Top 10 Strategic Technology Trends for 2018

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Summary

The intelligent digital mesh is a foundation for future digital business and its ecosystems. To create competitive advantage, enterprise architecture and technology innovation leaders must evaluate these top trends to identify opportunities that their organizations can exploit.

Overview

Key Findings

Artificial intelligence (AI) delivers value to every industry, enabling new business models. It does so by supporting key initiatives such as customer engagement, digital production, smart cities, self-driving cars, risk management, computer vision and speech recognition.

As people, places, processes and "things" become increasingly digitalized, they will be represented by digital twins. This will provide fertile ground for new event-driven business processes and digitally enabled business models and ecosystems.

The way we interact with technology will undergo a radical transformation over the next five to 10 years. Conversational platforms, augmented reality, virtual reality and mixed reality will provide more natural and immersive interactions with the digital world.

A digital business is event-centric, which means it must be continuously sensing and adapting. The same applies to the security and risk infrastructure that supports it, which must focus on deceiving potential intruders and predicting security events.

Recommendations

Enterprise architecture (EA) and technology innovation leaders using EA to master emerging and strategic trends must:

Devise new business scenarios using AI as the enabler for new business designs. Do so by engaging, educating and ideating with senior business leaders about their strategically relevant priorities.

Create a more natural and immersive user experience by deploying, where effective, conversational platforms and virtual, augmented and mixed reality.

Support Internet of Things (IoT) initiatives by developing and prioritizing targeted, high-value business cases to build digital twins and exploit cloud and edge computing synergistically.

Adopt a strategic approach for security and risk that continuously adapts based on risk and trust. Do so by communicating requirements to developers, achieving a DevSecOps environment.

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Analysis

Digital business blurs the physical and virtual worlds in a way that transforms business designs, industries, markets and organizations. The continuing digital business evolution exploits emerging and strategic technologies to integrate the physical and digital worlds, and create entirely new business models. The future will be defined by smart devices delivering increasingly insightful digital services everywhere. We call this mesh of interconnected people, devices, content and services the *intelligent digital mesh* . It's enabled by digital business platforms delivering a rich intelligent set of services to support digital business. As an EA or technology innovation leader seeking to exploit the intelligent digital mesh, you must respond to the disruptive technology trends driving this future.

Our top 10 strategic technology trends include three groupings of complementary trends (see Figure 1):

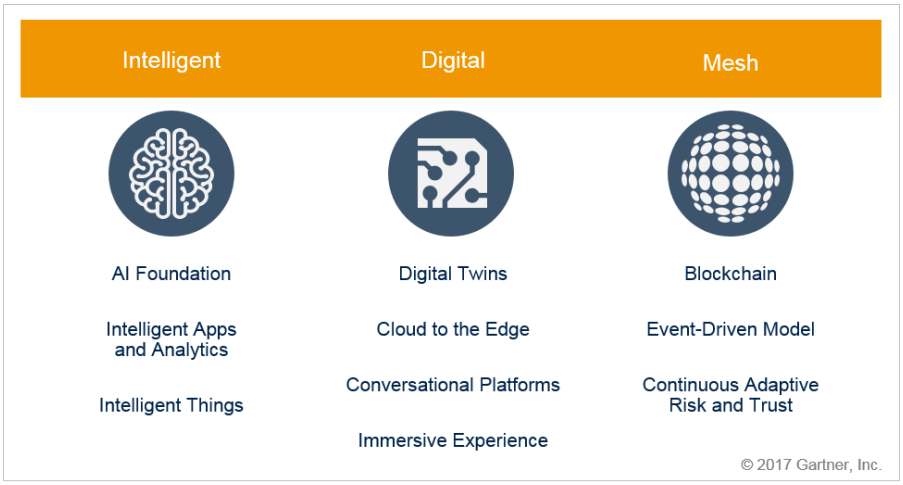
The **intelligent** theme explores how AI is seeping into virtually every existing technology and creating entirely new technology categories. The exploitation of AI will be a major battleground for technology providers through 2022. Using AI for well-scoped and targeted purposes delivers more flexible, insightful and increasingly autonomous systems.

The **digital** theme focuses on blending the digital and physical worlds to create a natural and immersive, digitally enhanced experience. As the amount of data that things produce increases exponentially, compute power shifts to the edge to process stream data and send summary data to central systems. Digital trends, along with opportunities enabled by AI, are driving the next generation of digital business and the creation of digital business ecosystems.

The **mesh** theme refers to exploiting connections between an expanding set of people and businesses — as well as devices, content and services — to deliver digital business outcomes. The mesh demands new capabilities that reduce friction, provide in-depth security and respond to events across these connections.

Our top 10 list highlights strategic trends that aren't yet widely recognized but have broad industry impact and significant potential for disruption. Through 2022, technologies related to these trends will reach a level of maturity that crosses a critical tipping point. And they'll experience significant changes. Examine the business impact of our top 10 strategic technology trends, and seize the opportunities to enhance your existing products, create new ones or adopt new business models. Digital business will transform your industry. Prepare for the impact of digital business on your industry and your business.

Figure 1. Top 10 Strategic Technology Trends for 2018



SOURCE: GARTNER (OCTOBER 2017)

Trend No. 1: AI Foundation

Interest in AI is growing, as shown by an increase of more than 500% in the number of inquiry calls from Gartner clients about topics related to AI in the past year. [1] A 2017 Gartner survey found that 59% of organizations are still gathering information to build their AI strategies, while the rest have already made progress in piloting or adopting AI solutions. [2] Furthermore, the market indicates strong investment in startups selling AI technologies. [3]

Creating systems that learn, adapt and potentially act autonomously will be a major battleground for technology vendors through at least 2020. The ability to use AI to enhance decision making, reinvent business models and ecosystems, and remake the customer experience will drive the payoff for digital initiatives through 2025.

The AI foundation consists of numerous technologies and techniques that have grown over many years. These include expert systems, decision trees, linear regression and neural networks. The level of capability has grown steadily. This is the result of:

Ever-more advanced algorithms using supervised, unsupervised and reinforcement-learning techniques

The availability of massive amounts of data to feed machine learning

Hardware advances (such as servers based on graphics processing units) delivering massive compute infrastructure to process the huge amount of data and sophisticated algorithms

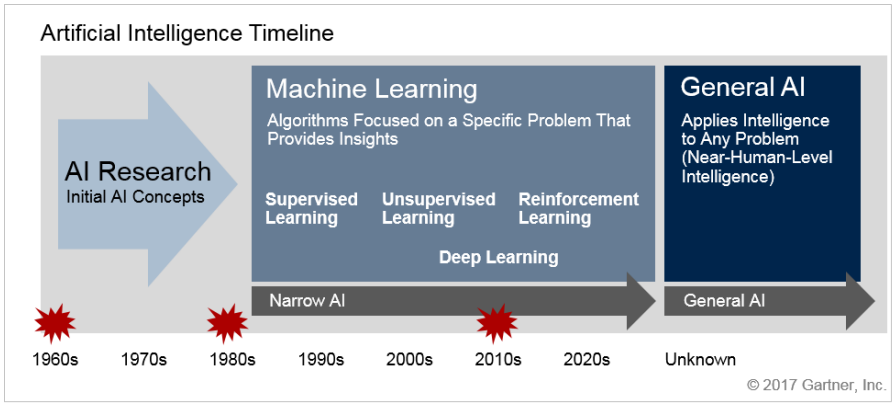
Advanced machine learning in the form of deep learning has further extended the problem domains that AI addresses. Examine the wide variety of AI-related techniques and exploit them as needed.

Today's AI Is Narrow AI

Today, the focus for AI is on "narrow AI" (see Figure 2). Narrow AI consists of highly scoped machine-learning solutions that target a specific task (such as understanding language or driving a vehicle in a controlled environment). The algorithms chosen are optimized for that task. All the real-world examples of AI in use or development are examples of narrow AI. Artificial general intelligence refers to the use of machine learning to handle a broad range of use cases. Such systems, were they to exist, would successfully perform any intellectual task that a human could perform and would learn dynamically, much as humans do. These systems may never exist, but interest in them continues in the popular media and among those predicting an "AI doomsday." Focus on business results enabled by applications that exploit narrow AI technologies, both leading-edge and older AI technologies. Leave general AI to the researchers and science fiction writers.

Evaluate a number of business scenarios in which AI could drive specific business value, and consider experimenting with one or two high-impact scenarios. For example, in banking, you could use AI techniques to model current real-time transactions, as well as make predictive models of transactions based on their likelihood of being fraudulent. If you're an early adopter or you're seeking to drive disruptive innovation, begin to implement predictive analytics, ensemble learning and natural-language processing. If you're a mainstream user or have more modest innovation goals, use third parties and packaged solutions with embedded AI (see "Ten Ways AI Will Appear in Your Enterprise — No One Source Can Meet All Your Business Needs" (/doc/code/335052?ref=ddisp)).

Figure 2. Narrow AI's Place in the Long History of AI



SOURCE: GARTNER (OCTOBER 2017)

AI techniques are evolving rapidly. You'll need to invest significantly in skills, processes and tools to successfully exploit these techniques. Investment areas include setup, integration, algorithm/approach selection, data preparation and model creation. In addition, it can take significant effort to exploit a system's learning capabilities, evaluate the accuracy of findings, and update the algorithms and models to improve results. Effort is required from not only the data scientists creating the system, but also others who have the knowledge needed to "train" the system. You'll need:

Data scientists to understand data and AI algorithms, and to formulate coherent questions or problem domains to which to apply these algorithms

Application developers to design interfaces, services and process flows

A lack of the relevant data sciences will probably hamper AI adoption in the short term. [4] By 2020, 30% of new development projects will deliver AI through joint teams of data scientists and programmers.

Applied AI gives rise to a range of intelligent implementations. These include physical devices (such as robots, autonomous vehicles and consumer electronics), as well as apps and services (such as virtual personal assistants [VPAs] and smart advisors). These implementations will be delivered as a new class of obviously intelligent apps and things. They'll provide embedded intelligence for a wide range of mesh devices, and existing software and service solutions. The data science needed to create these systems is complex. This means that many organizations will consume applied AI mainly through packaged intelligent apps and things. Alternatively, organizations will consume them through packaged platform services or "models as a service" that they can build into custom applications.

Related Research:

"Develop Your Artificial Intelligence Strategy Expecting These Three Trends to Shape Its Future" (/doc/code/324590?ref=ddisp)

"AI on the Edge: Fusing Artificial Intelligence and IoT Will Catalyze New Digital Value Creation" (/doc/code/319614?ref=ddisp)

"Market Trends: How AI and Affective Computing Deliver More Personalized Interactions With Devices" (/doc/code/315234?ref=ddisp)

"Applying Artificial Intelligence to Drive Business Transformation: A Gartner Trend Insight Report" (/doc/code/328114?ref=ddisp)

"Innovation Insight for Artificial Intelligence of Things — Machine Learning in the IoT Era" (/doc/code/336934?ref=ddisp)

"Where You Should Use Artificial Intelligence — and Why" (/doc/code/328113?ref=ddisp)

"Questions to Ask Vendors That Say They Have 'Artificial Intelligence'" (/doc/code/334005?ref=ddisp)

Trend No. 2: Intelligent Apps and Analytics

Organizations are applying AI techniques to create new app categories (such as virtual customer assistants [VCAs]) and improve traditional applications (such as worker performance analysis, sales and marketing, and security). Intelligent apps have the potential to transform the nature of work and the structure of the workplace. When building or buying an AI-powered app, consider where its AI impact will be. It's useful to focus on three target domains when exploring how and where to exploit AI:

Analytics: AI can be used to create more predictive and prescriptive analytics that can then be presented to users for further evaluation, or plugged into a process to drive autonomous action. AI is also being used for augmented analytics.

Process: AI can drive more intelligent actions by an application. For example, you can use AI for intelligent invoice matching or analysis of email documents to improve service flow. In the future, this can be extended further to identify patterns of work, from which process models can be built and executed.

User Experience: Natural-language processing used to create VPAs is one application of AI to the user experience. Further examples include facial recognition and other AI applications for understanding user emotions, context or intent, and predicting user needs.

During the next few years, virtually every app, application and service will incorporate some level of AI. Some of these apps will be obvious intelligent apps that couldn't exist without AI and machine learning. Others will be unobtrusive users of AI that provide intelligence behind the scenes.

There is an AI "land grab" from the large vendors making "big bets" and from startups seeking to gain an edge. They all aim to support or replace manual human-based activities with intelligent automation. Vendors such as Salesforce, SAP, Oracle and Microsoft are incorporating more advanced AI functions in their offerings. These vendors are exploiting AI to varying degrees, but they're all focusing on their traditional strongholds. For example, the main enterprise software vendors are emphasizing sales, service, marketing and ERP as particularly valuable areas for applying AI techniques. Microsoft is focusing on Office 365 and a strong developer ecosystem. Challenge your packaged software and service providers to outline how they'll be using AI to add business value in new versions. Explore how much of the new value will come from bleeding-edge, rather than older, AI technologies. Examine how they use AI to deliver advanced analytics, intelligent processes and new user experiences.

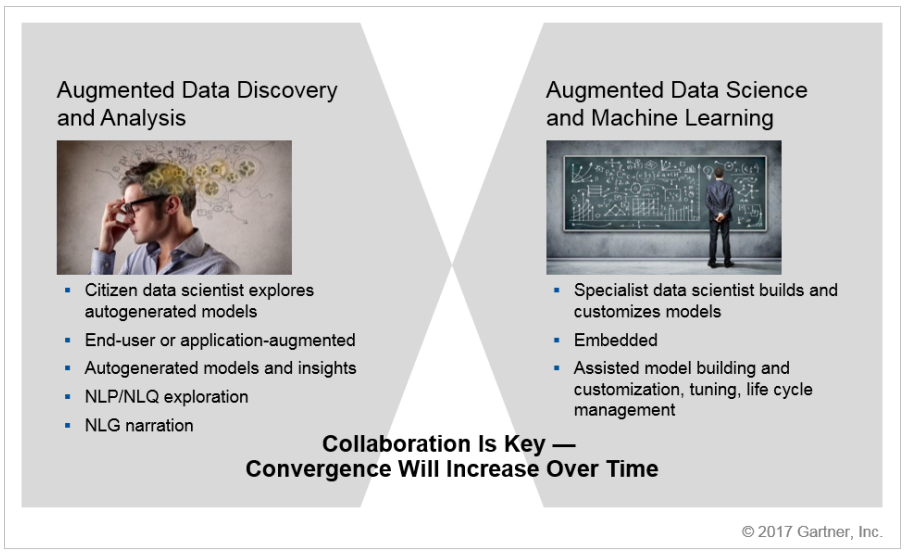
VPAs such as Google Now, Microsoft's Cortana and Apple's Siri are becoming smarter and are a rapidly maturing type of intelligent app. Some chatbots, such as Facebook Messenger, can be powered by AI (for example, Wit.ai) to deliver an intelligent app. These intelligent apps feed into the conversational platform trend to create a new intelligent intermediary layer between people and systems. If you're an early adopter or you're seeking to drive disruptive innovation, begin to implement targeted VCAs and VPAs where a high-value target persona (for example, a doctor, marketing leader or high-profit customer) could achieve significant benefit. If you're a mainstream user or have more modest innovation goals, consider more simple rule-based chatbots. Exploit prepackaged assistants or simple mobile assistants based on the VPA capabilities embedded in smartphones.

Intelligent apps can create a new intelligent intermediary layer between people and systems. They have the potential to transform the nature of work and the structure of the workplace, as seen with VCAs and enterprise advisors and assistants. These models free people to build on and extend the capabilities of the assistant. For example, in healthcare, advanced advisors and other AI-assisted capabilities have the potential to enhance doctors' understanding and their ability to deliver more personalized treatments. Explore intelligent apps as a way of augmenting human activity, and not simply as a way of replacing people.

Augmented Analytics Will Enable Users to Spend More Time Acting on Insights

Augmented analytics is a particularly strategic, next-generation data and analytics paradigm in which AI is having an impact (see Figure 3). It uses machine learning to automate data preparation, insight discovery and insight sharing for a broad range of business users, operational workers and citizen data scientists. Augmented analytics will enable expert data scientists to focus on specialized problems and on embedding enterprise-grade models into applications. Users will spend less time exploring data and more time acting on the most relevant insights. They will do so with less bias than in manual approaches.

Figure 3. Augmented Analytics for Citizen and Professional Data Scientists



NLG = natural-language generation; NLP = natural-language processing; NLQ = natural-language query

Source: Gartner (October 2017)

Enterprises will need to develop a strategy to address the impact of augmented analytics on currently supported data and analytics capabilities, roles, responsibilities and skills. They'll also need to increase their investments in data literacy. Both small startups and large vendors now offer augmented analytics capabilities that could disrupt vendors of business intelligence and analytics, data science, data integration, and embedded analytic applications. Data and analytics leaders must review their investments. By 2020, augmented analytics will be the dominant driver for data analysis systems. And by 2020, automation of data science tasks will enable citizen data scientists to produce a higher volume of advanced analysis than specialized data scientists.

Intelligent apps constitute a long-term trend that will evolve and expand the use of AI in apps and services through 2037. Establish a process to continually evaluate where your organization can apply AI today and over time. Use persona-based analysis to determine the most appropriate opportunities. Compare the roadmaps for AI exploitation across your packaged app and service provider portfolio. Proceed with caution if your organization is developing applications — the underlying AI elements for creating intelligent apps

aren't ready for most application development projects at scale. Ensure such projects have a very high potential business value. The competitive gaps and missed opportunity costs for laggards could be significant.

Related Research:

"Market Guide for Virtual Customer Assistants" (/doc/code/291810?ref=ddisp)

"Competitive Landscape: Virtual Personal Assistants, 2016" (/doc/code/300519?ref=ddisp)

"Augmented Analytics Is the Future of Data and Analytics" (/doc/code/326012?ref=ddisp)

"Hype Cycle for Analytics and Business Intelligence, 2017" (/doc/code/314848?ref=ddisp)

"How Enterprise Software Providers Should (and Should Not) Exploit the AI Disruption" (/doc/code/320055?ref=ddisp)

Trend No. 3: Intelligent Things

Intelligent things are physical things that go beyond the execution of rigid programming models and exploit AI to deliver advanced behaviors that interact more naturally with their surroundings and with people. AI is driving advances for new intelligent things, such as autonomous vehicles, robots and drones, and delivering enhanced capability to many existing things, such as IoT-connected consumer and industrial systems (see Figure 4).

Figure 4. Intelligent Things Span Many Sectors

SOURCE: GARTNER (OCTOBER 2017)

Intelligent things are either semiautonomous or fully autonomous. The word "autonomous," when used to describe intelligent things, is subject to interpretation. When Gartner uses this term to describe intelligent things, we don't mean that these intelligent things have AI-style freedom from external human control or influence. Rather, we mean that these intelligent things can operate unsupervised for a defined period to complete a task. Intelligent things may have various levels of autonomy, as shown by the following examples:

Self-directing vacuum cleaners that have limited autonomy and smartness

Drones that can autonomously dodge obstacles [5]

Unmanned aerial vehicles that can fly into buildings through windows and doors

Autonomous drones and robots will undergo significant technical evolution powered by new machine-learning models and algorithms. They will be used mainly in narrowly defined scenarios and controlled environments. Advances in one domain — such as more sophisticated algorithms that enable a robot to learn from its environment — will often have an application in another domain.

The use of autonomous vehicles in controlled settings (for example, farming, mining and warehousing) is a growing area of interest for intelligent things. In industrial settings, vehicles can be fully autonomous. By 2022, it's likely that autonomous vehicles will be used on roadways in limited, well-defined, geofenced and controlled areas. But general use of autonomous cars will probably require a person in the driver's seat in case the technology should fail — several U.S. states have passed laws stipulating this. In the near term, high-technology companies and traditional automotive manufacturers (such as Ford, Uber, Alphabet's Google, Volkswagen, Mercedes-Benz, Tesla, Nissan, BMW and Honda) will all be testing autonomous vehicles. Through at least 2022, we expect that semiautonomous scenarios requiring a driver will dominate. During this time, manufacturers will test the technology more rigorously, and the nontechnology issues will be addressed, such as regulations, legal issues and cultural acceptance.

AI will be embedded more often into everyday things, such as appliances, speakers and hospital equipment. This phenomenon is closely aligned with the emergence of conversational platforms, the expansion of the IoT and the trend toward digital twins. Amazon Echo is an example of an intelligent thing. It's a simple speaker connected wirelessly to an assistant, powered by machine learning. As conversational interfaces are delivered through other devices with a speaker or text input option, all these objects will become intelligent things.

Other markets have similar potential for embedded intelligence. For example, today's digital stethoscope can record and store heartbeat and respiratory sounds. Collecting a massive database of such data, relating the data to diagnostic and treatment information, and building an AI-powered doctor assistance app would enable doctors to receive diagnostic support in real time. However, in more advanced scenarios, significant issues such as liability, patient privacy and regulatory constraints must be considered. We expect that these nontechnical issues, and the complexity of creating highly specialized assistants, will slow embedded intelligence in industrial IoT and other business scenarios. Organizations that can address these barriers have the potential for significant competitive advantage.

Swarms of Intelligent Things Will Work Together

As intelligent things proliferate, we expect a shift from stand-alone intelligent things to a swarm of collaborative intelligent things. In this model, multiple devices will work together, either independently of people or with human input. For example, if a drone examined a large field and found that it was ready for harvesting, it could dispatch an "autonomous harvester." In the delivery market, the most effective solution may be to use an autonomous vehicle to move packages to the target area. Robots and drones on board the vehicle could then effect final delivery of the package. The military is leading the way in this area and is studying the use of drone swarms to attack or defend military targets. [6] Other examples include:

- Intel's use of a drone swarm for the U.S. Super Bowl halftime show in 2017 [7]
- A plan for Dubai to use autonomous police vehicles that can deploy their own drones for surveillance [8]
- Cooperative merge scenarios by Honda and other car manufacturers, in which vehicles communicate with one another to optimize traffic flows [9]

Related Research:

- "Use Scenarios to Plan for Autonomous Vehicle Adoption" (/doc/code/324588?ref=ddisp)
- "Supply Chain Brief: Favorable Regulations Will Accelerate Global Adoption of Autonomous Trucking" (/doc/code/321743?ref=ddisp)
- "Predicts 2017: Drones" (/doc/code/316163?ref=ddisp)
- "Hype Cycle for Drones and Mobile Robots, 2017" (/doc/code/331618?ref=ddisp)
- "Market Trends: Personal Assistant Robots for the Home" (/doc/code/300531?ref=ddisp)
- "Swarms Will Help CIOs Scale Up Management for Digital Business" (/doc/code/332924?ref=ddisp)

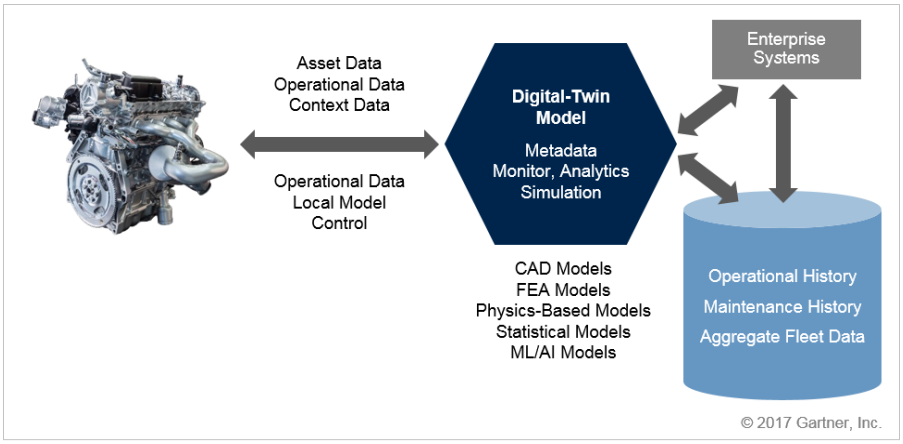
Trend No. 4: Digital Twins

A digital twin is a digital representation of a real-world entity or system (see Figure 5). The implementation of a digital twin is an encapsulated software object or model that mirrors a unique physical object (see Note 1). Data from multiple digital twins can be aggregated for a composite view across a number of real-world entities. The notion of a digital representation of real-world entities or systems is not new. You can argue that this was a central notion in the IT industry with the creation of computer-aided design representations of physical assets or profiles of individual customers. The difference in the latest iteration of digital twins is:

- The robustness of the models
- Digital twins' link to the real world, potentially in real time
- The application of advanced big data analytics and AI
- The ability to interact with them and evaluate "what if" scenarios

Digital twins in the context of IoT projects are leading the interest in digital twins today. [10] Well-designed digital twins of assets could significantly improve enterprise decision making. They are linked to their real-world counterparts and are used to understand the state of the thing or system, respond to changes, improve operations, and add value (see Figure 5).

Figure 5. Digital Twins Are Digital Representations of Real-World Objects



CAD = computer-aided design; FEA = finite element analysis; ML = machine learning

Source: Gartner (October 2017)

By 2020, we estimate there will be more than 20 billion connected sensors and endpoints, [11] and digital twins will exist for potentially billions of things. Benefits will include asset optimization, competitive differentiation and improved user experience in nearly all industries. As OEMs continue to work on connected products, they'll need to do more than just provide digital twins of their assets based on the essential elements described in Note 1. Rather, OEMs will need to think about their customers' evolving use cases and business models. Only by doing this can OEMs ensure that their hardware and software products remain competitive.

Organizations will implement digital twins simply at first. They will evolve them over time, improving their ability to collect and visualize the right data, apply the right analytics and rules, and respond effectively to business objectives. Through 2027, digital-twin use will expand beyond product engineers and data scientists. Operations managers will use them for assets where the cost-benefit analysis of risks in operations makes the case for digital twins compelling. We also expect that digital-twin models will proliferate, with suppliers increasingly providing customers with these models as an integral part of their offering.

Digital twins can enhance data insights and improve decision making, and will eventually help in the development of new business models. Their use will bring numerous benefits in different time frames, including:

Short term: Digital twins help in asset monitoring, optimization and improving the user experience, which is vital in nearly all industries. The shift from preventive to predictive (condition-based) maintenance is a particularly high-value use of digital twins. Customer benefits include reducing maintenance-driven downtime and lowering operating and maintenance costs.

Midterm: Organizations will use digital twins to operate factories and increase operational efficiency. They will use them to plan for equipment service and to predict equipment failure, enabling them to repair equipment to prevent its failure. Organizations will also use digital twins to enhance product development. They will do this by using them to simulate the behavior of new products based on the digital-twin insight from previous products, taking into consideration their cost, environment and performance. Digital twins offer the possibility of business models centered on guaranteed outcomes, such as specific asset performance guarantees.

Long term: Digital twins will aid innovation by providing insights into how products and services are used and how they can be improved. New business models may center on proactive advice. For example, automotive engineers could use digital twins, in conjunction with an analytics tool, to analyze how a specific car is driven to suggest new features to reduce accidents. Engineers might also suggest new products to serve the machine as a customer, where the machine and its digital twin have a budget for approved services. Other models may center on potential new marketplaces for digital twins, interfaces and suitably sanitized datasets from digital twins.

Digital Twins Will Be Linked to Other Digital Entities

Digital twins consolidate massive amounts of information on individual assets and groups of assets, often providing control of those assets. As the digital-twin trend evolves, twins will communicate with one another to create "digital factory" models of multiple linked digital twins. Digital twins of assets will be linked to other digital entities for people (digital personas), processes (law enforcement) and spaces (digital cities). Understanding the links across these digital entities, isolating elements where needed and tracking interactions will be vital to support a secure digital environment.

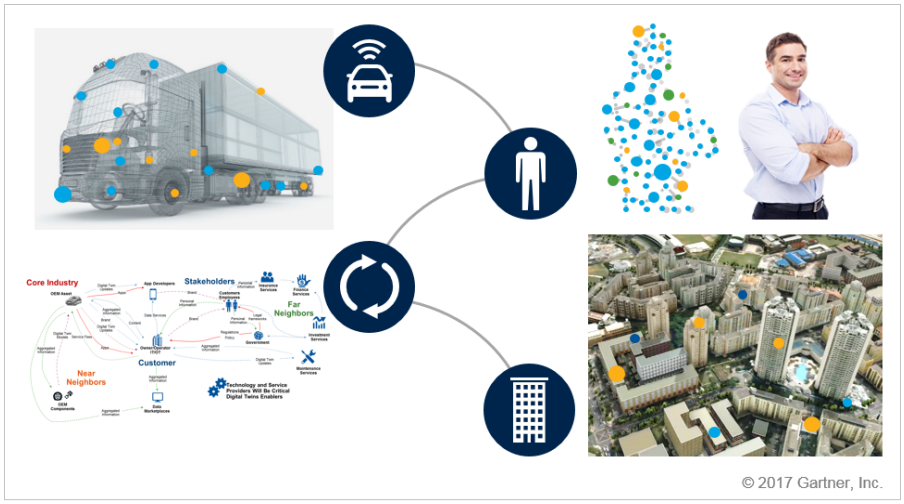
Although much attention is on digital twins of assets as part of an expanding IoT model, more sophisticated digital models of the real world have a much larger impact. Digital twins are built on the concept that virtual asset models coexist and are connected to real assets — they are twins. However, this concept isn't limited to assets (or things). Digital analogs of real-world elements are growing along many dimensions. Like digital twins, these other digital entities often grow from metadata structures and models of things in the real world that are disconnected from it, or are, at most, only loosely connected to it. Over time, these digital representations/models will be connected more tightly to their real-world counterparts. They will be infused with more sophisticated AI-based models, just as we are seeing with digital twins for assets. The following will be used for advanced simulation, operations and analysis (see Figure 6):

Future models of humans that could include rich biometric and medical data

Business operating system models defining the details of business processes and ecosystem interactions

Sophisticated models of buildings, cities and other places

Figure 6. Digital-Twin Models Will Expand to More Than Just Things



SOURCE: GARTNER (OCTOBER 2017)

Related Research:

"Innovation Insight for Digital Twins — Driving Better IoT-Fueled Decisions" (/doc/code/324871?ref=ddisp)

"Hype Cycle for the Internet of Things, 2017" (/doc/code/314298?ref=ddisp)

"Predicts 2017: IT and OT Convergence Will Create New Challenges and Opportunities" (/doc/code/318252?ref=ddisp)

"Digital Twins Will Impact Economic and Business Models" (/doc/code/328808?ref=ddisp)

"Create a Digital Twin of Your Organization to Optimize Your Digital Business Transformation Program" (/doc/code/331992?ref=ddisp)

"Digital Connectivism Tenet 1: We All Have a Digital Identity" (/doc/code/314842?ref=ddisp)

Trend No. 5: Cloud to the Edge

Edge computing describes a computing topology in which information processing and content collection and delivery are placed closer to the sources and sinks of this information. Edge computing draws from the concepts of mesh networking and distributed processing. It tries to keep the traffic and processing local, with the goal being to reduce traffic and latency. As such, the notion of edge content delivery has existed for many years. The "where to process the data" pendulum has swung between highly centralized approaches (such as a mainframe or a centralized cloud service) and more decentralized approaches (such as PCs and mobile devices). Connectivity and latency challenges, bandwidth constraints and greater functionality embedded at the edge favor distributed deployment models. The advantages of processing power and low costs of operating at hyperscale, coupled with the complexity of managing and coordinating thousands of geographically separated endpoints, favor the centralized model.

Much of the current focus on edge computing comes from the need for IoT systems to deliver disconnected or distributed capabilities into the embedded IoT world. Widespread application of the topology and explicit application and networking architectures aren't yet common. Systems and networking management platforms will need to be stretched to include edge locations and edge-function-specific technologies. These include data thinning, data compression and protection, and local analytics. Edge computing solves many pressing issues, such as high WAN costs and unacceptable latency. The edge computing topology will enable the specifics of digital business and IT solutions uniquely well in the near future.

Begin using edge design patterns in your mid- to longer-term infrastructure architectures. Immediate actions might include simple trials using colocation and edge-specific networking capabilities. You could also simply place remote-location or branch-office compute functions in a standardized enclosure (for example, "data center in a box"). Some applications, such as client-facing web properties and branch-office solutions, will be simpler to integrate and deploy. Data thinning and cloud interconnection will take more planning and experimentation to get right.

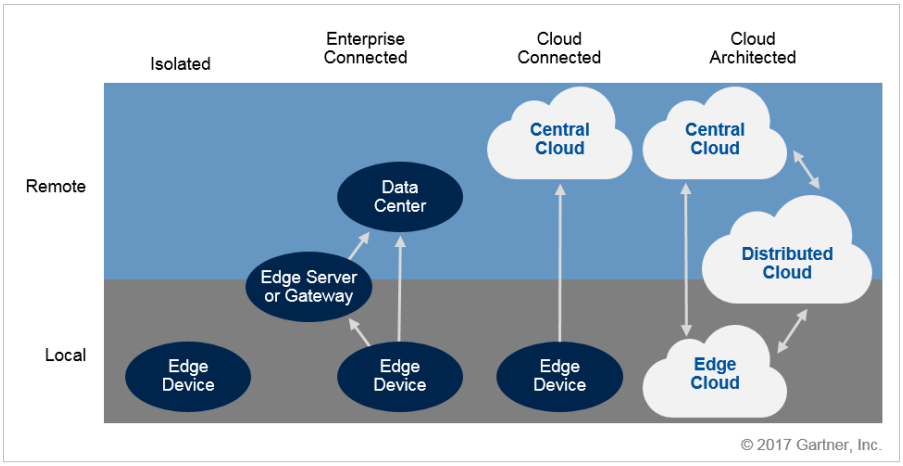
Edge Computing Brings Distributed Computing Into the Cloud Style

Most view cloud and edge computing as competing approaches. They view public cloud deployments as enjoying the economies of hyperscale, centralized data centers, with edge computing mandating processing to be pushed to the edge. But this is a misunderstanding of the two concepts. Cloud computing is a style of computing in which elastically scalable technology capabilities are delivered as a service using internet technologies. Cloud computing doesn't mandate centralization. Edge computing brings the distributed computing aspect into the cloud style. Consider cloud and edge computing as complementary rather than competing concepts (see Figure 7). You can use:

Cloud computing as a style of computing to create a service-oriented model and a centralized control and coordination structure

Edge computing as a delivery model, allowing for disconnected or distributed process execution of aspects of the cloud service

Figure 7. Cloud and Edge Computing Are Complementary Concepts



SOURCE: GARTNER (OCTOBER 2017)

Some cloud implementations already use an approach that distributes functionality to the edge (for example, Microsoft Office 365 and AWS Greengrass). We expect this approach will be used more frequently as cloud vendors push further into the IoT market, and IoT solution vendors adopt the cloud style as a way to manage their solutions more effectively. Although the IoT is a strong driver for a cloud-to-the-edge approach, the trend will also benefit mobile and desktop environments. More solutions similar to Office 365 are likely to appear.

Related Research:

"Cool Vendors in IoT Edge Computing, 2017" (/doc/code/325554?ref=ddisp)

"Expand Your Artificial Intelligence Vision From the Cloud to the Edge" (/doc/code/332821?ref=ddisp)

"A Guidance Framework for Architecting the Internet of Things Edge" (/doc/code/317186?ref=ddisp&latest=true)

"Explore the Roles of IoT Gateways in Five Edge Use Cases" (/doc/code/324780?ref=ddisp)

"The Edge Manifesto: Digital Business, Rich Media, Latency Sensitivity and the Use of Distributed Data Centers" (/doc/code/290109?ref=ddisp)

"Market Guide for Edge Computing Solutions for Industrial IoT" (/doc/code/326040?ref=ddisp)

Trend No. 6: Conversational Platforms

Conversational platforms will drive the next big paradigm shift in how humans interact with the digital world. They will shift the model from technology-literate people to people-literate technology. The burden of translating intent will move from the user to the computer. The system takes a question or command from the user in natural language. It responds by executing a function, presenting content or asking for additional input.

A conversational platform provides a high-level design model and execution engine in which user and machine interactions occur. As the term "conversational" implies, these interfaces are implemented mainly in the user's spoken or written natural language. In time, other input/output mechanisms will be added to exploit sight, taste, smell and touch for multichannel interaction. The use of expanded sensory channels will support advanced capabilities, such as emotion detection through facial expression analysis and human health status through olfactory analysis. But exploitation of these other sensory channels will be isolated and limited for the next three to five years.

Over the next few years, conversational interfaces based on natural-language interfaces will become the main design goal for user interaction. Gartner predicts that, by 2019, 20% of users' interactions with smartphones will be through VPAs. [12] A Gartner survey found that a quarter of smartphone users had used their VPA in the past month, most on a daily or weekly basis. [13]

Conversational platforms are most recognizably implemented in:

VPAs, such as Amazon Alexa, Apple's Siri, Google Assistant and Microsoft's Cortana

VCAs, such as IPsoft's Amelia, Watson Virtual Agent, and VCAs from [24]7, Artificial Solutions, Interactions, Next IT and Nuance

Chatbot frameworks, such as Amazon Lex, API.AI from Google, IBM Watson Conversation and Microsoft Bot Framework

Interactions in conversational platforms are typically informal and bidirectional. The interaction may be a simple request or question (such as "What's the weather forecast?" or "What time is it?") with a simple result or answer. Alternatively, it may be a structured interaction (such as that required to book a restaurant table or hotel room). As the technology matures, extremely complex requests will be possible, resulting in highly complex results. For example, the conversational platform may be able to collect oral testimony from crime witnesses, resulting in the creation of a suspect's image.

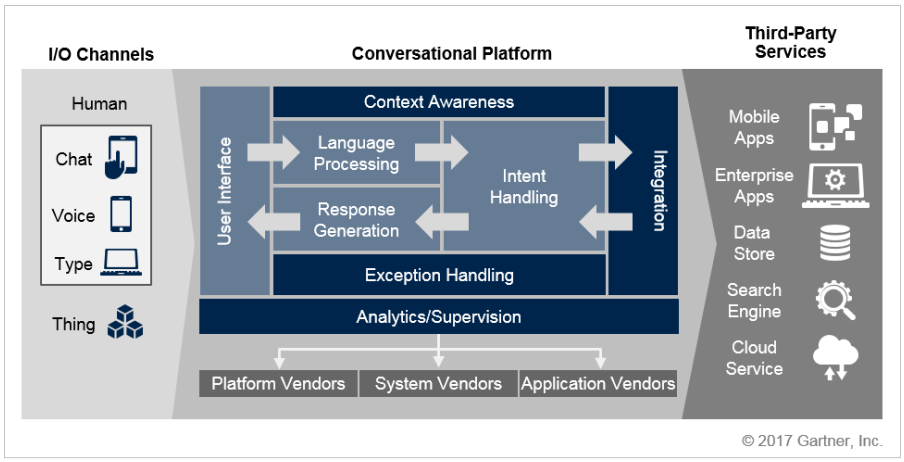
Integration With Third-Party Services Will Further Increase Usefulness

Conversational platforms have reached a tipping point: the usefulness of the systems has exceeded the friction of using them. But they still fall short. Friction is created when users need to know which domains the UI understands and what its capabilities are within those domains. The challenge that conversational platforms face is that users must communicate in a very structured way. This is often a frustrating experience. Rather than enabling a robust two-way conversation between the person and the computer,

most conversational platforms are mainly one-directional query or control systems that produce a very simple response. Over time, more conversational platforms will integrate with growing ecosystems of third-party services that will exponentially drive the usefulness of these systems. A primary differentiator among conversational platforms will be the robustness of their conversational models and the API and event models used to access, invoke and orchestrate third-party services to deliver complex outcomes.

By YE17, all the major industry players will have delivered their own version of a broadly applicable conversational platform. Some conversational platforms will support the supplier's own applications, and some will be generally available for enterprise buyers and third parties to build on (see Figure 8). Most will serve both purposes. Some platforms will be largely closed, while others will allow for replacement or extension of key components (such as natural-language processing engines and vocabularies). Examine the extensibility and mechanisms to link the conversational platform to other systems as part of any evaluation.

Figure 8. Conversational Platforms Include New User Experience Design Elements



I/O = input/output

SOURCE: GARTNER (OCTOBER 2017)

Through 2020, application vendors will increasingly include conversational platforms in packaged applications. They will do so to maintain a direct channel to their users, rather than being cut off by an intermediary conversational platform they don't control. We expect ongoing battles between application vendors and providers of general-purpose conversational platforms over the next three to five years.

The shifting user experience will create many new digital business opportunities, but will also pose significant IT security and management challenges. The realization of the continuous, immersive and conversational user experience will require a profoundly better appreciation of privacy and permission. Devices that are "always listening" may collect information from users without their consent. Missteps by vendors or questionable ethical use by law enforcement agencies will probably lead to regulation of the collection, storage and permissible uses of data.

Related Research:

"Architecture of Conversational Platforms" (/doc/code/323532?ref=ddisp)

"Cool Vendors in AI for Conversational Platforms, 2017" (/doc/code/326551?ref=ddisp)

"Innovation Insight for Conversational Commerce" (/doc/code/319111?ref=ddisp)

"Architecting and Integrating Chatbots and Conversational User Experiences" (/doc/code/326731?ref=ddisp&latest=true)

"Smart Agents Will Drive the Switch From Technology-Literate People, to People-Literate Technology" (/doc/code/277198?ref=ddisp)

"Hype Cycle for Human-Machine Interface, 2017" (/doc/code/313859?ref=ddisp)

Trend No. 7: Immersive Experience

While conversational platforms are changing the way in which people *interact* with the digital world, virtual reality (VR), augmented reality (AR) and mixed reality (MR) are changing the way in which people *perceive* the digital world. This combined shift in perception and interaction models leads to the future immersive user experience.

VR and AR are separate but related technologies. MR extends both approaches to incorporate the physical world in a more robust way. The visual aspect of the experience is important, but so are other sensory models, such as touch (haptic feedback) and sound (spatial audio). This is particularly so with MR in which the user may interact with digital and real-world objects while maintaining a presence in the physical world (see Note 2).

VR provides a computer-generated 3D environment that surrounds a user and responds to an individual's actions in a natural way. This is usually through an immersive head-mounted display (HMD) that blocks the user's entire field of vision. Gesture recognition or handheld controllers provide hand and body tracking, and touch-sensitive feedback may be incorporated. Room-based systems that provide a deeper sense of immersion deliver a 3D experience for multiple participants or one in which a person can walk in a room untethered.

AR is the real-time use of information in the form of text, graphics, video and other virtual enhancements integrated with real-world objects. It's presented using an HMD or mobile device. This overlaying of virtual-world elements on a real-world background differentiates AR from VR. AR aims to enhance users' interaction with the real physical environment, rather than separating them from it. This definition also applies to MR. In general, MR further combines elements of many types of immersive technologies.

The VR and AR market is adolescent and fragmented. However, investment continues to flow. In 2016, there was a huge amount of funding ($2.09 billion) and this is projected to increase by 3% to $2.16 billion in 2017. [14] Much of the investment is for core technologies still to be developed or for technologies advancing to their next stage. In 2017, Apple introduced ARKit [15] and Google introduced ARCore. [16] These immersive technology platforms are designed for the companies' respective mobile computing devices, and they indicate a very strong long-term interest from market share leaders.

VR and AR Can Help Increase Productivity

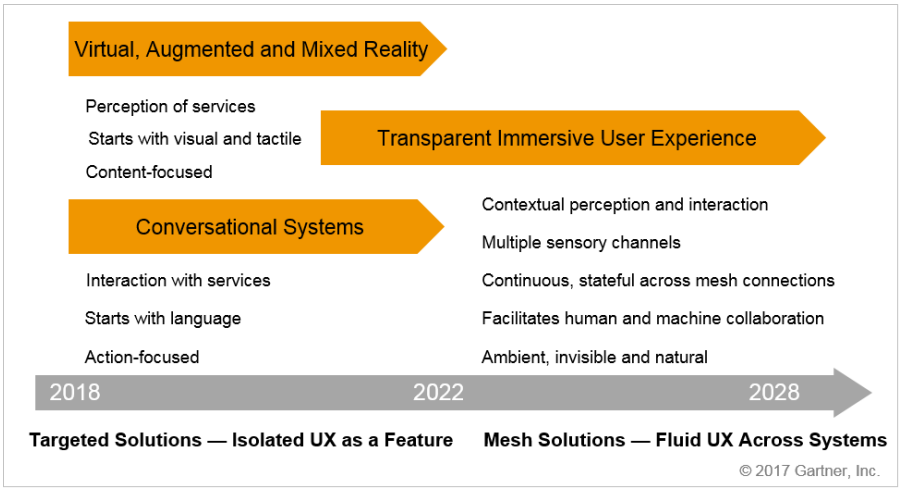
Interest and excitement are high, resulting in multiple, novelty VR applications. Many provide no real business value, other than in advanced entertainment, such as video games and 360-degree spherical videos. For businesses, this means that the market is chaotic. AR and VR are often used as a novelty for customer engagement. Usually this is via smartphone AR (as with Pokémon Go). Sometimes it's as an immersive experience using an HMD (such as Everest VR on HTC Vive, which enables viewers to enjoy the view as they virtually climb Mount Everest). However, 40% of organizations using or piloting AR find that the technology exceeds their expectations. [17] Examine real-life scenarios in which you can apply VR and AR to make employees more productive. You can use them to enhance design, training, visualization and to provide hands-free information. Only by examining and exploiting real-life scenarios can you drive tangible business benefits with these technologies.

Smartphones can also be an effective platform for mobile VR and AR. As with ARCore and ARKit, Google's Cardboard and Daydream and Samsung's Gear VR also use a smartphone as their computing platform. Snap your smartphone into one of these low-cost HMDs, hold it to your eyes, and see and interact with compelling virtual worlds. You don't even have to use one of these in an HMD configuration to experience AR — it can combine digital overlays on a real-world video experience. The device's screen becomes a "magic window" that displays graphics overlaid on top of real-world things. It superimposes contextual information that blends augmented data on top of real-world objects (such as hidden wiring superimposed on an image of a wall). Although this approach has significant limitations compared with more robust HMD-based approaches, it represents a widely available and cost-effective entry point. We expect the battle for smartphone-based AR to heat up in 2018. This is a result of Apple's release of ARKit and iPhone X, Google's release of ARCore, and the availability of cross-platform AR software development kits, such as Wikitude.

Through 2021, immersive consumer and business content and applications will evolve quickly. In 2018, the market for HMDs will grow and evolve significantly. It will reach 67.2 million shipped units and $18.8 million in revenue by 2021. [18] In the near term, consumers will be more likely to adopt HMDs. Video games will be the first popular HMD app type, assuming that the game providers can deliver compelling content. More specialized HMDs, and VR and AR content solutions, will become available for businesses. Through 2021, HMD technology will improve dramatically, but mobile AR will be the most widely adopted.

MR is emerging as the immersive user experience of choice (see Figure 9). It provides a compelling technology that optimizes its interface to better match how people view and interact with their world. MR exists along a spectrum and includes HMD for AR and VR, as well as smartphone- and tablet-based AR. MR also encompasses the use of smart mirrors and heads-up displays and projectors. It extends beyond the visual dimension to include auditory, haptic and other sensory input/output channels. MR also includes beacons and sensors embedded in the environment around the user.

Figure 9. The Future of the User Experience



UX = user experience

SOURCE: GARTNER (OCTOBER 2017)

The integration of VR and AR with multiple mobile, wearable, IoT and sensor-rich environments, and conversational platforms (the mesh) will extend immersive applications beyond isolated and single-person experiences. Rooms and spaces will become active with things, and their connection through the mesh will appear and work in conjunction with immersive virtual worlds. Imagine a warehouse that can not only recognize the presence of workers, but also help them understand the state of its equipment, and can visually point out parts requiring replacement. Although the potential of VR and AR is impressive, there will

be many challenges and roadblocks. Identify key target personas and explore targeted scenarios. For example, explore the needs of, and business value for, a target user in different settings, such as at home, in a car, at work, with a customer or traveling.

Related Research:

"Getting Started Developing Virtual Reality Experiences" (/doc/code/311404?ref=ddisp)

"Market Guide for Augmented Reality" (/doc/code/300282?ref=ddisp)

"Best Practices for Using Augmented Reality in Mobile Apps" (/doc/code/299004?ref=ddisp)

"Market Insight: Mixed-Reality Immersive Solutions Are the Ultimate User Experience for Everyone" (/doc/code/332650?ref=ddisp)

"Immersive Technologies Offer Infinite Possibilities" (/doc/code/323725?ref=ddisp)

"Immersive Digital: The Future of Operations in Oil and Gas" (/doc/code/336405?ref=ddisp)

Trend No. 8: Blockchain

Blockchain is evolving from a digital currency infrastructure into a platform for digital transformation. Blockchain and other distributed-ledger technologies provide trust in untrusted environments, eliminating the need for a trusted central authority. In this research, we use the term "blockchain" as a generic term for all distributed-ledger technologies.

Blockchain technologies offer a radical departure from current centralized transaction and record-keeping mechanisms. They can serve as a foundation of disruptive digital business for both established enterprises and startups. Blockchain will transform the exchange of value, much as http/html transformed the exchange of web-based information.

At its core, blockchain is a shared, distributed, decentralized and tokenized ledger. Blockchain provides business value by removing business friction. It does this by making the ledger independent of individual applications and participants. Everyone with a particular level of permissioned access sees the same information at the same time. Integration is simplified by having a single shared blockchain model. Blockchain also enables a distributed trust architecture that allows untrusted parties to undertake commercial transactions, and create and exchange value using a diverse range of assets (see Figure 10).

Blockchain is a powerful tool for digital business because of its ability to:

Remove business and technology friction

Enable native asset creation and distribution

Provide a managed trust model

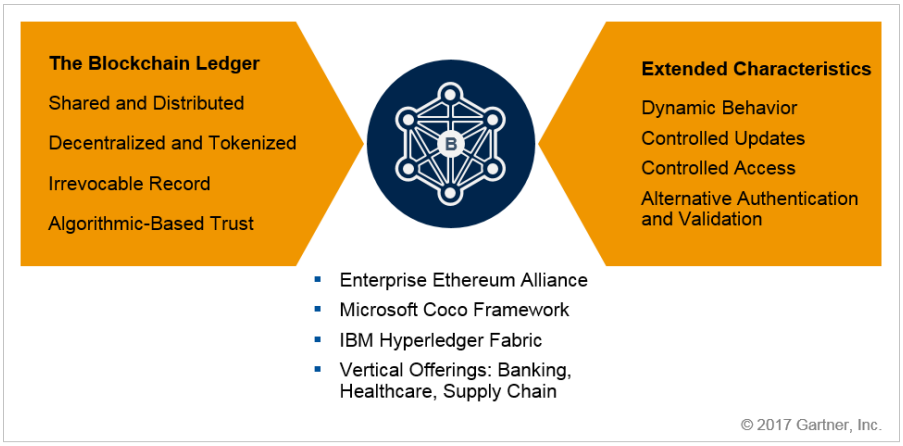
More dynamic behavior and business models can be added by:

Implementing smart contracts around the blockchain

Refining access and control to specific elements of the ledger

Creating different trust models

Figure 10. Key Elements of Blockchain



SOURCE: GARTNER (OCTOBER 2017)

Blockchain is gaining attention because it offers the promise to transform industry operating models. Funding in blockchain projects continues to grow, and one interesting development is the use of initial coin offerings as a source of funding. [19] The hype surrounding blockchain originally focused on the financial services industry. But blockchain has many potential applications beyond financial services, including government, healthcare, manufacturing, supply chain, content distribution, identity verification and title registry.

A critical aspect of blockchain technology is the unregulated creation and transfer of funds, exemplified by bitcoin. This capability funds much of blockchain development, but also concerns regulators and governments. The debates about permissioned, permissionless, hybrid and private ecosystems, and

governance will force a more robust analysis of distributed ledgers. Workable solutions will emerge in 2021 as these analyses are completed.

Blockchain Offers Significant Potential Long-Term Benefits Despite Its Challenges

Key potential benefits of blockchain include:

- Improved cash flow
- Lower transaction costs
- Reduced settlement times
- Asset provenance
- Native asset creation
- New trust models

Using a public blockchain can remove the need for trusted central authorities in record transactions and dispute arbitrations. This is because trust is built into the model through immutable records on a distributed ledger. The potential of this technology to radically transform economic interactions should raise critical questions for society, governments and enterprises. As yet, there aren't any clear answers to these questions.

Blockchain faces other key challenges that will undermine the delivery of robust scalable solutions through 2022. Blockchain technologies and concepts are immature, poorly understood and unproven in mission-critical, at-scale business operations. This is particularly so with the more complex elements that support more sophisticated scenarios.

Despite the challenges, the significant potential for disruption means you should probably begin evaluating blockchain, even if you don't aggressively adopt the technologies in the next few years. A practical approach to blockchain development demands:

- A clear understanding of the business opportunity and potential industry impact
- A clear understanding of the capabilities and limitations of blockchain technology
- A trust architecture
- The necessary skills to implement the technology

Develop clear language and definitions for internal discussions about the nature of the technology. Recognize that the terminology surrounding blockchain is in flux. This uncertainty masks the potential suitability of technology solutions to meet business use cases. Consequently, use extreme caution when interacting with vendors that have ill-defined/nonexistent blockchain offerings. Identify exactly how the term "blockchain" is being used, both internally and by providers. Monitor distributed-ledger developments, including related initiatives, such as consensus mechanism development, sidechains and blockchains. Resources permitting, consider distributed ledger as proof-of-concept development. But, before starting a distributed-ledger project, ensure your team has the business and cryptographic skills to understand what is and isn't possible. Identify the integration points with existing infrastructures to determine the necessary future investments, and monitor the platform evolution and maturation.

Related Research:

- "Understanding Blockchain Platform Architectures and Implementation Styles" (/doc/code/323596?ref=ddisp)
- "What CIOs Should Tell the Board of Directors About Blockchain" (/doc/code/323592?ref=ddisp)
- "How to Determine If You Need a Blockchain Project, and If So, What Kind?" (/doc/code/320247?ref=ddisp)
- "Top 10 Mistakes in Enterprise Blockchain Projects" (/doc/code/315768?ref=ddisp)
- "Toolkit: Overview of Blockchain Use Cases" (/doc/code/302283?ref=ddisp)
- "Hype Cycle for Blockchain Technologies, 2017" (/doc/code/332627?ref=ddisp)
- "Hype Cycle for Blockchain Business, 2017" (/doc/code/332628?ref=ddisp)

Trend No. 9: Event-Driven Model

Business is always sensing, and ready to exploit, new digital business moments (see "Business Events, Business Moments and Event Thinking in Digital Business" (/doc/code/338380?ref=ddisp)). This is central to digital business. Business events reflect the discovery of notable states or state changes, such as the completion of a purchase order. Some business events, or combinations of events, constitute business moments — detected situations that call for specific business actions. The most significant business moments have implications for multiple parties (for example, separate applications, lines of business or partners).

More business events can be detected more quickly and analyzed in greater detail by using event brokers, the IoT, cloud computing, blockchain, in-memory data management and AI. But technology alone can't deliver the full value of the event-driven model. That requires cultural and leadership change: IT leaders, planners and architects must embrace "event thinking." By 2020, event-sourced, real-time situational awareness will be a required characteristic for 80% of digital business solutions. And 80% of new business ecosystems will require support for event processing.

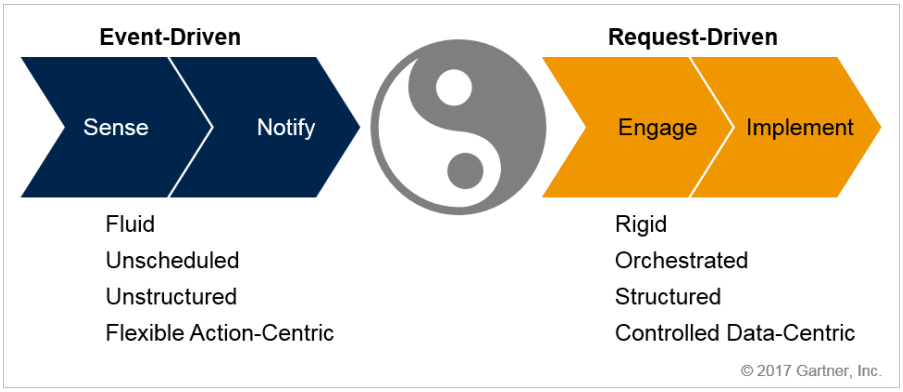
Event-driven architecture optimizes for agility, resiliency, extensibility, lower cost of change, open-ended design and web scale. A dynamic event-driven approach is required to achieve user goals in conversational platforms. The UI becomes more intelligent with conversational platforms, responding to a dynamic and shifting user context, and integrating various system elements on the back end. Data streams from the IoT represent streams of events. Real-time decision making and situational awareness demand continuous monitoring and assessment of events in real time.

Events Will Become More Important in the Intelligent Digital Mesh

All roads in our expanding intelligent digital mesh push toward greater importance for events. But most organizations use event processing for narrow purposes in isolated application contexts. They don't consider it a prevailing application design model equal to the request-driven service-oriented architecture. This perception must change to accommodate the push to digital business. It's also necessary to enable organizations to choose the most appropriate design model for the task at hand. Technology providers will incorporate more event-driven approaches across their product lines. Examples include Salesforce, with its Platform Events, and SAP, with the SAP Event Stream Processor.

The request-driven and event-driven application design models are complementary (see Figure 11). Both are useful and appropriate, depending on the type of business process being implemented. The request-driven model with its command-driven and structured approach provides more certainty and control of actions between services. But it's relatively rigid and stateful, with limited parallelism, and creates dependencies. The event-driven approach is more flexible, supporting real-time, business-driven event streams and scale. But it requires the introduction of an intermediary layer (event broker) and provides only eventual consistency. Process designers, architects and developers should view the two approaches as first-class and equal. Events will gradually become a preferred default approach because of their flexibility. Request-driven approaches will be applied where extra control and certainty are paramount.

Figure 11. Event-Driven and Request-Driven Application Design Models Are Complementary



SOURCE: GARTNER (OCTOBER 2017)

Related Research:

"Business Events, Business Moments and Event Thinking in Digital Business" (/doc/code/338380?ref=ddisp)

"Follow the Leaders: Digital Business Innovation Is Event-Driven" (/doc/code/323880?ref=ddisp)

"Assessing Event-Driven Architecture for Scalable and Reactive Web Applications" (/doc/code/310108?ref=ddisp&latest=true)

"Articulating the Business Value of Event-Driven Architecture" (/doc/code/324218?ref=ddisp)

"Gartner on Event Processing in Digital Business: Recent Research" (/doc/code/337898?ref=ddisp)

"Event-Driven Programming Models Will Disrupt End-User Applications" (/doc/code/326054?ref=ddisp)

"Digital Businesses Will Compete and Seek Opportunity in the Span of a Business Moment" (/doc/code/326637?ref=ddisp)

Trend No. 10: Continuous Adaptive Risk and Trust

The intelligent digital mesh and related digital technology platforms and application architectures create an ever-more-complex world for security. [20] The continuing evolution of the "hacker industry" and its use of increasingly sophisticated tools — including the same advanced technologies available to enterprises — significantly raise the threat potential. Relying on perimeter defense and static rule-based security is inadequate and outdated. This is especially so as organizations exploit more mobile devices, cloud-based services, and open APIs for customers and partners to create business ecosystems. IT leaders must focus on detecting and responding to threats, as well as more traditional measures, such as blocking, to prevent attacks and other abuses. At the same time, digital business will require more advanced access protection when systems and information are opened up to the digital mesh. Security and risk management leaders must adopt a continuous adaptive risk and trust assessment (CARTA) strategic approach. This is vital to securely enable access to digital business initiatives in a world of advanced, targeted attacks. It will enable real-time, risk- and trust-based decision making with adaptive responses. [21]

Trust models using ownership and control as a proxy for trust simply won't work in a world of IT-enabled capabilities delivered anytime to users, located anywhere and accessing capabilities from any device. Existing security decision making based on initial one-time block/allow security assessments for access and

protection is flawed. It leaves organizations open to zero-day and targeted attacks, credential theft, and insider threats. Trust (and risk) of digital business entities and their actions must be dynamic, and assessed continuously in real time as interactions take place and additional context is gained. A CARTA approach embraces the reality that we can't know the answers to security questions — such as access or blocking — in advance. We can't provide a risk-based answer to these security questions until:

The request is made.

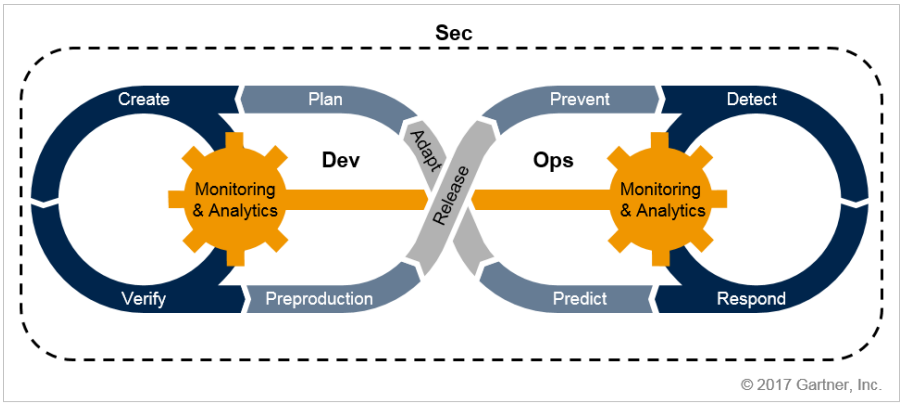
The context is known.

The relative risk and trust scoring of the entity and its requested behavior are assessed.

Barriers Must Come Down Between Security and Application Teams

As part of a CARTA approach, organizations must overcome the barriers between security teams and application teams. This is similar to the way in which DevOps tools and processes overcome the divide between development and operations. Security teams can't afford to wait until the end of the build-and-release pipeline to perform a detailed security scan. Security requirements must be clearly communicated and easily integrated into the processes of the developers, not the other way around. Information security architects must integrate security testing at multiple points into DevOps workflows in a collaborative way. This must be transparent to developers, and must preserve the teamwork, agility and speed of DevOps and agile development environments. This will result in DevSecOps (see Figure 12).

Figure 12. The DevSecOps Model



SOURCE: GARTNER (OCTOBER 2017)

To move toward this model, start with secure development and training, but don't make developers become security experts or switch tools. Adopt the concept of people-centric security. Empower developers to take personal responsibility for security. Compensate for this with monitoring, following a "trust and verify" mindset. All information security platforms should expose full functionality via APIs. In this way, processes can be integrated into the DevOps process and automated into the developer's preferred toolchain. Use proven version-control practices and tools for all application software and, just as important, for all scripts, templates and blueprints used in DevOps environments. Adopt a fixed infrastructure mindset in which production systems are locked down.

Continuous adaptive risk and trust can also be applied at runtime with approaches such as deception technologies. These technologies are becoming more important in a multilayered process as an alternative to existing tools to improve threat detection and response. Organizations that have chosen deception technologies over other approaches report simpler deployment, lower costs and less operational burden. But this comes at the cost of incomplete coverage. Complementary deployment with tools such as security information and event management, user entity and behavior analytics, and network traffic analytics will provide more complete coverage. However, this will result in a more complex security environment.

Advances in technologies such as virtualization and software-defined networking have made it easier to deploy, manage and monitor "adaptive honeypots" — the basic components of network-based deception. Organizations typically select deception technologies to detect lateral threat movements inside the network. This means that most deployments are internal, rather than in the demilitarized zone. Deception approaches can extend to servers and end-user endpoints, with decoy directories, files, data and credentials to catch an attacker. The idea is that, after a threat has penetrated the organization's external perimeter and is looking for, or moving to, a target, the attacker will interact with one of the decoys. This will trigger a high-confidence alert to the defending team.

Focus first on deception technologies for environments (such as the IoT, supervisory control, data acquisition and medical environments) in which technical challenges make it difficult, too expensive or impossible to use other security controls. Expand use as your expertise expands, and as tools mature and are better integrated into overall security frameworks and suites.

Related Research:

"Use a CARTA Strategic Approach to Embrace Digital Business Opportunities in an Era of Advanced Threats" (/doc/code/332400?ref=ddisp)

"2017 Planning Guide for Security and Risk Management" (/doc/code/312926?ref=ddisp&latest=true)

"DevSecOps: How to Seamlessly Integrate Security Into DevOps" (/doc/code/315283?ref=ddisp)

"Applying Deception Technologies and Techniques to Improve Threat Detection and Response" (/doc/code/314562?ref=ddisp&latest=true)

"Cool Vendors in Cloud Security, 2017" (/doc/code/326827?ref=ddisp)

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Hype Cycle for Emerging Technologies, 2017" (/doc/code/314560?ref=ddisp)

"Hype Cycle for Artificial Intelligence, 2017" (/doc/code/314732?ref=ddisp)

"Hype Cycle for Data Science and Machine Learning, 2017" (/doc/code/325005?ref=ddisp)

"Hype Cycle for the Internet of Things, 2017" (/doc/code/314298?ref=ddisp)

"Hype Cycle for Human-Machine Interface, 2017" (/doc/code/313859?ref=ddisp)

"Hype Cycle for Application Development, 2017" (/doc/code/314060?ref=ddisp)

"Hype Cycle for Data Security, 2017" (/doc/code/314204?ref=ddisp)

"Hype Cycle for Application Architecture, 2017" (/doc/code/314936?ref=ddisp)

"Hype Cycle for Platform as a Service, 2017" (/doc/code/314146?ref=ddisp)

Evidence

[1] Between June 2016 and June 2017, Gartner analysts took 4,353 inquiries related to AI. This represents a 523% increase year over year.

[2] Between 5 and 21 April 2017, the Gartner Research Circle conducted an online survey on AI development strategies. Of the 83 respondents, it found that:

Fifty-nine percent were still gathering knowledge to develop their AI strategies.

Twenty-five percent were piloting AI solutions.

Six percent were implementing AI solutions.

Six percent had deployed AI solutions.

[3] The following statistics show the growth in the market:

CB Insights reports that more than 550 startups that use AI as their core product raised $5 billion in funding in 2016. There were also 658 deals in 2016.

Venture Scanner says it's tracking 1,852 AI companies — 940 of them funded — in 13 categories and 70 countries. It says those companies have raised total funding of $16.8 billion.

TechSci Research projects, in a June 2016 report, that the AI market will grow at a compound annual rate of 75% between 2016 and 2021.

[4] Between 5 and 21 April 2017, the Gartner Research Circle conducted an online survey on AI development strategies. Of the 83 respondents, 54% believed that a lack of necessary staff skills would be a key challenge for organizations adopting AI.

[5] "Autonomous Miniature Aerial Vehicles: Vision-Based Obstacle Avoidance." (http://drones.cs.cornell.edu/) Cornell University.

[6] "How Swarming Drones Could Change the Face of Air Warfare." (http://www.defensenews.com/2016/05/17/how-swarming-drones-could-change-the-face-of-air-warfare/) Defense News.

[7] "Intel Powered the Drones During Lady Gaga's Super Bowl Halftime Show." (https://techcrunch.com/2017/02/05/intel-powered-the-drones-during-lady-gagas-super-bowl-halftime-show/) TechCrunch.

[8] "Police in Dubai Have Recruited a Self-Driving Robo-Car That Can 'Scan for Undesirables.'" (https://www.theverge.com/2017/6/29/15893802/dubai-police-robot-drone-car) The Verge.

[9] "Cooperative Merge." (http://hondanews.com/releases/honda-introduces-cooperative-mobility-ecosystem-at-ces-2017/videos/cooperative-merge) Honda.

[10] In June and July 2017, Gartner conducted an online study of 202 organizations in the U.S., Germany, China and Japan. It found that:

Twenty-four percent of organizations were already using digital twins.

Twenty-four percent planned to use digital twins in the next year.

Nineteen percent planned to use digital twins in the next three years.

Twenty percent didn't plan to use digital twins.

Those organizations that had already implemented the IoT were more likely to use, or plan to use, digital twins.

[11] "Forecast Analysis: Internet of Things — Endpoints, Worldwide, 2016 Update" (/doc/code/302435?ref=ddisp)

[12] "Predicts 2017: Personal Devices" (/doc/code/317569?ref=ddisp)

[13] In June and July 2017, Gartner conducted its personal technologies survey online. The 16,537 respondents ranged from 18 to 74 years old. They lived in the U.K., the U.S., Germany, China and India. The survey found that:

Twenty-five percent of respondents used their VPA in the past month.

Twenty-four percent used their VPA once or twice a day.

Sixteen percent used their VPA several times a day.

Thirty-two percent used their VPA several times a week.

[14] "AR/VR Sets New Records for Deals and Dollars in 2016." (https://www.cbinsights.com/research/ar-vr-startup-funding/) CB Insights.

[15] "Nine Cool AR Apps You Should Download to Try Out iOS 11's ARKit." (https://www.theverge.com/2017/9/20/16329366/ios-11-apple-arkit-best-new-ar-apps) The Verge.

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[17] Gartner conducted a survey on the use of digital technologies to drive digital business transformation. Of the 29% of organizations using or piloting AR, 40% reported that it exceeded their expectations. Sixty percent reported that the technology performed as expected. There were 228 respondents.

[18] "Forecast: Wearable Electronic Devices, Worldwide, 2017" (/doc/code/323691?ref=ddisp)

[19] "Blockchain ICO Funding Gains Steam vs VC Investment." (https://www.cbinsights.com/research/blockchain-ico-vc-funding-pace/) CB Insights.

[20] Gartner's Annual Global Risk and Security Survey (fielded online in February to March 2017 with 712 respondents from the U.S., U.K., Germany, Brazil and India) indicated that 86% of respondents feel that the digital world is creating new types and levels of risk for their business.

[21] Gartner's Annual Global Risk and Security Survey (fielded online in February to March 2017 with 712 respondents from the U.S., U.K., Germany, Brazil and India) showed that 64% of respondents agree that the agility to sense and respond to unknown and unexpected types of risk is increasing importance (relative to practices for prioritizing, managing, and mitigating known and expected risks).

Note 1
The Elements of a Digital Twin

The essential elements of a digital twin are:

Model: The digital twin is a functional, system model of the real-world object. The digital twin includes the real-world object's data structure, metadata and critical variables. More complex, composite digital twins can be assembled from simpler atomic digital twins.

Data: The digital twin's data elements relating to the real-world object include: identity, time series, current data, contextual data and events.

Uniqueness: The digital twin corresponds to a unique physical thing.

Ability to monitor: You can use the digital twin to query the state of the real-world object or receive notifications (for example, based on an API) in coarse or granular detail.

Note 2
Virtual, Augmented and Mixed Reality

The differences between VR, AR and MR are:

VR uses computer-generated (digital) environments to fully immerse users in a virtual "world."

AR overlays digital information on the physical world.

MR blends the physical and digital worlds in which users may interact with digital and real-world objects while maintaining presence in the physical world.