Hype Cycle for IT in the Middle East, 2020

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Initiatives: Infrastructure and Operations Leaders

The Hype Cycle for IT in the Middle East presents a snapshot of technologies and services that CIOs should consider. The technologies and services included have a direct impact on revenue generation, cost optimization, efficiency and/or quality improvement opportunities.

Analysis

What You Need to Know

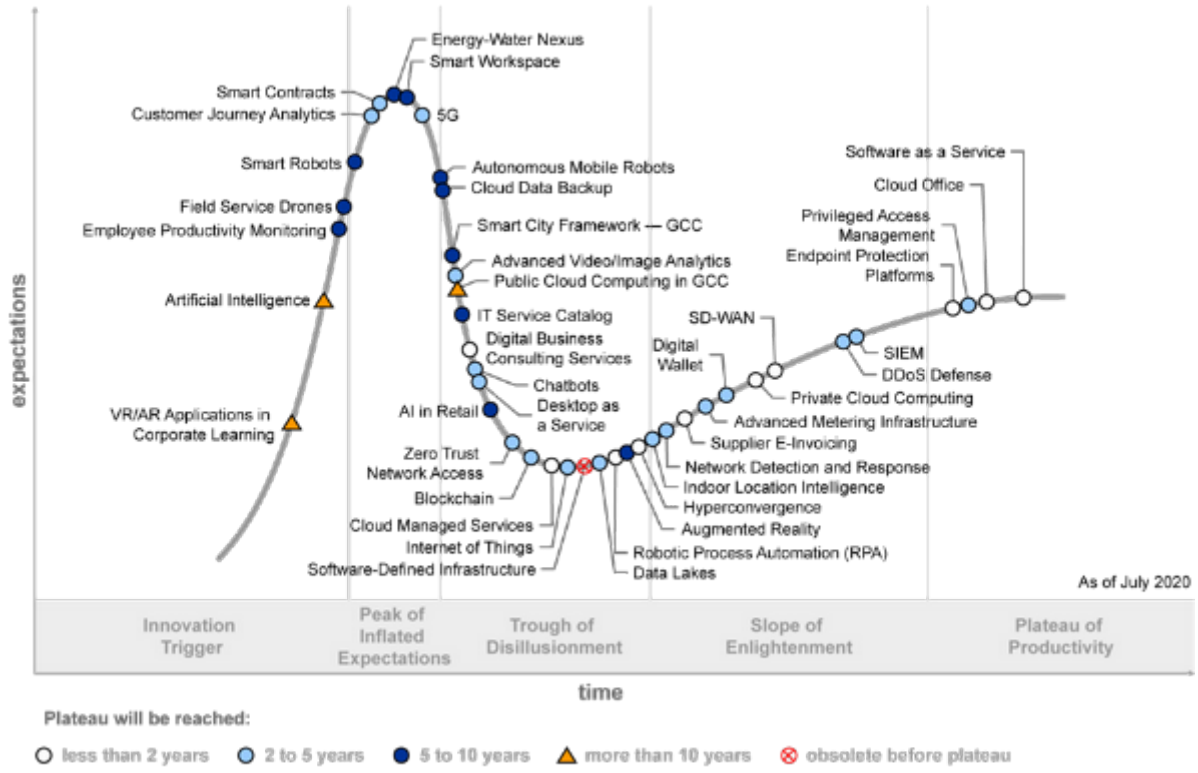
The Hype Cycle for IT in the Middle East is targeted at CIOs, IT leaders and technical professionals. This Hype Cycle highlights a snapshot of technologies, processes and standards that have transformational impacts across organizations in the Middle East region. This Hype Cycle is intended as a starting point for developing IT strategies and technology roadmaps. Actual selection and deployment of any of these technologies should be augmented with input from other technology and industry Hype Cycles, relevant research, and communication with analysts who have in-depth knowledge of the products and vendors. Interested readers can refer to Gartner's broader collection of Hype Cycles for more detail on these and related technologies.

The Hype Cycle

As per "Gartner Market Databook, 2Q20 Update," the Middle East and North Africa's annual IT spend in 2020 is forecast at $155 billion, a 2.9% decline year over year due to the COVID-19 pandemic. The first half of 2020 saw enterprises pulling back on strategic initiatives to focus on business optimization and cash preservation. Adoption of public cloud computing accelerated further as enterprises heavily leveraged public cloud for business continuity. The presence of global hyperscalers such as Amazon Web Services (AWS) in Bahrain and Microsoft Azure in the United Arab Emirates (UAE) provided customers with confidence that applications can be moved to the public cloud while adhering to local data residency requirements. Gartner client inquiries indicate increased interest in smart workspaces, location intelligence and artificial intelligence (AI) as enterprises begin to formulate a realistic "return to work" strategy with focus on employee well-being and safety. The 2020 Hype Cycle for IT in the Middle East assesses the technology maturity in areas such as cloud computing, AI/machine learning (ML) and data management. It also covers specific technologies in the banking, smart cities, healthcare, and oil and gas verticals.

Figure 1. Hype Cycle for IT in the Middle East, 2020

Hype Cycle for IT in the Middle East, 2020



Source: Gartner
ID: 441719

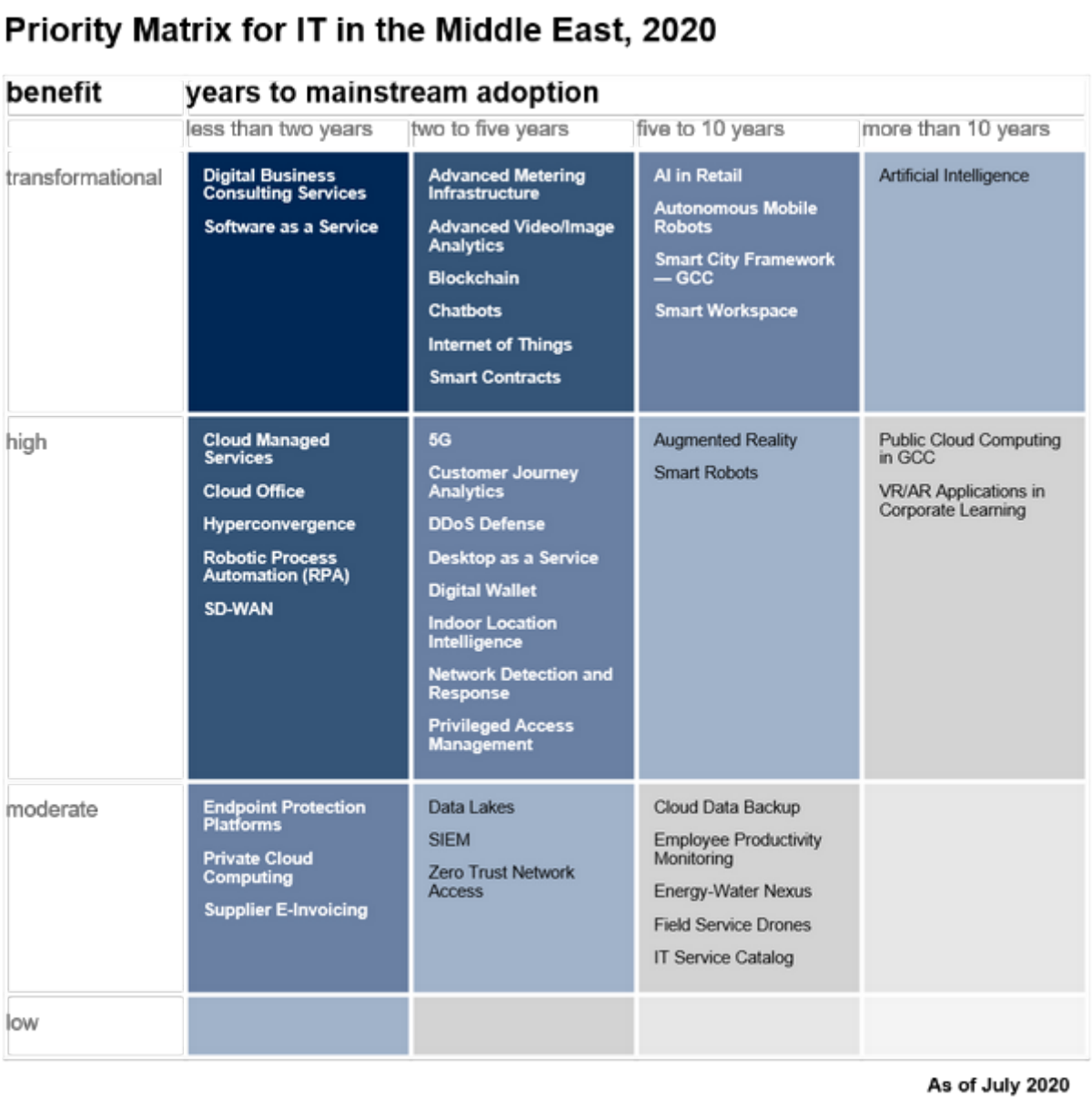
The Priority Matrix

The Priority Matrix maps the benefit rating for each technology against the length of time before Gartner expects it to reach mainstream adoption. This alternative perspective helps users determine how to prioritize their technology investments. In general, companies should begin in the upper-left section of the chart (transformational and less than two years), where the technologies have the most dramatic effects on business processes, revenue or cost-cutting efforts, and are available now or will be in the near future.

Technologies such as smart workspace, autonomous mobile robots and AI in retail are transformational in nature and are expected to become mainstream in five to 10 years owing to the increase in the number of digitalization projects currently underway. Blockchain, another transformation technology, has received significant interest from government and financial institutions in the region as they look for innovative ways to streamline records management and integrate with existing financial systems. Technologies such as hyperconvergence and software-defined WAN (SD-WAN) are expected to become mainstream in the next two years given the increased focus on infrastructure optimization and network performance in the region. Private cloud computing is expected to become mainstream in the next two years; however, the impact on the data center is expected to be moderate. This is because the skills and effort required to

maintain and manage private cloud deployments can potentially outweigh the benefits realized by deploying these solutions.

Figure 2. Priority Matrix for IT in the Middle East, 2020



Source: Gartner
ID: 441719

Off the Hype Cycle

The following technologies no longer appear on this Hype Cycle because they have matured, have been replaced by a technology more relevant to the GCC market or become obsolete, or they do not fit within the technology domains that this Hype Cycle covers:

- Transactive energy
- Disaster recovery as a service
- Digital government technology platforms

- Drone countermeasures
- Customer data platforms
- Threat intelligence platforms
- Network traffic analysis
- IT/OT alignment
- Application performance monitoring
- IT infrastructure monitoring

On the Rise

VR/AR Applications in Corporate Learning

Analysis By: Jeff Freyermuth

Definition: Virtual reality (VR) and augmented reality (AR) are two different yet related technologies. VR technologies create computer-generated environments to immerse users in a virtual environment. AR technologies overlay digital information on the physical world in order to enhance it and guide action. VR and AR allow organizations to create immersive learning opportunities and scenarios that are often expensive, resource intensive and challenging to replicate in fact-to-face training.

Position and Adoption Speed Justification: A growing number of organizations are experimenting with and piloting VR and AR platforms for a variety of different corporate learning use cases. With the recent shift toward remote work, organizations have been evaluating other ways to delivery face-to-face training. These tools are still in the infancy stage in corporate learning, as there are still challenges due to cost, time needed to create content, quality of the technology, inadequately designed content, voice and emotion recognition, and the need for considerable customization. In addition, organizations looking to use VR will require additional budget for needed hardware and viewing devices. However, COVID-19's derailment of all face-to-face training, coupled with the emergence of new solutions is driving growing demand, as buyers start their VR/AR journeys.

Organizations have initially been looking at use cases that are often too dangerous or too expensive to replicate in a face-to-face manner. Most early adopters looked at complex scenarios from the military, healthcare (i.e., surgeries), flight simulations and various safety training exercises. We are just starting to see organizations adopt VR and AR for sales training, product training and soft skills training, such as public speaking. However, based on most learning and development organizations being risk-averse and the technical maturity and challenges to be overcome, it will be over 10 years before these technologies reach the Plateau of Productivity.

User Advice: The use of VR and AR in corporate learning creates highly engaging learning opportunities that are often too expensive, too resource-intensive or too challenging to replicate in a face-to-face setting. For example, early adoption has been from retailers looking to prepare store employees for once-a-year events such as Black Friday, or unexpected high-risk scenarios like store robberies. In addition, a few healthcare providers are using VR to prepare ER managers for a wide variety of emergency scenarios. Further, the use of VR and AR should also be evaluated as an option for replacing face-to-face training during times when face-to-face is not permitted or allowed (example: due to COVID-19).

Since this is still a developing area, organizations should begin by seeking or creating well-designed content that is aligned to specific use cases or business initiatives. Gartner recommends organizations should begin their VR and AR implementation by identifying areas where there is prebuilt, out-of-the-box, high-quality content that meets your organization's specific requirements. In addition, based on the immaturity of the market, we recommend initially running experiments and pilots, and determining whether the product or platform is a good fit that provides additional value beyond traditional corporate training methods.

Business Impact: VR and AR can support a wide variety of simulation and training applications, including rehearsals, scenario reviews and responses to events. VR and AR can also shorten design cycles through immersive collaboration, and enhance the user interface experience. Businesses will benefit due to VR's and AR's immersive interfaces, helping create task efficiencies or reducing costs associated with new product design. These technologies can enhance the understanding of information through advanced graphical visualization and simulation technologies. The new generation of VR and AR applications and tools promises to support a wide variety of corporate learning activities, including:

- Complex simulation and training applications, including safety training
- Military simulation and training, such as flight simulators
- Rare retail store situations (e.g., Black Friday, robberies, etc.)
- Equipment operator training
- Product marketing to extend in the brand interaction or in product design
- Modeling, such as geomodeling in the oil industry
- Sales training to see how executives respond to various scenarios
- To enhance public speaking skills

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: FundamentalVR; PIXO VR; Strivr; Viar360; VirtualSpeech; WorldViz; zSpace; ZeroLight

Recommended Reading: "Top 10 Strategic Technology Trends for 2019: Immersive Experience"

"Getting Started Developing Virtual Reality Experiences"

Artificial Intelligence

Analysis By: Noha Tohamy

Definition: Artificial intelligence (AI) applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions, and take actions. In supply chain, AI can be deployed to improve supply chain functional and cross-functional performance. It augments human decision-making ability or automate routine and nonroutine tasks.

Position and Adoption Speed Justification: AI relies on machine learning techniques to identify patterns and make predictions. AI can span other data science techniques such as natural language processing and optimization. An AI solution refines its strategies through self-learning from new data and its previous performance, to recommend decisions or execute actions. AI solutions make sense of structured and unstructured data, and can interact with humans through written or conversational natural language.

Organizations can use AI to augment human decision making. For example, AI can augment current risk mitigation by analyzing large sets of internal and external data, continuously identifying evolving patterns, predicting disruptive events and potential resolutions.

Artificial intelligence supports organizations' vision for broader supply chain automation. Through self-learning, AI solutions can help automate various supply chain processes such as demand forecasting, quality management, or predictive maintenance. Adoption level of AI varies significantly among supply chain functions, with manufacturing and planning leading the pack.

In the last year, AI adoption has progressed significantly, due to better awareness, the vision of supply chain automation, and growing availability of supply chain specific AI solutions. Early adopters report promising benefits, yet are slow to embark on broader AI projects. Reaching the Plateau of Productivity in supply chain in 10 years or more will require technology maturity as well as organizational and cultural readiness and talent availability.

User Advice: Supply chain leaders responsible for AI and analytics strategy should:

- Experiment with AI in lower-order supply chain processes such as data and transaction management. These solutions span data harmonization, error detection and correction, and business process automation.

- Engage directly with vendors to understand the role AI plays in current offerings, how AI fits within the future product roadmap and how they plan to incorporate conversational AI to make their technology more user-friendly.
- Focus on specific use cases where you believe AI presents the highest potential and embark on small pilots, to gauge potential benefits and challenges to success
- Ensure availability of data science resources, internally or from service providers, to build and maintain AI solutions.
- Focus on cultural changes to ensure that the organization is in step with the AI vision. This includes training supply chain users on incorporating AI in their decision-making process.
- Define new career opportunities for supply chain users to pursue, once their nonroutine tasks are automated with AI.

Business Impact: AI impact on supply chain is transformational. By augmenting the ability to synthesize data, identify patterns and arrive at conclusions, AI supports humans' ability to analyze information and make data-based decisions.

AI supports the vision for automation across the supply chain. Fueled by machine learning, AI will continue to refine its findings and conclusions, arriving and executing optimal decisions with little to no human intervention.

AI-enabling technologies will have a major impact on supply chain talent, with its need for both the requisite technical skills and the business analytical acumen to successfully coexist and thrive with these technologies.

AI allows users to dedicate more time and talent to higher-order use cases, such as scenario planning or strategic network design. These use cases can surely benefit from some of the advanced technologies that comprise AI, but will continue to rely on human judgment and team collaboration.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Amazon Web Services (AWS); Google; IBM; Microsoft

Recommended Reading: "Supply Chain Leaders: Assert Supply Chain's Central Role in Your Enterprise's AI Adoption"

"Defining Digital Supply Chain Planning"

"Supply Chain 2029: Disruptions Impacting Future Innovation"

"Find Inspiration in 10 Use Cases of Artificial Intelligence in the Supply Chain"

Employee Productivity Monitoring

Analysis By: Helen Poitevin; Rashmi Choudhary

Definition: Employee productivity monitoring technologies use automated data collection and analytics to report on employees' activities, time spent, work locations and work patterns with a view to measuring and improving workforce productivity.

Position and Adoption Speed Justification: Employee productivity monitoring is not new. However, the digitalization of work has increased the ability to automatically track and monitor work activities. In response to the COVID-19 pandemic, many organizations have needed to shift many of their employees to remote working very quickly. This has significantly increased the level of interest in employee productivity monitoring technologies.

Many solutions that offer employee productivity monitoring functionality were built for other purposes, such as endpoint or digital experience monitoring, insider threat detection and business process management.

The practice of monitoring employees for the purpose of improving productivity is rife with ethical challenges. It can easily cross the "creepy line" and may create a toxic work culture. It can also make organizations the subject of news articles decrying poor practices.

Furthermore, productivity is highly context-specific. Measuring the volume of activities and time spent is frequently a very poor proxy for measuring productivity and impact.

Adoption rates will therefore vary. They will be higher in contexts where many employees carry out relatively routine and standardized work. Examples include employees in shared service centers and customer contact centers and other frontline workers. In contexts where employees do a significant amount of nonroutine work, employee productivity monitoring may be unsuitable.

User Advice: Application leaders focused on the digital workplace and seeking to invest in employee productivity monitoring technologies must:

- Inform their investment decisions through careful investigation of the data sources, user experience design and initial use case for tools that offer employee productivity monitoring. Most of the technologies used to monitor productivity were not built for that purpose. The data they collect can vary significantly and may not be representative of the work that employees actually do.
- Ensure that the technology is implemented ethically by testing it against a key set of human-centric design principles. Mitigate risks by pursuing a careful communication strategy. Messaging should align with the enterprise's response to the COVID-19 pandemic. Employees

should be notified about the purpose of the data collection and how measurement is done — they must be able to see how it can benefit them.

- Consider carefully which worker populations will be within the scope of any monitoring efforts, and which populations will be excluded. The data collected may alternatively be used to improve the employee experience.
- Use a checklist to ensure that the purpose and scope of data collection is in line with how the data will be used and that it will help employees do their best work. Application leaders must be able to explain the purpose of measurement and the data and types of calculation methods used. They must be explicit about who will see what data in support of which kind of decision. They must carefully evaluate how employees are likely to respond and what impact the monitoring will have on them.

Business Impact: The significant increase in remote working as a result of the COVID-19 pandemic has generated substantial interest in employee productivity monitoring technologies.

When used to identify and alleviate the challenges that remote workers face, these technologies can improve both the employee experience and business outcomes. Insights derived from employee productivity monitoring technologies can help leaders make changes at the organization, team or individual employee level to improve overall productivity. In some instances, employees can benefit by improving their time management skills.

However, these technologies also pose a substantial risk. They can create a toxic environment if their deployment is perceived to indicate a lack of trust. An employer's public perception — and therefore its brand — can be damaged, if stories of poorly implemented and communicated tools reach the press.

For many organizations, the risks will outweigh the potential benefits. Many tools may therefore be decommissioned, once a first set of insights has been generated and analyzed.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: ActiveOps; ActivTrak; enaible; Fin Analytics; Hubstaff; Microsoft (Workplace Analytics); Nexthink; Sapience; WorkMeter; WorkPuls

Recommended Reading: "Getting Value From Employee Productivity Monitoring Technologies for Remote and Office-Based Workers"

"Market Guide for Digital Experience Monitoring"

"Market Guide for Employee-Monitoring Products and Services"

"Workforce Planning — How to Use Technology to Support Planning Processes"

Field Service Drones

Analysis By: Jim Robinson

Definition: Drones for field service are portable, unmanned aerial vehicles remotely controlled by human pilots on the ground or outfitted to navigate autonomously, typically carrying cameras and sensors that can collect datasets for analysis. Some drones can be used to transport parts or tools, depending on regulations and mission parameters. Machine learning and algorithmic decision-making capabilities enable field service drones to make mission corrections/alterations autonomously and collect additional data in response to conditions.

Position and Adoption Speed Justification: Drones are being evaluated to serve as the "eyes" of field service organizations that:

- Require firsthand visual data to inspect equipment in remote or dangerous locations (such as pipelines and wind turbines)
- Need to see physical obstructions that are causing problems with function (such as a fallen tree on a power line)
- Service equipment that can only share data via short-range wireless data transfer

The traditional field service approach resulted in:

- Safety risks (for example, when technicians climb high towers in poor weather conditions)
- Expensive-to-use equipment (such as helicopters, cranes or bucket trucks)
- Travel time (to reach an observation point to perform inspections or troubleshooting)
- Multiple technicians on hand (to observe and protect the primary technician)

Organizations also are exploring more nascent opportunities to improve equipment uptime by:

- Analyzing video data or equipment telemetry to proactively identify issues or predict outages
- Transporting replacement parts to places where road conditions are a factor

Some pilot drone project results show significant potential, particularly when it comes to the number of inspections that can be performed and the relative safety of related tasks such as taking pictures. But field service drones will take at least five years to reach plateau. Organizations — especially in inspection-heavy industries such as real estate, government, utilities and insurance

— are still driving vendors to improve battery life, enhance AI-based machine vision capabilities and await aviation, safety and other regulations (such as “beyond visual line of sight”) that define how extensively drones can be used.

User Advice: Application leaders in field service organizations should build awareness about field service drone capabilities among field service department leadership. In addition to their well-known ability to travel into areas only accessible through flight, drones’ other functions also present potential. These include remote control, autonomous or mission-defined flight, communications, thermal or night vision sensors, pattern recognition, durability, cost, weather resistance, and potential integration to other systems such as predictive analytics, geographic information systems and schedule optimization.

Application leaders should work with field service leaders to develop a low-cost proof of concept, starting with job types that are currently performed by technicians or crews where utilizing a drone as part of the toolset could improve safety or efficiency. Identify which of the above features will be needed. Also, determine how regulatory factors, such as altitude, speed and total weight including cargo, impact the opportunity. Search the internet for information about rapidly changing local regulations such as bans, restrictions, special permits or certification requirements for activities such as flying beyond visual line of site (BVLOS), flying over people, at night and in restricted airspace.

Business Impact: As more organizations experiment with field service drones and as they are recognized as another means to reduce human-to-human contact they will be used more and more, especially as other industries use unmanned aerial vehicles (UAVs) more and more. Tests indicate that the cadence with which inspections may be performed could more than double in some use cases. This will depend on the nature of the inspection work, level of autonomy and regulatory impact. As AI-driven capabilities to autonomously capture, analyze and act on sensory data such as machine vision and thermal detection improve, drones will move beyond the “picture taker” role and ROI potential will increase. Parts deliveries could happen much more quickly, especially if poor road conditions are a factor for deliveries today. Other areas, such as lone worker observation, security and internet access, will also provide the benefits of technician satisfaction, safety, customer satisfaction and profitability.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Airobotics; Cyberhawk; DJI; PrecisionHawk

Recommended Reading: “Top 10 Strategic Technology Trends for 2020: Autonomous Things”

“Innovation Insight for Drones in Healthcare and Retail Last-Mile Delivery”

"Mitigate COVID-19's Impacts in Vertical Industries With These Vendor Action Items"

"Prepare for Drone Incursions With a Multilayered Countermeasures' Strategy"

"Market Insight: LTE Drone Services for Public Safety Operations Provides Growth Opportunity for CSPs"

At the Peak

Smart Robots

Analysis By: Annette Jump

Definition: Smart robots are electromechanical form factors that work autonomously in the physical world, learning in short-term intervals from human-supervised training and demonstrations or by their supervised experiences on the job. They sense environmental conditions, recognize and solve problems. Some can interact with humans using voice language, while some have a specialized function, like delivery or warehouse robots. Due to advanced sensory capabilities, smart robots may work alongside humans.

Position and Adoption Speed Justification: Smart robots have had significantly less adoption to date compared with their industrial counterparts (predefined, unchanged task) — but they received great hype in the marketplace, which is why smart robots are positioned climbing the Peak of Inflated Expectations. In the last 12 months, many of the established robot providers expanding their product line and new companies entering the market. Here are few examples:

- Whiz robot from SoftBank Robotics that will be sold under robot-as-a service (RaaS) model and originally be available only in Japan.
- Furhat Robot from a Swedish startup (Furhat Robotics) developing social robots.
- Smart Robotics that has introduced a robot valet for parking cars in France (Lyon).
- Temi robot from temi that will target home assistance for elderly and will incorporate Amazon's Alexa.

The market is becoming more dynamic though the cost of entry and user tech sophistication are still high. Also, the time lag between product announcements and launch dates remain quite long at six to 12 months. Some products are killed before they reach broad availability. Recent market examples of slow adoption and withdrawals are Rethink Robotics, very low rate on renewal contracts for SoftBank Robotics' Pepper three-year contracts and decision of Henn na Hotel, a Japanese hotel, the first hotel chain to replace smart robots with humans. Specialization also is very important to success, as no smart robot can address all industry specific use cases. Despite some advancements in AI, product and material experimentation in 2019 and early 2020, the progress is still slow, as companies are still trying to identify business valuable use cases. Therefore, the position of "smart robots" has not changed versus 2019 and still remains on the

Innovation Trigger curve. Hype and expectations will continue to build around smart robots during the next few years, as providers execute on their plans to expand their offerings and explore new technologies, like reinforcement learning to drive continuous loop of learning for robots.

User Advice: Users in light manufacturing, distribution, retail, hospitality and healthcare facilities should consider smart robots as both substitutes and complements to their human workforce. Begin pilots designed to assess product capability, and quantify benefits. Examine current business- and material-handling processes into which smart robots can be deployed; also, consider redesigning processes to take advantage of the benefits of smart robots with three- to five-year roadmaps for large-scale deployment. Smart robots could also be a quality control (QC) check at the end of the process, rejecting product with faults and collecting data for analysis.

Business Impact: Smart robots will make their initial business impact across a wide spectrum of asset-centric, product-centric and service-centric industries. Their ability to do physical work, with greater reliability, lower costs, increased safety and higher productivity, is common across these industries. The ability for organizations to assist, replace or redeploy their human workers in more value-adding activities creates potentially high — and occasionally transformational — business benefits. Typical and potential use cases include:

- Logistics and warehousing: Product picking and packing, e-commerce order fulfillment, locating and moving goods
- Medical/Healthcare: Patient care, medical materials handling, prescription filling
- Customer care
- Goods delivery due to social distancing and quarantine with COVID-19
- Manufacturing: Product assembly, stock replenishment, support of remote operations
- Delivery of packages and food
- Reception/Concierge in hospitality, retail, hospitals, airports, etc.
- Other: Disposal of hazardous wastes

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Aethon; Amazon Robotics; Google; iRobot; Panasonic; Rethink Robotics; Savioke; SoftBank Robotics; Symbotic; temi

Recommended Reading: “Top 10 Strategic Technology Trends for 2020: Autonomous Things”

“Forecast: IoT Enterprise Robots by Use Case, Worldwide, 2018-2028”

“Preparing for a Future When Your Next Manufacturing Employee Will Be a Robot”

“Top 10 AI and Sensing Technology Capabilities for Personal Assistant Robots in 2020”

Customer Journey Analytics

Analysis By: Jason Daigler; Lizzy Foo Kune

Definition: Customer journey analytics (CJA) is the process to track and analyze the way customers and prospects use a combination of available channels to interact with an organization over time. It covers all channels the customer has used, including those with human interaction (such as a call center), those that are fully automated (a website), those that provide assisted help to the customer (live chat and co-browsing), those that are operated in physical locations (a retail store) and those with a limited two-way interaction (advertising).

Position and Adoption Speed Justification: Customer journey analytics is a strategic priority for a variety of internal roles in several different industries, as application leaders and marketing leaders strive to gain a better understanding of customer acquisition, retention, satisfaction, advocacy and loyalty. In many cases, CJA initiatives begin as projects to create customer journey maps, which are snapshots of customer experiences for a given process. Often, organizations begin by manually mapping their perception of the customer journey without using data and analytics to track and measure journeys. For journey maps to become both more accurate and dynamic, organizations will ultimately need to power the journey maps with actual data. Without a clear strategy for capturing and linking the right data in each channel, organizations will lack a true understanding of the customer journey, beyond interactions wherein the customer is forced to reveal their identity.

CJA is accelerating in adoption as more applications begin to add elements of journey analysis into existing tools, such as customer data platforms, personalization engines, customer analytics applications, and multichannel marketing hubs.

User Advice: Customers hop from channel to channel over time, and as such organizations should not assume that continual investment in understanding customer behavior within a single channel will deliver more valuable insights than understanding the combination of channels they use. Similarly, organizations should be wary of key performance indicators (KPIs) that fail to consider the implications of customer activities in other channels, such as single-channel conversion rates. Starting with customer identification and journey mapping across only two to three channels, where data is both available and valuable, is an excellent way to start with CJA. The selected journey should also be one that is valuable to both the organization and the customer. Similarly, starting by manually mapping the internal perception of customer journeys is a reasonable starting point, as long as organizations intend to eventually validate the mapped journey with data and analytics. Organizations should also consider how they can orchestrate and automate journeys

based on the insight gained from CJA; this will necessitate integrating CJA solutions, and specifically their outputs, into other internal systems.

As stated above, journey analysis functionality is becoming more frequently embedded into other systems, so organizations should evaluate their existing technology stack to see if they're already paying for an application with journey analysis capabilities.

Business Impact: Organizations can obtain the following benefits from CJA:

- Higher customer satisfaction from more seamless and personalized interactions across channels.
- Better understanding of the benefits that each interaction delivers to the overall journey, resulting in better allocation of investment to supporting the overall relationship.
- Improved understanding of the interrelationships between different parts of the journey, allowing organizations to, for example, evaluate the expectations that are set in the beginning of a journey with the outcomes toward the end of a journey.
- The ability to diagnose pain points in the customer journey across channels to aid business prioritization of CX projects.
- More accurate customer segments, based on data from multiple channels as well as real-time data and predictive modeling, thereby increasing the effectiveness of marketing campaigns.
- More successful personalization tactics — whether on commerce sites, communication channels or elsewhere in the customer experience — based on data that gives a more complete view of the customer's activity in multiple channels instead of a single channel.
- More relevant and efficient customer service for customer-facing agents who have a more complete view of the customer's activities and difficulties, based on data from multiple channels.
- More effective marketing, allowing media channels to be an extension of customer communications.
- Improved customer experience and reduced customer churn through real-time next best actions orchestrated by insight gleaned from customer activity.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Adobe; BryterCX; Cerebri AI; Kitewheel; Salesforce; Splunk; Teradata; Thunderhead; Usermind; [24]7.ai

Recommended Reading: "How to Run a Do-It-Yourself Customer Journey Mapping Workshop"

"Market Guide for Customer Journey Analytics"

"Technology Insight for Marketing Analytics"

Smart Contracts

Analysis By: Martin Reynolds; Avivah Litan; Adrian Leow

Definition: A smart contract is a type of blockchain record that contains externally written code, and controls blockchain-based digital assets. When triggered by a specified blockchain write event, a smart contract immutably executes its code and may result in another blockchain event.

Smart contracts are neither smart nor contracts, and can only read from, and write to, the blockchain. All off-chain interactions with smart contracts must be handled by agents that map between off-chain assets and on-chain digital assets.

Position and Adoption Speed Justification: Smart contracts are well-developed for on-chain actions. For example, many cryptocurrencies are funded using an Ethereum smart contract style defined as ERC-20. These cryptocurrencies have not been hacked, despite the considerable financial gains to be made.

However, coupling a smart contract to business actions remains a challenge. This coupling works through external agents (for example, blockchain oracles) that write blockchain records to trigger a smart contract, and then read a blockchain record written by the smart contract to execute a business action.

Creating these external agents is just as challenging as creating a blockchain. This challenge arises because a corrupted agent could pervert an input to the smart contact by writing a modified record, or ignore an output record from a smart contract. Therefore, these external agents need redundancy and trust mechanisms that complement the blockchain system.

Blockchain's consensus mechanism is currently the only mechanism that supports functional smart contracts.

User Advice: Smart contracts can automate business transactions, executing transactions under mutually agreed terms embodied in the code. This approach eliminates human delays and costs, and potentially allows companies to execute far more transactions. This increased capacity comes at minimal incremental cost, thereby increasing efficiency, reducing operating costs, and opening new business models. Smart contracts, for example, can allow competitors to collaborate over shared resources without compromising their independence.

Application leaders looking at developing a strategy to deploy smart contracts should:

- Ensure that smart contract implementations are properly covered by legal agreements, such that unexpected or undesirable results are reversible outside of the blockchain.
- Identify use cases that can derive significant benefit from the contract automation processes promised by smart contracts and associated oracles. Such use cases will deliver some combination of, for example, accelerated business processes; reduced transaction costs; asset sharing with competitors; or new business models.
- Research the emerging platforms, technology, tools and frameworks to determine the level of resources needed for smart contract development.
- Identify integration points with existing processes to determine their impact on core industry and ecosystem value propositions. Assess the implications for your information management architecture, legal compliance policies, payment systems, customer service and other core business processes.
- Develop policies and processes to create reliable smart contract code and ensure that you have the tools to monitor its correct execution.

Business Impact: Smart contracts will develop in different forms and with differing levels of impact. Many will simply replace existing transactional tracking mechanisms and execution systems such as used in blockchain-based supply chain management use cases. As such, smart contracts will be impactful. However, only when truly secure and proven smart contracts and related off-chain interaction systems develop will smart contracts have the potential to transform commercial relationships through granular obligation recognition and secure value transference.

The future vision of smart contracts includes a potential replacement for simple or complex legal documents and transactions, and integration with AI systems. However, there are many obstacles to be overcome, such as organizational readiness, integration with systems of record, unanticipated “follow on” smart contracts, perceived lack of enforceability, potential evidentiary gaps, regulatory compliance, which may take many years to resolve.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: Augur; Ethereum Foundation; Gnosis; Hyperledger; Monax; Provable Technologies; R3

Recommended Reading: “Managing the Risks of Enterprise Blockchain Smart Contracts”

"Predicts 2020: Blockchain Technology"

"Guidance for Blockchain Solution Adoption"

Energy-Water Nexus

Analysis By: Bettina Tratz-Ryan

Definition: Energy production and water use are closely interdependent. The energy-water nexus is a term for the complex interplay of cause and effect between water and energy supply and consumption in smart cities, industries and homes.

Position and Adoption Speed Justification: According to the UN-Water directive, by 2020, half the world's population will be living in countries with water supply shortages. Factors that contribute to the shortage include:

- Water is critical to energy supply, such as hydrothermal as well as nuclear power plants.
- 70% of freshwater available globally is used for agricultural purposes, 22% for industrial use and 8% for residential consumption.
- The biggest loss of water is in transport and distribution.
- Although there are new technologies on desalination (removing the saline from saltwater to turn it into freshwater), the process consumes high amounts of energy (approximately 15 kWh to 17.1 kWh per 1,000 gallons of water produced).
- Water is integral for shale gas production.

While sustainable management of water and energy seem battling the risk for many organizations, the lack of true water pricing relative to the cost of delivery distorts the value perception at large. Analytics and data generation through Internet of Things (IoT) opens the insights into which processes in generation and use of water and energy can be optimized for sustainable societal development. Regions and countries with increasing cases of droughts and the shifts in water allocation are challenged in their economic and industrial performances, especially with those highly dependent on oil and natural gas. The uncontrollable increase of population and rapid industrialization in developing countries are also major contributors.

User Advice: CIOs in different water-intensive industries need to build the capital expenditure (capex) of water management tools, the critical factor of price volatility of energy, and the cost related to channel and supply water into their IT procurement models. CIOs must work with city leaders to make the gap between holistic investments versus price of water delivery visible

IT leaders in the industry need to track volatility in real time by analyzing data through smart city, water- and energy-management platforms and boards. End users need to look to involve new

energy sourcing that includes waste to energy, circular economy to generate energy and broader energy-generation models in microgrids and distributed grids.

CIOs in emerging economies should apply or evaluate technology solutions such as sensors, IoT and analytics together with modeling and simulation for energy use. They should also network with solutions that create water sustainability and quality of water harvesting and management as they are key concerns for developed markets as well. CIOs should also explore using sensors to prevent water leakages in pipelines and storage tanks.

Business Impact: Business is greatly affected by the availability and cost of energy and water as well as by the competing sources for other industries such as agriculture and food production in addition to water supply to cities. Cost of operations to produce water as well as energy based on competitive uses presents significant issues, and the potential stigma of using water for industrial uses instead of civic uses could prove a reputational risk. Transparency and public relations have to be shown to disperse the concerns for depletion or risk relative to operations. For example, the fracking industry in the southern U.S. is using water from urban centers to bring it to the fracking locations, causing discussions about droughts and water availability in the community. In different industries, the energy-water nexus has caused businesses to change their business processes. The textile industry is dyeing without water, saving the water and, in addition, also energy as the textiles do not need to be dried.

For organizations operating in countries in which the water prices are subsidized, the exploitation of water should be positioned more about responsible use versus scarcity that may lead to economic penalty.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: ABB; Accenture; Adasa; Black & Veatch; Deloitte; Fujitsu; GE Energy Connections; Hitachi

Recommended Reading: "Digitopia 2035 Scenario: A Sustainable Society — How to Increase Your Digital Ambition"

"How CSCOs Should Lead a Response to the Water Scarcity Challenge"

"Video: Kimberly-Clark's Water Strategy — Risk Management to Value Creation"

Smart Workspace

Analysis By: Gavin Tay; Annette Jump; Rashmi Choudhary

Definition: A smart workspace exploits the growing digitalization of physical objects brought about by the Internet of Things (IoT) to deliver new ways of working, scheduling resources, coordinating facility services, sharing information and collaborating. The programmability of physical environments enables smart workspaces to work contextually with mobile devices, software applications, enterprise social graphs and artificial intelligence (AI) to improve workforce efficiency and effectiveness. Any location where people work can be a smart workspace.

Position and Adoption Speed Justification: Digital workplace strategies that focus on facilities modernization, more agile work environments and the value of employee experience continue to shape interest in smart workspace technologies. We see synergies between 10 trends:

1. The IoT
2. AI-related technologies
3. Digital signage and electronic whiteboards
4. Indoor mapping
5. Smart buildings, including trends in integrated workplace management systems (IWMS)
6. IWMS platforms (as they move into IoT-based services)
7. Remote working/collaboration and virtual workspaces
8. Motion sensors
9. Wearables
0. Facial recognition

A smart workspace is a key aspect of a digital workplace initiative, as it includes strategists involved in facilities and real estate as key stakeholders. It applies to physical environments such as:

- Building and campus environments, including in-building open spaces
- Co-working spaces
- Office and desk spaces
- Conference rooms
- Huddle rooms (small spaces where people congregate)
- Retail and shop floors
- Manufacturing assembly lines

- Home spaces (workspace resulting from instituted remote work given COVID-19)

“Things” participate in a smart workspace. Examples include applications and devices such as electronic whiteboards, building interfaces (HVAC), large digital displays, smart badges, workstations, mobile devices and wearables.

As workers return to work post COVID, we’ll expect organizations to take full advantage of a smart workspace. It will require organizations to revisit design strategies to include methods for gaining a better understanding of how people participate in physical spaces or adhere to social distancing. Such insight can create new capabilities related to seating and room allocation, access management and wayfaring.

Adoption rates will vary based on organizations’ requirements to support flexible work models that optimize the physical and interactive aspects of places and things (as well as employees’ privacy concerns).

User Advice: Enterprise strategists focusing on a digital workplace strategy and digitalized business processes should follow smart workspace trends and look for deployment opportunities, such as meeting rooms, huddle rooms and in-building open spaces. Emerging applications will expand beyond traditional productivity scenarios to include situations that are more industry- and process-specific. Examples derived from COVID-19 include: an insurance professional using a remove digital pen that interacts directly with back-end processing systems; or a patient being remotely monitored via a wearable interface in their home that interfaces with diagnostic systems and advises healthcare professionals to improve care delivery. IT organizations will need to work much more closely with real estate and facilities teams, and vice versa. Identity, access management, privacy and security teams will also play a critical role. Anonymizing data is key to safeguard privacy expectations and help promote adoption of new services.

Additionally, electronic whiteboards are becoming integrated with traditional collaboration and content software systems, providing more opportunities for experimentation. Meeting artifacts can be better captured and connected to digital workplace graphs, to become more widely searchable. Beacons and sensors placed in key locations within a workplace can interact with mobile apps to deliver personalized information to workers, based on proximity. These can be used to improve employee learning, provide relevant information on products, or communicate safety procedures based on employee location. As workers return to work post COVID 19, contactless authentication using facial recognition and QR code scanning will become the norm.

The smart workspace will emerge at an uneven pace as organizations prioritize potential solutions independently of one another. For instance, building upgrades may take longer than expected, and some market sectors will be laggards in terms of smart workspace adoption. Localization needs will also influence smart workspace adoption.

Business Impact: Instituted remote working resulting from COVID-19 has diversified smart workspaces even further. They now span home spaces, to improved employee productivity and cultural perception of the workplace by workers, to improved customer experience as employees make better use of smart workspaces to serve clients. The results of these changes will often be a reduction in cost because office utilization data will guide decisions about what types of workspace are most conducive to employee effectiveness.

The digitalization and programmatic evolution of places and things will impact IT methodologies related to system design, requiring new skills for design teams to understand how people use places and things. Smart workspaces will also have organizational impacts as traditional software teams now need to work with facilities management teams in ways not previously envisioned. The digitalization and programmability of the workplace will create new integration opportunities. For instance, smart workspace activities will signal information to digital workplace graphs and smart machines, and vice versa.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: AgilQuest; Condeco; Estimote; Eutech Cybernetic; Microsoft; Oblong; Planon; PRYSM Group; Spacewell; Trimble

Recommended Reading: "Top 10 Strategic Technology Trends for 2019: Smart Spaces"

"Crafting Workspaces That Enhance the Employee Experience"

"Market Guide for Integrated Workplace Management Systems"

"Market Guide for Resource Scheduling Applications for the Workplace"

"Emerging Technology Analysis: Building Successful Solutions for Smart Spaces"

"Market Insight: Choose the Right Technology to Dynamically Track People Within a Smart Space"

5G

Analysis By: Sylvain Fabre

Definition: 5G is the next-generation cellular standard by the 3rd Generation Partnership Project (3GPP). The standard targets maximum downlink and uplink throughputs of 20 Gbps and 10 Gbps respectively, latency below 5 milliseconds and massive scalability. New system architecture includes core slicing as well as wireless edge.

Position and Adoption Speed Justification: Seventy-three operators have announced 5G rollouts (Source: Global mobile Suppliers Association [GSA], April 2020), just under 9% (up from 5% one

year ago) of mobile networks.

3GPP Release 16 freeze date has been postponed due to the COVID-19 pandemic, with a freeze target date of mid-2020.

5G encompasses a range of 3GPP standards focused on different functionality:

- R15: Extreme broadband (5G NSA and then 5G SA)
- R16: Augmentations for Industrial IoT (massive IoT, slicing and security improvements)
- R17: Augmentations for wider ecosystem expansion (freeze target date end of 2021)
- R18: Additional augmentations (e.g., extra territorial 5G systems, railway smart station services)

Due to this phased introduction, and the time required from the vendors' ecosystem to build standard compliant networks and grow silicon and device availability, Gartner expects the full potential for 5G use cases to materialize first in 2022.

Use of higher frequencies and massive capacity, will require very dense deployments with higher frequency reuse. Here we see regional differences, whereby mmWave will be leveraged in the U.S. and South Korea, but may not see initial adoption elsewhere.

Gartner expects many 5G deployments to initially focus on islands of deployment, without continuous national coverage.

Less than 45% of CSPs globally will have launched a commercial 5G network by 2025. Uncertainty about the nature of the use cases and business models that may drive 5G is currently a source of uncertainty for many CSPs, enterprises, and technology and service providers (TSPs). Gartner estimates that 5G capable handset penetration will reach 50% in 2023 in Western Europe, and could be a little faster in North America.

We are seeing different dynamics by regions, where in many parts of Africa for example, 5G would not be the next step to lower bandwidth services, and handset cost may be an inhibitor for lower income subscribers. Adoption is more aggressive in APAC and NAR, with Europe cautiously enthusiastic — and the developing world lagging.

User Advice: TSP product managers should:

- Focus mobile infrastructure planning on LTE, LTE-A, LTE-A Pro, small cells and heterogeneous networks (HetNets), as part of a planned transition toward 5G.
- Ensure backward compatibility to preceding generation (LTE) devices and networks. This is necessary because 5G coverage may be limited, so new 5G devices need to be able to seamlessly transition to 4G fallback infrastructure for uninterrupted service.

- Focus on related architecture initiatives — such as software-defined network (SDN), network function virtualization (NFV), CSP edge computing, distributed cloud architectures and cloud native containerization, as well as end-to-end security in preparation for 5G.
- Provide solutions where new frequency allocations (preferably) should be used for the latest technology — 5G — to benefit from lower cost per byte, higher bandwidth and more capacity.
- Help CSPs refine generic services to vertical-focused solutions (B2B) for 5G.
- Have a clear understanding of specific verticals and their use cases for more effective consultative selling of their 5G solutions.
- Build their ecosystem of partners to target verticals more effectively with 5G.

Enterprise business leaders should:

- Identify use cases that definitely require the high-end performance of 5G; these may be few or even nonexistent for many verticals.
- Evaluate the multiple IoT alternatives available that may prove adequate, more available and more cost-effective than 5G for many use cases (e.g., low-power wide-area [LPWA] such as NarrowBand Internet of Things [NB-IoT], long-range [LoRa], Wireless Smart Ubiquitous Networks [Wi-SUN]).
- Clarify the level of complexity involved in operating a private 5G network.
- Evaluate options for CSPs or other providers to be involved in running the 5G network.

Business Impact: Gartner Enterprise 5G Surveys indicate that vertical use cases with 5G would be first motivated by operational cost savings. Another driver is agility — in particular, in oil and gas and manufacturing.

In addition, the vertical users for 5G appear to value lower latency from ultrareliable and low-latency communications (URLLC) and expect 5G to outperform rivals in this area.

With massive machine-type communications (mMTC), scenarios of very dense deployments can occur, supported by the 5G target of 1 million connected sensors per square kilometer.

5G enables, principally, three technology deployment and business scenarios, which each support distinct new services, and possibly new business models (such as latency as a service):

- Enhanced mobile broadband (eMBB) supports high-definition video.
- mMTC supports large sensor and IoT deployments.

- URLLC covers high availability and very low latency use cases, such as remote vehicle/drone operations.

URLLC and mMTC will be implemented after eMBB. Only eMBB addresses the traditional mobile handset requirement of ever higher throughput. URLLC addresses time critical industrial applications such as automation, with latency around 1ms over a limited range for a limited number of connections — where reliability and latency requirements surpass bandwidth needs. Finally, mMTC addresses the scale requirements of IoT. Apart from some smart city scenarios, mMTC may not be required in most locations for some years, with NB-IoT and other LPWA such as LoRa being sufficient for a while.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Cisco; Ericsson; Huawei; NEC; Nokia; Samsung; ZTE

Recommended Reading: "Market Guide for 5G New Radio Infrastructure"

"Assessing 5G Mobile Technology for Organizations"

"How to Select 5G NSA/SA Migration Paths"

"Forecast: Communications Service Provider Operational Technology, 1Q20 Update"

"Market Trends: Strategies Communications Service Providers Can Use to Address Key 5G Security Challenges"

"Reduce Privacy Risks When Using 5G Products and Services"

Autonomous Mobile Robots

Analysis By: Dwight Klappich

Definition: Autonomous mobile robots (AMRs), formerly called smart automated guided vehicles (AGVs) in previous Gartner Supply Chain Execution Hype Cycles, add intelligence, guidance and sensory awareness to conventional AGVs, allowing them to operate independently and around humans. These new types of AGVs address the historic limitations of traditional AGVs, making them better suited to, and more cost-effective for, complex warehouses and collaborative activities.

Position and Adoption Speed Justification: AMRs will continue to gain traction in complex distribution centers and AMRs will increasingly develop to take over functions historically performed by humans on lift trucks such as product put-away or forward-picking replenishment with little to no human intervention. As computing power has multiplied and the cost of sensors

has declined, the power, flexibility and use cases for AMRs have grown while prices have come down leading to significant AMR market demand growth. However, while customer demand strengthens, resource availability to deploy AMRs is poised to become a barrier to growth. Gartner tracks over 50 AMR vendors that perform various warehouse tasks from simple transport moving goods from point A to B to more complex and sophisticated collaborative picking robots where the AMR supplement human labor. Market penetration is low overall with under 20,000 AMRs deployed commercially today, which when contrasted to the well over a million of lift trucks is a small market so far.

User Advice: Next-generation AMRs have become more autonomous and intelligent. They will transform warehouse operations over the coming decades. Costs and complexities will also come down, which will open up the market to more companies. Labor reductions seem the most likely drivers, but improvements in overall throughput and productivity will be the primary value, regardless of whether labor is reduced or not. Warehouse operations with a high volume of bulk (i.e., palette) product moves should consider some of the current generations of AMRs as an alternative or to supplement existing automation. Companies looking to build new automated facilities also should explore the potential value of these smart machines.

Business Impact: AMRs will continue to gain traction in complex distribution centers. The same technologies will emerge and also have applications outside warehouses as the technology matures. For example, in retail stores there is the potential that an AMR could unload trucks and deliver palettes of goods to specific departments in a store without human intervention. Smart AGVs will increasingly develop to take over functions such as product put-away or forward-picking replenishment with little to no human intervention. AMRs could also have a positive environmental impact as they reduce costs such as lighting, heating and air conditioning, because robots don't need any of that.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: 6 River Systems; Clearpath Robotics; Fetch Robotics; GreyOrange; Locus Technologies; Seegrid; Vecna

Recommended Reading: "Predicts 2020: Supply Chain Technology"

"Cool Vendors in Supply Chain"

"Innovation Insight for Autonomous Mobile Robots"

Cloud Data Backup

Analysis By: Jerry Rozeman; Chandra Mukhyala; Michael Hoeck

Definition: Policy-based, cloud data backup tools back up and restore production data generated natively in the cloud. The data can be generated by SaaS applications (e.g., Microsoft Office 365 or Salesforce) or by infrastructure as a service (IaaS) compute services (e.g., Amazon Elastic Compute Cloud [Amazon EC2] instances). Backup copies can be stored in the same or a different cloud location, or on-premises in the data center, where restore/recovery options should be offered in terms of restore granularity and recovery location.

Position and Adoption Speed Justification: Backup of data generated natively in public cloud is an emerging requirement, because cloud providers focus on infrastructure high availability and disaster recovery, but are not responsible for application or user data loss. Most SaaS applications' natively included data protection capabilities are not true backup, and they lack secure access control and consistent recovery points to recover from internal and external threats.

As Microsoft Office 365 (O365) gains more momentum, O365 backup capabilities have begun to emerge from mainstream backup vendors and small vendors. IaaS data backup, on the other hand, is a more nascent area that caters to organizations' need to back up production data generated in the IaaS cloud. Native backup of IaaS usually resorted to snapshots and scripting, which may lack application consistency, restore options, data mobility, storage efficiency and policy-based automation. However, more data center backup vendors now offer improved cloud storage backup capabilities that automate snapshot management and address some cloud-native limitations.

User Advice: Before migrating critical on-premises applications to SaaS or IaaS, organizations need a thorough understanding of cloud-native backup and recovery capabilities and should compare them to their situations today. If the native capabilities seem to fall short (e.g., in application consistency, security requirements and recovery point objective [RPO]), factor additional backup costs into the total cost of ownership (TCO) calculation before migrating to the cloud. Organizations planning to use cloud-native recovery mechanisms should ensure that their contracts with cloud providers clearly specify the capabilities and costs associated with the following items in terms of native data protection:

- **Backup/restore methods** — This describes how user data backup and restore are done, including any methods to prevent users from purging their own "backup copies" and to speed up recovery after a propagated attack, such as ransomware.
- **Backup/restore performance** — Some users have observed poor recovery time objectives (RTOs) when restoring or recovering data from cloud object storage.
- **Retention period** — This measures how long cloud providers can retain native backups free of charge or with additional cost.
- **Clear expectations in writing, if not service-level agreement (SLA) guarantees, regarding recovery time objectives** — RTO measures how long it takes to restore at different granular levels, such as a file, a mailbox or an entire application.

- **Additional storage cost due to backup** — Insist on concrete guidelines on how much storage IaaS's native snapshots will consume, so that organizations can predict backup storage cost.

For third-party backup tools, focus on ease of cloud deployment, policy automation for easy management, data mobility, storage efficiency and flexible options in terms of backup/recovery granularity and location.

Business Impact: As more production workloads migrate to the cloud (in the form of SaaS or IaaS), it has become critical to protect data generated natively in the cloud. Deploying data protection for cloud-based workloads is an additional investment; however, this is often an afterthought, because it was not part of the business case. Without additional protection of cloud-based data, customers face additional risks, due to the impact of data loss, data corruption or ransomware attacks on their data.

SaaS and IaaS providers typically offer infrastructure resiliency and availability to protect their systems from site failures. However, when data is lost due to their infrastructure failure, the providers are not financially responsible for the value of lost data, and provide only limited credit for the period of downtime. When data is lost to user errors, software corruption or malicious attacks, user organizations are fully responsible themselves. The more critical cloud-generated data is, the more critical it is for users to provide recoverability of such data.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Sample Vendors: Actifio; Cohesity; Commvault; Dell EMC; Druva; Rubrik; Spanning Cloud Apps; Veeam; Veritas Technologies

Recommended Reading: "Adopt Microsoft Office 365 Backup for Damage Control and Fast Recovery After Malicious Attacks"

"Debunking the Myth of Using EFSS for Backup"

Sliding Into the Trough

Smart City Framework — GCC

Analysis By: Bettina Tratz-Ryan

Definition: The smart city framework for the GCC is the ability to apply an urban governance approach to develop a sustainable societal ecosystem affecting citizens' life, stimulate the economy, and protect the environment. The strategy development, as well as its execution, is driven by a group of public sector and citizen stakeholders as well as the commercial developers. Those

stakeholders define and measure the impact of technology through data and analytics to create a user-focused and contextualized experience.

Position and Adoption Speed Justification: Smart cities have been embedded in national and local government strategies in the GCC to create economic diversification and improve the economic, social and environmental infrastructure of GCC countries. With the economic development connected in societal development and citizen comfort, citizen and business success and expectation are expressed and measured in citizen happiness.

Compared with other regions and countries, speed of adoption is accelerating from the development of free zones, new trading centers and new “greenfield” neighborhoods. They are being developed in conjunction with real estate developers, business partners and leisure industry as investors. The region is building technology leadership in blockchain and AI, with departments being established that bring governance on digital ethics and data exchange. Smart city investments are closely linked to national digital government strategies. Between the UAE and Saudi they have developed strategy agencies and government boards to lead the implementation of the respective smart city and district. This creates momentum of economic development in scale.

User Advice: We recommend:

- CIOs and IT leaders need to restructure their performance indicators for infrastructure and data architecture investments in terms of the ability to show KPIs that include citizen impact. Therefore, CIOs and IT leaders in local government and businesses must understand the business impact of smart city strategies, new district development and urban centers as in Saudi. Or a business service that needs to have a citizen satisfaction link for Dubai’s happiness index. This also applies for all investing organizations into the GCC on smart city opportunities
- CIOs in local government and/or participating in business ecosystems need to apply technology solutions and analytics of operational, IoT and user data to create a model of the complex urban environment. That includes the ability to swiftly express the results of actions. This also includes the development and the support of open data portals to encourage application development, creating the platforms to offer innovative experiences.
- CIOs of real estate developers and industrial zones, like Dubai Design District, DMCC or the Red Sea Development Program, need to understand technology solutions that create smart services to drive competitive experiences for users and citizens. That includes smart building and operational management solutions, as well as infrastructures for creating a digital urban environment.

Business Impact: Real-time data created from IoT and social community data will need to be orchestrated to become high-quality data to be able to offer user defined and contextualized services that will create citizen impact and satisfaction, or citizen happiness. Therefore, data

management and governance become a critical tool for a CIO to enable a sustainable pipeline for internal government services, as well as citizen engagement. Linking into local user satisfaction models like the happiness index of Dubai can support the positioning of local business development. The business acceleration through blockchain and financial data sharing is the key for the sustainable interaction between stakeholders in government and industry. Especially with big events like Expo 2020 in Dubai (now in 2021 due to Corona) triggering innovation of those as a showcase.

Enterprises are mandated to report the satisfaction of their customers which is driving the integration of rating and feedback loop in business applications. There will be a reputational and business risk if customers and users cannot provide the feedback in a user-friendly way.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Sample Vendors: Accenture; Cisco; Deloitte; Eutech Cybernetic; Hitachi; IBM; NXN; Orange Business Services; Siemens

Recommended Reading: "Turning Smart Cities Into Intelligent Urban Ecosystems"

Advanced Video/Image Analytics

Analysis By: Nick Ingelbrecht

Definition: Advanced video/image analytics is the application of machine learning methods (including deep neural networks) to automatically identify significant information contained in image and video streams (a series of images or pixels) in the visible and nonvisible light spectrum.

Position and Adoption Speed Justification: Advanced video/image analytics has advanced through the Gartner Hype Cycle, supported by an emerging body of proven use cases and competitive products. Video/image analytics using deep neural networks and advanced data modeling are gaining traction in security, retail, automotive, manufacturing and other specialist vertical markets, but are still overhyped by many vendors. By contrast, traditional video/image analytics using geometric analysis and rule-based systems have already reached early mainstream adoption. Advanced applications range through facial recognition in crowds, OCR and license-plate recognition to autonomous vehicles, and in the retail industry, shelf and shopper analysis. Mainstream adoption remains elusive due to:

- A lack of plug-and-play solutions
- Integration and scaling challenges
- The underestimated sparsity of properly labeled data

- Fragmented markets, diverse buying centers and product evaluation challenges
- Proprietary algorithms and patent pools
- Lack of independent standardization and performance benchmarks
- Price, performance and reliability: high-end systems are expensive to maintain and support, and building business cases with adequate ROI remains challenging.

Adoption is being aided by the fast-growing market for computer vision tooling and services (e.g., data annotation, augmentation and preparation) and increasing customer demand for greater levels of automation and evaluation of video/image data.

Exponential increases in video/image traffic are driving demand for automation. The application of deep neural networks for advanced video/image analytics has raised the bar in terms of nuisance alarm management and new functionality, especially in human behavior recognition and complex classification tasks. Product maturity and improved price/performance will drive mainstream adoption during the 2023 to 2025 time frame, enabled by more embedded edge inferencing in sensors and edge devices, along with packaged applications and self-configuring, integration-ready third-party applications.

User Advice: Data and analytics leaders should work with Gartner to survey the competitive landscape and shortlist competent vendors, especially if there are complex and varied analytics requirements:

- Work with key stakeholders across the organization to prioritize business use cases and define the types of analytics required and levels of performance/accuracy necessary to deliver business value, paying particular attention to the impact on business processes and change management implications.
- Analyze the potential to use advanced video/image analytics to answer both critical issues (such as COVID-19 mitigation measures) as well as broader business questions — for example, leveraging a video surveillance investment to improve health and safety benefits to employees or enhanced customer, citizen or student experiences.
- Hold vendors/integrators accountable for meeting agreed project outcomes rather than the performance of individual system elements.
- Properly estimate the ROI of image analytics solutions not just taking into consideration expensive training but also maintenance costs of image-based machine learning models.
- Pilot video/image analytics solutions prior to production in order to test vendor claims, and stage a “vendor shootout” for large or high-stakes deployments in the real-world deployment environment during different lighting and environmental conditions.

- Adopt an analytics-driven total systems approach that balances the trade-offs between different system elements, and resist internal pressures for piecemeal upgrades and bolt-on investments.
- Use business process mapping (BPM) tools to understand the impact of new analytics to create cost-optimized workflows, especially when deployed in conjunction with command-and-control systems and information security management and decision management suites.
- For customized projects, determine the available data assets, and build an appropriate problem taxonomy that will address your business objectives.

Business Impact: The benefit rating for advanced video/image analytics is transformational, as these technologies will become essential to interpret automatically the world in both visual and nonvisual spectrums (e.g., infrared, laser/lidar and spectral analysis). Anomaly detection, object and behavior recognition, and complex scene understanding are being enabled by advances in image and video analytics. Beyond security, automotive, robotics, retail and commercial, advanced video/image analytics have huge and growing application potential in the healthcare, manufacturing, supply chain/logistics, banking and finance, government and media industries.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: AnotherBrain; binhai.ai; Deepomatic; Herta; iOmniscient; Landing AI; Matroid; Microsoft Azure; Trax; viisights

Recommended Reading: "Emerging Technologies: Top Advanced Computer Vision Use Cases for Retail"

"Venture Capital Growth Insights: Computer Vision"

"Emerging Technology Analysis: Integrate Computer Vision Catalysts for Software Product Innovation"

"Critical Steps to Cash In on the Computer Vision Gold Rush"

"Video Analytics Functionality Spectrum: Competitive Advantage Lies in Basic Performance and Unique Features"

"Innovation Insight for Video/Image Analytics"

"Market Trends: Facial Recognition for Enhanced Physical Security — Differentiating the Good, the Bad and the Ugly"

Public Cloud Computing in GCC

Analysis By: Santhosh Rao

Definition: Public cloud computing is a style of computing in which scalable and elastic, IT-enabled capabilities are provided as a service to external customers, using internet technologies — i.e., public cloud computing uses cloud computing technologies to support customers external to the provider's organization.

Position and Adoption Speed Justification: Public cloud adoption in the Gulf Cooperation Council (GCC) has accelerated in lieu of the COVID-19 pandemic. The presence of global hyperscalers, such as Amazon Web Services (AWS), Microsoft Azure, SAP and Oracle has offered comfort and confidence to enterprises commencing their cloud journey. Furthermore, during the past two years, local IT hosting companies and telecommunication providers have been transforming themselves to deliver cloud services. Early adopters of the public cloud include midsize enterprises, e-commerce startups that are typically "born in the cloud," and large enterprises that are beginning to deploy remote work solutions and business-critical applications on the public cloud to leverage the agility and elasticity that the hyperscalers offer.

User Advice: CIOs and IT leaders in the GCC region should view public cloud computing as an important component of their infrastructure strategy. CIOs must identify an owner who is responsible for orchestrating the organization's enterprisewide cloud strategy and work with functional leads who are responsible for helping scope the various business and technical requirements. They must take a bimodal approach toward cloud adoption by balancing risk and due diligence with rapid acquisition and deployment of cloud services. New initiatives centered around the Internet of Things (IoT), artificial intelligence (AI) and machine learning can leverage the agility and pay-per-use nature of public cloud computing. Decisions on migrating existing applications to the cloud must be based on a thorough analysis of pros and cons of moving these applications to the cloud.

Regulatory requirements on data locality are unclear, and government policy toward cloud computing is not yet formulated in most countries in the GCC. Therefore, CIOs are advised to work with risk and compliance teams to determine the impact of moving applications to the public cloud, particularly when leveraging public cloud data centers hosted outside the region. For scenarios in which enterprises lack in-house skills to move and manage applications in the cloud, we recommend that they leverage the services of managed service providers that can take responsibility for migrating and managing applications in the public cloud.

Business Impact: Public cloud services generate economies of scale and sharing of resources that can increase agility and choices of technologies. For enterprises, the cloud has the potential to become the foundation that enables businesses to transform, differentiate and gain a competitive advantage. Cloud computing can accelerate time to market and help organizations build capabilities rapidly on initiatives such as data and analytics, the IoT and AI.

Such projects often have uncertain business outcomes and require a fail-fast approach. Attributes such as agility, elasticity and pay per use make cloud computing a compelling solution for such

Mode 2 projects. Enterprises can also leverage the elastic nature of the cloud for application-bursting scenarios in which the computing capabilities of public cloud are leveraged as an extension to on-premises resources when required. Infrastructure services such as disaster recovery and backup/archive are also potential use cases for which the cloud can be beneficial.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Emerging

Sample Vendors: Amazon Web Services; BIOS Middle East; du; eHosting DataFort (MIDIS GROUP); Etisalat; Microsoft Azure; Mobily; Moro Hub; Oman Data Park; STC Group

Recommended Reading: "2019 CIO Agenda: A GCC Perspective"

IT Service Catalog

Analysis By: Siddharth Shetty

Definition: IT service catalogs support fulfillment of requests from business users by simplifying how IT communicates the details of IT service offerings and enabling easy submission of requests. This catalog should provide clear information on pricing, service-level commitments, escalation/exception-handling procedures and instructions for how to request IT services. Most IT service management (ITSM) tools also provide a process workflow engine to automate, manage and track service request fulfillment.

Position and Adoption Speed Justification: IT service catalogs gained impetus with the ITIL v3 update more than a decade ago (in 2007); however, analysis of IT Score for Infrastructure and Operations (ITSIO) reveals limited adoption. Core service catalog request functions are usually found in ITSM tool implementations or even excel sheets where formal ITSM tools do not exist. Stand-alone IT service catalog tools do not have as much influence in the market as they used to do in the past. There is greater interest in IT service catalogs over the past year, which is reflected in the progress along the Hype Cycle, as expectations about service catalogs have become more realistic. Some clients still confuse simple service request fulfillment with a more robust service catalog.

User Advice: Some service catalogs end up as documentation projects that are never read by anyone outside the authoring team, because the catalog ends up in an internal document repository. The most useful and effective service catalog designs are focused on specific customer segments or business user profiles, using terms and concepts that directly relate to the users' wants and needs, in language they are comfortable with, not "IT speak." Before developing an IT service catalog, I&O organizations should develop an IT service portfolio, and should internalize the distinctions among services, processes, products and platforms. For each service catalog entry, define the service delivery process workflow steps and milestones for tracking success. This

connection to the back-office service fulfillment processes supports automation and improves IT efficiency. I&O organizations with a lower I&O maturity (an ITSIO score of 2 or lower) should focus on service request fulfillment for now, and be prepared to revisit the service catalog at a later stage. Otherwise, they are likely to produce an asset database that is focused on technical components and IT capabilities that may not really represent IT services. IT service catalogs are expected to evolve in line with changing business expectations. Hence, most IT service catalog projects fail because they are deemed as a one-time exercise and become obsolete over time because of nonmaintenance. Accountability for maintaining the IT service catalog, via an IT service catalog manager, is crucial to ensure it delivers value over an extended period of time.

Business Impact: Service catalogs simplify the service request process for customers and link to automated service delivery processes for improved IT efficiency. Presenting a single "face" of IT to the customer for all kinds of IT interactions (e.g., incident logging, change requests, service requests, project requests and new portfolio requests) simplifies the customer experience and improves satisfaction. Understanding the costs associated with delivery, communicating the price for requested services, and making connections to key customer results obtained through service usage help IT organizations demonstrate value provided to their organizations. The use of standard services also helps ensure delivery consistency, manage customer expectations, control output quality and reduce the volume of exceptions or ad hoc requests.

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Recommended Reading: "So You've Been Asked to Create an IT Service Portfolio and IT Service Catalog"

"Magic Quadrant for IT Service Management Tools"

"2019 Strategic Roadmap for IT Service Management"

"Critical Capabilities for IT Service Management Tools"

Digital Business Consulting Services

Analysis By: Chrissy Healey; Brendan Williams

Definition: Digital business consulting services (DBCS) are consulting services with the objective of generating increased business value by using digital technologies to optimize clients' operating models and/or transform business models. These services include digital strategy and design, digital operations improvement, digital employee experience, digital customer experience, digital product and service innovation, and digital business model transformation.

Position and Adoption Speed Justification: Eighty-two percent of those surveyed in Gartner's 2020 Gartner CEO and Senior Business Executive Survey indicated plans to increase investment in digital capabilities. Relatively few organizations have embarked upon comprehensive, top-to-bottom digital transformation. Focused projects are common, usually digital customer experience and digital strategy initiatives. Many organizations continue to struggle with execution of digital strategies, most often due to internal hurdles like talent, culture, and technical debt and external hurdles like regulatory and political uncertainty. Yet, pressures from board leaders, investors, competitors, vendors, and clients are a catalyst for businesses to transform. Even in an economic downturn, 52% of organizations said they would increase speed of digital business initiatives. While demand has slowed in some areas, these organizations are seeking help from digital business consultancies to scale their digital initiatives across lines of businesses and geographies and to extend activities across more of their business processes (each of which is reflected by the six key DBCS service lines).

User Advice: Organizations must factor digital into corporate strategy to meet business priorities to identify and capture cost efficiencies, alongside profitable growth. Across all industries and countries, these organizations seek to take advantage of the opportunities and mitigate the risks presented by the shift to digital business. Yet, those stating digital business investments have been better or exceeded expectations over the last three to five years were just 20% in Gartner's 2020 CEO and Senior Business Executive Survey. Forty-eight percent indicated results have been in-line with expectations. As organizations seek to transform to meet the challenges of the current economic environment, they are adjusting their business models. Fifty-nine percent of those surveyed indicated they are planning significant changes to their business models in one or more areas. Consulting providers have responded to this rising demand with increasingly sophisticated offerings aimed at helping these organizations achieve their digital business ambitions, while managing the change required.

Digital technologies such as predictive analytics, artificial intelligence, cloud service portfolios, and the IoT have incredible potential, but are not magic solutions. Many organizations are finding that implementing these technologies is harder in practice than they were led to believe. The hype surrounding the transformative technologies underpinning DBCS has served to obscure the reality. Organizations who are considering using DBCS should:

- Involve in the buying team visionary leaders of the business functions that will be impacted by changes envisioned in the DBCS project, to ensure successful buy-in post project.
- Demand that their providers also bring fundamental business consulting capabilities, such as business process improvement, organizational design, and above all, cultural change, alongside driving current and future technology vision.
- Select a provider that includes in its solution an approach for building skills which will enable and drive transformative change when the provider finishes the project.

- Seek providers that are investing in intellectual property and assets that can accelerate and bring a data-centric approach to DBCS opportunities.

Business Impact: In 2020, primarily those who are seeking DBCS are large enterprises and government agencies. Small and midsize organizations remain a challenge for many providers to broadly reach in terms of scaling sales effort and pricing accordingly.

Thus, current market penetration is primarily from:

- New business with large enterprise and government entities, first-time buyers of DBCS.
- New business in the same area with existing buyers (e.g., scaling up a digital CX pilot).
- New business in a new area with existing buyers (e.g., previously digital CX, but now have initiatives in other areas of business).

As enterprise organizations and government entities continue to see success, the full market for DBCS, which includes small and medium enterprise organizations and government entities, will further open. Additionally, the rise in the use of assets, digital platforms, and automation is starting to increase the ability of DBCS providers to serve the small and medium enterprise markets.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Accenture; Boston Consulting Group; Capgemini; Cognizant; Deloitte; EY; KPMG; McKinsey & Co.; PwC; Tata Consultancy Services

Recommended Reading: "Forecast Analysis: Digital Business Consulting Services, Worldwide"

"In an Economic Slowdown, Consulting Product Managers Should Target CEOs With Prior Digital Business Success"

"Market Share Analysis: Consulting Services, Worldwide, 2019"

Chatbots

Analysis By: Magnus Revang

Definition: A chatbot is a domain-specific conversational interface that uses an app, messaging platform, social network or chat solution for its conversations. Chatbots range in sophistication from simple, decision-tree-based, to implementations built on feature-rich platforms. They are always narrow in scope. A chatbot can be text- or voice-based, or a combination of both.

Position and Adoption Speed Justification: Chatbots represent the No. 1 use of artificial intelligence (AI) in enterprises. Primary use cases are in customer service, human resources, IT help desk, self-service, scheduling, enterprise software front ends, employee productivity and advisory. There are also a variety of offerings in the market, such as developer self-service platforms, managed products, middleware offerings, integrated offerings and best-of-breed approaches.

Chatbots in social media, service desk, HR or commerce, as enterprise software front ends and for self-service, are all growing rapidly. Still, the vast majority of chatbots are simple, relying on scripted responses in a decision tree and relatively few intents. Similar to chatbots are virtual agents, which are broader in scope and sophistication, require more infrastructure and staffing to maintain, and are designed for an extended relationship with their users outside of single interactions. Users will interact with hundreds of chatbots, but few virtual agents.

The majority of implemented chatbots are unsophisticated and rule-based — failing to live up to expectations of stakeholders. The number of proofs of concept (POCs) is high, as is the failure rate to bring even unsophisticated chatbots into production. Gartner is seeing a backlash against chatbots, primarily focused on unsophisticated implementations.

User Advice:

- Start POCs for chatbots today, because most enterprises experience trouble scaling from the initial POC to production. The focus should be on uncovering the hindrances that will stand in your way.
- Treat vendors as tactical, not strategic — acknowledge that you'll most likely want to switch vendors in the future.
- Focus on vendors offering platforms that can support multiple chatbots.

Business Impact: Chatbots are the face of artificial intelligence and will impact all areas where there is communication between humans today. Customer service is a huge area where chatbots are already influential. Indeed, this will have a great impact on the number of service agents employed by an enterprise and how customer service itself is conducted. For chatbots as application interfaces, the change from "the user learns the interface" to "the chatbot is learning what the user wants" has significant implications for onboarding, training, productivity and efficiency inside the workplace. To summarize, chatbots will have a transformational impact on how we interact with technology.

Chatbots have played a strategic role in several companies' response to COVID-19. This might have an acceleration effect on the technology.

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Adolescent

Sample Vendors: Amazon; Cognigy; Google; IBM; Microsoft; NTT DOCOMO; Oracle; Rasa; Rulai

Recommended Reading: "Architecture of Conversational Platforms"

"Market Guide for Conversational Platforms"

"Market Guide for Virtual Customer Assistants"

Desktop as a Service

Analysis By: Nathan Hill; Michael Silver

Definition: Desktop as a service (DaaS) is a service offering that provides users with an on-demand, virtualized desktop experience delivered from a remotely hosted location. It includes provisioning, patching and maintenance of the management plane and resources to host workloads.

Position and Adoption Speed Justification: Organizations have long been interested in adopting virtual desktop infrastructure (VDI), but complexity and capital investment have made VDI implementations difficult. Relying on a service provider to take on the risk of platform build-out and to provide high-volume computing services is an attractive alternative for organizations that want to deliver applications on a device-neutral basis.

DaaS vendors originate from a software, cloud or hosting backgrounds. Some own the complete platform (such as Amazon WorkSpaces and Microsoft Windows Virtual Desktop), while others leverage hyperscale platforms, especially from Amazon and Microsoft, to bring a service-brokered offering to market.

The adoption of cloud office and SaaS increases the viability of a DaaS solution as an organization's data and services become increasingly externalized, especially when supporting highly geographically dispersed workers. This, coupled with the entry of Microsoft into the market, has injected a significant amount of hype back into DaaS. Microsoft isn't the only DaaS choice, but it heavily influences digital workplace I&O leaders' thinking, due to Microsoft's control points in the ecosystem. DaaS is moving toward the Trough of Disillusionment partly because of greater understanding of its long-term cost implications, but also as knowledge of all strengths and weaknesses become more widely understood.

COVID-19 has highlighted the value and business continuity strength of DaaS in its ability to rapidly enable remote work where on-premises options have stalled due to issues with data center access and infrastructure supply chains. COVID-19 is likely to accelerate adoption of DaaS, and may perpetuate as a delivery architecture even when employees return to the office.

User Advice: Enterprises should consider DaaS for use cases related to transient access requirements, business continuity needs or accelerating business goals. The typically high total

cost of ownership (TCO) makes it hard to justify DaaS, but COVID-19 has highlighted it as a very strong solution for remote working and work-from-home scenarios. Organizations should not hesitate to conduct a proof of concept (POC) to gain a better understanding of how this service can benefit their organization.

Use DaaS for:

- Short-term employees, such as seasonal workers, where user volumes spike, or for workspace provisioning to third parties and contractors. The per-user/per-month common billing approach makes this ideal to avoid asset-loss risk and to reduce the provisioning lead time associated with notebooks.
- Merger and acquisition (M&A). As with short-term employees, VDI can help with M&As, but the lead time for infrastructure procurement and underutilized capacity may make DaaS a better fit to accelerate the M&A process, even if only temporarily.
- Remote workers. DaaS can extend the workspace to remote users, especially with hyperscale solutions that have deep global penetration, and may be preferable to expanding an existing data center or colocation footprint.
- Business continuity. DaaS can be used as a workspace recovery solution and has proven a successful solution during COVID-19, enabling organizations to securely extend work from home.

Graphics-enabled DaaS extends the service to designer use cases. However, the cost differential compared with on-premises VDI and the performance sensitivity can be even greater here. Organizations must test functionality and performance thoroughly. Look to combine DaaS with other services provided from the same cloud provider to improve network connectivity to the cloud (such as SLA-backed, dedicated links) to optimize performance.

For smaller organizations that are aggressively migrating to cloud services and have fewer legacy integration challenges, the adoption of DaaS as a complete workforce solution is likely to be more viable. Typically, these organizations do not want to invest capital expenditure (capex) in data center infrastructures and operating expenditure (opex) in associated administration staff, if this distracts them from their core business goals.

Business Impact: DaaS has suffered from the challenges associated with the technologies that power it, namely server-based computing (SBC) and VDI. Cost, complexity and connectivity have all been inhibitors. However, with more organizations looking to deliver user-centric services across different devices and locations with an ever-increasing consumption of cloud services (SaaS, storage and productivity tools), DaaS is considered a strategic solution. The benefits of the “pay-per-use” utility of the DaaS opex model have gained mind share, as has the entry of Microsoft into the market. However, the service needs to be able to deliver a complete workspace solution for it to

be viable as a primary business platform. Growth in adoption through the COVID-19 pandemic is helping to accelerate maturity in the service, but hype still remains.

Many DaaS vendors are expanding their service portfolio beyond simple OS hosting to deliver a complete workspace management life cycle solution. However, organizations that are totally reliant on browser-agnostic web applications will question the need for a Windows OS-based workspace intermediary.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Amazon; Citrix; Diso; Dizzion; Evolve IP; Microsoft; Nutanix; Tehama; VMware; Workspot

Recommended Reading: "Market Guide for Desktop as a Service"

"Forecast Analysis: Desktop as a Service, Worldwide"

"Microsoft's WVD Will Accelerate Virtual Desktop Maturity but May Not Lower Total Cost of Ownership Enough"

"Physical, Virtual and Cloud Desktops: Is a Hybrid Approach Inevitable?"

"How to Keep End Users Connected to the Digital Workplace During Disruptions"

AI in Retail

Analysis By: Robert Hetu; Kelsie Marian

Definition: AI in retail includes a combination of advanced technologies in varying degrees of hype. In current popular cases, AI refers to systems that change behaviors without being explicitly programmed based on data collected, usage analysis and other observations. These systems learn to identify and classify input patterns, probabilistically predict and operate unsupervised. AI in retail is a key enabling technology for algorithmic retailing.

Position and Adoption Speed Justification: AI is surging in retail, and use cases span the entire business value chain. With the ongoing acceleration of retail digital transformation driven by many factors including COVID-19, AI will be required to facilitate the required coordination. Common business use cases for AI in retail include fraud and anomaly detection, marketing, demand forecasting, multichannel order execution, smart check-out and robotic operational assistance. Technologies commonly found in retail AI include computer vision (CV), natural language processing (NLP), machine learning (ML), deep learning (DL), and deep neural networks (DNNs). For most retailers, the likely first use of AI will be its leverage through AI-enabled applications, as many modern applications have now incorporated AI as part of business process and execution

support. As AI becomes more enmeshed in the daily operations of the organizations, it will have real impacts on associates and customers and therefore must be strategically driven. As AI continues to move relatively quickly into the trough, expect it to remain there for several years, keeping it on the five to 10 years' time to productivity.

User Advice: Hype and exuberance have fueled explosive interest in AI. It is the single most important technology for retailers to win in the next decade. For success, CIOs need a way to make strategic business sense of the wide and growing range of AI applications that are available, as well as ones the enterprise can build itself. During the current pandemic, retailers are learning a hard lesson that organizations are woefully unprepared for disruption. Real time is not going to be fast enough to deliver consumer expectations for highly accurate prescriptive product recommendations and quick ability to take possession. This requires anticipatory shipping, personalized offers, highly flexible assortments and inventory, leveraging expert knowledge of customer behavior. But consider a larger role for AI, functioning as the nervous system for the organization, supporting continuous adaptation. The human nervous system is a complex network of nerves and cells carrying messages to and from the brain, through the spinal cord, to various parts of the body. Retailers will succeed in this decade by embracing AI as a nervous system, serving as a foundation for retail adaptation strategies, providing intelligence, automation and augmentation for physical and digital touchpoints, the supply chain, and the entire human workforce. Resources will be automatically reconfigured and redeployed to maximize opportunities, while higher-level conscious decision making is informed by various signals to drive adaptation strategies.

Gartner has developed a strategic framework for AI use cases. Leveraging the strategic framework for AI use cases is a way to ensure that projects align with a comprehensive digital business strategy and support its ongoing success. The framework will become an even more valuable tool when it's populated with use cases for the organization. Leverage the following as next steps to build out an AI strategy:

- List AI-enabled projects planned or in progress and Identify strategic importance.
- Plot projects on the strategic AI framework and use to engage with senior business leaders to discuss AI.
- Develop long-range plans for strategic AI investments, and track the maturity of relevant AI technologies.
- Measure projects, including cost optimization gains and reallocation of funds for digital transformation.

Business Impact: DL and ML have superior capabilities in application areas, where the input dimension is very high (for example, speech, image, video, text and other signal processing areas). CV will be a significant enabler of automation, smart check-out and robotics; therefore, we expect a

lot of business activity in that space. Also, completely new product categories (such as personal assistants, surveillance and other smart machines) are to be expected. Additionally, retailers can use smart data discovery tools with visualization to put information in the hands of business analysts and users, to take advantage of significant potential in creating business value and competitive advantage. Smart data discovery will transform the retail organization by providing the ability to analyze big data and to take appropriate actions to expand business opportunities.

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Amazon Web Services; Brandwatch; everseen; Google (Cloud AI); IBM; Manthan; Microsoft Azure; Rubikloud; Symphony RetailAI; Tata Consultancy Services

Recommended Reading: "Preparing for the AI-Based Retail Nervous System"

"Survey Analysis: Retail Use of Artificial Intelligence Expected to Surge"

"What Retail CIOs Need to Know About AI for Merchandising"

"Retailers Must Move Beyond Chatbots to Gain Competitive Advantage Through Conversational Commerce"

"Market Guide for Smart Robots in Retail"

"2020 Retail Digital Transformation and Innovation Trends"

Zero Trust Network Access

Analysis By: Steve Riley

Definition: Zero trust network access (ZTNA) creates an identity- and context-based, logical-access boundary around an application or set of applications. The applications are hidden from discovery, and access is restricted via a trust broker to a set of named entities. The broker verifies the identity, context and policy adherence of the specified participants before allowing access, and prohibits lateral movement elsewhere in the network. This removes the application assets from public visibility and significantly reduces the surface area for attack.

Position and Adoption Speed Justification: ZTNA is a synthesis of concepts promulgated by the Cloud Security Alliance's software-defined perimeters (SDP) project, by Google's BeyondCorp vision, and in O'Reilly's *Zero Trust Networks* book. Early products on the market tended to focus on use cases involving access to web applications. Newer, more complete products work with a wider range of applications and protocols.

As more organizations suddenly find themselves transitioning to much more remote work, hardware-based VPNs exhibit limitations. ZTNA has piqued the interest of those seeking a more flexible alternative to VPNs and those seeking more precise access and session control to applications located on-premises and in the cloud. ZTNA vendors continue to attract venture capital funding. This, in turn, encourages new startups to enter an increasingly crowded market and seek ways to differentiate. Merger and acquisition (M&A) activity in this market is underway, with several startup vendors now having been acquired by larger networking, telecommunications and security vendors.

User Advice: Organizations should evaluate ZTNA for any of these use cases:

- Opening up applications and services to collaborative ecosystem applications, such as distribution channels, suppliers, contractors or retail outlets without requiring the use of a VPN or DMZ.
- Normalizing the user experience for application access — ZTNA eliminates the distinction between being on and off the corporate network.
- Application-specific access for IT contractors and remote or mobile employees as an alternative to VPN-based access.
- Extending access to an acquired organization during M&A activities, without having to configure site-to-site VPN and firewall rules. The merged companies can quickly and easily share applications without requiring the underlying networks and/or identity systems to be integrated.
- Enabling users on personal devices — ZTNA can improve security and simplify bring your own device (BYOD) programs by reducing full management requirements and enabling more-secure direct application access.
- Cloaking systems on hostile networks, such as systems facing the public internet used for collaboration.
- Carrying encryption all the way to the endpoints for scenarios where you don’t trust the carrier or cloud provider.
- Permitting users in potentially dangerous areas of the world to interact with applications and data in ways that reduce or eliminate risk prone to originate in those areas.
- Securing access to enclaves of IoT devices if the device can support lightweight SDP agent or a virtual-appliance-based connector on the IoT network segment for connection.

Business Impact: The benefits of ZTNA are immediate. Similar to a traditional VPN, services brought within the ZTNA environment are no longer visible on the public internet and, thus, are shielded from attackers. In addition, ZTNA brings significant benefits in user experience, agility, adaptability and ease of policy management. For cloud-based ZTNA offerings, scalability and ease

of adoption are additional benefits. ZTNA enables digital business transformation scenarios that are ill-suited to legacy access approaches. As a result of digital transformation efforts, most enterprises will have more applications, services and data outside their enterprises than inside. Cloud-based ZTNA services place the security controls where the users and applications are — in the cloud. Some of the larger ZTNA vendors have invested in dozens of points of presence worldwide for low-latency access.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Akamai; AppGate; Cato Networks; Cisco; Netskope; Perimeter 81; Proofpoint; Pulse Secure; SAIFE; Zscaler

Recommended Reading: "Market Guide for Zero Trust Network Access"

"Zero Trust Is an Initial Step on the Roadmap to CARTA"

"Solving the Challenges of Modern Remote Access"

"Quick Answer: Cost Effectively Scaling Secure Access While Preparing for a Remote Workforce"

"The Future of Network Security Is in the Cloud"

Blockchain

Analysis By: David Furlonger; Rajesh Kandaswamy; Christophe Uzureau

Definition: A blockchain is an expanding list of cryptographically signed, irrevocable blocks of records shared by all participants in a peer-to-peer (P2P) network. Each block of records is time stamped and references links to previous data blocks. Anyone with access rights can historically trace a state change in data or an event belonging to any participant. Distributed ledgers are design limited and lack decentralized and tokenized elements.

Position and Adoption Speed Justification: A blockchain is an expanding list of cryptographically signed, irrevocable blocks of records shared by all participants in a peer-to-peer (P2P) network. Each block of records is time stamped and references links to previous data blocks. Anyone with access rights can historically trace a state change in data or an event belonging to any participant. Distributed ledgers are design limited and lack decentralized and tokenized elements.

User Advice:

- Educate senior leaders about the opportunities and threats that blockchain capabilities introduce. Use clear language and definitions in internal discussions about how distributed ledgers may or may not improve existing systems and processes.

- Continue to develop proof of concepts (POC) — especially in the context of market ecosystems. Identify integration points with existing infrastructures (for example, digital wallets, core systems of record, customer service applications and security systems). Analyze the role, maturity and interdependence of synergistic technologies such as artificial intelligence (AI) and the Internet of Things (IoT) as key levers in the evolution of blockchain complete and enhanced solutions.

Executives planning on deploying blockchain solutions must:

- Ensure sufficient innovation capacity is applied to the evolution of distributed ledgers and blockchains outside of your immediate industry.
- Identify integration points with existing legacy infrastructures. Evaluate the total cost of ownership against existing systems. Be very cautious about vendor lock-in and merely replatforming the enterprise without any additional value.

Business Impact: Blockchain provides an opportunity for enterprise leaders to imagine new kinds of business models and revenue flows. In particular, leaders decentralize commercial exchange, thereby reducing friction and cost, by monetizing multiple forms of assets. Enterprise leaders also face a threat from startups and businesses that can use the five core elements of the blockchain concept to disrupt and disintermediate markets and industries. This is done by offering capabilities like identity portability, trustless interactions, smart contracts and new forms of value exchange. These opportunities and threats will evolve over the next 10 years in varying degrees, affording strategic planners an opportunity to proactively address opportunities and threats. Regulation will play a significant role in the speed of evolution. Recent developments around the framing of compliance for token use and initial coin offerings (ICOs) are to be watched, as well as general consumer behavior toward, and acceptance of, multiple forms of assets. Progression with identity management will change the power structure in many industries and should be viewed through both a business and technology lens.

For distributed ledger concepts to really transform industry operating models via automation, and for economies of scale to improve efficiency, there needs to be a wholesale reimagination of digital transformation. COVID-19 may provide that catalyst. However, rather than encourage collaboration, it may increase fragmentation, making it harder for cross-industry and cross-jurisdiction consortia to be successful. Multiple business use cases have yet to be proven, and accurate value outcomes have yet to be calculated. It is unclear whether current approaches for using distributed ledgers provide sufficient differentiation compared with existing, proven messaging and data technologies. Clearly, interoperability of both technologies and processes is a significant requirement.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Algorand; Block.one; Cardano; Ethereum; Hyperledger; Neo; R3; Zilliqa

Recommended Reading: "Understanding the Gartner Blockchain Spectrum and the Evolution of Technology Solutions"

"Guidance for Blockchain Solution Adoption"

Cloud Managed Services

Analysis By: Craig Lowery

Definition: Cloud managed services are IT service offerings that provide for the day-to-day management of, and operational responsibility for, cloud service environments. A select set of professional services are typically offered and highly coordinated with the managed services to assist with cloud strategy, workload migration, solutions architecture, and ongoing transformation efforts. Cloud service brokerage is often delivered as a cloud managed service.

Position and Adoption Speed Justification: Cloud managed services providers (MSPs) have varying levels of capability based on the specific technologies and personnel roles they use to deliver their services. MSPs differentiate from each other in how they automate the delivery of their professional and managed services. Providers develop an integrated combination of proprietary, open source and partner technologies to serve their targeted use cases and customer sets. Providers also face the same challenges as end users in developing and retaining a skilled workforce but are generally better positioned to attract and cultivate those resources.

Demand for cloud managed services has grown steadily, tracking the increase in adoption of public cloud. The move to more cloud-native solutions and complex deployment scenarios such as hybrid cloud and multicloud have substantially emphasized the need for the professional services expertise. Strong cloud MSPs will demonstrate cloud capabilities aligned with hyperscale cloud infrastructure and platform services (CIPS) providers and will embrace new technology innovations such as artificial intelligence, automation, data services, and edge computing.

User Advice: Organizations considering cloud managed service offerings must carefully assess providers to ensure the provider has up-to-date expertise and a track record of success. Providers typically offer cloud-related IT service offerings across the adoption spectrum from initial and ongoing advisory services (design), implementation services (build) and managed services (run). Look for providers with capabilities across this continuum and evidence of a defined product roadmap. These attributes are present in the providers that are most likely to have a full understanding of cloud-specific requirements and, therefore, the most complete cloud professional and managed service capabilities.

Other factors to consider:

- Demonstrable partnerships with leading cloud providers, including partner status in cloud provider partner programs.
- Proven expertise and commitment to long-term support of your strategic cloud provider(s).
- Certifications held by individual engineers, operators and deployment managers.
- Customer use cases demonstrating successful delivery of managed service offerings.
- Expertise in the industry, region and country associated with the target environment.
- Demonstration of innovation in delivering new capabilities beyond cloud.
- Integration of noncloud capabilities (such as on-premises infrastructure management) in an end-to-end visibility and management scheme.
- Investment in cloud and digital technologies consistent with market trends, such as multicloud management and hybrid cloud computing.

Selecting a cloud managed services provider may create a dependency on the provider that can be difficult to sever in the event the provider cannot successfully deliver the offering. Perform a careful and thorough inspection of the services prior to making long-term commitments.

Business Impact: Good cloud MSPs help cloud-adopting organizations scale their cloud skills and capabilities quickly and effectively. The primary benefit is to augment the organization's expertise with certified, experienced personnel to provide advice and convey best practices. Even so, some customers choose to fully outsource large portions of their cloud estate to an MSP. The secondary benefit is to provide the tooling and day-to-day management of a highly dynamic operating environment, which many organizations are often unable to source themselves. In these ways, cloud managed services help an organization to fully exploit the full capabilities of the cloud for near- and long-term benefits. Addressing the immediate challenges of workload migration and establishing an operational environment result in only modest benefits. However, when organizations work with providers to unlock the disruptive potential possibilities of cloud computing, engaging in more innovative, digital processes, they are more likely to achieve profound transformative outcomes over time.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Accenture; Bespin Global; Capgemini; Cognizant; Deloitte; Logicworks; Rackspace; Smartronix; Tata Consultancy Services; Wipro

Recommended Reading: "Magic Quadrant for Public Cloud Infrastructure Professional and Managed Services, Worldwide"

"Critical Capabilities for Public Cloud Infrastructure Professional and Managed Services, Worldwide"

Internet of Things

Analysis By: Alfonso Velosa; Benoit Lheureux

Definition: The Internet of Things (IoT) is a core building block for digital business and digital platforms. IoT is the network of dedicated physical objects that contains embedded technology to communicate and sense or interact with their internal states and/or the external environment. IoT comprises an ecosystem that includes assets and products, communication protocols, applications, and data and analytics.

Position and Adoption Speed Justification: Gartner's CIO Survey 2020 shows that IoT is regarded by CIOs as one of the top five game-changing technologies, with enterprises vary widely on their IoT adoption depth and maturity. Enterprises on a global basis have ongoing IoT-enabled initiatives for use cases ranging from incremental benefits (for example, asset optimization or compliance reporting) to transformative benefits (for example, product as a service or guaranteed asset uptime). The more developed use cases center on fleet management and industrial equipment maintenance, where ROI is calculated from cost optimization such as reducing maintenance and fuel costs. Many enterprises are now exploring employee and citizen safety solutions using IoT enabled capabilities. Finally, Gartner's 2019 IoT Survey indicates that while enterprises expect a 3-year payback on average for their IoT projects, 42% expect payback in less than 2 years. In the 2020 economic downturn, many clients are pushing for even shorter project paybacks.

The hype has decreased from the highs in 2016 through 2019; we reflect this by moving the profile's position into the trough. Enterprises continue to address cost, complexity and scaling challenges implementing IoT-enabled business solutions, as well as increased adoption of contact-less monitoring solutions, drone inspections, etc. driven by the 2020 pandemic. Challenges include end-to-end integration complexity, the need to bridge cultural divides between IT and operations, confusing vendor marketing, especially as they increasingly shift to IoT-enabled business solutions, security concerns, and the 2020 pandemic disruption on IoT project schedules.

User Advice: CIOs should take action to address IoT concerns across the following areas:

- Business: Measure and deliver IoT value based on digital and strategic business objectives. If you are still experimenting, use a proof of business value approach. Build business cases with project payback of less than 18 months to account for implementation challenges and cultural resistance. Add employee and customer safety to your priority list of IoT projects and capabilities.

- Management: Build or contribute to an IoT center of excellence (COE) composed of IT, operational and business personnel. Use the COE to drive global alignment on best practices, alignment to business objectives, budgeting and people allocation. Remember that IoT is really about business process transformation, so focus on culture change first and technology second to ensure success.
- Architecture: Ensure the architecture teams focuses on both the IT and operational technology portfolio as well as the need to manage a multi-IoT platform approach. Ensure analytics and applications are part of the conversation.
- Skills: Invest in business and architecture skills to support project ideation and prioritization, as well as technical skills for IoT platforms, integration, analytics and security. Drive learning via projects with short-term outcomes, and include business leaders, IT leaders, and front-line workers.
- Vendors: Assess and select providers on how they lower project risk for your enterprise via their vertical market expertise, technical capabilities (including best-of-breed partners) and trained professional services partners. Ensure your vendors integrate into your IT infrastructure.
- Governance: Establish accountability, participation, predictability and transparency policies for IoT — addressing sponsorship, budgets, digital ethics, data ownership and rights to monetize IoT data, etc...
- Risk: Scan for threats from enterprises in your ecosystem who may use IoT capabilities to damage or limit your differentiation and competitiveness.

Business Impact: As an evolutionary business impact, IoT will impact most enterprises' internal operations, differentiation, competitive position, and product strategies. Connected things will help lower costs, drive revenue, and improve enterprise processes in these types of usage scenarios:

Optimization of a range of business processes:

- Cost optimization: Lower operating costs for energy reduction, maintenance minimization, minimizing inventory spoilage, lowering theft
- Operations optimization: Better productivity, increased efficiency, logistics and coordination
- Optimize assets: Asset utilization, health monitoring, reliability, predictive maintenance
- Conserve resources: Energy efficiency and pollution reduction

New revenue strategies:

- Generate revenue via improved products, contractual services, usage-based pricing, and monetizing IoT data

- Increase engagement: Improved experiences of consumers, citizens and others in order to improve loyalty and increase customer lifetime value

Safety focus:

- Drive employee and citizen safety by monitoring and checking people's health, shifting to over-the-air updates to avoid in person visits, fall monitoring for the elderly and remote workers.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: ABB; Alibaba Cloud; Altizon; GE Digital; Hitachi Vantara; Tencent; Vodafone

Recommended Reading: "Predicts 2020: As IoT Use Proliferates, So Do Signs of Its Increasing Maturity and Growing Pains"

"Toolkit: Enterprise Internet of Things Maturity"

"Survey: Manufacturers See Quick Return on IoT Projects"

"Forecast: Enterprise and Automotive IoT, Worldwide"

Software-Defined Infrastructure

Analysis By: Philip Dawson

Definition: Software-defined infrastructure (SDI) includes the broad set of software-defined anything (SDx) infrastructure components and the software-defined data center (SDDC). SDI also includes non-data-center infrastructure deployed in Internet of Things (IoT) applications and an SD edge of edge-based adapters, monitoring devices, gateways, appliances and machines.

Position and Adoption Speed Justification: Data center infrastructure is well-covered with compute (SDC), network (SDN) and storage (SDS), but SDI also extends to non-data-center infrastructure with the use of monitoring devices or machines that are software-defined. This is enabled through the use of sensors and adapters that are abstracted through software, becoming SDI in edge, IoT and operational technology (e.g., retail POS), rather than traditional, IT-driven SDI through data center or cloud. In 2020, we are seeing SDI move to vendor-specific silo technology (not heterogeneous service drive) and, hence, obsolete as multivendor interoperable standards.

User Advice: As SDI initiatives roll out, consider the integration and measurement of non-data-center edge infrastructure. Focus on core IT SDI for compute, network, storage and facilities, but consider the impact of SDI on IoT, edge computing, remote office/branch office (ROBO) and other operational technologies. Key verticals operating in multiple, geographically distributed locations

(such as retail, manufacturing, retail banking, distribution and utilities) are extending IoT and non-data-center SDI initiatives for new IT operations and functions. Expect SDI to be tied to a specific vendor or technology silo.

Business Impact: With the increase of IoT touching edge-based operational technology, SDI reaches beyond and between SDDCs, and leverages SDI benefits and features for new multimode applications and edge IoT endpoints. However, SDI is now tied to vendor technology not interoperability.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Obsolete

Sample Vendors: IBM; Intel; Microsoft; Red Hat; VMware; Wipro

Recommended Reading: "Simplify Intelligent Infrastructure by Using Workload Architectures"

"Drive Administration, Application and Automation Capabilities of Infrastructure-Led Disruption"

Data Lakes

Analysis By: Nick Heudecker; Henry Cook

Definition: A data lake is a concept constituting a collection of storage instances of various data assets combined with one or more processing capabilities. Data assets are stored in a near-exact, or even exact, copy of the source format and in addition to the originating data stores.

Position and Adoption Speed Justification: Though data lakes have started emerging from the Trough of Disillusionment, a majority of the market still exhibits significant confusion over the data lake concept, how it compares to concepts like data warehouses and data hubs, and how it supports different user groups and service-level agreements. Another portion of the market is embracing packaged data lake offerings from cloud providers and other vendors. These packaged offerings help enterprises conceptualize both what a data lake is and where the data lake fits into their data estate. Adoption of these products has pushed data lakes through the Trough of Disillusionment and toward the Slope of Enlightenment.

This progression has come at a cost. Data lakes have already run their course for many organizations. Some companies struggled to determine the return on investment for their data lake projects, failing to uncover a single meaningful outcome that originated from their lake. Others found some success in their experiments but struggled to evolve those experiments into production for a variety of reasons. Many of these organizations gave up on their data lakes, preferring to use infrastructure that accommodated diverse analytics consumers, rather than solely accommodating data scientists.

Despite progression along the Hype Cycle, data lake success is far from guaranteed. Infrastructure is only one part of the data lake equation. Data and analytics leaders must design and implement a pipeline to move projects into production, ensure high quality, reproducible outcomes, and develop highly skilled individuals that can derive value from datasets with varying levels of context, quality and format.

User Advice:

- The fundamental assumption behind the data lake concept is that everyone accessing a data lake is moderately to highly skilled at data manipulation and analysis. Before implementing a data lake, ensure you have either the necessary skills, such as data science or engineering, or a plan to develop them.
- Recognize that results will likely be difficult to reproduce between analysts. By definition, data stored in data lakes lacks semantic consistency and data governance of any kind. This makes data analysis highly individualized (a consumerization of IT goal) at the expense of an easy comparison or contrast of analytic findings (also indicative of consumerization of IT).
- There are certain SLA expectations that can be served by data lakes. However, most end-user SLAs for analytics rely on repeatability, semantic consistency and optimized delivery. Once data lake efforts confront these SLAs, it is time to explore alternative information management architectures, such as the logical data warehouse, to rationalize how information is stored with how it is used.
- Evaluate a variety of implementation options. Cloud-based data lake offerings are increasingly popular choices and provide a simple pattern for data ingestion and consumption, but no two data lakes are the same. Your users' needs may require a radically different implementation than prepackaged services. Expect your data lake to be a portfolio of processing capabilities.
- Many organizations think of a data lake to share data within the organization, roughly equivalent to data as a service. This frequently results in multiple copies and lineages of data — exactly what many data lake advocates said wouldn't happen. Alternative architectures, like data hubs, are often better fits for such use cases (see "Use a Data Hub Strategy to Meet Your Data and Analytics Governance and Sharing Requirements").

Business Impact: The data lake concept has the potential to have a high impact on organizations, but its effect is only moderate at present. To get full value from a data lake, its users must possess all the skills of a system analyst, data analyst *and* programmer. They should also have significant mathematical and business process engineering skills — otherwise it will still have a significant impact, but a highly undesirable one.

Depending on the method of implementation, a data lake can be a low-cost option for massive data storage and processing. Processed results can be moved to an optimized data storage and access platform, based on business requirements and tool availability. However, the potentially

high impact of this will be diluted by vendors seeking to use the term “data lake” merely as a means of gaining entry to the highly mature analytics and data management markets. This presents the potential for some very real lost opportunities and large sunk costs, as a balanced warehouse/services/lake architectural approach would be the better solution.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Amazon Web Services; Cambridge Semantics; Cazena; Google Cloud Platform; IBM; Informatica; Microsoft; Oracle; Zaloni

Recommended Reading: “How to Avoid Data Lake Failures”

“Solve Your Data Challenges With the Data Management Infrastructure Model”

“Efficiently Evolving Data From the Data Lake to the Data Warehouse”

“Data Hubs, Data Lakes and Data Warehouses: How They Are Different and Why They Are Better Together”

“Building Data Lakes Successfully”

“Metadata Is the Fish Finder in Data Lakes”

Robotic Process Automation (RPA)

Analysis By: Frances Karamouzis; Saikat Ray; Melanie Alexander

Definition: Robotic process automation (RPA) is a licensed software tool for building scripts to integrate any application via the user interface and a control dashboard/orchestrator which automates routine, repetitive, rules based, predictable tasks using structured digital data.

Position and Adoption Speed Justification: In their initial form (over five years ago), RPA tools predominantly focused on task-centric use cases. End-user adoption has been consistently growing, and tools are expanding to automate more extensive process workflows. Vendors have grown and made extensive R&D investments. There are also new entrants, such as SAP and Microsoft. Gartner estimates the software market has reached over $1.3 billion and the services market is over $5 billion (with continued growth expected). Many buyers have expressed remorse as organizations have not architected their approach in a strategic manner and nor applied the right tools. As such, there has been movement through the Peak of Inflated Expectations, and we foresee a renaissance by morphing offerings and end-user zeal for operational excellence in a digital mode. This will now be heightened with the sharp increase in a work-from-home environment, which requires the default to be digital.

User Advice: Awareness and targeted usage within specific functional areas and industries is high (i.e., shared services, BPO deals, finance and accounting). However, there is still a large addressable market for a truly "industrialized" (repeatable, consistent, highly scaled) adoption as part of digitalized operations initiatives.

To maximize the benefits of RPA offerings:

- Understand that the starting point for your investment and overall choices needs to begin at the strategic design level; more specifically, with the overall architecture of the hyperautomation strategy, which includes a portfolio rather than one targeted technology. The overall approach and architecture for the automation of business and IT processes form the foundation that underpins workflow, efficiency, efficacy and business agility. Missteps are unforgiving, as processes are fossilized with far-reaching operational impacts.
- Ensure the use of multidisciplinary governance and coordination across business units, IT, security, sourcing and assurance functions.
- Stratify the overall portfolio of business stakeholder demand and build your hyperautomation roadmap. Determine the targeted role for RPA offerings within that strategic roadmap. The stratification of the portfolio will need to cut across several key variables: risk, reward, data profile (volume, velocity and viscosity of data) and business process profile (ranging from simple, well-defined rote examples to complex, SME-intensive, exception-heavy areas).

Business Impact: Experienced users of RPA have moved beyond simple, well-defined, highly repetitive use cases for their RPA software. Organizations are actively seeking to automate complex, subject matter expert (SME)-intensive, exception-heavy business processes. Thus, a majority of clients will demand that RPA vendors showcase functionality or partnerships across multiple automation technologies. These include process mining (also referred to as "process discovery" or "e-process mining"), ingestion engines (optical character recognition [OCR], computer vision and many other technologies), analytics, user experience and machine learning. The ability to integrate multiple automation technologies will be table stakes for RPA vendors to effectively compete and address the user demand.

Organizations will not want to invest in multiple RPA offerings, but rather select the one that has the most robust options for the largest array of use cases. Thus, the use of one or more of the complementary technologies — which Gartner refers to as the "hyperautomation technology portfolio" — will be considered a must-have ingredient for business process automation initiatives and will be the norm. The biggest user challenges will include how to architect the solution, vetting the maturity of the complementary technologies, determining how many vendors to utilize, sorting out the combinations of licensing and contracting options, and ongoing governance issues. Therefore, one of the critical variables that will determine the value of RPA-centric automation implementations will be the effective use and architecture of complementary technologies.

Clients focusing on RPA-centric initiatives rather than strategically analyzing the larger technology toolbox options — iBPMS, iPaaS platforms, LCAP and decision management systems — will find it challenging to deliver on the larger portfolio of business demands in the digital age.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Sample Vendors: AntWorks; Automation Anywhere; Blue Prism; Kofax; Microsoft; NICE; Pegasystems; SAP; UiPath; WorkFusion

Recommended Reading: "Predicts 2020: RPA Renaissance Driven by Morphing Offerings and Zeal for Operational Excellence"

"Magic Quadrant for Robotic Process Automation Software"

Augmented Reality

Analysis By: Tuong Nguyen

Definition: Augmented reality (AR) is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects and presented using a mobile, head-mounted-type display or projected graphics overlays. It is this "real world" element that differentiates AR from virtual reality. AR aims to enhance users' interaction with the environment, rather than separating them from it.

Position and Adoption Speed Justification: Current technology is best suited for purpose-built, specialized solutions. As such, position and adoption speed will vary by vertical and industry. Current horizontal tasks seeing the most traction are task itemization, visual design and context-based work instruction. This profile represents a homogeneous view of AR implementations across market segments.

Market interest is growing steadily, but AR continues to struggle with mismatched expectations (vendors promising solutions beyond current capabilities) and poor implementations (for example, solutions delivered without immersive development [3D design and interface] knowledge or workflow integration, or not mapped to business value or need). Current solutions are better described as AR-inspired solutions — experiences that contain elements of AR to offering limited, purpose-built capabilities. AR adoption continues mainly in enterprise applications. Consumer-facing implementations are still struggling to show consumers consistent value. Better hardware, coupled with more compelling use cases, is needed before further progress can be made.

Based on Gartner inquiry (25% increase in inquiries in 2019 over 2018) and industry news, B2B AR continues to gain traction as more enterprises are seeing the value of using AR in their workflow. Moreover, a Gartner 2020 CIO survey indicates that 27% of respondents are currently using, or

evaluating/exploring AR. HMD sales reflect the burgeoning pilot deployments. Advancements in HMD hardware (lighter, more durable, safer, etc.) will provide more compelling hands-free use cases for AR as well.

User Advice: Organizations looking to implement AR experiences should:

- Decide on the audience for your AR experience. Internal- and external-facing solutions are not transposable.
- Restrict initial trials to a specific task or goal. Set benchmarks against unaugmented solutions to understand risks and benefits.
- Set the business goals, requirements and measurements for your AR implementation before choosing a provider.
- Rich and robust offerings can bring value only if you have a clear intention for the deployment. For external-facing implementations, use AR as an extension of your brand and experience. For internal-facing implementations, use AR as a tool that will enhance employee job function.

This could include, for example, delivering context-specific information at the point of need for mobile workers, better leveraging experts (using one-to-many video support) in plant and maintenance operations, or enhancing business processes via AR-based training and instruction.

Business Impact: AR bridges the digital and physical world and provides cognitive augmentation for user. AR provides a digital filter to enhance the user's surroundings with relevant, interesting and/or actionable information. This has an impact on both internal- and external-facing solutions. For example, internally, AR can provide value by providing checklists for training and maintenance or for remote telestration in see-what-I-see video collaborations. Externally, it offers brands, retailers and marketers the ability to seamlessly combine physical campaigns with their digital assets. As such, AR is broadly applicable across many markets, including gaming, industrial design, digital commerce, marketing, mining, engineering, construction, energy and utilities, automotive, logistics, manufacturing, healthcare, education, customer support, and field service.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Apple; Atheer; Google; Librestream; Microsoft; PTC; Scope AR; Ubimax; Upskill; Wikitude

Recommended Reading: "Venture Capital Growth Insights: Immersive Technologies"

"Emerging Technology Analysis: Augmented and Mixed Reality Opportunity for 3D Design Software and Vertical ISVs"

"Quality Is the Key to Avoiding 'Digital Distortion' With Your Augmented Reality Strategy"

"Competitive Landscape: Head-Mounted Displays for Augmented Reality and Virtual Reality"

"3D Design and Device Convenience Hinder AR and VR Adoption"

"Augmented and Virtual Reality in the Digital Workplace: Top Use Cases"

"Market Opportunity Decision Framework for Tech CEOs: Augmented Reality and Virtual Reality Use Cases"

"Competitive Landscape: Augmented Reality Tools for Enterprise, 2018"

"Market Guide for Augmented Reality"

"Market Trends: Advancements in Immersive See-Through Technologies Will Differentiate Augmented Reality Glasses"

Hyperconvergence

Analysis By: Philip Dawson; Jeffrey Hewitt

Definition: Hyperconvergence is scale-out software-integrated infrastructure designed for IT leaders seeking operational simplification. Hyperconvergence provides a building block approach to compute, network and storage on standard hardware under unified management. Hyperconvergence vendors build appliances using off-the-shelf infrastructure, engage with system vendors that package software as an appliance, or sell software for use in a reference architecture or certified server. Hyperconvergence may also be delivered as a service or in a public cloud.

Position and Adoption Speed Justification: Hyperconvergence solutions are maturing and adoption is increasing as organizations seek management simplicity. VMware vSAN utilization among VMware ESXi customers, and Storage Spaces Direct utilization among Microsoft Windows Server 2016 and 2019 Datacenter edition customers are on the rise. Nutanix, an early innovator in HCIS appliances, has largely shifted to a software revenue model and continues to increase the number of OEM relationships. Hyperconvergence vendors are achieving certification for more-demanding workloads, including Oracle and SAP, and end users are beginning to consider hyperconvergence as an alternative to integrated infrastructure systems for some workloads. Meanwhile, suppliers are expanding hybrid cloud deployment offerings. Larger clusters are now in use, and midsize organizations are beginning to consider hyperconvergence as the preferred alternative for on-premises infrastructure for block storage. Meanwhile, a growing number of hyperconvergence suppliers are delivering scale-down solutions to address the needs of remote office/branch office (ROBO) and edge environments typically addressed by niche vendors.

User Advice: IT leaders should implement hyperconvergence when agility, modular growth and management simplicity are of greatest importance. The acquisition cost of hyperconvergence may be higher and the resource utilization rate lower than for three-tier architectures, but management efficiency is often superior. Hyperconvergence requires alignment of compute and storage refresh cycles, consolidation of budgets, operations and capacity planning roles, and retraining for organizations still operating separate silos of compute, storage and networking. Adopt for mission-critical workloads, only after developing knowledge with lower-risk deployments, such as test and development. Workload-specific proofs of concept are an important step in meeting the performance needs of applications. Consider the impact on DR and networking. Test under a variety of failure scenarios, as solutions vary greatly in performance under failure, their time to return to a fully protected state and the number of failures they can tolerate. Consider nonappliance options to enable scale-down optimization of resources for high-volume edge deployments. In product evaluations, consider the ability to independently scale storage and compute, retraining costs, and the ability to avoid additional operating system, application, database software and hypervisor license costs. In large deployments, plan for centralized management of multiple smaller clusters. For data center deployments, ensure that clusters are sufficiently large to meet performance and availability requirements during single and double node failures. While servers are perceived as commodities, they differ greatly in terms of power, cooling and floor space requirements, and performance, so evaluate hyperconvergence software on a variety of hardware platforms for lowest total cost of ownership and best performance.

Business Impact: The business impact of hyperconvergence is greatest in dynamic organizations with short business planning cycles and long IT planning cycles. Hyperconvergence enables IT leaders to be responsive to new business requirements in a modular, small-increment fashion, avoiding the big-increment upgrades typically found in three-tier infrastructure architectures. Hyperconvergence provides simplified management that decreases the pressure to hire hard-to-find specialists. It will, over time, lead to lower operating costs, especially as hyperconvergence supports a greater share of the compute and storage requirements of the data center. For large organizations, hyperconverged deployments will remain another silo to manage. Hyperconvergence is of particular value to midsize enterprises that can standardize on hyperconvergence and the remote sites of large organizations that need cloudlike management efficiency with on-premises edge infrastructure. As more vendors support public cloud deployments, hyperconvergence will also be a stepping stone toward public cloud agility.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Cisco Systems; Dell Technologies; Hewlett Packard Enterprise (HPE); Huawei; Microsoft; Nutanix; Pivot3; Red Hat; Scale Computing; VMware

Recommended Reading: “Magic Quadrant for Hyperconverged Infrastructure”

“Critical Capabilities for Hyperconverged Infrastructure”

“Toolkit: Sample RFP for Hyperconverged Infrastructure”

“The Road to Intelligent Infrastructure and Beyond”

“Use Hyperconverged Infrastructure to Free Staff for Public Cloud Management”

Indoor Location Intelligence

Analysis By: Annette Zimmermann

Definition: Indoor location intelligence refers to services and solutions that generate, process and analyze data in an indoor environment to provide insight on the location (and movement) of objects and people from a historic, real-time or predictive perspective. The underlying technologies are wide-ranging and include Wi-Fi, BLE, infrared, ultrasound, RFID and UWB.

Position and Adoption Speed Justification: We positioned this profile one position further in the post-trough area. The two broad use cases for location intelligence are people monitoring and asset tracking, and these can be divided into hundreds of sub-use cases. With the COVID-19 outbreak, interest in this technology has further accelerated. There is high interest in people tracking analytics from a social distancing and contact tracing use case perspective from both enterprise and public organizations. An increasing number of vendors in the indoor location intelligence space have released specific social distancing solutions that can include different elements such as special tracking devices, analytics software and a mobile app to help employees return to work. Moreover, organizations that have a lot of external traffic such as retail shops, airports, hospitals, stadiums, etc. are looking to location intelligence to adhere to social distance guidance. In either context, location intelligence can help but is likely not the answer to everything. In addition, especially contact tracing applications require change in user behavior i.e., users’ willingness to participate in an COVID-19-tracing program.

The main issues that organizations need to deal with are technology choices and data privacy. Some technologies provide centimeter accuracy versus 4 to 5 meters. The high precision technologies tend to be more expensive, hence there is a trade-off, and organizations need to precisely define their use cases to determine what accuracy level they need.

Location data is sensitive data and hence needs to be treated as such, especially in an external client-facing situation.

User Advice: Enterprise application leaders who are looking to deploy indoor location intelligence solutions should:

- Define three to five use cases that you are looking to address and in as much detail as possible. This fine-tuned assessment of use cases will determine which technology and vendor to choose.

- Understand the direct trade-off between location accuracy and cost and deploy the technology that supports the use case. Overdelivery on accuracy will significantly increase costs, while underdelivering on accuracy will bring no value and the project may fail.
- In a consumer scenario, determine which type of customer data you will collect, store and process, and for which purpose. Set up different scenarios that categorize the data types. These categories should be location data of objects and location data of people, and then further refined by anonymized versus identifying data. This will give guidance on which data privacy regime to follow.
- In case of (consumer) app-based deployments, provide opt-in mechanisms by letting users decide which personal data they want to share and ultimately how they want to engage with a brand.
- Be transparent toward staff on which and when location data is processed/stored by emphasizing the safety aspect of such a solution and the fact that their personal location data is not being tracked off-premises. This can be done with a tag or wearable, that is only used on-premises.

Business Impact: Gartner sees strongest growth for indoor location intelligence solutions in healthcare, retail, and manufacturing, followed by hospitality, public transport/airports and the public sector.

Business benefits/impacts for healthcare are:

- Monitor mobile assets (such as infusion pumps) in real time to reduce time spent on searching and to reduce stock
- Track patients to optimize the flow
- Receive an alert when valuable assets are being removed
- Monitor compliance behavior, such as hand sanitation
- Provide wayfinding and appointment management to patients to reduce no-show rates and improve customer experience

Business benefits/impacts for retail are:

- Manage staff based on monitoring customer traffic
- Understand footfall and shopping behavior
- Provide turn-by-turn navigation in larger shopping venues

- Customer engagement and CX

Business benefits/impacts for manufacturing are:

- Track parts/pallets to save time and reduce costs
- Collision avoidance/accident prevention
- Worker safety — use geofencing to warn employees of dangerous zones/equipment
- Monitor idle tools
- Access control

Business benefits/impacts for public sector are:

- Locating assets and people in an emergency
- Improve evacuation process
- Access control

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: AiRISTA Flow; Aruba; Cisco; Cloud4Wi; Esri; Purple; Quuppa; Ubisense; Zebra

Recommended Reading: "Magic Quadrant for Indoor Location Services, Global"

"Market Guide for Indoor Location Application Platforms"

"CIO Guide: How Location Services Can Help Mitigate COVID-19 Spread"

Network Detection and Response

Analysis By: Lawrence Orans; Jeremy D'Hoinne

Definition: Network detection and response (NDR) technology uses a combination of machine learning, rule-based detection and advanced analytics to detect suspicious activities on enterprise networks. NDR tools analyze raw traffic and/or flow records (for example, NetFlow) to build models that reflect normal network behavior. When the NDR tools detect abnormal traffic patterns, they raise alerts. NDR solutions monitor north-south and east-west traffic. These tools also provide workflow capabilities to enable security teams to respond to incidents.

Position and Adoption Speed Justification: NDR has begun to pull out of the Trough of Disillusionment as adoption of the tools continues to grow. One challenge that enterprises face with NDR is the growth in encrypted traffic, as Gartner estimates that HTTPS browsing routinely exceeds 80% of total internet traffic. Vendors offer a wide range of support for analysis of encrypted traffic. A handful of vendors are positioned in the line of traffic and natively support the termination, decryption and analysis of SSL/TLS traffic. However, the majority of NDR solutions are implemented out-of-band, and their analysis of encrypted traffic is limited to techniques that do not inspect the payload, such as JA3 fingerprinting, or similar methods. A few vendors offer more advanced analysis for detecting suspicious encrypted traffic by monitoring the lengths and arrival times of messages within traffic flows and other data transmission patterns (this technique is helpful, but not as valuable as plain text analysis).

False positives are generally not a major problem with NDR technology, but they are an unavoidable issue with any machine learning-based detection tools and have somewhat slowed adoption of these solutions. Many users of NDR solutions report that they have had to tune these tools to avoid registering false positives, particularly from traffic generated by vulnerability scanners. The NDR solutions had indicated “reconnaissance port scanning” and “anomalous lateral movement” due to traffic from the scanners.

Response functionality has begun to mature in these tools. Some vendors emphasize an automated response capability (for example, commands are sent to a firewall to drop packets), and many vendors integrate with SOAR and other automation tools. Other vendors emphasize manual response by emphasizing threat hunting tools.

User Advice: Enterprises that are considering NDR tools should ensure success by giving their security teams the training they need to gain maximum value from these solutions. Additionally, enterprises should ensure they have qualified personnel to triage the alerts and other signals from the NDR. Because these tools highlight anomalies, gaining maximum value from NDR tools requires a strong understanding of the overall traffic patterns and specific protocol patterns in your enterprise network.

Proper positioning of the NDR sensors is critically important. Network security professionals should carefully plan sensor deployment so that the sensors can analyze the most relevant network traffic. Scalability of the sensors is also important. Some vendors offer sensors that support up to 100 Gbps of line rate capture, whereas other vendors’ sensors can only scale up to 10 Gbps.

Business Impact: NDR solutions are valuable tools that assist network security professionals in the detection of compromised endpoints and targeted attacks. These tools have limited native blocking ability, or none at all (because most are implemented outside of the line of traffic), but they offer manual and/or automatic functionality for responding to alerts. Many NDR solutions can also be implemented to detect suspicious activity in IaaS environments.

As more enterprises adopt a “direct to net” approach from branch offices (for example, implementing a local internet breakout and sending web traffic directly from the branch office to the internet), NDR solutions positioned in a data center will not see that traffic. However, most organizations that implement the “direct to net” approach still retain their MPLS connections to their private or public cloud data centers, so NDR tools will remain valuable for that traffic.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Awake Security; Cisco; Darktrace; ExtraHop; Fidelis Cybersecurity; FireEye; Gigamon; Lastline; Plixer; Vectra

Recommended Reading: “Market Guide for Network Traffic Analysis”

“Infrastructure Security Primer for 2020”

“Applying Network-Centric Approaches for Threat Detection and Response”

Climbing the Slope

Supplier E-Invoicing

Analysis By: Balaji Abbabatulla

Definition: Supplier e-invoicing is the set of business processes required to receive, validate and archive B2B invoices from suppliers in an electronic format. Supplier e-invoicing requires cross-functional knowledge spanning business, accounting, regulations and IT. Supplier e-invoicing processes involve a lot of complexity, especially when invoices are received from suppliers in multiple countries.

Position and Adoption Speed Justification: Adoption of supplier e-invoicing continues to increase as more organizations start using e-invoicing and usage increases in organizations with existing e-invoicing applications. Some of the key factors driving such increased adoption include:

- Improved maturity of software application and enabling technologies
- The increasing number of governments that are mandating e-invoicing
- Maturing digital transformation programs

Increasing adoption will lead supplier e-invoicing to the Plateau of Productivity in less than two years. However, this position on the Hype Cycle represents a worldwide average, which might vary considerably from country to country. For example, in some countries, supplier e-invoicing might still sit before the Peak of Inflated Expectations when a new government mandate is expected to be

introduced soon. While these factors encourage the growth of e-invoicing, traditional challenges continue to slow down the pace of such adoption. Such challenges include the complexity of complying with varying and evolving sets of government regulations and the continuous investment required to train and onboard new suppliers. These constraints restrict the innovation from evolving faster.

User Advice: Start evaluating supplier e-invoicing project opportunities now, regardless of your company's size or financial shape. It's only a matter of time before supplier e-invoicing becomes a mandatory requirement, either by regulation or as an accepted practice of your trading partners. This is true wherever you are, whether you are a buyer or a seller, or whether you simply take part in a more complex B2B process. Chances are that, at least for a portion of your business partners, supplier e-invoicing is common practice already, making supplier e-invoicing more and more mandatory for you, if you want to stay in that trading community.

Acknowledge the complexity of deploying supplier e-invoicing software. Don't overestimate the immediate cost savings from supplier e-invoicing in your business case. Never underestimate the consequences of regulations' diversity across countries. Potential problems are in the details. Multicountry supplier e-invoicing projects can take years to implement. Proceed with a succession of projects, and go down the path of least resistance first (e.g., the countries where regulations are simpler). Turn as many transactions as you can, as quickly as you can, into an electronic form. Measure the perceived value carefully (typically by unit cost of processing of an invoice).

If you need international supplier e-invoicing, focus on high invoice volume countries first and shortlist software vendors who are have certified solutions for these countries. Some countries (e.g., Brazil in South America) might require a particularly complex solution. Some countries (e.g., Russia) might need a local operator to achieve compliance. The diversity of supplier e-invoicing regulations across countries is very high. Because regulations change often, solutions deployed over the cloud are generally preferable. You should favorably consider providers that actively monitor the legislation in the countries you do business in — so being compliant (and staying compliant, as regulations change) becomes their problem, not yours.

Business Impact: Supplier e-invoicing has traditionally delivered cost savings due to the digitization of paper invoice receipt and validation processes. However, the supplier e-invoicing market is beginning to offer much more value beyond digitization of paper invoice. ROI of supplier e-invoicing software can increase significantly by using additional insights, such as duplicate payments or fraudulent invoices, to eliminate wasteful expenses. Furthermore, vendors are beginning to support adjacent processes, such as payment execution or working capital optimization, by providing early actionable insights to optimize such processes. Some vendors are investing in developing in-depth compliance suites that cover multiple countries and geographic regions. Such vendors are also collaborating with governments in helping them define and roll out supplier e-invoicing regulations. Creating a partnership with such vendors will help expand the value derived from supplier e-invoicing to multiple global locations. Software vendors are beginning to offer features that encourage suppliers to adopt supplier e-invoicing. Easier

collaboration to resolve disputes or exceptions, interoperability with multiple networks and access to multiple buying organizations are features that help improve supplier adoption and thereby increase ROI for buying organizations.

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Basware; Circulus; Corcentric; EDICOM; Esker; Pagero; Sovos; Taulia; Tradeshift; Tungsten Network

Recommended Reading: "Competitive Landscape: Supplier e-Invoicing, Worldwide, 2020"

"3 Steps to Creating an E-Invoicing Vendor Shortlist"

"Growth Strategies for Tech CEOs of Supplier E-Invoicing Software Vendors"

"Success With AP Invoice Automation Requires More Than Paper to Digital"

Advanced Metering Infrastructure

Analysis By: Zarko Sumic

Definition: Advanced metering infrastructure (AMI; frequently referred to as "smart metering") is a composite technology comprising several elements: consumption meters, a two-way communication channel, a data collection engine (headend) and a data repository (meter data management). Jointly, they support all phases of the meter data life cycle, from data acquisition to the final provisioning of energy consumption information, to utility applications, corporate users or end customers.

Position and Adoption Speed Justification: In a broader context, AMI is a vertical example of an Internet of Things (IoT) technology that plays a significant role in utility sector digitalization. Different energy market structures, regulatory drivers and benefit expectations create different ownership models of the components of the AMI technology stack, which favors different technology solutions across the globe. Many U.S. electric utilities have deployed AMI, following the U.S. government's Smart Grid Investment Grant (SGIG) program. However, concerns with investment recovery, combined with customer backlash in some markets, driven by concerns over billing accuracy, data privacy and electromagnetic force's impact on customer health, have somewhat impeded the pace of adoption. The primary element in the backlash, however, has been the lack of good utility customer communications.

As of the beginning of 2020, there were more than 100 million meters installed in the U.S. and almost one billion AMI meters installed globally. Most EU countries are considering plans to replace 80% of their meters by 2020, although in some cases, governments have reduced

mandated smart meter replacement. Commitments include the U.K. (with 56 million meters by 2020) and France (with 35 million meters by 2020). Similar programs exist in Australia and New Zealand, as well as in other parts of the world.

Utilities that have not been part of the first deployment wave (European utilities looking for more-efficient meter reading technology to enable opening of competitive retail market) or second wave (U.S. utilities driven by SGIG subsidies) are now considering general-purpose technologies. NB-IoT or IoT platforms are being looked at as alternatives to AMI offerings from vertically focused metering vendors.

User Advice: In addition to providing utility-centered benefits (such as meter reading cost reduction, out-of-schedule meter reads, revenue theft prevention and outage notification), AMI also can provide benefits related to the energy market. This includes things like enabling customer switching by remote turn-off or turn-on functions, customer and societal benefits for supporting energy efficiency programs (for example, bill reduction), and addressing energy sustainability concerns. Because of its composite technology and the fact that it spans operational technology (OT) and IT domains, AMI requires interdisciplinary governance and can be treated as a proxy for wider digital grid transformation initiatives. Although in most deployments AMI is tied to meter-to-cash and initially integrated with CIS systems, AMI must support a variety of applications and end-user needs for energy consumption data. Therefore, it must meet a wide spectrum of requirements for data latency, persistency and the scalability of energy consumption data.

The infusion of computational power on the OT side of AMI influences technology life expectancy and raises supportability issues. Maintaining smart meters is increasingly similar to maintaining IT assets, such as desktops and laptops, because they both share the same distributed nature, increasingly Internet-Protocol-enabled communications and shorter technology update cycles. Consequently, CIOs must ensure that IT asset management best practices are followed when considering the operation and management of the AMI asset.

Before embarking on AMI initiatives, CIOs should have a clear understanding of project ownership, expected deliverables, governance issues, security, intellectual property considerations, consumer communication, technology maturity and the vendor's expertise. Utilities should be careful about technology selection, available standards, component interoperability, security implications, performance, scalability and future-proofing technology selections to meet evolving needs.

The AMI market is now being impacted by penetration of general-purpose IoT solutions in the smart metering market that impact multiple aspects, including technology selection, operating model and price. Thus, CIOs need to evaluate AMI deployment as a part of their overall IoT strategy.

Business Impact: Affected areas include customer service, billing or revenue management, revenue protection, real-time and time-of-use pricing, demand response, prepayment, distribution network analysis, and outage reporting.

In addition to its primary function of supporting all phases of the meter data life cycle, AMI frequently includes the ability to remotely manipulate customers' connections (connect or disconnect). In some instances, AMI provides on-premises displays to notify customers of variable energy prices and other consumption-related information. In some installations, AMI enables the utility to control consumer load (demand dispatch) by accessing smart thermostats or by accessing consumer appliances via home-area networks, such as in-home broadband over a power line or Zigbee.

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Aclara; Honeywell (Elster); Iskraemeco; Itron; Landis+Gyr; Xylem

Recommended Reading: "Top 10 Trends Driving the Utility Industry in 2020"

"Market Guide for Meter Data Management"

Digital Wallet

Analysis By: Dayna Ford

Definition: Digital wallets establish credentials to enable users to make remote or face-to-face transactions from connected devices such as mobile phones, desktops, kiosks and Internet of Things (IoT) devices. Credentials can be payment-related, such as bank cards, bank accounts and prepaid cards, or non-payment-related such as tickets, loyalty cards and boarding passes.

Position and Adoption Speed Justification: After a long slow start, digital wallets are finally gaining material traction globally, while not yet catching up to China which is one order of magnitude higher in mobile user penetration. The COVID-19 pandemic has accelerated adoption in many markets as much face-to-face commerce shifted to digital during nonessential business closures and global stay-at-home orders, and as consumers seek contactless ways to pay in essential face-to-face transactions. Deferred and installment payment wallets such as Klarna and Afterpay are gaining traction in new markets, most notably the U.S., and this trend may accelerate in the face of pandemic-related economic softening.

The top challenge facing digital wallet adoption has been the lack of a compelling value proposition for both consumers and merchants simultaneously. It takes more than efficiency and security to change ingrained consumer behavior, especially in mature payments markets with well-developed consumer use habits around traditional cards. Customers need to see a strong value proposition to change their payment behavior. For example, Starbucks and Walmart have gained momentum as they offer wallet services throughout their large networks of stores, with useful features such as quick check-out, loyalty points and targeted coupons. Organizations with strong brand and industry influence as well as a large captive customer base tend to be best positioned.

Mobile providers such as Apple, Google and Samsung have the ability to leverage the device relationship to preprovision their wallet solutions and encourage consumer awareness and adoption.

It will take at least two years before most wallets develop value propositions that consistently appeal to customers and merchants.

User Advice: Enterprises interested in offering their own digital wallets should:

- Define the use case and customer benefits. If your business is related to payment solutions in industries such as parking, transportation, retail and e-commerce, look for ways to make the customer experience easier through the presence of digital wallets. Be aware of the large amount of upfront investment you need to commit to in order to market your solution and obtain resources necessary to support ongoing operations of the wallet. These include marketing, customer service, tech support, app development and payment integration. If your business is not directly related to providing payments, think through the value proposition question as to what benefits you can bring to customers. Successful solutions need to address real customer pain points.
- Understand the challenge of merchant acquisition in an increasingly regulated and crowded payment space. Merchants also need incentives and benefits before they are willing to invest in the technology to accept new digital wallets.
- Position digital wallets as a way to increase the value of your core product and service offerings. For example, retailers could include digital wallets in shopping apps to improve the in-store check-out process. Banks could include digital wallets in their banking apps to both complement their other services and increase the overall value of banking apps.
- Move away from designing to the technology, such as the use of Near Field Communication (NFC) and quick response codes (QR codes), and toward a design focusing on customer value and experience.

Enterprises looking to integrate third-party wallets should:

- Understand the most popular digital wallets used by your customers and integrate those in addition to the traditional payment methods such as credit card or bank transfer.
- Balance the need to lower payment fees against the benefit of driving higher sales and conversion with a frictionless payment experience. Some wallets offer a streamlined customer experience. For example, PayPal and Amazon Pay support one-click payment, as do Apple Pay and Alipay with biometric authentication. Even though fees are often higher than traditional payment methods, the improved conversion may result in positive ROI.

Business Impact: Most businesses will not launch a stand-alone digital wallet to compete with leading payment players such as Alipay and PayPal. Rather, they will integrate wallets from those leading providers to promote customer engagement and drive higher revenue, or offer wallets as a natural extension of the existing business. For example, retailers like Starbucks and Walmart launched their own digital wallets by leveraging the advantages in captive user base, brand awareness and customer adoption incentives. In some markets (such as India and Switzerland) where there is a common digital payment infrastructure, industry players will work together to increase interoperability and acceptance. This could be a winning strategy, because participants get a share of a larger "pie."

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Alipay; Apple; Early Warning Services; Gemalto; Google; Mahindra Comviva; PayPal; Paytm; Samsung Electronics; WeChat

Recommended Reading: "The Future of Commerce Payments in a Digital Society"

"How to Drive Adoption of Digital Wallets"

"12 Key Questions to Ask When Selecting a Digital Commerce Payment Vendor"

Private Cloud Computing

Analysis By: Thomas Bittman

Definition: Private cloud computing is a form of cloud computing used by only one organization, or one that ensures an organization is completely isolated from others. As a form of cloud computing, it has full self-service, full automation behind self-service and usage metering. It does not have to be on-premises or owned or managed by the enterprise.

Position and Adoption Speed Justification: Private and public cloud computing are at opposite ends of the "isolation" spectrum. As public cloud providers have offered virtual private cloud, dedicated instances and dedicated hosts, the gap between private and public has become a spectrum of isolation choices. Recent offerings from the major cloud providers for on-premises cloud footprints (tethered cloud) have created another, newer form of private cloud computing — and these immature alternatives are keeping private cloud from the Hype Cycle plateau.

Organizations that build a private cloud service are emulating public cloud computing providers to acquire similar benefits — mainly agility, mainly for new cloud-native applications, and mainly for business value and growth. This can be for infrastructure as a service (virtual machines or containers), platform as a service, or, in some situations, software as a service.

Due to cost and complexity, most successful private clouds are built and delivered by third parties.

This term is also used to describe a very different trend, where traditional infrastructures are being modernized with virtualization, some automation and some self-service. In this manner, they are leveraging only some valuable attributes of cloud computing, but are applying them to existing applications with traditional infrastructure requirements. However, because these are different trends, Gartner does not include this form of modernization in our definition of private cloud. But when the goal is IT efficiency or modernization for existing applications, these “just enough cloud” architectures can be beneficial.

User Advice:

- Evaluate third-party options first. These include hosted private cloud, managed services, virtual private cloud alternatives, tethered cloud or public cloud.
- Choose your private cloud strategy based on the necessary return on investment or business goals. If business growth or business value for new applications is the goal, consider a true cloud architecture. If IT efficiency or IT modernization for existing applications is the goal, choose cloud-inspired technologies and methods to implement. Just-enough cloud is often enough.
- Focus on business and application needs first; don’t start with the technology. One technology architecture and operational model cannot support all of the application needs of a typical enterprise. Either build multiple architectures and operational models, or leverage third parties.
- Focus on services that fit the cloud model: standard, high volume and self-service; those that require agility and horizontal scalability; and usages that might be short-lived.
- Consider the long-term roadmap for your private cloud services. Build with the potential to integrate, interoperate or migrate to public cloud alternatives at the appropriate time.
- Manage the scope of work — start small and expand based on the business case.
- Build expertise in managing multiple architectural and operational models, and multicloud — this is more valuable to an enterprise than expertise in building a single cloud architecture.

Business Impact: Cloud computing enables agility that an enterprise can use to react quickly to business requirements in functionality or scale. Due to economies of scale, cloud computing can also improve efficiency and lower costs. However, because leveraging a true cloud computing architecture requires applications and operational models designed for cloud computing, the cost of transformation for existing applications does not always justify the investment.

True private cloud computing is used when enterprises aren’t able to find cloud services that meet their needs in terms of regulatory requirements, functionality or intellectual property protection.

True private cloud computing is almost always purpose-built for a specific set of new applications, and its success can be measured in revenue or market share.

When the primary goal of a private cloud is IT efficiency, businesses can reduce costs and improve overall operational efficiency for their existing application portfolios by leveraging cloud technologies where appropriate. They can then add manual or custom intervention, or customized changes as needed, to support those applications.

However, enterprises need to recognize that these are two different goals with different architectures, and trying to accomplish them in a single architecture usually achieves none of the goals well. Being bimodal based on business and application needs makes the most business sense.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Hewlett Packard Enterprise (HPE); IBM; Microsoft; Red Hat; VMware

Recommended Reading: "Rethink Your Internal Private Cloud"

"Building 'Just Enough' Private Cloud With Virtualization Automation"

SD-WAN

Analysis By: Andrew Lerner

Definition: Software-defined wide-area network (SD-WAN) products replace traditional branch routers. They provide several features: dynamic path selection, based on business or application policy; centralized policy and management of WAN edge devices; and zero-touch configuration. SD-WAN products are WAN transport/carrier-agnostic, and can create secure paths across multiple WAN connections. SD-WAN products can be hardware- or software-based, and managed directly by enterprises or embedded in a managed service offering.

Position and Adoption Speed Justification: Rampant client interest in SD-WAN products continues, and we estimate that more than 25,000 customers have deployed SD-WAN products in production networks, which is over 600,000 branch locations. We expect continued rapid growth of SD-WAN deployments, and forecast vendor revenue to grow at a more than 23% compound annual growth rate (CAGR) for the next three years. In conjunction with a hybrid WAN topology, SD-WAN improves availability, cost and performance for enterprise WANs. Organizations moving to hybrid or internet-only WAN transport are driven toward SD-WAN products, because of their improved path selection functionality and manageability. Large numbers of vendors (several dozen) are competing in the market, including incumbent network and security vendors, startup vendors and smaller vendors with regional or vertical focus.

User Advice: Networking leaders should refresh their branch WAN equipment by implementing SD-WAN when they're migrating apps to the public cloud, building hybrid WANs, equipment is at end of life, or managed network service/MPLS contracts are up for renewal. Follow a comprehensive SD-WAN selection process by evaluating a diverse set of vendors and running a pilot. This is particularly important now, because not all offerings on the market are stable and scalable. Include network security teams in the design, planning and implementation, because SD-WAN-enabled hybrid WANs directly affect placement of security controls, such as firewalls and secure web gateways (SWGs).

Business Impact: The main purpose of emerging SD-WAN products is to create simpler and more cost-effective branch office WANs that map to modern application and cloud architectures. These products are significantly faster, easier to deploy and more manageable than traditional, router-based solutions. The benefits of an SD-WAN approach are substantial, compared with traditional, router-based WAN architectures, including reduced capital and operational expenditures (capex/opex) at the WAN edge, improved provisioning times, and the potential for enhanced branch availability.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Aryaka; Cato Networks; Cisco; Fortinet; Palo Alto Networks; Silver Peak; Versa Networks; VMware

Recommended Reading: "Technology Insight for SD-WAN"

"Magic Quadrant for WAN Edge Infrastructure"

"Solution Comparison for SD-WAN"

"Assessing the Strengths and Weaknesses of SD-WAN Technology"

DDoS Defense

Analysis By: Lawrence Orans; Rajpreet Kaur; Claudio Neiva

Definition: Distributed denial of service attacks use multiple techniques to disrupt business use of the internet or to extort payment from businesses to stop the attacks. DDoS defense products and services detect and mitigate such attacks.

Position and Adoption Speed Justification: This year, distributed denial of service (DDoS) defense progresses slightly to the right along the Slope of Enlightenment. There have been no record-breaking DDoS attacks since a 1.7 Tbps attack in February 2018. In response to that attack, and in order to keep up with advances made by attackers, many DDoS mitigation providers continue to

invest in their infrastructure (for example, many scrubbing center providers have added more scrubbing centers and more aggregate bandwidth in recent years). The shifting threat landscape requires that DDoS mitigation vendors continue to evolve their products and add additional detection techniques to thwart more complex and varied DDoS attacks. The good news is that today, enterprises have more choices than ever for DDoS mitigation services, as the three leading IaaS providers now have mature offerings. Nonetheless, DDoS attacks continue to be a serious threat to enterprises.

User Advice: DDoS mitigation services should be a standard part of business continuity/disaster recovery planning, and they should be included in all internet service procurements when the business depends on the availability of internet connectivity. Most enterprises should look at detection and mitigation services that are available from communications service providers (CSPs), hosters or DDoS security-as-a-service specialists (for example, “scrubbing center” providers). To defend against complex, application-based attacks, a hybrid solution of local protection (on-premises DDoS appliances) and cloud-based mitigation services is a strong option. The content delivery network (CDN) approach to DDoS protection is also a strong approach, particularly when the organization is already using a CDN for content distribution to improve the performance of its website. However, the CDN approach only protects websites. It does not protect against attacks aimed at nonweb targets (for example, corporate firewalls, VPN servers and email servers). Another option for DDoS mitigation services comes from the IaaS providers. The leading IaaS providers (Amazon Web Services [AWS], Microsoft Azure and Google Cloud) all offer basic and advanced (fee-based) DDoS mitigation services.

Because of the increased awareness of DDoS attacks, more CSPs and hosters have entered the market for DDoS mitigation services. Some have built their own infrastructure, whereas others have partnered with specialty DDoS mitigation service providers. Still others have actually been offering services over many years, which has enabled them to develop strong expertise. Prospective customers should gauge the level of experience of CSPs and make sure that the price of their services reflects their level of experience.

Enterprises that are frequent targets of DDoS attacks should consider the “always on” option available from scrubbing center providers. With this model, the customer pays a premium of approximately 50% over the “on-demand” service, so that traffic always flows through the scrubbing center before it arrives at the customer’s website (or any destination that they are protecting). Enterprises should also note that the average attack size is approximately 15 Gbps (according to published reports from several DDoS mitigation providers).

The increased competition in the DDoS mitigation market has also led to more competitive pricing and pricing models. Many providers now offer packages that are more cost-effective because they include a fixed number of mitigations per year (as opposed to an unlimited mitigation model). Enterprises that are at less risk of being attacked frequently are good candidates for these new pricing models with a fixed number of mitigations. These enterprises should also consider the less expensive services from ISPs and hosters.

Business Impact: Any website can be targeted by DDoS attackers. Attackers will sometimes target nonweb resources (such as firewalls) to disrupt users' access to the internet. DDoS mitigation services are highly effective in mitigating these attacks. For example, a good DDoS mitigation provider will restore access to a company's website, even during a large-scale attack. Enterprises that lack DDoS mitigation services could face an extended outage and could incur heavy financial losses in the event of an attack. Also, if the enterprise does not defend itself properly during an attack, its reputation could be negatively impacted. Thus, DDoS mitigation services are a highly valuable investment for every enterprise that needs to protect its web presence and its access to the internet.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Mature mainstream

Sample Vendors: Akamai; AT&T; F5; Imperva; Link11; Neustar; Nexusguard; NETSCOUT (Arbor Networks); Radware; Verizon

Recommended Reading: "Market Guide for DDoS Mitigation Services"

"Solution Comparison for DDoS Cloud Scrubbing Centers"

"DDoS: A Comparison of Defense Approaches"

SIEM

Analysis By: Kelly Kavanagh; Mitchell Schneider

Definition: Security information and event management (SIEM) technology supports threat detection, compliance and security incident management through the collection and analysis (both near real time and historical) of security events, as well as a wide variety of other contextual data sources. The core capabilities are a broad scope of log event collection and management, the ability to analyze log events and other data across disparate sources, and operational capabilities (such as incident management and response, dashboards and reporting).

Position and Adoption Speed Justification: Detection of, and early response to, threats from targeted and broad-based malware attacks is the primary driver for purchasing SIEM technologies. SIEM products have existed for a long time, but continue to evolve to address changing threats across a growing range of environments (cloud, OT and IoT), increases in the volume, velocity and variety of data sources, and increasingly constrained security resources and expertise. Modern SIEM products use a variety of techniques, including correlation, statistical analysis and machine learning to identify threats. Organizations are increasingly bringing infrastructure as a service (IaaS) and SaaS environments into the scope of monitoring via SIEM. OT and IoT environments represent challenges to monitoring with SIEM products, with a number of vendors developing native capabilities or partnerships with OT technology providers to enable coverage. SIEM vendors

are introducing more advanced incident response capabilities natively or via integration with security orchestration, automation and response (SOAR) products. Traditional on-premises deployment of SIEM is still prevalent, but vendors are increasing options for cloud SIEM and for hybrid cloud and premises-based deployments. The combination of new demands of SIEM products and the capabilities evolving to meet them keeps this mature market just off the Plateau of Productivity.

User Advice: Security and risk management leaders considering deploying a SIEM solution should first define their use cases, which will inform the requirements for log management, threat monitoring, user and resource access monitoring, security incident response management, and compliance reporting. Other stakeholders in the organization (such as audit and compliance, network operations, server administration, database administration, and application support areas) should be consulted to provide assistance with defining the initial use cases and roadmap. It may be necessary that the SIEM tool has access to nonsecurity data sources that would provide additional business context for security event monitoring (such as user directories, configuration management databases [CMDBs] and vulnerability assessment products). Organizations should document their network and system topologies, and where security controls are deployed throughout the organization. Estimates of log volume and event rate velocities, in addition to the number of log/data sources, should be documented for the initial use cases, as well as planned use cases that may be implemented within the next 12 to 24 months. Furthermore, buyers must plan to administer, manage, operate, and update detection and response content in the SIEM and consider whether an external service provider will be required to provide basic management of the solution and/or 24/7 security event monitoring and alerting. In addition to traditional software and appliance options, buyers should evaluate cloud SIEM options that do not require customer deployment and management.

Business Impact: SIEM solutions improve an organization's ability to quickly detect attacks and data breaches, and improve incident investigation and response capabilities. However, they require an ongoing investment in resources (budget, expertise and staffing) for both technology operations and security event monitoring to realize their true value. SIEM tools also support other use cases (such as the reporting needs of organizations with regulatory compliance obligations, as well as those subject to internal and external audits).

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: AT&T Cybersecurity; Dell Technologies (RSA); Exabeam; IBM; LogRhythm; Micro Focus; Microsoft; Rapid7; Securonix; Splunk

Recommended Reading: "Magic Quadrant for Security Information and Event Management"

“Critical Capabilities for Security Information and Event Management”

“Establish Scope and Requirements for a Successful Security Information and Event Management Deployment”

“How to Deploy a Security Information and Event Management Solution Successfully”

“Overcoming Common Causes for SIEM Solution Deployment Failures”

Entering the Plateau

Endpoint Protection Platforms

Analysis By: Paul Webber

Definition: Endpoint protection platforms provide protection from malware, usually via the installation of an agent on the endpoint. This must protect against existing and emerging threats and exploits including protection against malware, both file-based and fileless exploits, identification and prevention of threats using behavioral analysis, allow-listing of known applications, processes and scripts, and investigation and reporting of the configuration of the endpoint.

Position and Adoption Speed Justification: The EPP market has adapted to more advanced threats and stealthier attackers. Organizations currently place a premium on preventing unknown and non-file-based attacks, and the addition of machine learning and cloud-based look-up as an alternative to local signature-based identification. Ease of use, low resource utilization and reduced maintenance are still expected.

Principal evolutions in the EPP market are cloud-native solutions that are easier to deploy and manage, plus advances in behavior-based detection and analytics, that allow identification of zero-day threats.

Improvements in native OS security protect credentials, prevent kernel attacks and can isolate browser and applications, together with vulnerability management and hardening. These advances are eroding the scope for EPP vendors. It is shifting the focus of attackers toward application security weaknesses and fallibility of the end user. More stealthy attacks mean that EDR features are required to detect and respond to advanced threats that would otherwise bypass EPP tools reliant on prevention and protection alone.

User Advice: Because of the shift of attacks toward more advanced and stealthy techniques, security and risk management leaders responsible for endpoint security should look for products with these capabilities:

- A single agent with a combination of protection against known threats and exploits with behavioral analysis, preferably cloud-hosted, plus associated look-up of unknown items.

- Ability to report internet, network and application activity to derive additional indications of potentially malicious activity and identify unknown threats or anomalous activity.
- Facilities to scan systems for vulnerabilities and report/manage the installation of security patches, in order to improve hardening and reduce attack surface.
- A capability to rapidly contain threats when identified and to remediate systems remotely, preferably with optional automation for each of these features.
- The provision of managed services offerings to augment in-house teams where organizations lack internal resources or skills to manage advanced EPP solutions.

Business Impact: EPP is still a commonly deployed layer of malware prevention and is considered basic security hygiene for all organizations. Self-propagating, indiscriminate malware is now joined by attacks that focus on individuals and organizations. Attackers exploit poor configuration, unpatched systems and steal credentials to gain entry, then use living-off-the-land attacks and fileless malware to bypass security controls. Despite sophisticated, stealthy attackers, a well-configured and maintained EPP product can still significantly lower the risk of malware and targeted attacks. All industry sectors and scales of organization must reexamine their endpoint protection approach and invest in additional capabilities and layers of protection for the endpoint.

Advanced adversaries targeting the organization can evade protection solutions, making detection and response capabilities critical to identifying attacks, fraud and breaches. Therefore, EPP solutions should not be the only layer of endpoint protection but be part of a wider set of security controls.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Cisco; CrowdStrike; Cybereason; McAfee; Microsoft; SentinelOne; Sophos; Symantec; Trend Micro

Recommended Reading: “Critical Capabilities for Endpoint Protection Platforms”

“Magic Quadrant for Endpoint Protection Platforms”

“Top Security and Risk Management Trends”

“Innovation Insight for Extended Detection and Response”

Privileged Access Management

Analysis By: Felix Gaehtgens; Michael Kelley

Definition: Privileged access management (PAM) tools help organizations provide secure privileged access to critical assets and meet compliance requirements by managing and monitoring privileged account activity. PAM tools offer features that:

- Discover and manage privileged accounts and keys on systems, devices and applications
- Automatically randomize, manage and vault passwords and other keys
- Control access to privileged accounts, including shared and emergency accounts
- Isolate, monitor, record and audit privileged access sessions

Position and Adoption Speed Justification: Interest in PAM tools continues to grow, with many organizations identifying PAM as a top 10 security control. PAM tools are mature for legacy use cases, but they continue to evolve, along with adoption of better practices from enterprises, with regards to just-in-time privileged access, zero standing privileges, secrets management and cloud use cases. For this reason, the position of PAM tools in this years' Hype Cycle continues to advance, but it will take more than two years to reach the Plateau of Productivity. PAM tools are increasingly used to secure remote privileged access scenarios. Some clients also use PAM tools to secure operational technology and industrial control systems. Securing privileged access to IaaS and PaaS is maturing, and vendors are offering SaaS-based PAM capabilities. Additionally, vendors in the PAM market have developed tools to answer the challenge of managing access and secrets in highly dynamic environments such as DevSecOps and containers, with several secrets management products available today.

User Advice: PAM tools enforce the privileged operations model for your organization:

- Plan for a roadmap that emphasizes a risk-based approach to prioritize the most risky types of accounts, or most critical assets. Plan for just-in-time privileged access and zero standing privileges.
- Get alignment from PAM users on any necessary changes to working practices. Without this, users will attempt to bypass or subvert the tools. Political boundaries and turf mentalities in organizations will prevent comprehensive utilization of PAM practices and erode security.
- Scrutinize offerings from multiple vendors; pricing for tools is converging into bundled offerings but varies in licensing metrics (per user/per asset/per session). Tools from multiple vendors can be integrated in a best-of-breed approach.
- Ensure that administrative accounts for network devices, hypervisors, IaaS, PaaS and SaaS are within scope as well.
- Determine which delivery model works best for your organization: hardware appliance, VM, SaaS or deployed into IaaS environments.

- Account for all privileged access, whether that access is human-based or software-based. For example, do not overlook service and software accounts — they are a considerable source of security and operational risk.
- Failover, disaster recovery planning and emergency access are crucial for success; ensure that your solution is highly available.
- Integrate PAM tools SIEM for logging, IGA for life cycle management, and change management/ITSM tools for tighter access control. CMDB and ITSM tools can also help drive account discovery.
- Automate privileged tasks as much as possible to eliminate the need for full operating-system-level privileged access by people and to enable automated privileged tasks to be executed by lesser skilled personnel.

Business Impact: Privileged access is high risk and many breaches can be attributed to privileged access misuse, stolen privileged credentials or hijacked privileged accounts. A PAM tool can mitigate the risk arising from the existence of privileged accounts, while the attack surface presented by privileged accounts is reduced by working toward zero standing privileges, the highest form of just in time (JIT) PAM access. PAM tools provide robust and granular control, transparency, scalability, and more accountability for privileged access compared to manual controls and custom or generic tools. Particularly, they offer the following benefits:

- Mitigate risks and achieve visibility of privileged operations and account use.
- Enable privileged access only when it is necessary — according to the principle of least privilege.
- Allow remote privileged access, including to third parties.
- New approaches to PAM include a focus on JIT privileged access, further reducing standing privileged access and getting closer to the principle of least privilege.
- Mitigate risks associated with malware targeting privileged accounts.
- Eliminate hard-coded passwords in application code, scripts and configuration files.
- Enable a forensic review of privileged access activity.
- Provide real-time monitoring, auditing and alerting of privileged activities.
- Manage credentials for DevSecOps toolchain and containers.
- Provide delegation for automated privileged tasks, which help significantly increase IT staff efficiency and reduce operating costs.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: ARCON; BeyondTrust; Centrify; CyberArk; Hitachi ID Systems; One Identity; senhasegura; Symantec; Thycotic; WALLIX

Recommended Reading: "Magic Quadrant for Privileged Access Management"

"Critical Capabilities for Privileged Access Management"

"Best Practices for Privileged Access Management Through the Four Pillars of PAM"

"IAM Leaders' Guide to Privileged Access Management"

"Remove Standing Privileges Through a Just-in-Time PAM Approach"

Cloud Office

Analysis By: Gavin Tay

Definition: Cloud office, also known as the "new work nucleus," refers to a collection of the most broadly used SaaS-based personal productivity, horizontal collaboration and communication tools, combined into one product. It generally includes email, IM, file sharing, conferencing, document management and editing, search and discovery, and collaboration. Microsoft's Office 365 and Google's G Suite are the primary examples. The term "cloud office" is a general term. "Microsoft Office" refers to a specific set of products.

Position and Adoption Speed Justification: Cloud office continues to advance quickly along the Hype Cycle as enterprise adoption grows and the technologies become well-understood. In 2020, cloud office has reached the Plateau of Productivity as it becomes an accepted cornerstone of most organizations' collaboration and communications infrastructure.

Enterprise adoption has increased on account of a general preference for cloud deployments and the desire to reduce costs, redeploy IT staff, drive simplicity and provide more functionality to users. Vendors are also offering their most attractive new features — such as mobile apps, content discovery tools and artificial intelligence available through cloud deployments only.

User Advice: Application leaders responsible for digital workplace initiatives should:

- Look beyond a "like for like" deployment that focuses only on recreating previous on-premises functionality through the cloud. Although this can be a good initial step, investigate the unique capabilities of cloud office suites to improve digital dexterity, efficiency and innovation.

- Not assume that the chosen cloud office product will meet all collaboration and communication requirements. Look beyond cloud office to meet specific needs or user requirements.
- Monitor the cloud office vendor's roadmap and product announcements closely. The cloud model assumes almost continuous enhancement with new features and improvements coming regularly. Assess these additions for their impact on your operations and how to take advantage of them.
- Plan specific efforts to address user adoption by focusing on user change management. It is usually not obvious how to use the new capabilities to increase effectiveness. Users will benefit from assistance and guidance, perhaps from more advanced colleagues, as a part of the digital dexterity initiative.
- Look to cloud office suites as a source for continuous innovation in a form that is relatively easy to adopt. Innovations like every day AI, cross-tool integration, and better meetings are likely to come from cloud office products.

Business Impact: Cloud office solutions are so widely adopted that they are becoming the basis on which other vendors innovate, through add-ons and integrations. Cloud office is an important part of the emerging new work nucleus. These products support a wide variety of styles of collaboration including video, conversational, and social as well as the more conventional email and IM. Most organizations have made the move, developed a plan, or specifically decided to put off making a move that will be difficult to avoid in the longer term. Organizations that were adept at using cloud office prior to COVID-19 have had a much easier time pivoting to mandatory remote work.

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Google; Microsoft; Zoho

Recommended Reading: "Market Guide for Cloud Office Migration Tools"

"Create a Culture of Digital Dexterity With the 'New Work Nucleus'"

"Enable More Productive Meetings With Google G Suite or Microsoft Office 365"

"Maximize the Effectiveness of Office 365 and G Suite With Everyday AI"

"How to Organize IT to Support Office 365, G Suite and Other Digital Workplace Applications"

Software as a Service

Analysis By: Christian Hestermann

Definition: SaaS is an application model in which the software is owned, delivered and managed by the provider. It uses a pay-for-use or subscription model, with a consistent version of the application simultaneously offered to multiple customers. SaaS is overwhelmingly delivered through a multitenant public cloud model, although some applications are available as a single-tenant or on-premises version.

Position and Adoption Speed Justification: SaaS has existed in some markets for more than 20 years, and has established itself as the normal delivery model for various application types. It is the primary delivery model for productivity tools, communication tools and line-of-business solutions including CRM, HCM, financials and procurement. Preferring the cash flow benefits of subscription over licensing, almost all application vendors have expressed an intent to make SaaS their primary, and usually exclusive, delivery model. Although a significant minority of enterprise customers still questions the appropriateness of a multitenant public cloud delivery model, virtually all organizations are making significant use of SaaS today. However, SaaS has not been established as the norm for all forms of software, including highly strategic applications such as broad operational ERP suites or ERP for manufacturing operations. SaaS as a concept should be considered as having reached the Plateau of Productivity, but the transition toward cloud-based application services is still arguably at its midpoint. The utilization of SaaS, and the maturity of many existing offerings, will continue to evolve rapidly for at least another 10 years.

User Advice: SaaS should be a first preference when considering new application capabilities unless there are specific reasons not to, such as lack of critical functionality, concern for data residency requirements, complex integration requirements or when the regular updates are too disruptive. If you want to help your organization make the most effective use of SaaS:

- Give up on the idea that the IT department will own application choice and usage. IT can and should no longer be fully in charge of the organization's digital destiny, and instead will increasingly be in the role of internal consultant or broker for applications that are the primary responsibility of the lines of business.
- Treat SaaS as the first and preferred option for most application capabilities, but prepare your organization for ongoing changes in business processes as a result.
- Strengthen IT's ability to build and maintain integrations between SaaS applications, including cloud-to-cloud integrations. Build data management and analysis as well as security skills across multiple clouds.
- Embrace standard SaaS offerings, if you can afford to give up some capabilities seen as less critical.
- Account for the fact that frequent updates of SaaS applications will occur, and you will not have control over them. To reduce business risk, frequent regression testing needs to be highly

automated.

- Build a culture of continuous improvement to take advantage of upgrades while minimizing negative impact.
- Develop policies and processes to govern the entire SaaS application life cycle, from approval through operations to obsolescence.
- Create a SaaS competency center to centralize and share SaaS-specific knowledge and practices for procurement, negotiation, provisioning, use, support, continuity, customization and decommissioning.
- Strengthen your organization's SaaS cloud contract management to reduce risk and minimize unexpected costs.

Business Impact: The one-size-fits-all model of SaaS represents a form of discipline and adherence to standard processes that is almost impossible to emulate within an IT department that is inevitably pressured into countless modifications and changes that escalate software costs. SaaS does not require a capital investment in hardware and licenses, which further reduces its initial costs. In subsequent years, however, SaaS may be more expensive than traditional software offerings because the operating expense remains consistent or grows over time. The majority of SaaS vendors does not offer full pay-per-use models. Future demands to customize or integrate SaaS applications are usually more expensive than comparable modifications of traditional software, and may be impossible.

SaaS is a perfect choice for organizations that do not have the IT resources to deploy and maintain on-premises software. This is prevalent in small or midsize businesses, as well as in large enterprises with limited capabilities in their IT departments or business units. SaaS enables companies or business departments to get to live-deployment status more quickly, especially when deploying less-complex applications. On an ongoing basis, SaaS provides more agility for making changes through self-service interfaces and greater innovation because SaaS providers deliver ongoing enhancements through the service. However, business innovation does not come for free and needs the ability to frequently review, revise and change business processes. SaaS is also a great option for organizations to test or experiment with new ideas that may or may not be fully implemented or continued.

The downside of SaaS is that usage tends to sprawl, with organizations paying for a larger set of services and seats than are necessary. Unfortunately, the best practices for the control of SaaS, and the associated toolset, remain relatively immature. Also, the cost for continuous regression testing in more complex, multicloud environments can reduce the cost benefit.

Benefit Rating: Transformational

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Sample Vendors: Box; Coupa; Dropbox; Google; Microsoft Office 365; Oracle; Salesforce; ServiceNow; Workday; Zoom

Recommended Reading: "How to Cut Software and SaaS Costs and Quickly Improve Cash Flow in Times of Crisis"

"SaaS Cloud Contract Management Must Be Strengthened to Reduce Risk and Minimize Unexpected Costs"

"How to Plan for Resiliency in the Cloud"

"SaaS SLAs: Reduce Risk and Improve Service by Negotiating These Key Terms"

"4 Preparation Steps to Optimize SaaS Negotiations"

"Toolkit: Prudently Accelerate Cloud Acquisitions for SaaS Using Gartner's Triage Methodology"

"A Public Cloud Risk Model: Accepting Cloud Risk Is OK, Ignoring Cloud Risk Is Tragic"

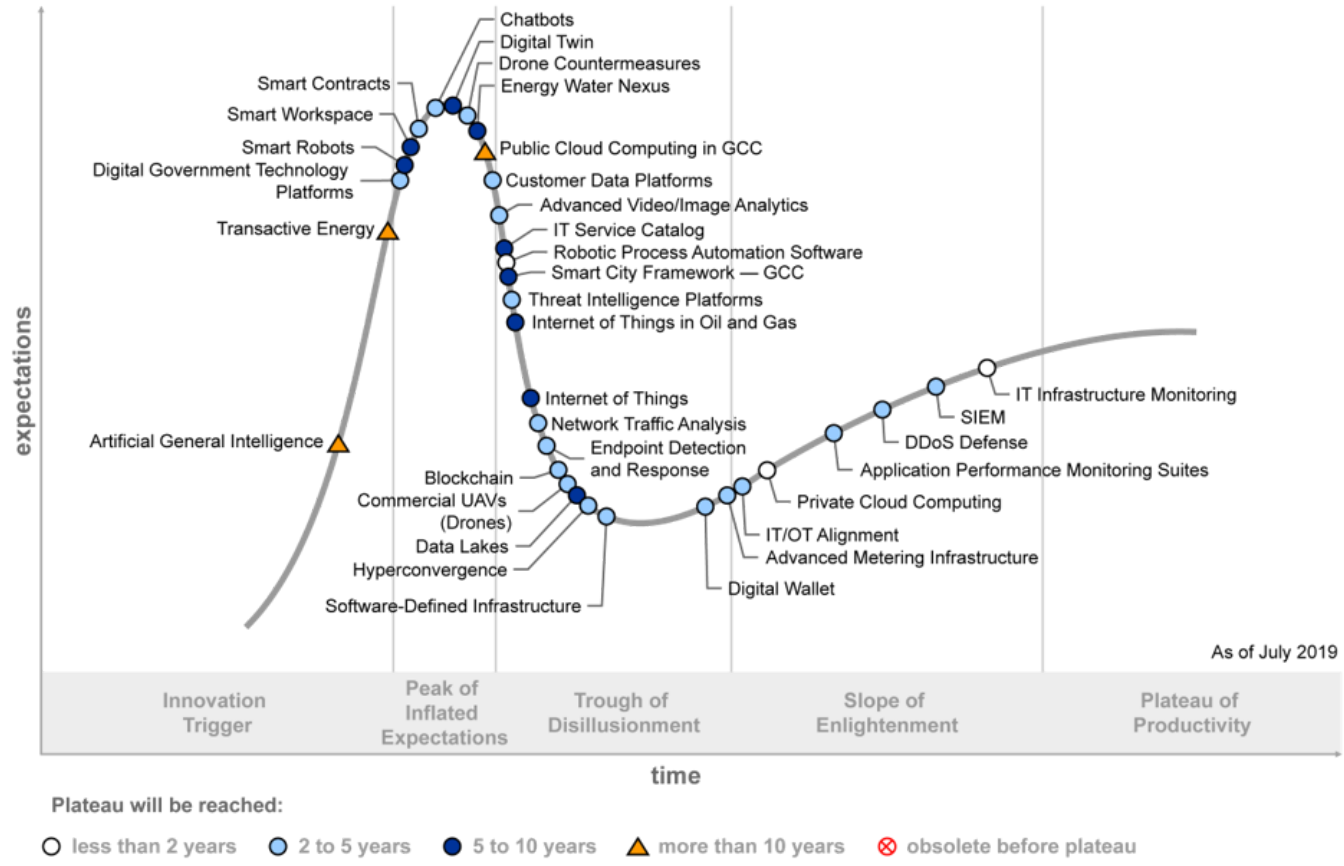
"Magic Quadrant for Cloud Access Security Brokers"

"Midsize Enterprise CIOs: Take These 4 Key Actions When Deploying SaaS"

"Toolkit: Comparison of Total Cost of Ownership Between On-Premises and SaaS Business Applications for Midsize Enterprises"

Appendixes

Figure 3. Hype Cycle for IT in GCC, 2019



Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 1: Hype Cycle Phases

Phase	Definition
Innovation Trigger	A breakthrough, public demonstration, product launch or other event generates significant press and industry interest.
Peak of Inflated Expectations	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the technology is pushed to its limits. The only enterprises making money are conference organizers and magazine publishers.
Trough of Disillusionment	Because the technology does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.

Phase	Definition
Slope of Enlightenment	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the technology's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
Plateau of Productivity	The real-world benefits of the technology are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
Years to Mainstream Adoption	The time required for the technology to reach the Plateau of Productivity.

Source: Gartner (July 2020)

Table 2: Benefit Ratings

Benefit Rating	Definition
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
High	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
Moderate	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Low	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (July 2020)

Table 3: Maturity Levels

Maturity Level	Status	Products/Vendors

Maturity Level	Status	Products/Vendors
Embryonic	■ In labs	■ None
Emerging	■ Commercialization by vendors ■ Pilots and deployments by industry leaders	■ First generation ■ High price ■ Much customization
Adolescent	■ Maturing technology capabilities and process understanding ■ Uptake beyond early adopters	■ Second generation ■ Less customization
Early mainstream	■ Proven technology ■ Vendors, technology and adoption rapidly evolving	■ Third generation ■ More out-of-box methodologies
Mature mainstream	■ Robust technology ■ Not much evolution in vendors or technology	■ Several dominant vendors
Legacy	■ Not appropriate for new developments ■ Cost of migration constrains replacement	■ Maintenance revenue focus
Obsolete	■ Rarely used	■ Used/resale market only

Source: Gartner (July 2020)

Evidence

This research is based on industry-specific analyst inquiries and consulting engagements with several clients across GCC, as well as GCC strategic plans and national policies.

Document Revision History

Hype Cycle for IT in GCC, 2019 - 15 July 2019

Hype Cycle for IT in GCC, 2018 - 13 July 2018

Hype Cycle for IT in GCC, 2017 - 20 July 2017

Hype Cycle for IT in GCC, 2016 - 18 July 2016

Hype Cycle for IT in GCC, 2015 - 17 July 2015

Recommended by the Authors

Understanding Gartner's Hype Cycles

Recommended For You

How to Determine If DRaaS Will Save Money

Tool: 100-Plus Ideas to Optimize and Reduce I&O Costs

How I&O Can Properly Deliver Kubernetes Support

Shared Incentives for Modernization (Humana)

How to Maintain Operational Viability as I&O Experts Retire

Supporting Initiatives

Infrastructure and Operations Leaders

Track