies will be developing within the context of the next few LTE releases (14 and 15) before becoming incorporated as standard features of 5G NR. Extending the types of topologies supported by cellular—beyond the traditional base-station-centric, one-to-many model—is a key path toward increasing the scope of applications addressable by 5G technology.
- **Mobile broadband:** The primary drivers of mobile broadband 5G connectivity will eventually lie with industry and IoT use-cases, even though mobile broadband and fixed wireless access (FWA) services will be a focus for operators in the short term. FWA services can be deployed to extend coverage beyond the fixed fiber network, but as 4G LTE (LTE Advanced/LTE Advanced Pro) services progress further, operators may find it difficult to find new use-cases that could justify or drive demand for services not already addressed by existing technologies.
- **Fiber:** The need to deploy fixed infrastructure with fiber for 5G backhaul is expected to boost opportunities for extending fiber network availability. If current predictions for network densification hold true, the need for fiber will be significant.
- **Low Earth Orbit (LEO) Satellites:** The renaissance in LEO deployments is clear and on the rise with at least 15-20 companies, including OneWeb and SpaceX, planning to launch large LEO constellations in the next few years. Many of these LEO constellations are focusing on Earth Imaging as this application provides a huge opportunity to service providers.

5G Standardization & deployment timeline



Ubiquitous Video

Ubiquitous Video refers to the ability to capture, create, consume, and distribute video content almost anywhere. The explosive growth of video services has been driven by multiple factors, including the high penetration of camera-enabled mobile phones and commoditization, which have enabled displays of various sizes and shapes to be placed in almost any location with a range of wired and wireless connectivity options.

Trend: The growing use of screens and cameras across multiple consumer- and enterprise-device categories, along with increasingly advanced broadcast, fixed, and mobile data networks, has powered an explosion in video consumption, creation, distribution, and data traffic. More importantly, video content is increasingly expanding beyond entertainment into industrial applications for medical, education, security, and remote controls, as well as digital signage.

Q: Why is ubiquitous video important in 2018?

A: Video is poised to have an impact beyond the display supply chain itself. IHS Markit believes early adopters in other industries should pay attention to multiple factors affecting ubiquitous video in 2018 which could heavily influence future adoption strategies across numerous markets: Higher quality video and the increasing proliferation of displays will drive expansion within the video ecosystem while impacting strategies in adjacent industries.

More video, more data, better quality

Data volumes continue to skyrocket; more video content is being consumed than ever before across a broad range of devices, networks, and services. In addition, the ability to both capture and consume video content almost anywhere continues to increase, across traditional and new forms of video.

At the same time, video quality continues to improve; HD is now the standard, with 4K (UHD) growing rapidly and the industry increasingly pushing better quality through HDR (High Dynamic Range). Beyond that, 8K devices will start to emerge; the first consumer 8K TV sets and broadcast channels will launch in 2018—but the short-term impact will be limited. It's important to note that 8K video will also have an impact beyond entertainment, with potential advanced use-cases in telepresence, as well as remote control applications for un-manned vehicles, drones, surgery, and industrial processes. However, 8K entails more than simply making new TV sets available. Rather, 8K

video will necessitate an altogether fresh playbook, which will include broad infrastructure investments as well as significant advancements across the production chain, from 8K cameras and lenses to data processing to bandwidth for broadcast and distribution channels.

The growth of video has led to a related explosion of data resulting in implications for both fixed and mobile networks. Capacity issues remain, but as service providers push fiber deeper into the network—in some cases all the way to the home network to deliver gigabit speeds—the bandwidth bottleneck has shifted from the last mile to the actual home network. Mobile operators in mature markets consistently report that video makes up more than 50% of their data traffic and is growing rapidly. The move toward higher-resolution video, along with the increased consumption and distribution of video in all areas, presents challenges to operators in how they manage both traffic and new opportunities for those that can successfully monetize video services.

More displays

The proliferation of enhanced video is only perpetuated through changes in how people are consuming it. In 2018, the display industry is responding to this demand through a growing installed base of HDR and OLED in mobile devices and digital signage, increasing screen sizes, new 18:9 aspect ratios (closer to cinematic widescreen), and full-screen smartphone displays.

Growth across all vertical markets is expected globally, especially in retail, corporate, government, education, and public spaces, which will prompt further demand for advancements in display technology and the development of unique product designs and form factors.

- In the digital signage market, smart mirrors and transparent displays coupled with AR applications are being incorporated in different retail settings to elevate the shopping experience. The evolution of both LCD and LED video walls, growth in the outdoor high brightness signage market, IWBs (interactive white boards), and other interactive touch displays will drive much of the growth in revenue expected for this year.

- In the programmatic video space, machine learning and AI will drive new video formats, content, and business model optimization. The increased use of machine learning applied to customer data, behavior, and contextual information will create new opportunities, including wider-reaching advertising, content recommendations, and personalized video content. To deliver this type of programmatic video experience, companies must invest in both machine learning technologies and data infrastructure at the same time as content spending continues to increase, further driving costs. Amazon and Netflix will spend more than $11.5 billion on programming in 2018, with Facebook and Apple also reporting their own $1 billion video investment plans.

- One of the fundamental issues with the development of a smart city is recurring funding. At the moment, one of the clear paths to this is through advertising on current city assets by adding screens. The increased adoption of these technologies will improve advertising monetization, enable cities and companies alike to optimize their business models across free, subscription, and transactional services, and will lead to increased development of easily customizable content.

Beyond 2018, foldable and flexible displays will play a critical role in enabling increased mobile video consumption on much bigger, yet convenient, displays. They will also be a key feature in the ongoing battle between premium smartphone manufacturers looking for differentiation.

Screens, video creation & consumption everywhere

Consumers demand for video shifting fast

50% of data consumed is video driving mobile monetization business models

Retail and enterprises maximize advertising strategies

Online video grew 3.2x faster than non-video display reaching over $2 billion in H1 2017

Social media driving video

Social networks driving video led strategies with more than 2 billion active users on Facebook and 300 million on Twitter

Home consumption changing from outside the home

More than 50million pay TV customers worldwide are multi-screen users, streaming their subscription content to mobile devices (in/outside the home)

Quality Assurance drives adoption in manufacturing

Need for track and trace measures leading to 3.7 million machine vision cameras in 2018

Public safety demand for screens and video

Law enforcement monitors of social media using situational intelligence in 21,000 different public safety control rooms in 2016

Computer Vision

Computer vision is the application of technology to extract information from digital images and videos, with the goal of automating tasks that human eyes do today. Specific tasks that are necessary include image acquisition, processing, analyzing, and understanding, to allow for decisions/actions to be taken by the system, device, or robot. Machine vision, traditionally found in industrial manufacturing, is generally considered to be a sub-set of computer vision and is also referred to as embedded vision.

Trend: The increasing importance of computer vision is directly tied to the mega-trend of digitization that has been playing out in the industrial, enterprise, and consumer segments over the past 20 years. The proliferation of image sensors, as well as improvements in image processing and analysis, have enabled a broad range of applications and use-cases including industrial robots, drone applications, intelligent transportation systems, high-quality surveillance, medical applications, and automotive safety.

Q: How is computer vision converging with other technologies to impact major markets?

A: Computer vision has become increasingly sophisticated over the past few years and has moved beyond its roots in machine vision and image processing. Today it is used for everything from advanced driver assistance systems (ADAS) in automotive, to sophisticated telepresence units in enterprise, and complex industrial robots performing assembly and QA tasks. As seen in 2017, applications are expanding into consumer electronics, with one example being the Apple iPhone X, which uses Face ID to unlock the device, forgoing the password system or fingerprint-sensing technology of old.

Looking ahead to 2018, there are some specific areas where IHS Markit sees computer vision playing a key role in accelerating or enabling markets:

In automotive, moving beyond ADAS, computer vision is expected to be a key enabler for semi-autonomous and eventually fully autonomous vehicles. CMOS sensors for cameras will certainly be integrated throughout the vehicle, increasing the ability to detect, recognize objects, and help improve driver awareness. However, cameras do not cover the entire spectrum of environments and situations a car will encounter, including night driving, rain, and snow. To cope with all possible scenarios and ensure reliability for a truly autonomous car (driverless), the system needs to rely on multiple sensor systems such as LIDAR, RADAR, ultrasound, and infrared, with back-up sensor systems as an additional safety requirement. Together, these will be able to augment and enhance the computer vision capability for the vehicle.

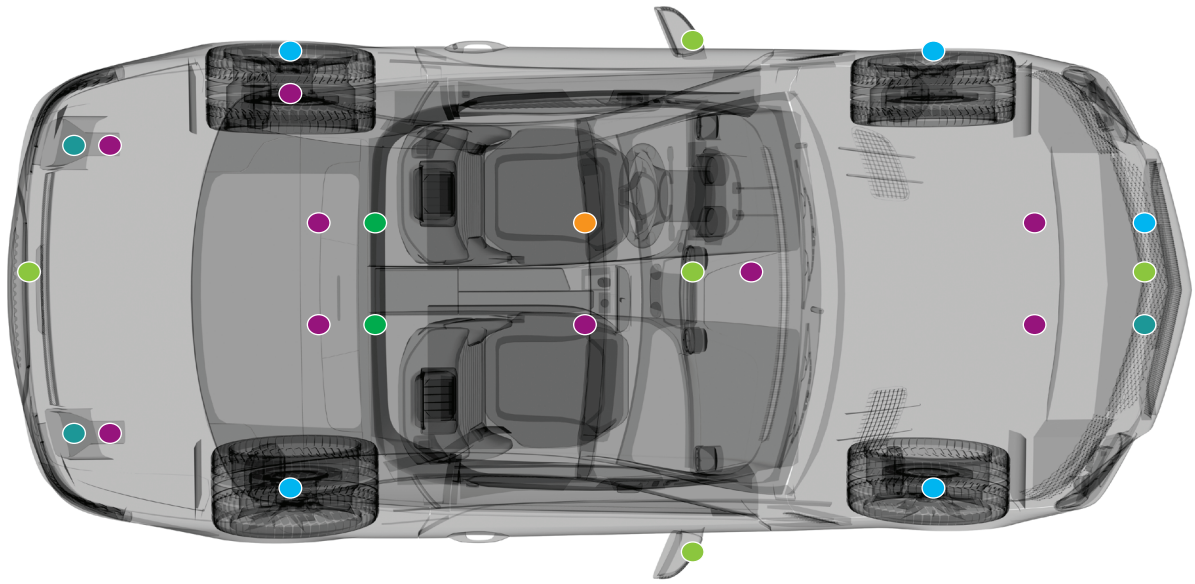
For security and surveillance markets, computer vision has become a vital tool in collating insights from the mass of available video surveillance feeds. Deep-learning powered analytics are enabling accurate and sophisticated classification of video scenes in both live and recorded feeds. These tools have obvious benefits for safety and security. Examples include live facial recognition, where security operatives are alerted to individuals on watch lists passing in front of a camera, or video forensics where large volumes of recorded video can be quickly scanned to investigate incidents. Computer vision is also enabling video surveillance cameras to take on multiple uses outside of security, such as collecting customer demographic information and assisting in logistics or quality control.

For consumer markets, adoption has picked up for cameras outside the home, primarily for security purposes. Video doorbells are one example, with cloud-based solutions offering consumers the ability to see and record packages being left at the house, as well as interacting with people at the door, even when they are not at home. However, more recently, IHS Markit is seeing a push for in-home cameras, particularly by Amazon. Through computer vision and AI, smart cameras in the home can play an important role in regulating access and security, allowing unrestricted passage to and throughout the home for those that the device recognizes as the rightful inhabitants of the residence. Amazon has proposed a new delivery paradigm, enabled by an Amazon Key in-home camera, which would allow for packages to actually be delivered inside the home while residents are away. As with connected video doorbells, this would be cloud based, so that residents can view and verify deliveries in real time.

Given these emerging opportunities, there will be new challenges to ensure appropriate and integrated technologies in computer vision for hardware, such as cameras, sensors, and computing, as well as for software, including those related to AI and machine learning.

Example of ADAS system configuration for automated driving – “Smart” architecture

Smart architecture 2022



Robots and drones

Robots and drones are autonomous or semi-autonomous machines that are capable of completing complex, often repetitive actions. Robots may be fixed or mobile but are typically land-based, while drones are commonly viewed as aerial and include fixed-wing, rotor-based, airships, and balloons.

Trend: The global market for robots and drones will grow to $3.9 billion in 2018. Beyond that number, however, the deeper underpinnings of the story lie in the disruptive potential of robots and drones to transform longstanding business models in manufacturing and industry, impacting critical areas such as logistics, material picking and handling, navigational autonomy, and delivery.

Q: How can one device like a robot or drone change an enterprise business model?

A: Robots and drones have the potential to act as a catalyzing force and drive improvement in enough areas of a given enterprise to deliver a tangible impact to its business model especially when the impact of accelerating force of connectivity, cloud, and AI on adoption are considered. For that to occur, however, the technology behind robots and drones must demonstrate a readiness level shown to have passed rigorous testing and deemed successful in carrying out missions repeatedly. A framework of globalized and standardized regulations, absent in the current landscape, is also needed.

Artificial intelligence (AI) is crucial to the next step in the evolution of drones and their broader adoption by more industries. The key ingredient is collision avoidance—which is where AI will equip drones in order to make effective decisions regardless of circumstance. As an example, the latest development in visual mapping and navigation technology for drones includes use of a laser or camera alongside state-of-the-art electronic components to help drones successfully carry out their mission. To date, enterprises are overhauling their logistics systems by incorporating drones in any number of ways, but AI is providing the longer-range control that allows drones to be moved outside a plant or factory for deployment in the real world, such as what Amazon is doing with drones in delivering products to customers, through its Amazon Prime Air service.

Advances in drone connectivity will allow faster real-time response

Drones will also drive greater demand for connectivity, due to the real-time need for data analysis and processing. But while improvements in video quality are allowing enterprises and public safety systems alike to maximize the use of drones, advancement is still needed for the connectivity portion in drones to ensure widespread and strong coverage. In the public safety sector, this would translate into drones being able to connect video feeds directly into computer-aided dispatch (CAD) systems, giving the dispatcher a bird's-eye view of an incident, significantly increasing situational awareness. In the case of natural disasters, drones can fly over impacted areas—not only conducting surveillance for search and rescue, but also delivering necessities like food, water, and medical equipment without putting first responders in harm's way.

Drones are also being used today as temporary cell towers to provide communications coverage in areas where cell towers have been knocked out. AT&T recently deployed a flying COW (cell on wheels) in Puerto Rico, providing wireless connectivity in an area up to 40 square miles. In some cases, a single flying COW can provide coverage for up to 8,000 people. Use-cases like these will continue to drive advancements in drone connectivity to satisfy demand for stronger coverage.

Demand driving price pressure for Service Robots increases adoption and replacement of labor

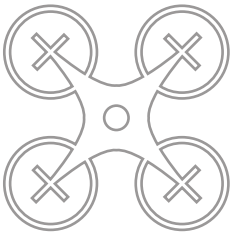
In the short term, robots will primarily help humans work more effectively; in the long term, robots will become sufficiently skilled and affordable enough to replace humans in many tasks. Already, professional service robots are utilized by early-adopter industries including agriculture, logistics, medical and healthcare, and domestic help. Demand for service robots has increased considerably, especially for agricultural processes like seeding, planting, harvesting, pruning, weeding, picking, sorting, spraying, and materials handling.

In the logistics sector, service robots have been mostly deployed in automated warehouses. Following Amazon's recent acquisition of Kiva Robotics, large companies have been actively investing in logistics and automated warehouse applications, hoping to reduce worker ranks while attempting to increase efficiency. In the medical arena, meanwhile, the price of surgical robots is falling and their use in medical operations is expanding, making the medical industry among the fastest growth sectors for robots.

More than

56 million

domestic service robots will be shipped from 2017-2021



29 million

consumer drones will be shipped from 2017-2021

Blockchain

Blockchain is a distributed digital ledger technology utilizing cryptography and timestamps to provide a permanent record of various types of transactions and interaction. Blockchain is the underlying technology enabling Bitcoin, and it is currently being considered for a wide range of applications across many vertical markets.

Trend: Blockchain enables decentralized transactions and is the technology underpinning digital currency such as bitcoin and ether. Blockchain penetration is most evident in the financial services industry, with payments-related solutions as early adopters. Blockchain-based services beyond financial services are already being developed and deployed and will continue to ramp in 2018. These include: the use of blockchain to improve advertising measurement and combat ad-fraud; blockchain-based systems for distributing music royalty payments; solutions to better track and manage electronics supply chains.

Q: Despite massive buzz and hype, implementing blockchain technology beyond fintec remains more promise than reality. Will 2018 be the year when blockchain shows true relevance and real-world applications beyond financial services?

A: While 2018 will see the commercial deployment of a variety of new applications using blockchain technologies, the scale of blockchain implementation will be limited and rely on hybrid applications of the technology. For many, the commercial potential of blockchain is still unclear, and blockchain services face challenges ahead of commercial deployment—including hurdles with local regulation and many sensitive questions involving privacy vs. transparency, speed of execution, and compute requirements.

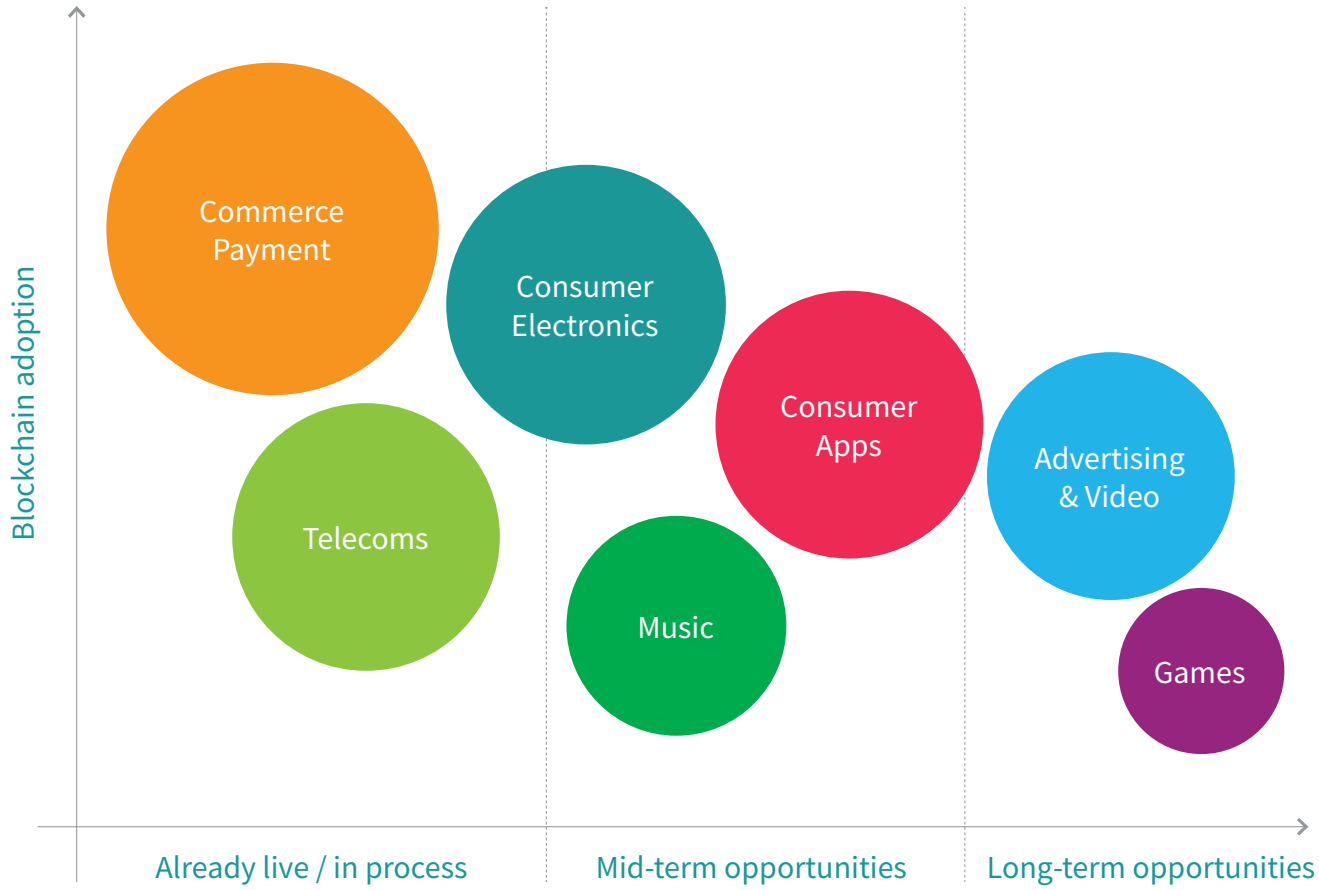
While financial services are currently blockchain's most potent use-case, the technology will also exert a significant impact on a wider set of industries, including automotive, defense, health and medical, media, and telecommunications. Mobile operators are among the most eagerly positioned to take advantage of blockchain activity, with opportunities to cut internal costs, authenticate payments and identity, manage roaming, and aid expansion into areas such as IoT, M2M, and smart cities.

Overall, however, the timeline for blockchain disruption and transformation of an industry will vary greatly, depending on industry readiness and as companies continue to experiment with the technology. To this end, blockchain use-cases and business models must evolve significantly ahead of time before mainstream adoption can occur, IHS Markit believes.

Blockchain's key features are not always advantageous. For instance, immutability has been promoted as a benefit, ensuring the security of data and preventing fraud and corruption. However, the same immutability that confers security on blockchain data also makes it all but impossible to remove or revise a record, raising challenges as well.

Not one single solution will serve for all, and a number of new "blockchain-inspired" technologies might make a better fit for a specific industry.

Blockchain opportunites in technology, media and telecom



For more information technology.ihs.com

Follow the conversation @IHS4Tech

AMERICAS
T +1 844 301 7334
E technology_us@ihsmarkit.com

EMEA
T +44 1344 328 300
E technology_emea@ihsmarkit.com

APAC
T +604 291 3600
E technology_apac@ihsmarkit.com

About IHS Markit

IHS Markit (Nasdaq: INFO) is a world leader in critical information, analytics and solutions for the major industries and markets that drive economies worldwide. The company delivers next-generation information, analytics and solutions to customers in business, finance and government, improving their operational efficiency and providing deep insights that lead to well-informed, confident decisions. IHS Markit has more than 50,000 key business and government customers, including 85 percent of the Fortune Global 500 and the world's leading financial institutions. Headquartered in London, IHS Markit is committed to sustainable, profitable growth.

197091997-CU-1217